UPES
UNIVERSITY OF TOMORROW

SCHOOL OF
HEALTH SCIENCES
AND TECHNOLOGY

B.Tech.
Food Technology

Four-Year Program

Program Structure | 2023-2027

UPES Bidholi Campus, P.O. Bidholi via Prem Nagar, Dehradun, Uttarakhand-248007
Tel: +91 0135 2770137 | Website: www.upes.ac.in

UPES

School of Health Sciences and Technology

[B.Tech. Food Technology]

Program Structure

2023-2027

UPES Campus
"Energy Acres"
2776090
P.O Bidholi via Prem Nagar, Bidholi
www.upes.ac.in
Dehradun – 248007
(Uttarakhand)

Tel: + 91-135-2776053/54
Fax: + 91-135-

URL:

Contents

1.0 Abbreviations

Cat	Category
L	Lecture
T	Tutorial
P	Practical
Cr	Credits
UC	University Core
PC	Program Core
PRJ	Project Work (including Seminars, Dissertation, and Internships)
PE	Program Elective (includes Specialization courses)
UE	University Elective (includes Signatory, Exploratory and Open Electives)
TC	Total Credits

2.0 Vision and Mission of the University:

Vision of UPES

To be an Institution of Global standing for developing professionally competent talent contributing to nation-building.

Mission of UPES

- Develop industry-focused professionals with an international outlook.
- Foster an effective outcome-based education system to continually improve teaching-learning and research.
- Inculcate integrative thought process among students to instil lifelong learning.
- Create a global knowledge ecosystem through training, research & development and consultancy.
- Practice and promote high standards of professional ethics and develop harmonious relationships with the environment and society.

3.0 SOHST Vision

- Leadership in Health Sciences & Technology for improving Planetary, and Public Health

Mission

- **To create t**hought leaders and change makers.
- **To design** appropriate, holistic and sustainable programs
- **To converge** multi-disciplinary efforts to make a difference for people and the planet.

4.0 Programme Educational Objectives (PEOs)

PEO1: To prepare students for successful careers in industry and research institutes.

PEO2: To develop skills in students to enable them to solve problems with relevance to Food Technology research, industry, and societal issues.

PEO3: To enable students to work in a team with a multidisciplinary approach.

PEO4: To promote and inculcate ethics and code of professional practice among students.

5.0 Program Outcomes (POs)

Graduates will be able to:

PO1 Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex bio-engineering problems.

PO2 Identify, formulate, research literature, and analyze complex Food Technology problems reaching substantiated conclusions using the first principles of mathematics, natural and life sciences, and engineering sciences.

PO3 Design solutions for complex Food Technology 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.

PO4 Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Create, select and apply appropriate techniques, resources, and modern Food Technology tools including prediction and modelling to complex Food Technology activities with an understanding of the limitations.

PO6 Apply reason informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional Food Technology practice.

PO7 Understand the impact of professional and global issues in societal and environmental contexts, and come up with ideas for global solutions, demonstrate the knowledge and need for sustainable development.

PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of the bio-engineering practice.

PO9 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communicate effectively on complex bio-engineering activities with the 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.

PO11 Demonstrate knowledge and understanding of the Food Technology and management principles and apply these to one's work, as a member and leader in a team, to manage projects in multidisciplinary environments.

PO12 Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Graduates will be able to:

PSO1	Learn and understand post-harvest technologies, food chemistry, food preservation, food processing and food packaging and labelling for the effective utilization of agricultural commodities to develop healthy and nutritious foods.
PSO2	Analyze economically feasible equipment for the modernization of traditional food processing.
PSO3	Investigate the functions of ingredients and additives in food, the importance of Food quality, safety and hygiene, food regulations and regulatory bodies and IPR
PSO4	Apply the knowledge of food engineering & technology principles from the various aspects of food technology and related disciplines to solve practical and real-world problems.

6.0 Overview of Credit Allocation/ Credit Break up

Category-wise Credit distribution

Category	**Number of Credits**	**Credit Percentage (%)**
University Core (UC)	42	16.25
Programme Core (PC)	76	45
Programme Elective (PE)	12	7.5
University Elective (UE)	34	21.25
Projects (PRJ)	15	9.375
Mandatory Non-Credit Courses (MNC)	2 Qualifier courses (Social Internship- IInd Sem) (Govt/ NGO/ Startup Internship- IVth Sem)	
Total	160	100

Modes of Evaluation for Theory: Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			

Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

7.0 Programme Structure

Cat	**Semester 1/ Course Codes**	**Subjects**	**L**	**T**	**P**	**C**
UC	CHEM1001	Chemistry	2	1	1	4
UC	PHYS1002	Physics	2	1	1	4
UC	MATH1048	Mathematics (I)	2	1	0	3
PC	HSFT 1002	Introduction to Food Technology	2	1	1	4
UC	HSBT1003	Introduction to IT Systems for Health Sciences	2	0	1	3
UC	School for Life	Living Conversations (SFL)	1	1	0	2
	Total		**11**	**5**	**4**	**20**

	Semester 2	Subjects	L	T	P	C
UC	MATH 1038	Mathematics (II)	2	1	0	3
UC	ECEG 1005	Basic Electrical and Electronics Engineering	2	0	0	2
UC	MEPD 1003	Workshop Practices	1	0	1	2
UC	MECH 1005	Engineering Graphics	1	0	1	2
UC	MECH 1006	Engineering Thermodynamics	2	1	0	3
PC	HSCC 2022	Biostatistics	2	0	0	2
PC	New course	Biochemistry	2	1	1	4
UC	School for Life	Critical Thinking and Writing (SFL)	1	1	0	2
MNC	HUMN 1019	Social Internship	0	0	0	0
	Total		**13**	**4**	**3**	**20**

	Semester 3	Subjects	L	T	P	C
PC	HSFT 2001	Post Harvest Technology	2	0	1	3
PC	HSFT 2002	Microbiology & Microbial Technology	2	0	1	3
PC	MECH 2033	Fluid Flow	2	0	1	3
PC	HSFT 2005	Food Preservation Technology	2	0	0	2
UE		Exploratory Elective 1	3		0	3
UC	School for Life	Leadership and Teamwork	1	1	0	2
UC	School for Life	Environmental Science	3	1	0	4
	Total		**15**	**2**	**3**	**20**

	Semester 4	Subjects	L	T	P	C
PC	MECH 2038	Refrigeration and Cold Chain	2	1	1	3
PC	HSFT 2007	Fruit and Vegetable Processing Technology	2	**1**	1	4
PC	MECH 2037	Heat and Mass Transfer (with FT)	2	0	1	3
PC	HSFT 2008	Cereal Pulse and Oil Seed Technology	2	1	1	4
UE		Exploratory Elective 2	3	0	0	3
UC	School for Life	Working With Data	1	1	0	2
MNC		Government/NGO/Startup Internship-Qualifying	0	0	0	0
	Total		**12**	**4**	**4**	**20**

	Semester 5	Subjects	L	T	P	C
PC	HSFT 3007	Instrumental Methods of Food Analysis	2	0	1	3
PC	HSFT 3008	Beverage Technology	2	0	1	3
PC	HSFT 3009	Bakery & Confectionary Technology	2	1	1	4
PC	HSFT 3010	Milk Processing Technology	2	1	1	4
PRJ	PROJ 3108	Project I (RM/ Sci writing)	0	0	1	1
UE		Exploratory Elective 3	3	0	0	3
UC	School for Life	Design Thinking	1	1	0	2
		Total	**12**	**3**	**5**	**20**

	Semester 6	Subjects	L	T	P	C
PC	HSFT 3015	Food Packaging Technology	2	1	1	4

PC	HSMB 3009	Fermentation & Industrial Microbiology	2	0	1	3
PC	HSFT 3016	Meat, Poultry and Fish Technology	2	1	1	4
PE		Program Elective - I	2	1	0	3
PRJ	PROJ 3109	Project II (Research plan/ synopsis)	0	0	1	1
UE		Exploratory Elective 4	3	0	0	3
UC	School for Life	Start your Start-Up (SFL)	1	1	0	2
MNC	SIIB 3106	Summer Industrial Internship-Qualifying	0	0	0	0
	Total		**12**	**4**	**4**	**20**

	Semester 7	**Subjects**	**L**	**T**	**P**	**C**
PC	HSFT 4001	Food Safety, Law and Regulations and IPR	2	1	0	3
PC	HSFT 4002	Food Quality and Sensory Evaluation	2	1	1	4
PE		Program Elective - II	2	1	0	3
PE		Program Elective - III	2	1	0	3
PRJ	PROJ 4105	Project III (Hands-On experience)	0	0	3	3
UE		Exploratory Elective 5	3	0	0	3
PRJ	SIIB 4107	Summer Internship Presentation	0	0	1	1
	Total		**11**	**4**	**5**	**20**

	Semester 8	**Subjects**	**L**	**T**	**P**	**C**
PC		Emerging Technologies in Food Processing	1	1	0	2
PE		Program Elective - IV	2	1	0	3
PE		Program Elective - V	2	1	0	3
PRJ	PROJ 4125	Project IV (Startup/ Industrial/ Research)	0	0	9	9
UE		Exploratory Elective 6	3	0	0	3
	Total		**8**	**3**	**9**	**20**
	Total credits for all semesters					**160**

8.0 List of available Courses in Programme Electives

PE-1	Food waste management	Food Supply Management and Logistics	Facility Planning and Material Handling
PE-2	Food Plant Sanitation	Enzymes in Food Industry	Instrumentation and Process Control
PE-3	Food Branding and Advertisement	Food Additives and Ingredients	Industrial Safety and Hazard
PE-4	Quality Assurance and Certification	Bioprocess Engineering	Nutraceuticals and Functional Foods
PE-5	Food Rheology and Texture	Food Process Plant Design	Food Biotechnology

SEMESTER I

CHEM 1001	Chemistry	L-T-P-C: 2-1-1-4

- **COURSE OBJECTIVES:**

The objective of the Chemistry is to acquaint the students with the basic phenomenon/concepts of chemistry, the student faces during the course of their study in the industry and Engineering field. The student with the knowledge of basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field. The student will be able to understand the new developments and breakthroughs efficiently in engineering and technology. The introduction of the latest (R&D oriented) topics will make the engineering student upgraded with new technologies.

- **COURSE OUTCOMES:**

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

CO1. Understand microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.

CO2. Comprehend bulk properties and processes using thermodynamic considerations.

CO3. Rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.

CO4. List major chemical reactions that are used in the synthesis of molecules.

CO5. Apply the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.

Course Content/ Syllabus **45 Hours**

UNIT-I: Atomic and Molecular Structure **8 hours**

Schrodinger equation. Particle in a box solution and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

UNIT-II: Spectroscopic techniques and applications **6 hours**

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic

molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques. Diffraction and scattering.

UNIT-III: Intermolecular forces and potential energy surfaces 5 hours

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

UNIT-IV: Use of free energy in chemical equilibria 5 hours

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid-base, oxidation-reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

UNIT-V: Periodic properties 6 hours

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard and soft acids and bases, molecular geometries.

UNIT-VI: Stereochemistry 5 hours

Representations of 3-dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transition metal compounds.

Text and Reference books:

1. Pahari, A. K., & Chauhan, B. S. (2006). *Engineering chemistry*. Laxmi Publications.
2. MOHAPATRA, R. K. (2015). *Engineering Chemistry with Laboratory Experiments*. PHI Learning Pvt. Ltd.
3. Singh, D., & Vats, S. K. (2013). *Comprehensive Engineering Chemistry: Corrected and Updated*. IK International Pvt Ltd.
4. Kakkar, R. (2015). *Atomic and Molecular Spectroscopy*. Cambridge University Press.
5. Atkins, P., Atkins, P. W., & de Paula, J. (2014). *Atkins' physical chemistry*. Oxford university press.
6. Solomons, T. G., & Fryhle, C. B. (2008). *Organic chemistry*. John Wiley & Sons.

CHEMISTRY LABORATORY

EXPERIMENTS

Choice of 10-12 experiments from the following:

1. Determination of surface tension and viscosity.
2. Thin layer chromatography.
3. Ion exchange column for removal of hardness of water.
4. Determination of chloride content of water.
5. Colligative properties using freezing point depression.
6. Determination of the rate constant of a reaction.
7. Determination of cell constant and conductance of solutions.
8. Potentiometry - determination of redox potentials and EMFs.
9. Synthesis of a polymer/drug.
10. Saponification/acid value of an oil.
11. Chemical analysis of a salt.
12. Lattice structures and packing of spheres.
13. Models of potential energy surfaces.
14. Chemical oscillations- Iodine clock reaction.
15. Determination of the partition coefficient of a substance between two immiscible liquids.
16. Adsorption of acetic acid by charcoal.
17. Use of the capillary viscometers to demonstrate the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of the egg.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	3	1	1	1	1	1				1	1		1	1		1
CO 2	3	3	2	3	2	2			3		3		3	3		2
CO 3	1	2	3	2	1	3				1						
CO 4	1	1		1	2				1	1				2		
Average	2	1	1	1	1	1	0	0	1	1	1		1	1	0	1

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				Mid Term Exam	End Term Exam	Total
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			End Term Examination		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

PHYS 1002	**Physics**	**L-T-P-C: 2-1-1-**

- **COURSE OBJECTIVES:**

To demonstrate the various phenomenon of light, principles of LASER and electron optics and their applications in health sciences. To understand the basic radiation, characteristics, interaction and detection used in nuclear medicine and health sciences. To develop an understanding of the state of matter and its characteristics along with the fundamentals of x-rays and applications in health sciences. To utilize the fundamentals of quantum mechanics in various areas of health sciences.

- **COURSE OUTCOMES:**

After completion of this course, the students will be able to

CO1. Learn the significance of light, lasers, electron optics and their application in health sciences.

CO2. Illustrate the basic radiation, its characteristics, interaction and detection used in nuclear medicine and health sciences.

CO3. Comprehend the utilization of X-ray characteristics, properties and applications in health sciences.

CO4. Apply the fundamentals of Quantum Mechanics in various areas of health sciences.

Course Content **45 hours**

Unit-I: Light, LASER, and electron optics **12 hours**

Interference, waves and Huygens principle, phase and path difference, diffraction, difference with interference. Introduction to LASER, Absorption, Spontaneous and Stimulated emission of radiation, Population inversion & types of pumping, Main components of a LASER, Construction & working of Ruby and Helium-Neon laser, applications in health sciences.

Electron optics, the motion of an electron in uniform electric and magnetic field, scanning electron microscopy (SEM), transmission electron microscopy (TEM), and applications of microscopy in health sciences.

Unit-II: Basic Radiation Physics **12 hours**

Introduction, Classification of radiation – ionizing and non-ionizing, Nuclear structure, Nuclear reactions, Radioactivity, Modes of radioactive decay-alpha decay, beta decay,

gamma decay, Radioactive isotopes, G.M. and Scintillation counters, Precautions in radioisotope handling, Nuclear Medicine.

Unit-III: Solid-State Physics and X-ray Diffraction 12 hours

States of matter, Introduction to Solid State Physics: single crystals, polycrystalline and amorphous materials, Lattice, Basis and crystal structure, Unit Cell (primitive and non-primitive), Bravais lattices, lattice planes, Miller indices, SC, BCC, and sodium chloride structures, closed packed structures (FCC and HCP).

Origin of X-rays, properties of X-rays, Moseley's law, X-ray diffraction, Structure determination by X-ray diffraction, Bragg's law, applications of X-rays in health sciences.

UNIT-IV: Quantum Mechanics for Biologists 9 hours

Introduction to Quantum Mechanics, Wave-particle duality, De Broglie waves, Wave function and its interpretation, Normalization, Uncertainty principle and its applications.

Text Books/ Latest volume, edition

1. Malik H.K, Singh A.K. (2011) Engineering Physics, TMH, New Delhi. ISBN: 9780070671539
2. Beiser A. (2002) Concepts of Modern Physics, McGraw Hill Education. ISBN: 9780070495531
3. Ghatak A. (2012) Optics, McGraw Hill Education. ISBN: 978-1259004346.
4. Sahni V., Goswami D. (2008) Nano Computing, McGraw Hill Education Asia Ltd., ISBN: 978007024892.
5. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing, 2004).
6. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).

Physics Laboratory

List of Experiments:

1. To determine the frequency of AC mains by using a sonometer.
2. To study the Hall effect and hence determine the Hall coefficient (R_h) and carrier density (n) of a given semiconductor material.
3. To study the induced emf as a function of the velocity of the magnet passing through the coil (Faraday's Law).

4. To study the charge delivered due to electromagnetic induction.
5. To study the variation of a magnetic field with distance along the axis of a current-carrying circular coil and hence estimate the radius of the coil.
6. To plot the characteristics of photocurrent vs voltage at different frequencies.
7. To determine the Numerical Aperture of an optical fibre and study about the bending losses. 8. To study the laser beam diffraction.
8. Study both the current-voltage characteristic and the power curve to find the maximum power point (MPP) and efficiency of a solar cell.
9. To find the Planck's constant by using LEDs.
10. Presentation related to any science concept.

Relationship between the Program Outcomes (POs), Program Specific Outcomes and Course Outcomes (COs)

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	
CO4	-	-	3	-	2	-	-	-	-	-	-	-	-	-	-	
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	
Avg	-	3	3	3	2	-	-	-	-	3	-	-	-	-	-	

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)
"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

HSFT 1002	**Introduction to Food Technology**	**L-T-P-C: 2-**

➢ COURSE OBJECTIVES

The "Introduction to Food Technology" course provides an in-depth exploration of the exciting field of Food Technology. The basic food processing techniques, principles of techniques, nutritional behaviour of foods, needs and working of essential nutrients. In this course, the student will explore the newest frontiers in nutrition and learn how to apply nutrition principles to their own food choices. Solidly based on Food science, this course will help to understand how key concepts of different food processing and preservation techniques and their

application in different foods. Nutrients (carbohydrates, lipids, proteins, vitamins, minerals, and water) affect health, disease, energy balance, and weight control.

- **COURSE OUTCOMES**

Upon completion of this course, the students will be able to

CO1. Define Food technology and its composition and food groups.

CO2. Comprehend the nutritional importance of different foods.

CO3. Describe carbohydrates, protein, lipids, minerals and vitamins with their digestion and absorption.

CO4. Analyze different processing techniques and their effect on Food products.

CO5. Apply the basics of food processing and shelf-life extension.

Course Content **45 hours**

UNIT-I: Introduction to Food Technology **10 hours**

Introduction to Food Science as a discipline and its scope; Recent developments in the field of food science. Food shelf life, Food safety. Water activity, reaction rates, pH, temperature, buffers, pressure, osmosis etc. and storage life of food; Interactions of water with food components.

UNIT-II: Nutritional Aspect of Food **12 hours**

Definition of nutrition, health, nutritional status and malnutrition. Recommended Dietary Allowances (RDA)- Definition, factors affecting RDA and methods used for deriving RDA. Basic food groups according to ICMR and the concept of a balanced diet.

UNIT-III Energy and Carbohydrates **10 hours**

Energy- Definition, units of measurement, direct and indirect calorimetry; Determination of energy value of food, Total Energy requirement, Factors affecting physical activity, Factors

affecting Basal Metabolic Rate, factors affecting Thermic effect of food, Recommended, Dietary Allowances and Sources.

Carbohydrates- Definition, composition, functions, maintenance of blood sugar levels, requirement, sources, digestion, and absorption; Dietary fibre- Definition, classification, physiological effects and sources.

UNIT-IV: Proteins and Lipids 8 hours

Proteins- Definition, composition, nutritional classification of proteins and amino acids, functions, sources, requirements, digestion, and absorption. Evaluation of protein quality: PER, BV and NPU.

Lipids- Definition, composition, functions, sources, requirements, digestion, and absorption. Essential fatty acids – Definition, functions, sources, and effects of deficiency.

UNIT-V: Minerals and Trace Elements, Vitamins 5 hours

Macro minerals- Calcium, Phosphorous, Sodium and Potassium: Functions, requirements, sources, and effects of deficiency. Micro minerals- Iron, Iodine, Copper, Fluorine and Zinc: Functions, sources, requirements, and effects of deficiency. Fat-soluble Vitamins – Vitamin A, D, E and K: Functions, requirements, sources, and effects of deficiency. Water Soluble Vitamins – Thiamine, riboflavin, niacin, ascorbic acid, folic acid, vitamin B6 and vitamin B12: Functions, requirements, sources, and effects of deficiency. Antioxidants, pigments and flavours.

Text / Reference Books:

1. Potter, N. N., & Hotchkiss, J. H. (2012). *Food science*. Springer Science & Business Media.
2. Mudambi, S. R. (2001). *Fundamentals of foods and nutrition*. New Age International.
3. Srilakshmi, B. (2006). *Nutrition Science*. New Age International.
3. Rolfes, S. R., Pinna, K., & Whitney, E. (2014). *Understanding normal and clinical nutrition*. Cengage learning.
4. Dixon, J., & Ballantyne-Brodie, E. (2015). 13 The role of planning and design in advancing a bio-nutrition-sensitive food system. *The Routledge handbook of planning for health and well-being: Shaping a sustainable and healthy future*.
5. Schlenker, E., & Roth, S. L. (2013). *Williams' Essentials of Nutrition and Diet Therapy-Revised Reprint-E-Book*. Elsevier Health Sciences.

Introduction to Food Technology Laboratory

Experiments:

1. Estimation of calorific value of food.
2. Estimation of moisture content.
3. Estimation of ash content.
4. Preparation of buffers (acidic, neutral and alkaline) and determination of pH.
5. Qualitative identification of carbohydrates – glucose, fructose, galactose, sucrose, maltose, lactose.
6. Preparation of Osazones and their identification.
7. Qualitative identification of amino acids – histidine, tyrosine, tryptophan, cysteine, arginine.
8. Qualitative identification of lipids – solubility, saponification, acrolein test, Salkowski test, Lieberman-Burchard test.
9. Qualitative tests for minerals.
10. Quantitative estimation of glucose.

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	2	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
Average	-	3	3	3	2	-	-	-	-	3	-	-	-	-	-

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_ " No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			End Term Examination		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

MATH 1048	**Mathematics-I**	**L-T-P-C: 2-1-0-3**

- **COURSE OBJECTIVES:**

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling the more advanced levels of mathematics and applications that they would find useful in their disciplines.

- **COURSE OUTCOMES**

Upon completion of the course, the students will be able to:

CO1. Understand differential and integral calculus to notions of curvature and improper integrals. Apart from some other applications, they will have a basic understanding of Beta and Gamma functions.

CO3. Illustrate the tool of power series and Fourier series for learning advanced Engineering Mathematics.

CO4. Describe functions of several variables that are essential in most branches of engineering.

CO5. Apply the essential tool of matrices and linear algebra in a comprehensive manner.

Course Contents **45 hours**

UNIT-I: Calculus **8 hours**

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle’s Theorem, Mean value theorems, Taylor’s and Maclaurin's theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

UNIT-II: Sequences and Series **15 hours**

Convergence of sequences and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithmic functions; Fourier series: Half range sine and cosine series, Parseval’s theorem.

UNIT-III: Multivariable Calculus (Differentiation) **12 hours**

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

UNIT-IV: Matrices **10 hours**

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

TEXTBOOKS/REFERENCES:

1. Flanders, H., & Price, J. J. (2014). *Calculus with analytic geometry*. Academic Press.
2. Garg, R. (2017). *Engineering Mathematics-I*. Khanna Publishing House.
3. Duffy, D. G. (2021). *Advanced engineering mathematics with MATLAB*. Crc Press.
4. Dass, H. K. (2008). *Advanced engineering mathematics*. S. Chand Publishing.
5. Ramana, B. V. (2018). Higher Engineering Mathematics. Tata McGraw Hill.
7. Poole, D. (2014). *Linear algebra: A modern introduction*. Cengage Learning.
8. Grewal, B. S., & Grewal, J. S. (1996). Higher engineering mathematics. *2002, Khanna Publishers, New Delhi*.

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	
CO4	-	-	3	-	2	-	-	-	-	-	-	-	-	-	-	
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	
Avg	-	3	3	3	2	-	-	-	-	3	-	-	-	-	-	

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			End Term Examination		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

HSBT 1003	**Introduction to IT systems for Health Sciences**	**L-T-P-C: 2-**

- **COURSE OBJECTIVES**

  To know the basics of computers, various types of databases, and applications of databases in the field of life sciences. Students understand the basics of data visualization.

- **COURSE OUTCOMES**

Upon completion of the course, the student shall be able to

CO1. Defines the basics of computer systems.

CO2. Explain the management of the database-information gathering, requirement

CO3. Understand the basics of data visualization and reporting.

CO4. Understand the role of bioinformatics in drug discovery

CO5. Apply this knowledge in planning and managing the projects.

Course Content **30 hours**

UNIT-I: KNOWING COMPUTER: **5 hours**

What is a Computer, Basic Applications of Computer; Components of Computer System, Central Processing Unit (CPU), input/output Devices, Computer Memory, Concepts of Hardware and Software; Concept of Computing, Data and Information; evolution of computing devices.

UNIT-II: BASICS OF DATA HANDLING: **5 hours**

Types of data; structured, unstructured and semi-structured data; Introduction to the database, ACID properties, SQL & NoSQL databases, BASE Properties, ER Diagram, Introduction to Inmemory processing, Basics Excel Operations, Graphs and formulas in Ms Excel.

UNIT-III: Protein And Genome Databanks **5 hours**

GenBank, SwissProt, PDP, RefSeq. Concept of Information Systems and Software: Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project.

UNIT-IV: Visualization: **5 hours**

Basics of Tableau for visualization, Reports and graphs, data connection; Tableau Calculations & Filters; Dashboard.

UNIT-V: Data analysis in Preclinical development: **5 hours**

Chromatographic data analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS)

Introduction to IT systems for Health Sciences Laboratory

Experiments:

1. MS. Excel: Getting to Know Excel, The Ribbon, Identify the terminology and elements of the Ribbon.
2. The Work Surface, Recognize the main terms used to describe Excel's work canvas.
3. Navigation, Utilize the keyboard or mouse to select cells and ranges in a spreadsheet. Controlling Your Start Experience
4. Decide what happens when you start the Excel application. Creating Your First File: create your first Excel file, enter data, and create a table.
5. Formatting: Format cells by selecting fonts and colour fills to make information more attractive. Basic Math: Utilize basic mathematics including multiplication and division in Excel.
6. Essential Formula Knowledge: Formula Anatomy, Understanding Excel Formula Anatomy, Cell Referencing – Theory: Learn about working with absolute and relative cell referencing.
7. Cell referencing – Example: See absolute and relative cell referencing in practice and learn about ways to copy and paste formulas.
8. Function Anatomy: Use to understand the anatomy of Excel functions and what their components mean. Math Functions: Learn basic math functions including SUM, ROUND, and SUBTOTAL.
9. Basic Statistics: Learn basic statistical functions including COUNT, COUNTA, AVERAGE, MAX, MIN, MEDIAN, and MODE. Logic Functions: Learn to build standalone logical IF functions and make them more complex by nesting AND and OR within them. Text Functions: Learn to break apart text with the LEFT, RIGHT, MID, FIND and SEARCH functions, and to combine text with the & character. Understanding Dates: Understand how dates work in Excel using the TODAY, YEAR, MONTH, DAY, and DATE functions. Understanding Time: Understand how time works in Excel and how to change from whole numbers into time increments and back again.
10. Tableau: Basics-Start Page-Show Me; Connecting to Excel Files; Connecting to Text Files; Connect to Microsoft SQL Server; Connecting to Microsoft Analysis Services; Creating and Removing Hierarchies; Bins; Joining Tables; Data Blending.
11. Tableau Basic Reports-Parameters; Grouping Example 1; Grouping Example 2; Edit Groups; Set; Combined Sets; Creating a First Report; Data Labels; Create Folders; Sorting Data; Add Totals, Sub Totals and Grand Totals to Report
12. Tableau Calculations & Filters-Calculated Fields; Basic Approach to Calculate Rank; Advanced Approach to Calculate Rank; Calculating Running Total; Filters Introduction; Quick Filters; Filters on Dimensions; Conditional Filters; Top and Bottom Filters; Filters on Measures; Context Filters; Slicing Filters; Data Source Filters; Extract Filters

Text Books and References:

1. Shortliffe, H. E., & Cimino, J. J. (2014). *Biomedical informatics: computer applications in health care and biomedicine*. Springer-Verlag London.
2. Wang, B. (2006). *Computer applications in pharmaceutical research and development*. John Wiley & Sons.

3. Rastogi, S. C., Rastogi, P., & Mendiratta, N. (2022). *Bioinformatics: Methods and Applications-Genomics, Proteomics and Drug Discovery*. PHI Learning Pvt. Ltd.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1				2	3	1				1			1	2		
CO 2				2	3	1				1			1	2		
CO 3		3		2	3	1		2	2	1		2	1	2		
CO 4				3	3	1				2			1	2	2	
CO 5		2										0.5				
Average	0	1	0	2	3	1	0	1	1	1	0	1	1	2	1	0

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)
"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	Life Skill - I	L-T-P-C: 3-1-1-5

- **COURSE OBJECTIVES**
- **COURSE OUTCOMES**
- **CATALOG DESCRIPTION**

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)
"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

UPES
UNIVERSITY OF TOMORROW

SEMESTER II

MATH 1038	Mathematics-II	L-T-P-C: 2-

- **COURSE OBJECTIVES:**

The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced levels of mathematics and applications that would be essential for their disciplines.

- **COURSE OUTCOMES:**

After completion of the course, the students will be able to:

CO1. Understand and apply the mathematical tools needed in evaluating multiple integrals and their usage.

CO2. Analyze the tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing with engineering problems.

CO3. Apply effective mathematical tools for the solutions of differential equations that model physical processes.

Course Content **45 hours**

UNIT-I: Multivariable Calculus (Integration) Multiple Integration **8 hours**

Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

UNIT-II: First-order ordinary differential equations **8 hours**

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT-III: Ordinary differential equations of higher orders **10 hours**

Second-order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

UNIT-IV: Complex Variable **10 hours**

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

UNIT-V: Integration Contour integrals **9 hours**

Integration Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

TEXTBOOKS/REFERENCES:

1. Iyengar, T. K. V., Gandhi, B. K., Ranganatham, S., & Prasad, M. V. S. S. N. (1977). *Engineering Mathematics-I*. S. Chand Publishing.
2. Flanders, H., & Price, J. J. (2014). *Calculus with analytic geometry*. Academic Press.
3. Garg, R. (2017). *Engineering Mathematics-I*. KHANNA PUBLISHING HOUSE.
4. Duffy, D. G. (2021). *Advanced engineering mathematics with MATLAB*. Crc Press.
5. Dass, H. K. (2008). *Advanced engineering mathematics*. S. Chand Publishing.
6. Ramana, B. V. (2018). Higher Engineering Mathematics. Tata McGraw Hill.
7. Poole, D. (2014). *Linear algebra: A modern introduction*. Cengage Learning.
8. Grewal, B. S., & Grewal, J. S. (1996). Higher engineering mathematics. *2002, Khanna Publishers, New Delhi*.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	2	3			1		3		2			3	2	1		
CO 2	3	3			2		1					1	2		1	1
CO 3	2	3			1		1			3				1	1	2
CO 4	1	1			2		1					2	3		1	3
Average	2	3			2		2		1	1	0	2	2	1	1	2

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				Mid Term Exam	End Term Exam	Total
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			End Term Examination		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

ECEG 1005	**Basic Electrical and Electronics Engineering**	**L-T-P-C: 2-**

- **COURSE OBJECTIVES:**

The students will be introduced to basic signal, spectrum, and amplifier concepts for analog electronic circuits. The focus of this course is not only to develop the student's ability to analyze and design basic analog electronic circuits with passive components and/or active elements like diode, transistors and Op-Amp. Besides, some experiments were provided to help students to have a thorough grasp of the basic electronic circuit problem.

- **COURSE OUTCOMES:**

After completion of this course, the students will be able to:

CO1. Define the basics of EE abstractions on which analysis and design of electrical and electronic circuits and systems are based.

CO2. Comprehend the use of abstractions to analyze and design simple electronic circuits.

CO3. Solve the differential equations describing the time behaviour of circuits containing energy storage elements.

CO4. Analyze complex devices such as semiconductor diodes and field-effect Transistors modelled and how the models are used in the design and analysis of useful circuits.

CO5. Apply the design and construct circuits, and take measurements of circuit behaviour.

Course Content **30 hours**

UNIT-I: D.C. & A.C circuits: D.C. circuits **6 hours**

Ohm's law, Kirchhoff's Laws, Thevenins, Nortons, superposition theorem, Maximum power transfer theorem, Reciprocity, Compensation and Tellegan's Theorem. D.C. circuits, Nodal and Mesh analysis.

Series and Parallel A.C. circuits: Series and Parallel A.C. circuit, Series and Parallel resonance. Q factor, cut-off frequency and bandwidth, the importance of earthling& power factor.

UNIT-II: Electromagnetism: **6 hours**

Transformers: Principle, construction and working of transformer, Efficiency and regulation. Electrical Machines: Introduction to D.C. Machines, induction motor, Synchronous machines.

Measuring Instruments: Voltmeter, Ammeter, Wattmeter, Energy meter.

UNIT-III: Semiconductors **8 hours**

Crystalline material: Mechanical properties, Energy band theory, Fermi levels; Conductors, Semiconductors and Insulators: electrical properties, band diagrams.

Semiconductors: intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers.
Formation of P-N junction, energy band diagram, built-in-potential forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics; Junction capacitance and Varactor diode. Simple diode circuits, load line, linear piecewise model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

UNIT-VI: Bipolar Junction Transistors 10 hours

Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action, injection efficiency, base transport factor and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor

Reference Books

1. Kothari, D. P., Nagrath, I. J., & Nagrath, I. J. (2010). *Basic Electrical Engineering* (Vol. 3). Tata McGraw Hill.
2. Bakshi, U. A., & Bakshi, M. V. (2020). *Electrical technology*. Technical Publications.
3. Prasad, R. (2014). *Fundamentals of electrical engineering*. PHI Learning Pvt. Ltd.
4. Kulshreshtha, D. C. (2010). *Basic Electrical Engineering*. Jaypee University of Information Technology, Solan, HP.
5. Malvino, A. (1998). *Electronic principles*. McGraw-Hill, Inc.
6. Tooley, M. (2019). *Electronic circuits: fundamentals and applications*. Routledge.
7. Maini, A. K., & Agrawal, V. (2009). *Electronic devices and circuits*. John Wiley & Sons.
8. Singh, B. P., & Singh, R. (2006). *Electronic devices and integrated circuits*. Pearson Education India.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	2	1			1	0.5	3		2			3	2	1		
CO 2	1	2	2				1					1	2		1	1
CO 3	2	3		2	1	2	1			3				1	1	2
CO 4	1	1	2		2		1		0.5			2	3		1	3
CO 5		2	1	0.5	1		1.5	2.5		2				0.5		

Average	1	2	1	1	1	1	2	1	1	1	0	1	1	1	1	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

COURSE OBJECTIVES:

The objective of this subject is to make students familiar with basic engineering practices in a workshop. This will help in equipment, handling, and repair and save wastage of time.

- **COURSE OUTCOMES:**

Upon completion of this course, the students will be able to:

CO1. Know how casting and welding are carried out

CO2. Understand how metalwork is carried out and the fitting of different parts in equipment.

CO3. Outline the applications of carpentry in various domains of food processing and additives.

CO4. Analyze the principles of hot working and cold working.

CO5. Apply rolling and forging, drawing and extrusion.

Course Content

UNIT-I: Manufacturing Methods

Casting, forming, machining, joining, advanced manufacturing methods. CNC machining, Additive manufacturing.

UNIT-II: Fitting operations & power tools

Sketch, specification and applications of fitting work holding tools-bench vice, V-block with clamp and C-clamp. Sketch, specification, material, applications and methods of using fitting marking and measuring tools-marking table, surface plate, angle plate, universal scribing block, try-square, scriber, divider, centre punch, letter punch, callipers, vernier calliper, etc.

UNIT-III: Electrical & Electronics

UNIT-IV: Carpentry

Types, sketches, specifications, materials, applications and methods of using carpentry tools-saws, planners, chisels, hammers, pallets, marking gauges, vice, try square, rule, etc. Types of woods and their applications. Types of carpentry hardware and their uses. Plastic moulding, glass cutting.

UNIT-V: Metal casting

Types, specifications, material and applications of arc welding transformers. Types, specifications, material and applications of arc welding accessories and consumables. Demonstration of metal joining operations- arc welding, soldering and brazing. Show the effect of current and speed. Also, demonstrate various welding positions.

UNIT-VI: Welding

Arc welding & gas welding, brazing

Laboratory Experiment wise

Experiment 1. The casting of metal sheets

Experiment 2. Welding through Non-traditional Machining

Experiment 3. Metalworking on Lath machine

Experiment 4. Fitting of furniture

Experiment 5. Carpentry of wooden materials
Experiment 6. Application of Additive in Carpentry
Experiment 7. Hot working cold working
Experiment 8. Rolling of sheets
Experiment 9. Forging, drawing, extrusion

Text Books/References:

1. Chapman, W. (2019). *Workshop Technology Part 1*. Routledge.
2. Garg, S. K. (2009). Comprehensive Workshop Technology (Manufacturing Processes).
3. Fassi, I., & Shipley, D. (2017). Micro-manufacturing technologies and their applications. *Springer Tracts in Mechanical Engineering*, *10*, 978-3.
4. Asthana, R., Kumar, A., & Dahotre, N. B. (2006). *Materials processing and manufacturing science*. Elsevier.
5. Rao, P. N. (2013). *Manufacturing technology* (Vol. 1). Tata McGraw-Hill Education.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	2	1			1	0.5	3		2			3	2	1		
CO 2	1	2	2				1					1	2		1	1
CO 3	2	3		2	1	2	1			3				1	1	2
CO 4	1	1	2		2		1		0.5		0	2	3		1	3
CO 5		2	1	0.5	1		1.5	2.5		2				0.5		
Average	1	2	1	1	1	1	2	1	1	1	0	1	1	1	1	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)
"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

MECH 1005	**Engineering Graphics**	**L-T-P-C: 1-0-1-2**

COURSE OBJECTIVES:

To construct any structure or machine correctly and methodically, one must record his idea before starting construction work. These recorded ideas become more vivid and forceful if they are shown on paper in the form of drawings of the structure or machine. Such a drawing will be a very great help to the man who looks after the construction of this structure or machine.

- **COURSE OUTCOME:**

After the completion of the course, the students will be able to:

CO1. Comprehend the sheet metal industry.

CO2. Interpret engineering data in the form of drawings.

CO3. Analyze different lines and their importance.

CO4. Apply the Project's different solids, and customize Computer aided designs and drawings.

Course Content **15 hours**

UNIT-I: Drawing Techniques and Scales **4 hours**

Various types of lines, principles of dimensioning, size and location as per IS code of practice (SP-46) for General Engineering. Drawing: Practice drawing, various types of lines and dimensioning exercises. Drawing exercises pertaining to symbols. Conventions and Exercise of lettering techniques. Freehand printing of letters and numerals in 3, 5, 8 and 12 mm sizes, vertical and inclined at 75 degrees. Instrumental lettering in a single stroke. Linear scale, Diagonal scale &Vernier scale. Projection of point, line and plane

UNIT-II: Projections of Solids **3 hours**

Regular solids of revolution and polyhedrons etc. and their auxiliary views. Sectioning of Solids, Principal of sanctioning, Types of sanctioning and their practice on the projection of solids, Sectioning by auxiliary planes.

UNIT-III: Development of Surfaces **4 hours**

Development of surfaces of cylinders, cones, pyramids, prism etc. Exercises involving the development of unique surfaces like Y-piece, hopper, tray, truncated pieces etc. Intersection of Surfaces: Intersection of cylinders, cones and prisms with their axes being vertical, horizontal or inclined. Exercise on the intersection of solids-cylinder and cylinder, cylinder and cone, prism and prism.

Unit-IV: Isometric Projection **4 hours**

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Unit-V: Overview of Computer Graphics

Listing the computer technologies that impact graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The

Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects; Isometric Views of lines, Planes, Simple and compound Solids];

Unit-VI: Customization & CAD Drawing

Consists of the set-up of the drawing page and the printer, including scale settings, setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Practice of Orthographic projections. Simple Trusses: Graphical Method.

Reference Book:

1. Madsen, D. A., & Madsen, D.P. (2016). *Engineering drawing & design*. Cengage Learning.
2. Dhawan, R. K. (2019). *A Textbook of Engineering Drawing*. S. Chand Publishing.
3. Bhatt, N. D., Panchal, V. M., & Ingle, P. R. (2010). *Engineering Drawing*. Charotar Publishing House Pvt. Limited.

Program Outcomes Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	3				1	2			1		1		1		2	
CO 2	3				1				1		1		1		2	
CO 3	3				1				1		1		1		2	
CO 4	3				1				1		1		1		2	
Average	3	0	0	0	1	1	0	0	1	0	1		1	0	2	0

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			End Term Examination		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

MECH 1005	**Engineering Thermodynamics**	**L-T-P-C: 2-1-0-3**

- **COURSE OBJECTIVES:**

To understand the concepts of engineering thermodynamics. To acquire knowledge about the laws of thermodynamics and its applicability. To be able to solve complex engineering problems using thermodynamic principles.

- **COURSE OUTCOMES:**

After the completion of the course, the students should be able to:

CO1. Define the basics of thermodynamics, mass and energy conservation principle and work and heat for a closed and open system.

CO2. Comprehend the concepts and applications of energy, entropy and exergy.

CO3. Analyze the thermodynamic cycles and evaluate performance parameters.

CO4. Apply the laws of thermodynamics to solve engineering problems.
CO5. Estimate heat of reaction and heat capacities for various processes using tools like spreadsheets.

Course Content **45 hours**

UNIT-I: Introduction to Thermodynamics **8 hours**

Scope of thermodynamics, Dimensions and units, temperature, pressure, work, energy and heat, thermodynamic system and control volume, thermodynamic properties, processes and cycles, Thermodynamic equilibrium.

UNIT-II: First law of thermodynamics **8 hours**

State functions; equilibrium; phase rule; reversible process; constant P, V, T processes, mass, and energy balance for open systems, the first law of thermodynamics for steady flow process.

UNIT-III: Phases and, phase transitions **8 hours**

PVT behaviour; description of materials – Ideal gas law, van der Waals, virial, and cubic equations of state; Reduced conditions & corresponding states theories; correlations in the description of material properties and behaviour; Calculations are done using tools like spreadsheets/MS Excel; Defining Thermodynamic packages in simulators (ASPEN/DWSim).

UNIT-IV: Heat effects **8 hours**

latent heat, sensible heat, standard heats of formation, reaction, and combustion. Calculations are done using tools like spreadsheets/MS Excel.

UNIT-V: Second law of thermodynamics **8 hours**

Concepts of the second law, Heat engines, Carnot's theorem; Thermodynamic Temperature Scales; Entropy; Entropy changes of an ideal gas; Mathematical statement of the second law; Entropy balance for open systems; Calculation of ideal work, and Lost work.

UNIT-VI: **Applications of thermodynamics** **5 hours**

Flow processes, pumps, compressors, and turbines; The Carnot refrigerator; Vapor-compression cycle; Absorption refrigeration; Heat pump, Liquefaction processes.

Reference Books:

1. Nag, P. K. (2011). Engineering Thermodynamics, Available energy, Availability and Irreversibility, McGraw-Hill Education.
2. Borgnakke, C., & Sonntag, R. E. (2022). *Fundamentals of thermodynamics*. John Wiley & Sons.
3. Cengel, Y. (2011). Thermodynamics an Engineering Approach. by Yunus A Cengel. *Thermodynamics an Engineering Approach, Digital Designs*.
4. Rogers, G. F., & Mayhew, Y. R. (1992). Engineering Thermodynamics, Heat and Work Transfer.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	3	2	1	1		2	2		2	2	1	3	2	1	3	3
CO 2	3	3	2	1		3	2	2	2	2	1	3	2	1	3	2
CO 3	3	3	2	2		3	1	1	2	2		2	1	1	3	3
CO 4	2	1	1	1	1	2			2	1		3	1	1	3	2
CO 5	2	2	2	1		1			2	2		3	1	1	3	2
Average	2.6	2	1.6	1.2	0.2	2.2	1	0.6	2	1.8	0.4	2.8	1.4	1	3	2.4

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	Biochemistry	L-T-P-C: 2-1-1-4

➢ COURSE OBJECTIVES:

The course is aimed at giving students exposure to the basic role of biomolecules and their chemical interactions inside the cell. It provides deeper insight into structures, properties and functions of major biomolecules and metabolic pathways in living systems.

➢ COURSE OUTCOMES:

Upon the completion of the course, the students will be able to:

CO1. Explain the structure and functions of different chemical building blocks of life.

CO2. Identify and draw structures of various types of biomolecules.

CO3. Understand about basic concepts of enzymes and the central role of enzymes in catalyzing the reactions in living systems.

CO4. Apply knowledge of primary biochemical pathways leading to synthesis and catabolism of major bio-molecules.

Course content **45 hours**

UNIT-I: Monosaccharides **8 hours**

Structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers. Disaccharides- Maltose, Lactose and Sucrose. Polysaccharides-homo and heteropolysaccharides, structural and storage polysaccharides. Anabolism and catabolism, Glycolysis, Production of acetyl CoA, Citric acid cycle, Gluconeogenesis.

UNIT-II: Amino acids and Enzymes **8 hours**

Classification, chemical and physical properties of different amino acids. Natural modification of amino acid, titration curve of amino acid and its significance. Introduction to protein structure and function, alpha helix, beta pleated sheets, tertiary and quaternary structure of proteins, and different non-covalent and covalent interactions. Amino acid metabolism-Amino acid deamination and transamination, urea cycle. Introduction to enzymes, classification of enzymes, mechanism of action, factors affecting enzyme activity, Michaelis-Menten equation, significance of Km, Vmax and turnover number.

UNIT-III: Building blocks of lipids **8 hours**

Fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes. Introduction to lipid micelles, monolayer and bilayer. Fatty acid synthesis and transport.

UNIT IV: Nucleotides **8 hours**

Structure and properties. Nucleic acid structure-Watson - Crick Model of DNA. Structure of major species of RNA. De novo synthesis of purine and pyrimidine nucleotides. Disorders of purine and pyrimidine metabolism.

Biochemistry Laboratory

Experiments

1. Numerical calculations for preparation of the solution, e.g. Normality, Molality, Molarity, dilutions and dilution factors.
2. Preparation of buffer and pH measurement
3. Qualitative test for carbohydrates
4. Qualitative test for amino acids.
5. Quantitative estimation of protein by Bradford/Bicinchoninic acid method
6. Assay of salivary amylase.
7. Qualitative test for lipids.
8. Tests for lipids- Salkowski/Lieberman-Burchard test.

Reference Books

1. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN 13: 978-1464126116.
2. Devlin, T. M. (Ed.). (2010). *Textbook of biochemistry with clinical correlations*. John Wiley & Sons. ISBN: 978-9354641558.
3. Mougios, V. (2019). *Exercise biochemistry*. Human Kinetics Publishers.
4. White, S. (2011). Principles and techniques of biochemistry and molecular biology. ISBN 13: 978-1316614761.
5. Sawhney, S. K., & Singh, R. (2000). Introductory Practical Biochemistry. Narosa Publishing House (New Delhi), ISBN-13: 978-8173193026.

CO-PO Mapping

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	3	2	1	1		2	2		2	2		3	2	1	3	3
CO 2	3	3	2	1		3	2	2	2	2		3	2	1	3	2
CO 3	3	3	2	2		3	1	1	2	2		2	1	1	3	3
CO 4	2	1	1	1		2			2	1		3	1	1	3	2
CO 5	2	2	2	1		1			2	2		3	1	1	3	2
Average	3	2	2	1	0	2	1	1	2	2	0	3	1	1	3	2

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				Mid Term Exam	End Term Exam	Total
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			End Term Examination		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

HSBT 2003	Biostatistics	L-T-P-C: 2-0-0-2

- **COURSE OBJECTIVES:**

This course defines the principal concepts of biostatistics. Recognize the definition of statistics, its subject and its relations with the other sciences. Restate the principal concepts of biostatistics methods. Collect data relating to variable/variables which will be examined and calculate descriptive statistics from these data.

- **COURSE OUTCOMES:**

CO1. Identify the roles of biostatistics in the prevention of disease and the improvement of health.
CO2. Compute basic descriptive statistics and explore data analytic methods.
CO3. Analyze the concept of appropriate statistical methods.
CO4. Apply different design tools used for data analysis including screening designs and response surface designs

Course Content **30 hours**

UNIT-I: Sources of data **8 hours**

Types of data collection methods; Measurement of disease frequency, Person-time exposure.

Types of measures – reliability, validity, accuracy, questionnaire construction, index construction and scaling, observe variation, diagnostic tests, measurement issues, evaluating sources of data.

STUDY DESIGNS: - epidemiological study designs, AN overview of study designs, descriptive studies, ecological studies, Case-control, Cohort, Randomized control trials, Systematic review and meta-analysis – Hybrid designs in epidemiology – Community-based epidemiologic studies, Causation and association, Hills Criterion.

UNIT-II: Data ethics **7 hours**

IRBs, Informed consent, Confidentiality, Clinical trials, Behavioral & social experiments. Natural history and spectrum of disease: Concepts of Disease Occurrence Chain of Infections Epidemic Disease Occurrence Epidemic Patterns.

Public Health Surveillance: Purpose and characteristics of public health surveillance. Identifying health problems for surveillance. Working with data for surveillance Evaluating and improving surveillance.

UNIT-III: Introduction to Biostatistics **8 hours**

Frequency distribution Measures of central tendency: Mean, Median, Mode-Pharmaceutical examples Measures of dispersion: Dispersion, Range, standard deviation. Descriptive Statistics – Variables, Pie charts, bar graphs, histograms, Scatterplots Distribution, Measuring Center, Measuring Spread, Density curves, Types of variables, Error-I type, Error-II type, Standard error of mean (SEM), Confidence Intervals

UNIT-IV: Design and Statistical analysis **7 hours**

Probability: Overview of probability. Types of Distribution: Binomial distribution, Normal distribution, Poisson's distribution, Null hypothesis, alternative hypothesis, Sampling: Types of sampling, Power Statistics for sample size analysis. Design and Analysis of experiments using parametric and non-parametric methods. Correlation and Simple Linear Regression.

Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R Online Statistical Software.

Factorial Design: Definition. Advantage of factorial design Response Surface methodology: Central composite design, Historical design, Optimization Techniques.

Reference Books

1. Gordis, L. (2004). Epidemiology. Third edition. Philadelphia: Elsevier Saunders.
2. Pagano, M. & Gauvreau, K. (2000). Principles of Biostatistics. Belmont, CA: Wadsworth.
3. Dicker, R. C., Coronado, F., Koo, D., & Parrish, R. G. (2006). Principles of epidemiology in public health practice; an introduction to applied epidemiology and biostatistics.
4. Gordis, L. (2013). *Epidemiology e-book*. Elsevier Health Sciences.
5. Buring, J. E. (1987). *Epidemiology in medicine* (Vol. 515). Lippincott Williams & Wilkins.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1																
CO 2																
CO 3																
CO4																
Average																

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			End Term Examination		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

HSBT 2003	**Critical Thinking and Writing (SFL)**	**L-T-P-C: 2-0-0-2**

- **COURSE OBJECTIVES**
- **COURSE OUTCOMES**
- **CATALOG DESCRIPTION**

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

SEMESTER III

XXXX XXXX	Post Harvest Engineering	L-T-P-C: 2-0-1-3

- **COURSE OBJECTIVE:**

This course describes the operations that are carried out after harvesting agricultural produces. Processes like cleaning, drying, winnowing, grading, packaging, transportation, and storage come under post-harvest engineering. Equipments and their engineering, operation and maintenance are described in it.

- **COURSE OUTCOMES:**

Through this course, students should be able to:

CO1. Define post-harvest technology and the different processes involved.

CO2. Describe the physical characteristics of cereal grains, pulses and oilseeds.

CO3. Understand the functional properties of cereal grains, pulses and oilseeds.

CO4. Analyze various milling and post-milling operations.

CO5. Apply post-harvest methods of cereals, fruits, vegetables and oil seeds.

Course Content **45 hours**

UNIT-I: Introduction to Post harvest Technology **8 hours**

Overview of post-harvest technology: concept and science of post harvest technology, production and post harvest losses, reasons for losses, the 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

UNIT-II: Post harvest handling operations **10 hours**

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, size reduction, colour grading, specific gravity grading, equipment's for grading of fruits and vegetables, their grading efficiency

UNIT-III: Separation and Drying **10 hours**

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, grain drying theory, grain dryers, liquid dryers, Spray dryer, drum dryer, vacuum dryer. Gelatinization temperature and significance of glass transition temperature.

UNIT-IV: Parboiling **5 hours**

Parboiling: process, changes during parboiling, parboiling methods, advantages and disadvantages of parboiling with respect to milling, nutritional and cooking quality of grain. Various methods of parboiling i.e., CFTRI and other methods.

UNIT-V: Milling of grains **5 hours**

Milling of grains, 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

UNIT-VI: Materials handling **7 hours**

Introduction to different conveying equipments used for handling grains, conveying equipments used for 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, characteristics, design and operation, chain conveyer: principle of operation, advantages, disadvantages; design; screw conveyor: principle of operation, advantages, disadvantages, bucket conveyer: capacity, speed, principles of operation; pneumatic conveying system: capacity and power requirement, types, air/product separators; gravity conveyor design considerations, capacity and power requirement.

Post Harvest Technology Laboratory

LIST OF EXPERIMENTS

1. Physical and morphological characteristics of food grains
2. Cleaning of cereal grains
3. Pasteurisation of food samples
4. Blanching of Fruits and vegetables
5. Sterilisation of Food samples
6. Parboiling of rice
7. Milling of wheat (size reduction)
8. Milk cream separation
9. Milling of rice
10. Extraction of oils from oil seeds

Reference and Textbooks

1. Sahay, K. M., & Singh, K. K. (1996). *Unit operations of agricultural processing*. Vikas Publishing House Pvt. Ltd.
2. Chakraverty, A., Mujumdar, A. S., & Ramaswamy, H. S. (Eds.). (2003). *Handbook of postharvest technology: cereals, fruits, vegetables, tea, and spices* (Vol. 93). CRC press.
3. Chakraverty, A., & Singh, R. P. (2014). *Postharvest technology and food process engineering*. CRC Press.
4. Das, S. K., & Chakraverty, A. M. A. L. E. N. D. U. (2003). Grain-drying systems. *Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices*, 139-166.

Program Outcomes / Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	3	2	2	2	3	1	3			2		1	1		2
CO 2	3	3	3	2	3	1	3			2		1	1		2
CO 3	1	1	1	2	3	2	3			2		1	1		2
CO 4	3	2		3	3	2			0	3	0	3	3		2
CO 5	2	2	1.5	1			1			1		2	1		2
Average	2	2	2	2	3	2	2	0	0	2	0	2	1	0	2

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

HSMB 2019	**Microbiology & Microbial Technology**	**L-T-P-C: 2-0-1-3**

- **COURSE OBJECTIVES:**

The course provides the students with a conceptual and experimental background in the broad discipline of microbiology. The students will be introduced to the major groups of microorganisms and their diversity in structure and functions and microbial interactions. Emphasis has been laid on bacterial growth, nutrition, control, metabolism, and genetics. To make the student aware of microbial culture selection for fermentation processes. Media formulation, inoculum development and process optimization. The course also introduces the students to the scope and relevance of microbes in the field of medicine, agriculture, and industry.

- **COURSE OUTCOMES:**

At the end of the course, students will be able to:

CO1. Comprehend the conspicuous presence of microbes in the environment and their influence on our daily lives as part of the food, soil, air environment, and disease development.

CO2. Describe the immense diversity in the microbial world, their varied inter or intra-community interactions and their contribution to the biotech industry.

CO3. Perform microbial culture selection for fermentation processes, media formulation, inoculum development and process optimization.

CO4. Operate fermenters, and apply basic concepts for the selection of a reactor.

Course Content **45 hours**

UNIT-I: Introduction to Microbiology: **8 hours**

History and Scope- Role of Microbes in agriculture, public health, medicine and industry. Organization of Prokaryotic and Eukaryotic: cell structure and function. Diversity of the microbial world, Viruses and their acellularity, and Archaea.

UNIT-II: Microbial Nutrition and Growth: **10 hours**

Types of growth media, growth phases, and culture methods. Fundamentals of microbial physiology and metabolism (Aerobic & anaerobic respiration, fermentation, Entner Duodruffs pathway, photosynthesis, nitrogen fixation).

UNIT-III: Fundamentals of microbial ecology: **8 hours**

Microbes from Marine, Freshwater and Terrestrial Environments, Microbial Interactions (Symbiotic, non-symbiotic). Negative interactions: Pathogenic Microbes. Control of microbial growth – (Effect of heat, Sterilization, disinfectants, therapeutic agents, antimicrobial resistance). Application of sterilization methods in Food and Industrial Microbiology.

UNIT-IV: Industrial microbiology: **12 hours**

Brief history and developments in industrial microbiology, Sources of industrially important microbes and methods for their isolation, preservation and maintenance of industrial strains, strain improvement, Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates. Types of fermentation processes - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch (eg. baker’s yeast) and continuous fermentations;

Measurement and control of fermentation parameters- pH, temperature, dissolved oxygen, foaming and aeration.

UNITV: Microbial products: 7 hours

Industrial production of citric acid, ethanol, penicillin, glutamic acid, vitamin B12, enzymes (amylase, protease, lipase), Wine, and beer.

Laboratory (Ask Kamesh for fermentation experiments: 3-4)

- Isolation of fungi from soil: Dilution plate method, Warcup method, stamping method.
- Isolation of fungi from plant material: Epiphytic fungi, washing method, implant method, impression method; endophytic fungi.
- Growth measurement of fungi- linear and biomass.
- Effect of environmental (pH, temperature) and nutritional factors (carbon, nitrogen sources) on the growth of fungi.
- Isolation and identification of microscopic algae from soil and water.
- Isolation and identification of protozoa from environmental samples.
- Screening for antibiotic-producing microbes (antibacterial, antifungal).

References:

1. Prescott's Microbiology by Willey, Sherwood and Woolverton.
2. Brock Biology of Microorganisms by Madigan, Martinko, Stahl and Clark.
3. General Microbiology by Stanier, Ingraham, Wheelis and Painter.
4. Microbiology, M. Pelczar, E. Chan, N. Kreig, 5th ed, MGH.
5. Biotechnology and Safety Assessment Thomas J.A., Fuch R.L Academic Press 3rd Edition 2002
6. Biological Safety Principles and Practices Fleming D.A., Hunt D. ASM Press 3rd. ed. 2000
7. Bioethics Ben Mepham Oxford University Press 2008
8. Stanbury P. F., A. Whitaker, S. J. Hall. Principles of Fermentation Technology Publisher: Butterworth-Heinemann
9. W. Crueger and A. Crueger: Biotechnology. A Textbook of Industrial Microbiology, Publisher: Sinauer Associates Gerald Reed.
10. Casida L. E. J. R: Industrial Microbiology by Publisher: New Age (1968). Unit I:

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4

CO 1	2	0	2	0	0	0	3	0	1	0	0	3	1	2	1	1
CO 2	0	1	2	0	2	1	0	0	1	2	0	3	1	3	1	1
CO 3	1	3	2	0	2	1	0	0	1	3	0	3	1	2	1	1
CO4	3	0	2		0	2	2	0	1	1	0	3	1	3	1	1
Average	2	1	2	0	1	1	1	0	1	2	0	3	0	2	1	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)
"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	**Fluid Flow**	**L-T-P-C: 2-0-1-3**

- **COURSE OBJECTIVES:**

To introduce and explain fundamentals of Fluid mechanics that are useful in the applications of Aerodynamics, Hydraulics, Gas dynamics, Food Engineering, Heat Transfer, dairy plants, beverage industries, etc.

- **COURSE OUTCOMES:**

Upon successful completion of this course, the student will be able to:

CO1. Learn about fluid flow properties and calculation of hydrostatic forces on flat or curved surfaces.

CO2. Explore the detailed analysis of kinematics and dynamics of fluid for laminar and turbulent flow and exploit the conservation equations for the flow regimes of practical interest.

CO3. Understand boundary layer theory for a variety of constraints and the basics of a turbulent flow.

CO4. Explain the basics of compressible flow and carry out dimensional analysis for practical prototyping.

CO5. Apply fluid flow properties to different liquid foods.

Course Content **30 hours**

UNIT-I: Introduction to fluid flow **6 hours**

Introduction to fluid, various physical properties of a fluid, concept of viscosity, units of viscosity, factors affecting the rheological parameters, fluid pressure and its measurement, pressure, manometers, concept of Reynolds's number, types of fluid flow, rate of flow or discharge, derivation of the continuity equation, different types of energies of a liquid in motion, pressure energy, kinetic energy, potential head, derivation of Bernoulli equation, hydraulic coefficients.

UNIT II: Application of Fluid flow **8 hours**

Practical applications of Bernoullies equation, venturi meter, orifice meter, pitot tube, rotameter, loss of head due to friction in viscous flow, Darcy-Weisbach formula; energy losses in pipes; major energy losses; minor energy losses; coefficient of friction or fanning friction factor or skin friction factor; drag coefficient; different types of pumps.

UNIT III: Introduction to Rheology **8 hours**

Definition of Rheology; ideal elastic and plastic behaviour; ideal viscous behaviour; stress-strain diagram of a biomaterial; rheological diagram; the concept of apparent viscosity, time-independent fluids (no memory fluids); power law (viscous) fluids; different types of

fluids; Herchel-Bulkley fluids: Time-dependent fluids (memory fluids) like thixotropic fluids; antithixotropic (or rheopectic) fluids.

UNIT IV: Theories, laws and different instruments 8 hours

Derivation of Hagen-Poiselle equation or theory of capillary viscometer; Stokes law; Viscometry, capillary tube viscometer; Ostwald viscometer; falling sphere resistant method; rotational viscometer; cone and plate type viscometer; circular disc viscometer; oscillatory measurements method.

Reference Books

1. Sawhney, G. S. (2011). *Fundamentals of fluid mechanics*. IK International Pvt Ltd.
2. Bansal, R. K. (2005). *A textbook of fluid mechanics and hydraulic machines:(in SI units)*. LAXMI Publications, Ltd.
3. Kumar, S. (2010). Fluid Mechanics: Basic Concepts & Principles. Ane Books Pvt. Ltd.
4. Modi, P. N., & Seth, S. M. (2019). *Hydraulics and Fluid Mechanics Including Hydraulics Machines*. Rajsons Publications Pvt. Ltd.

Fluid Flow Laboratory

Experiments

1. Flow measurement using a venturi meter.
2. Determination of pipe friction factor.
3. Performance test on Kaplan turbine.
4. Performance test on the reciprocating pump.
5. Flow measurement using an Orifice meter.
6. Verification of Bernoulli's theorem.
7. Performance test on Francis turbine.
8. Performance test on a centrifugal pump.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	1			1		3				2		3				
CO 2		1								1			2			

CO 3	1		2			2						2				
CO 4	1	1		3		1				3		2			3	
Average	1	1	1	1	0	2	0	1	0	2	0	2	1	0	1	0

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	**Food Preservation Technology**	**L-T-P-C: 2-0-0-2**

- **COURSE OBJECTIVES:**

The objective of this subject is to give knowledge of basic principles of different food preservation and processing to improve the shelf life of food products. Effect of different food preservation techniques on food quality.

- **COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

CO1. Learn the status of food processing and overview of food processing industries in India.

CO2. Explain various factors responsible for spoilage of food products, and how to prevent them through independent written assignments and exam questions.

CO3. Describe different food processing operations like pasteurization, blanching, sterilization, baking & Roasting, frying etc.

CO4. Understand fundamental concepts and knowledge of low-temperature processing operations in food preservation.

CO5. Critically analyze the concept of evaporation, concentration, dehydration & equipments used for these operations.

Course Content **30 hours**

UNIT-I: Introduction to food preservation **6 hours**

Basic principles, importance of food processing and preservation, Overview of food industries, Status of food processing industry in India. Classification of foods, Types of food spoilage, viz. microbiological, enzymatic, chemical and physical spoilages and their effects on food quality.

UNIT-II: High-temperature processing **8 hours**

Principles of thermal processing, **Pasteurization:** theory, equipment and its effect on foods. **Sterilization:** Theory, Processing and Equipment and effect on foods. **Blanching** theory, purpose, equipment and effect on foods. **Canning of foods**: categories of foods for canning**. Frying**: theory, purpose, equipment and effect on foods, heat and mass transfer in frying

UHT processing, Irradiation and Microwave processing of foods,

Microbial destruction in batch and continuous sterilization, methods of heat transfer, heat resistance of microorganisms, factors affecting heat resistance of microorganisms, TDT curve. **Low-temperature processing:** Low temperature required for different food; Freezing, Refrigeration, chilling and Freezing of food, freezing principles, low and fast

freezing, freezing process, Determining freezing load, freezing rate, estimation of freezing time of foods, Types of freezers, Thawing of frozen foods.

Unit-III: Drying and Dehydration **8 hours**

Evaporation, Concentration and Dehydration, Drying operation i.e., spray, freeze, vacuum dryer etc.), Drying of solid and liquid foods, Types of dryers, their advantages and disadvantages, Concentration of liquid food by evaporators, Continuous, Multiple effects (2, 3, 4 effect evaporator), Falling and Rising film evaporators, Principles of freeze concentration, Membrane processes for liquid food concentration. Role of water activity in food preservation, control of aw by addition of solutes and moisture removal, Measurements of water activity, Intermediate moisture food (IMF), Moisture sorption isotherm.

UNIT-IV: Use of Preservatives **8 hours**

Natural and chemical preservatives: types, mechanism of action and application; fermentation, purposes and advantages of smoking, sulphating, and pickling.

Reference Books

1. Potter, N. N., & Hotchkiss, J. H. (2012). *Food science*. Springer Science & Business Media.

2. Frazier, W. C., & Westhoff, D. C. (1996). *Food Microbiology*, 4th ed, Tata McGraw Hill Pvt. Ltd.

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

4. Karel, M., Fennema, O. R., & Lund, D. B. (1975). *Principles of food science. Part II. Physical principles of food preservation*. Marcel Dekker, Inc.

5. Rahman, M.S. (1999). *Handbook of Food Preservation*, Marcel Dekker, Inc.

6. Valdavik V.A., & Christian E.W. (2003). *Essentials of Food Science*. Springers.

Program Outcomes / Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**

CO 1	2			1		3				2		1	3			
CO 2		1						2		1				2		2
CO 3	1		2			2						2	2			
CO 4	1	1		3		1				3			2	1		3
CO 5	1	3	1			2		3				1		3		
CO 6	1	1						1								
Average	1	1	1	1	0	1	0	1	0	1	0	1	1	1	0	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	**Life Skill - III**	**L-T-P-C: 3-1-1-5**

- **COURSE OBJECTIVES**

- **COURSE OUTCOMES**

- **CATALOG DESCRIPTION**

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

XXXX XXXX	Life Skill - IV	L-T-P-C: 3-1-1-5

- **COURSE OBJECTIVES**

- **COURSE OUTCOMES**

- **CATALOG DESCRIPTION**

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

XXXX XXXX	Exploratory Elective 1	L-T-P-C: 3-0-0-3

- **COURSE OBJECTIVES**

- **COURSE OUTCOMES**

- **CATALOG DESCRIPTION**

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

SEMESTER IV

XXXX XXXX	Heat and Mass transfer	L-T-P-C: 2-0-1-3

- **COURSE OBJECTIVE:**

To introduce students with fundamentals concerning the calculations and principles involved in heat and mass transfer in Food processing.

- **COURSE OUTCOME:**

On completion of this course, the students will be able to:

CO1. Learn the basic modes of heat and mass transfer and their laws.

CO2. Understand heat and mass transfer coefficients of heterogeneous phases in unit operations

CO3. Evaluate temperature distribution in heat conduction and analyze heat transfer through fins.

CO4. Analyze different heat and mass transfer equipments and processes.

CO4. Apply principles and laws of heat and mass transfer in engineering applications and design heat exchangers and evaporators.

Course Contents: **30 hours**

UNIT 1: Introduction **8 hours**

Units, definitions, Basic modes of Heat transfer, Thermal conductivity for various types of materials, convection heat transfer co-efficient, Stefan Boltzmann's law of Thermal radiation**.**

UNIT 2: Heat Transfer **8 hours**

Heat conduction, Heat conduction in the composite wall structure, thick-walled tube, sphere, insulation, unsteady state condition, Natural and forced convection, heat transfer in laminar and turbulent flows inside tubes, condensation, design of heat exchangers, the basic equation of radiation. Dimensional Analysis

UNIT 3: Mass Transfer **8 hours**

Modes of mass transfer, Fick's law of diffusion, diffusion theory, the analogy between heat, mass and momentum transfer, interphase mass transfer, overall mass transfer coefficient, mass transfer in equipment, humidification and dehumidification, the role of diffusion in mass transfer, oxygen uptake in cell culture, factors affecting cellular oxygen demand, oxygen transfer from gas bubble to cell. Dimensional Analysis

UNIT 4: Separation Processes **6 hours**

Evaporation, drying, Liquid-liquid separation, vapour-liquid separation, and membrane separation.

HEAT AND MASS TRANSFER LABORATORY

EXPERIMENTS

1. Determination of radiation constant of brass, iron, unpainted and painted glass.
2. Steam distillation – To calculate the efficiency of steam distillation.
3. To determine the overall heat transfer coefficient by a heat exchanger.
4. Construction of drying curves (for calcium carbonate and starch).
5. Determination of moisture content and loss on drying.
6. Determination of humidity of the air – i) From wet and dry bulb temperatures – use of Dew point method.
7. Description of Construction working machinery such as fluidized bed coater, fluid energy mill, and dehumidifier.
8. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots.
9. Size reduction: To verify the laws of size reduction using a ball mill and determine Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of the Ball Mill.

10. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.

Reference Books

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

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

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

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

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

Program Outcomes / Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	2					3				2			1	3		
CO 2		1			3		3	2		1					2	
CO 3	1		2			2	3						2	2		
CO 4	1	1		3	1	1	3			3				2	1	
CO 5	1	3	1	1		2	1	3					1		3	
Average	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**1**	**0**	**1**	**0**		**1**	**1**	**1**	**0**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment	**End Term Examination**	

Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	Refrigeration and Cold Chain	L-T-P-C: 2-1-1-4

- **COURSE OBJECTIVES:**

The objective of this subject is to know about cooling and freezing importance in food processing. The students will know about Frozen food products like ice cream, confectionary products, and other desserts prepared using freezing temperatures.

- **COURSE OUTCOMES:**

After the completion of the course, the students will be able to:

CO1. Define the terminology associated with refrigeration systems and cold storage design.

CO2. Understand basic refrigeration systems and identify methods for performance improvement.

CO3. Explain different refrigeration techniques for different foods.

CO4. Evaluate the quality of frozen food preserved using the refrigeration technique.

CO5. Apply refrigeration and freezing in Food Industries.

Course Content **45 hours**

UNIT-I: Principles of Refrigeration **8 Hours**

Refrigeration cycles, Vapour Compression and Vapour Absorption cycles, Refrigerants, characteristics of different refrigerants, Ozone Depletion Potentials, Greenhouse Potential Refrigerants, use of non-polluting refrigerants, net refrigerating effect, tome of refrigeration - Components of a Refrigeration system: Compressor, condenser, Evaporator, Expansion valves piping and different controls. Atmospheric air and its properties, Psychometrics, and Energy considerations

UNIT-II: Cold Storage Design and Construction **10 hours**

Small and large commercial storage, Insulation, properties of insulating materials, air diffusion equipment, Doors, and other openings. Cold load estimation: prefabricated systems, walk-in-coolers, and Refrigerated container trucks: Freezer storage, Freezer room Temperatures, insulation of freezer rooms: Pre-cooling and pre-freezing. Cold Storage practice, Stacking and handling of material in and around cold rooms, Optimum temperatures of storage for different food materials-meat and poultry products, marine products, fruits and vegetables, spices, and food grains.

UNIT-III: Operation and maintenance of refrigeration systems **12 hours**

Controlled atmosphere and modified atmosphere storages Controlled atmosphere and Modified atmosphere storages Principles and basics of their construction, Chilling of Foods Chilling equipment for liquid foods, Secondary refrigerants and direct expansion techniques in chilling, Chilled foods transport and display cabinets - Basics of Chilled foods microbiology, Packaging of Chilled foods - Hygienic design considerations for chillers and chilled Storages. Cool storage and their applications. Evaporative cooling and its applications

UNIT-IV: Freezing of foods **10 hours**

Freezing equipment, Freezing rates, the growth rate of ice crystals, crystal size and its effect on texture and quality of foods, Freezer types, and Individual quick freezing. Cryogenic Freezing, Freezing practice as applied to marine foods, meat and poultry, fruits, and vegetables.

Reference Books

1. Whitman, B., Johnson, B., Tomczyk, J., & Silberstein, E. (2012). *Refrigeration and air conditioning technology*. Cengage Learning.
2. Tomczyk, J., Silberstein, E., Whitman, B., & Johnson, B. (2016). *Refrigeration and air conditioning technology*. Cengage Learning.
3. Hundy, G. F., Trott, A. R., & Welch, T. C. (2008). *Refrigeration and air-conditioning*. Butterworth-Heinemann.
4. W F, S., & Jones, J. W. (1981). *Refrigeration and Air conditioning*. McGraw-Hill Book Co.

Program Outcomes / Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1						3				2		3	1	3		
CO 2				3	3		3	2		1					2	
CO 3	0	2	2			2	3					3	2	2		
CO 4		1		3	1	1	3			3		2		2	1	
CO 5	0	3	1	1		2	1	3					1		3	
Average	**0**	**1**	**1**	**1**	**1**	**2**	**2**	**1**	**0**	**1**	**0**	**2**	**1**	**1**	**1**	**0**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

;

XXXX XXXX	**Fruit and Vegetable Processing Technology**	L-T-P-C: 2-1-1-4

COURSE OBJECTIVES:

This course is designed to be the foundation course in Food Technology. Students know about the basic concepts and principles of Fruit and vegetable-based food products. Students study the various types of fruits, vegetables and their products with respect to production, processes and equipments required for the manufacture of fruit and vegetable products.

- **COURSE OUTCOMES:**

Through this course, students should be able to:

CO1. Learn fundamental and applied research across fruit and vegetable categories to provide value-added solutions to current and future problems encountered by Fruit and vegetable processing industry.

CO2. Define different fruit products as per FSSAI

CO3. Describe the threshold limits of various ingredients to be used in fruit and vegetable-based products.

CO4. Understand and apply the principles underpinning the safe and effective production of fruit and vegetable products.

CO5. Apply processes employed in the manufacture of fruit and vegetable-based products and beverages through the construction of Process Flow Diagrams.

Course Content **45 Hours**

UNIT-I: Introduction to Fruits and Vegetables **12 hours**

Structural, Compositional and Nutritional aspects of fruits and vegetables. Post harvest changes, storage, handling and preservation of fresh fruits and vegetables, controlled and modified atmosphere storage. Present scenario of fruits and vegetable industry in India.

UNIT-II: Processing and preservation of Fruits and vegetables **12 hours**

Techniques of processing and preservation of fruits and vegetables by refrigeration and freezing, canning and bottling, drying and dehydration. Canning: Machinery and equipments, canning of different fruits and vegetables.

UNIT-III: Processed Fruit and vegetable products **10 hours**

The processed fruits and vegetable products: Juices and pulps, Concentrates and powders, Squashes, cordials nectars, fruit drinks and carbonated beverages and its quality control. Jam, Jellies and Marmalades. Preserves, candies and crystallized fruits. Tomato products: Puree, Paste, Ketchup, Sauce and soup. Chutneys, pickles and other products.

UNIT-IV: Other fruit and vegetable products **9 hours**

Condiments, spice oils, oleoresins, Processing of cashew nuts, coffee and cocoa beans, and tea leaves, Specialty fruit and vegetable products. Fermented fruit and vegetable products. By-products of fruits and vegetable

FRUIT AND VEGETABLE TECHNOLOGY LABORATORY

EXPERIMENTS

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; Preparation of syrup;
7. Preparation of raisins, dried fig and dried banana;
8. Preparation of anardana;
9. Preparation of papain;
10. Preparation of pickles;
11. Preparation of dried ginger;
12. Preparation of dried onion and garlic;
13. Preparation of banana and potato wafers;
14. Preparation of dehydrated leafy vegetables;
15. Visit to fruits and vegetables pack house, canning plant, and vegetable dehydration plant.

Reference Books

1. Srilakshmi, B. (2003). *Food science*. New Age International.

2. Mudambi, S. R. (2007). *Fundamentals of foods, nutrition&diet therapy*. New Age International

3. Manay, N. S. O. (2001). *Food: facts and principles*. New Age International.

4. Sharma, S., & Nautiyal, M. C. (2009). *Postharvest technology of horticultural crops* (Vol. 2). New India Publishing.

5. Minifie, B. (2012). *Chocolate, cocoa and confectionery: science and technology*. Springer Science & Business Media.

6. Yahia, E. M., & Carrillo-Lopez, A. (Eds.). (2018). *Postharvest physiology and biochemistry of fruits and vegetables*. Woodhead publishing.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1	1		3	1		3	2				2		3	1	3
CO 2				2					1		1	0			
CO 3	3	1	2						1				3	2	2

CO 4						1	2				3		2	1	
CO 5	3	3					1		1					1	
Average	1	1	1	1	0	1	1	0	1	0	1	0	2	1	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX Cereal Pulse and oil seed Technology L-T-P-C: 2-1-1-4

- **COURSE OBJECTIVES:**

This course gives complete knowledge about the structure and composition of various cereals and legumes. The course gives the knowledge about processing various cereals and legumes. It enables the students to understand and identify various critical control points that occur during the processing and storage of grains. The course gives knowledge about various processes involved in the manufacturing of various cereal and legume-based products and the utilization of by-products.

- **COURSE OUTCOMES:**

At the end of the course, the student should be able to:

CO1. Learn the fundamentals of grains, through in-class discussions, electronic simulations and exam questions.

CO2. Communicate clearly about storage and processing of grains, through independent written assignments and exam questions.

CO3. Describe the contributions of processing in maintaining the quality and safety of cereals and legumes, through clicker questions, class discussion and exam questions.

CO4. Outline specific requirements for the preparation of value-added products from cereals and legumes.

CO5. Critically analyse Food grains' quality and safety, costs and benefits.

Course Content **45 hours**

UNIT-I: Introduction to cereal grains **9 hours**

Composition, Structure and Processing characteristics of Cereal grains and Pulses, Post harvest, Processing practices for their safe storage. FSSAI standards for cereal grains and their products.

UNIT-II: Wheat processing **10 hours**

Wheat and its quality characteristics for milling into flour and semolina, Flour milling, Turbo grinding and air classification, Flour grades and their suitability for baking purposes, Assessment of flour quality and characteristics, Milling of Durum wheat, Macaroni products. Ingredients, Technology, and quality parameters for baked products: Bread, Biscuits and cakes; Breakfast cereals.

UNIT-III: Rice Processing **11 hours**

Parboiling and milling of paddy, Quality characteristics, Curing and ageing of rice, Processed rice products.

UNIT-IV: Corn, barley and millet processing **8 hours**

Dry and Wet milling of corn, Starches, and their conversion products, malting of barley, Pearling of Millets, Milling of legume pulses by traditional and improved processes. Anti-nutritional factors in pulses and their methods of inactivation

UNIT-V: Oil seeds **7 hours**

Different types of oil seeds, Oil seeds storage, processing, milling, oil extraction, and clarification of oils. By-products of grains and oil seeds and their utilization.

Cereal, Pulse and Oil Seeds Technology Laboratory

List of Experiments

1. Morphological characteristics of cereals
2. Physical properties of cereals
3. Chemical properties of cereals
4. Parboiling of paddy
5. Cooking quality of rice
6. Milling of rice; Conditioning and milling of wheat;
7. Production of sorghum flakes
8. Production of popcorn, 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; Visit to Cereal processing unit

Reference Books

1. Potter, N. N., & Hotchkiss, J. H. (2012). *Food science*. Springer Science & Business Media.
2. Matz, S.A. (2010) Cereal Technology.
3. Matz, S.A. (2012) Bakery Technology.
4. Technology of Cereals, by NL. Kent, Pergamon Publisher
5. Chakraverty A & De DS. 1981. *Post-harvest Technology of Cereals, Pulses and Oilseeds*. Oxford & IBH.
6. ***Unit Operations*** of Agricultural Processing. By ***K M Sahay***, K.K. Singh. Edition, 2, Publisher, Vikas Publishing House Pvt

Program Outcomes / Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	1		3	1		3	2				2		3	1	3	1
CO 2				2					1		1	1				
CO 3	3	1	2						1				3	2	2	3
CO 4						1	2				3		2	1		

CO 5	3	3					1		1					1		3
Average	1	1	1	1	0	1	1	0	1	0	1	0	2	1	1	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	**Life Skill - V**	**L-T-P-C: 2-0-0-2**

- **COURSE OBJECTIVES**
- **COURSE OUTCOMES**
- **CATALOG DESCRIPTION**

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

XXXX XXXX	Exploratory -II	L-T-P-C: 3-0-0-3

- **COURSE OBJECTIVES**
- **COURSE OUTCOMES**
- **CATALOG DESCRIPTION**

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4

CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

SEMESTER V

XXXX XXXX	Instrumental Methods of Food Analysis	L-T-P-C: 2-0-1-3

- **COURSE OBJECTIVES:**

In this subject, students know about different analyses carried out to check the quality of raw and processed food products. Different equipment's used in food analysis.

- **COURSE OUTCOMES:**

At the end of the course, the student should be able to:

CO1. Explain various analytical methods for the analysis of different food samples.

CO2. Describe different methods for the analysis of nutritional components.

CO3. Outline the contributions of grinding equipments used for the preparation of samples for analysis.

CO4. Understand the fundamental concepts and knowledge related to instruments like Electrophoresis, Spectrophotometer, and Various separation techniques like sedimentation, filtration, and centrifugation.

CO5. Apply spectroscopy instruments like UV, Visible and Fluorescence in food analysis.

Course Content **30 hours**

UNIT-I: Introduction to Food Analysis **6 hours**

Various analytical methods for food samples such as food colour, pH value, turbidity, *etc.* Uses and roles of various engineering techniques viz. extraction, dissolution, digestion and grinding for preparation of samples for analysis.

The physicochemical analysis of food: carbohydrates, proteins, fat, vitamins and minerals by various methods, Methods of moisture analysis in foods – drying methods, infrared moisture analyser; Water activity.

UNIT-II: Measure physical and chemical properties of foods 7 hours

Various food components, Separation methods – filtration, centrifugation, sedimentation, *etc.* Electrophoresis methods for protein: gel electrophoresis, paper electrophoresis, high voltage electrophoresis, and starch gel electrophoresis. Basic principles of spectroscopy instruments: UV, visible and fluorescence spectroscopy. Colourimetric methods of analysis for protein amino acids, carbohydrates, sugars, vitamins, near-infrared analytical techniques for moisture proteins, fats, fibres, vitamins, minerals *etc.* Atomic absorption spectrophotometric and ICP-MS/OES method for minerals analysis. Basics of FTIR, NMR, EDX.

UNIT-III: Instrumental Analysis of Food 8 hours

Polarimetric methods for analysis for carbohydrates, fats and fatty substances and amino acids analysis. Refractometric techniques (refractive index) and instruments for various food components including flavour components and food additives. Methods for measuring textural properties of foods – Instron food tester, pentameter *etc.* Methods for measuring rheological and viscoamylographic properties of foods –viscoamylograph, extensograph, aerographic instruments.

UNIT-IV: Application of chromatography 9 hours

Types of columns and their applications, high-pressure pumps, and various type of detectors for HPLC methods, Uses and basic instruments of gas chromatograph and gas-liquid chromatography-mass spectrophotometers and their applications in food analysis. Maintenance and troubleshooting of the equipment, standard curve, precision and accuracy, and standardization of equipments.

Instrumental Methods of Food Analysis Laboratory

EXPERIMENTS

1. Sampling plan; Sample collection and preparation for analysis;

2. Sensory evaluation of products;
3. Quality evaluation of raw materials:
4. Fruits, vegetables, cereals, dairy products, meat, poultry, products;
5. Quality evaluation of food products for colour and taste of marketed products;
6. Analysis of heavy metals using atomic absorption spectrophotometer;
7. Estimation of physic acid using a spectrophotometer;
8. Separation of amino acids by two-dimensional paper chromatography;
9. Identification of sugars in fruit juice using TLC;
10. Separation of pralines by ion-exchange chromatography;
11. Molecular weight determination using sephadox-gel;
12. Identification of organic acids by paper electrophoresis; Gel-electrophoresis for analytic techniques;
13. Quantitative determination of sugars and fatty acid profile by GLE;
14. Quantitative make-up of water and fat-soluble vitamins using HPLC;
15. Separation of sugars by paper chromatography;
16. Analysis of wheat flour;
17. Analysis of foods for pesticide and drug residues;

Reference Books

1. Cruz Rui M. S. Et.Al, (2020). Methods In Food Analysis. Taylor & Francis
2. S. Nieisen. 2017. Food Analysis Laboratory Manual, 5th Ed. Springer, NY, USA.
3. Semih Ötles. 2009. Handbook of Food Analysis Instruments. CRC Press, Boca Raton, FL, USA.
4. Da-Wen Sun. 2008. Modern Techniques for Food Authentication. Elsevier Inc., Burlington, MA, USA.

Program Outcomes **Course Outcomes**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	1		3	1		3	2				2		1		3	1
CO 2				2					1		1	2	2	0		
CO 3	3	1	2						1						3	2
CO 4						1	2				3		1		2	1
CO 5	3	3					1		1			3	1			1
Average	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**0**	**2**	**1**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	Beverage Technology	L-T-P-C: 2-0-1-3

➢ COURSE OBJECTIVES:

This course is designed to acquaint students of Food Technology with basic concepts and principles that they must know and understand while dealing with the production technology of various kinds of beverages in any beverage industry. The course provides beverage technologists with impulses within the context of the development of new plants and machines. The Course includes an introduction to the beverages, their classification, quality characteristics, production technology, raw material, and machineries.

➢ COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1. Discuss fundamentals of processing of beverages (alcoholic and non-alcoholic drinks, sports drinks, packaged water and fruit juices)

CO2. Understand the principles underpinning the safe and effective production of beverages

CO3. Illustrate processes employed in the manufacture of different beverages through Process Flow Diagrams.

CO4. Apply the usage of additives and ingredients in beverage manufacturing.

Course Content **30 hours**

UNIT-I: Beverage Processing **6 hours**

Definition, Status and Scope of the Indian beverage industry, Quality of water for the beverage industry and its importance, Classification of beverage (carbonated and Noncarbonated, alcoholic and Non-alcoholic etc.).

UNIT-II: Processing of Alcoholic & Non-Alcoholic Beverages 8 hours

Processing of carbonated and non-carbonated beverages. Technology and application of carbonation processes for beverage industries. Processing of alcoholic drinks: Processing and technology. Fermentation, Distillation, Filtration, Ageing of Beer, Wine, Whisky, Vodka, Rum, Champagne, health and energy drinks. Dairy drinks: lassi, fruit milkshakes, whey drinks.

UNIT-III: Processing of Tea and coffee 7 hours

Various types of tea, tea concentrates, tea fermentation processes, and decaffeination process. Type of coffee, drying, fermentation, roasting and browning processes and their importance. Quality components of Tea and Coffee.

UNIT-IV: Equipments and Machineries for Processing of Fruit Juices 9 hours

Extraction, de-bittering, filtration and clarification, bottling and packaging. Processing of cocoa beverages. Properties of wastewater and wastewater treatment.

FSSAI specifications for beverages, Food Safety and Standards (Alcoholic Beverages) Regulations, 2018; FSSAI Standards for caffeinated beverages soft and energy drinks

Beverage Technology Laboratory

LIST OF EXPERIMENTS

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 flavoured tea.
5. Preparation of 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 the mineral water plant.

Reference Books

1. Beverages: Technology, Chemistry and Microbiology by A. H Varnam and J.M. Sutherland, Springer-Science
2. Chemistry and Technology of Soft Drinks and Fruit Juices by Philip R. Ashurst, Wiley Blackwell
3. Innovative Technologies in Beverage Processing by Ingrid Aguilo-Aguayo and Lucia Plaza, Wiley Blackwell
4. Hans Michael Eblinger. 2009. Handbook of Brewing: Processes, Technology, Markets. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim. Germany.
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.
6. Philip R. Ashurst. 2005. Chemistry and Technology of Soft Drinks and Fruit Juices, 2nd Ed. Blackwell Publishing Ltd., Oxford, UK.
7. 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.
8. V.K. Joshi and Ashok Pandey. 1999. Biotechnology: Food Fermentation – Microbiology, Biochemistry and Technology, Vol. II. Educational Publishers & Distributors, New Delhi**.**
9. Alan H. Varnam and Jane P. Sutherland. 1994. Beverages: Technology, Chemistry and Microbiology. Chapman, London, UK.

Program Outcomes / Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	1		3	1		3	2				2		3	1	3	1
CO 2				2					1		1					
CO 3	3	1	2						1				3	2	2	3
CO 4						1	2				3		2	1		
CO 5	3	3					1		1					1		3
Average	1	2	1	1	0	1	1	0	1	0	1	0	2	1	1	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)			**Total**

Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning	**Mid Term Exam**	**End Term Exam**	
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	Bakery and Confectionary Technology	L-T-P-C: 2-1-1-4

- **COURSE OBJECTIVES:**

The objective of this course is to make students familiar with the basic principles of bakery and bakery products. Ingredients important in bakery and their standards as per FSSAI. Different bakery products like bread, biscuits, rusk, buns, toffee and chocolate etc.

- **COURSE OUTCOMES:**

After the completion of the course, the students will be able to:

CO1. Define various raw materials used for the preparation of bakery and confectionery products.

CO2. Understand the basic operation and working of various equipments involved in bakery and confectionary technology.

CO3. Sketch various processes used for the manufacturing of bakery and confectionery products.

CO4. Compare various processes used for the manufacturing of bakery and confectionery products and their quality determination.

CO5. Apply knowledge to develop new bakery and confectionery products.

Course Content **45 hours**

UNIT-I: Introduction to baking **9 hours**

Status of bakery and confectionery industries in India; Raw materials for bakery and confectionery products- essential and optional ingredients; Functionality of bakery ingredients.

FSSAI specification of raw materials; Bakery equipments: divider, rounder, proofer, moulder; equipments used in baking, different types of ovens, and slicer.

UNIT-II: Types of Bakery Products **10 hours**

Different types of bread and preparation of bread using different methods, quality evaluation of bread, bread faults and remedies, staling of bread; Types, methods of preparation and quality evaluation of biscuits; Types, methods of preparation and quality evaluation of cakes, cake faults and remedies; Preparation of other bakery products: rusks, crackers, buns, muffins, and pizza; Pasta products.

UNIT-III: Confectionary Products 12 hours

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

UNIT-IV: Bakery and Confectionary Industry 14 hours

Layout, setting up of units and hygienic conditions required in bakery plant; Operation and maintenance of bakery equipments. Food safety rules and regulations for bakery and confectionery products;

Bakery and Confectionary Technology Laboratory

Experiments

1. Quality analysis of raw materials used in the Bakery and confectionery industry according to PFA standards
2. **2** Preparation and evaluation of Bakery and Confectionery products:
3. Bread: White Sandwich; High volume milk bread, using different methods
4. Cakes: with eggs; without eggs, ;using different methods
5. Biscuits: using different methods
6. Buns,
7. Pizza
8. Candy
9. Study and analysis of the production charts used for different products by bakery industries,
10. visits to the Bakery and Confectionery industry,
11. Local market survey for Bakery and confectionery products.

Reference Books

1. Khatkar B. S. (2011) *Baking Science and Technology*, Arihant Publication.

2. AmendolaJ. & Rees N. (2003) *Understanding Baking: The Art & Science of Baking*, Wiley.

3. Dubey S. C. (2002) *Basic Baking*, The Society of Indian Bakers.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	1		3	1		3	2				2	1		3	1	3
CO 2				2					1		1	2	1			
CO 3	3	1	2						1					3	2	2
CO 4						1	2				3	1		2	1	
CO 5	3	3					1		1			1			1	
Average	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**0**	**2**	**1**	**1**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	Milk Process Technology	L-T-P-C: 2-1-1-4

- **COURSE OBJECTIVES:**

This course enables students to understand the nutritive importance of milk and milk products. The course gives the knowledge of various physical and chemical properties of milk and manufacturing processes like pasteurization, sterilization UHT treatment, and homogenization which are used in milk and milk product preparation. The course has enlightened the utilization of dairy waste or by-products. Cleaning and sanitation of milk plants have been covered in this course.

- **COURSE OUTCOMES:**

Through this course, students should be able to:

CO1. Report about the status of the milk industry in India.

CO2. Learn milk production, collection, testing, export, import and total turnover.

CO3. Understand the Processing of milk and milk products.

CO4. Analyze the effect of different processing methods on the quality characteristics of milk and milk products.

CO5. Apply the knowledge of milk's nutritive value and add milk to our diet.

Course Content **45 hours**

UNIT -I: Introduction to Milk Industry **10 hours**

Status of the dairy sector in India. Definition, physicochemical characteristics, chemical composition, microbiological quality, and nutritional importance of milk and milk products.

UNIT-II: Milk production and Quality evaluation **10 hours**

Production, collection, testing quality, cooling, storage, and transportation of liquid milk. Receiving and quality assessing of liquid milk in the dairy industry for detection of adulteration, the decision for acceptance/rejection of the milk.

UNIT-III: Processing of Milk **10 hours**

Standardization and/or processing (pasteurization, sterilization and Ultra High-Temperature processing), storage, packaging and distribution of liquid milk: whole, standardized, toned, double-toned, and skimmed milk. Recombined, reconstituted, and flavoured milk. Cleaning and sanitization of dairy equipments and plant.

UNIT-IV: Milk Products **10 hours**

Definition, composition, methods of preparation/production, quality and/or grading parameters, packaging, storage characteristics, uses and shelf-life of cream, butter and ghee; evaporated and condensed milk, skimmed, whole and instant milk powders.

UNIT-V: Value added Dairy Products **7 hours**

Technology and chemistry of Ice-Creams, fermented milk (curd, yoghurt etc.) and milk products (cheeses, buttermilk, lassi etc.); other milk products (khoa, casein, whey proteins, lactose etc.); milk and milk product-based sweets (burfi, rasogolla, milk-cake, kalakand etc.)

Milk Process Technology Laboratory

EXPERIMENTS

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.
7. Preparing standardized milk as per requirement.
8. Separation of fat from milk.

9. Pasteurization and homogenization of milk.
10. Packaging of liquid milk.
11. Preparation of curd and yoghurt**.**
12. Visit to chilling centre and dairy plant.

Reference Books

1. Outlines of Dairy Technology by Sukumar De, Oxford University Press.
2. Dairy Engineering and Management by Taufil Ahmed
3. Principles of Dairy Processing by James N.Warner, Wiley Eastern Ltd.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1	1		3	1		3	2				2	1		3	1
CO 2				2					1		1	2			
CO 3	3	1	2						1					3	2
CO 4						1	2				3	1		2	1
CO 5	3	3					1		1			1			1
Average	1	1	1	1	0	1	1	0	1	0	1	1	0	2	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total

Weightage (%)	30	20	20	20	10	100

XXXX XXXX	**Project-I**	**L-T-P-C: 0-0-1-1**

- **COURSE OBJECTIVES**
- **COURSE OUTCOMES**

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

XXXX XXXX	Life Skills - VI	L-T-P-C: 2-0-0-2

- **COURSE OBJECTIVES**

- **COURSE OUTCOMES**

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

XXXX XXXX	Exploratory - III	L-T-P-C: 3-0-0-3

- **COURSE OBJECTIVES**

- **COURSE OUTCOMES**

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

SEMESTER VI

XXXX XXXX	Food Packaging Technology	L-T-P-C: 2-1-1-4

- **Course Objectives**

This course enables students to understand the importance of packaging of food. The course gives the knowledge of various physical and chemical properties of packaging materials and their manufacturing process which are used in various food industries. Course provides the deep knowledge about various types of packaging material depending upon the type of food.

It enables the students to study the major technical, safety and legislative issues involved in modern food packaging practices.

- **Course Outcomes**

At the end of the course, the student should be able to:

CO1. Explain various physical and chemical properties of packaging materials.

CO2. Communicate clearly about the different type of packaging material, manufacturing and their functions.

CO3. Apprise the contributions of packaging material in increasing the shelf life of food products.

CO4. Analyze food packaging approaches with regard to materials, preservation of food quality and safety, costs and benefits.

Course Content **45 hours**

UNIT-I: Introduction to Food Packaging **8 hours**

Objectives and functions of packaging and packaging material. Current status and global trends in food packaging. Packaging requirements and selection of packaging materials, properties of materials such as tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength, tear strength, and their methods of testing and evaluation.

UNIT-II: Types of Packaging Materials **10 hours**

Paper: pulping, fibrillation and beating, types of papers and their testing methods, cellulosic, paper board. Glass: composition, properties, types of closures, methods of bottle making. Metals: Tinplate containers, tinning process, components of tinplate, tin-free steel (TFS), types of cans, aluminium containers, lacquers Plastics: types of plastic films, laminated plastic materials, co-extrusion, edible films, biodegradable plastics.

UNIT-III: Properties of plastic packaging materials 8 hours

Rigid and flexible plastics (polyamides, polyester, polyvinyl chloride, polyvinyl alcohol, polycarbonates, olefins, cellophane, ionomers, copolymers, phenoxy, acrylic, and polyurethanes) containers and films (oriented, coextruded, laminates, metallized) and their mechanical sealing and barrier properties.

UNIT-IV: Quality Characteristics of Packaging Materials 8 hours

Theory of permeability, factors affecting permeability, permeability coefficient, gas transmission rate (GTR) and its measurement, water vapour transmission rate (WVTR) and its measurement, prediction of shelf life of foods, selection, and design of packaging material for different foods.

UNIT-V: Specific packaging requirements of different food products 8 hours

Different packaging systems for dehydrated foods, frozen foods, dairy products, fresh fruits and vegetables, meat, poultry, and sea foods.

Food Packaging Laboratory

Experiments

1. Study and testing the properties of different packaging materials (paper, plastic, glass & metal).
2. Study of symbols and labels used on food packaging material.
3. Identification of various types of plastic food packaging material.
4. Determination of changes in packaged foods.
5. Study of food packaging under different packaging conditions.
6. Preparation and applications of edible packaging.
7. Comparative evaluation of different packages for some specific foods like spongy, crispy texture foods etc.
8. Study of shelf life of foods under different packaging and environmental conditions.

Reference Books

1. Mahadeviah, M., & Gowramma, R. V. (1996). *Food packaging materials*. Tata McGraw-Hill.

2. Sacharow, S., & Griffin, R. C. (1980). Principles of food packaging. Tata McGraw-Hill
3. Robertson, G. L. (2016). *Food packaging: principles and practice*. CRC press.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	1		3	1		3	2				2		1		3	1
CO 2				2					1		1	2	2			
CO 3	3	1	2						1						3	2
CO 4						1	2				3		1		2	1
CO 5	3	3					1		1			3	1			1
Average	1	1	1	1	0	2	1	0	1	0	1	1	1	0	2	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	Fermentation and Industrial Microbiology	L-T-P-C: 2-0-1-3

- **COURSE OBJECTIVES**

The above subject is important for students interested in fermented foods and industrial microbiological products. The students will know about fermentation and biochemical changes during fermentation. The students will know about different fermented food products.

- **COURSE OUTCOMES**

After the completion of the course, the students will be able to:

CO1. Describe the scope of fermentation technology in the food industry.

CO2. List various parts, designs and working of fermenters.

CO3. Understand cultivation techniques of industrial microorganisms.

CO4. Analyze the primary and secondary metabolites of fermented products.

CO5. Apply the knowledge to develop new fermented products.

Course Content **30 hours**

UNIT-I: Introduction to Fermentation **6 hours**

Fermentation process. Importance of Fermented products. Isolation, preservation and maintenance of pure culture. Preparation of substrates/media, inoculums. Rate of microbial growth and death. Fermentation kinetics, Mushroom cultivation

UNIT-II: Types of fermentation **8 hours**

Types of fermentation sub-merged/solid state, Batch /continuous fermentation. Fermenter design, operation, measurement and control in fermentation. Process variables and its control, recovery of fermentation products and conversion into marketable /storage forms. Aeration and agitation in fermentation: Oxygen requirement, measurement of adsorption coefficients, sterilization of air and media; scale up in fermentation.

UNIT-III: Fermented products **8 hours**

Production of bakers yeast, food yeast, Single Cell Protein, beer, wine, cider, vinegar, organic acids and enzymes Lactic acid fermentation of milk, vegetables, cereals and meat, mixed fermentation of cereal legumes and milk. Alcoholic fermentation of fruit juices, sugar, and starch substrates. IMFL/ distilled spirits. Oriented Fermented Products, soy sauce, pickles, fermented milk, and cheeses. Microbial fats. Indian traditional sweet, savoury and snack food products: Sweets, Namkins, Papads, wari, Idli, Dosa, Dhokla etc.

UNIT-IV: Spoilage of fermented Products **8 hours**

Microbial spoilage, preservation, and food poisoning of different food products. Different types of microorganisms associated with food poisoning.

Fermentation and Industrial Microbiology Laboratory

LIST OF EXPERIMENTS

1. Study of fermenter/bioreactor accessory
2. Demonstration of different types of fermenters
3. Inoculation, Isolation & screening of culture,
4. Production, recovery and control tests for the following fermented products such as Alcohol
5. Production, recovery and control tests for the following fermented products such as Baker's yeast,
6. Production, recovery and control tests for the following fermented products such as Citric acid Production, recovery and control tests for the following fermented products such as Amylases, Pectinase,
7. Yoghurt,
8. Wine/Cider
9. Serial dilution and isolation of microbes as well as coliform detection in potable water
10. Sauerkraut etc.,
11. Production of polysaccharides,
12. Production of traditional fermented foods such as rabri, bhatura, dahi, dhokla, kanji etc.

Reference Books

1. Prescott, S. C., & Dunn, C. G. (1949). Industrial microbiology. *Industrial microbiology*.
2. Casida, L. E. (2018). *Industrial microbiology*. New Age International Publishers.
3. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2013). *Principles of fermentation technology*. Elsevier.

Program Outcomes **Course Outcomes**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	1		3	1		3	2				2		1		3	1
CO 2				2					1		1	2	2			
CO 3	3	1	2						1						3	2

CO 4						1	2				3		1		2	1
CO 5	3	3					1		1			3	1			1
Average	1	1	1	1	0	1	1	0	1	0	1	1	1	0	2	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	**Meat, Poultry and Fish Technology**	**L-T-P-C: 2-1-1-4**

- **COURSE OBJECTIVES:**

This course enables students to understand the importance of Meat, Fish and Poultry Technology in the food sector. The course gives the knowledge of various physical and chemical properties of meat and meat products, their manufacturing process, processing, ageing, meat preservation, byproducts of the meat industry, structure and function of eggs, quality aspects of eggs, egg products and processing, the importance of eggs, meat and fish in nutrition. It enables students to study the major technical, safety and legislative issues involved in modern meat processing.

- **COURSE OUTCOMES:**

Through this course, students should be able to:

CO1. Discuss the status of meat processing in India and abroad.

CO2. Describe the physicochemical characteristics of meat and meat products.

CO3. Understand the process of conversion of muscle to meat.

CO4. Analyse the factors affecting the meat products

CO5. Apply different processing techniques in meat, poultry and fish products.

Course Content **45 hours**

UNIT-I: Introduction to Meat Industry **8 hours**

Meat and poultry industries in India – kinds of meat animals and poultry birds, Current levels of production, consumption, and export of category products. Nutritional, safety, health, and hygienic considerations. Pre-slaughter care – methods of stunning – slaughtering – dressing of meat and poultry – post-slaughter care and post-mortem inspection – classification and quality of meat

UNIT-II: Slaughtering Procedures and meat processing **8 hours**

Pre-slaughter care – Antemortem examination, methods of stunning, slaughtering and – dressing techniques of meat and poultry – post-slaughter care and post-mortem inspection, rigour mortis, conversion of muscle to meat –Quality of meat, – Aging & tenderization; Meat preservation techniques – chilling, freezing, curing, smoking, canning, drying, chemical preservation, and irradiation of meat, Meat processing technology- classification, recent trends in meat processing, curing agents and additives – meat products – comminuted, emulsified, formed and sectioned meat – sausage, enrobed, fermented, smoked, canned meat products; packaging of meat and meat products; hygiene and sanitary conditions, waste disposal in a meat processing plant; byproducts of meat industry and their utilization.

UNIT-III: Egg and its processing **8 hours**

Egg: Structure, composition, nutritional and functional characteristics of eggs. Grading and candling, spoilage, storage and transportation of whole eggs. Factors affecting egg quality and preventive measures. Processing of eggs for liquid products (white, yolk and whole egg)

and solid products (albumen powder, whole egg powder) for preservation through pasteurization, and drying.

UNIT-IV: Fish and its processing **10 hours**

Fish: Types of fish, composition, structure, post-mortem changes in fish. Handling of freshwater/marine fish. Canning, smoking, freezing and dehydration of fish. Unit operations in fish processing, Filleting and freezing, canning salting and drying of fish Fish sausages, enrobed fish products and homemaking; Spoilage of fish, Fish sauce and protein concentrates; byproducts of the fish industry.

Meat, Poultry and Fish Laboratory

- **EXPERIMENTS**
  1. Pre-slaughter operations of meat animals and poultry birds
  2. Evaluation of Physico-chemical properties of meat, pH, colour, marbling, WHC, water activity, etc
  3. Study of post-mortem changes
  4. Meat cutting and handling
  5. Preservation of meat by freezing
  6. Preservation of meat by curing and pickling
  7. Preservation of meat by dehydration
  8. Evaluation of quality and grading of eggs
  9. Preservation of shell eggs
  10. Preparation of value-added poultry meat products
  11. Value-added egg products
  12. Visit to the abattoir.

Reference Books

1. Lawrie, R.A. (2022). Meat Science. Pergamon Press.
2. Parkhurst, C., & Mountney, G. J. (2012). *Poultry meat and egg production*. Springer Science & Business Media.
3. Chen, F. (2012). *Handbook of meat, poultry and seafood quality* (pp. 232-245). L. M. Nollet, T. Boylston, P. C. Coggins, M. B. Gloria, G. Hyldig, C. R. Kerth, ... & Y. H. Hui (Eds.). Hoboken, NJ: Wiley-Blackwell.

4. Vaclavik V.A. & Christian E.W. (2003) *Essentials of food science*. 2nd edition, Springer International.
5. Laurie R.A. (1998) Lawrie's meat Science. 6th edition. Woodhead Publishing Ltd.
6. Stadelman W.J. and Cotterill O.J. (2001) Egg science and technology. CBS Publishers.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	1		3	1		3	2				2		3	1	3	1
CO 2				2					1		1	0				
CO 3	3	1	2						1				3	2	2	3
CO 4						1	2				3		2	1		
CO 5	3	3					1		1					1		3
Average	1	1	1	1	0	1	1	0	1	0	1	0	2	1	1	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	Program Elective – I	L-T-P-C: 2-1-0-3

COURSE OBJECTIVES

COURSE OUTCOMES

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" **No correlation** with syllabus

XXXX XXXX	Exploratory - IV	L-T-P-C: 3-0-0-3

COURSE OBJECTIVES

COURSE OUTCOMES

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

XXXX XXXX	Life Skills - VI	L-T-P-C: 1-1-0-2

COURSE OBJECTIVES

COURSE OUTCOMES

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															

CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

SEMESTER VII

XXXX XXXX	Food Safety, Law and regulations & IPR	L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

This course is based on presenting the basic principles and practices of food safety. Students will know about how foodborne illness is transmitted, how it impacts public health, and how it can be controlled. The course will have four major components: 1) foodborne pathogens, 2) foodborne chemical and physical hazards, 3) foodborne biological toxins and allergens, and 4) the management activities required to ensure food safety and public health. This will include a discussion of food safety management practices such as Hazard Analysis Critical Control Points (HACCP), public health policies, risk assessment, sanitation, and pathogen and allergen controls in foods.

- **COURSE OUTCOME:**

At the end of the course, the student should be able to:

CO1. Explain the concept of food safety and quality.

CO2. Understand the common causes of foodborne illness.

CO3. Relates the microbiological concepts with food spoilage.

CO4. Describe the characteristics of important foodborne pathogens and hazards.

CO5. Apply the procedures to be used in the control of foodborne illness.

Course Content **45**
hours

UNIT I: Importance of Food Safety **12 hours**

Overview of Food Safety and Hazards, General Overview, Concept of Food Safety and Quality, Food safety hazards and Contamination, Biological, chemical, and physical hazards. Prevention and control of microbiological and chemical hazards. Food allergen, Naturally occurring toxins, pesticides, Food additives, The role of food preservation in food safety.

UNIT II: Food Safety Act and Regulations 10 hours

FSSAI, Food Safety Act and Regulations, Safety Aspects of Food Processing Methods: Issues in foods safety, Food safety inspection service (FSIS) and their utilization. Food safety aspects of novel methods of food processing such as Pulse electric field (PEF), high-pressure processing (HPP), thermal and non-thermal processing, and irradiation of foods.

UNIT III: Food Safety Management Systems: **10 hours**

Principles of HACCP and their applications. Benefits from implementing a HACCP system, and their role in the food safety system. Food safety regulations and standards. Codex Alimentarius Commission, FSSAI. ISO Standards

UNIT IV: IPR and Patents **11 hours**

IPR and Patent, Copywrite, Quality assurance, Total Quality Management; GMP/GHP; GLP, GAP; Sanitary and hygienic practices

Reference Books

1. FSSAI Rules and Regulations Booklets, 2006 and 2011.
2. Alli, I. (2003). *Food quality assurance: principles and practices*. CRC Press.
3. Schmidt, R. H., & Rodrick, G. E. (2003). *Food safety handbook*. John Wiley & Sons.
4. Varzakas, T., & Tzia, C. (Eds.). (2015). *Handbook of food processing: food safety, quality, and manufacturing processes* (Vol. 35). CRC Press.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	1		3	1		3	2				2		1		3	1
CO 2				2					1		1	2	2	0		

CO 3	3	1	2						1						3	2
CO 4						1	2				3		1		2	1
CO 5	3	3					1		1			3	1			1
Average	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**0**	**2**	**1**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	Food Quality and Sensory Evaluation	L-T-P-C: 2-1-1-4

- **COURSE OBJECTIVES:**

  The objectives are to introduce the principles and methods of Food Quality Control and Assurance, principles, and selection of panellists for sensory evaluation. Quality characteristics of food like texture, viscosity, water and oil absorption properties etc.

- **COURSE OUTCOMES:**

  Upon completion of this course, the student will be able to:

  CO1. Define principles and methods of Quality Control and Assurance in foods,

  CO2. Understand the principles of sensory evaluation.

  CO3. Describe the sensory evaluation of food products.

  CO4. Analyze hazards and critical control points of different existing production processes.

  CO5: Apply different sensory scorecards to different processed foods.

Course Content **45 hours**

UNIT-I: INTRODUCTION TO FOOD QUALITY **10 Hours**

Food quality and its role in the food industry, the need of quality control, factors affecting quality control, Quality attributes, dominant and hidden attributes, Colour: Role of colours in quality spectra, different types of colour, measuring instruments; Viscosity – types of fluids, different viscometers to measure viscosity; Consistency – methods used to measure consistency or product difference between viscosity and consistency; Size and shape - Method to find shape and size of food and food products.

UNIT-II: Physical Quality parameters **11 hours**

Defects: Classification, genetic- physiological defects- Structural, off colour, character, entomological Defects holes, Scars, lesions, off colouring, curled leaves, pathological

defects, Mechanical defects, Extraneous or foreign material defects; Measurement of defects: Improving visibility by dilution, white background, colour differences, standardization of conditions, reference standards, counts and measures, isolation of defects by floatation, elution, electronic sorting, Internal defects.

UNIT-III: Texture **10 hours**

Classification, role of firmness, yielding quality, juiciness, chewiness, fibrousness, grittiness, mealiness, stickiness, measurement of texture/ kinaesthetic characteristics by compression, mechanical thumb, puncture tester, succulometer, shearing by tenderometer, texturometer, maturometer, fibro meter, moisture content, by Brabender moisture tester, alcohol insoluble solids, colour, consistency & sound measurement for kinesthetics.

UNIT-IV: Flavour **10 hours**

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 and interaction of tastes; Odour: Definition, classification, mechanisms, olfactory abnormalities, Odor testing, techniques, thresholds, Odor intensities; 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.

UNIT-V: Sensory evaluation **8 hours**

Definition, classification and methods, sensory evaluation of different products; panel members; quality as required for judges, sensory laboratory requirements and setup.

Food Quality and Sensory Evaluation Laboratory

List of Experiments

1. Food quality attributes, dominant and hidden Quality attributes
2. Quality attributes of bakery products.
3. Quality attributes of milk products
4. Quality attributes of Fruit and vegetable products
5. Oxidative stability of fat-rich products

6. Quality of packaging materials and labelling of food products
7. Sensory Analysis of Food Products
8. Hedonic scale for sensory analysis
9. Descriptive analysis of food products
10. Physical Quality attributes of food grains.

Reference Books

1. Munoz, A. M. (Ed.). (2013). *Sensory evaluation in quality control*. Springer Science & Business Media.
2. Herschdoerfer, S. (Ed.). (2012). *Quality Control in the Food Industry V2* (Vol. 2). Elsevier.
3. Civille, G. V., & Carr, B. T. (2015). *Sensory evaluation techniques*. CRC press.
4. Ranganna, S. (1986). *Handbook of analysis and quality control for fruit and vegetable products*. Tata McGraw-Hill Education.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	1		3	1		3	2				2		1		3	1
CO 2				2					1		1	2	2	2		
CO 3	3	1	2						1						3	2
CO 4						1	2				3		1		2	1
CO 5	3	3					1		1			3	1			1
Average	1.4	0.8	1	0.6	0	0.8	1	0	0.8	0	1.2	1	1	0.4	1.6	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				Mid Term Exam	End Term Exam	Total
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			End Term Examination		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	Program Elective - II	L-T-P-C: 2-1-0-3

COURSE OBJECTIVES

COURSE OUTCOMES

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				Mid Term Exam	End Term Exam	Total
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			End Term Examination		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	Program Elective - III	L-T-P-C: 2-1-0-3

COURSE OBJECTIVES

COURSE OUTCOMES

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total

Weightage (%)	30	20	20	20	10	100

XXXX XXXX	**Project - III**	**L-T-P-C: 0-0-3-3**

COURSE OBJECTIVES

COURSE OUTCOMES

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	Exploratory - V	L-T-P-C: 3-0-0-3

- **COURSE OBJECTIVES**

- **COURSE OUTCOMES**

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4

CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

XXXX XXXX	**Summer Training Presentation**	**L-T-P-C: 0-0-1-1**

COURSE OBJECTIVES

COURSE OUTCOMES

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															

Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

SEMESTER VII

XXXX XXXX	Project IV	L-T-P-C: 0-0-9-9

COURSE OBJECTIVES

COURSE OUTCOMES

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 100%

XXXX XXXX	Program Elective – IV	L-T-P-C: 2-1-0-3

COURSE OBJECTIVES

COURSE OUTCOMES

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total

Weightage (%)	30	20	20	20	10	100

XXXX XXXX	**Program Elective - V**	**L-T-P-C: 2-1-0-3**

COURSE OBJECTIVES

COURSE OUTCOMES

Course Content

- **UNIT-1**

Reference Books

1.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															
Average															

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX Emerging Technologies in Food Processing L-T-P-C: 1-1-0-2

- **COURSE OBJECTIVES:**

The objective of this subject is to impart knowledge of emerging technologies used for food processing and their application in food processing.

- **COURSE OUTCOMES:**

Upon completion of the course, the student will be able to:

CO1. Illustrate the principle and mechanism of novel food processing technologies.

CO2. Assess effect of the emerging technologies on the overall quality of food

CO3. Evaluate the Importance of emerging technologies in food processing

CO4. Apply emerging technologies in food processing

Course Content **30 hours**

UNIT-I: Emerging thermal techniques **6 hours**

Dielectric heating, ohmic heating, infrared heating: Principle, Equipment, applications, Effect on food quality and microbes

UNIT-II: Emerging non-thermal techniques **8 hours**

Pulsed electric field processing, Processing using electric arc discharges, Oscillating magnetic fields, Pulsed light and UV light, processing using Pulsed X-rays 40%, Processing using ultrasound, High-pressure processing, Combination of high pressure and other minimal processing techniques;

UNIT-III: Separation and extraction **8 hours**

Separation and concentration of food components, Supercritical extraction, Membrane concentration: Principle, equipment and applications, types of membrane system.

UNIT-IV: Other Technologies **8 hours**

Modified atmosphere packaging, controlled atmosphere storage, cryogenic chilling and freezing, dehydrofreezing; Freeze drying and concentration Hurdle Technology, etc

Reference Books

1. Fellows, P. J. Food Processing Technology: Principles and Practice, CRC Press, 2009.
2. Sun, Da-Wen, Emerging Technologies for Food Processing, Academic Press, 2005.
3. Barbosa-Canovas, Tapia and Cano, Novel Food Processing Technologies, CRC Press, 2004.
4. Ohlsson, Minimal Processing Technologies in Food Industry, Woodhead Publishing Limited, 2002

Program Outcomes Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1	1		3	1		3	2				2		1		3
CO 2				2					1		1	2	2	2	

CO 3	3	1	2						1						3
CO 4						1	2				3		1		2
CO 5	3	3					1		1			3	1		
Average	**1.4**	**0.8**	**1**	**0.6**	**0**	**0.8**	**1**	**0**	**0.8**	**0**	**1.2**	**1**	**1**	**0.4**	**1.6**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	PE-I Food Waste Management	L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

This course is about the waste generated during the processing of food products and minimization of waste in food Processing, valorization of unused co-products, and improvement of the management of unavoidable wastes. The different sessions of the course are described below.

- **COURSE OUTCOMES:**

Upon successful completion of the course, students can be able to:

CO1. Learn different types of Food waste.

CO2. Define factors responsible for food waste generation

CO3. Understand techniques to minimize food waste

CO4. Differentiate the by-products obtain from food waste

CO5. Apply Food waste management techniques to reduce waste

Course Content **45 hours**

UNIT-I: Introduction to waste management **10 hours**

Key drivers for waste management and co-product recovery in food processing: Waste minimization, management and co-product recovery in food processing. Consumer interest in food processing waste. Optimizing manufacturing to minimize waste in food Processing: Chain management issues and good housekeeping procedures to minimize food processing waste.

UNIT-II: Technologies for food waste separation **10 hours**

Key issues and technologies for food waste separation and co-product recovery: Process optimization to minimize energy use in food. The importance of microbiological risk management in the stabilization of food processing co-products. Effects of postharvest changes in quality on the stability of plant co-products: Response to adverse environments.

UNIT-III: Utilization of waste **10 hours**

Effect of destructuring on foods and their components and their components: lessons from other industries, preservation process and tools for breakdown/disassembly. Enzymatic extraction and fermentation for the recovery of food. Supercritical fluid extraction and other technologies for extraction. Separation technologies for food wastewater treatment and product recovery: Principal for separation, separation, and recovery technologies. Fermentation, biogas and biohydrogen production.

UNIT-IV: Risk Management in Waste Processing **8 hours**

The importance of microbiological risk management in the stabilization of food processing co-products. Waste management and co-product recovery in dairy processing. Waste management and co-product recovery in fish processing. Recovery and reuse of trimmings and pulps from fruit and vegetable.

UNIT-V: High-value by-products **7 hours**

High-value by-products from plant foods: nutraceuticals, micronutrients, cosmetics, and pharmaceuticals. Waste management in particular food industry sectors and recovery of specific co-products: meat, dairy product, and fish. Responsible for waste disposal and waste value addition. High-value co-products from plant foods: nutraceuticals, micronutrients, and functional ingredients.

References

1. Närvänen, E., Mesiranta, N., Mattila, M., & Heikkinen, A. (2020). Food waste management. *Springer International Publishing, Cham.*
2. Panda, H. (2011). *The Complete Book on Managing Food Processing Industry Waste: Managing Food Industry Waste, Food Waste Management, Management of Food Processing Waste, Food Waste Recycling, Waste Management in Food Manufacturing, Food Waste Collection, Food Waste Collection, Disposal & Recycling, Waste Management Plan, Food Waste Recovery, Fruit Waste Utilization, Waste Utilization of Fruits and Vegetables, Fruit and Vegetable Waste Management, Waste Utilization in Food Industry, Method for Quantitative Recovery of ....* ASIA PACIFIC BUSINESS PRESS Inc.
3. Waldron, K. W. (Ed.). (2009). *Handbook of waste management and co-product recovery in food processing*. Elsevier.
4. Närvänen, E., Mesiranta, N., Mattila, M., & Heikkinen, A. (2020). Introduction: A framework for managing food waste. *Food waste management: Solving the wicked problem*, 1-24.

Program Outcomes / Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1				2					3		1			1		1
CO 2	1		2		0.5	1			1	3		1	1		0.5	2
CO 3		1.5	1		1			1		1				2	1	1
CO 4	1			0.5					1		1	1	1.5	2		
CO 5	0.5	1	2		1	1		1.5		1	3	0.5			1	1
Average	1	2	1	1	1	1	0	1	1	1	1	1	1	1	1	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

XXXX XXXX	PE-I Food Supply Management and logistics	L-T-P-C: 2-1-0-3

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

- **COURSE OBJECTIVES:**

The objective of this subject is that students should know about the proper transportation of food. How transportation of raw material from farm to industry, storage houses is carried out. After processing, the finished product is supplied to the market. How this supply chain is managed is discussed in this subject.

- **COURSE OUTCOMES:**

After completion of the course, the students will be able to:

CO1. Know the concept of food supply.

CO2. Learn the Importance of food supply.

CO3. Understand the requirement of supply facilities for food products.

CO4. Apply distribution channel of food products.

Course Content **45 hours**

UNIT-I: Introduction to Supply Chain **8 hours**

Supply chain concepts; system dynamics, coordination in the supply chain, measuring supply chain performance, structural improvement; improvement in infrastructure, the internet, e-business and supply chain, internet exercises.

UNIT-II: Understanding the Supply Chain **10 hours**

The objectives of the supply chain, decision phases in a supply chain, process views of a supply chain, competitive and supply chain strategy, and drivers of the supply chain:- Facilities, Inventory, Transportation, Information, and Sourcing.

Designing Distribution Networks:- Role of distribution in a supply chain, factors influencing, distribution network, managing risk in the supply chain.

UNIT-III: Aggregation Planning in a Supply Chain 10 hours

Role of aggregation planning in the supply chain, aggregation planning, strategies, role of IT in aggregate planning, Inventory planning.

UNIT-IV: Managing Economy of Scales and Managing Uncertainty 8 hours

Warehouse/Storage- Meaning and Role, Importance of Storage & Warehousing risk in storage, the role of warehouseman, Negotiable Warehouse Receipt & its uses. Licensing procedures for traders and commission agents etc. Procedure for allocation of shops, Dispute settlement, Logistics & Transport Supports, Importance of Processing & Selling Value Added Products.

UNIT-V: Regulatory Issues of Transportation 9 hours

System of licensing, Regulation of warehouses, WDRA, role and functions of WDRA Pledge Finance Scheme of MoA, GoI, WDRA Accreditation of Warehouses, Other Marketing institutions i.e. FCI, CWC, SWC, MMTC and STC.

Reference Books

1. Dani, S. (2015). Food Supply Chain Management and Logistics: From Farm to Fork Paperback
2. Accorsi, R., & Manzini, R. (Eds.). (2019). *Sustainable food supply chains: planning, design, and control through interdisciplinary methodologies*. Academic Press.
3. Marsden, T., & Morley, A. (Eds.). (2014). *Sustainable food systems: building a new paradigm*. Routledge.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1				2					3		1			1		1
CO 2	1		2		0.5	1			1	3		1	1		0.5	2
CO 3		1.5	1		1			1		1				2	1	1
CO 4	1			0.5					1		1	1	1.5	2		
CO 5	0.5	1	2		1	1		1.5		1	3	0.5			1	1
Average	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	PE-I Facility Planning and Material handling	L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

The students will become familiar with the basic types of plant layouts and the factors to be considered for layout design, comprehend the procedure for designing the layouts in a systematic manner, understand different kinds of tools that can be used for the analysis of material flow and activities in a plant, realise how the space is estimated and allocated for different work centres and the facilities.

- **COURSE OUTCOMES:**

After completion of the course, the students will be able to:

CO1. Learn role and application design and layout in food plant construction.

CO2. Understand the effects of various parameters on food plant design and layout.

CO3. Describe the food processing facility in the best possible way.

CO4. Apply facility planning for raw and final processed food.

Course Content **45 hours**

UNIT-I: Introduction **8 hours**

General principles of food plant Design and layout, Classification of food processing plants, food plant design concepts, situations giving rise to plant design problems and general design considerations (technical, economic, legal, safety and hygiene). Executive design making in a food plant.

Material handling: Elementary concept of material handling in the food industry, equipment and functioning of belt conveyor, screw conveyor, bucket elevator and pneumatic conveyor.

UNIT-II: Food Plant Location and Size **10 hours**

Factors affecting plant location, their interaction with plant location, and location theory models for evaluation of alternate locations. Economic plant size, factors affecting the plant size (technical and economical), raw material availability, market demand, competition in the market, return on investment etc. Procedures for estimation of economic plant size (breakeven analysis and optimization), and estimation of volume of production for each product.

UNIT-III: Equipment, Product and Process Design **10 hours**

Process equipments, material handling equipment, service equipment, instruments and controls, considerations involved in equipment selection, economic analysis of equipment alternatives using optimization techniques and cash flows, the economic decision on spare equipment, prediction of service life of the equipment Design of product, product specifications, least cost mix of raw materials, process design, process selection considering technical, economic and social aspects. Process planning and scheduling, flow sheeting, flow diagrams and process flow charts including their design and computer-aided development of flow charts.

UNIT-IV: Plant Layout **7 hours**

Types of layouts, considerations involved in planning an efficient layout, preparation and development of layout, evaluation of alternate layouts, use of computers in development and evaluation of layouts, equipment symbols, flow sheet symbols, electric symbols,

graphic symbols for piping systems, standards for space requirement and dimensions, distances between critical plant areas and for different plant facilities.

UNIT-V: Building, Service Facilities and Plant Surroundings 10 hours

Requirements in respect of building type, wall, ceiling and floor construction, building height and building materials. Requirements of the steam, refrigeration, water, electricity, waste disposal, lighting, ventilation, drainage, CIP system, dust removal, fire protection etc. Design and installation of piping system, codes for building, electricity, boiler room, plumbing and pipe colouring. Planning of offices, laboratories, lockers and toilet facilities, canteen, parking lots and roads, loading docks, garage, repair and maintenance shop, and warehouses.

Reference Books

1 Maroulis, Z. B., & Saravacos, G. D. (2007). *Food plant economics*. CRC Press.

2 Toledo, R. T., Singh, R. K., & Kong, F. (2007). *Fundamentals of food process engineering* (Vol. 297). New York: Springer.

3 Barker, G. B. (2017). *The engineer's guide to plant layout and piping design for the Oil and Gas Industries*. Gulf Professional Publishing.

Program Outcomes / Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	1		3	1		3	2				2		1		3	1
CO 2				2					1		1	2	2	2		
CO 3	3	1	2						1						3	2
CO 4						1	2				3		1		2	1
CO 5	3	3					1		1			3	1			1
Average	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**0**	**2**	**1**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				Mid Term Exam	End Term Exam	Total
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			End Term Examination		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	PE-II Food Plant Sanitation	L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

The object of the present course is to make students familiar with cleaning and sanitization of food premises and equipments. Students should know about the process and ingredients used for cleaning and sanitization.

- **COURSE OUTCOMES:**

At the end of the course, the student should be able to:

CO1. Learn the application of good practices in food industries

CO2. Describe the cleaning of food plant

CO3. Understand the sanitization of food plant

CO4. Analyze standard operating practices

CO5. Apply standard Food cleaning procedures.

Course Content hours **45**

UNIT-I: Introduction to Food Plant Sanitation **8 hours**

Good manufacturing practices, current good manufacturing practices; Standard operating procedures, good laboratory practices, sanitation; Sanitation and the food industry: Sanitation, sanitation laws and regulations and guidelines, establishment of sanitary, potential risks of foodborne bioterrorism, bioterrorism protection measures, role of pest management in biosecurity; Relationship of microorganisms to sanitation, allergens, allergen control.

UNIT-II: Food contamination **10 hours**

Food contamination, protection against contamination; 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; Pest control: Insect infestation, cockroaches, insect destruction, rodents, birds, use of pesticides, integrated pest management.

UNIT-III: Sanitary design and construction for food processing **10 hours**

Site selection, site preparation, building construction considerations, processing and design considerations, pest control design; Low-moisture food manufacturing and storage sanitation: Sanitary construction considerations, receipt and storage of raw materials, cleaning of low-moisture food manufacturing plants.

UNIT-IV: Dairy processing plant sanitation **10 hours**

Role of pathogens, sanitary construction considerations, soil characteristics in dairy plants, sanitation principles, cleaning equipment; Meat and poultry plant sanitation: Role of sanitation, sanitation principles, cleaning compounds for meat and poultry plants, sanitisers for meat and poultry plants, sanitation practices, sanitation procedures; Seafood plant sanitation: Sanitary construction considerations, contamination sources, sanitation principles, recovery of by-products.

UNIT-V: Fruit and vegetable processing plant sanitation **10 hours**

Contamination sources, sanitary construction considerations, cleaning considerations, cleaning of processing plants, cleaners and sanitisers, cleaning procedures, evaluation of sanitation effectiveness; Beverage plant sanitation: Mycology of beverage manufacture, sanitation principles, non-alcoholic beverage plant sanitation, brewery sanitation, winery sanitation, distillery sanitation

Reference Books

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.
5. Y. H. Hui, Bernard L. Bruinsma, J. Richard Gorham, Wai-Kit Nip, Phillip S. Tong and Phil Ventresca. 2003. Food Plant Sanitation. Marcel Dekker, Inc., NY, USA.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1				2					3		1			1		1
CO 2	1		2		0.5	1			1	3		1	1		0.5	2
CO 3		1.5	1		1			1		1				2	1	1
CO 4	1			0.5					1		1	1	1.5	2		
CO 5	0.5	1	2		1	1		1.5		1	3	0.5			1	1
Average	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				Mid Term Exam	End Term Exam	Total
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			End Term Examination		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX PE-II Enzymes in Food Industry L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

On completing this course students should be able to know about Isolation and Purification of enzymes, understand the concept of enzyme immobilization techniques and the application of enzymes in food industries. This course enables the students to know the different types of enzymes and its application in food industries.

- **COURSE OUTCOMES:**

At the end of the course, the student should be able to:

CO1. Learn about enzyme production and isolation.

CO2. Describe how the purification of enzymes is carried out.

CO3. Understand the application of enzymes in food processing.

CO4. Apply the enzyme in the production of new food products.

Course Content 45 hours

UNIT-I: Introduction to enzymes 8 hours

Classification and nomenclature, mechanism of enzyme action, enzyme kinetics, factors affecting the rate of enzymic reactions, and sources of enzymes.

UNIT-II: Factors affecting Enzyme activity 10 hours

enzyme concentration, substrate concentration, environmental conditions, inhibitors, activators and cofactors Undesirable and desirable enzymic reactions in foods

UNIT-III: Sources of enzymes 10 hours

Different sources, extraction of enzymes and purification, enzyme technology and application Enzymes in milk and cheese industries: enzymes in milk processing and cheese production

UNIT-IV: Enzymes in Meat industry 10 hours

Enzymes in tenderization of meat Enzymes in the baking industry Enzymes in the production of beverages and fruit juices: enzymes in tea, cocoa, wine, beer, whiskey, cider, etc

UNIT-V: Enzymes in sugar industries 7 hours

Types of enzymes in sugar industry; isolation, purification and assay of enzymes, Enzymes in fats, oil, flavour and fragrances Immobilized enzymes in food processing.

Reference Books

1. G.A. Tucker and L.F.J. 2009. Enzymes in Food Processing Woods Springer
2. Muthuswamy C. 2015. Enzymes in Food and Beverage Processing CRC Press, London
3. Panesar P.S., Marwaha S.S. and Kumar H. 2010. Enzymes in Food Processing – Fundamentals and potential application IK International Publishing House, 9380026331
4. Aehle W. Enzymes in Industry: production & applications Wiley-VCH Verlag GmbH & Co.
5. Khan M.Y. and Khan F. 2015. Principles of Enzyme Technology PHI Publication, New Delhi ISBN 8120350413
6. Ray R.C. and Rosell C.M. 2017. Microbial Enzyme Technology in Food Applications CRC Press, London ISBN: 1498749844

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1				2					3		1			1		1
CO 2	1		2		0.5	1			1	3		1	1		0.5	2

CO 3		1.5	1		1			1		1				2	1	1
CO 4	1			0.5					1		1	1	1.5	2		
CO 5	0.5	1	2		1	1		1.5		1	3	0.5			1	1
Average	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	PE-II Instrumentation and Process Control	L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

The students will learn the process of industrial production of food. The students will be familiar with equipments and instruments and their process control. Different processes are used in food processing and control of different processes. Computer-based control of food processing.

- **COURSE OUTCOMES:**

After the completion of the course, the students will be able to:

CO1. Learn about equipment and instruments used in the food industry.

CO2. Know the functioning of equipment and instruments used in the food industry.

CO3. Understand the role of Instruments in the processing of food.

CO4. Describe the maintenance of instruments.

CO5. Apply the process control in food process industries.

Course Content **45 hours**

UNIT-I: Instrumentation and Process Control **8 hours**

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;

UNIT-II: Flow Measurements **10 hours**

Liquid level measurement, different methods of liquid level measurement; Flow measurement: Kinds of flow, rate of flow, total flow differential pressure meters, variable area meters, food flow metering.

UNIT-III: Weight measurement **10 hours**

Mechanical scale, electronic tank scale, conveyor scale; Measurement of moisture content, specific gravity, measurement of humidity, measurement of viscosity, turbidity, colour, measurement of density, brix, pH, enzyme sensors, automatic valves; Transmission: Pneumatic and electrical; Control elements, control actions, pneumatic and electrical control systems.

UNIT-IV: Process control **10 hours**

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; Transducers: Classification, self-generating transducers, variable parameter type, digital, actuating and controlling devices; 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;

UNIT-V: Computer-based monitoring and control **10 hours**

Importance, hardware features of data acquisition and control computer, signal interfacing, examples in food processing.

Reference Books

1. Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGraw-Hill 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 & Instrumentation. Prentice-Hall of India Pvt. Ltd. New Delhi.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO 1	3								3		1			1	
CO 2	1		2			1			1		2			2	
CO 3		1.5	2		1					1	3	2	1	1	1
CO 4	1								1		1	2			1
CO 5		1	2		1	1				1	3		1	1	
Average	1	1	2	0	1	1	0	0	1	0	2	1	0	1	0

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	PE-III Food Branding and Advertisement	L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

The students will know about the importance of good sales of a food product through branding and advertisement. The students will learn ingredients, health benefits, novel structure and sensory are important for the sale of a product.

- **COURSE OUTCOMES:**

At the end of the course, the student should be able to:

CO1. Learn how branding in food marketing is carried out.

CO2. Know the different types of branding strategies.

CO3. Describe the importance of advertising in food marketing.

CO4. Apply branding strategies to increase sales of a food product.

Course Content **45 hours**

UNIT-I: Food Branding and Advertisement **8 hours**

Marketing planning process; managing the marketing mix; objective setting; strategy formulation, implementation, and evaluation. Food marketing evolution (transaction cost framework, resource dependency theory, resource-based approach).

UNIT-II: Marketing channels **10 hours**

Food marketing channel organization and management (power-dependence, conflict, cooperation and coordination); Food marketing channel strategies (relationship marketing, value-adding partnerships, networks).

Unit-III: Marketing strategies 12 hours

The marketing strategies applied by agents throughout the chain will be investigated (i.e. food producers, ingredient suppliers, manufacturers, distributors, grocers, and food service operators).

UNIT-IV: Marketing issues 15 hours

Key issues addressed will include brand management strategies in the food sector; NPD strategies, supply chain strategies, supplier and product selection processes, and customer and brand portfolio decision-making.

Reference Books

1. Gunter, B. (2016). *Food Advertising: Nature, impact and regulation*. Springer.
2. Story, M., & French, S. (2004). Food advertising and marketing directed at children and adolescents in the US. *International Journal of Behavioural Nutrition and Physical Activity, 1*, 1-17.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1		2		2					3		1			1		1
CO 2			2		0.5	1			1	3		1	1		0.5	2
CO 3		1.5	1		1			1		1				2	1	1
CO 4		0.5		0.5					1		1	1	1.5	2		
CO 5		1	2		1	1		1.5		1	3	0.5			1	1
Average	**0**	**1**	**1**	**1**	**1**	**1**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Modes of Evaluation

Continuous Assessment- 70% and End Term Examination- 30%

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)			**Total**

Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning	**Mid Term Exam**	**End Term Exam**	
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

End-Term Examination- 30%

XXXX XXXX	PE-III Food Additives and Ingredients	L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

The objective of this subject is to make students familiar with important food additives, their classification and their use in food products. Students will know about types of food additives. Level of use and toxicity of food additives.

- **COURSE OUTCOMES:**

After the completion of the course, the students will be able to:

CO1: Define food preservatives, additives, flavouring agents, sweeteners, nutrients, and thickeners for healthy foods.

CO2: Classify the role of different food additives in the food processing industry with their roles.

CO3: Understand the role of food additives in Food Quality

CO4: Determine the role of various food additives in health maintenance and cure of diseases.

CO5: Apply knowledge in the selection of additives according to their mode of action and compatibility with food products.

Course Content **43 hours**

UNIT-I: Introduction to Food Additives **10 hours**

Food Additives: definitions, classification and applications, food preservatives-classifications, antimicrobial agents, types and their action, Antioxidants (synthetic and natural, mechanism of oxidation inhibition), anti-browning agent (types and mode of

action, application); Chelating agents: types, uses and mode of action; Coloring agents: colour retention agents, applications and natural colourants, sources of natural colour, misbranded colours, colour extraction techniques, colour stabilization. Safety concerns, regulatory issues in India, and international legal issues.

UNIT-II: Flavouring Agents **12 hours**

Flavours (natural and synthetic flavours), flavour enhancers, flavour stabilization, flavour encapsulation; Flour improvers: leavening agents, humectants and sequestrants, hydrocolloids, acidulants, pH control agents buffering salts, anticaking agents.

UNIT-III: Sweeteners **10 hours**

natural and artificial sweeteners, nutritive and non-nutritive sweeteners, properties and uses of saccharin, acesulfame-K, aspartame, corn sweeteners, invert sugar sucrose and sugar alcohols (polyols) as sweeteners in food products; Emulsifiers: types, selection of emulsifiers, emulsion stability, functions, and mechanism of action.

UNIT-IV: Nutrient supplements & thickeners **11 hours**

Polysaccharides, bulking agents, antifoaming agents, synergists, antagonists; additives food uses and functions in formulations, permitted dosages, indirect food additives; harmful effects/side effects associated with various additives (various diseases).

References

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

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

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

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

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

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	3								3		1				1	
CO 2	1		2			1			1		2	1			2	
CO 3		1.5	2		1			1		1	3		2	1	1	
CO 4	1						1		1		1	1.5	2			
CO 5		1	2		1	1				1	3			1	1	
Average	**1**	**1**	**2**	**0**	**1**	**1**	**0**	**0**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**0**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	PE-III Industrial safety and Hazard	L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

The students should get comprehensive knowledge of safety and hazards aspects in industries and the management of hazards. Students will learn about changes that occur during food processing, and the chances of mishappening to workers, therefore, precautions are very important.

- **COURSE OUTCOMES:**

Upon the completion of the course, the students will be able to:

CO1. Learn different hazards in the food processing sector.

CO2. Discuss how hazards should be prevented.

CO3. Understand the toxicity during food processing and prevention.

CO4. Apply the mock drill to prevent any damage.

Course Content **45 hours**

UNIT-I: Fire And Explosion **8 hours**

Introduction-Industrial processes and hazards potential, mechanical electrical, thermal and process hazards. Safety and hazards regulations, Industrial hygiene. Factories Act, 1948 and Environment (Protection) Act, 1986 and rules thereof. Shock wave propagation, vapour cloud and boiling liquid expanding vapour explosion (VCE and BLEVE), mechanical and chemical explosion, multiphase reactions, transport effects and global rates.

UNIT-II: Relief Systems **10 hours**

Preventive and protective management from fires and explosion-inerting, static electricity passivation, ventilation, sprinkling, proofing, relief systems – relief valves, flares, scrubbers.

UNIT-III: Toxicology 12 hours

Hazards identification-toxicity, fire, static electricity, noise and dust concentration; Material safety data sheet, hazards indices- Dow and Mond indices, hazard operability (HAZOP) and hazard analysis (HAZAN).

UNIT-IV: Leaks And Leakages 7 hours

Spill and leakage of liquids, vapours, gases and their mixture from storage tanks and equipment; Estimation of leakage/spill rate through hole, pipes and vessel burst; Isothermal and adiabatic flows of gases, spillage and leakage of flashing liquids, pool evaporation and boiling; Release of toxins and dispersion. Naturally buoyant and dense gas dispersion models; Effects of momentum and buoyancy; Mitigation measures for leaks and releases.

UNIT-V: Case Studies 8 hours

Flixborough, Bhopal, Texas, ONGC offshore, HPCL Vizag and Jaipur IOC oil-storage depot incident; Oil, natural gas, chlorine and ammonia storage and transportation hazards.

Reference Books

1. Crowl, D. A., & Louvar, J. F. (2001). *Chemical process safety: fundamentals with applications*. Pearson Education.
2. Lees, F. (2012). *Lees' Loss prevention in the process industries: Hazard identification, assessment and control*. Butterworth-Heinemann.
3. Deshmukh, L. M. (2005). *Industrial Safety Management: Hazard Identification and Risk Control*. McGraw-Hill Education.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	1		2			1			1							

CO 2			2		1			1		1	3	2	1	1	1	1
CO 3	1			1			1		1			2			1	1
CO 4			2		1	1				1	3		1	1		
Average	**1**	**0**	**2**	**0**	**1**	**1**	**0**	**0**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	PE-IV Quality Assurance and Certification	L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

The objective of the Quality Assurance and Certification course is to make students familiar with Quality control and Quality assurance. Students should know about different certification agencies and their requirements.

- **COURSE OUTCOMES:**

At the end of the course, the student should be able to:

CO1. Define the Food Quality.

CO2. Learn about quality control.

CO3. Describe quality assurance.

CO4. Understand the Certification agencies in Food processing.

CO5. Apply different laboratory control measures.

Course Content **45 hours**

UNIT-I: Food quality **12 hours**

Definition and its role in the food industry; Quality attributes, classification; Colour and gloss: Definition, different colours, colour measurement by spectrophotometer, Munsell colour 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-colour, character; Entomological defects: Holes, scars, lesions, off-colouring, curled aves, pathological defects; Mechanical defects, extraneous or foreign material defects; Measurement of defects: Improving visibility by dilution, white background, colour differences, standardization of conditions, reference

standards, counts and measures, isolation of defects by floatation, elution, electronic sorting and internal defects.

UNIT-II: Flavour 10 hours

Definition and its role in food quality; Taste: Classification, taste qualities, relative intensity, reaction time, effect of disease, temperature, and taste medium on taste, basic tastes, interaction of tastes; Odour: Definition, classification, neutral-mechanisms, olfactory abnormalities, 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;

UNIT-III: Laboratory quality measurement 10 hours

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, contour method, other procedures; 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;

UNIT-IV: Comparison of laboratory panels with consumer panels 10 hours

Limitations of consumer survey; Quality of raw materials: Physical, chemical, and microbial quality; Quality of products during processing and after processing: Colour, 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.

UNIT-V: Quality inspection 10 hours

Quality control; 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.

Reference Books

1. Alli, I. (2003). *Food quality assurance: principles and practices*. CRC Press.
2. Schmidt, R. H., & Rodrick, G. E. (2003). *Food safety handbook*. John Wiley & Sons.
3. Hester, R. E., & Harrison, R. M. (Eds.). (2001). *Food safety and food quality* (Vol. 15). Royal Society of Chemistry.

Program Outcomes / Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1				2					3		1		1		1	
CO 2	1		2		0.5	1			1	3		1		0.5	2	
CO 3		1.5	1		1			1		1			2	1	1	
CO 4	1			0.5					1		1	1.5	2			
CO 5	0.5	1	2		1	1		1.5		1	3			1	1	
Average	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

XXXX XXXX	PE-IV Bioprocess Engineering	L-T-P-C: 2-1-0-3

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

- **COURSE OBJECTIVES:**

The objective of bioprocess engineering is to make students familiar with different equipments used in food bioprocessing. Students will learn applications of engineering in Bioprocess and products obtained after bioprocess engineering.

- **COURSE OUTCOMES:**

After the completion of the course, the students will be able to:

CO1. Learn the kinetics of microbial growth and enzymes, sterilization, aeration, agitation, and downstream processing.

CO2. Select the best appropriate conditions and instrumentation for favourable growth kinetics.

CO3. Describe fermenters economically and beneficially.

CO4. Evaluate the changes caused by various factors affecting aeration, agitation, and kinetic processes.

CO5. Create problem-solving strategies, methods, and models in accordance with the current and future prospects in bioprocess engineering.

Course Content **45 hours**

UNIT-I: Kinetics of microbial growth and death 8 hours

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

UNIT-II: Simple enzyme kinetics 10 hours

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

UNIT-III: Air sterilization, aeration, and agitation 12 hours

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

UNIT-IV: Downstream processing and product recovery 15 hours

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

Reference Books:

1. Kumar, H. D. (2007). *A textbook on biotechnology*. Affiliated East West Press.
2. Prescott, S. C., & Dunn, C. G. (1949). Industrial microbiology. *Industrial microbiology.*
3. Najafpour, G. (2015). *Biochemical engineering and biotechnology*. Elsevier.

4. Belkin, S., Endo, I., Enfors, S. O., Hu, W. S., Mattiasson, B., Nielsen, J., ... & Zhou, W. (2010). Advances in biochemical engineering/biotechnology. *Biotechnology*, *123*.

5. Kargi, M. S. L. F., & DeLisa, M. (2017). *Bioprocess engineering: basic concepts*. Prentice Hall.

6. Lee, B. H. (2014). *Fundamentals of food biotechnology*. John Wiley & Sons.

7. Moo-Young, M. (2019). *Comprehensive biotechnology*. Elsevier.

Program Outcomes / Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	3								3		1				1	
CO 2	1		2			1			1		2	1			2	
CO 3		1.5	2		1					1	3		2	1	1	
CO 4	1			1					1		1	1.5	2			
CO 5		1	2		1	1				1	3			1	1	
Average	**1**	**1**	**2**	**0**	**1**	**1**	**0**	**0**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**0**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total

Weightage (%)	30	20	20	20	10	100

XXXX XXXX PE-IV Nutraceuticals and functional foods L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

The objective of this subject is to make students familiar with Nutraceuticals and functional foods. Students should learn about natural health products, the fortification of food products, and the importance of nutritionally enriched food.

- **COURSE OUTCOMES:**

At the end of the course, the student should be able to:

CO1. Define various functions of nutraceuticals and functional foods,

CO2. Communicate clearly about different types of nutraceuticals and functional foods and their health benefits.

CO3. Discuss the contributions of functional foods and nutraceuticals in the prevention of diseases.

CO4. Understand fundamental concepts of functional food and nutraceuticals.

CO5. Analyze the health benefits of functional foods and nutraceuticals, identifying strengths, limitations, and future directions.

Course Content 45 hours

UNIT-I: Nutraceuticals and functional foods 8 hours

Nature, type and scope of nutraceutical and functional foods. nutraceutical and functional food applications and their health benefits, Nutraceutical compounds and their classification based on chemical and biochemical nature with appropriate descriptions.

UNIT-II: Specific Nutraceuticals 12 hours

Nutraceuticals for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension etc, antioxidants and other phytochemicals, (isoflavones, lycopene's), their role as nutraceuticals and functional foods, Dietary fibers, and complex carbohydrates as functional food ingredients. protein as a functional food ingredient, Probiotic foods and their functional role, and Herbs as functional, health-promoting activities of common herbs.

UNIT-III: Cereal products as functional foods 10 hours

Oats, wheat bran, rice bran etc. Functional vegetable products, oilseeds, and sea foods. Coffee, tea and other beverages as functional foods/drinks and their protective effects.

UNIT-IV: Stability of functional and nutraceutical foods 15 hours

Processing, storage, and interactions of various environmental factors of functional and nutraceutical foods. Marketing and regulatory issues for functional and nutraceutical foods. Recent development and advances in the areas of functional and nutraceutical & foods.

Reference Books

1. Mangaraj, S, (2013) Handbook of Nutraceuticals and Functional Foods Soybean as an Example, Satish Serial Publishing House
2. Rajesh K Kesharwani (2022). Nutraceuticals And Functional Foods In Immunomodulators (Hb 2022), Springer
3. Farnworth, E. R. T. (Ed.). (2008). *Handbook of fermented functional foods*. CRC press.
4. Hurst, W. J. (Ed.). (2008). *Methods of analysis for functional foods and nutraceuticals*. CRC press.
5. Wildman, R. E. (Ed.). (2016). *Handbook of nutraceuticals and functional foods*. CRC press.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2	PSO3	PSO4

CO 1	1			2					3		1				1	
CO 2	1		2			1			1			1			2	
CO 3		1.5	2		1					1			2	1	1	
CO 4	1			1					1		1	1.5	2			
CO 5		1	2	2	1	1				1	3			1	1	
Average	**1**	**1**	**2**	**1**	**1**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	PE-V Food Rheology and Texture	L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

The objective of the present study is to learn about the rheology and texture of foods. Students will know different types of food properties, and the effect of food structural properties. Students will understand the microstructure of foods and their effect on food quality.

- **COURSE OUTCOMES:**

Upon successful completion of the course, students can be able to:

CO1. Define the rheological properties of foods.

CO2. Learn the textural properties of foods.

CO3. Understand the fundamental structure of foods.

CO4. Demonstrate the microstructure of foods.

CO5. Apply the textural properties to develop new food.

Course Content **45 hours**

UNIT-I: Fundamentals of Structuring **8 hours**

Polymer, Colloid, and Materials Science**;** Food Polymers, Polymer Solutions, Phase Transitions, Colloids and Surface Chemistry, Mechanical and Rheological Properties, Rheology of Foods, Mechanical Properties of Food Solids, Food Structure in the Mouth and Beyond

Unit-II: Food Structuring **15 hours**

Traditional Food Structuring and Texture Improvement, Approaches to Food Structuring, Extrusion and Spinning, Structuring Fat Products, Structure and Stability, Gels, Gelation Mechanisms, Mixed Gels, The Microstructure of Gels, Structure-Property Relations in Gels

Unit-III: Microstructural Components and Food Assemblies 12 hours

Water and Ice, Proteins, Lipids, Carbohydrates, Cells and Cell Membranes, Structural Aspects of Animal Tissue, Structural Aspects of Plant Tissue

Food Microstructure and Quality: Measurement of Texture, Structural Aspects of Food Texture, Quality and Structure

Unit- IV: Microstructure and Mass Transfer 10 hours

Solid-Liquid Extraction: Fundamental Aspects of Extraction, The Extraction Process, Extraction of Food Materials, Modifying Microstructure, Modeling the Extraction Process.

Reference Books

1. Aguilera, J. M., & Stanley, D. W. (1999). *Microstructural principles of food processing and engineering*. Springer Science & Business Media.
2. Moskowitz, H. R. (2017). *Food texture*. Routledge.
3. Roos, Y. H., & Drusch, S. (2015). *Phase transitions in foods*. Academic Press.
4. Barnes, H. A., Hutton, J. F., & Walters, K. (1989). *An introduction to rheology* (Vol. 3). Elsevier.
5. Marangoni, A. G. (2004). *Fat crystal networks* (Vol. 140). CRC Press.
6. Friberg, S., Larsson, K., & Sjoblom, J. (Eds.). (2003). *Food emulsions*. CRC Press.
7. Barbosa-Cánovas, G. V., & Vega-Mercado, H. (1996). *Dehydration of foods*. Springer Science & Business Media.
8. DeRossi, D., Kajiwara, K., Osada, Y., & Yamauchi, A. (1991). Polymer gels. *Fundamentals and Biomedical Applications*.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1				2					3		1			1		1
CO 2	1		2		0.5	1			1	3		1	1		0.5	2
CO 3		1.5	1		1			1		1				2	1	1
CO 4	1			0.5					1		1	1	1.5	2		
CO 5	0.5	1	2		1	1		1.5		1	3	0.5			1	1
Average	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	PE-V Food Plant Layout and Design	L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

The objective of this subject is to train students to manage the food processing plant in terms of the optimum arrangement of all the sections of the industry. Students should understand raw material reception, storage, processing, packaging and supply and transportation.

- **COURSE OUTCOMES:**

Upon successful completion of the course, students can be able to:

CO1: Learn a layout for a Food processing plant.

CO2: Identify the right, machinery based on application.

CO3: Understand the composition of the material used for machine design meeting the requirements.

CO4: Analyze the machinery set up in process flow meeting the standards and effective output.

CO5: Estimate and design plant layouts for different food sectors effectively.

Course Content	**45 hours**
UNIT-I: Layout Features	**8 hours**

Introduction to plant design - special features of food process industry-types of processing machineries-Manufacturing processes-concept -types-special features for fruit, vegetable, bakery & milk products.

UNIT-II: Plant Location 10 hours

Plant location, location theory and models-plant site selection-estimation of series- peak and 107 critical load-Economic plant size-plant layout objectives-classical and practical layout.

UNIT-III: Presentation Of The Layout 10 hours

Development and presentation of the layout-preparation of machinery layout for fruit, vegetables and meat-size reduction machinery layout-size reducing mills-types of machinery for separation of products by size shape and colour.

UNIT-IV: Evaporation And Drying Plant Layout 8 hours

Evaporation plant layout-single, multiple, vacuum and film evaporators-types and concepts, drying plant layout drying process, drier types, selection of driers.

UNIT-V: Processing Plant Layout 9 hours

Bake oven and frying plant types, concepts, and layout. Filling closing and labeling plant layout. Organization and trends in plant layout - sample layout, installation procedure for food processing plant.

Reference Books

1. Moran, S. (2016). *Process plant layout*. Butterworth-Heinemann.

2. Slade, F.H (1967). *Food processing Plants*. Leonardhill Books, London.

3. Handbook, A. S. H. R. A. E. (2017). Fundamentals, ASHRAE–American society of heating. *Ventilating and Air-Conditioning Engineers*.

4. Hall, H.S. and Rosen, Y. (1976). Milk plant layout, F.A.O. Publication.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1				2					3		1			1		1

CO 2	1		2		0.5	1			1	3		1	1		0.5	2
CO 3		1.5	1		1			1		1				2	1	1
CO 4	1			0.5					1		1	1	1.5	2		
CO 5	0.5	1	2		1	1		1.5		1	3	0.5			1	1
Average	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100

XXXX XXXX	PE-V Food Biotechnology	L-T-P-C: 2-1-0-3

- **COURSE OBJECTIVES:**

The objective of this subject is that students will know about biotechnology in food production and processing. Students should understand the genetic modification and production of genetically modified food products.

- **COURSE OUTCOMES:**

At the end of the course, the student should be able to:

CO1. Define the biochemical and metabolic pathways of biological systems used in food production.

CO2. Learn the difference between old biotechnology and modern biotechnology.

CO3. Describe the extensive history of food biotechnology and how it affects modern food production.

CO4. Understand the beneficial effects of microorganisms on foods with regards to nutritional and functional properties.

CO5. Apply the fermentation processes in producing different products.

Course Content **45 hours**

UNIT-I: Introduction to Food Biotechnology **10 hours**

General overview of Food Biotechnology, Principles of genetic engineering, Improvement of processing of various crops, Basic principles of Gene cloning, Food safety and biotechnology- Impact of Biotechnology on microbial testing of foods, New challenges and DNA-based methods in food authentication, Real-time PCR-based methods.

Unit-II: Transgenic plants and animals 10 hours

Introduction, Methods to produce transgenic animals, Risks and ethical issues related to their production

Unit-III: Antibiotics and Toxins Produced by Microorganisms 10 hours

Bacteriocins, Types and methods to produce bacteriocins, Aflatoxins, Antagonistic microbes, Intellectual property rights, Benefits of securing IPR.

Unit-IV: Protein engineering 10 hours

Introduction to protein engineering, Methods in protein engineering, Applications of protein engineering, Bio-flavours, Bio-colours, Fermented products, Soya based fermented products, Biosensors

Reference Books

1. Lee, B. H. (2014). *Fundamentals of food biotechnology*. John Wiley & Sons.
2. Tombs, M.P. (1991). *Biotechnology in Food Industry*. Open University Press, Milton Keynes.
3. Joshi, V. K., & Pandey, A. (Eds.). (1999). *Biotechnology: food fermentation: microbiology, biochemistry, and technology* (Vol. 1). Educational Publishers & Distributors.
4. Schwartzberg, H. G., & Rao, M. A. (Eds.). (1990). *Biotechnology and food process engineering*. CRC Press.

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1				2					3		1			1		1
CO 2	1		2		0.5	1			1	3		1	1		0.5	2
CO 3		1.5	1		1			1		1				2	1	1

CO 4	1			0.5					1		1	1	1.5	2		
CO 5	0.5	1	2		1	1		1.5		1	3	0.5			1	1
Average	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

1 = weakly mapped (Low), 2 = moderately mapped (Medium), 3 = strongly mapped (High)

"_" No correlation with syllabus

Theory Assessment:

	Continuous Assessment/Internal Assessment (50)				**Mid Term Exam**	**End Term Exam**	**Total**
Components	Surprise Test/Quiz	Assignments	Group Discussion/ Presentations	Project Based Learning/Tutorial based learning			
Weightage (%)	10	10	10	20	20	30	100

Laboratory Assessment:

	Continuous Assessment/Internal Assessment			**End Term Examination**		
Components	Experimental Performance	Viva voce	Lab record	Major Experiments (Practical)	Viva voce	Total
Weightage (%)	30	20	20	20	10	100