DEPARTMENT OF FOOD TECHNOLOGY
SCHOOL OF ENGINEERING AND TECHNOLOGY

SYLLABUS

FOR

B. TECH FOOD TECHNOLOGY

[2026]

ISLAMIC UNIVERSITY OF SCIENCE AND TECHNOLOGY, KASHMIR

Vision of the Department

- To be a leader in all domains of Food Technology, through teaching, research, outreach, innovation and entrepreneurship

Mission of the Department

- To impart complete education employing advanced technology and infrastructure so as to shape the students into qualified professionals
- To develop the personality of students, instilling in them a sense of belonging and responsibility towards society
- To work for the production of trained manpower well equipped to serve both the food industry and society as a whole
- To establish integration with industry and address issues of practical importance
- To cater to the emerging needs and concerns of consumers, by providing thrust in the areas of food engineering, technology and research innovations with continuous upgradation.

Program Educational Objectives

- To produce professionals imbibing both theoretical and practical know how of food processing and related areas to serve academia, industry as well as the society.
- To disseminate the knowledge of current foods issues socially and globally, and enable the students to address them employing latest techniques in food processing.
- To provide learning opportunities in multidisciplinary fields involving chemistry, biochemistry, engineering, microbiology, biochemical and other aspects of food along with its preservation, processing, quality and packaging.
- To provide a thorough industrial exposure to students so as to enable them to be capable enough to serve in national and multinational organizations.

Program Outcomes

- On successful completion of the program
- Graduates will be able to apply knowledge of Food Science, Engineering and Mathematics.
- Graduates will be able to demonstrate identification, formulation and problem solving related to Food sector.
- Graduates will be able to generate mass awareness on the importance of safe, wholesome and nutritious foods.
- Graduates will be able to design new food products as per societal demand.
- Graduates will be in a position to apply their up-to-date knowledge practically within food industries.
- Graduates will be able to work in food industries, research organizations and academics.
- Graduates will be able to demonstrate knowledge with professional ethics.

SEMESTER-I

Course Code	Course Title	CREDITS				Total Credits	Contact hours	EXAMINATION SCHEME				
		L	T	P	S			Internal	Assignment	End Term	Practical	Total
PHY111F	Applied Physics	2	0	1	0	3	4	25	10	35	30	100
CHM112F	Applied Chemistry	2	0	1	0	3	4	25	10	35	30	100
MTH113F	Engineering Mathematics-I	3	0	0	0	3	3	30	20	50	0	100
EVS114F	Environmental Science and Elementary Biology	2	0	0	0	2	2	15	10	25	0	50
CSE115F	Introduction to Computer and Computer Applications	2	0	1	0	3	4	25	10	35	30	100
ENG116F	Communicative English and Soft Skills	3	0	0	0	3	3	30	20	50	0	100
MEC117F	Engineering Graphics and Design	0	0	2	0	2	4	30	20	50	0	100
	Total					**19**	**24**					

SEMESTER-II

Course Code	Course Title	CREDITS				Total Credits	Contact Hours	EXAMINATION SCHEME				
		L	T	P	S			Internal	Assignment	End Term	Practical	Total
DFT162C	Fundamentals of Food Preservation and Processing	2	1	1	0	4	5	25	10	35	30	100
DFT163C	Fluid Mechanics	3	0	1	0	4	5	25	10	35	30	100
DFT164C	Food Chemistry	3	0	1	0	4	5	25	10	35	30	100
DFT165F	Nutritional Biochemistry	2	0	0	0	2	2	15	10	25	0	50
DFT166G	Manufacturing Process Laboratory	0	0	2	0	2	4	15	10	0	25	50
MTH161F	Engineering Mathematics-II	3	0	0	0	3	3	30	20	50	0	100
					Total	**19**	**24**					

SEMESTER-III

Course Code	Course Title	CREDITS				Total Credits	Contact Hours	EXAMINATION SCHEME				
		L	T	P	S			Internal	Assignment	End Term	Practical	Total
DFT211C	Post- Harvest Technology of Fruits and	3	0	1	0	4	5	25	10	35	30	100
DFT212C	Food Microbiology	3	0	1	0	4	5	25	10	35	30	100
DFT213C	Thermodynamics	3	0	0	0	3	3	30	20	50	0	100
DFT214C	Unit Operations in Food Processing	3	0	1	0	4	5	25	10	35	30	100
DFT215F	Food Plant Hygiene & Sanitation	2	0	0	0	2	2	15	10	25	0	50
DFT216F	Technology of Milk and Milk	2	0	1	1	4	5	25	10	35	30	100
Open Elective												
	Open Elective	2	0	0	0	2	2	15	10	25	0	50
	Total					**23**	**27**					

SEMESTER-IV

Course Code	Course Title	CREDITS				Total Credits	Contact Hours	EXAMINATION SCHEME				
		L	T	P	S			Internal	Assignment	End Term	Practical	Total
DFT261C	Fruit and Vegetable Technology	2	0	1	1	4	5	25	10	35	30	100
DFT262C	Food Biotechnology	2	0	1	0	3	4	25	10	35	30	100
DFT263C	Food Process Engineering	3	0	1	0	4	5	25	10	35	30	100
DFT264C	Mass Transfer Operations	2	1	1	0	4	5	25	10	35	30	100
ELE265G	Basic Electrical and Electronics	2	1	1	0	4	5	25	10	35	30	100

OPEN ELECTIVE												
	Open Elective	2	0	0	0	2	2	15	10	25	0	50
	TOTAL					**21**	**26**					

SEMESTER-V

Course Code	Course Title	CREDITS				Total Credits	Contact Hours	EXAMINATION SCHEME				
		L	T	P	S			Internal	Assignment	End Term	Practical	Total
DFT311C	Heat Transfer Operations	2	1	1	0	4	5	25	10	35	30	100
DFT312C	Engineering Properties of Food Materials	2	0	1	0	3	4	25	10	35	30	100
DFT314C	Food Additives and Ingredients	2	0	1	0	3	4	25	10	35	30	100
DFT315C	Cereal and Pulses Processing Technology	2	0	1	1	4	5	25	10	35	30	100
DFT316C	Edible Oil Technology	2	0	1	0	3	4	25	10	35	30	100
Discipline Centric Elective (Any One)												
DFT317E	Food Entrepreneurship	1	1	0	0	2	2	15	10	25	0	50
DFT318E	Technology of Flavors	1	1	0	0	2	2	15	10	25	0	50
	MOOCS/ Swayam	2	0	0	0	2	2					
Open Elective												
	Open Elective	2	0	0	0	2	2	15	10	25	0	50
	Total					**21**	**26**					

SEMESTER-VI

Course Code	Course Title	CREDITS				Total Credits	Contact Hours	EXAMINATION SCHEME				
		L	T	P	S			Internal	Assignment	End Term	Practical	Total
DFT361C	Packaging Technology	3	0	1	0	4	5	25	10	35	30	100
DFT362C	Food Quality and Safety	2	0	0	1	3	3	30	20	50	0	100
DFT363C	Technology of Spices and Plantation Crops	2	0	1	0	3	4	25	10	35	30	100
ELE364G	Process Control and Instrumentation	3	0	1	0	4	5	25	10	35	30	100
DFT365E	By-product utilization and Waste Management in Food Industry	2	0	1	0	3	4	25	10	35	30	100

Discipline Centric Elective (Any One)												
DFT366E	Risk Assessment and Food Safety	1	1	0	0	2	2	15	10	25	0	50
DFT367E	AI in Food Processing	1	1	0	0	2	2	15	10	25	0	50
	MOOCS/ Swayam	2	0	0	0	2	2					

Open Elective												
	Open Elective	2	0	0	0	2	2	15	10	25	0	50
	Total					**21**	**25**					

SEMESTER-VII

Course Code	Course Title	CREDITS				Total Credits	Contact Hours	EXAMINATION SCHEME				
		L	T	P	S			Internal	Assignment	End Term	Practical	Total
DFT411C	Meat, Fish and Poultry Products Technology	2	0	1	1	4	5	25	10	35	30	100
DFT412C	Bakery and Confectionery Technology	2	1	1	0	4	5	25	10	35	30	100
DFT413C	Advanced Instrumentation Techniques	2	0	2	0	4	6	25	10	35	30	100
DFT414F	Credit Seminar /Project	0	0	0	1	1	1	NA	NA	100	NA	100
DFT415G	Food Plant Layout and Management	2	0	0	1	3	3	30	20	50	0	100
DFT416C	Enzymes in Food Processing	1	1	0	0	2	2	15	10	25	0	50

Discipline Centric Electives (Any One)												
DFT417E	Food and Nutrition	1	1	0	0	2	2	15	10	25	0	50
DFT418E	Beverage Technology	1	1	0	0	2	2	15	10	25	0	50
	MOOCS/Swayam	2	0	0	0	2	2					
	Total					**20**	**24**					

SEMESTER-VIII

Course Code	Course Title	Total Credits	EXAMINATION SCHEME				
			Comprehensive viva (Internal)	Industrial component	Project Report	Viva Voce / Presentation (External)	Total
DFT451C	**In-Plant Training**	20	200	50	50	100	400

Semester wise credits

Semester	Credits
1st	19
2nd	19
3rd	23
4th	21
5th	21
6th	21
7th	20
8th	20
Total	164

SEMESTER-I

Course Code: PHY111F						Course Title: Applied Physics				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	1	0	3	4	25	10	35	30	100

Course Objectives:

- Understand fundamental principles of fluid mechanics and their applications in real systems
- Explain classification and behaviour of materials, especially semiconductors, using band theory.
- Apply vector algebra and vector calculus concepts to physical and electromagnetic systems
- Analyse electromagnetic laws governing electric and magnetic fields.
- Understand principles of laser physics and spectroscopic phenomena.
- Develop problem-solving ability in applied physics relevant to engineering and scientific

UNIT I: Kinetic theory

Equation of state of a perfect gas, work done in compressing a gas. Kinetic theory of gases - assumptions, concept of pressure. Kinetic interpretation of temperature; rms speed of gas molecules; degrees of freedom, law of equipartition of energy (statement only) and application to specific heat capacities of gases; concept of mean free path, Avogadro's number

UNIT II: Semiconductor Physics

Classification of solids as conductors, semiconductors and insulators on the basis of bands theory, Semiconductors and its types, Qualitative description of PN-junction, Light emitting and photo diodes, Hall effect: theory and its applications

UNIT III: Vector Calculus

Vectors, Review of vector algebra, vector algebra in component form, Vector analysis, Gradient of a scalar field, Divergence and Curl of the vector field in Cartesian coordinates, Concept of line, surface and volume integrals, Gauss's divergence theorem and Stokes's theorem,

UNIT IV: Spectroscopy

Laser: Introduction, characteristics of Laser, Spontaneous and stimulated emission, Einstein's Coefficients, population inversion, pumping mechanism, Types of lasers, He-Ne laser, Application of Lasers. Atomic Spectra, Zeeman Effect, Stark Effect, Paschen-Back effect, Raman Spectroscopy

Course Outcomes:

- Evaluate surface phenomena such as surface tension, capillarity, terminal velocity, and pressure excess in bubbles and drops.
- Classify materials as conductors, semiconductors, and insulators using band theory and explain working principles of PN junction devices, LEDs, photodiodes, and Hall effect applications.
- Perform vector operations and compute gradient, divergence, and curl; apply Gauss and Stokes theorems to physical problems.
- Apply fundamental electromagnetic laws including Coulomb's law, Gauss's law, Biot–Savart law, Ampere's law, and Faraday's induction law to analyse field interactions.
- Explain laser principles including stimulated emission, population inversion, Einstein coefficients, and working of He–Ne laser.
- Interpret atomic spectra and analyse Zeeman, Stark, Paschen–Back effects, and Raman spectroscopy for material characterization.

Books Recommended:

1. *Griffith, D.J. Introduction to Electrodynamics, Prentice Hallof India Private Limited, New Delhi.*
2. *Jordan, C and Balmain, K.G. Electromagnetic Waves and Radiating System, Prentice Hall of Ind. Pvt. Ltd., New Delhi.*
3. *Kraus, J.D. Electrodynamics, McGraw Hill, New York.*
4. *Feynman, R.P., Leighton, R.B. & Sands, M.The Feynman Lectures on Physics Vol. I, II, III, Narosa Publishing House, New Delhi.*
5. *H. C.,Ohanian, Modern Physics, Prentice Hall of India (P) Ltd., New Delhi.*
6. *Beiser, A; Mahajan S; Choudary, S.R. Concepts of Modern Physics, McGraw Hill Education (India) Private Limited.*
7. *Takwale, R.G., Puranik, P.S. Introduction to Classical Mechanics, McGraw Hill Education (India) Private Limited.*
8. *Omar M. A., Elementary Solid State Physics, Prentice Hall of India.*

Practicals

1. To determine the value of e/m of an electron by Thomson Method.
2. To determine the value of Acceleration due to gravity (g) by using the Bar Pendulum.
3. To determine the wavelength of sodium light by diffraction.
4. To determine the value of Young's Modulus of a rectangular steel bar by Bending of Beam Method.
5. To verify Stefan's Law by Electrical Method.
6. To determine the value of moment of inertia of a fly wheel.
7. To study V-I characteristics of a diode.
8. To study the Hall Effect and hence calculate Hall coefficient, carrier density and charge mobility.
9. To verify Biot-Savart's law.
10. To determine the value of Planck's constant using LED Method.

Course Code: CHM112F						Course Title: Applied Chemistry				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	1	0	3	4	25	10	35	30	100

Course Objectives:

- To make the students conversant with thermodynamics and the concepts involved.
- To develop an understanding of chemistry pertaining to synthesis of different types of solutions and dilutions.
- To acquaint students with the concepts of biomolecules and their classification
- To provide the knowledge of various spectroscopic and chromatographic techniques.

Unit I: Chemical Thermodynamics

Introduction and Importance, Intensive and extensive properties, Energy and work, Heat Capacity First Law of Thermodynamics, Work done in Isothermal and Adiabatic Conditions. Heat capacities, Relation between Cp and Cv, Second Law Of Thermodynamics, Concept of Entropy, Carnot engine, Gibbs free energy. Free Energy Changes as Criteria of Reversible and Irreversible process, Gibbs-Helmholtz's equation, Clausius- Clapeyron equation.

Unit II: Fundamental Chemistry

Molecular weight & Equivalent weight of elements and compounds. Normality, Molarity, Molality. Stock and working solutions. Molar and Normal solutions of compounds and acids. (NaCl, NaOH, HCl, H_2SO_4, H_3PO_4, CH_3COOH, etc.); Preparation of percent solutions – w/w, v/v w/v (solids, liquids, and acids); Conversion of a percent solution into a molar solution; Saturated and supersaturated solutions; Standard solutions: Technique for preparation of standard solutions and Storage. e.g., glucose, albumin, etc.; Dilutions-Diluting Normal, Molar and percent solutions. Preparing working standard from stock standard; Part dilutions: Specimen dilutions. Serial dilutions. Dilution factors.

Unit III: Biomolecules

Carbohydrates–Classification, Structure and properties. Monosaccharides, Oligosaccharides and Polysaccharides, Lipids - Classification, Structure and use of lipids in food, saturated and unsaturated fats, hydrogenation of fats. Lipid oxidation, rancidity, factors affecting rate of

oxidization, Proteins, and amino acids – Physical and chemical properties, protein structure. Pigments in foods – Chlorophyll. carotenoids and their anthocyanins

Unit IV: Instrumental Techniques

Electromagnetic Radiation, Electromagnetic Spectrum, Light Absorption (Beers Lambert Law) UV-Vis spectroscopy, intensity and absorption shifts (Types of Transition, Chromophores, Auxo-chromes and Applications) Infrared Spectroscopy, Fingerprint and group frequency regions, fundamental bands (Modes of vibration, IR bands corresponding to different functional groups and Applications). Concept of chromatography and its types.

Course Outcomes:

Better understand the engineering processes involving chemistry and their applications relevant to the discipline.

Books Recommended:

1. *C. Kuriacose and J. Rejaraman: Chemistry in Engineering and Technology Volumes I & II(Tata McGraw Hill publishing company Limited, New Delhi)*
2. *P.C. Jain. Engineering Chemistry, (Dhanpat Rai & Sons, Nai Sarak; New Delhi).*
3. *Physical Chemistry – Puri Sharma and Pathania.*
4. *Inorganic Chemistry (J.D. Lee).*
5. *Physical Chemistry by Peter Atkins, Julio de Paula*
6. *Electrochemistry and Corrosion Science by N. Perez*
7. *A Textbook of Organic Chemistry, V. K. Ahluwalia and Madhuri Goyal*
8. *Organic Chemistry: Stereochemistry, I. L. Finar, Pearson Education*
9. *Environmental chemistry by A. K. De, New Age International*
10. *C.V. Agarwal - Chemistry of Engineering Materials (Tata publishing Works, Varanasi)*
11. *L. A. Munro – Chemistry in Engineering (Prentice Hall, New York)*
12. *Chemistry of Engineering Materials, C.P. Murthy, C.V. Agarwal and A. Naidu BS*
13. *O. P. Vermani and A.K. Narula – Applied Chemistry Theory and Practice, (Wiley Eastern Limited, New Delhi).*
14. *R. M. E. Diamand: Applied Chemistry for Engineers, (Pitman)*
15. *Laboratory Manual on Engineering Chemistry by S.K. Bhasin and Sudha Rani, Dhanpat Rai Publishing Company, New Delhi (2004).*

Practicals

1. Basic Introduction on Solution Preparation, Concentration terms, Handling of Glass ware, Chemicals, Instruments: Precautions.
2. Preparation of different types of Normal solutions of solid and liquid solutes
3. Preparation of different types of Molar solutions of solid and liquid solutes
4. Preparation of different types of Percent solutions of solid and liquid solutes
5. Determination of normality and molarity of some solutions using acid base titration method.
6. To determine the temporary and permanent hardness of a sample of water by complexometric titration.
7. To determine the Alkalinity of the given sample of water.
8. Determination of acid value of a given mineral oil or vegetable oil
9. UV-Vis. study of some commercially available naturally coloured food pigments
10. FT-IR study of glucose and other naturally coloured food pigments

Course Code: MTH113F						Course Title: Engineering Mathematics-I				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
3	0	0	0	3	3	30	20	50	0	100

Course Objectives

1. Develop an in-depth understanding of Taylor's and Maclaurin's series, partial derivatives, and their applications in engineering problems.
2. Learn the application of Beta and Gamma functions, as well as multiple integrals in solving problems related to area, volume, and surface integrals.
3. Analyse and solve ordinary differential equations including higher-order, exact, and special functions like Bessel's and Legendre's equations, and understand basic vector calculus operations.

Unit I: Functions of Single and Multiple Variables

Taylor's and Maclaurin's series expansions, Indeterminate forms, Curvature and asymptotes, Tracing of curves, Functions of two or more variables, Partial differentiation, Homogeneous functions and Euler's theorem, Total derivatives and composite functions, Derivatives of implicit functions, Change of variables and Jacobians, Error analysis, Maxima and minima of multivariable functions

Unit II: Integral Calculus

Fundamental theorem of Integral Calculus, Mean Value theorems, Evaluation of definite integrals - reduction formulae, Gamma and Beta functions – elementary properties, Rectification of standard curves, Volumes and surfaces of revolution, Double and triple integrals, change of order of integration, Applications of multiple integrals to compute area, volume, mass, and centre of gravity

Unit III: Ordinary Differential Equations

Exact and Bernoulli's differential equations, Equations reducible to exact form, First-order and higher-degree differential equations (Clairaut's equation), Higher-order linear differential equations, Methods for finding complementary functions and particular integrals, Method of variation of parameters, Simultaneous linear differential equations with constant coefficients,

Cauchy's and Legendre's linear equations, Bessel's and Legendre's differential equations, Series solution methods

UNIT IV: Application of Derivatives

Increasing and decreasing functions, maxima and minima of a function, derivative tests, Rolle's Theorem and Lagrange's mean value Theorem (without proof), Taylor's series and Fourier Series.

Course Outcomes

1. Analyse and apply Taylor's and Maclaurin's series and partial derivatives in solving problems involving multivariable functions.
2. Evaluate double and triple integrals and use them in computing area, volume, surface area, mass, and centre of gravity in engineering contexts.
3. Solve ordinary differential equations of various forms and apply vector calculus theorems to physical and engineering problems.

Books Recommended:

1. *James Stewart, Calculus, Early Transcendentals.*
2. *Hari Arora, A Textbook of Engineering Mathematics Vol I, II. (Calculus and Linear Algebra).*
3. *N. P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.*
4. *D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.*
5. *Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.*
6. *Advanced Engineering Mathematics by Jain, R.K. and Iyengar SRK, Narosa, 200.*

Course Code: EVS114F						Course Title: Environmental Science & Elementary Biology				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	0	0	2	2	15	10	25	0	50

Course Objectives

- To introduce concepts of environment and sustainability.
- To understand ecosystems, biodiversity and resource conservation.
- To create awareness of pollution and global environmental issues.
- To provide basics of cell structure and functions

UNIT I: Environmental Pollution and Global Issues

- Definition, Causes, Effects and Control Measures of Air, water and soil Pollution
- Global Issues: Greenhouse Effect, Global Warming and Acid Rain, Droughts Floods, etc.,
- Pollution from Food Processing Industries and Mitigation Strategies
- Water Quality Parameters (pH, DO, BOD, COD, TDS, etc.)

UNIT II: Ecosystem and Natural Resources

- Types of Ecosystems
- Structure and Function of an Ecosystem
- Ecological Pyramids
- Ecological Succession
- Natural Resources: Classification and conservation
- Biodiversity: Definition, Values, Threats and Conservation Approaches – In-situ and Ex-situ
- Classification of Species as per IUCN
- Agroecology: Growing Food the Ecological Way
- Circular Food Systems: Turning Waste into Resources

UNIT III: Introduction to Environment and Sustainability

- Public Environmental Awareness and Methods of its Propagation
- Consumerism and Green Consumerism

- Alternatives to Conventional Development – Sustainable Development and Its Goals
- Food Security: Definition, Dimensions and its Inter-linkage with Environmental Sustainability
- Innovative and Sustainable Food Packaging Solutions

UNIT IV: Elementary Biology

- Definition of a Cell
- Types of Cells: Prokaryotic vs Eukaryotic
- Overview of Organelles in Plant and Animal Cells
- The Cell Membrane and Transport Mechanisms
- Energy Factories: Mitochondria and Chloroplasts

  Cell Division Basics: Mitosis and Binary Fission

Course Outcomes

- Understand what environment and sustainability mean and why they matter in daily life.
- Learn how ecosystems work, why biodiversity is important and ways to protect nature.
- Know the main types of pollution, global environmental problems and how they can be reduced.
- Get a clear idea of how cells function as the basic unit of life.

Books Recommended:

1. *Ecology and Environment by P.D. Sharma (Rastogi Publications).*
2. *Environmental Studies by Erach Barucha (Oxford Publications).*
3. *Environmental Studies from Crises to Cure authored by R. Rajagopalan; Published by Oxford University Press.*
4. *Environmental Management by Oberoi.*
5. *Principles of Environmental Science: Inquiry & Applications (Special Indian Edition) authored by William Cunningham & Mary Cunningham; Published by Tata McGraw*
6. *Perspectives of environmental studies by AP Kaushik and CP Kaushik. New age international publications.*
7. *Environment by Shankar IAS academy.*

Course Code: CSE115F						Course Title: Introduction to Computer and Computer Applications				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	1	0	3	4	25	10	35	30	100

COURSE OBJECTIVES:

- To understand the basic concepts of programming.
- To know the basics of algorithmic and recursion as a tool of problem solving.

UNITI

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc. Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart /Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

UNITII

Branching, Loops, and Arrays: Arithmetic expressions and precedence, Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops. Arrays, Arrays (1-D, 2-D), Character arrays and Strings.

UNITIII

Algorithms, Order complexity and Functions: Basic Algorithms, Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required), Function, Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.

UNITIV

Recursion: Recursion as a different way of solving problems. Example programs, such as Finding Factorial. Quick sort or Merge sort, Structure, Structures, Defining structures and Array of Structures.

Pointers: Idea of pointers, defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation), File handling.

Course Outcomes:

- Apply various programming skills for solving discipline centric problems.

Books Recommended:

1. *E. Balaguruswamy, Programming in ANSI C, McGraw Hill Education India.*
2. *Yashavant Kanetkar, Let Us C, BPB Publications*
3. *Gottfried, Schaum's Outline of Programming with C, McGraw Hill Education India.*
4. *Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.*

Practicals

1. Identify the different parts of a computer system, know how each and every part of a computer system works, learn how different parts of the computers work together to produce a desirable output.
2. Create a document using a suitable word processing package, with at least three paragraphs and perform editing operations to understand document creation and Text manipulation with Scientific Notations
3. Create a formal letter using a suitable word processing package, to place a purchase order for procurement of books. Use mail merge feature
4. Table creation, Table formatting and Conversion. Use tables for list of books.
5. Cereal subjects.
6. Create a Power-point presentation with at least 6 slides.
7. Using simple mathematical formulas in excel.
8. CHARTS – Line, XY, Bar and Pie.
9. Familiarization with the programming environment
10. Simple computational problems using arithmetic expressions
11. Problems involving if-then-else structures
12. Simple programs on loops and arrays

Course Code: ENG116F						Course Title: Communicative English and Soft Skills				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
3	0	0	0	3	3	30	20	50	0	100

Course Objectives:

- This course aims to enable students to communicate effectively in different settings like academic, professional and social environments.
- To improve their pronunciation, vocabulary and grammatical knowledge for effective communication.
- To enable students to use appropriate body language in academic and professional settings.
- To train the learners in various forms of spoken and written communication skills, including presentations, group discussions, public speaking, reports, projects, application, and CV/Resume writing

UNIT-I

- **Understanding Communication**

- Definition of Professional and Technical Communication, Importance of Professional and Technical Communication, Features of Professional and Technical Communication, Forms of Professional and Technical Communication
- Concept and Process of Communication, Types of Communication (Verbal and Non-Verbal Communication), Effective Communication, Barriers to Effective communication, Non-Verbal Communication: Body Language (Kinesics, Proxemics, Haptics, Chronemics, Oculesics), Paralanguage (Tone of Voice, Pitch, Volume, Speaking Rate, Pauses and Silence)

Tasks*: Tasks based on body language (using emotions cards and role play) (Lab)*

UNIT-II

- **Basics of English Grammar, Vocabulary and Phonetics**

- Parts of speech, Tenses, Modals, Articles, Punctuation, Types of Sentences (Simple, Complex and Compound), Vocabulary Building, English Sounds (Consonants, Vowels and Diphthongs)

Tasks: *Identify and explain various grammatical elements like parts of speech, tenses, modals, articles while reading different texts through handouts*

Tasks: *Use dictionary for word meaning, pronunciation and grammar*

Tasks: *Practicing consonants, vowels and diphthongs (LAB)*

UNIT-III

- **Listening, Speaking, Reading and Writing (LSWR):**

-Definition and Process of Listening, Activities to Develop Listening Skills

- Definition and Importance of Speaking Skills, Activities to Develop Listening Skills
- Definition and Purpose of Reading, Types of Reading, Reading Tactics and Strategies.
- Definition and Process of Writing (Planning, Organizing, Drafting, Revising and Publishing), Types of Writing, Elements of Effective Writing

Tasks: *Listening to speeches (ted talks, podcasts, documentaries, news) for comprehension, pronunciation, grammar and vocabulary*

Tasks: *Classroom activities on extempore, presentation, role play, introducing yourself*

Tasks: *Reading of newspaper, short stories & poems individually and in groups*

Tasks: *Paragraph writing on (hobbies, likes, dislike, images), reports, notices*

Tasks: *Note taking and note making while listening and reading*

UNIT-IV

- **Presentation and Writing Skills**

- Preparing PowerPoint Presentations, Presenting Papers, Group Discussions and Debates, preparing for and Facing Job Interviews

Tasks: *PowerPoint Presentations ------ Classroom/(Lab)*

Tasks: *Paper & oral presentations----- Classroom/(Lab)*

Tasks: *Group discussions & Debates---Classroom/(Lab)*

Tasks: *Mock interviews ------Classroom/(Lab)*

- Preparing Cover Letters, Preparing CVs/Resumes, Writing Different Types of Applications/Letters, Writing E-mails, Writing Messages, Writing Different Types of Reports,

Tasks: *Writing cover letters*

Tasks: *Writing a CV/resume*

Tasks: *Writing applications/letters (Job applications, complaints, apologies, enquiries, requests, etc.)*

Tasks: *Writing brief messages (WhatsApp, SMS, Chats, etc.)*

Tasks: *Writing reports*

Tasks: Writing emails

Course Outcomes:

At the end of the course the learner will be able to:

- Understand and apply the basics of English grammar in oral and written communication.
- Develop verbal and non-verbal communication skills for effective oral communication.
- Develop listening, speaking, reading and writing ability for their professional, academic and personal life.

Books Recommended:

1. *Michael Swan, Practical English Usage, OUP, 1995.*
2. *Wood F.T. Remedial English Grammar, Macmillan, 2007.*
3. *William Zinsser, On Writing Well, Harper Resource Book, 2001.*
4. *Liz Hamp-Lyons and Ben Heasly, Study Writing, Cambridge University Press, 2006.*
5. *Sanjay Kumar and Pushp Lata, Communication Skills, Oxford University Press, 2011.*
6. *Exercises in Spoken English, Parts I-III, CIEFL, Hyderabad, Oxford University Press*.

Course Code: MEC117F						Course Title: Engineering Graphics & Design				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
0	0	2	0	2	4	30	20	50	0	100

Course Objectives:

• To develop graphic skills for representation of concepts, ideas and design of engineering products.

• To provide an overview of computer graphics, customization and drawing using CAD.

- **Module I**

Introduction to Conventional Drawing: Importance of Engineering Drawing, drawing instruments and materials, B.I.S. and ISO Conventions, Dimensioning & Tolerances, First angle and third angle projection method.

Projection of Points, Lines and Planes: Projection of points in different quadrants. Orthographic Projection of Straight Line parallel to one plane and inclined to the other plane– Straight Line inclined to both the planes–True Length and inclination of lines with reference planes–Traces of line–Projection of Planes, projection of planes with its inclination with two reference planes.

- **Module II**

Projection of Solids and Sections of Solids: Classifications of Solids, Projections of right and regular solids, Section plane perpendicular to one plane and parallel to other, Section plane inclined to one plane and perpendicular to another plane.

- **Module III**

Orthographic and Isometric Projections: 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.

- **Module IV**

Introduction to CAD: Introduction to Computer Aided Drafting (CAD), Reasons for implementing CAD, Applications of CAD, Benefits/limitations of CAD, Hardware of CAD

system, Types of CAD software, the Menu System, Toolbars, Standard, Object Properties, Dialog boxes and windows, Shortcut menus, Different commands used in CAD.

1. Exercise on CAD software for projection of lines with reference to different planes
2. Exercise on CAD software for projection of planes with its inclination with two reference planes.
3. Exercise on CAD software for projection of solids with reference to different planes.
4. Exercise on CAD software for Section plane perpendicular to one plane and parallel to other.
5. Exercise on CAD software for Section plane inclined to one plane and perpendicular to another plane.

Course Outcomes:

- Perform freehand sketching of basic geometrical constructions and multiple views of objects.
- Draw projections and solids and development of surfaces.

Books Recommended:

1. *Gill P. S., Engineering Drawing, S. K. Kataria and sons.*
2. *Bhatt N. D., Engineering Drawing, Charotar Book Stall.*
3. *James D. Bethune, Engineering Graphics with Auto CAD, Pearson Education.*

Reference Books:

1. *Shah M. B., Rana B. C., Engineering Drawing and Computer Graphics, Pearson Education.*
2. *Agrawal B., Agrawal C. M., Engineering Graphics, TMH Publication*.

SEMESTER-II

Course Code: DFT162C						Course Title: Fundamentals of Food Preservation and Processing				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	1	1	0	4	5	25	10	35	30	100

Course Objectives:

- To provide a general understanding of the concept of food preservation, processing and its historical background. Preservation of food using heat treatment method and Introduction to basic thermal processing.
- Awareness regarding low temperature preservation
- Awareness regarding drying, dehydration and concentration. Know-how of Bio-preservatives comprising organic acids and antibiotics.
- Basic understanding of advanced processing techniques with accent on principles, mechanism of action and impact on food attributes.

Unit-I: Principles and Methods of Food Preservation (Conventional Methods): Introduction and Historical Development of Food Preservation. Principles and objectives of food processing. Preservation by mild and severe heat treatment: Pasteurization, blanching, sterilization and canning. Spoilage in canning. Thermal death time, thermal death curve, D, z and F value, 12-D concept, relationship between D and K, spoilage probability, commercial sterility.

Unit-II: Preservation by low temperature: Chilling, refrigeration and freezing. Methods of freezing, freezing curve, requirement for refrigerated storage, changes during refrigeration.

Unit III: Preservation by Drying: dehydration, drying curve, Mechanism and methods of drying- air drying, sun drying, tunnel drying, cabinet dryer, spray drying, fluidized bed dryer, drum dryer and freeze drying. Intermediate and high moisture foods. Preservation by food additives.

Unit IV: Principles and Methods of Food Preservation (Modern & Non-Thermal Techniques): Irradiation: types, dose, mechanism, and applications Microwave heating-Properties, mechanism, microwave generator- Magnetron, and microwave food application. Introduction to hydrostatic pressure technology, ohmic heating and extrusion cooking.

Course Outcomes:

- Have the basic understanding of concepts of Food Preservation and Processing. Comprehension of principles and equipment used in thermal processing.
- Comprehension of techniques of Low Temperature Preservation using refrigeration and freezing technology
- Understanding the phenomena of Drying and Dehydration with stress on varied techniques, principles and equipment and also the Knowledge regarding bio preservatives, antibiotics and organic acids, their efficacy as preservatives.

Basic understanding of advanced processing techniques, acquaintance regarding principles, equipment and food implication

Books Recommended:

1. *P.J. Fellows. Food Processing Technology: Principles and Practice. 5th Edition, Woodhead Publishing (Elsevier), 2023.*
2. *M. Shafiur Rahman (Ed.). Handbook of Food Preservation. 3rd Edition, CRC Press, Taylor & Francis, 2020.*
3. *R. Paul Singh and Dennis R. Heldman. Introduction to Food Engineering. 6th Edition, Academic Press (Elsevier), 2024.*
4. *Norman N. Potter and Joseph H. Hotchkiss. Food Science. 5th Edition, Springer, 1995.*
5. *A.M. Desrosier and J.N. Desrosier. The Technology of Food Preservation. 4th Edition, CBS Publishers & Distributors.*

Practicals

1. To study the efficacy of pasteurization
2. To study enzyme inactivation in vegetables before preservation.
3. To study sterilization of food containers/equipment.
4. To study can defects and reformation techniques.
5. To preserve foods by canning.
6. To study moisture removal using drying.
7. To detect common preservatives used in foods.
8. To study extrusion processing for snack preparation.
9. To study components and working of refrigeration system.
10. To study the D, Z and F value

Course Code: DFT163C						Course Title: Fluid Mechanics				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
3	0	1	0	4	5	25	10	35	30	100

Course Objectives:

- To introduce the students to the important engineering properties of fluids.
- To describe the behaviour of static and moving fluids under different conditions.
- To explain the measurement of fluid flow and different flow measuring apparatus.

UNIT I: Properties of fluids: Density, Viscosity, Specific weight, Specific Volume, Specific gravity. Thermodynamic properties: Compressibility, Bulk modulus, Surface tension, and Capillarity. Pressure and Its Measurement: Fluid pressure at a point, Application of Pascal's law, Pressure variation in a fluid at rest, Absolute, Gauge, Atmospheric, and vacuum pressures, Measurement of pressure, Simple and Differential manometers.

UNIT II: Application of Forces: Hydrostatic forces on surfaces- Total pressure and centre of pressure- Vertical plane surface submerged in liquid- Horizontal plane surface submerged in liquid- Inclined plane surface submerged in liquid- curved surface submerged in liquid. Archimedes' Principle, Buoyancy, Application in fluid foods.

UNIT III: Kinematics of flow: Types of fluid flow, Rate of flow, continuity equation, continuity equation in three dimensions, velocity and acceleration, velocity potential function, and stream function. Dynamics of Flow: Equations of motion, Euler's equation of motion. Bernoulli's equation and its Practical applications, the Momentum equation.

UNIT IV: Flow & Flow Measurements: flow losses in pipes, Darcy equation, minor head losses in pipes and pipe fittings. Venturi meter, orifice meter, and rotameter. Pumps: types of pumps & characteristics. Fans, blowers & compressors.

Course Outcomes:

- Understand the various important fluid properties and classification of fluids.
- Understand the flow behaviour of fluids in rest and movement.
- Comprehend the basics of fluid flow measurement and principle of measuring devices.

Books Recommended:

1. *Kumar D.S, (2004). Fluid Mechanics and Fluid Power Engineering by Kataria& sons.*
2. *Bansal R.K (2005). A textbook of Fluid Mechanics & Hydraulic Machines, Laxmi Publication (P) Ltd.*

Practicals

1. Calibrate the given rotameter.
2. Observe various pressure measurement devices.
3. Study the transition from laminar to turbulent flow and determine the Reynolds number for a flow through a pipe.
4. Determine the co-efficient of discharge through venturi meter and orifice meter.
5. Determine the hydrostatic thrust acting on a plane immersed in water.
6. Determine the head loss in a pipeline due to sudden expansion, sudden contraction and bends in a pipe.
7. Study the flow through a variable area duct and verify Bernoulli's energy equation.
8. To verify Stoke's law and to study the variation of the drag co-efficient with Reynolds number (Re) for sphere.
9. Determine the losses due to friction in pipes.
10. Study of pressure drop in a packed bed.
11. Study centrifugal pump characteristics.

Course Code: DFT164C						Course Title: Food Chemistry				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
3	0	1	0	4	5	25	10	35	30	100

Course Objectives

- To impart foundational knowledge of composition, structure, and chemical behaviour of major food components
- To develop an understanding of key physical and chemical properties of food macromolecules and their transformations during processing
- To train students in essential analytical techniques for evaluating food components by conducting laboratory experiments

UNIT I Introduction - importance of food chemistry. Composition of food. Physio-chemical and nutritional changes occurring during food processing treatment. Pigments: structure and their role in foods

UNIT II Carbohydrate: functional properties of sugars and polysaccharides in foods, chemical reactions of carbohydrates– Gel Formation, Hydrolysis, Enolization, Mutarotation, Dehydration, Browning reactions. Starch- structure, gelatinization and retrogradation of starch. Structure and functional properties of Gums, pectin, pentosans, cellulose dietary fibre and β–glucan.

UNIT III Lipids: physical characteristics of lipids (melting, softening, specific gravity, refractive index smoke, flash and fire point, turbidity point), chemical properties of fats (Reichert Meisel value, polenske value, iodine value, peroxide value, saponification value), Edible fats and oils, Changes in fats and oils-rancidity, lipolysis, flavour reversion. Auto-oxidation and its prevention, Technology of edible fats and oils-Refining, Hydrogenation and Interesterification.

UNIT IV Proteins: Common Food proteins, Functional properties of Proteins, Denaturation, renaturation, Gelation, and Hydrolysis of proteins Enzymes: Introduction, classification, General characteristics, Enzymes in food processing, Industrial uses of Enzymes, Immobilized enzymes Nomenclature, Definition, mechanism of enzyme action, factors affecting enzyme action, Enzyme Kinetics and inhibition, enzymes important in foods.

Course Outcomes

- Explain the composition and chemical reactions of major food components (carbohydrates, lipids, proteins, and enzymes), and relate them to their functional roles in food systems.
- Analyse and interpret the physicochemical changes in food constituents during processing, such as gelatinization, browning, rancidity, and enzymatic modifications.
- Demonstrate proficiency in standard laboratory methods for qualitative and quantitative analysis of food components, including moisture, ash, sugars, starch, protein, fat, and fiber content.

Books Recommended:

1. *Fennema, O.R. Food Chemistry, 4thEdn. CRC Press USA.*
2. *Meyer, L.H. Food Chemistry, CBS Publishers and Distributors, New Delhi.*
3. *Nelson and Cox, Lehninger Principles of Biochemistry.*
4. *Richardson and finely. Chemical Changes in Food during Processing. CBS Publishers and Distributors, New Delhi*.

Practicals

1. General Introduction to food chemistry lab-Cleaning and handling of glassware, use and handling of chemicals, safety in the lab.
2. Preparation and Standardization of different reagents
3. Determination of moisture on dry matter basis in a given sample
4. Determination of ash content in a given sample.
5. Preparation and Standardization of different reagents.
6. Quantitative tests for monosaccharides and disaccharides.
7. Determination of reducing sugars by Nelson-Somogyi Method
8. Estimation of sugars by Lane and Eyon method.
9. Quantitative determination of starch in cereal grains.
10. Determination of Amylose and amylopectin.
11. Determination of protein by Kjeldahl method.
12. Saponification value, Iodine value.
13. Acid value, peroxide value.
14. Estimation of crude fat content by Soxhlet method.
15. Determination of crude fiber.

Course Code: DFT165F						Course Title: Nutritional Biochemistry				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	0	0	2	2	15	10	25	0	50

Course Objectives:

- Understand the fundamental concepts of food, nutrition, energy metabolism, anthropometry, and nutritional assessment.
- Explain the physiological functions and nutritional significance of carbohydrates, proteins, lipids, vitamins, and minerals in human health.
- Develop an understanding of balanced diets, nutritional requirements across different age groups, and nutrition-related disorders.
- Acquire knowledge of macro- and micronutrients, their dietary sources, functions, recommended requirements, deficiency diseases, toxicity, and their role in maintaining optimal health

UNIT-1

Concepts of food and nutrition. Basic food groups - energy yielding, body building and functional foods. Units of energy. Calorific and nutritive value of foods. Measurement of Calories by bomb calorimeter. Basal metabolic rate (BMR) - definition, determination of BMR and factors affecting BMR. Respiratory quotient (RQ) of nutrients and factors affecting the RQ. SDA - definition and determination - Anthropometric measurement and indices – Height, Weight, chest and waist circumference MI.

UNIT-II

Physiological role and nutritional significance of carbohydrates, lipids and protein. Evaluation of proteins by nitrogen balance method - Biological value of proteins - Digestibility coefficient, biological value, Protein Energy Ratio and Net Protein Utilization. Protein energy malnutrition – Kwashiorkor and Marasmus.

UNIT-III

Balanced diet, example of low and high-cost balanced diet - for infants, children, adolescents, adults and elderly people. ICMR classification of five food groups and its significance food pyramid. Signs of obesity (types, prevention and treatment)

UNIT-IV

Minerals - sources, requirement, physiological function, deficiency and toxicity of calcium, sodium, potassium, iron, magnesium, chromium. Cobalt, copper, manganese, molybdenum,

selenium, iodine and zinc. Vitamins - definition and types of vitamins, sources, requirement, biological functions, deficiency symptoms of thiamine, riboflavin, niacin, pyridoxine, pantothenic acid, folic acid, biotin, cyanocobalamin, vitamins C, A, D, E and K. Hypervitaminosis.

Course outcomes

- Explain the basic concepts of food and nutrition, energy metabolism, basal metabolic rate (BMR), respiratory quotient (RQ), specific dynamic action (SDA), and anthropometric measurements used in nutritional assessment.
- Describe the physiological functions and nutritional significance of carbohydrates, proteins, and lipids, and evaluate protein quality using biological and nutritional indices.
- Plan balanced diets for different age groups based on ICMR dietary guidelines and assess common nutritional disorders such as protein-energy malnutrition and obesity.
- Discuss the dietary sources, physiological functions, recommended requirements, deficiency symptoms, and toxicity of essential vitamins and minerals, and relate their importance to human health and nutrition.

***Books for Study**:*

1. M. Swaminadhan (1995) Principles of Nutrition and Dietetics.Bappco.

2. Aravind Kumar (1999). Human rights and social movements, Anmol publishers.

3. Margaret Mc Williams (2012). Food Fundamentals (10th ed) Prentice Hall

4. Tom Brody (1998). Nutritional Biochemistry (2nded), Academic press, USA

Reference:

***1.** Garrow, JS, James WPT and Ralph A (2000). Human nutrition and dietetics (10th ed) Churchill Livingstone.*

2. Andreas M. Papas (1998). Antioxidant Status, Diet, Nutrition, and Health (1st ed) CRC press. 3. Human Rights – Piarey Lal Mehta, Neena Verma, P I Mehta (1999). 4. Human rights and social movements - Aravind Kumar (ed) (1999)

Course Code: DFT166G						Course Title: Manufacturing Process Laboratory				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
0	0	2	0	2	4	15	10	0	25	50

Course Objectives

- To provide exposure to the students with hands on experience on various basic engineering practices in mechanical engineering.

Practicals

1. Study of Machine Tools: Lathe, Shaper, Slotter, and Planer – Types of cutting tools and relative motion between tool and workpiece.
2. Study of Machine Tools: Grinding, Milling, and Drilling – Tool types and kinematic systems.
3. Job fabrication using Lathe machine (turning and facing).
4. Job fabrication on Shaper/Slotter machine (keyway or slot cutting).
5. Job fabrication on Milling machine (face and side milling operations).
6. Job fabrication on Drilling machine (spot and through holes).
7. Identification and measurement of single- and multi-point cutting tools; model making using plastic/wood/rubber.
8. Overview of primary manufacturing processes: casting, forming, machining, joining – applications, advantages, and industrial relevance.
9. Study and demonstration of Shielded Metal Arc Welding (SMAW) / Manual Metal Arc Welding (MMAW).
10. Fabrication of Lap and T-joints using arc welding under variable parameters.
11. Study of Gas Tungsten Arc Welding (TIG) and Gas Metal Arc Welding (MIG) processes.
12. Fabrication of Butt Joint using TIG welding at variable current settings.
13. Fabrication of Butt Joint using MIG welding at variable current settings.
14. Friction welding of 16 mm mild steel rods at varying rotational speeds.
15. Fabrication of wooden components using carpentry tools and joints

Course Outcomes

•Use welding equipment to join the structures, carry out the basic machining operations

Books Recommended

1. S.K. Hajra Choudhury, A.K. Hajra Choudhury & Nirjhar Roy (2010). *Elements of Workshop Technology, Vol. I*. Media Promoters & Publishers Pvt. Ltd., Mumbai.
2. S.K. Hajra Choudhury, A.K. Hajra Choudhury & Nirjhar Roy (2010). *Elements of Workshop Technology, Vol. II*. Media Promoters & Publishers Pvt. Ltd., Mumbai.
3. P.N. Rao (2018). *Manufacturing Technology, Vol. I* (5th ed.). McGraw Hill Education, New Delhi.
4. P.N. Rao (2018). *Manufacturing Technology, Vol. II* (5th ed.). McGraw Hill Education, New Delhi.
5. R.K. Jain (2014). *Production Technology*. Khanna Publishers, New Delhi.
6. O.P. Khanna (2018). *Welding Technology*. Dhanpat Rai Publications, New Delhi.
7. Serope Kalpakjian & Steven R. Schmid (2018). *Manufacturing Engineering and Technology* (8th ed.). Pearson Education.
8. Amitabha Ghosh & A.K. Mallik (2017). *Manufacturing Science* (3rd ed.). East-West Press Pvt. Ltd., New Delhi.
9. R.S. Parmar (2015). *Welding Engineering and Technology*. Khanna Publishers, New Delhi.
10. W.A.J. Chapman (2013). *Workshop Technology, Part II*. CBS Publishers & Distributors, New Delhi

Course Code: MTH161F						Course Title: Engineering Mathematics-II				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
3	0	0	0	3	3	30	20	50	0	100

Course Objectives:

- To understand the different concepts involved in statistical analysis.
- To provide an insight of probability and numerical analysis techniques.

UNIT I: Linear Algebra

Elementary row and column transformations; Rank of a matrix, Reduction to normal form and inverse using Gauss-Jordan method, Consistency and solution of linear systems of equations Eigen values and Eigen vectors; Cayley-Hamilton Theorem, Diagonalization of matrices; Linear and orthogonal transformations, Bilinear and quadratic forms, Limit, continuity, and derivative of functions of a complex variable, Analytic functions, Cauchy-Riemann (C-R) equations, harmonic and conjugate functions

UNIT II: Numerical Analysis

Finite differences, Newton's forward and backward interpolation formulae, Central difference interpolation formulae. Solution of polynomial and transcendental equations – bisection, Newton – Raphson and regula – falsi methods. Trapezoidal and Simpsons 1/3 rules for numerical integration.

UNIT III: Descriptive Statistics

Introduction to statistics and its engineering relevance, Diagrammatic and graphical representation of data, Measures of Central Tendency, Mean, Median, Mode, Geometric Mean, Harmonic Mean. Measures of Dispersion, Range, Mean deviation, Quartile deviation, Standard deviation, Variance, Coefficient of variation. Skewness and Kurtosis. Karl Pearson's and Spearman's correlation coefficients. Regression Analysis. Axioms and basic rules of probability, Conditional probability and Bayes' theorem, Random variables: Probability Distributions - Discrete: Binomial, Poisson, Continuous: Normal, Exponential (optional).

UNIT IV: ANOVA, Experimental Design and Sampling Techniques

Principles of experimental design (randomization, replication, blocking). Sampling methods for food matrices (random, stratified, systematic). Completely Randomized Design (CRD),

Randomized Complete Block Design (RCBD). One-way and two-way ANOVA. Assumptions of ANOVA (normality, homogeneity of variance), interpretation of ANOVA tables for food technology applications.

Course Outcomes:

- Implement the mathematical solution to problems of engineering and technology.

Books Recommended:

1. *James Stewart, Calculus, Early Transcendentals.*
2. *Hari Arora, A Textbook of Engineering Mathematics Vol I, II. (Calculus and Linear Algebra).*
3. *N. P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.*
4. *D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.*
5. *Advanced Engineering Mathematics by Jain, R.K. and Iyengar SRK, Narosa, 2000*

SEMESTER-III

Course Code: DFT211C						Course Title: Post-Harvest Technology of Fruits and Vegetables				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
3	0	1	0	4	5	25	10	35	30	100

Course Objectives:

- To provide a comprehensive understanding of post-harvest physiological and biochemical changes in fruits and vegetables
- To familiarize students with ripening processes, ethylene regulation, and post-harvest handling techniques.
- To introduce modern storage technologies and sustainable practices to minimize post-harvest losses and maintain produce quality

UNIT I

Effect of climate change on post-harvest quality and losses. Importance and role of post-harvest technology. Present status of post-harvest technology in India. Post-harvest changes in fruits and vegetables. Composition, nutritive value, and factors affecting post-harvest losses. Factors responsible for changes in colour, texture, and flavour after harvest. Respiration and water loss: Physiology of respiration, factors affecting the rate of respiration, respiratory quotient, and calculations based on Q10. Loss of water from harvested horticultural crops. Basic introduction to sensor-based monitoring of physiological parameters (e.g., respiration, moisture loss

UNIT II

Biosynthesis of ethylene: Regulation and action on harvested fruits. Role of ethylene in fruit ripening. Controlling agents for regulating ethylene action. Use of ethylene inhibitors and commercial ripening agents (e.g., 1-MCP, ethephon). Ripening process: Fruit maturation and physiological changes. Climacteric and non-climacteric fruits. Climacteric drift: Special reference to apple and avocado. Smart packaging for ethylene control and real-time monitoring. Role of biotechnology and CRISPR in modifying ripening behavior non-ripening mutants of tomato. Non-ripening mutants of tomato" broaden to *"Ripening mutants and genetic regulation of fruit ripening.*

UNIT III

Post-harvest handling and transportation of fruits and vegetables: Importance and need. Cold chain logistics and real-time monitoring (IoT-based systems). Recent advances in sorting,

grading, and packaging automation. Digital traceability systems in supply chain (e.g., QR codes, blockchain).

Maturity indices. Method of harvesting. Perishable and durable crops. Cooling of produce. Packaging. Methods of transportation. Causes of losses: Mechanical damage. Overheating. Supply chain management of fruits and vegetables.

UNIT IV

Storage systems for fruits and vegetables. Active and intelligent packaging systems. Types of storage: Zero energy cool chamber. Low-temperature storage. Hypobaric storage. Modified atmospheric storage. Controlled atmospheric storage

Course Outcomes

1. Understand the biological and chemical processes influencing postharvest quality of fruits and vegetables.
2. Apply appropriate handling, packaging, and storage methods to extend shelf life and reduce losses.
3. Evaluate post-harvest technologies and recommend suitable solutions for commercial and small-scale supply chain

Books Recommended:

1. *Wills, R.B. (2002). Post-harvest: An Introduction to the physiology and handling of fruits and vegetables, CBS Publishers & Distributors, New Delhi.*
2. *Kadar AA.1992. Post-harvest Technology of Horticultural Crops. 2nd Ed. University of California.*
3. *Pantastico B. 1975. Post-Harvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables. AVI Publ.*
4. *Salunkhe DK, Bolia HR & Reddy NR. 1991. Storage, Processing and Nutritional Quality of Fruits and Vegetables. Vol. I. Fruits and Vegetables. CRC.*
5. *Thompson AK. 1995. Post-Harvest Technology of Fruits and Vegetables. Blackwell Sci.*
6. *Lloyd, A. & Penizer, R (1998). Handling, transportation and storage of fruits and vegetables, AVI Publications*

Practicals

1. Evaluation of morphological features of some selected fruits and vegetables.
2. Evaluation of maturity indices of fruits and vegetables.
3. Identification of equipment and machinery used in preservation of fruits and vegetables
4. Packaging methods and types of packaging.
5. Studies on effect of post-harvest treatments for shelf-life elongation of fruits.
6. Studies on various storage systems and structures.
7. Identification of physiological disorders and spoilages in fruits and vegetables.
8. Visit to commercial packaging house and CA store.
9. Visit to fruit ripening units.
10. Study and preparation of can products
11. Visit to fruit orchard.
12. To determine the optimum temperature for storage of different fruits and vegetables

Course Code: DFT212C						Course Title: Food Microbiology				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
3	0	1	0	4	5	25	10	35	30	100

Course Objectives:

- To teach students, how to grow different types of microorganisms.
- To teach students, how the food spoilage by microorganisms can be controlled.
- To teach students, how to develop axenic cultures.
- To teach students, how to preserve microbial cultures.

UNIT I: Food and microorganisms: Food as substrate for microorganisms, Hydrogen ion concentration, moisture, water activity, oxidation reduction potential, inhibitory substances *"Nutritional requirement for growth of Bacteria, Growth media and its types"* Microbial growth and reproduction: Definition of growth, growth curve, growth rate, generation time, measurement of growth, effect of environmental factors such as temperature, moisture, salt, pH, and radiation on growth. Control of micro-organisms by physical, chemical and biological agents, *"Bacteriological filters – Uses and applications"* Thermal death time, Z, F and D values.

UNIT II: Microbial techniques: Isolation and development of axenic cultures, Serial dilution, spread plate method, pour plate method and streak plate method. Preservation of microbial cultures. Methods of genetic improvement: *"Selection of natural variants, Induced mutations by physical and chemical mutagenic agents, Recombinant DNA technology".*

UNIT III: Food Spoilage - Microbial and biochemical aspect of food spoilage, role of bacteria, yeast and molds in food spoilage, Spoilage of cereal and cereal products, fruits and vegetables, meat and meat products, milk and milk products, fish and fish products, spoilage of egg and poultry and heated canned foods. Food intoxication and food infection, poisoning, causative microorganisms, and prevention

UNIT IV: Methods for microbial examination of foods (traditional methods). Total plate count, coliform count, yeast and mold count *"Cultivation of anaerobic microorganisms"*

Rapid methods: Antibody assay methods (Fluorescent antibody technique, radio immune assay, ELISA), Molecular methods like PCR and RT PCR.

Course Outcomes

- Understand how intrinsic and extrinsic factors (pH, water activity, redox potential, moisture, inhibitory substances) influence microbial growth in foods.
- Describe nutritional requirements, growth phases, generation time, and methods for measuring microbial growth, and evaluate environmental effects on microorganisms.
- Apply principles of microbial control using physical, chemical, and biological methods, including calculation and interpretation of thermal death parameters (D, Z, and F values).
- Perform basic microbiological techniques such as isolation, cultivation, enumeration, serial dilution, and maintenance of pure cultures.
- Compare classical and modern approaches for microbial strain improvement including selection, mutagenesis, and recombinant DNA technology.
- Analyse microbial and biochemical mechanisms responsible for spoilage in different food commodities and identify preventive strategies.
- Distinguish between food infection, intoxication, and poisoning, including causative organisms and control measures.

Books Recommended:

1. *Book of Biochemistry by Rama Rao AVSS, 1999, LK and S Publishers, Visakhapatanm, Indian.*
2. *Text Book of Biochemistry by Satyanarayan,*
3. *Dubey, R.C., and Maheshwari, D. K. (2001). A text book of microbiology, S. Chand and Co., New Delhi.*
4. *Pelczar, M. J., Chan, E. G. S. and Krieg, N.R. (2002). Microbiology 5th edition, Tata McGraw Hill and Co, New Delhi.*

Practicals

1.Enumeration of coliforms by MPN method

2. Preparation of selective and Differential media

3. Demonstration of serial dilution method and techniques of isolation and enumeration of microorganisms.

4.Assessing Sanitary quality of Contact

5. Preparation of bacterial smear.

6. Monochrome staining.

7. To stain the given bacteria by Gram's staining method.
8. To demonstrate acid fast staining.
9. To measure the size of given microorganisms by ocular micrometer.
10. Analysis of Air processing facility for microbial load
11. To determine the motility of bacteria by hanging drop method

Course Code: DFT213C						Course Title: Thermodynamics				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
3	0	0	0	3	3	30	20	50	0	100

Course Objectives

- To understand the fundamental thermodynamic principles.
- To understand the law of thermodynamics.
- To understand the different phases of pure substances.
- To familiarize students with steam and steam boilers.

UNIT I: Introduction to thermodynamics, Macroscopic and microscopic approach; thermodynamic system, surroundings and boundary; energy and its forms. Zeroth law of thermodynamics. Joules experiments, equivalence of heat and work. First law of thermodynamics. Limitations of first law. Heat effects: sensible heat; latent heat; standard heat of reaction, formation and combustion.

UNIT II: Kelvin Plank and Clausius statements of second law and their equivalence; heat pump and heat engines. Carnot cycle and Carnot heat engine, Clausius inequality, concept of entropy, entropy change during various processes. Third law of thermodynamics.

UNIT III: Volumetric properties of pure fluids: PVT behavior of pure substances, critical behavior, virial equation, compressibility factor, ideal gas. Vapor liquid equilibrium: phase rule, PT xy, P xy and T xy diagram, Raoult's Law and Henry's Law

UNIT IV: Steam generator: properties of steam, formation of steam, steam table, steam throttling. Classification of boilers, fire tube boiler, Cochran boiler, Lancashire boiler, Cornish boiler, water tube boiler, Babcock & Wilcox boiler. Guidelines for the choice of a new boiler. Essentials of a good boiler. Various boiler mountings & accessories

Course Outcomes

- Apply the understanding of the laws and application of thermodynamics.
- Define the working and essentials of different boilers.

***Books Recommended*:**

1. *Nag, P. K. (2005). Engineering Thermodynamics (3rd edition). Tata Mc Graw Hill Publishing Company Limited.*
2. *Smith, J. M., Van Ness, H. C. & Abbott, M. M., Introduction to Chemical Engineering Thermodynamics. McGraw Hill Education (India) Private Limited.*
3. *Vasandani, V.P., and Kumar, B.S. (1998). Heat Engineering, Metropolitan Book Company Pvt. Ltd., 1, Netaji Subhash Marg, New Delhi.*

Course Code: DFT214C						Course Title: Unit Operations in Food Processing				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
3	0	1	0	4	5	25	10	35	30	100

Course Objectives:

- To understand the preliminary operations involved in food processing.
- To familiarize the students with the industrial processes involving size reduction, sieving, mixing and agitation.
- To provide the students with insight of various separation and crystallization processes, their principles and equipment.

Unit-I: Introduction & Material Handling: Introduction to unit operations in food processing, Properties of food materials: size, shape, density, roundness, roundness ratio, porosity. Cleaning: definition, objective and its different methods, Grading: Sieving, separation based on size (mesh size), Types of screens: stationary screens – grizzlies, gyrating screens, vibratory screens, and effectiveness of screens. Sorting, effectiveness of sorting, machine vision sorting system. Material handling systems: types of conveyors, elevators, and pneumatic systems.

Unit-II: Size Reduction- Definition, stress-strain diagram, Theory of comminution, size reduction laws- Kick's law, Rittinger's law and Bond's Law, calculation of energy required during size reduction, size reduction equipment: Crushers – grinders, ultrafine grinders, cutters. Size enlargement equipment, Effects of size reduction on sensory characteristics and nutritive value of food.

Unit III: Mixing and Agitation in Food Processing: Objectives and importance in food processing, Difference between mixing, agitation, blending, and homogenization. Mixing mechanisms and characteristics: flow patterns in liquid and solid mixing. Equipment for mixing and agitation. Effects of mixing on food quality. Homogenization - Principle & equipment.

Unit IV: Mechanical Separation: Filtration-principle of filtration; types of filtrations, theory of filtration, filter media, filter aid, and filter cake. Equipment- filter press, rotary drum, shell & leaf filter, vacuum filter, centrifugal filter, plate and frame filter press. Ultrafiltration, membrane, reverse osmosis. Sedimentation- Stoke's law. Free and hindered settling.

Equipment for sedimentation. Crystallization, nucleation, crystal growth. Crystallisation equipment

Course Outcomes:

- Develop the understanding of material handling.
- Understand the processing of foods in terms of common unit operations like size reduction, mixing, and separation.
- Implement their computational skills in calculating the energy required in size reduction, mixing.
- Understand the construction, working and applicability of various size reduction, mixing and separation equipment

Books recommended:

1. *Sahay, K.M. and Singh. K (1998). Unit Operations of Agricultural Processing by Kalya Publishers, Ludhiana.*
2. *Mcabe W. L. and Smith J. C. (7thEdition). Unit operations of chemical engineering. Mc Graw Hill Publication.*
3. *GeanKoplis C. J. (3rd Edition). Transport processes in unit operations. Prentice Hall of India.*
4. *P. Fellows. (2000) Food processing technology. Principles and practice. Ellis Horwood England and V C H publishers Germany*
5. *Earl, P. (1994). Unit operation in Food Processing, Elsevier Science UK.*

Practicals

1. Demonstration and operation of size reduction equipment
2. Understand the operations of a plate and frame filter press
3. Understand the working of ribbon mixer.
4. Determination of the capacity of a screw conveyor and power loss for different angle of inclination.
5. Determination of thickness and diameter of objects using screw gauge
6. Measurement of linear dimensions using Vernier Caliper
7. Crushing of rock salt in the Jaw Crusher, and Determination of average size by sieving.
8. Demonstration and operation of fluidization
9. To determine and analyse the size distribution of a fixed granular solid by using a RoTap sieve Shaker.
10. Industrial Visit for grading and sorting line

Course Code: DFT215F						Course Title: Food Plant Hygiene and Sanitation				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	0	0	2	2	15	10	25	0	50

Course Objectives

By the end of this course, students will be able to:

- Understand the importance of personal hygiene, sanitary behaviour, and safe food handling practices in preventing food contamination
- Explain sanitation principles related to food processing environments, including plant layout, equipment hygiene, and sanitary design.
- Develop knowledge of cleaning and disinfection methods, sanitizers, and microbial indicators used to evaluate hygienic conditions.
- Understand sanitation requirements across different food industries such as fruit and vegetable, dairy, cereal, meat, poultry, and egg processing.
- Analyse sanitation aspects of storage, transportation, pest control, and water quality management in food systems.
- Understand waste management strategies, effluent treatment processes, and environmental sanitation practices in food industries.
- Evaluate by-product utilization and waste valorisation approaches for sustainable food processing operations.
- Recognize the role of sanitation programs in food safety assurance and regulatory compliance.

UNIT I: Introduction: Importance of personal hygiene of food handlers – habits, clothing, illness, and education. Food safety practices in rural and urban food preparation. Personal hygiene and food handling behaviour. Sanitary aspects of buildings, layout of food processing plants and equipment hygiene. Methods to establish and maintain sanitary practices in food handling and processing environments.

UNIT II: Industrial hygiene: Principles and methods of cleaning and disinfection – use of heat and chemicals, chemical tests for sanitizer strength. Cleaning agents and disinfectants.

Microbial contamination and control. Microorganisms as indicators of sanitary quality. Sanitation requirements in fruit and vegetable, dairy, cereals, meat, egg and poultry industries

UNIT III: Waste disposal and sanitation: Food storage and transport sanitation, pest and rodent control. Water sanitation – sources, quality, usage in food plants. Water purification, disinfection and contamination prevention. Effluent treatment plant (ETP) layout and control techniques.

UNIT IV: By-products utilization in dairy, egg, poultry, and meat processing industries. Waste types – solid and liquid; characterization and treatments. Wastewater and solid waste management: primary, secondary, and tertiary (advanced) treatments – physical, chemical, biological, aerobic and anaerobic methods. Sanitary evaluation of food plants and role of sanitation in food safety assurance.

Course Outcomes

- After successful completion of this course, students will be able to:
- Demonstrate knowledge of personal hygiene standards and safe food handling practices applicable to food preparation and processing environments.
- Assess sanitary design and hygiene conditions of food processing facilities and recommend corrective measures.
- Apply principles of cleaning, disinfection, and sanitizer testing to maintain hygienic conditions in food industries.
- Identify sources of microbial contamination and evaluate microbial indicators used to monitor sanitary quality.
- Design sanitation protocols for different food sectors including dairy, meat, cereals, fruits, vegetables, poultry, and egg industries.
- Evaluate sanitation practices related to food storage, transport, pest control, and water treatment systems.
- Analyze industrial waste streams and recommend suitable treatment methods including physical, chemical, biological, aerobic, and anaerobic processes.
- Explain the structure and function of effluent treatment plants and their role in pollution control.
- Assess by-product utilization strategies and waste management systems for sustainable food processing.
- Interpret sanitation audit results and justify sanitation programs as a critical component of food safety assurance systems.

Course Code: DFT216F						Course Title: Technology of Milk and Milk Products				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	1	1	4	5	25	10	35	30	100

Course Objectives

- To provide students with comprehensive knowledge of milk composition, properties, processing and preservation techniques.
- To develop understanding of technologies involved in manufacture of concentrated, dried, fermented, frozen and traditional dairy products.
- To impart knowledge regarding quality changes, hygiene and sanitation in dairy industries.
- To familiarize students with dairy standards, good manufacturing practices and food safety systems in dairy processing.

UNIT I: Overview of dairy industry in India. Definition, composition, physical structure and nutritional significance of milk. Factors affecting milk composition and milk secretion. Physical and physicochemical properties of milk: acidity and pH, redox potential, density and specific gravity, optical properties, viscosity and rheology of milk. Production, collection, procurement, reception and storage of milk in dairy processing plants

UNIT II: Principles and operations involved in milk processing. Homogenization: objectives, operation of homogenizer, factors affecting fat globule size and homogenization efficiency. Pasteurization: definition, methods and operation of HTST pasteurizer. UHT processing and sterilization of milk. Standardization of milk and cream separation. Basic principles of concentration and drying of milk.

UNIT III Manufacture, processing, physicochemical properties, microbiology and nutritive value of concentrated and dried milk products including evaporated milk, sweetened condensed milk, skim milk powder and whole milk powder. Technology and quality aspects of cream, butter, margarine and dairy spreads. Processing and varieties of cheese. Frozen dairy products: ice cream, role of ingredients and defects in ice cream. Manufacture and quality aspects of traditional Indian dairy products and infant foods

UNIT IV: Concepts of hygiene and sanitation in dairy industry. Cleaning and disinfection in dairy plants. CIP and COP systems, deposit formation and cleaning schedules. Good hygienic and manufacturing practices in dairy processing. HACCP in dairy industry.

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Course Outcomes

- Understand the structure, composition, properties and microbiology of milk.
- Explain principles and operations involved in processing and preservation of milk and dairy products.
- Acquire knowledge regarding manufacture, quality evaluation and storage of various dairy products.
- Apply concepts of hygiene, sanitation, quality assurance and food safety systems in dairy industries.

Books Recommended:

1. *Smit, Gerrit (2003). Dairy Processing: Improving Quality, Woodhead Publishing Ltd., England.*
2. *De, Sukumar (1991). Outlines of Dairy Technology, Oxford University Press, Delhi.*
3. *Varnam, A.H. and Sutherland, J.P. (1994). Milk and Milk Products, Chapman and Hall, New York, USA.*
4. *Walstra, P., Geurts, T.J., Noomen, A., Jellema, A. and Boekel, M.A.J.S. (1999). Dairy Technology: Principles of Milk Properties and Processes, Marcel Dekker Inc., New York*

Practicals:

1. Platform tests (Acidity, COB and Alcohol test).
2. Determination of specific gravity by lactometer.
3. Determination of liquid milk fat by Gerber's method.
4. Separation and standardization of milk.
5. Testing efficiency of pasteurization of milk.
6. Determination of common adulterants and preservatives in milk.
7. Determination of SNF percentage and TS percentage of milk with lactometer.

8. Methylene blue reduction test of milk.
9. Preparation of flavoured milk.
10. Cream separation.
11. Preparation of ice cream.
12. Preparation of indigenous milk products like paneer, channa, and kaladhi.

Visit to different milk processing plants

SEMESTER-IV

Course Code: DFT261C						Course Title: Fruit and Vegetable Technology				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	1	1	4	5	25	10	35	30	100

Course Objectives:

- Understand the status, scope, and technological developments in fruit and vegetable production and processing at national and global levels.
- Comprehend thermal and non-thermal processing techniques—including infrared blanching, ultrasound processing, freezing, drying, and hurdle technology—for preservation of fruits and vegetables.
- Develop knowledge of formulation, processing, standards, and quality control of fruit-based products such as juices, pickles, jams, jellies, marmalades, preserves, and candied products.
- Explain enzymatic reactions in fruits and vegetables, especially enzymatic browning, and evaluate methods for their control.
- Understand the role of preservatives, natural antimicrobials, and clean-label strategies in enhancing shelf life and safety of fruit and vegetable products.

UNIT I

Introduction to Processing Technologies: Indian and global scenario of Fruit and Vegetable production and processing. Principles of post-harvest handling to reduce losses. Recent advancements in sorting, grading, and minimal processing techniques. Infrared Blanching, Ultrasound processing. Heat processing of fruits and vegetables: principles and considerations and the defects thereof. Nutritional importance and bioactive potential of fruits and vegetables. Introduction to hurdle technology and its relevance in fruit and vegetable preservation.

UNIT II

Processing and Preservation of Fruit Products: Definition, formulation, preparation and FPO/FSSAI/BIS standards of fruit juices, tomato products, pickles, and their spoilage. Jams, Jellies and Marmalades: Preparation of fruits, processing steps involving pectin, its extraction and requirement, theories of jelly formation. Preserve, candied and crystallized fruits and

vegetables. Incorporation of functional ingredients (e.g., prebiotics, plant extracts) in fruit-based products. Quality control parameters and sensory evaluation techniques for fruit products.

UNIT III

Freezing, Drying, and Innovative Packaging: General methods of freezing of fruits and vegetables, NIR freezing, cryogenic freezing, packaging and storage of frozen food. Changes during storage of frozen products. Cold Plasma, Low temperature conditioning technology of fruits and vegetables, Refractance window drying of fruits and vegetables. Dehydration of fruits and vegetables by osmo-dehydration and freeze drying. Examples of dried and frozen products. Technology of fresh-cut fruits and vegetables. Packaging innovations: edible coatings, MAP and smart packaging systems

UNIT IV

Enzymes and their Applications in fruit and vegetable technology. Enzymatic browning and methods for its control. Use of preservatives in fruit and vegetable products and their mode of action. Natural antimicrobials and clean-label preservation approaches.

Course Outcomes:

- Explain the current status and technological trends in fruit and vegetable processing industries at national and global levels.
- Develop formulations and processing protocols for fruit-based products including juices, pickles, jams, jellies, marmalades, preserves, and candied products in compliance with regulatory standards.
- Evaluate the role of pectin chemistry, gel formation mechanisms, and functional ingredient incorporation in product quality and stability.
- Assess biochemical and physicochemical changes occurring during storage of frozen and dried products and recommend appropriate control strategies.
- Explain enzymatic reactions in fruits and vegetables, particularly enzymatic browning, and design suitable control measures using processing and additives.
- Evaluate the mechanisms of action of chemical preservatives, natural antimicrobials, and clean-label preservation techniques for extending shelf life and ensuring safety.

Books Recommended:

1. Girdhari Lal & Sidappa, (1996). Fruits and vegetable preservation, ICAR (New Delhi).

2. Srivastava, (2000). Preservation of fruits and vegetable, IBD Co. Lucknow.

3. Khader Vijaya, (2000). Preservation of fruits and vegetable, Kalyani Publication.

4. Verma. L. R. & Joshi. V. K., (1994). Post-harvest technology of fruits and vegetables – Handling, Processing, Fermentation and Waste management

Practicals

1. Determination of TSS, and acidity of fruit Juices.
2. Determination of Vitamin C content by titration method.
3. Determination of Beta carotene content of juices by HPLC and spectrophotometric method.
4. Preparation of jams and determination of its sugar content.
5. Preparation of fruit products by using Pearson Square method.
6. Preparation of pickles and its quality assessment.
7. Adequacy of blanching using guaicol and hydrogen peroxide.
8. Preparation of tomato puree, paste and ketchup
9. Organoleptic evaluation of fruit and vegetable products prepared in class practicals.
10. Visit to a local fruit processing plant.

Course Code: DFT262C						Course Title: Food Biotechnology				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	1	0	3	4	25	10	35	30	100

Course Objectives

- Understand the principles, types, and classification of fermentation processes used in food and bioprocess industries.
- Develop knowledge of fermentation systems, fermenter design, instrumentation, sterilization, and inoculum preparation.
- Understand microbial growth kinetics, product formation rates, and factors influencing fermentation efficiency.
- Learn downstream processing techniques for recovery and purification of intracellular and extracellular products.
- Analyze biomass production processes including single cell protein and biofuel production from microorganisms.
- Develop awareness of industrial biotechnology applications such as production of pigments (e.g., beta-carotene) from microbial sources.

UNIT I

Fermentation- Definition, types, advantages and disadvantages. Classification of food fermentations- Alcoholic, lactic and acetic acid fermentations. Fermentation systems (batch and continuous systems), fermenter design, instrumentation and control. Fermentation raw materials. Media sterilization, antifoam agents, foam sensing, control device, Inoculum development.

UNIT II

Microbial production of various primary and secondary metabolites- Alcohol, amino acids (glutamic acid and lysine), organic acids (citric, acetic and lactic acid), enzymes (pepsin, amylase). Rate of microbial growth and death, Rate of product formation.

UNIT III

Downstream processing of extracellular and intracellular products, cell rupture- introduction, separation process with examples. Immobilised enzyme technology- methods of immobilization and applications.

UNIT IV

Introduction, Role of Different Substrates in Bioethanol Production from molases and industrial wastes, Methods of Ethanol Production from molasses and industrial wastes, Pretreatment of Molasses, Role of Microbes in ethanol production, Quality parameters

Biomass production: Single Cell proteins from algae using open ponds, Biofuel production from fresh water and marine microorganisms. Production of beta carotene from Dunaliela.

Course Outcomes

- Explain different fermentation types, systems, and classifications and evaluate their industrial significance.
- Describe industrial production processes for metabolites such as alcohol, amino acids, organic acids, and enzymes
- Apply principles of downstream processing for separation, recovery, and purification of bioproducts.
- Evaluate cell disruption techniques and select appropriate separation methods for intracellular and extracellular products.
- Assess biomass production systems including single cell protein and microbial biofuel production technologies.
- Describe industrial production of value-added microbial products such as beta-carotene and evaluate their applications.

Books Recommended:

1. *Prescott & Dunn (1992), Industrial Microbiology, 4th Edition. CBSPublishers, New Delhi.*
2. *Ward, O. P. (1989). Fermentation Biotechnology- Principles, Process and Products. Prentice Hall Publishers, New Jersey.*
3. *Stansbury, P.F., Whitaker, A and Hall, S. J. (1995). Principles of Fermentation Technology, Pergamon Press, Oxford.*
4. *Young, M. Y. (1984). Comprehensive Biotechnology (Vol.1-4) , Pergamon Press Oxford.*

Practicals

1. To study different parts of a fermenter
2. To study the operation /working of a fermenter
3. To study media formulation and sterilization of a fermentation process
4. Production of Alcohol.
5. Isolation and screening of microorganisms for antibiotic production (crowded plate technique).
6. Preparation of Yoghurt.
7. Visit to fermentation plant.

Course Code: DFT263C						Course Title: Food Process Engineering				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
3	0	1	0	4	5	25	10	35	30	100

Course Objectives

- To introduce the students to the basics of food process engineering.
- To teach the principle and applications of drying and thermal processing in food processing.
- To teach the basic principle of refrigeration and freezing of food materials.
- To describe the basic concepts of extrusion process and its application in food processing.

UNIT I:

Principles of thermal processing and microbial inactivation kinetics. Thermal resistance of microorganisms and spores, survivor curves, D-value, Z-value, F-value. Heat penetration studies and process calculation methods for canned foods. Mathematical and graphical methods for process evaluation. Retort design and operation. Emerging thermal technologies including ohmic heating, microwave-assisted thermal sterilization, radio frequency heating, aseptic processing, and high-temperature short-time (HTST) processing. Impact of thermal processing on food quality, nutrient retention, and shelf life.

UNIT II:

Principles of refrigeration and psychrometry. Refrigerants: classification, thermodynamic properties, environmental impact, and selection criteria. Vapor compression and vapor absorption refrigeration systems. Components and performance evaluation of refrigeration systems. Pressure–enthalpy charts and refrigeration cycle analysis. Cooling load estimation, coefficient of performance (COP), refrigerant flow calculations, and energy optimization.

UNIT III:

Principles and thermodynamics of food freezing. Ice crystal formation, freezing point depression, freezing curves, freezing rate, and freezing time calculations. Heat and mass transfer during freezing. Effect of freezing on food microstructure and quality. Engineering aspects of air blast freezers, plate freezers, fluidized bed freezers, immersion freezers, scrape surface freezers, cryogenic freezing systems, vacuum freezing, and individual quick freezing

(IQF). Freeze concentration and frozen food storage stability. Emerging freezing technologies and modeling of freezing processes.

UNIT IV:

Principles and classification of food extrusion systems. Engineering design and operational characteristics of single-screw and twin-screw extruders. Transport phenomena, rheology, heat transfer, pressure generation, and residence time distribution in extrusion systems. Raw material functionality and extrusion cooking behaviour. Effect of process variables including feed moisture, barrel temperature, screw configuration, and screw speed on product quality. Development of expanded snacks and texturized foods using extrusion technology. Advances in extrusion including 3D food printing and high-moisture extrusion technology.

Course Outcomes

- Understand various basic aspects of food process engineering
- Comprehend the inactivation of micro-organisms during thermal processing and its calculations.
- Understand the processing of foods by high temperature, low temperature and extrusion processes.

Books Recommended:

1. *Smith, P.G. (2010). Introduction to Food Process Engineering (2nd edition). Springer New York Dordrecht Heidelberg London*
2. *Berk, Z. (2009). Food Process Engineering and Technology (1st edition). Academic press publications, Elsevier.*
3. *Singh, R.P. and Heldmann, D.R. (2009). Introduction to Food Engineering (4th edition). Academic press publications, Elsevier.*

Practicals

1. Determination of thermal process time by graphical & formula method.
2. Drying rate characteristics of different food materials.
3. To study the drying characteristics of a given material in a fluidized bed dryer.
4. Study of rehydration process and determination of diffusivity and activation energy.
5. Determination of sorption isotherm of a food sample.
6. Study of design parameters and refrigeration load capacity of a cold storage plant.
7. Determination of freezing curve and freezing time of selected food material.
8. Visit to a food processing industry

Course Code: DFT264C						Course Title: Mass Transfer Operations				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	1	1	0	4	5	25	10	35	30	100

Course Objectives

- Introduce the fundamental concepts of mass transfer, including units, dimensions, molecular diffusion, and mechanisms of mass transfer in different phases.
- Enable students to analyse and apply mass transfer principles in food-related operations such as extraction, distillation, absorption, adsorption, and drying.
- Develop the ability to evaluate and optimize mass transfer equipment and processes like membranes, leaching, and humidification systems to improve process efficiency in food industries.

UNIT I

Units and Dimensions: System of Units, Conversion of units, Mole Fraction and Mole percent, Mass Fraction and Mass percent, Concentration in different forms, Mass balancing, Principles of molecular diffusion and diffusion between phases, Fick's Law, Diffusivity, Diffusion in solids, Knudsen diffusion, surface diffusion, self-diffusion

UNIT II

Extraction: Liquid-liquid extraction, selectivity & choice of solvent, liquid-liquid extraction equipment. Leaching-Introduction, leaching equipment, electrodialysis system, reverse osmosis, Ultrafiltration, types of reverse osmosis and ultrafiltration systems. Membrane performance, concentration polarization**.** Supercritical fluid extraction. Effect of processing conditions on extraction process. Multistage extraction process. Membrane processes, concentration polarization, gel polarization, reverse osmosis. Microfiltration, ultrafiltration, nano filtration and electrodialysis

UNIT III

Distillation–Vapour liquid equilibrium, relative volatility, flash &batch distillation, steam distillation, vacuum distillation, Fractional distillation and pervaporation and pervaporation

membranes. T-xy & xy curves for distillation, azeotropic mixtures, and distillation tower. Dehydration, moisture diffusion, drying rate curves, dehydration systems.

UNIT IV

Absorption Introduction to absorption, the mechanism of absorption, Absorption equipment, Limiting gas-liquid ratio, Flooding, different packings in packed column. Adsorption, adsorption in column and also add ion exchange. Desorption or stripping. Principles of humidification & dehumidification, wet and dry bulb temperature, psychrometric chart, cooling tower.

Course Outcomes

- Explain the principles of molecular diffusion, mass transfer mechanisms, and phase equilibria in food processing operations.
- Apply mass transfer principles to analyse and design unit operations such as extraction, distillation, absorption, adsorption, and drying.
- Evaluate the performance of mass transfer equipment (membrane systems, packed towers, drying units) and propose optimizations for energy-efficient and high-quality food processing

Books Recommended:

1. *GeanKoplis C. J. Transport processes and separation process principles, 4th Edition. Prentice Hall of India.*
2. *McCabe. Warren L., Smith. Julian C., Peter Harriott, Unit Operations of Chemical Engineering, 7th Edition. McGraw-Hill, Inc., New Delhi.*
3. *Treyball R.E, Mass Transfer Operation, 3rd Edition-McGraw Hill Publication.*
4. *Singh, R.P., & Heldman. Introduction to Food Engineering, 3rd Edition, Academic Press, London, UK.*
5. *Humelblau D.M.& Riggs, J. B., Basic principles and Calculation in Chemical Engineering, 7thEdition.Prentice-Hall of India Pvt. Ltd*.

Practicals

1. To determine the drying characteristics of a given sample by drying in a tray dryer.
2. To study the edible oil extraction from food samples (Solid Liquid Extraction)
3. Determination of the diffusion coefficient of an organic vapour (e.g. CCl4) in air.
4. To study the extraction of essential oils from different Himalayan sources
5. To determine the conductivity of unknown solution.
6. To study the separation of different components by using distillation apparatus
7. To study the extraction of starch from different sources an example of solid liquid extraction
8. To study the mass transfer characteristics of protein extraction from different food samples
9. To study the extraction of caffeine from the coffee10. To study the preparation of sugar from sugar cans an example of crystallization
11. To study the extraction of beta-carotene by using vacuum distillation

Course Code: ELE265G						Course Title: Basic Electrical & Electronics				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	1	1	0	4	5	25	10	35	30	100

Course Objectives

- To acquaint the students with concepts of current, electromagnetism, and working of motors.
- To provide an understanding of various transformers and their working.
- To familiarize the students with semiconductor devices and transistors.

UNIT I

DC Circuits:

Ohm's Law, Electrical circuit elements, Resistance in series, Resistance in parallel, Equivalent Resistance, Kirchoff's laws, Analysis of simple circuits with dc excitation, Superposition, Thevenin and Norton Theorems.

UNIT II

AC Circuits:

Representation of sinusoidal waveforms, Peak and RMS values, Phasor representation, Real power, Reactive power, Apparent power, Power factor, Analysis of single-phase ac circuits, Resonance in series and parallel RLC circuits.

UNIT III

Transformers and Electrical Machines:

Transformers: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformer, regulation and efficiency.

Electrical Machines:

Introduction to DC Machines (D.C Generators and D.C Motors), Introduction to Synchronous Machines.

UNIT IV

Basic Electronics:

Semiconductors, Diode, Zener diode, Bipolar Junction Transistor, Transistor as a switch, Transistor circuit configuration, Transistor characteristics, Field Effect Transistor, Operation of a Cathode Ray Oscilloscope (CRO), Introduction to Measuring instruments.

Course Outcomes

- Explain the working and operation of transformers and motors
- Apply theorems of electrical circuits in engineering.

Books Recommended:

D.P. Kothari and I.J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 2010.

1. *D.C. Kulshreshtha, Basic Electrical Engineering, McGraw Hill, 2009*
2. *V.D. Toro, Electrical Engineering Fundamentals, Prentice Hall India, 1989*

Reference Books:

1. *E. Huges, Electrical and Electronics Technology, Pearson, 2010.*
2. *Charles K. Alexander, Mathew N.O. Sadiku, Fundamentals of Electric circuits, McGraw Hill.*
3. *Jack E. Kemmerly William H. Hayt, Engineering Circuit Analysis, Mc Graw Hill, 2012.*
4. *L.S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.*

Practicals

1. To study the series and parallel operation of resistors.
2. To verify the KVL and KCL in D.C Circuits.
3. To verify Thevenin's and Superposition Theorem.
4. To measure electric power in single phase AC circuits.
5. Study of V-I characteristics of diode.
6. To study and draw the characteristics of half wave and full wave rectifiers.
7. To obtain Zener diode characteristics and use Zener diode as voltage regulator.
8. To plot V-I characteristics of BJT.
9. To perform open circuit and short circuit tests on a single-phase transformer.
10. To perform polarity test on a single-phase transformer.

SEMESTER-V

Course Code: DFT311C						Course Title: Heat Transfer Operations				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	1	1	0	4	5	25	10	35	30	100

Course Objectives

- To learn the phenomenon of heating and cooling of food products.
- To understand the basic modes of heat transfer such as conduction, convection, and radiation
- To study the fundamentals of heat transfer and learn how they are related to the design and operation of food processing equipment.
- To learn mathematical equations to design and evaluate the performance of simple heat exchangers.

UNIT I

Introduction: Basic modes of heat transfer. Heat transfer by conduction: basic laws of conduction, resistance in series, heat flow through plane wall, composite wall and cylinders, Thermal properties of food: specific heat, thermal conductivity and thermal diffusivity. Also include steady state heat transfer, conductive heat transfer through tubular pipe Applications in Food Industry, Enthalpy balance in Heat Exchange equipment.

UNIT II

Heat transfer by Convection- natural and forced. Heat transfer by Radiation- Stefan-Boltzmann, black body radiation, emission, irradiation, surface absorption, reflection and transmission, grey surface, microwave heating, mechanism of microwave heating, microwave oven and microwave heating of food and its application in food industry, Overall coefficient of Heat Transfer, Estimation of convective heat transfer for free and forced convection coefficient by dimensionless numbers.

UNIT III

Evaporation- energy and material balance. Types of evaporation-open kettle evaporator, falling film evaporator, Rising Film Evaporator, forced circulation evaporator, agitated film evaporator, Counter and Parallel Flow, single and multiple effect evaporator.

UNIT IV

Heat exchange equipment. Types of heat exchangers: shell and tube heat exchanger, plate type heat exchanger, Scraped Surface Heat Exchanger, NTU, Fins in heat exchangers. Selection of heat exchanger for food industry, Ohmic Heating, LMTD, Fouling of heat transfer surfaces, mechanism and calculation of extra area required by fouled surfaces. Also include calculation of effectiveness of heat exchangers by NTU method.

Course Outcomes

- To get familiarized with the various thermal properties of the food.
- To understand phenomenon of heat transfer as basis for understanding how various food processes operate.
- To understand various heat transfer operations applied in food industry.

Books Recommended:

1. *Kern, D. Q., Process Heat Transfer, MC Graw Hill Publication, New Delhi.*
2. *Dutta, B. K., Heat Transfer Principles and Application, PHI.*
3. *Mccabe W.L., Smith, J.C. (2008). Unit Operations of Chemical Engineering 7th edition, MC Graw Hill Publication, New Delhi*.

Practical

1. To determine coil side overall heat transfer coefficient (h) for different agitation speeds in given agitation vessel.
2. To find out the heat transfer coefficient of vertical cylinder in natural convection.
3. To find the surface heat transfer coefficient for a pipe flowing heat by forced convection to air flowing through it, for different air flow rate and heat flow rate.
4. To determine the total thermal resistance and thermal conductivity of composite wall.
5. To find out the Stefan Boltzmann Constant.
6. To find out the emissivity of a test plate.
7. To study the heat transfer in shell and tube heat exchanger.
8. To determine the overall efficiency of single and multiple effect evaporator.

Course Code: DFT312C						Course Title: Engineering Properties of Food Materials				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	1	0	3	4	25	10	35	30	100

Course Objectives

- To introduce the students to the basics and important surface properties of food materials
- To teach the importance of thermal properties of foods in different states
- To teach the rheological characteristics of food materials and their industrial significance
- To describe the electric and dielectric properties applied in various novel processing techniques of foods

UNIT I

Surface Properties of Foods: Gibbs Adsorption Equation, Absorption and Adsorption Characteristics of Food Material, Interfacial Energy, Angle of Repose, Contact Angle and Surface Tension of Food, properties of Powders like flour, spices, milk powder etc.

UNIT II

Thermal and Thermodynamic Properties of Foods: Latent Heat, Specific Heat of Unfrozen and Frozen Foods, Thermal Conductivity of Unfrozen and Frozen Foods, Thermal Diffusivity of Unfrozen and Frozen Foods, Thermal Compression and Expansion, Glass and Phase Transition in Food Materials.

UNIT III

Rheological and Textural Properties of Foods: Viscosity and Deformation in Food Material, Flow Behaviour, Viscous and Plastic Flow, Viscoelastic Behaviour, Compression, Snapping-Bending, Cutting Shear, Puncture, Penetration, Texture Profile Properties, Farinograph and Mixograph.

UNIT IV

Electric and Dielectric Properties of Foods: Electrical Conductivity and Ohmic Heating of Food Material, Maxwell's Equations of Electromagnetics, Dielectric Constant and Dielectric Loss Factor of Foods, Radiofrequency and Microwave Heating of Food Material

Course Outcomes

- Understand various important and basic physical properties of food materials
- Comprehend the engineering aspects of food properties
- Understand the principle of electric and dielectric properties and their importance in food processing

Books Recommended:

1. *Rao, M.A., Rizvi, S.S.H, Dutta, A.K. and Ahmad, J. (2014). Engineering Properties of Foods (4th Edition). CRC Press Taylor & Francis Group*
2. *Sahin, S. and Sumnu, S.G. (2006). Physical Properties of Foods. Springer Science Business Media, LLC., 233 Spring Street, New York, NY 10013, USA*

Practicals

1. Determination of the angle of repose of food material of different particle/gain size
2. Determination of surface tension and contact angle of a spread and ketchup
3. Determination of the contact angles of powdered food material onto the air-liquid interface
4. Study of flow behavior of different Newtonian and non-Newtonian food materials
5. Determination of glass transition temperature of fruit juice sample using temperature ramp frequency seep test
6. Study on electrical conductivity of a liquid food material using lab scale ohmic heating setup
7. Determination of viscosity of food materials using Viscometer

Course Code: DFT314C						Course Title: Food Additives and Ingredients				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	1	0	3	4	25	10	35	30	100

Course Objectives

- Understand definitions, classifications, and technological roles of food additives in modern food systems.
- Explain regulatory frameworks, permissible limits, and safety evaluation of food additives according to national and international standards.
- Develop knowledge of preservatives, antioxidants, and chelating agents including their mechanisms and applications.
- Understand functional ingredients such as stabilizers, emulsifiers, thickeners, and sweeteners and their role in food formulation.
- Analyze natural versus synthetic additives with respect to safety, health impact, and clean-label trends.
- Understand the chemistry, stability, and technological role of food colors, enzymes, and modified starches.
- Gain insight into emerging innovations including nanotechnology-based additives and enzyme-modified ingredients.
- Develop the ability to evaluate additive selection for product quality, safety, and regulatory compliance.

UNIT I

Food additives: Definitions, classification, and functions. Nutritional and non-nutritional food additives. Naturally occurring food additives – vitamins, minerals, amino acids. Regulatory aspects of food additives (FSSAI, Codex), recent developments in food additive classifications, novel additives like plant polyphenols and dietary fibres

UNIT II

Food Preservatives: Classification – natural & chemical; Mode of action and roles. Antioxidants& Chelating Agents: Natural and synthetic antioxidants, mode of action, food

applications. Clean-label preservatives, GRAS concept, permissible limits (FSSAI/FAO), health implications.

UNIT III

Stabilizers, thickeners, and emulsifiers: Types and applications in food. Natural emulsifiers (lecithin, gum arabic). Sweeteners: Classification – artificial, non-nutritive, and natural sweeteners; health implications. Flavor enhancers (MSG), salt replacers (e.g., potassium chloride).

UNIT IV

Colours: Natural and synthetic, permitted colours, stability and applications. Enzymes: Types and roles. Starch modifiers: Chemical nature and role in processing. Nanotechnology-based additives, enzyme-modified ingredients in clean-label foods

Course Outcome

- Classify food additives based on function, origin, and regulatory status and explain their roles in food systems.
- Interpret regulatory standards and permissible limits for additives and assess compliance requirements for food products.
- Explain mechanisms of action of preservatives, antioxidants, and chelating agents and select suitable options for different foods
- Evaluate health implications and safety considerations associated with natural, synthetic, and novel additives.
- Differentiate types of stabilizers, emulsifiers, thickeners, and sweeteners and justify their applications in formulations.
- Assess functional performance and stability of food colors, enzymes, and modified starches during processing and storage.
- Analyse clean-label ingredient strategies including natural preservatives, enzyme-modified ingredients, and plant-based additives

Books Recommended:

1. Branen AL, Davidson PM &Salminen S. 2001. Food Additives. 2nd Ed.Marcel Dekker.
2. Gerorge AB. 1996. Encyclopedia of Food and Color Additives. Vol. III.CRC Press

Practicals

1. Estimation of oxidizing agents (e.g., benzoyl peroxide) in wheat flour samples.
2. Qualitative detection of monosodium glutamate (MSG) in food products using paper chromatography.
3. Study of antioxidant action of potassium metabisulphite in model food systems.
4. Determination of diacetyl content in butter using colorimetric method.
5. Spectrophotometric estimation of total chlorophyll content in green vegetables.
6. Determination of calcium oxide content in food ash.
7. Estimation of volatile oil from spices using Clevenger apparatus.
8. Detection of synthetic oil-soluble color in food samples.
9. Extraction and concentration of oleoresins from selected spices using organic solvents

Course Code: DFT315 C						Course Title: Cereal and Pulses Processing Technology				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	1	1	4	5	25	10	35	30	100

Course Objectives

- To impart knowledge about the physical structure and chemical composition and milling of wheat.
- To make the students aware with knowledge and understanding the basic structure, composition and different processes involved with rice and corn and millet processing.
- To expose the students to composition, processing and storage of pulses and to impart them with different extraction methods.

UNIT I

General introduction, importance and production trends of cereals in India and globally. Post-harvest losses, spoilage, storage and protection of food grains. Structure, composition, physicochemical characteristics of cereal starches and proteins. Wheat: Structure, types, composition and physicochemical characteristics. Cleaning, tempering and conditioning. Wheat milling, advanced flour milling techniques (roller and stone milling), patent flour. Rheological and functional characteristics of wheat flour and milling products. By-product utilization including bran and germ valorisation.

UNIT II

Rice: Structure, classification, quality characteristics and physicochemical properties. Milling and parboiling of paddy. Curing and aging of paddy. Evaluation of milling, cooking, nutritional and storage qualities of raw and parboiled rice. Processed rice products (flaked, expanded and puffed rice). Stabilized rice bran and its nutraceutical applications. By-products: husk, bran, and their utilization in health foods and oil recovery

UNIT III

Corn and other coarse grains: Structure, types and composition of corn. Wet and dry milling of corn. Starch and its conversion products (maltodextrins, glucose syrup, HFCS). Processed corn products (popped corn, corn flakes, extruded snacks). Maize germ oil and its refining.

Importance and processing of other cereals and millets (sorghum, pearl millet, finger millet). Pearling and malting of barley. Oats: milling, nutritional benefits and product applications.

UNIT IV.

General introduction to pulses, Production and utilization trends of various pulses; Grain classification, structure and composition; Importance of pulses, post-harvest quality and quantity losses. Post-harvest processing and storage of pulses including control of infestation, Processing of legumes for protein concentrates and isolates using membrane and enzymatic techniques. National and International quality and grading standards. Milling of Pulses, Advances in Milling Technology. Nutritional and Anti-nutritional factors and methods of inactivation and equipment involved in milling By-products of pulse milling and their utilization

Course Outcomes

- Know the importance of cereals, legumes and oilseeds in human nutrition.
- Understand and gain the knowledge of structure, composition and different milling processes associated with wheat, rice, corn and millets.
- Expose the students to different processes related to production of Flaked, puffed rice, popcorn, corn flakes etc

Books Recommended:

1. *Hoseney RS. 1994. Principles of Cereal Science and Technology. 2nd Ed. AACC.*
2. *Kay DE. 1979. Food Legumes. Tropical Products Institute.*
3. *Kent NL. 1983. Technology of Cereals. 4th Ed. Pergamon Press*
4. *Kulp K & Ponte GJ. 2000. Handbook of Cereal Science and Technology. 2nd Ed. Marcel Dekker.*
5. *Lorenz KL.1991. Handbook of Cereal Science and Technology. Marcel Dekker.*
6. *Marshall WE & Wadsworth JI. 1994. Rice Science and Technology. Marcel Dekker.*
7. *Mathews RH. 1989. Legumes Chemistry, Technology and Human Nutrition. Marcel Dekker.*
8. *Matz SA. 1969. Cereal Science. AVI Publ.*
9. *Pomeranz Y. 1987. Modern Cereal Science & Technology. VCH Pub*

Practicals

1. Determination of wet and dry gluten from wheat flour.
2. Conditioning of wheat
3. Parboiling of rice
4. Quality tests of rice
5. Assessment of degree of polishing
6. Malting of barley
7. Puffing and popping of grains.
8. To check the cooking quality of different rice Varieties.
9. Visit to local roller flour mill.
10. Visit to local bakery.
11. Visit to local rice hulling unit.
12. Extraction of oil using expellers
13. Study of milling characteristics using ball mill

Course Code: DFT316C						Course Title: Edible Oil Technology				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	1	0	3	4	25	10	35	30	100

Course Objectives

- To expose the students to composition, processing and storage of pulses and to impart them with different extraction methods and refining processes related to edible fats and oils.

UNIT-1

Sources, chemical composition physical and chemical characteristics functional and nutritional importance of dietary oils and fats. Post-harvest handling storage and processing of oilseeds for direct use and consumption. Mechanical expression of oil by hydraulic pressing and expelling, semi-continuous and continuous solvent extraction systems, distillation for separation of oil and solvent, Physico-chemical characteristics of natural oils, fats and fatty acids.

UNIT-II

Properties of Oils and Fats: Oiliness and viscosity, cloud point, titre, density and coefficient of expansion, melting point, plasticity of fats & plastic range, smoke, flash and fire points, Boiling point; solubility and miscibility, refractive index, Acid value, saponification value, Iodine value, thiocyanogen value, diene value, acetyl and hydroxyl value Reichert-Meissl and Polensky values, and Kirschne value, Peroxide Value, Anisidine Value, Oxirane Value, TBA value, Totox value, unsaponifiable matter.

UNIT-III

Refining: Physical and Chemical refining of oils, Clarification, degumming, neutralization (alkali refining), bleaching, deodorization techniques / processes. Blending of oils. Processing of refined oils: Hydrogenation, fractionation, winterization, inter-esterification etc. for obtaining tailor-made fats and oils. Changes during processing and storage of oils and fats, polymorphism, rancidity and reversion. Production of butter oil, lard, tallow, Margarine, Cocoa butter equivalents, shortenings, low fat spreads, peanut butter etc. Speciality fats and designer

lipids for nutrition and dietetics, especially by biotechnology. Special uses of fat for several foods, like chocolate, bread, biscuit, mayonnaise, salad, frying, etc.

UNIT-IV

Adulteration tests for vegetable and animal fats and oils and their chemistry: Boudiens Test, Halde Test, Halphen's test, Hexa Bromide Test, Ammonium Molybdate test, Bellier's Turbidity Test, Test for the presence of Argemone, Sal Neem Kusum, Karanja, Animal fat, Allylisothiocyanate test, Detection of rice bran oil in other oils and other relevant test. FSSAI Regulations for fats and oils. Industrial fats and oils, shortenings, salad oils, margarine, non-caloric fats; standard and quality control, packaging and storage of fats and fatty foods.

Books Recommended:

1. Williams. P.N. & Devine. J. (1996). The Chemistry and Technology of Edible Oil and Fats.

2. Berk, & Bhatia (2008). Handbook of Industrial Oil and Fat Products, Vol 1-4. CBS Publishers, New Delhi.

3. Meyer, (1998). Food Chemistry. CBS Publishers, New Delhi.

4. Hamilton, R.J. and Bharti, A. Ed. 1980. Fats and Oils: Chemistry and Technology. Applied Science, London.

5. Salunkhe, O.K. Chavan, J.K, Adsule, R.N. and Kadam, S.S. 1992. World Oilseeds: chemistry, Technology and Utilization. VNR, New York.

6. Wolf, I.A. Ed. 1983. Handbook of Processing and Utilization in Agriculture. (2 vol. set). CRC Press, Florida

7. Chemistry and Technology of Oils and Fats, 2003, Edited by M.M. Chakraborty

8. Handbook of Oil Technology by AOCS

Practicals:

1. Determination of efficiency of oil extraction techniques (mechanical expelling and solvent extraction).
2. Determination of Free Fatty Acid (FFA) / Acid Value content of different oils
3. Detection of Adulteration in Fats and oils.
4. Determination of Specific Gravity/Density of Oils and Fats
5. Determination of deep-fat frying performance of some refined oils.
6. Determination of stability of fats & oils.
7. Determination of Smoke point of Oils and Fats
8. Identity tests for various oils.
9. Visit to an oil extraction unit.

Course Code: DFT317E						Course Title: Food Entrepreneurship				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
1	1	0	0	2	2	15	10	25	0	50

Course Outcomes:

- Entrepreneurialskillsnecessaryforsuccessinthefoodprocessingsector.
- Techniquesforassessingandenhancingpersonalentrepreneurialabilities.
- Thestrategiesforeffectivemarketingandsalesoffoodproducts.
- Records keeping essentials for managing a food processing unit

UNIT-1

Relevant standards, Process standards, and procedures required to operate a food processing unit. Evaluation of personal an organizational performance. Technical requirements for raw materials, packaging materials, preservation methods, Quality requirements and standards for processed foods, including product safety and consistency, techniques for conducting market surveys to identify trends, opportunities, and customer needs**.** Market demand, customer preferences, and competition analysis, sales, marketing, and distribution strategies for processed food product, business management skills required to operate a food processing unit.

UNIT-II

Methods for evaluating and identifying viable food products. Importance of market trends, market share analysis, and competitor strategies within the processed food sector. Methods for determining product pricing, Market trends, market share analysis, and competitor marketing strategies within the processed food sector. Importance of quality standards and requirements for ensuring product safety and consistency. Marketing and branding strategies.

UNIT-III

Registrations and approvals and license and permit. Entrepreneur's Memorandum and registration with the DIC's. Sourcing of Utilities, actors influencing the selection of an optimal location, financial management, loans available (seed capital, working capital and long- term loans). Relevant financial institutions, Cost benefit Ratio, financial viability and profitability projections for investment decisions.

UNIT-IV

Processing requirements, Management (purchasing, inventory control, production scheduling, and quality assurance. Licensing and Permits, Food safety and hygiene standards, use of chemicals, disinfectants, and sanitizers used, food quality parameters, safe storage of raw materials, packaging materials, and finished goods, Inventory management and supply chain coordination, setting up a code of business.

Course Outcomes

- Explain the regulatory requirements, quality standards, and operational procedures for establishing and managing a food processing unit.
- Evaluate market opportunities, identify viable food products, and formulate appropriate marketing, branding, and pricing strategies.
- Prepare business plans by assessing financial feasibility, investment requirements, statutory approvals, and sources of finance.
- Apply production management, inventory control, food safety, hygiene, and quality assurance principles for the efficient operation of food processing enterprises.

Books Recommended:

1. Fellows, P.J. (2017). *Food Processing Technology: Principles and Practice* (4th ed.). Woodhead Publishing, Elsevier.
2. Khanka, S.S. (2020). *Entrepreneurship Development*. S. Chand & Company Ltd., New Delhi.
3. Charantimath, P.M. (2018). *Entrepreneurship Development and Small Business Enterprises* (3rd ed.). Pearson Education, New Delhi.
4. Kotler, P. & Keller, K.L. (2022). *Marketing Management* (16th ed.). Pearson Education.
5. Alli, I. (2004). *Food Quality Assurance: Principles and Practices*. CRC Press, Boca Raton, Florida.
6. Motarjemi, Y. & Lelieveld, H. (2014). *Food Safety Management: A Practical Guide for the Food Industry*. Academic Press, Elsevier.

Course Code: DFT318E						Course Title: Technology of Flavors				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
1	1	0	0	2	2	15	10	25	0	50

Course Objectives

• To understand the basics of foods flavours.

• To learn the isolation of flavouring compounds techniques from different food materials.

• To study the identification and quantification of flavouring compounds by different analytical techniques.

UNIT I

Introduction: Definition of flavours, classification of food flavours. Flavour extraction: Methods of flavour extraction, isolation, separation and equipment used. Volatile and non-volatile flavouring compounds, non-enzymatic browning reactions.

UNIT II

Food flavours in different food products: Principal components and properties, baked products, cheese, milk, meat, fish, wine, coffee, tea, chocolate. Flavour encapsulation: types of encapsulations, factors affecting stabilization of encapsulated flavour and their applications in food industry. Packaging and storage of flavours: Packaging and flavour compounds interaction.

UNIT III

Flavour enhancers their properties and toxicity. Flavour analysis: methods of flavour evaluation, sensory evaluation (discrimination analysis, descriptive analysis) Instrumental analysis (spectroscopy, chromatography).

UNIT IV:

Advanced Flavour Science and Applications: Flavour chemistry and formation mechanisms: Reaction flavours, Maillard reaction–derived flavours, lipid oxidation products, enzymatic flavour formation. Off-flavours: Causes, detection, and control methods in food systems. Flavour stability: Factors affecting flavour retention (pH, temperature, oxygen, light, water activity) and stabilization techniques. Biotechnological production of flavours: Microbial and enzymatic synthesis of natural flavour compounds, fermentation-derived flavours, and regulatory aspects of bio-Flavours. Regulatory and safety aspects of flavours: International

standards, labelling requirements, permissible limits, toxicological evaluation, and quality assurance. Emerging trends: Clean-label flavour technologies, natural flavour replacers, plant-derived flavour compounds, and innovations in flavour delivery systems.

Course Outcomes

- Classify food flavours and explain the principles of flavour extraction, isolation, encapsulation, packaging, and storage.
- Describe the flavour characteristics of major food products and evaluate factors affecting flavour quality and stability.
- Apply sensory and instrumental techniques for flavour analysis and assess the role of flavour enhancers and off-flavours in food systems.
- Evaluate advanced flavour technologies, biotechnological production methods, regulatory requirements, and emerging trends in flavour science for food applications

Recommended Books

1. Reineccius, G. A. Flavor Chemistry and Technology. 2nd Edition, CRC Press, Boca Raton, 2006.
2. Acree, T. E., & Teranishi, R. (Eds.). Flavor Science: Sensible Principles and Techniques. American Chemical Society, Washington, D.C., 1993.
3. Taylor, A. J., & Mottram, D. S. (Eds.). Flavour Science: Recent Developments. Royal Society of Chemistry, Cambridge, 1996.
4. Heath, H. B. Source Book of Flavours. AVI Publishing Company, Westport, 1981.
5. Belitz, H. D., Grosch, W., & Schieberle, P. Food Chemistry. 4th Revised Edition, Springer, Berlin, 2009.

SEMESTER-VI

Course Code: DFT361C						Course Title: Packaging Technology				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
3	0	1	0	4	5	25	10	35	30	100

Course Objectives

- To impart knowledge and skills on the various aspects of selection of packaging materials for the packaging of food products
- To acquaint the students about the various types, characteristics and functional properties of various packaging materials.
- To impart the knowledge about the various packaging operations related to packaging machinery

UNIT I

Introduction to packaging: definition, functions, and scope. Factors affecting shelf life of food materials during storage. Packaging requirements and importance for different food categories. Packaging systems and types: flexible and rigid; retail and bulk; primary, secondary and tertiary packaging. Levels of packaging material selection, Packaging design and development with reference to environmental and consumer considerations.

UNIT II

Different types of packaging materials, their key properties and applications. Metal cans, plastic packaging and commonly used polymers in food packaging with their barrier properties. Manufacture and processing of plastic packaging materials. Glass containers: types of glass, manufacture of glass and glass containers, closures. Paper and paperboard packaging: characteristics, applications, and barrier modifications. Comparative evaluation of material properties for selection

UNIT III

Nutritional labelling and regulatory considerations for packaged food. Controlled and Modified Atmosphere Packaging (CAP/MAP), shrink and cling films, vacuum and gas packaging. barcode, sensors. Packaging waste: factors affecting material choice, recyclability, and disposal. Printing and labelling techniques; lamination methods.

UNIT IV

Advanced packaging technologies biosensors. Smart packaging with antimicrobial, nano-enabled, edible and biodegradable materials. Retort pouch technology, microwavable, biodegradable, and edible packages; Principles and applications of Active Packaging, Smart and Intelligent Packaging, Antimicrobial packaging Safety aspects of packaging materials; sources of toxic materials and migration of toxins into food materials, packaging and flavour interaction.

Course Outcomes

- To understand the basic concept of packaging and its packaging functions.
- To understand the properties of packaging materials along with their methods of testing and evaluation.
- Ability to understand the basic concept of packaging materials and their various forms.
- To give the detailed account of protective lacquers and coatings for metal containers.
- To understand the basic concept about the rigid and flexible plastics, containers and films along with their mechanical and sealing properties.

Books Recommended:

1. *Principal of Food Packaging by Sacharow & Griffin, Van Nastrand Rainhold Company, New York.*
2. *Food Packaging Materials by Mahadeviah & Growramma*
3. *A Handbook of Food Packaging by Frank A. Paine*
4. *Food Packaging Materials by N. T. Crosby*
5. *Canning and Aseptic Packaging by Ranganna, TMH.*

Practicals

1. Test the thermal shock resistance of glass container.
2. Determine the WVTR of some packaging materials.
3. To estimate wax content of wax paper.
4. To determine the bursting strength of a carton board.
5. To determine the amount of tin coating in a can plate.
6. Testing of lacquered tin plate steel for following: -

i. Continuity of tin layer.

ii. Resistance of lacquer to acid.

7. Determination of iron content in canned foods.
8. Test for alkalinity on the surface of glass jar.

9. To study the compression strength of a box.
10. To study the puncture resistance of a cardboard.
11. To study the drop resistance of a given packaging material.
12. Identification of different packaging materials
13. Tests of packaging materials

Course Code: DFT362C						Course Title: Food Quality and Safety				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	0	1	3	3	30	20	50	0	100

Course Objectives

- To impart the knowledge about the regulatory aspects of Foods and their Quality control.
- To acquaint the students about the Implementation of HACCP and its implications in Food industries.
- To impart the knowledge about the industrial legislation Including WTO, GATT, Patent laws, acts.

UNIT I:

Concept of quality and safety of foods. Hazards and types of hazards, Food adulteration, common food adulterants; Methods to detect food adulteration

UNIT II:

Quality management system, concept of total quality management (TQM).

Prerequisite Programs (PRP) for food safety: GAP, GMP, GHP, GLP — principles and their role in food industry. objectives, principles; GHP – objectives, principles; GMP – objectives, GMP in food industry.

UNIT III:

Food safety standards act- 2006 and regulation 2011.- Food Safety and Standards Authority of India (FSSAI)- Functions, Registration and Licensing of food businesses.

UNIT IV

BIS, International Organization for standardization (ISO): Introduction, ISO standards, benefits. ISO 9000, ISO 22000. Codex Alimentarius Commission.

Course Outcomes

- Ability to understand the food quality evaluation and the basic concept of total quality control.
- To understand the various requirements related to good manufacturing practices, good hygienic process and codex alimentarium commission.

- To understand the basic concept of FSSAI, HACCP and its implications in food industries.
- To provide the students about the in-depth understanding of ISO 9000 series, ISO 22000 series and ISO19011.
- To understand the industrial organization and types of organization structure, forms of business organization.
- To impart the knowledge about the division of Industries including industrial sectors both private and public, social obligations of industries towards society.
- To provide the students about the in-depth knowledge related to Industrial legislation, disputes trade unions: Industrial legislation and laws, acts and disputes.
- To give the brief overview of industrial disputes act-1947, WTO, GATT, Patent Laws and IPR.

Books Recommended

1. *Quality Assurance for the Food Industry by J. Andres Vasconcellos.*
2. *Food Safety Handbook by Ronald H. Schmidt and Gary E. Rodrick.*
3. *Bioterrorism and food safety by Barbara A. Rasco & Gleyn E. Bledsoe.*
4. *Quality control in food industry (Vol. I and II) by Kramer and Twingg.*
5. *Various acts, orders, standards & specification.*
6. *The prevention of Food Adulteration Act, 1945, Universal Laws*.

Course Code: DFT363C						Course Title: Technology of Spices and Plantation Crops				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	1	0	3	4	25	10	35	30	100

Course Objectives

- To develop the understanding of spices and their processing.
- To study the flavours in various food products
- To acquaint students with the processing of plantation crops

UNIT I:

Spices and Condiments: Current scenario, production status, and economic importance of spices in India. Spices and condiments: definition and classification. Chemical composition, uses, and processing of major spices with emphasis on pepper, cinnamon, turmeric, fennel, chilli, cardamom (small and large), cumin, mint, ginger, garlic, fenugreek, and saffron.

UNIT II:

Spice Processing and Flavour Technology: Oleoresins and essential oils. Cryogenic grinding of spices. Microbial contamination and insect infestation in spices and their control. Food flavours: development of flavour during processing, natural and synthetic flavourings, stability of flavours during food processing. Flavour enhancers, their properties, and toxicity.

UNIT III:

Coffee and Tea Processing: Coffee: composition, post-harvest processing, manufacture of coffee powder, and instant coffee. Tea: composition, post-harvest processing, types of tea, manufacture, and grading.

UNIT IV:

Cocoa and Chocolate Technology: Cocoa: cocoa bean chemistry and composition, processing of cocoa beans, cocoa powder production. Chocolate: types, manufacture, processing technology, and enrobing technology.

Course Outcomes

- Explain the production status, composition, processing methods, and economic importance of major spices, condiments, and plantation crops.
- Evaluate flavour development, spice processing technologies, essential oils, oleoresins, and factors affecting flavour quality and stability.
- Apply appropriate processing techniques for the manufacture of coffee, tea, cocoa, and chocolate products while maintaining product quality.
- Assess the quality, safety, microbial contamination, storage, and value-addition opportunities in spices, flavouring materials, and plantation crop products

Books Recommended:

1. Purse glove, J.W. (1998). Spices Vol and Vol II, Longman Publications.
2. *Tainter, D.R. And Grenis, A.T. (1993). Spices and Seasonings- A Food Technology Handbook, VCH Publishers, Inc.*
3. *Merory, J. (1978). Food flavourings, Composition, Manufacture and Use, 2nd edition, AVI Publishing, INC.*
4. Farrel, K.T. (1985). Spices, condiments and Seasonings, AVI Publishing, INC.
5. *Heath, H, B. &Reineccius, G. (1996). Flavour Chemistry and Technology. CBS Publishers & Distributors, New Delhi*

Practicals

1. Determination of moisture in whole and ground spices.
2. Determination of total ash in spices.
3. Sampling and determination of extraneous matter in spices.
4. Determination of pungency rating (Scoville method) in red pepper.
5. Adulteration tests for different spices.
6. Organoleptic evaluation of flavours.
7. Identification of saffron by sulphuric – diphenylamine test.
8. Microscopic examination of spices.
9. Detection of Argemone seeds in mustard.
10. Extraction of oil from spices.

Course Code: ELE364G						Course Title: Process Control and Instrumentation				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
3	0	1	0	4	5	25	10	35	30	100

Course Objectives

- To study introduction to instruments and their representation
- To learn measurement principles, constructional features, advantages, limitation etc of various possible instruments for a particular measurement situation.
- To deal with the general treatment of Instruments and their characteristics.

Unit-I:

An Industrial process, process parameters, Actuating and controlling devices, batch and continuous process. Measuring Devices: Elements of measuring system and their function, Process measurement: statics and dynamics, transducers: classification and its role in food industry.

Unit-II:

Functions and general classification of instruments used in food industry: temperature measurement, Pressure, Level, water activity measurement, Humidity measurement, and color measurement, Viscosity of liquid foods, density, specific gravity. Biosensors for food application.

Unit-III

Controllers and Indicators: Temperature control in food dehydration and drying, electronic controllers, atmosphere control in food preservation, timers and indicators in food processing, food sorting and grading control, discrete controllers, adaptive and intelligent controllers Process control- Introduction, process model, control loop elements, process dynamics, modes of control- on/off control, proportional control, integral control, derivative control combined control modes, controller tuning.

Unit IV:

Control technique: P&ID symbology, negative feedback control, feed forward control, ratio control, environmental control, cascade control, control equipment.

Course Outcomes

- To learn and understand Instrumentation principles, measuring techniques and data analysis.
- To familiarize the students with latest instruments used for food measurement and characterization.
- To lay emphasis on measurement standards and calibration methods which are essential feature of measurement operation in food industry.

Books Recommended:

1. Bhuyan, Manabendra. (2006) Measurement and Control in Food Processing, CRC.

2. Instrumentation and Sensors for the Food Industry by Erika Kress-Rogers And Christopher J.B. Brimelow

3. Process Systems Analysis and Control, by Coughanowr, D. R., 2nd edition McGraw Hill 1991.

4. Principles of Industrial Instrumentation, by Patranabis D.,

5. Principles of Industrial instrumentation by Eckman D.P., Willey Eastern,1978

6. Curtis Johnson (2004). Process Control Instrumentation. The Prentice Hall of India.

7. Eckman, D.P. (2004). Industrial Instrumentation. CBS Publishers & Distributors, New Delhi

Practicals

1. To study the performance of Relay control combination of P, I and D control schemes in a temperature control system.
2. To study the open loop and closed loop step response of first, second and third order simulated linear systems.
3. Determination of calibration
4. Determination of pH in Food Samples Using pH Meter
5. Determination of Water Activity in Processed and Fresh Foods

Course Code: DFT365E						Course Title: By-Product Utilization and Waste Management in Food Industry				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	1	0	3	4	25	10	35	30	100

Course Objectives:

- To acquaint students with characterization and utilization of by-products from food industries.
- To understand the treatment processes of effluent from food industries.

UNIT I

Characterization and utilization of by-products from cereals, pulses, oilseeds, fruits, vegetables, plantation, dairy, eggs, meat, fish and poultry processing industries.

UNIT II

Unit concept of Treatment of food industry effluents. Screening, sedimentation, floatation as pre and primary treatments, biological oxidations: objects, organisms, reactions, oxygen requirements, aeration devices and equipment's. Treatment's system: lagoons, trickling filters, activated sludge process, oxidation ditches, rotating biological contractors their variations and advanced modifications.

UNIT III

Advanced wastewater treatment systems. Physical separations, Micro-strainers, Filters, Ultra filtration and reverse osmosis. Physio-chemical separations: activated carbon adsorption, Ion exchange electro-dialysis and magnetic separation. Chemical oxidations and treatment Coagulation and flocculation. Disinfection. Handling and disposal of sludge.

UNIT IV

Elements of importance in efficient management of food wastes. Standards for emission or discharge of environmental pollutants from food processing industries

Course Outcomes

- Understand the significance of food safety in public health and identify different categories of food hazards and contamination routes.
- Develop foundational knowledge of toxicological principles and epidemiology relevant to foodborne diseases.
- Comprehend scientific principles and structured approaches used in food risk analysis, including assessment, management, and communication.
- Understand methodologies used in qualitative and quantitative risk assessment, including dose–response modelling and predictive microbiology.
- Gain knowledge of food safety management systems such as GMP, GHP, SSOP, HACCP, and ISO standards.
- Analyze traceability, recall systems, and auditing procedures used to ensure regulatory compliance.
- Understand national and international regulatory frameworks governing food safety and risk-based decision making.
- Develop awareness of emerging food safety risks and contemporary challenges affecting global food systems

***Books Recommended**:*

1. *Water and waste water Tech. 5th Ed. By Mark & Hammer, PHI.*
2. *Industrial microbiology by L.E. Casida, New Age Publication.*
3. *Environmental pollution by K.C. Agrawal.*
4. *Environmental pollution control engineering by C.S. Rao.*
5. *Food processing waste management by green and Kramer (AVI)*
6. *By- products from food industries: utilization and disposal by AFSI*

Practicals

1. Identification of waste from agriculture and food processing (Dairy/ Meat/ Fruits Vegetables / Alcoholic beverages/ cereals)
2. Study and layout of wastewater treatment system (ETP)
3. Identification of co-products from the F&V industry, estimation, and utilization to develop value-added products.
4. Identification of waste from the animal industry and utilisation to develop value-added products.

5. Identification of various co-products from the dairy industry, estimation, and utilization to develop value-added products.
6. Identification of co-products from the cereal industry, estimation, and utilization to develop value-added products.
7. Determination of physico-chemical properties of wastewater.
8. Estimation of BOD (Biological Oxygen Demand)
9. Estimation of COD (Chemical Oxygen Demand)
10. Visit to Wastewater Treatment Plant.

Course Code: DFT366E						Course Title: Risk Assessment and Food Safety				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
1	1	0	0	2	2	15	10	25	0	50

Course Objectives

- Introduce principles and framework of food safety risk analysis.
- Develop understanding of hazard identification and dose–response assessment.
- Train students in exposure assessment and risk characterization.
- Familiarize students with international regulatory frameworks and risk management principles.
- Enable application of risk assessment tools to real-world food safety problems.

UNIT I

Concept of hazard and risk; evolution of food safety risk assessment; components of risk analysis: risk assessment, risk management and risk communication; science-based decision making; role of international organizations such as Food and Agriculture Organization, World Health Organization, Codex Alimentarius Commission and World Trade Organization; SPS Agreement and international harmonization of food standards.

UNIT II

Types of food safety hazards (chemical, biological, physical); principles of toxicology; acute, sub-chronic and chronic toxicity studies; carcinogenicity and reproductive toxicity; dose–response assessment; NOAEL, LOAEL; Benchmark Dose (BMD/BMDL) approach; uncertainty/safety factors; derivation of Health-Based Guidance Values (HBGVs); role of expert committees such as Joint FAO/WHO Expert Committee on Food Additives and Joint FAO/WHO Meeting on Pesticide Residues

UNIT III

Principles of dietary exposure assessment; food consumption data and residue monitoring data; deterministic and probabilistic approaches; chronic and acute exposure estimation; cumulative and aggregate exposure; Margin of Exposure (MOE); risk characterization; uncertainty analysis and interpretation of risk estimates.

UNIT IV

Risk management decision-making process; establishment of Maximum Residue Limits (MRLs); harmonization of standards and trade implications; precautionary principle; risk communication strategies; crisis management and food recalls; emerging issues: antimicrobial resistance, heavy metal contamination (e.g., cadmium), food fraud, climate change impacts, and mixture risk assessment.

Course Outcomes

- Identify chemical, biological and physical hazards and interpret toxicological data.
- Derive Health-Based Guidance Values (ADI, ARfD, TDI) using NOAEL/BMD approaches.
- Perform dietary exposure calculations and conduct risk characterization.
- Critically evaluate risk management decisions in national and international contexts.

Books Recommended:

1. Motarjemi, Y. & Lelieveld, H. (2014). *Food Safety Management: A Practical Guide for the Food Industry*. Academic Press, Elsevier.
2. Hubbard, B. (Ed.). (2011). *Risk Assessment of Chemicals: An Introduction*. Royal Society of Chemistry, Cambridge.
3. van Leeuwen, C.J. & Vermeire, T.G. (2007). *Risk Assessment of Chemicals: An Introduction*. Springer, Dordrecht.
4. Duffus, J.H., Nordberg, M. & Templeton, D.M. (2007). *Glossary of Terms Used in Toxicology* (2nd ed.). IUPAC and Royal Society of Chemistry.
5. Klaassen, C.D. (Ed.). (2022). *Casarett & Doull's Toxicology: The Basic Science of Poisons* (10th ed.). McGraw-Hill Education.
6. Eaton, D.L. & Gilbert, S.G. (Eds.). (2013). *Principles of Toxicology* (3rd ed.). Wiley-Blackwell.

Course Code: DFT367E						Course Title: AI in Food Processing				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
1	1	0	0	2	2	15	10	25	0	50

Course Objectives:

- Introduce students to fundamental concepts of Artificial Intelligence (AI) and Machine Learning (ML) in the context of food science.
- Develop understanding of AI applications in food composition, quality analysis, processing, safety, and sensory evaluation.
- Enable students to use basic AI tools, datasets, and simple models relevant to food systems.
- Build practical skills for applying AI in decision-making, prediction, classification, and optimization in food industry operations

Unit I: Introduction to Artificial Intelligence (AI) in Food Systems

Definition and scope of Artificial Intelligence, Components of AI: Machine Learning (ML), Deep Learning (DL), Data Analytics; Types of ML: Supervised, Unsupervised, Reinforcement Learning; Overview of datasets used in food science; Role of AI in food supply chain, processing, quality, and safety; Limitations and ethical considerations in AI applications in food industry

Unit II: AI in Basic Food Composition Analysis

AI in analysis of major food components: moisture, proteins, fats, carbohydrates, ash; Spectroscopy-based AI models (NIR, FTIR, hyperspectral imaging); Prediction models for nutritional composition; AI in detection of changes due to storage, processing, and adulteration; Case studies: Milk composition prediction using sensors; AI for fruit maturity and grading

Unit III: AI in Food Quality and Sensory Evaluation

Computer vision systems for colour, texture, size, and appearance; AI-based sensory evaluation and e-nose/e-tongue; ML models for shelf-life prediction; AI in texture analysis and rheological properties; Grading and sorting using deep learning: fruits, grains, spices; Fault detection in processed foods using image recognition systems

Unit IV: AI in Food Processing and Safety

Process optimization using AI (thermal processing, drying, extrusion, fermentation); Predictive

microbiology using ML; Hazard detection using AI (contaminants, pathogens); AI-enabled traceability and blockchain in food safety; Smart packaging and IoT-enabled monitoring

Course Outcomes

1. Explain basic principles of AI, ML, and data science.
2. Apply AI tools for analysis of basic food components (carbohydrates, proteins, fats, vitamins, moisture).
3. Use ML models for quality evaluation and prediction in food products.
4. Apply AI for food authentication, adulteration detection, and safety assessment.
5. Interpret outputs from AI-based systems such as NIR, computer vision, and sensor-based models.
6. Work with small datasets in Python/AI platforms to build simple predictive models.

Books Recommended:

1. Sun, D.W. (Ed.). (2024). *Artificial Intelligence for Food Engineering*. CRC Press, Boca Raton, Florida.
2. Sun, D.W. (Ed.). (2016). *Computer Vision Technology for Food Quality Evaluation* (2nd ed.). Academic Press, Elsevier.
3. Sun, D.W. (Ed.). (2010). *Infrared Spectroscopy for Food Quality Analysis and Control*. Academic Press, Elsevier.
4. Gunasekaran, S. (Ed.). (2001). *Non-destructive Food Evaluation: Techniques to Analyze Properties and Quality*. Marcel Dekker, New York.
5. Barbon, S., Valous, N.A. & Sun, D.W. (Eds.). (2023). *Artificial Intelligence and Big Data Analytics for Smart Food Processing*. CRC Press, Boca Raton, Florida.
6. Bishop, C.M. (2006). *Pattern Recognition and Machine Learning*. Springer, New York.

SEMESTER-VII

Course Code: DFT411C						Course Title: Meat, Fish and Poultry Products Technology				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	1	1	4	5	25	10	35	30	100

Course Objectives

- This course aims to develop knowledge of students about the meat industry in India and abroad.
- The course aims to impart knowledge to students about techniques and practices in modern abattoirs/slaughter houses.
- The course will enable the students to appreciate the application of modern scientific principles in processing, packaging of meat and fish products.

UNIT I

Present status of meat, poultry and fish industries in India. Traditional meat products. Sources of meat and meat products in India, importance of livestock sector in national economy. Chemical composition, nutritional profile and microscopic structure of meat. Inclusion of sustainability aspects of meat industry (e.g., water footprint, greenhouse gas emissions), emerging segments like plant-based and cultured meat, and role of regulatory agencies such as FSSAI and APEDA in meat quality control and exports

UNIT II

Modern abattoir practices – pre-slaughter care, ante-mortem inspection of live animals, slaughtering techniques of large animals, small animals and poultry. Post-mortem examination of meat, conversion of muscle into meat/post-mortem changes in meat, factors affecting post-mortem changes in meat. Properties of fresh meat – water holding capacity of meat, colour, pigments, texture and juiciness. Meat microbiology and safety – spoilage characteristics of meat, preventive measures for avoiding meat spoilage. Inclusion of humane handling and stunning techniques, basics of HACCP application in slaughter operations, and post-mortem interventions like rapid chilling and electrical stimulation for improving meat quality and shelf life

UNIT III

Meat processing – comminution, emulsification, curing, smoking, ageing and tenderization. Meat products – fermented meats, comminuted meat products, sausages, ham, bacon and meat analogues. Meat storage and preservation – by moisture control (dehydration, freeze drying and intermediate moisture meat), by temperature control (chilling, freezing and thermal processing), by direct microbial inhibition (irradiation and chemical preservatives). Meat packaging, meat industry by-products and their utilization. Integration of advanced preservation techniques such as high-pressure processing and sous-vide; enhancement of packaging section with Modified Atmosphere Packaging (MAP), vacuum packaging, and smart/intelligent packaging; enrichment of "meat analogues" with modern plant-based alternatives using extrusion and mycoproteins

UNIT IV

Inspection of live birds, slaughter and dressing of poultry. Composition and nutritive value of poultry meat. Poultry products – structure, composition, nutritive value and functional properties of eggs, grading of eggs, measures of egg quality and factors affecting egg quality. Preservation and safe handling of eggs. Egg powder and egg-based products. Types of fish. Composition, structure, nutritional profile and post-mortem changes in fish. Handling of freshwater fish. Canning of fish. Different fish products. Curing, smoking, salting, canning, freezing and drying of fish. Comminuted fish products, fish protein concentrate, packaging of fish, utilization of fish and marine industry by-products. Enrichment of this unit with value-added poultry and fish products like surimi, liquid egg products, and ready-to-eat fish curry in retort pouches. Improved content on egg grading techniques (e.g., Haugh unit, yolk index) and recovery of bioactives like fish collagen and peptides from processing waste. Emphasis on cold-chain logistics in fish handling.

Course Outcomes:

- The students are expected to appreciate the importance of livestock sector in national economy.
- The students are expected to understand and identify the need of modern scientific abattoirs/ slaughter houses.
- The students will gain knowledge about the specific processing technologies used for meat, poultry and fish products

Books Recommended:

1. Lawrie, R. A. (1975). Meat Science. 2ndEdn. Pergamon Press. Oxford UK.

2. Meat processing and Meat Products Handbook, EIRI Board of Consultants and Engineers, Indian Institute of Consultants, New Delhi

Practicals

1. Determination of pH of raw and processed meat samples.
2. Evaluation of water-holding capacity (WHC) of meat by meat swelling capacity method.
3. Estimation of extract release volume (ERV) of minced meat.
4. Determination of specific gravity of eggs using salt solutions and candling.
5. Formulation and preparation of value-added meat products (e.g., sausages, meatballs).
6. Demonstration of slaughtering and dressing procedures for poultry.
7. Evaluation of external and internal egg quality parameters.
8. Preservation of shell eggs using lime coating, oiling, and refrigeration.
9. Quality analysis of processed fish products (chemical, sensory, packaging).
10. Assessment of hygiene and sanitation protocols in a meat processing plant.
11. Industrial visit to meat, poultry and egg processing facilities.

Course Code: DFT412C						Course Title: Bakery and Confectionery Technology				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	1	1	0	4	5	25	10	35	30	100

Course Objectives

- To make the students aware about food safety rules and regulations and maintenance of hygienic conditions in bakery units.
- To impart knowledge about different ingredients used in bakery and to make the students aware about production processes of different bakery products.
- To teach the students manufacturing processes involved for confectionary products and to evaluate their quality parameters.
- To make the students aware with knowledge and understanding in the basic operation and working of various equipments involved in bakery and confectionary technology.

UNIT I

Introduction to bakery technology, current status, growth rate and economic importance of bakery Industry in India. Types of bakery products, nutritional quality and safety, pertinent standards & regulations, safety concerns related to additives used in bakery products. Essential and Optional Ingredients. Wheat flour Quality Parameters, Role of Flour in Bakery, Flour Specifications for different Bakery Products, SWOT analysis for Indian Bakery Products, Identification of different bakery equipment's

.

UNIT II

Bread, Buns and Pizza base Ingredients used, Bread Science, Preferments and Fermentation, Doug Rheology, Processes for bread, buns, and pizza base, changes taking place during baking, equipment used in bread making, Product quality characteristics, faults, and corrective measures.

UNIT III

Ingredients & processes for cakes, Cookies and Biscuits, equipment used, product quality characteristics, faults, and corrective measures. Different types of icings. ingredients & processes for pastry, product quality characteristics, faults and corrective measures.

UNIT IV

Introduction to Confectionary technology, current status, growth rate and economic importance of Confectionary Industry in India. Different types of Confectionaries, Characteristics and processing of raw material; General Technical Aspects of Industrial Confectionery, Chocolate Processing, Manufacture, Boiled Sweets and Candies, , Toffees Ingredients and Processing, chewing gums, Fondants, - Ingredients and Processing, Crystallized Confectionery, Quality and standards/ Regulations to be followed in the Confectionary Industry and packaging requirements

Course Outcomes

- Describe the structure, market trends, and regulatory requirements of the bakery and confectionery industry.
- Classify bakery and confectionery ingredients based on functionality and evaluate their effects on product quality and safety.
- Explain dough rheology, fermentation mechanisms, and physicochemical changes occurring during baking.
- Design processing steps for bread, buns, pizza bases, cakes, cookies, biscuits, and pastries using appropriate equipment.
- Evaluate product quality attributes and diagnose faults in bakery and confectionery products and recommend corrective actions.
- Analyze manufacturing processes for confectionery products including chocolates, boiled sweets, lozenges, gums, fondants, and marzipan.
- Assess the role of additives, standards, and regulatory compliance in ensuring safety and quality of bakery products.
- Select suitable packaging materials and storage conditions for bakery and confectionery products.
- Apply scientific and technological principles to improve product formulation, texture, stability, and shelf life.
- Integrate processing, quality control, and regulatory considerations to develop safe and marketable bakery and confectionery products.

Books Recommended:

1. Bernrd .Minife. W. (2003), Chocolate, Cocoa and Confectionary.

2. Mathur. R.B.L. (1999), Handbook of cane sugar technology, CBS Publishers.

3. FaridiHamed , (2003), The Science of Cookie and Cracker Production.

4. Matz, (1989). Bakery Engineering and Technology, Vol I and II, CBS Publishers, New Delhi.

5. Stanley. P & Linda. S. (2007), Technology of Bread Making, Blackwell Publishing. Stanley. P & Linda. S. (2006), Baked Products, Blackwell Publishing.

6. Matz, (1989). Cookie and Cracker Technology, CBS Publishers, New Delhi.

Practicals

1. Role of Ingredients for Bakery products
2. Formula balancing for baked products
3. Determination of Gluten content and Gluten development in Flours
4. Water and oil absorption capacity of Flours
5. Preparation and quality evaluation of Biscuits and Cookies
6. Preparation and quality evaluation of croissant
7. Preparation and quality evaluation of doughnuts, and pizza base
8. Preparation and quality evaluation of Breads and Buns
9. Preparation of:1. Candies, 2.Caramel, 3.Toffees
10. Visit to bakery and confectionary Industries.

Course Code: DFT413C						Course Title: Advanced Instrumentation Techniques				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	2	0	4	6	25	10	35	30	100

Course Objectives

- Understand theoretical principles and instrumentation of advanced analytical and characterization techniques used in food, biochemical, and material analysis.
- Develop practical knowledge of chromatographic, spectroscopic, thermal, rheological, microscopic, and molecular analytical methods.
- Gain familiarity with operation, calibration, and interpretation of results obtained from modern analytical instruments.
- Understand sample preparation procedures and analytical protocols for qualitative and quantitative analysis.
- Develop analytical skills for assessing physicochemical, structural, compositional, and functional properties of food and biological samples.
- Understand applications of molecular and structural analysis tools such as PCR, NMR, and X-ray techniques.
- Build competency in laboratory safety, instrumentation handling, and scientific reporting.

UNIT-I

Chromatography: Theory, components, working, and applications of HPLC, UHPLC and GC, Spectroscopic techniques: Theory, instrumentation and applications of FTIR, NIR, UV Visible, Refractometry and colorimetry: Theory, principle, and applications of bench-top refractometer and hunter Lab colorimeter

UNIT-II

Rheological and texture measurements: Principle, instrumentation and working of Rheometer; texture analyser; viscometer and rapid visco analyser (RVA), Differential scanning calorimetry: Principle, working and applications of DSC.

UNIT-III

Nuclear magnetic resonance: Principle, instrumentation, applications and interpretation of NMR spectra X-ray crystallography: Principle, applications and interpretation of spectra.

UNIT-IV

Microscopy: Theory, instrumentation, and its applications of Scanning electron microscope and Transmission Electron Microscope, Polymerase chain reaction: Principle and applications in food.

Course Outcomes

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

- Explain working principles and components of chromatographic techniques such as HPLC, UHPLC, and GC.
- Interpret spectroscopic data obtained from FTIR, NIR, and UV–Visible spectroscopy for qualitative and quantitative analysis.
- Describe principles and applications of mass spectrometry and evaluate its use in GC, LC, and ICP systems.
- Analyze elemental composition using atomic absorption spectroscopy and interpret analytical outputs.
- Measure physicochemical properties such as refractive index and color values using refractometry and colorimetry.
- Evaluate rheological and textural properties of materials using rheometers, viscometers, texture analyzers, and RVA.
- Interpret thermal behavior of samples using differential scanning calorimetry.
- Explain structural analysis principles using NMR, X-ray crystallography, and electron microscopy techniques.
- Apply PCR techniques for detection and analysis of biological components in food systems.
- Integrate analytical results to draw scientific conclusions and prepare structured laboratory reports.

Reference

1. S. Nielsen. *Food Analysis.* 6th Edition, Springer, 2024.
2. D.W. Sun (Ed.). *Modern Techniques for Food Authentication.* 3rd Edition, Academic Press (Elsevier), 2024.
3. Leo M.L. Nollet and Fidel Toldrá (Eds.). *Handbook of Food Analysis.* 3rd Edition, CRC Press, 2023.
4. R.P.W. Scott. *Principles and Practice of Chromatography.* CRC Press.

5. D.A. Skoog, F.J. Holler, and S.R. Crouch. *Principles of Instrumental Analysis.* 7th Edition, Cengage Learning, 2018.

Practicals:

1. Determination of sugar content and total soluble solids using a bench-top refractometer.
2. Colour measurement of food samples using Hunter Lab colorimeter.
3. Separation and identification of compounds using HPLC.
4. Analysis of volatile compounds using Gas Chromatography (GC).
5. Determination of absorbance spectra using UV–Visible spectrophotometer.
6. Functional group identification of food constituents using FTIR spectroscopy.
7. Determination of viscosity of liquid foods using viscometer.
8. Texture profile analysis of food products using texture analyser.
9. Pasting property analysis of starch/flour samples using Rapid Visco Analyzer (RVA).
10. Rheological characterization of food systems using rheometer.
11. Thermal property analysis of food materials using DSC.
12. Mineral estimation using Atomic Absorption Spectroscopy (AAS).
13. Observation of microstructure of food materials using SEM/TEM images.
14. Interpretation of NMR spectra of selected compounds.

Course Code: DFT414F						Course Title: Credit Seminar/Project				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
0	0	0	1	1	1	NA	NA	100	NA	100

Course Description (Credit Seminar/Project)

- Develops the ability to identify and investigate a contemporary research problem in Food Technology.
- Enhances skills in literature survey, critical analysis, scientific writing, and technical presentation.
- Provides hands-on experience in planning, executing, and interpreting experimental or analytical research.
- Promotes independent learning, problem-solving, innovation, and research ethics.
- Encourages the application of theoretical knowledge to address real-world challenges in food processing, quality, safety, and sustainability.
- Improves communication skills through seminar presentations, technical discussions, and report preparation.
- Prepares students for higher education, industrial research and development (R&D), entrepreneurship, and professional careers in the food sector.

Course Code: DFT415G						Course Title: Food Plant Layout and Management				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
2	0	0	1	3	3	30	20	50	0	100

Course Objectives

- Understand fundamental concepts of marketing, marketing environment, strategic planning, and marketing research.
- Gain knowledge of factory building design considerations, cost structures, and economic feasibility analysis.
- Understand plant maintenance systems and their role in efficient industrial operations.
- Comprehend concepts, functions, and importance of human resource management in industrial organizations.
- Develop awareness of workforce planning, recruitment, training, and industrial relations.
- Integrate managerial, economic, and operational principles for effective industrial management.

UNIT I

Nature, scope and types of marketing, marketing environment, strategic marketing planning, marketing information system and marketing research. Market segmentation, targeting and positioning. Product decisions: product mix, product life cycle, new product development, branding decisions (Basis). Pricing: objectives, channel, management-channel types

UNIT II

Plant Location and Layout-Concept and factors governing plant location. Location economics comparison of rural vs urban plant sites, plant site selection guide. Classes of layout problems, objectives, principles and types of layouts. Layouts of different types of food and fermentation industries – canning, dairy, bread, biscuit, beer, tomato processing, rice mill and wheat mill.

UNIT III

Factory Building and Cost Analysis- Considerations in building design and construction. Fixed cost, variable cost, depreciation, methods of economic analysis, profitability analysis of a plant.

Plant Maintenance-Objectives and importance of maintenance, Factory Building and Cost Analysis Considerations.

UNIT IV

Introduction- Introduction to Human Resource Management and its definition, functions of human resource management, Causes and effects of industrial disputes in India, Need for human resource planning, process of human resource planning, methods of recruitment, Meaning and importance of placement and induction. Training and development- Difference between training and development, principles of training.

Course Outcomes

- Explain marketing concepts, segmentation strategies, and product positioning for industrial and consumer markets.
- Design suitable plant layouts for different food and fermentation industries based on operational requirements.
- Calculate fixed and variable costs, depreciation, and profitability indicators for industrial projects.
- Assess building design considerations and maintenance requirements for efficient plant operations.
- Explain functions of human resource management and analyze workforce planning and recruitment processes.
- Integrate marketing, operational, financial, and human resource principles for effective management of food processing enterprises.

Books Recommended

1. Varshney, R.L. and Gupta, S.L. *Marketing Management: An Indian Perspective.* Sultan Chand & Sons, New Delhi.
2. James B. Dilworth**.** *Operations Management: Design, Planning and Control for Manufacturing and Services.* McGraw-Hill Education.
3. R.C. Arora**.** *Production and Operations Management.* PHI Learning Pvt. Ltd., New Delhi.
4. Gary Dessler**.** *Human Resource Management.* 16th Edition, Pearson Education, 2020.
5. M. Mahajan**.** *Industrial Engineering and Production Management.* Dhanpat Rai Publications, New Delhi.

Course Code: DFT416C						Course Title: Enzymes in Food Processing				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
1	1	0	0	2	2	15	10	25	0	50

Course Objectives

- Provide fundamental knowledge of enzyme structure, classification, kinetics, and mechanisms relevant to food systems.
- Explain the role of enzymes in major food processing operations such as baking, dairy, brewing, fruit and vegetable processing, and meat tenderization.
- Familiarize students with industrial production, extraction, purification, and immobilization of enzymes.
- Develop understanding of enzyme stability, inhibition, and optimization under food processing conditions.
- Highlight applications of enzymes in improving food quality, safety, shelf life, nutrition, and sustainability.
- Introduce emerging enzymatic technologies in functional foods, nutraceuticals, and waste valorisation.

UNITI

Enzymes classification, properties, characterization, kinetics and immobilization; fermentative production of enzymes (amylases, proteases, cellulases, pectinases, xylanases, lipases) used in food industry and their downstream processing.

UNIT II

Enzymes for starch modification (maltodextrins and corn syrup solids: liquefaction, saccharification, dextrinization, isomerization for production of high-fructose-corn-syrup, fructose and fructo- oligosaccharides). Enzymes for protein modification (hydrolysates and bioactive peptides), Enzymes for Lipid modification.

UNIT III

Enzymes as processing aids: Role of enzymes in Dairy processing (cheese making and whey processing), meat processing (tenderization and flavor development) and fish processing De-skinning, collagen extraction etc.,) Egg processing, Brewing**,** Baking (fungal -amylase for bread making; maltogenic -amylases for anti-staling; xylanases and pentosanes.

UNIT IV

Role of enzymes in the production of flavours (enzyme-aided extraction of plant materials for production of flavours, production of flavour enhancers such as nucleotides, MSG; flavours from hydrolyzed vegetable/animal protein)

Course Outcomes:

- Describe the classification, structure, kinetics, and mechanism of action of food-related enzymes.
- Analyse the role of enzymes in different food processing sectors including bakery, dairy, beverages, fruits, vegetables, and meat products.
- Apply knowledge of enzymes to improve food quality attributes such as texture, flavor, color, and nutritional value.

Books Recommended:

1. Whitaker, J.R., Voragen, A.G.J. & Wong, D.W.S. (Eds.). (2003). *Handbook of Food Enzymology*. Marcel Dekker, New York.
2. Whitehurst, R.J. & van Oort, M. (Eds.). (2010). *Enzymes in Food Technology* (2nd ed.). Wiley-Blackwell, Oxford.
3. Rao, M.B. & Deshpande, V.V. (Eds.). (2017). *Industrial Enzymes: Structure, Function and Applications*. Springer Nature, Singapore.
4. Pandey, A., Webb, C., Soccol, C.R. & Larroche, C. (Eds.). (2005). *Enzyme Technology*. Asiatech Publishers Inc., New Delhi.
5. Aehle, W. (Ed.). (2007). *Enzymes in Industry: Production and Applications* (3rd ed.). Wiley-VCH, Weinheim, Germany.
6. Trevan, M.D. (1980). *Immobilized Enzymes: An Introduction and Applications in Biotechnology*. John Wiley & Sons, Chichester.

Course Code: DFT417E						Course Title: Food and Nutrition				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
1	1	0	0	2	2	15	10	25	0	50

Course Objectives

1. Understand advanced concepts of human nutrition, nutrient metabolism, and their relevance to food technology.
2. Explain the role of functional foods, nutraceuticals, probiotics, and bioactive compounds in promoting health and preventing disease.
3. Apply nutritional principles in the development, reformulation, fortification, and evaluation of processed foods.
4. Evaluate the impact of food processing on nutritional quality, bioavailability, and health outcomes.
5. Understand emerging concepts such as personalized nutrition, nutrigenomics, nutrition security, and sustainable food systems.

UNIT I:

Advanced concepts in human nutrition: Scope and relevance for food technologists, Macronutrient metabolism: Carbohydrates, proteins, lipids – digestion, absorption, metabolic pathways and regulation, Micronutrients: Bioavailability, interactions, stability during processing, Nutrient–nutrient and nutrient–drug interactions, Nutritional genomics and nutrigenomics, Energy balance, metabolic disorders (obesity, metabolic syndrome, diabetes), Biomarkers of nutritional status and assessment techniques

UNIT II:

Functional foods: Concept, classification, and global trends, Bioactive compounds: Polyphenols, carotenoids, phytosterols, omega-3 fatty acids, peptides, Probiotics, prebiotics, symbiotic and postbiotics, Dietary fibre: Physiological functions and technological implications, Nutraceuticals: Regulatory framework and health claims.

UNIT III:

Nutritional formulation strategies in processed foods, Fortification and biofortification: Principles, challenges, and case studies, Reformulation approaches: Sugar reduction, salt

reduction, fat replacers, Clean-label and plant-based nutrition trends, Nutritional labelling, health claims, and regulatory compliance, Sensory–nutrition interface in product development, Nutritional quality evaluation of novel and processed foods

UNIT-IV

Role of food technology in combating malnutrition (undernutrition and overnutrition), Nutrition across the lifecycle: Infants, elderly, clinical and therapeutic diets, Food processing and its impact on nutrient retention and bioavailability, Risk–benefit analysis of food components (additives, contaminants, ultra-processed foods), Personalized nutrition and digital health tools, Sustainability, food systems, and nutrition security, Emerging research areas in advanced nutrition science

Course Outcomes

- Explain the metabolism of macro- and micronutrients, nutritional assessment techniques, and the relationship between nutrition and metabolic disorders.
- Evaluate the health benefits, technological applications, and regulatory aspects of functional foods, nutraceuticals, probiotics, and bioactive food components.
- Design and assess nutritional improvement strategies including food fortification, reformulation, clean-label product development, and nutritional quality evaluation.
- Analyze the influence of food processing on nutrient retention, personalized nutrition approaches, nutrition security, and the role of food technology in addressing global nutritional challenges.

Books Recommended

1. Gropper, S. S., & Smith, J. L**.** *Advanced Nutrition and Human Metabolism.* Cengage Learning.
2. Ross, A. C., Caballero, B., Cousins, R. J., Tucker, K. L., & Ziegler, T. R**.** *Modern Nutrition in Health and Disease.* Wolters Kluwer.
3. Gibney, M. J., Lanham-New, S. A., Cassidy, A., & Vorster, H. H. *Introduction to Human Nutrition.* Wiley-Blackwell.
4. Wildman, R. E. C., & Kelley, M**.** *Handbook of Nutraceuticals and Functional Foods.* CRC Press.
5. Damodaran, S., Parkin, K. L., & Fennema, O. R**.** *Fennema's Food Chemistry.* CRC Press.

Course Code: DFT418E						Course Title: Beverage Technology				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
1	1	0	0	2	2	15	10	25	0	50

Course Objectives

To provide a technical view of beverages and a full discussion of Manufacturing processes in the context of technology and its related chemistry as well as a more fundamental appraisal of the underlying science.

UNIT- I

Types of beverages and their importance; status of beverage industry in India; Manufacturing technology for juice-based beverages; synthetic beverages; technology of still, carbonated, low-calorie and dry beverages; role of various ingredients of soft drinks, carbonation of soft drinks.

UNIT- II

Classification of non-alcoholic beverages (fruit beverages, carbonated drinks, functional beverages, sports and energy drinks, and herbal drinks)

UNIT- III

Alcoholic beverages- types, manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process.

UNIT- IV

Packaged drinking water- definition, types, manufacturing processes, quality evaluation and raw and processed water, methods of water treatment, mineral water, natural spring water, flavored water, carbonated water.

Course Outcomes

- Explain the classification, composition, processing technologies, and quality attributes of various non-alcoholic beverages, including fruit-based, carbonated, functional, sports, energy, and herbal beverages.
- Describe the formulation, processing, carbonation, and quality control of soft drinks and other beverage products, along with the functional role of different ingredients.
- Explain the principles of fermentation, brewing technology, yeast physiology, and quality evaluation of alcoholic beverages such as beer, wine, and related products.

- Evaluate the manufacturing processes, water treatment methods, quality standards, packaging requirements, and regulatory aspects of packaged drinking water, mineral water, and other specialty water beverages.

Recommended Books

1. Priyadarshini, S., & Chakraborty, S. *Beverage Processing: Technology, Quality, and Safety.* CRC Press.
2. Ashurst, P. R. *Chemistry and Technology of Soft Drinks and Fruit Juices.* Wiley-Blackwell.
3. Briggs, D. E., Boulton, C. A., Brookes, P. A., & Stevens, R. *Brewing: Science and Practice.* Woodhead Publishing.
4. Hui, Y. H. (Ed.). *Handbook of Fruits and Fruit Processing.* Wiley-Blackwell.
5. De, S. *Outlines of Dairy Technology.* Oxford University Press.

SEMESTER-VIII

Course Code: DFT451C						Course Title: In-Plant Training				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Comprehensive viva (internal)	Industrial component	Project Report	Viva Voce / Presentation (external)	Total
NA	NA	NA	NA	20	NA	200	50	50	100	400