

**DEPARTMENT OF FOOD TECHNOLOGY
SCHOOL OF ENGINEERING AND TECHNOLOGY**

SYLLABUS

FOR

M.Sc. FOOD SCIENCE & TECHNOLOGY

(SEMESTER I –IV)



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

S. No.	Course Code	Course Name	Course Type	Credit					Examination Components	
				Total	L	T	P	S	Component	Marks
1	DFT501C	Introduction to Microbiology and Biochemistry	Core	4	3	0	1	0	Mid-Term Assignment End Term Practical	25 10 35 30
2	MTH501F	Research Methodology	Fundamental	2	1	0	1	0	Mid-Term Assignment End Term Practical	25 10 35 30
3	DFT502C	Fruit and Vegetable Technology	Core	4	3	0	1	0	Mid-Term Assignment End Term Practical	25 10 35 30
4	DFT503C	Cereals, Pulses and Oil seed Technology	Core	4	3	0	1	0	Mid-Term Assignment End Term Practical	25 10 35 30
5	DFT507C	Thesis	Core	4	4	0	0	0	End Term	100
Discipline Centric Elective (Any Two)										
6	DFT504E	Milk and Milk Products Technology	Discipline Centric Elective	2	2	0	0	0	Mid-Term Assignment End Term	15 10 25
7	DFT505E	Food Additives and Ingredients	Discipline Centric Elective	2	2	0	0	0	Mid-Term Assignment End Term	15 10 25
8	DFT506E	Bakery and Confectionary Technology	Discipline Centric Elective	2	2	0	0	0	Mid-Term Assignment End Term	15 10 25
Total Credits				22						

Semester II

S. No.	Course Code	Course Name	Course Type	Credit					Examination Components	
				Total	L	T	P	S	Component	Marks
1	DFT551C	Food Safety and Quality Control	Core	3	3	0	0	0	Mid-Term Assignment End Term	30 20 50
2	DFT552C	Food Processing and Preservation	Core	3	2	0	1	0	Mid-Term Assignment End Term Practical	25 10 35 30
3	DFT553C	Chemistry of Foods	Core	4	3	0	1	0	Mid-Term Assignment End Term Practical	25 10 35 30
4	DFT554C	Microbiology of Foods	Core	4	3	0	1	0	Mid-Term Assignment End Term Practical	25 10 35 30
5	DFT558C	Thesis	Core	4	4	0	0	0	End Term	100
Discipline Centric Elective (Any Two)										
6	DFT555E	Waste Management and By-product Utilization	Discipline Centric Elective	2	2	0	0	0	Mid-Term Assignment End Term	15 10 25
7	DFT556E	Food Toxicology	Discipline Centric Elective	2	2	0	0	0	Mid-Term Assignment End Term	15 10 25
8	DFT557E	Technology of Spices and Plantation Crops	Discipline Centric Elective	2	2	0	0	0	Mid-Term Assignment End Term	15 10 25
Total Credits				22						

Semester III

S. No.	Course Code	Course Name	Course Type	Credit					Examination Components	
				Total	L	T	P	S	Component	Marks
1	DFT601C	Technology of Animal Products	Core	3	2	0	1	0	Mid-Term Assignment End Term Practical	25 10 35 30
2	DFT602C	Food Process and Engineering	Core	3	3	0	0	0	Mid-Term Assignment End Term	30 20 50
3	DFT603C	Food Packaging	Core	3	2	0	1	0	Mid-Term Assignment End Term Practical	25 10 35 30
4	DFT604C	Credit Seminar	Core	1	1	0	0	0	End Term	100
5	DFT605C	Thesis	Core	5	5	0	0	0	End Term	500
Discipline Centric Elective (Any Two)										
6	DFT606E	Food Plant Design and Management	Discipline Centric Elective	2	2	0	0	0	Mid-Term Assignment End Term	15 10 25
7	DFT607E	Industrial Plant Hygiene and Sanitation	Discipline Centric Elective	2	2	0	0	0	Mid-Term Assignment End Term	15 10 25
8	DFT608E	Snack Technology	Discipline Centric Elective	2	2	0	0	0	Mid-Term Assignment End Term	15 10 25
9	DFT609E	Advanced Instrumentation in Food Processing	Discipline Centric Elective	2	2	0	0	0	Mid-Term Assignment End Term	15 10 25
Total Credits				19						

Semester IV

S. No.	Course Code	Course Name	Course Type	Credit					Examination Components	
				Total	L	T	P	S	Component	Marks
5	DFT651C	Thesis	Core	20	20	0	0	0	End Term	800
Total Credits				20						

SEMESTER I

Course Code: DFT501C						Course Title: Introduction to Microbiology and Biochemistry				
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 the basic concepts of microbial world evolution.
- To study the characteristics and reproduction of various microbes.
- To understand the basic concepts of biochemistry.
- To understand the structural organization and functions of different biomolecules.

UNIT I:

Discovery of microbial world. Theory of spontaneous generation. The Germ theory of disease. Historical development of immunisation. Prokaryotic cell. Shape, size and arrangement of bacterial cells. Morphology of bacteria: Cell wall, Cell membrane, Spore, Capsule.

UNIT II:

Reproduction in bacteria (Sexual and Asexual). Microbial growth. Growth curve of batch culture, continuous culture and synchronous culture. Factors affecting growth of bacteria. Measurement of growth: Direct microscopic count, the plate count method, Turbidometric method.

UNIT III:

Biochemistry: Definition, scope, and importance in food science and human nutrition. Overview of macronutrients (carbohydrates, proteins, lipids) and micronutrients (vitamins, minerals, water). Proteins: Introduction and role in food and biological systems. Amino acids: classification, essential vs non-essential, nutritional and functional significance. Classification of proteins (simple, conjugated, derived), Major dietary sources, Levels of structural organization (primary, secondary, tertiary, quaternary), Biochemical functions of proteins (structural, enzymatic, transport, hormonal, protective)

UNIT IV:

Carbohydrates: General structure and biochemical functions (energy, storage, structural role). Lipids: Fatty acids, brief introduction (saturated, unsaturated, essential fatty acids). Classification (simple, compound, derived), Dietary sources, Structure and biochemical functions (energy, cell membrane, signalling, insulation). Vitamins and Minerals: Introduction

and significance in health and metabolism. Vitamins: fat-soluble (A, D, E, K) and water-soluble (B-complex, C). Minerals: macro and micro.

Practicals

1. Instruments of microbiology laboratory and their functions.
2. Monochrome staining.
3. To stain the given bacteria by Gram's staining method.
4. Preparation of nutrient medium.
5. Plating techniques: Spread plate Technique, Pour plate technique, Pour plate technique.
6. Qualitative analysis of carbohydrates and proteins using Molisch's, Benedict's, Biuret, and Ninhydrin tests.
7. Estimation of reducing sugars in food samples by the DNS (3,5-dinitrosalicylic acid) method.
8. Estimation of protein content in food samples by the Lowry method.
9. Determination of Vitamin C content in fruit juice by the DCPIP titration method.

COURSE OUTCOMES:

- Grasp the basic knowledge of microbial world.
- Explain the importance & uses of biomolecules in relation to their structural organization.

Books Recommended:

1. *Book of Biochemistry by Rama Rao AVSS, 1999, LK and S Publishers, Visakhapatnam, 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. *Pelezar, M. J., Chan, E. G. S. and Krieg, N.R. (2002). Microbiology 5th edition, Tata McGraw Hill and Co, New Delhi*

Course Code: MTH501F						Course Title: Research Methodology				
L	T	P	S	Total Credits	Total Contact Hour	Examination				
						Internal	Assignment	End Term	Practical	Total
1	0	1	0	2	3	25	10	35	30	100

Course Objectives

- To develop fundamental knowledge of research methodology and scientific inquiry.
- To apply statistical techniques for data collection, analysis, and interpretation.
- To develop analytical and critical thinking skills for research.
- To promote ethical research practices, including proper referencing and plagiarism awareness.

UNIT I:

Research Methodology: Meaning, objectives and types of research, research approaches, Significance of research, Research and scientific methods, research process and criteria of good research definition and identification of a research problem

UNIT II:

Population and sample – types of statistical data – collection and classification of data – Frequency distribution – Diagrammatic Representation of data – Measures of central tendencies – Mean, Median and Mode: Measures of dispersion – Range, Quartile deviation, standard deviation, Skewness and Kurtosis – Sampling techniques – Simple and Stratified Random Sampling techniques.

UNIT III:

Basic concept of hypothesis testing - Type I and type II errors. Two-way analysis of variance (RBD), LSD, - Multiple comparison tests (DMRT). – t test for independent samples, paired samples, F test two sample variances, Chi square test for goodness of fit. One-way ANOVA, two-way ANOVA, Correlation & Regression (three variables).

UNIT IV:

Data pre-processing and data management, Data cleaning, transformation and normalization – Handling missing data and outliers. Application of statistical software packages: Use of MS Excel, SPSS/R, and MATLAB for data entry, data visualization, statistical analysis and interpretation. Multivariate data analysis – Principal Component Analysis (PCA), Cluster Analysis (introductory level). Referencing style, plagiarism checking tools, IPR (Intellectual Property Rights).

Practicals

1. Identification and formulation of a research problem.
2. Preparation of a questionnaire and collection of primary data.
3. Data coding, entry, and classification using MS Excel/SPSS.
4. Construction of frequency distribution tables and graphical presentation of data.
5. Calculation of measures of central tendency (Mean, Median, and Mode).
6. Calculation of measures of dispersion (Range, Quartile Deviation, and Standard Deviation).
7. Application of sampling techniques for selection of samples.
8. Hypothesis testing using t -test and Chi-square test.
9. Analysis of data using correlation, regression, and one-way ANOVA.
10. Data cleaning, referencing, plagiarism checking, and statistical analysis using Excel/SPSS/R

Course Outcomes

- Explain the principles of research methodology and formulate research problems and hypotheses.
- Apply appropriate sampling methods and descriptive statistical techniques for data analysis.
- Perform hypothesis testing and interpret statistical analyses using suitable statistical methods.
- Utilize statistical software for data management, analysis, interpretation, and ethical reporting of research findings.

Recommended Books

1. Kothari, C. R., & Garg, G. (2019). *Research Methodology: Methods and Techniques* (4th ed.). New Age International Publishers.
2. Montgomery, D. C. (2020). *Design and Analysis of Experiments* (10th ed.). John Wiley & Sons.
3. Gupta, S. C., & Kapoor, V. K. (2020). *Fundamentals of Applied Statistics* (4th ed.). Sultan Chand & Sons.
4. Field, A. (2018). *Discovering Statistics Using IBM SPSS Statistics* (5th ed.). SAGE Publications.
5. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate Data Analysis* (8th ed.). Cengage Learning.

Course Code: DFT502C						Course Title: Fruit and Vegetable 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 the knowledge of post-harvest changes occurring in the fruits and vegetables.
- To provide broader overview of ripening processes in fruits.
- To provide knowledge of integrated post-harvest management of crops.
- To provide an overview of different storage system for fresh produce.

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. 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:

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.

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 OUTCOMES:

- Understand the post-harvest biology of fruits and vegetables.
- Grasp the techniques available for storage of fresh produce after harvest.

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*

Course Code: DFT503C						Course Title: Cereals, Pulses and Oilseed 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 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 and refining processes related to edible fats and oils.

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 valorization.

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:

Pulses and oilseeds: Composition, anti-nutritional factors and mitigation techniques. Post-harvest processing and storage. Processing of legumes for protein concentrates and isolates using membrane and enzymatic techniques. Milling of pulses – methods and equipment. Important oilseeds: sources, composition and nutritional value. Processing technologies: expeller and solvent extraction. Refining of oils, value-added processing: cold pressing, fractionation, winterization, inter-esterification, hydrogenation, and applications of zero-trans-fat oils.

Practicals

1. Determination of wet and dry gluten content in wheat flour samples.
2. Conditioning and tempering of wheat using laboratory-scale setup.
3. Laboratory parboiling and steaming of paddy.
4. Quality testing of raw and parboiled rice (size, shape, colour, etc.).
5. Assessment of rice polishing degree using Kett rice polisher.
6. Malting process of barley – steeping, germination, and kilning.
7. Puffing and popping of grains using dry heat and sand roasting.
8. Cooking quality evaluation of different rice varieties (elongation ratio, water uptake).
9. Industrial visit to a roller flour mill.
10. Industrial visit to a bakery unit.
11. Visit to rice milling/hulling plant.
12. Extraction of oil using screw press expeller.
13. Milling characteristics and particle size analysis using ball mill

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.
- Understand different refining processes and detection of adulteration in oils and fats.

Books Recommended:

1. Chakrabarty MM. 2003. *Chemistry and Technology of Oils and Fats*. Prentice Hall.
2. Dendy DAV & Dobraszczyk BJ. 2001. *Cereal and Cereal Products*. Aspen. Hamilton
- RJ & Bhati A. 1980. *Fats and Oils - Chemistry and Technology*. App. Sci. Publ.

3. *Hoseney RS. 1994. Principles of Cereal Science and Technology. 2nd Ed. AACC.*
4. *Kay DE. 1979. Food Legumes. Tropical Products Institute.*
5. *Kent NL. 1983. Technology of Cereals. 4th Ed. Pergamon Press.*
6. *Kulp K & Ponte GJ. 2000. Handbook of Cereal Science and Technology. 2nd Ed. Marcel Dekker.*
7. *Lorenz KL.1991. Handbook of Cereal Science and Technology. Marcel Dekker.*
8. *Marshall WE & Wadsworth JI. 1994. Rice Science and Technology. Marcel Dekker.*

Course Title: Thesis	Course Code: DFT507C	Total Credits	Total Marks
Review of literature on contemporary research areas to identify a research topic in consultation with the advisory, followed by seminar presentation before the committee and submission of a write-up.		4	100

Course Code: DFT504E						Course Title: Milk and Milk Products Technology				
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	-	50

COURSE OBJECTIVES:

- To develop knowledge of students in technology, manufacturing, processing and packaging of different milk products viz; concentrated, dried, fermented, coagulated and frozen dairy products.
- To impart knowledge about dairy hygiene and sanitation.

UNIT I

Introduction to Milk and its constituents, Evaporated and condensed milk: manufacture and uses. Milk powders: spray drying, drum drying. Infant formula, baby food, and dairy whiteners. Brief introduction of traditional Indian dairy products: Paneer, khoa, rabri, basundi, kulfi, rabri, chhana, lassi.

UNIT II

Cream: separation of cream and types of cream. Butter: types, manufacture (batch & continuous), quality defects. Ghee and butter oil: manufacture and grading. Margarine and spreads.

UNIT III

Fermented milks: dahi, yogurt, probiotic dairy products. Cheese: classification, basic steps in manufacture of cheese, paneer and chhana.

UNIT IV

Ice cream: Composition of ice creams. Role and functionality of different ingredients. Technology of ice cream manufacture: mix preparation, pasteurization, homogenization, aging, freezing, hardening.

COURSE OUTCOMES:

- The students will gain knowledge about specific technologies and manufacture of different milk and milk products.
- The students are expected to understand the nutritional importance of different milk and milk products.

- The students will gain knowledge about the good hygienic practices in the manufacture of different milk products.

Books Recommended:

1. *Smit, Gerrit (2003). Dairy processing: improving quality, Woodhead publishing limited, England.*
2. *De, Sukumar (1991). Outlines of dairy technology, Oxford University press, Delhi.*
3. *Varnam, A.H., Sutherland, J.P. (1994). Milk and milk products, Chapman and Hall, New York, USA*
4. *Walstra, P., Geurts, T.J., Noomen, A., Jellema, A., Boekel, M.A.J.S (1999). Dairy Technology: Principles of milk properties and processes, Marcel Dekker, Inc, New York.*

Course Code: DFT505E						Course Title: Food Additives and Ingredients				
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 develop the understanding of additives used in food products and the benefits thereof.

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. Replace: Bleaching & maturing agents with flavor enhancers (MSG), salt replacers (e.g., potassium chloride).

UNIT IV:

Colors: Natural and synthetic, permitted colors, 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 OUTCOMES:

- Define the utility and effects of using additives in food.

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.*

Course Code: DFT506E						Course Title: Bakery and Confectionary Technology				
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 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.

UNIT I:

Introduction to bakery and Confectionary technology, current status, growth rate, and economic importance of bakery and Confectionary 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.

UNIT II:

Bread, Buns and Pizza base, Ingredients used, bread science, fermenters and fermentation, Dough 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:

Confectionary Products: Characteristics and processing of raw material; General Technical Aspects of Industrial Confectionery, Chocolate Processing, Manufacture, Boiled Sweets, Tablets, Lozenges, Sugar Panning Tablets – Ingredients and Processing, chewing gums, Fondants, Marzipan- Ingredients and Processing, Crystallized Confectionery, Quality and standards/ Regulations to be followed in the Bakery Industry and packaging requirements

COURSE OUTCOMES:

- To gain the knowledge about the current status of bakery and confectionary industry in India and world.
- Build knowledge about the manufacturing processes of different bakery products and their quality evaluation.
- Develop knowledge about raw materials used and technology for the manufacturing of confectionary products and will be able to assess different defects and their remedial measures.
- Acquire knowledge of working, operation, and maintenance of various bakery equipments used in bakery units.

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.*
7. *FaridiFaubion, Dough Rheology and Baked product texture*

SEMESTER II

Course Code: DFT551C						Course Title: Food Safety and Quality Control				
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 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 food safety and food quality. Food hazards: biological, chemical, physical and emerging hazards. Food spoilage and contamination. Risk analysis: risk assessment, risk management and risk communication. Foodborne diseases and outbreaks. Quality concepts: Quality attributes of foods (sensory, nutritional, microbiological, physical and chemical quality). Quality control vs quality assurance. Total Quality Management (TQM). Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Sanitation Standard Operating Procedures (SSOP).

UNIT II:

Sampling techniques and quality inspection. Statistical quality control (control charts, acceptance sampling. Proximate analysis and quality parameters of major food commodities. Microbiological quality control. Shelf-life evaluation and accelerated testing.

UNIT III:

National and international food regulatory systems. Role of Codex Alimentarius Commission. Import–export regulations and certification. Food safety standards act- 2006 and regulation 2011. Food Safety and Standards Regulations (Licensing, Packaging & Labelling, Food Product Standards, Additives, Contaminants, etc.)

UNIT IV:

Food auditing and inspection procedures. Traceability and recall systems. HACCP certification, ISO standards, Organic certification, Halal and other certification systems. Food

fraud and adulteration. Emerging contaminants (microplastics, heavy metals, pesticide residues).

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 alimentarius 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.
- 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 & Gleyne E. Bledsoe.
4. Quality control in food industry (Vol. I and II) by Kramer and Twigg.
5. Food Safety Standards Act-2006

Course Code: DFT552C						Course Title: Food Processing and Preservation				
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 provide a general understanding of the concept of food preservation, processing and its historical background. Preservation using heat. Introduction to basic thermal processing.
- Awareness regarding low-temperature preservation, drying and dehydration
- Know-how of Bio-preserved comprising organic acids and antibiotics.
- Basic understanding of advanced processing techniques with accent on principles, mechanism of action, equipments 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.

Practicals

1. Blanching of vegetables: Time-temperature optimization and enzyme inactivation test (peroxidase test).
2. Pasteurization of milk/fruit juice: Phosphatase test (if facility available).
3. Thermal Death Time (TDT) determination: Construction of thermal death curve.
4. Calculation of D-value and z-value: Using microbial survivor data.
5. Determination of F-value and 12-D concept (numerical exercise): Canned food safety evaluation.
6. Canning of fruits/vegetables: Exhausting, sealing, processing, cooling.
7. Study of refrigeration system components: Compressor, condenser, evaporator (demonstration).
9. Quality changes during refrigerated storage: Weight loss, color change, texture evaluation.
10. Tray drying of fruits/vegetables: Determination of drying rate and drying constant.
11. Water activity measurement of food samples
12. Demonstration of microwave heating in food samples
13. Demonstration of ohmic heating in a food sample
14. Extrusion cooking of foods
15. Numerical problems on D, Z, F values and lethality calculations

COURSE OUTCOMES:

- Have the basic understanding of concepts of Food Preservation and Processing. Comprehension of principles and equipments used in thermal processing.
- Comprehension of techniques of Low Temperature Preservation. Understanding the phenomena of Drying and Dehydration with stress on varied techniques, principles and equipments.
- Knowledge regarding biopreservatives, antibiotics and organic acids, their efficacy as preservatives. Have the understanding of Irradiation as processing technique and its effects and safety issues.
- Basic understanding of advanced processing techniques, acquaintance regarding principles, equipments and food implication.

Books Recommended:

1. *Desrosier (2006). The Technology of Food Preservation, 4th edition, CBS Publishers & Distributors, New Delhi.*

2. *Potter and Hotchkiss (2006). Food Science, 5th edition, CBS Publishers & Distributors, New Delhi.*
3. *Zueth (2005). Food Preservation Techniques, CBS Publishers & Distributors, New Delhi.*
4. *Manay, N. S., & Shadaksharaswamy M. (2002). Foods, facts and principles (second edition). New age international publishers, New Delhi.*
5. *Fellows, P. (2004). Food processing Technology: Principles & Practices, 2nd edition, CRC Press USA.*

Course Code: DFT553C						Course Title: Chemistry of Foods				
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 and understand the physico-chemical properties of foods.
- To study and understand the nature of chemical reactions in the foods.

UNIT I

Introduction and importance of food chemistry. Composition of Food. Water, chemistry of water in food systems. Carbohydrates: 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, cellulose, β -glucan, and dietary fiber.

UNIT II

Lipids: Physical characteristics of lipids (melting, softening, specific gravity, refractive index, smoke, flash and fire point, turbidity point), chemical properties of fats (reichertmeissel value, polenske value, iodine value, peroxide value, saponification value), Edible fats and oils, Changes in fats and oils-rancidity-hydrolytic and oxidative. Technology of edible fats and oils-refining, and hydrogenation.

UNIT III

Proteins: Basic structure of proteins. Functional properties of Proteins, Denaturation, renaturation, Gelation, and Hydrolysis of proteins. Common Food proteins.

UNIT IV

Enzymes: Introduction, nomenclature, classification, Enzymes in food processing, mechanism of enzyme action, factors affecting enzyme action, Immobilized enzymes. Pigments: Definition, types and their role in foods. Vitamins and Minerals.

Practicals

1. General Introduction to food chemistry lab-Cleaning and handling of glass ware, 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. Qualitative analysis of carbohydrates by Colour reactions.
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 Kjeldhal method.
12. Saponification value, Iodine value.
13. Acid value, peroxide value.
14. Estimation of crude fat content by Soxhlet method

COURSE OUTCOMES:

- Recognize, distinguish and describe the molecular structures and properties of major food components.
- Relate molecular structure to properties of components found in food.
- Analyze and predict how the composition & conditions within a food influence functional property of food molecules.
- Describe major chemical reactions in foods and their mechanism.

Books Recommended:

1. *Fennema, O.R. Food Chemistry, 4th Edn. 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.*

Course Code: DFT554C						Course Title: Microbiology of Foods				
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 students to the world of microorganisms (Prokaryotes).
- To teach students how different microorganisms can be grown *in-vitro*.
- To teach students how bacterial growth (spoilage) can be controlled.
- To teach students isolation and preservation of microbial cultures.

UNIT I

Importance and significance of microorganisms in food science. Factors affecting the growth of microorganisms in food – Intrinsic and Extrinsic parameters. Food as substrate for microorganisms, Hydrogen ion concentration, moisture, water activity, oxidation reduction potential, inhibitory substances. 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.

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

Practicals

1. Preparation of microbiological culture media (Nutrient Agar, Nutrient Broth, Potato Dextrose Agar).

2. Isolation and development of pure cultures of microorganisms from food samples.
3. Enumeration of microorganisms in food samples using the Standard Plate Count (SPC) method.
4. Study of the effect of environmental factors (temperature, pH, and salt concentration) on bacterial growth.
5. Determination of the bacterial growth curve of a batch culture.
6. To demonstrate acid fast staining.
7. Enumeration of coliforms by MPN method
8. Assessing Sanitary quality of Contact Surfaces by Swabbing method
9. Analysis of Air processing facility for microbial load

COURSE OUTCOMES:

- Morphologically characterize bacteria.
- Carry out culturing of bacteria.
- Control the spoilage causing micro-organisms
- Isolate and preserve microbial cultures.

Books Recommended:

1. Dubey, R.C., and Maheshwari, D. K. (2001). *A text book of microbiology*, S. Chand and Co., New Delhi.
2. Pelezar, M. J., Chan, E. G. S. and Krieg, N.R. (2002). *Microbiology 5th edition*, Tata McGraw Hill and Co, New Delhi.
3. Purohit, S. S. (2001). *Microbiology, Fundamentals and applications*.
4. Sharma, P.D. (2000). *Microbiology, A text book for university students*.
5. Frazier, W. C. & Westhoff, D. C. (1996). *Food Microbiology*, Tata McGraw Hill and Co
6. James, M.J. (1997). *Modern Food Microbiology*, 4th Edition, CBS Publishers, New Delhi
7. Barnart, G.J. (1997). *Basic Food Microbiology*, CBS Publishers, New Delhi.
8. Stainer, R.Y. (1996). *General Microbiology*, 5th edition, Mac Millan Publishers, New Delhi.

Course Code: DFT555E						Course Title: Waste Management and By-Product Utilization				
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 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. Elements of importance in efficient management of food wastes. Standards for emission or discharge of environmental pollutants from food 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 equipments. 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. Physico-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

Principles of by-product utilization and circular bioeconomy. Waste hierarchy (reduce, reuse, recycle, recover). Biorefinery concept in food industries. Recovery of value-added components from food processing wastes. Emerging technologies in by-product utilization. Economic and environmental aspects.

COURSE OUTCOMES:

- Classify and explain different types of food waste and their utilization.

- Outline industrial effluent generation patterns, as well as its management and disposal techniques.

Books Recommended:

1. Hammer, M. J., & Hammer, M. J. Jr. *Water and Wastewater Technology* (5th ed.). Prentice Hall of India (PHI).
2. Casida, L. E. Jr. *Industrial Microbiology*. New Age International Publishers.
3. Agrawal, K. C. *Environmental Pollution*. Nidhi Publishers.
4. Rao, C. S. *Environmental Pollution Control Engineering*. New Age International Publishers.
5. Green, J. H., & Kramer, A. (Eds.). *Food Processing Waste Management*. AVI Publishing Company.

Course Code: DFT556E						Course Title: Food Toxicology				
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, principles and scope of food toxicology and the mechanisms of toxic action in biological systems.
- Explain the absorption, distribution, metabolism and excretion (ADME) of toxic substances and evaluate factors influencing toxicity.
- Identify naturally occurring food toxicants, processing-induced toxic compounds, environmental contaminants and food residues, and assess their health impacts.
- Develop knowledge of toxicity testing, risk assessment, risk management and national and international food safety standards for ensuring consumer health.

UNIT I

Introduction to toxicology. Definitions: toxin, toxicant, hazard, risk, exposure. Dose-response relationship. Threshold levels – LD₅₀, ADI and TDI concepts. Absorption, distribution, metabolism and excretion (ADME) of toxic substances. Biotransformation (Phase I and Phase II reactions). Mechanisms of toxicity. Target organ toxicity. Acute, sub-acute and chronic toxicity. Carcinogenicity, mutagenicity and teratogenicity. Bioaccumulation and biomagnification. Toxicokinetics and toxicodynamics.

UNIT II

Natural toxins in food. Toxicants in plant foods: anti-nutritional factors (phytates, oxalates, tannins, protease inhibitors), cyanogenic glycosides, glycoalkaloids (solanine), lectins and mycotoxins (aflatoxins, ochratoxin, fumonisins, patulin). Toxicants in animal foods: Marine toxins (ciguatera toxin, saxitoxin), Biogenic amines and Shellfish poisoning. Toxic constituents formed during processing and storage: Maillard reaction products, Acrylamide, Polycyclic aromatic hydrocarbons (PAHs), Nitrosamines and Heterocyclic amines.

UNIT III

Residues: Insecticides, herbicides and fungicides. Maximum residue limits (MRLs). Heavy metals and trace elements: lead, mercury, cadmium, arsenic. Sources and health effects. Food allergies and sensitivities: natural sources and chemistry of food allergens. Pesticide Environmental contaminants: dioxins, PCBs, microplastics, veterinary drug residues,

hormones and antibiotics. Packaging-related contaminants: Migration of plastics, bisphenol A, phthalates.

UNIT IV

Toxicity testing methods: In vivo and in vitro toxicity testing. Principles of risk assessment: Hazard identification, Hazard characterization, Exposure assessment and Risk characterization. Risk management and risk communication. Maximum permissible limits and international standards. Biomarkers of exposure and toxicity. Emerging issues in food toxicology. Case studies on food poisoning and contamination incidents.

Course Outcomes (COs)

- Explain the principles of toxicology, dose-response relationships, toxicokinetics, toxicodynamics and mechanisms of toxicity.
- Identify and evaluate natural food toxicants, processing-induced toxic compounds and their effects on human health.
- Assess the occurrence, sources and health risks associated with pesticide residues, heavy metals, packaging contaminants and other environmental toxicants in foods.
- Apply the principles of toxicity testing, risk assessment, risk management and food safety regulations to evaluate toxicological hazards in food systems.

Recommended References

1. Klaassen, C. D. (Ed.). *Casarett and Doull's Toxicology: The Basic Science of Poisons*. McGraw-Hill Education.
2. Hayes, A. W., & Kruger, C. L. *Hayes' Principles and Methods of Toxicology*. CRC Press.
3. Duffus, J. H., Nordberg, M., & Templeton, D. M. (Eds.). *Glossary of Terms Used in Toxicology*. Royal Society of Chemistry.
4. Shibamoto, T., & Bjeldanes, L. F. *Introduction to Food Toxicology*. Academic Press.
5. Reilly, C. *Metal Contamination of Food: Its Significance for Food Quality and Human Health*. Wiley-Blackwell.
6. Frazier, W. C., & Westhoff, D. C. *Food Microbiology*. McGraw-Hill Education.

Course Code: DFT557E						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	0	0	2	2	15	10	25	0	50

COURSE OBJECTIVES:

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

UNIT I

Definition, classification and importance of spices and plantation crops. Role in food, pharmaceutical and nutraceutical industries. Global and Indian production scenario. Chemical Composition and Post-harvest Technology for spices, Export potential. Export requirements. Spice Board of India. GI tagging (Kashmir Saffron GI). Quality certification and traceability

UNIT II

Equipment's used in the processing of spices; spice encapsulation; recent developments in production, retention and recovery of spices, Chemical Composition and Methods of Processing of different spices-pepper, cinnamon, turmeric, fennel, chilli, cardamom (small and big), cumin, mint, ginger, garlic cloves, fenugreek, saffron, Cryogenic grinding of spices effect of processing on spice quality: contamination of spices with micro-organisms and insects.

UNIT III

Definition, classification and importance of plantation crops, Composition, post-harvest processing and manufacture of coffee, Tea and Cocoa powder, Cocoa bean chemistry, processing for chocolate manufacturing, Enrobing technology, Oleoresins and essential oils.

UNIT IV

Flavour Technology: Essence (flavour) recovery techniques from fruits, spices and herbs, liquid and Solid flavour production; Flavouring remixing: flavour intensifiers, synthetic flavours; effect of processing on flavour quality. Spice Oleoresins: Definition, method of extraction, isolation, separation equipment. Spices and flavour quality evaluation: Criteria for assessment of flavour quality; identification of natural food flavours; methods of flavour

evaluation (chemical, instrumental, sensory); PFA standards for flavouring materials and flavours.

COURSE OUTCOMES:

- Explain various spices and flavors in food and processing of plantation crops.

Books Recommended:

1. *Purseglove, 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 flavorings, 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.*

Course Title: Thesis	Course Code: DFT558C	Total Credits	Total Marks
Preparation of Synopsis, Synopsis Seminar Presentation before the Committee The student shall prepare and submit a research synopsis in the prescribed format under the guidance of the supervisor. The student shall present the synopsis before the Committee and incorporate the recommendations before final approval.		4	100

SEMESTER III

Course Code: DFT601C						Course Title: Technology of Animal Products				
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:

- 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.

UNIT I:

Importance of animal products in human nutrition. Production scenario and economic importance in India. Composition and nutritive value of meat, poultry, fish, eggs and milk. Structure and functional properties of muscle proteins. Post-mortem changes in muscle: Rigor mortis, ageing and tenderization

UNIT II:

Slaughtering and dressing of animals. Hygienic handling of meat and poultry. Factors affecting quality of meat, fish and eggs. Spoilage of animal products: Microbial, enzymatic and oxidative spoilage. Shelf-life and preservation principles

UNIT III:

Meat processing operations: Cutting, deboning, curing, smoking, comminution and emulsification. Preservation of meat: Chilling and freezing of meat, Canning, cooking, drying, pickling, curing and smoking; prepared meat products like sausages, kebabs, etc. Intermediate moisture and dried meat products, Packaging of meat products.

UNIT IV:

Poultry processing: Slaughtering, dressing, chilling and freezing. Processing of poultry products. Packaging and storage of meat and poultry products: Chilling, freezing, modified atmosphere packaging (MAP). Quality evaluation and safety considerations. Eggs: Composition, handling, candling, washing, coating, packaging and storage. Egg processing (Egg powder manufacturing, pasteurization, etc., Spoilage and its control).

Practicals

1. Determination of the proximate composition of meat (moisture, protein, fat and ash).

2. Evaluation of the physicochemical quality of meat, including pH, water-holding capacity (WHC) and cooking loss.
3. Assessment of freshness and quality of fish by sensory evaluation and determination of total volatile basic nitrogen (TVB-N) (demonstration, if facilities are available).
4. Evaluation of egg quality by measuring Haugh unit, yolk index, albumen index and shell quality.
5. Candling and grading of eggs based on internal and external quality characteristics.
6. Preparation of a cured meat product (e.g., cured meat or bacon) and evaluation of product quality.
7. Preparation of an emulsified meat product (e.g., chicken sausage or meat nuggets) and quality assessment.
8. Packaging and storage studies of meat products using conventional packaging and/or modified atmosphere packaging (MAP), followed by evaluation of shelf-life parameters.
9. Microbiological quality assessment of meat or poultry products by Total Plate Count (TPC) and detection of coliforms.
10. Sensory evaluation of processed meat and poultry products using a hedonic scale for colour, flavour, texture, juiciness and overall acceptability.

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., & Ledward, D. A. *Lawrie's Meat Science* (8th ed.). Woodhead Publishing.
2. Aberle, E. D., Forrest, J. C., Gerrard, D. E., & Mills, E. W. *Principles of Meat Science* (5th ed.). Kendall/Hunt Publishing Company.
3. Toldrá, F. (Ed.). *Handbook of Meat Processing*. Wiley-Blackwell.
4. Hui, Y. H. (Ed.). *Handbook of Meat and Meat Processing*. CRC Press.
5. Stadelman, W. J., & Cotterill, O. J. *Egg Science and Technology* (4th ed.). Food Products Press.

Course Code: DFT602C						Course Title: Food Process and Engineering				
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 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:

Fluid Flow in Food Processing: Introduction to food process engineering and importance of fluid flow in food processing industries. Properties of fluids: density, specific gravity, viscosity, surface tension and compressibility, Reynolds number and flow regimes. Measurement of fluid flow using Venturimeter, Orifice meter, Rotameter and Pitot tube. Pumps used in food industries: Centrifugal pumps and positive displacement pumps, construction, working principles and applications.

UNIT II:

Heat Transfer in Food Processing: Introduction to heat transfer. Modes of heat transfer: conduction, convection and radiation. Heat exchangers: Classification, construction, working principles and applications in the food industry. Evaporation and Evaporators: Principles and objectives of evaporation. Steam economy and factors affecting evaporation. Operation and applications of single-effect and multiple-effect evaporators. Types of evaporators: Open pan, short-tube, long-tube, rising film and falling film evaporators.

UNIT III:

Unit Operation: Introduction to unit operation in food processing, cleaning: objective and its different methods, Grading: Sieving, separation based on size (mesh size), effectiveness of screens. Sorting: machine vision sorting system. Material handling systems. Size Reduction- Definition, Theory of comminution, size reduction laws- Kick's law, Rittinger's law and

Bond's Law, size reduction equipment. Mixing and Agitation in Food Processing, Difference between mixing, agitation, blending, and homogenization. Filtration-principle of filtration; types of filtrations, theory of filtration, filter media, filter aid, and filter cake. Membrane separation: Principle and types. Sedimentation and Crystallization.

UNIT IV

Extrusion: Introduction to extrusion process of food, Classification of extrusion process, Types of extruders-single screw and twin-screw extruder, Design features and operational characteristics, Effect of extrusion parameter on product quality and optimization.

COURSE OUTCOMES:

- Explain the fundamental principles of fluid flow, fluid properties, flow behaviour, and fluid transport systems used in food processing industries.
- Analyse the mechanisms of heat transfer and evaluate the operation and performance of heat exchangers and thermal processing equipment used in food manufacturing.
- Describe the principles, construction, operation and applications of single-effect and multiple-effect evaporators used for the concentration of food products.
- Apply engineering principles to solve basic numerical problems related to fluid flow, heat transfer and evaporation, and select appropriate processing equipment for specific food processing operations.

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.*

Course Code: DFT603C						Course Title: Food Packaging				
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 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

Practicals

1. Study of different types of packaging systems: Primary, secondary, tertiary packaging (sample-based identification).
2. Identification of flexible and rigid packaging materials
3. Measurement of shelf-life influencing factors: Moisture content, water activity, oxygen exposure (demonstration).
4. Packaging requirement analysis for different food categories: Liquid, dry, fatty, frozen foods (case study practical).
5. Development of a packaging layout considering consumer & environmental aspects.
6. Determination of thickness of packaging films
7. Water Vapor Transmission Rate (WVTR) determination
8. Oxygen Transmission Rate (OTR) study (demonstration/theoretical)
9. Study of metal cans: Double seam examination (demonstration).
10. Comparative evaluation of barrier properties of materials
11. Nutritional labelling exercise, Design label as per FSSAI standards.
12. Vacuum packaging demonstration
13. Shrink film packaging practical
14. Assessment of recyclability and disposal options of packaging materials

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.
- Ability to understand the various aspects related to packaging equipment and machinery including vacuum packaging machines, seal and shrink-packaging machine.
- To understand different forms of Food packaging systems for different food products including dehydrated foods, dairy products, meat, poultry and sea foods.
- Ability to understand the specialized techniques in food packaging including Active and intelligent packaging systems, retortable pouches and aseptic packaging

Books Recommended:

- Sacharow, S., & Griffin, R. C. *Principles of Food Packaging*. Van Nostrand Reinhold Company, New York.
- Mahadeviah, M., & Gowramma, R. V. *Food Packaging Materials*. Tata McGraw-Hill Publishing Company.
- Paine, F. A., & Paine, H. Y. *A Handbook of Food Packaging*. Springer.
- Crosby, N. T. *Food Packaging Materials*. Applied Science Publishers.
- Ranganna, S. *Canning and Aseptic Packaging*. Tata McGraw-Hill Publishing Company.
- Robertson, G. L. *Food Packaging: Principles and Practice* (3rd ed.). CRC Press.
- Mirajkar, M., & Menon, S. *Food Science and Processing Technology, Volume II*. Kanishka Publishers.

Course Title: Credit Seminar	Course Code: DFT604C	Total Credits	Total Marks
Credit Seminar: The student shall prepare a written seminar report and deliver a seminar on a contemporary research topic related to the field of specialization based on a comprehensive review of scientific literature. The seminar presentation, written report, technical content, critical analysis, and response to questions shall be evaluated by all faculty members of the department.		1	100

Course Code DFT606E						Course Title: Food Plant Design and Management				
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 provide an understanding of the principles of marketing, plant location and layout, and their applications in food processing industries.
- To develop knowledge of factory building design, cost analysis, plant maintenance, and economic evaluation for efficient food industry operations.
- To familiarize students with the principles and practices of human resource management, including manpower planning, recruitment, training, and industrial relations in food processing organizations.

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 the concepts of marketing management, market segmentation, product planning, pricing, and distribution strategies relevant to the food industry.
- Evaluate plant location, layout, factory design, cost analysis, and maintenance practices for efficient operation of food processing industries.
- Apply the principles of human resource management, including workforce planning, recruitment, placement, training, and industrial relations, to improve organizational performance in food industries.

References

1. Kotler, P., Keller, K. L., Chernev, A., & Brady, M. *Marketing Management* (16th ed.). Pearson Education.
2. Singh, R. P., & Heldman, D. R. *Introduction to Food Engineering* (5th ed.). Academic Press.
3. Sahay, B. S., & Sahay, V. *Production and Operations Management*. New Age International Publishers.
4. Dessler, G. *Human Resource Management* (16th ed.). Pearson Education.
5. Ramaswamy, H., & Marcotte, M. *Food Processing: Principles and Applications* (2nd ed.). CRC Press.

Course Code: DFT607E						Course Title: Industrial 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:

- Introduction to Food Hygiene and Sanitation and its significance in Food Industries.
- Understanding general principles of Food Hygiene in relation to food preparation.
- Microbial contamination of food and various physical and chemical techniques used for their control.
- Understanding sanitary aspects of water supply with emphasis on kind of impurities, purification and disinfection techniques
- Basic knowledge of physical and chemical factors in cleaning.

UNIT I

Introduction: Importance of personal hygiene of food handlers, hygienic habits, clothing, illness, and education. Food safety practices in rural and urban food preparation. Personal hygiene and food handling behaviour.

UNIT II

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. Principles and methods of cleaning and disinfection, use of heat and chemicals, cleaning agents and disinfectants, and chemical tests for sanitizer strength.

UNIT III

Industrial hygiene: Microbial contamination and its control. Microorganisms as indicators of sanitary quality. Sanitation requirements in fruit and vegetable, dairy, cereal, meat, egg, and poultry processing industries.

UNIT IV

Waste disposal and sanitation. Food storage and transport sanitation, pest and rodent control. Water sanitation: sources, quality, and usage in food processing plants. Water purification, disinfection, and contamination prevention. Effluent Treatment Plant (ETP): layout and control techniques.

COURSE OUTCOMES:

- Understand the significance of Food Hygiene and sanitation in Food industries. Various Hygiene principles employed during food preparation. Hygiene design of buildings and process equipments.
- Microbial contamination of food and various physical and chemical techniques used for mitigation.
- Know-how of sanitary aspects of water supply and purification and disinfection techniques.
- Basic knowledge of chemical and physical factors in cleaning. Acquaintance regarding detergents and sanitizers with stress on their chemistry and antimicrobial spectrum.
- Understanding procedures employed for sanitary evaluation of food plants.

Books Recommended:

1. Principles of Food Sanitation by Marriott and Norman, G.
2. Hygiene and Sanitation in Food Industry by S. Roday, TMH
3. Guide to Improve Food Hygiene by Gaston and Tiffney, TMH.
3. Practical Food Microbiology & Technology by Harry H. Weiser, Mountney, J. and Gord, W.W.
4. Food Poisoning and Food Hygiene by Betty C. Hobbs, London publication.

Course Code: DFT608E						Course Title: Snack Technology				
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 provide knowledge of the processing technologies for grain-, fruit-, vegetable-, and nut-based snack foods, including traditional and value-added products.
- To develop an understanding of extrusion technology, formulation, processing, flavouring, colouring, packaging, and quality aspects of snack foods.
- To familiarize students with the equipment and unit operations used in the manufacture of fried, baked, roasted, dried, coated, and extruded snack products.

UNIT I

Technology for grain-based snacks: whole grains - roasted, toasted, puffed, popped and flakes, coated grains-salted, spiced and sweetened; flour based - batter and dough-based products; savory and farsans; formulated chips and wafers, papads, instant premixes of traditional Indian snack foods.

UNIT II

Technology for fruit and vegetable-based snacks: Chips, wafers; Technology for coated nuts - salted, spiced and sweetened; chikkis.

UNIT III

Extrusion, Extruded snack foods: Formulation and processing technology, coloring, flavoring and packaging.

UNIT IV

Equipment's for frying, Baking and drying, toasting, roasting and flaking, popping, blending, Coating, chipping. Corn flacks (scones, crozans) cheeses balls Baked snakes.

Course outcomes:

- Explain the processing technologies involved in the manufacture of grain-, fruit-, vegetable-, and nut-based snack foods.

- Apply the principles of extrusion processing, formulation, flavouring, colouring, packaging, and quality control in the development of snack products.
- Evaluate and select appropriate processing equipment and unit operations for the production of various fried, baked, roasted, dried, coated, and extruded snack foods.

Books recommended:

1. Booth, R. G. *Snack Food*. Springer Science & Business Media.
2. Lusas, E. W., & Rooney, L. W. (Eds.). *Snack Foods Processing*. CRC Press.
3. Fellows, P. J. *Food Processing Technology: Principles and Practice* (5th ed.). Woodhead Publishing.
4. Harper, J. M. *Extrusion of Foods* (2nd ed.). CRC Press.
5. Raina, U., & Kashyap, S. *Traditional Indian Foods: Processing, Quality and Nutritional Perspectives*. New India Publishing Agency.

Course Code: DFT609E						Course Title: Advanced Instrumentation in Food Processing				
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 make students familiar with the advanced instrumentation in food technology
- To make students understand the principle and application of instruments in food analysis

UNIT I:

Chromatographic and Spectroscopic Techniques: Theory, principles, instrumentation, components, working and applications of chromatographic techniques including High-Performance Liquid Chromatography (HPLC), Ultra High-Performance Liquid Chromatography (UHPLC) and Gas Chromatography (GC). Principles of spectroscopic techniques including Fourier Transform Infrared Spectroscopy (FTIR), Near Infrared Spectroscopy (NIR) and UV-Visible Spectroscopy. Applications of chromatographic and spectroscopic methods in qualitative and quantitative analysis of food components, contaminants, additives and quality assessment.

UNIT II:

Mass Spectrometry and Atomic Spectroscopic Techniques: Principle, instrumentation and applications of Mass Spectrometry (MS). Coupled analytical techniques including Gas Chromatography-Mass Spectrometry (GC-MS), Liquid Chromatography-Mass Spectrometry (LC-MS) and Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) for food analysis. Theory, components, instrumentation and applications of Atomic Absorption Spectroscopy (AAS) for determination of minerals, trace elements and heavy metals in foods. Introduction to refractometry and colorimetry, including principles, instrumentation and applications of bench-top refractometer and HunterLab colorimeter in food quality evaluation.

UNIT III:

Rheological and Thermal Analytical Techniques: Principles, instrumentation, working and applications of rheological measurements in food systems. Study of rheometer, texture analyser, viscometer and Rapid Visco Analyser (RVA) for evaluation of texture, viscosity and

pasting properties of foods. Principle, instrumentation, working and applications of Differential Scanning Calorimetry (DSC) for the analysis of thermal transitions, phase changes and stability of food materials. Introduction to Nuclear Magnetic Resonance (NMR), including principle, instrumentation, applications and interpretation of NMR spectra in food analysis.

UNIT IV:

Advanced Imaging and Molecular Techniques: Theory, instrumentation and applications of microscopy in food analysis, including Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). Principle, instrumentation, applications and interpretation of X-ray crystallography for structural characterization of food components. Principle, methodology and applications of Polymerase Chain Reaction (PCR) in food analysis, including food authentication, detection of foodborne pathogens, genetically modified organisms (GMOs) and species identification.

COURSE OUTCOMES:

- Understand the working and principle of instruments used in food technology
- Understand the role of advanced instrumentation in understanding the food matrix

Books recommended:

1. Nielsen, S. S. *Food Analysis* (6th ed.). Springer.
2. Skoog, D. A., Holler, F. J., & Crouch, S. R. *Principles of Instrumental Analysis* (7th ed.). Cengage Learning.
3. Pomeranz, Y., & Meloan, C. E. *Food Analysis: Theory and Practice* (3rd ed.). Springer.
4. Christian, G. D., Dasgupta, P. K., & Schug, K. A. *Analytical Chemistry* (7th ed.). Wiley.
5. Harris, D. C. *Quantitative Chemical Analysis* (10th ed.). W. H. Freeman and Company.
6. Willard, H. H., Merritt, L. L., Dean, J. A., & Settle, F. A. *Instrumental Methods of Analysis* (7th ed.). CBS Publishers & Distributors.

Course Code: DFT605C		Course Title: Thesis		
Total Credits: 5	Marks Distribution			
	Advisor	Mid Term Presentation	End Term Presentation	Total
	200	150	150	500
The student shall commence research work as per the approved synopsis under the guidance of the supervisor(s). The student shall submit periodic progress reports and deliver two research progress seminars before the Committee during the semester (mid-semester and end-semester), presenting the work completed, experimental results, challenges encountered, and the proposed plan for subsequent research. The committee shall evaluate the progress and provide recommendations for further research.				

SEMESTER IV

Course Code: DFT651C			Course Title: Thesis		
Total Credits 20	Marks Distribution				
	Advisor	Mid Term Presentation	Thesis Writing	Viva voce	Total
	200	200	100	300	800
The student shall present the progress of research before the Departmental Committee during the mid-semester, demonstrating the completion of experimental work, analysis of results, and readiness for thesis submission. At the end of the semester, the student shall prepare and submit the thesis in the prescribed format and defend the research work through a viva voce before the External Examiner(s). The thesis shall be evaluated for its originality, scientific quality, methodology, analysis, presentation, and overall contribution to the field.					