Course Design

BSc. (Hon.) Food Science and Technology

(A Four-Year Course)

Under

A faculty of School of Advanced Agriculture Sciences and Technology

Department of Food Technology

Proposed by

Dr. Hradesh Rajput

Dr. Sudhir Kumar

**Course Name: B.Sc. (Hons.) Food Science and Technology**
**Total Credits: 175**
**Duration: Four Year**
**Course Start Year: 2026-27**

| I Year / I Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sr. No. | Course Code | Course Title | Credits | Internal (midterm) | External (Practical) | End term | Total |
| 1. | BFST-1001 | Fundamentals of Food Science | 4(3+1) | 20 | 30 | 50 | 100 |
| 2. | BFST-1002 | General Microbiology | 3(2+1) | 20 | 30 | 50 | 100 |
| 3. | BFST-1003 | Basic Food Chemistry | 3(2+1) | 20 | 30 | 50 | 100 |
| 4. | BFST-1004 | Computer Applications in Food Science | 2(1+1) | 20 | 30 | 50 | 100 |
| 5. | BFST-1005 | Comprehension & Communication Skills in English | 2(1+1) | 20 | 30 | 50 | 100 |
| 6. | BFST-1006 | Basic Agriculture* | 2(1+1) | 20 | 30 | 50 | 100 |
| 7. | BFST-1007 | Introductory Biology* | 2(1+1) | 20 | 30 | 50 | 100 |
| 8. | BFST-1008 | Elementary Mathematics* | 2(2+0) | 50 | - | 50 | 100 |
| 9. | BFST-1009 | NSS/NCC/Physical Education & YogaPractices** | 2(0+2) | - | 100 | - | 100 |
| | | **Total Credits** | **20** | | | | **800** |

*Note: Course number BFST-1006, BFST-1007 and BFST-1008 Choose any two course

| I Year / II Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sr. No. | Course Code | Course Title | Credits | Internal (midterm) | External (Practical) | End term | Total |
| 1. | BFST-2001 | Food Chemistry | 4(3+1) | 20 | 30 | 50 | 100 |
| 2. | BFST-2002 | Food Microbiology | 4(3+1) | 20 | 30 | 50 | 100 |
| 3. | BFST-2003 | Food Additives | 4(3+1) | 20 | 30 | 50 | 100 |
| 4. | BFST-2004 | Food and Beverages | 4(3+1) | 20 | 30 | 50 | 100 |
| 5. | BFST-2005 | Human Nutrition | 3(2+1) | 20 | 30 | 50 | 100 |
| 6. | BFST-2006 | Human Values & Ethics* | 1(1+0) | 50 | - | 50 | 100 |
| | | **Total Credits** | **20** | | | | **600** |

| II Year / III Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sr. No. | Course Code | Course Title | Credits | Internal (midterm) | External (Practical) | End term | Total |
| 1. | BFST-3001 | Principles of Food Processing | 4(3+1) | 20 | 30 | 50 | 100 |
| 2. | BFST-3002 | Post-harvest Technology | 4(3+1) | 20 | 30 | 50 | 100 |
| 3. | BFST-3003 | Dairy Science | 3(2+1) | 20 | 30 | 50 | 100 |
| 4. | BFST-3004 | Food Packaging Technology | 3(2+1) | 20 | 30 | 50 | 100 |
| 5. | BFST-3005 | Food Engineering-I | 3(2+1) | 20 | 30 | 50 | 100 |
| 6. | BFST-3006 | Nano Technology in Foods | 3(2+1) | 20 | 30 | 50 | 100 |
| 7. | BFST-3007 | Environmental Studies & Disaster Management | 3(2+1) | 20 | 30 | 50 | 100 |
| | | **Total Credits** | **23** | | | | **700** |

| II Year / IV Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sr. No. | Course Code | Course Title | Credits | Internal (midterm) | External (Practical) | End term | Total |
| 1. | BFST-4001 | Food Engineering-II | 4(3+1) | 20 | 30 | 50 | 100 |
| 2. | BFST-4002 | Processing of Cereal Pulses and oilseeds | 4(3+1) | 20 | 30 | 50 | 100 |
| 3. | BFST-4003 | Processing of Fruits and Vegetables | 4(3+1) | 20 | 30 | 50 | 100 |
| 4. | BFST-4004 | Processing of Milk and Milk Products | 3(2+1) | 20 | 30 | 50 | 100 |
| 5. | BFST-4005 | Fermentation Technology | 3(2+1) | 20 | 30 | 50 | 100 |
| 6. | BFST-4006 | Food Analysis and Instrumentation | 3(2+1) | 20 | 30 | 50 | 100 |
| 7. | BFST-4007 | Entrepreneurship Development and Business Communication | 2(1+1) | 20 | 30 | 50 | 100 |
| | | **Total Credits** | **23** | | | | **700** |
| III Year / V Semester | | | | | | | |
| Sr. No. | Course Code | Course Title | Credits | Internal (midterm) | External (Practical) | End term | Total |
| 1. | BFST-5001 | Food Preservation Technology | 4(3+1) | 20 | 30 | 50 | 100 |
| 2. | BFST-5002 | Meat, Fish and Poultry Technology | 4(3+1) | 20 | 30 | 50 | 100 |
| 3. | BFST-5003 | Bakery & confectionary Technology | 4(3+1) | 20 | 30 | 50 | 100 |
| 4. | BFST-5004 | Food Safety and Quality Assurance | 3(2+1) | 20 | 30 | 50 | 100 |
| 5. | BFST-5005 | Sensory Evaluation of food | 3(2+1) | 20 | 30 | 50 | 100 |
| 6. | BFST-5006 | Communication Skills and Personality Development | 2(1+1) | 20 | 30 | 50 | 100 |
| 7. | BFST-5007 | Intellectual Property Rights | 1(1+0) | 50 | - | 50 | 100 |
| | | **Total Credits** | **21** | | | | **700** |
| III Year / VI Semester | | | | | | | |
| Sr. No. | Course Code | Course Title | Credits | Internal (midterm) | External (Practical) | End term | Total |
| 1. | BFST-6001 | Extrusion Technology | 4(3+1) | 20 | 30 | 50 | 100 |
| 2. | BFST-6002 | Enzyme Technology | 4(3+1) | 20 | 30 | 50 | 100 |
| 3. | BFST-6003 | Functional Foods and Nutraceuticals | 4(3+1) | 20 | 30 | 50 | 100 |
| 4. | BFST-6004 | Food Laws and Regulations | 3(2+1) | 20 | 30 | 50 | 100 |
| 5. | BFST-6005 | Food Waste Management and Sustainability | 3(2+1) | 20 | 30 | 50 | 100 |
| 6. | BFST-6006 | Educational / Industrial Tour | 2(0+2) | 20 | 30 | 50 | 100 |
| | | **Total Credits** | **20** | | | | **600** |
| III Year / VII Semester | | | | | | | |
| Sr. No. | Course Code | Course Title | Credits | Internal (midterm) | External (Practical) | End term | Total |
| 1. | BFST-7001 | Experimental Learning Programme (ELP) | 0+20 | - | 200 | - | 200 |
| 2. | BFST-7002 | Industrial Problem solving | 0+2 | - | 100 | - | 100 |
| 3. | BFST-7003 | Credit Seminar | 0+2 | - | 100 | - | 100 |
| | | **Total Credits** | **24** | | | | **400** |
| III Year / VIII Semester | | | | | | | |
| Sr. No. | Course Code | Course Title | Credits | Internal (midterm) | External (Practical) | End term | Total |
| 1. | BFST-8001 | Industrial Training/ Project Report | 0+24 | - | 200 | - | 200 |
| | | **Total Credits** | **24** | | | | **200** |

# Semester: I

## FUNDAMENTALS OF FOOD SCIENCE (BFST-1001)

**Course Objectives**

- Understand the principles of food science, different areas of food science, and the historical evolution of food processing.
- Understand the basics of plant and animal foods, their structure, composition, nutritional value, storage changes, and processing methods.

**THEORY**

**UNIT I**

Introduction, History and evolution of food processing technology.

**UNIT II**

Compositional, Nutritional and Technological Aspects of Plant Foods

Cereals and Millets: Structure and composition of cereals and millets. Wheat: Structure and composition, Types: Hard/Soft, Longitudinal structure of wheat grain. Malting, Gelatinization of starch, Types of browning: Maillard browning, Caramelization. Rice: Structure and composition, Parboiling of rice, Advantages and disadvantages of parboiling.

Pulses: Structure and composition of pulses, Toxic constituents in pulses, Processing of pulses: Soaking, Germination, Decortication, Cooking, Fermentation.

Fats and Oils: Classification of lipids, Types of fatty acids: Saturated fatty acids, Unsaturated fatty acids, Essential fatty acids, Trans fatty acids, Refining of oils: Methods of refining, Advantages and limitations, Hydrogenation, Rancidity: Hydrolytic rancidity, Oxidative rancidity, Prevention of rancidity.

Fruits and Vegetables: Classification of fruits and vegetables, General composition, Enzymatic browning, Pigments: names and sources, Dietary fibre, post-harvest changes: Climacteric rise, Horticultural maturity, Physiological maturity, Physical changes, Chemical changes, Physiological changes, Pathological changes during storage.

**UNIT III**

Compositional, Nutritional and Technological Aspects of Animal Foods

Flesh Foods – Meat, Fish and Poultry

Meat: Definition of carcass, Concept of red meat and white meat, Composition of meat, Marbling, Post-mortem changes: Rigor mortis, Tenderization, Ageing of meat.

Fish: Classification of fish, Aquaculture, Composition of fish, Characteristics of fresh fish, Spoilage of fish: Microbiological, Physiological, Biochemical.

Poultry and Eggs: Structure of hen's egg, Composition and nutritive value, Egg proteins, Characteristics of fresh egg, Deterioration of egg quality, Difference between broilers and layers.

**UNIT III**

Milk and Milk Products

Definition of milk, Chemical composition of milk, Constituents of milk, Processing of milk, Pasteurization, Homogenization, Types of market milk, Overview of milk products.

**PRACTICALS**

1. Study of enzymatic and non-enzymatic browning reactions.
2. Study of gelatinization behaviour of various starches.
3. Study of gluten formation in different flours.
4. Study of malting and germination.
5. Study of dextrinization in foods.
6. Identification of pigments in fruits and vegetables and the effect of pH and heat on them.

## GENERAL MICROBIOLOGY (BFST-1002)

**Course Objectives**

- To introduce the basic concepts of microbiology.
- To understand morphology, classification and physiology of microorganisms.
- To study microbial growth, reproduction and control.
- To develop laboratory skills in microbiological techniques.

**THEORY**

**Unit I**

Introduction to Microbiology, History and scope of microbiology, Classification of microorganisms, Prokaryotes and eukaryotes, Major groups of microorganisms

**Unit II**

Microbial Cell Structure, Structure of bacterial cell, Cell wall, capsule, flagella and pili, Structure of fungi, yeast and viruses, Endospores and their significance.

**Unit III**

Microbial Growth and Nutrition, Nutritional requirements, Growth curve, Factors affecting growth, Culture media and cultivation.

**Unit IV**

Microbial Metabolism, Aerobic and anaerobic respiration, Fermentation, Enzymes and metabolism, Energy production

**Unit V**

Control of Microorganisms, Sterilization and disinfection, Physical and chemical agents, Antibiotics and antimicrobial resistance, Applications in food industry.

**PRACTICALS**

1. Microscopy.
2. Preparation of media.
3. Sterilization methods.
4. Isolation of microorganisms.
5. Gram staining.
6. Microbial enumeration.

## BASIC FOOD CHEMISTRY (BFST-1003)

**Course Objectives**

1. To introduce the chemical composition and properties of food constituents.
2. To understand the role of carbohydrates, proteins, lipids, vitamins, minerals, and water in foods.
3. To study chemical reactions occurring during food processing and storage.
4. To understand the relationship between food chemistry and food quality.
5. To develop analytical skills for evaluating food composition.

**THEORY**

**Unit I**

Introduction to food chemistry, Composition of foods, Water in foods, Water activity

**Unit II**

Carbohydrates: structure and functions, Starch gelatinization, Sugars and sweeteners

**Unit III**

Proteins and amino acids, Denaturation, Functional properties

**Unit IV**

Lipids and fatty acids, Rancidity, Emulsions

**Unit V**

Vitamins and minerals, Pigments, Enzymatic and non-enzymatic browning

**PRACTICAL'S**

1. Moisture determination.
2. Ash estimation.
3. pH measurement.
4. Estimation of reducing sugars.
5. Gluten determination.
6. Browning reactions.

## COMPUTER APPLICATIONS IN FOOD SCIENCE (BFST-1004)

**Course Objectives**

1. To familiarize students with computer fundamentals and information technology.
2. To develop skills in computer applications relevant to food science.
3. To introduce software tools for data analysis, documentation, and presentations.
4. To understand digital technologies used in food industries.
5. To promote the use of information systems in food research and quality management.

**THEORY**

**Unit I**

- Introduction to computers, Hardware and software, Operating systems

**Unit II**

- MS Word, MS Excel, MS PowerPoint

**Unit III**

- Internet and e-resources, Digital databases, Food information systems

**Unit IV**

- Statistical software in food science, Data handling and analysis, Spreadsheet applications

**Unit V**

- Applications of AI and ICT in food industry, Digital quality management, Industry 4.0 concepts

**PRACTICALS**

1. MS Office applications.
2. Data analysis in Excel.
3. Preparation of presentations.
4. Internet searching.
5. Food database handling.

# Syllabus follow according to BSc. Agriculture

1. Comprehension & Communication Skills in English (BFST-1005)
2. Basic Agriculture* (BFST-1006)
3. Introductory Biology* (BFST-1007)
4. Elementary Mathematics*(BFST-1008)
5. NSS/NCC/Physical Education & YogaPractices**(BFST-1009)

# Semester: II

## FOOD CHEMISTRY (BFST-2001)

**Course Objectives**

- To understand the chemistry of foods, food composition, role of each component and their interactions.
- To understand the functional aspects of food components and their role in food processing.

**THEORY**

**UNIT I**

Introduction and Water, Introduction to Food Chemistry, Composition of food, Water: Definition, Structure of water and ice, Types of water in foods, Water activity and its role in food systems.

**UNIT II**

Lipids and Proteins, Lipids: Classification of lipids, Physical and chemical characteristics, Chemical deterioration of fats and oils: Auto-oxidation, Rancidity, Lipolysis, Flavor reversion Proteins: Classification and structure of proteins, Plant and animal proteins, Physicochemical properties, Functional properties of proteins

**UNIT III**

Carbohydrates: Classification, Structure, Chemical reactions of carbohydrates
Flavour: Definition of flavour, Basic tastes, Common food flavours and their characteristics

**UNIT IV**

Vitamins and Minerals
Vitamins: Water-soluble vitamins: Fat-soluble vitamins
Minerals: Major minerals, Minor minerals, Toxic minerals in foods

**UNIT V**

Natural Food Pigments, Enzymes and Browning Reactions in Foods, Natural food pigments, Food enzymes, Browning reactions: Enzymatic browning, non-enzymatic browning, Importance in food quality and processing

**UNIT VI**

Physico-Chemical and Nutritional Changes During Food Processing & New Food Product Development, Changes During Processing: Drying and dehydration, Irradiation, Freezing, Canning, New Food Product Development: Definition, Importance, Need for product development, Steps in product development, Product development tools, Reasons for product failure

**PRACTICALS**

1. Preparation of primary and secondary standard solutions.
2. Estimation of moisture content.
3. Determination of Gelatinization Temperature Range (GTR) of different starches and effect of additives on GTR.
4. Determination of percent free fatty acids.
5. Estimation of peroxide value.
6. Estimation of total ash.

## FOOD MICROBIOLOGY (BFST-2002)

**Course Objectives**

- To understand the important genera of microorganisms associated with food and their characteristics.
- To understand the role of microbes in fermentation, spoilage and food-borne diseases.
- To understand food safety and hygiene, and the types of hazards associated with food.
- To understand current food regulations and food safety management systems.

**THEORY**

UNIT I:

Introduction to Food Microbiology and Types of Microorganisms in Food, Definition and scope of food microbiology. Classification and types of microorganisms in food: Bacteria, Fungi, Viruses. Significance of spores in food microbiology.

UNIT II

Microbial Growth in Food and Food Spoilage. Bacterial growth curve. Factors affecting growth of microorganisms in food. Sources of microorganisms in foods. Food spoilage microorganisms. Spoilage of: Milk and dairy products, Meat, poultry and seafood, Cereals and cereal products, Fruits and vegetables, Canned foods.

UNIT III

Food Preservation and Control of Microorganisms. Principles and methods of food preservation. Physical methods of food preservation: Dehydration, Freezing, Cold storage, Heat treatment, Irradiation. Biopreservatives (Bacteriocins). Thermobacteriology: Thermal Death Time (TDT) curve, D-value, Z-value, F-value, 12D concept. Hurdle technology. Non-thermal preservation methods: Pulsed Electric Field (PEF), High Hydrostatic Pressure (HHP), Emerging preservation technologies.

UNIT IV

Food Fermentations. Fermentation: definition and types. Microorganisms used in food fermentations. Dairy fermentations: Starter cultures, Types of starter cultures, Concept of probiotics. Fermented foods and their manufacture: Vinegar, Sauerkraut, Tempeh, Miso, Soy sauce, Yoghurt, Beer, Wine, Traditional Indian fermented foods.

UNIT V

Food-Borne Diseases: Types: Food-borne infections, Food intoxications, Toxi-infections. Origin and symptoms of common food-borne diseases. Preventive measures.

UNIT VI

Food Safety and Food Safety Management Systems: Food safety and hygiene. Types of food hazards: Physical hazards, Chemical hazards, biological hazards, Allergen hazards. Food contamination and its control, Food regulations. Food Safety Management Systems: GMP, GHP, HACCP. Overview of food safety standards and regulations.

**PRACTICALS**

1. Preparation of microbiological media.
2. Sterilization techniques.
3. Isolation and cultivation of microorganisms.
4. Enumeration of microorganisms by Standard Plate Count.
5. Microscopic examination and staining techniques.
6. Detection of microorganisms in food samples.
7. Study of fermented foods and cultures.
8. Food safety and hygiene assessment of food samples.

## FOOD ADDITIVES (BFST-2003)

**Course Objectives**

1. To introduce students to the classification, functions, and applications of food additives in food systems.
2. To understand the chemical, technological, and toxicological aspects of food additives.
3. To study the role of additives in improving food quality, safety, shelf life, and consumer acceptability.
4. To familiarize students with regulatory requirements and standards governing the use of food additives.
5. To develop practical knowledge regarding the selection, evaluation, and application of food additives in food processing.

**THEORY**

UNIT I

Introduction to Food Additives: Definition and importance of food additives. History and development of food additive use. Classification of food additives. Functions of food additives in food systems. Benefits and limitations of food additive usage. Food additive regulations and labeling requirements. Regulatory agencies: FSSAI, Codex Alimentarius, FDA, EFSA

UNIT II

Preservatives and Antioxidants: Preservatives: Definition and classification, Mechanism of antimicrobial action. Class I preservatives: Salt, Sugar, Vinegar, Spices. Class II preservatives: Benzoic acid and benzoates, Sorbic acid and sorbates, Sulphur dioxide and sulphites, Propionic acid and propionates, Nitrites and nitrates. Antioxidants: Introduction and significance, Mechanism of oxidation in foods. Natural antioxidants: Tocopherols, Ascorbic acid, Rosemary extracts. Synthetic antioxidants: BHA, BHT, TBHQ, Propyl gallate. Applications and safety considerations

UNIT III

Sweeteners, Colours and Flavouring Agents: Sweeteners: Introduction and classification, Nutritive and Non-nutritive sweeteners, Artificial sweeteners: Saccharin, Aspartame, Sucralose, Acesulfame-K. Natural sweeteners: Stevia, Monk fruit sweetener. Food Colours: Importance and functions, Natural food colours: Curcumin, Carotenoids, Anthocyanins, Chlorophyll, Beet pigments, Synthetic food colours, FD&C dyes and lakes, Stability and safety of food colours. Flavouring Agents: Natural flavours, Nature-identical flavours, Artificial flavours, Flavour enhancers: MSG, Nucleotides.

UNIT IV

Emulsifiers, Stabilizers and Texturizing Agents. Emulsifiers: Principles of emulsification, Types and applications, Lecithin, Mono and diglycerides, Polysorbates. Stabilizers and Thickeners: Hydrocolloids and gums, Pectin, Carrageenan, Guar gum, Xanthan gum, Alginates, Cellulose derivatives. Texturizing Agents: Gelling agents, Anti-caking agents, Humectants, Bulking agents, Foaming agents

UNIT V

Emerging Food Additives and Safety Evaluation: Novel Food Additives: Functional additives, Nutraceutical additives, Encapsulated additives, Natural bio-preservatives. Toxicological Evaluation: Acceptable Daily Intake (ADI), NOAEL and LOAEL concepts, Risk assessment procedures, Safety evaluation methods. Regulatory Framework: Food additive standards under FSSAI, Codex General Standard for Food Additives, Labelling and consumer awareness, Current trends and future prospects

**PRACTICALS**

1. Identification and classification of commonly used food additives.
2. Determination of sulphur dioxide in food products.

3. Estimation of benzoic acid in beverages.
4. Determination of synthetic food colours in foods.
5. Evaluation of antioxidant activity of natural and synthetic antioxidants.
6. Preparation and evaluation of emulsions using different emulsifiers.
7. Effect of hydrocolloids on texture and viscosity of foods.
8. Development of low-calorie products using artificial sweeteners.
9. Comparative study of food labels for additive declarations.
10. Case studies on food additive regulations and safety assessments.

**Recommended Readings**


1. Branen, A.L., Davidson, P.M., Salminen, S. & Thorngate, J.H. (2002). *Food Additives*. Marcel Dekker, New York.
2. DeMan, J.M. (2018). *Principles of Food Chemistry*. Springer.
3. Damodaran, S., Parkin, K.L. & Fennema, O.R. (2017). *Fennema's Food Chemistry*. CRC Press.
4. Deshpande, S.S. (2002). *Handbook of Food Toxicology*. Marcel Dekker.
5. Food Safety and Standards Authority of India (FSSAI). Food Safety and Standards Regulations.
6. Codex Alimentarius Commission. *General Standard for Food Additives (GSFA)*.

## FOOD & BEVERAGES (BFST-2004)

**Course Objectives:**

1. To provide an understanding of the technology and processing of food and beverage products.
2. To study the role of ingredients, processing methods, and packaging in the food and beverage industry.
3. To analyze the nutritional, sensory, and functional properties of food and beverage products.
4. To understand the commercialization and market trends in the food and beverage sectors.
5. To explore emerging technologies and sustainability practices in the food and beverage industry.

Unit 1: Introduction to Food and Beverages Technology

- Overview of the food and beverage industry
- Classification of food and beverage products
- Raw materials and ingredients used in food and beverage formulations
- Processing technologies: blending, mixing, fermentation, and extraction

Unit 2: Processing of Non-Alcoholic Beverages

- Water, fruit juices, and vegetable juices
- Carbonated drinks, energy drinks, and sports beverages
- Dairy-based beverages: milkshakes, flavored milk, and dairy smoothies
- Health beverages: functional drinks, teas, and herbal drinks

Unit 3: Processing of Alcoholic Beverages

- Brewing: beer and ale production
- Winemaking: fermentation and aging techniques
- Distilled beverages: whiskey, rum, and vodka
- Fermentation and maturation in alcoholic beverage production

Unit 4: Nutritional and Sensory Aspects of Food and Beverages

- Nutritional properties of food and beverages
- Sensory evaluation techniques: taste, texture, aroma, and appearance
- Functional foods and beverages: bioactive compounds and health benefits
- Role of fortification and enrichment in food and beverage products

Unit 5: Emerging Trends and Sustainability in the Food and Beverage Industry

- Plant-based and alternative protein beverages
- Innovations in food and beverage processing: 3D printing, HPP, and cold plasma
- Sustainability practices: packaging, waste reduction, and energy efficiency
- Regulatory frameworks and market trends in the food and beverage industry

**References:**


1. Hui, Y. H. (2012). *Handbook of Food and Beverage Fermentation Technology.* CRC Press.
2. Faridi, H., & Haug, W. (2018). *Food and Beverage Quality Control: An Overview.* Wiley-Blackwell.
3. Wrolstad, R. E., & Smith, D. E. (2016). *Fruit and Vegetable Processing.* Springer.
4. Singleton, V. L., & Spector, G. (2017). *Wine Analysis and Production.* Springer.
5. Codex Alimentarius: *Food & Beverages Standards and Guidelines.* FAO/WHO.

## HUMAN NUTRITION (BFST-2005)

**Course Objectives**

1. To provide a comprehensive understanding of the principles of human nutrition and the role of nutrients in maintaining health.
2. To study the digestion, absorption, metabolism, and functions of macronutrients and micronutrients.
3. To understand nutritional requirements across different stages of the life cycle.
4. To evaluate nutritional status using various assessment methods and dietary guidelines.
5. To develop awareness regarding malnutrition, lifestyle disorders, and national nutrition programs.

**THEORY**

UNIT I: Introduction to Human Nutrition

Concept and scope of human nutrition, Nutrients and their classification, Functions of food in the body, Balanced diet and food groups, RDA, Dietary Guidelines for Indians (ICMR-NIN), Nutritional status and determinants of nutrition

UNIT II: Macronutrients and Energy Metabolism

Carbohydrates: Classification and functions, Digestion, absorption, and metabolism, Glycemic index and glycemic load

Proteins: Amino acids and protein quality, Digestion, absorption, and metabolism, Protein-energy malnutrition

Lipids: Classification and functions, Essential fatty acids, Digestion, absorption, and metabolism, Cholesterol and cardiovascular health

Energy Metabolism: BMR, Factors affecting energy requirements, Energy balance and obesity

UNIT III: Micronutrients and Water

Vitamins: Fat-soluble vitamins, Water-soluble vitamins, Functions, sources, deficiencies, and toxicities

Minerals: Major minerals: Calcium, Phosphorus, Magnesium, Sodium, Potassium, Trace minerals: Iron, Zinc, Iodine, Selenium, Copper, Functions, sources, deficiencies, and toxicities

Water: Functions and distribution in the body, Water balance and requirements, Electrolyte balance

UNIT IV: Nutrition Through the Life Cycle

Nutrition during pregnancy and lactation, Infant and child nutrition, Nutrition for preschool and school-age children, Adolescent nutrition, adult nutrition, Nutrition for elderly individuals, Special nutritional needs during physiological stress and illness

UNIT V: Nutritional Assessment, Malnutrition and Public Health Nutrition

Nutritional Assessment: Anthropometric assessment, Clinical assessment, Biochemical assessment, Dietary assessment methods

Malnutrition: Undernutrition and overnutrition, Protein Energy Malnutrition (PEM), Micronutrient deficiencies, Obesity and lifestyle disorders

Public Health Nutrition: National Nutrition Programs, Mid-Day Meal Scheme, ICDS, POSHAN Abhiyaan, Food fortification and nutrition education

**PRACTICALS**

1. Identification of common foods and food groups.
2. Calculation of Body Mass Index (BMI).

3. Anthropometric measurements (height, weight, waist-hip ratio, skinfold thickness).
4. Dietary survey using 24-hour recall method.
5. Food frequency questionnaire.
6. Calculation of nutrient intake using food composition tables.
7. Meal planning for different age groups.
8. Assessment of nutritional status of individuals.
9. Preparation of balanced diets for specific physiological conditions.
10. Study of nutrition labels and dietary guidelines.

**Recommended Readings**


1. Srilakshmi, B. (2022). *Nutrition Science*. New Age International Publishers.
2. Bamji, M.S., Krishnaswamy, K. & Brahmam, G.N.V. (2017). *Textbook of Human Nutrition*. Oxford & IBH Publishing.
3. Wardlaw, G.M. & Smith, A.M. (2018). *Contemporary Nutrition*. McGraw-Hill Education.
4. Whitney, E. & Rolfes, S.R. (2020). *Understanding Nutrition*. Cengage Learning.
5. ICMR-NIN. *Dietary Guidelines for Indians* (Latest Edition).
6. Gibney, M.J., Margetts, B.M., Kearney, J.M. & Arab, L. (2013). *Public Health Nutrition*. Wiley-Blackwell.


**Human Values & Ethics (BFST-2006) – Syllabus will follow according to BSc. Agriculture**

# Semester: III

## PRINCIPLES OF FOOD PROCESSING (BFST-3001)

**Course objectives:**

1. To introduce students to the fundamental principles and concepts of food processing.
2. To understand the various unit operations involved in food processing.
3. To explore the physical, chemical, and biological changes that occur during food processing.
4. To familiarize students with the different methods used to process foods and extend their shelf life.
5. To enable students to critically evaluate the impact of different processing technologies on food quality and nutrition.

Unit 1: introduction to food processing and unit operations

- Overview of food processing and its importance.
- Classification of food processes: primary and secondary processing.
- Basic unit operations in food processing: heating, cooling, drying, filtration, mixing, etc.
- Mass transfer and heat transfer principles in food processing.
- Introduction to food processing equipment and machinery.

Unit 2: thermal processing and its impact on food quality

- Principles of heat transfer in food: conduction, convection, and radiation.
- Thermal processes: pasteurization, sterilization, blanching, and canning.
- Effects of heat on food texture, color, flavor, and nutritional content.
- Calculation of time-temperature combinations for various processes.
- Emerging thermal processing technologies (microwave, ohmic heating).

Unit 3: preservation by non-thermal methods

- Principles of non-thermal food preservation methods: high pressure processing (hpp), pulsed electric fields (pef), cold plasma, and uv-c.
- Impact of non-thermal preservation on food quality, nutrition, and shelf life.
- Applications of non-thermal methods in the food industry.
- Comparison of non-thermal and thermal methods in terms of energy efficiency and food quality preservation.

Unit 4: drying and dehydration technologies

- Principles of drying and dehydration: moisture migration, rate of drying.
- Methods of drying: sun drying, hot air drying, freeze drying, spray drying, and vacuum drying.
- Impact of drying on food texture, color, and nutritional value.
- Applications of drying in fruits, vegetables, dairy, and meat products.
- Challenges in drying process and innovations in drying technologies.

Unit 5: food packaging and emerging processing technologies

- Basic principles of food packaging: functions and types of packaging materials.
- Advances in packaging materials: active packaging, edible films, and nano-packaging.
- New and emerging processing technologies: 3d food printing, ultrasound processing, and fermentation-based methods.

- Sustainability in food processing: waste management, energy use, and eco-friendly packaging.

**References:**


1. Fellows, p. J. (2017). *Food processing technology: principles and practice* (5th ed.). Woodhead publishing.
2. Ramaswamy, h. S., & mark, h. (2004). *Food processing: principles and applications.* Crc press.
3. Rao, m. A., & rizvi, s. S. H. (2012). *Engineering properties of foods* (4th ed.). Crc press.
4. Singh, r. P., & heldman, d. R. (2009). *Introduction to food engineering* (4th ed.). Academic press.
5. Smith, d. M. (2018). *Handbook of food processing equipment.* Springer.

## POST-HARVEST TECHNOLOGY (BFST-3002)

**Course Objectives**

1. To provide knowledge of post-harvest physiology and handling of agricultural produce.
2. To understand causes of post-harvest losses and methods for their prevention.
3. To study harvesting, grading, packaging, storage, and transportation technologies.
4. To familiarize students with post-harvest management systems for fruits, vegetables, cereals, pulses, and plantation crops.
5. To develop skills for maintaining quality, safety, and shelf life of agricultural commodities.

**THEORY**

UNIT I: Introduction to Post-Harvest Technology

- Scope and importance of post-harvest technology
- Post-harvest losses in India and their economic significance
- Maturity indices and harvesting standards
- Harvesting methods and equipment
- Factors affecting post-harvest quality
- Supply chain management of agricultural produce

UNIT II: Post-Harvest Physiology and Biochemistry

Fruits and Vegetables: Respiration and transpiration, Ethylene production and action, Ripening processes, Climacteric and non-climacteric fruits, Senescence and deterioration

Biochemical Changes: Changes in carbohydrates, Changes in proteins and lipids, Pigment degradation, Texture modifications, Flavor and aroma development

UNIT III: Post-Harvest Handling Operations

Primary Operations: Cleaning and washing, Sorting and grading, Trimming and peeling, Waxing and coating

Packaging: Functions of packaging, Packaging material, MAP, CAP

Transportation: Transportation systems, Cold chain logistics, Handling during transit, Distribution management

UNIT IV: Storage Technologies

Storage Principles: Factors affecting storage life, Temperature and humidity management

Storage of Fruits and Vegetables: Ambient storage, refrigerated storage, Controlled atmosphere storage, Hypobaric storage

Storage of Cereals and Pulses: Traditional and scientific storage methods, Grain storage structures, Insect and pest control, Fumigation techniques

UNIT V: Post-Harvest Loss Management and Value Addition

Post-Harvest Losses: Quantitative and qualitative losses, Physiological losses, Microbial spoilage, Mechanical damage

Value Addition: Minimal processing, Fresh-cut fruits and vegetables, Dehydrated products, Convenience foods

Emerging Technologies: Edible coatings, Smart packaging, Nanotechnology applications, Sustainable post-harvest management

**PRACTICALS**

1. Determination of maturity indices in fruits and vegetables.
2. Assessment of physiological loss in weight during storage.
3. Study of respiration and transpiration rates.
4. Grading and quality evaluation of fruits and vegetables.
5. Packaging studies using different packaging materials.
6. Evaluation of storage conditions and shelf life.
7. Determination of post-harvest losses in selected commodities.

8. Study of cold storage and controlled atmosphere storage systems.
9. Quality assessment of stored cereals and pulses.
10. Preparation and evaluation of minimally processed fruits and vegetables.

**Recommended Readings**


1. Kader, A.A. (2002). *Postharvest Technology of Horticultural Crops*. University of California.
2. Verma, L.R. & Joshi, V.K. (2000). *Post Harvest Technology of Fruits and Vegetables*. Indus Publishing.
3. Thompson, A.K. (2015). *Fruit and Vegetables: Harvesting, Handling and Storage*. Wiley-Blackwell.
4. Wills, R., McGlasson, B., Graham, D. & Joyce, D. (2007). *Postharvest: An Introduction to the Physiology and Handling of Fruit, Vegetables and Ornamentals*. UNSW Press.
5. Sudheer, K.P. & Indira, V. (2007). *Post Harvest Technology of Horticultural Crops*. New India Publishing Agency.
6. FAO Manuals on Post-Harvest Management and Storage Technologies.


**DAIRY SCIENCE (BFST-3003)- Syllabus will follow according to BSc. Agriculture**

## FOOD PACKAGING TECHNOLOGY (BFST-3004)

**Course Objectives:**

1. To provide students with a comprehensive understanding of food packaging materials, technologies, and their role in food preservation and safety.
2. To explore the principles of packaging design, including the choice of materials, technologies, and sustainability considerations.
3. To understand the influence of packaging on food quality, shelf life, and consumer perception.
4. To examine the emerging trends and innovations in food packaging, including active, intelligent, and environmentally friendly packaging.
5. To equip students with practical knowledge on the regulatory standards, labeling, and safety requirements related to food packaging.

Unit 1: Introduction to Food Packaging

- The role and importance of packaging in food preservation, safety, and convenience.
- Functions of food packaging: Protection, containment, communication, convenience, and branding.
- Historical evolution of food packaging technologies.
- Types of food packaging: Primary, secondary, and tertiary packaging.
- Consumer and environmental factors influencing packaging design.

Unit 2: Packaging Materials for Food

- Types of packaging materials: Glass, plastic, paper, metals, and composite materials.
- Properties of packaging materials: Mechanical, thermal, barrier, and aesthetic properties.
- Selection criteria for food packaging materials based on food type, shelf life, and market needs.
- Packaging for different food categories: Fresh, processed, perishable, shelf-stable, and frozen foods.
- Innovations in biodegradable and sustainable packaging materials.

Unit 3: Food Packaging Technologies

- Traditional and modern packaging technologies: Vacuum packaging, modified atmosphere packaging (MAP), and controlled atmosphere packaging (CAP).
- Active and intelligent packaging: Oxygen scavengers, moisture regulators, and antimicrobial packaging.
- The use of nanotechnology in food packaging: Nanocomposites and nanocoatings.
- Packaging for convenience foods: Ready-to-eat, ready-to-cook, and single-serve packaging.
- Packaging machinery: Types of machinery and the packaging process.

Unit 4: Shelf Life and Food Quality in Packaging

- The impact of packaging on food quality attributes: Freshness, flavor, texture, and color.
- Shelf-life extension through packaging: Control of oxygen, moisture, temperature, and light.
- Packaging and food microbiology: Role of packaging in controlling microbial growth.
- The role of packaging in maintaining nutritional value during storage and distribution.
- Packaging and sensory properties of food: Consumer perception and preferences.

Unit 5: Packaging Regulations, Sustainability, and Future Trends

- Regulatory frameworks for food packaging: FDA, EU regulations, and Codex Alimentarius guidelines.
- Packaging labeling requirements: Nutritional information, allergens, and recycling symbols.
- Sustainability in food packaging: Environmental impact, recycling, and waste management.
- Innovations and trends in food packaging: Smart packaging, edible packaging, and sustainable materials.
- Future challenges in food packaging: E-commerce packaging, consumer demand for sustainability, and the role of technology in packaging innovation.

**References:**


1. Robertson, G. L. (2016). *Food Packaging: Principles and Practice* (4th ed.). CRC Press.
2. Soroka, W. (2015). *Fundamentals of Food Packaging.* Springer.
3. Rahman, M. S. (2017). *Handbook of Food Preservation* (3rd ed.). CRC Press.
4. Niskanen, E. (2021). *Sustainable Food Packaging Technologies: Materials, Processes, and Applications.* Elsevier.
5. Welles, M. (2016). *Food Packaging and Shelf Life: A Practical Guide.* Wiley-Blackwell.

## FOOD ENGINEERING – I (BFST-3005)

**Course Objectives**

- To understand the principle of Unit Operation.
- To acquaint students with the fundamentals of Food Engineering and its processes.
- To understand the basics of designing food plants and systems.

**THEORY:**

UNIT I: Introduction

Concept of Unit Operation, Units and dimensions, Unit conversions, Dimensional analysis, Mass and Energy Balance, Related numerical

UNIT II: Design of Food Plant and Grinding & Mixing Unit Operation

Important considerations for designing food plants, Types of plant layouts, Design and layout of storage godown, Principles and equipment used in grinding in food industry, Principles and equipment used in mixing in food industry

UNIT III: Fluid Flow in Food Processing

Liquid transport systems, Newton's Law of Viscosity, Principle of capillary tube and rotational viscometer, Properties of non-Newtonian fluids, Flow characteristics, Reynolds Number, Bernoulli's Equation, Flow measurement devices, Related basic numerical

## NANO TECHNOLOGY IN FOODS (BFST-3006)

**Course Objectives**

1. To introduce the fundamental concepts, principles, and applications of nanotechnology in food systems.
2. To understand the synthesis, characterization, and properties of nanomaterials used in food and agriculture.
3. To study nanoencapsulation and nano-delivery systems for bioactive compounds, nutrients, and food additives.
4. To explore the applications of nanotechnology in food processing, packaging, safety, and quality enhancement.
5. To evaluate safety, toxicological, regulatory, and ethical aspects associated with nanotechnology in foods.

**THEORY**

UNIT I: Introduction to Nanotechnology and Nanomaterials

History and development of nanotechnology, Concepts and scope of nanotechnology, Nanoscale dimensions and properties, Classification of nanomaterials: Nanoparticles, Nanofibers, Nanotubes, Nanocomposites, Physical, chemical, and biological properties of nanomaterials, Importance of nanotechnology in food systems

UNIT II: Synthesis and Characterization of Nanomaterials

Synthesis of Nanomaterials: Top-down approach, Bottom-up approach, Physical methods, Chemical methods, Biological and green synthesis methods

Characterization Techniques: Particle size analysis, Dynamic Light Scattering (DLS), Electron Microscopy (SEM and TEM), Atomic Force Microscopy (AFM), X-Ray Diffraction (XRD), Zeta potential analysis

Factors Affecting Nanoparticle Stability: Surface charge, Aggregation, Environmental conditions

UNIT III: Nanoencapsulation and Delivery Systems

Nanoencapsulation: Principles and importance, Encapsulation techniques, Nanocapsules and nanospheres

Delivery Systems: Liposomes, Nanoemulsions, Solid lipid nanoparticles, Nanostructured lipid carriers, Polymeric nanoparticles

Applications: Delivery of vitamins, Delivery of antioxidants, Delivery of probiotics, Controlled release systems, Bioavailability enhancement

UNIT IV: Applications of Nanotechnology in Foods

Food Processing: Nanotechnology in food manufacturing, Nano-sensors for process monitoring, Quality enhancement technologies

Food Packaging: Active packaging, Intelligent packaging, Antimicrobial packaging, Nano-composite packaging materials, Shelf-life extension technologies

Food Safety: Nano-biosensors, Detection of contaminants, Detection of pathogens, Traceability systems

Functional Foods and Nutraceuticals: Nano-enabled nutraceuticals, Fortified foods, Personalized nutrition

UNIT V: Safety, Regulatory and Future Perspectives

Nanotoxicology: Interaction of nanoparticles with biological systems, Potential health risks, Environmental impacts

Safety Assessment: Risk analysis, Exposure assessment, Toxicological evaluation

Regulatory Aspects: FSSAI regulations, Codex Alimentarius guidelines, international regulations and standards

**PRACTICALS**

1. Introduction to nanotechnology laboratory and safety practices.
2. Preparation of nanoemulsions by different methods.
3. Study of nanoencapsulation techniques.
4. Characterization of nanoparticles using particle size analysis.
5. Determination of zeta potential of nanoparticles.
6. Preparation and evaluation of edible nano-coatings.
7. Study of nanocomposite packaging materials.
8. Demonstration of nano-sensors used in food quality monitoring.
9. Literature review and seminar on recent advances in food nanotechnology.
10. Case studies on nanotechnology applications in food industries.

**Recommended Readings**


1. Morris, V.J., Groves, K. & Harding, S.E. (2017). *Food Biotechnology and Nanotechnology*. Wiley-Blackwell.
2. McClements, D.J. (2020). *Nanoparticle and Microparticle-Based Delivery Systems*. CRC Press.
3. Dekker, M. (2018). *Nanotechnology in the Food, Beverage and Nutraceutical Industries*. Woodhead Publishing.
4. Chaudhry, Q., Castle, L. & Watkins, R. (2010). *Applications of Nanotechnologies in Food*. Royal Society of Chemistry.
5. Rai, M. & Ribeiro, C. (2018). *Nanotechnology Applications in Food: Flavor, Stability, Nutrition and Safety*. Springer.
6. Singh, R.P. & Heldman, D.R. (2022). *Introduction to Food Engineering and Emerging Technologies*.


**ENVIRONMENTAL STUDIES & DISASTER MANAGEMENT (BFST-3007)- Syllabus will follow according to BSc. Agriculture**

# Semester: IV

## FOOD ENGINEERING – II (BFST-4001)

**Course Objectives**

1. To understand the principles and applications of refrigeration and freezing in food preservation.
2. To study heat and mass transfer operations involved in food processing industries.
3. To understand psychrometric principles and steam generation systems used in food plants.
4. To learn the design and operation of evaporation and dehydration systems.
5. To develop analytical and problem-solving skills through engineering calculations relevant to food processing.

**THEORY**

UNIT I: Refrigeration and Freezing

Importance of refrigeration and freezing in food preservation, Concept and selection of refrigerants, Properties and classification of refrigerants, Refrigerants used in food industries, Description of Vapour Compression Refrigeration (VCR) cycle, Components of refrigeration systems: Compressor, Condenser, Expansion valve, Evaporator, Pressure–Enthalpy (P-H) charts and tables, Refrigeration effect and coefficient of performance (COP), Effect of superheating and subcooling, Principles of food freezing, Freezing curves of foods, Factors affecting freezing rate, Freezing time calculations using Plank Equation, Frozen food storage and quality changes during storage, Applications in food industries

UNIT II: Heat and Mass Transfer

Heat Transfer: Systems for heating and cooling food products, Thermal properties of foods, Specific heat, Thermal conductivity, Thermal diffusivity, Modes of heat transfer, Mass Transfer: Principles of mass transfer, Fick's Law of Diffusion, Diffusion coefficient, Applications in food processing

Membrane Separation Systems: Principles and applications of membrane processing, Electrodialysis, Reverse Osmosis (RO), Ultrafiltration (UF), Nanofiltration (NF)

UNIT III: Psychrometrics, Steam, Evaporation and Dehydration

Psychrometrics: Relative humidity, Absolute humidity, Dew point temperature, Wet bulb and dry bulb temperatures, Psychrometric chart, Applications of psychrometric charts in food industries

Steam Generation: Generation and properties of steam, Thermodynamics of phase change, Steam tables and their applications, Boilers used in food industries

Evaporation: Principles of evaporation, Boiling point elevation, Types of evaporators

Drying and Dehydration: Principles of drying, Moisture content on wet basis and dry basis, Drying characteristics of foods, Drying rate curves, Quality changes during dehydration, Related engineering numericals

**PRACTICALS**

1. Study of refrigeration system components.
2. Determination of refrigeration load and COP.
3. Calculations using P-H charts.
4. Freezing time calculations using Plank equation.
5. Determination of thermal conductivity of food materials.
6. Evaluation of heat transfer coefficients.
7. Study of plate and tubular heat exchangers.
8. Membrane separation demonstrations (RO/UF).
9. Psychrometric chart applications and calculations.

10. Steam table calculations.
11. Determination of moisture content on wet and dry basis.
12. Evaluation of drying characteristics of food materials.
13. Study of evaporators used in food industries.
14. Industrial visit to refrigeration or food processing plant.

**Recommended Readings**


1. Singh, R.P. and Heldman, D.R. (2009). Introduction to Food Engineering (4th Edition). Academic Press.
2. Rao, D.G. (2010). Fundamentals of Food Engineering. PHI Learning.
3. Fellows, P.J. (2017). Food Processing Technology: Principles and Practice. Woodhead Publishing.
4. Toledo, R.T. (2007). Fundamentals of Food Process Engineering. Springer.
5. Geankoplis, C.J. (2018). Transport Processes and Separation Process Principles. Pearson.

## PROCESSING OF CEREAL PULSES AND OILSEEDS (BFST-4002)

**Course Objectives**

1. To provide fundamental knowledge on the composition, processing, and utilization of cereals, pulses, and oilseeds.
2. To understand the post-harvest handling, milling, and storage of cereals, pulses, and oilseeds.
3. To study the processing techniques for value addition and product development.
4. To explore quality control measures and food safety regulations in cereal, pulse, and oilseed processing.
5. To familiarize students with emerging trends, innovations, and sustainability in the industry.

Unit 1: Introduction to Cereal, Pulse & Oilseed Processing

Composition and nutritional value of cereals, pulses, and oilseeds, post-harvest handling and storage techniques, Anti-nutritional factors and their removal techniques, Importance of processing in enhancing nutritional and functional properties

Unit 2: Processing of Cereal Products

Milling of cereals: wheat, rice, maize, barley, oats, and millets, Flour, starch, and semolina production, Baking technology: bread, biscuits, and pasta processing, Breakfast cereals and extruded products

Unit 3: Processing of Pulses and Legumes

Pre-milling treatments and pulse milling technology, Traditional and modern pulse processing methods, Fermentation and germination techniques, Protein extraction and utilization in food industries

Unit 4: Processing and Utilization of Oilseeds

Extraction methods: mechanical pressing, solvent extraction, and cold pressing, Refining of edible oils and modification techniques, By-products utilization: oilseed cakes and meal processing, Hydrogenation, interesterification, and margarine production

Unit 5: Quality Control, Safety, and Regulations

Nutritional and sensory evaluation of processed products, Food safety standards and regulations (FSSAI, Codex, ISO), Packaging, shelf life, and storage requirements.

**References:**


1. Kent, N. L. (2003). *Technology of Cereals.* Elsevier.
2. Chakraborty, A., & Singh, R. (2011). *Post-Harvest Technology of Cereals, Pulses, and Oilseeds.* CBS Publishers.
3. Wrigley, C., Corke, H., Seetharaman, K., & Faubion, J. (2016). *Encyclopedia of Food Grains.* Elsevier.
4. FSSAI and Codex Guidelines on Cereal, Pulse, and Oilseed Processing.

## PROCESSING OF FRUIT & VEGETABLE (BFST-4003)

**Course Objectives**

1. To provide knowledge about the composition, processing, and preservation of fruit and vegetable products.
2. To understand the physicochemical and nutritional properties of fruits and vegetables.
3. To study different processing techniques and their impact on product quality and safety.
4. To explore quality assurance, packaging, and storage of processed fruit and vegetable products.
5. To familiarize students with regulatory standards and emerging trends in the fruit and vegetable processing industry.

Unit 1: Introduction to Fruit and Vegetable Processing

Importance and scope of fruit and vegetable processing, Composition and nutritional value of fruits and vegetables, post-harvest physiology and factors affecting quality, Preprocessing operations: washing, peeling, cutting, blanching

Unit 2: Processing and Preservation of Fruit and Vegetable Products

Thermal processing: canning, pasteurization, and sterilization, Freezing and refrigeration techniques, Drying and dehydration methods (sun drying, spray drying, freeze drying), Chemical and biological preservation methods

Unit 3: Production of Fruit and Vegetable-Based Products

Juice, nectar, and concentrate processing, Jam, jelly, marmalade, and preserves, Pickles, sauces, and chutneys, Fermented vegetable products and probiotic applications

Unit 4: Quality Control and Packaging of Processed Products

Sensory, physicochemical, and microbiological evaluation, Spoilage and defect detection in fruit and vegetable products, Packaging materials and techniques for extended shelf life, Storage conditions and transportation of processed products

Unit 5: Emerging Trends and Regulations in Fruit & Vegetable Processing

Minimal processing and fresh-cut technology, High-pressure processing (HPP) and cold plasma technology, Regulatory guidelines: FSSAI, Codex, FDA, ISO, HACCP, Sustainable processing and waste utilization in the industry

References:


1. Ranganna, S. (2007). *Handbook of Analysis and Quality Control for Fruit and Vegetable Products.* Tata McGraw-Hill.
2. Barrett, D. M., Somogyi, L. P., & Ramaswamy, H. S. (2005). *Processing Fruits: Science and Technology.* CRC Press.
3. Fellows, P. J. (2017). *Food Processing Technology: Principles and Practice.* CRC Press.
4. FSSAI and Codex Guidelines on Fruit and Vegetable Processing.

## PROCESSING OF MILK AND MILK PRODUCTS (BFST-4004)

**Course Objectives**

1. To provide comprehensive knowledge about the composition and properties of milk.
2. To understand the principles and practices involved in milk procurement, quality testing, and processing.
3. To study various methods of fluid milk processing, including pasteurization, homogenization, and sterilization.
4. To learn about packaging, storage, and distribution of fluid milk.
5. To familiarize students with quality control measures and safety regulations in the dairy industry.

Unit 1: Introduction to Dairy Processing

Overview of dairy industry and significance of milk products, Composition and properties of milk, Microbiology of milk and its role in dairy product quality, Classification of milk products

Unit 2: Processing and Manufacturing of Fermented Dairy Products

Principles of fermentation in dairy products, Manufacturing of yogurt, curd, kefir, and cultured butter, Microbial cultures and their role in fermentation, Quality parameters and defects in fermented dairy products

Unit 3: Production of Concentrated and Dried Milk Products

Manufacturing of condensed milk and evaporated milk, Spray drying and roller drying of milk powders, Instantization and reconstitution properties of dried milk, Quality control and storage stability of dried milk products

Unit 4: Processing of Fat-Rich Dairy Products

Butter and ghee: composition, processing, and quality standards, Cream separation and manufacturing of cream-based products, Ice cream and frozen dairy desserts: formulation and processing, Factors affecting the texture and stability of fat-rich dairy products

Unit 5: Cheese and Specialty Dairy Products

Classification and varieties of cheese, Cheese-making technology: steps and processing parameters, Functional and probiotic dairy products, Dairy product packaging, storage, and marketing trends

**References:**


1. Walstra, P., Wouters, J. T. M., & Geurts, T. J. (2006). *Dairy Science and Technology.* CRC Press.
2. Fox, P. F., & McSweeney, P. L. H. (2017). *Dairy Chemistry and Biochemistry.* Springer.
3. Tamime, A. Y. (2009). *Dairy Processing: Improving Quality.* CRC Press.
4. FSSAI and Codex Guidelines on Dairy Product Processing.


## FERMENTATION TECHNOLOGY (BFST-4005)

**Course Objectives**

- To understand the principles of Food Fermentation Technology.
- To study the types of starters used in the food industry.
- To study the production of various fermented foods.

**THEORY:**

UNIT I: Introduction: Fermentation process, Importance of fermented products, Isolation and maintenance of pure culture, Preparation of substrates/media and inoculum, Rate of microbial growth and death, Fermentation kinetics

UNIT II: Fermentation Technology

Types of fermentation: Submerged fermentation, Solid-state fermentation, Batch fermentation, Continuous fermentation, Fermenter design, operation, measurement and control, Recovery of fermentation products and conversion into marketable/storage forms, Aeration and agitation in fermentation, Oxygen requirements, Sterilization of air and media, Scale-up in fermentation

UNIT III: Fermented Products

Production of: Baker's yeast, Food yeast, Single Cell Protein (SCP), Beer, Wine, Cider, Vinegar, Cheese, Lactic acid fermentation of: Milk, Vegetables, Cereals, Mushroom cultivation

PRACTICAL

1. Study of a bio-fermentor: design, operation, downstream processing and product recovery.
2. Solid-state fermentation.
3. Fermentation of sugars by yeasts.
4. Production of baker's yeast.
5. Production of yogurt using DVI cultures.
6. Development of a fermented food/drink utilizing plant products, animal products, or by-products as substrates.

**Compulsory Readings**


1. Brian, J. Wood (1997). *Microbiology of Fermented Foods*, Volumes I & II.
2. Joshi, V.K. & Pandey, A. (2009). *Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology*, Volumes I & II.
3. Stanbury, P.F., Whitaker, A. and Hall (2013). *Principles of Fermentation Technology*.


Additional Resources


1. Adams, M. & Moss, M. (2008). *Food Microbiology*, 2nd Edition.
2. Garbutt, J. (1997). *Essentials of Food Microbiology*.

## FOOD ANALYSIS AND INSTRUMENTATION (BFST-4006)

**Course Objectives**

1. To provide fundamental knowledge of food analysis and quality assessment techniques.
2. To understand the principles, operation, and applications of analytical instruments used in food laboratories.
3. To develop skills in chemical, physical, and instrumental methods of food analysis.
4. To familiarize students with modern chromatographic, spectroscopic, and electrophoretic techniques.
5. To enable students to interpret analytical data for quality control, research, and regulatory compliance.

**THEORY**

UNIT I: Introduction to Food Analysis and Sampling

Importance and scope of food analysis, Objectives of food analysis, Sampling techniques and sample preparation, Sources of errors in food analysis, Accuracy, precision, sensitivity, and specificity, Quality assurance and quality control in analytical laboratories, Good Laboratory Practices (GLP)

UNIT II: Proximate Analysis of Foods

Determination of moisture content, ash content, crude protein, crude fat, crude fiber and carbohydrates, Food composition and nutritional labelling, Applications of proximate analysis in food industries

UNIT III: Spectroscopic Techniques

Principles of spectroscopy, Electromagnetic spectrum, Beer-Lambert Law

UV-Visible Spectroscopy: Principle and instrumentation, Applications in food analysis

FTIR: Principle and instrumentation, Applications in food quality assessment

AAS: Principle and instrumentation, Mineral analysis in foods

Colorimetry: Principles and applications

UNIT IV: Chromatographic and Electrophoretic Techniques

Chromatography: Principles and classification, Paper chromatography, Thin Layer Chromatography (TLC), Gas Chromatography (GC), HPLC, Applications in food analysis

Electrophoresis: Principle and instrumentation, Gel electrophoresis, SDS-PAGE, Applications in protein analysis

Modern Separation Techniques: Introduction to LC-MS and GC-MS, Applications in food authenticity and safety

UNIT V: Advanced Food Analysis and Instrumentation

Food Texture Analysis: Texture profile analysis, Texture analyzer and applications

Thermal Analysis: Differential Scanning Calorimetry (DSC), Thermogravimetric Analysis (TGA)

Microscopy: Light microscopy, Electron microscopy (SEM and TEM)

Rapid Analytical Techniques: Biosensors, Near Infrared Spectroscopy (NIR), Digital imaging systems

Applications in Food Quality and Safety: Detection of adulterants, Residue analysis, Food authenticity studies, Quality assurance and regulatory compliance

**PRACTICALS**

1. Laboratory safety and handling of analytical instruments.
2. Determination of moisture content in food samples.
3. Determination of ash content.
4. Estimation of crude protein by Kjeldahl method.
5. Determination of crude fat by Soxhlet extraction.
6. Determination of crude fiber content.

7. Estimation of reducing sugars using spectrophotometric methods.
8. Determination of acidity and pH of foods.
9. Separation of food pigments using paper chromatography.
10. Thin Layer Chromatography (TLC) of food components.
11. Demonstration of HPLC and GC systems.
12. Mineral estimation using Atomic Absorption Spectroscopy (Demonstration).
13. Texture analysis of food products.
14. Quality evaluation and interpretation of analytical data.

**Recommended Readings**


1. Nielsen, S.S. (2017). Food Analysis (5th Edition). Springer.
2. Pomeranz, Y. and Meloan, C.E. (2000). Food Analysis: Theory and Practice. Springer.
3. Skoog, D.A., Holler, F.J. and Crouch, S.R. (2018). Principles of Instrumental Analysis. Cengage Learning.
4. Ranganna, S. (2010). Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Tata McGraw Hill.
5. Sehgal, S. (2016). A Laboratory Manual of Food Analysis. CBS Publishers.
6. AOAC International. Official Methods of Analysis.


**ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS COMMUNICATION (BFST-4007)- Syllabus will follow according to BSc. Agriculture**

# Semester: V

## TECHNOLOGY OF FOOD PRESERVATION (BFST-5001)

**Course Objectives**

- To understand the role of biological agents (microorganisms) in food preservation.
- To learn the science behind various food preservation and processing technologies.
- To understand the technological applications of preservation concepts in conventional Indian foods.

**THEORY:**

**UNIT I**: Food Microbiology

Principles of Food Preservation, Microorganisms associated with foods: Bacteria, Yeasts, Molds Importance of microorganisms in foods, Classification of microorganisms based on: Temperature, pH, Water activity, Nutrient requirements, Oxygen requirements. Typical growth curve of microorganisms, Classification of foods based on pH, Food infection and food intoxication, Shelf life, Perishable, semi-perishable and shelf-stable foods

**UNIT II**: Food Preservation by Low Temperature

Refrigeration and Freezing: Introduction to refrigeration, Cool storage and freezing, Principles of freezing, Freezing curve, Changes occurring during freezing, Types of freezing: Slow freezing, Quick freezing, Thawing and its effects on food, Changes during thawing

**UNIT III**: Food Preservation by High Temperature

Thermal Processing: Sterilization, Commercial sterilization, Pasteurization, Blanching

**UNIT IV**: Food Preservation by Moisture Control

Drying and Dehydration: Definition and importance, drying as a preservation method, Sun drying vs mechanical dehydration, Heat and mass transfer, Factors affecting drying rate, Normal drying curve, Types of dryers used in food industry

Evaporation: Definition, Factors affecting evaporation, Types of evaporators used in food industry: Batch/Pan evaporator, Rising film evaporator, falling film evaporator, Natural circulation evaporator, forced circulation evaporator, Scraped surface evaporator, Vacuum pan evaporator, Applications of evaporation in food industry

**UNIT V**: Food Preservation by Chemical and Biological Methods

Chemical Preservation, Definition and principles, Class I preservatives, Class II preservatives: Biological Preservation Fermentation as a preservation method, Protective cultures, Bacteriocins (e.g., Nisin), Biopreservation concepts

**Practical content**

1. Determination of thermal death time of microorganisms.
2. Study of refrigeration and freezing preservation methods.
3. Study of dehydration and drying characteristics of foods.
4. Preparation of fruit and vegetable products using preservation techniques.
5. Determination of preservative levels in food products.
6. Preparation of fermented food products.
7. Demonstration of canning and bottling operations.
8. Evaluation of shelf-life of preserved foods.

**Compulsory Readings**


1. Fellows, P.J. (2009). *Food Processing Technology: Principles and Practice*.
2. Potter, N.N. & Hotchkiss, J.H. (2012). *Food Science*.
3. Banwart, G. (2012). *Basic Food Microbiology*.
4. Frazier, W.C. & Westhoff, D.C. *Food Microbiology*.

## MEAT, FISH AND POULTRY TECHNOLOGY (BFST-5002)

**Course Objectives**

1. To provide knowledge about the composition, structure, and nutritional value of meat, fish, and poultry products.
2. To understand the post-mortem biochemical changes and their impact on product quality.
3. To study various processing, preservation, and packaging technologies for meat, fish, and poultry products.
4. To explore quality control measures, food safety, and regulatory standards.
5. To familiarize students with emerging trends, innovations, and sustainability in the industry.

**Course Outcomes**

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

1. Explain the principles of processing and preservation of meat, fish, and poultry products.
2. Identify biochemical and microbial factors affecting product quality.
3. Apply processing techniques for value-added meat, fish, and poultry products.
4. Assess quality control measures and safety regulations in the industry.
5. Understand innovations, market trends, and sustainability in the processing sector.

Unit 1: Introduction to Meat, Fish, and Poultry Technology

- Structure, composition, and nutritional aspects
- Post-mortem biochemical changes in muscle (rigor mortis)
- Classification and grading of meat, fish, and poultry
- Factors affecting meat quality and tenderness

Unit 2: Processing and Preservation of Meat Products

- Slaughtering and carcass processing
- Chilling, freezing, and thermal processing techniques
- Curing, smoking, and drying of meat
- Sausage and comminuted meat product processing

Unit 3: Processing and Preservation of Fish and Poultry Products

- Handling, transportation, and storage of fresh fish and poultry
- Chilling and freezing techniques for fish and poultry
- Canning, smoking, and drying of fish products
- Egg processing: liquid egg, egg powder, and value-added egg products

Unit 4: Quality Control and Safety in Meat, Fish, and Poultry Processing

- Microbial spoilage and shelf-life extension techniques
- Food safety hazards: pathogens, toxins, and contaminants
- HACCP, GMP, and food safety management systems
- Packaging technologies for meat, fish, and poultry products

Unit 5: Innovations and Sustainability in Meat, Fish, and Poultry Industry

- Functional and restructured meat products
- Plant-based meat alternatives and cultured meat technology
- By-product utilization and waste management
- Regulatory standards: FSSAI, Codex, USDA, and EU regulations

**References:**


1. Lawrie, R. A. & Ledward, D. A. (2014). *Lawrie's Meat Science.* Woodhead Publishing.
2. Hui, Y. H. (2012). *Handbook of Meat and Meat Processing.* CRC Press.
3. Mead, G. C. (2004). *Poultry Meat Processing and Quality.* CRC Press.
4. FSSAI and Codex Guidelines on Meat, Fish, and Poultry Processing.

## BAKERY & CONFECTIONARY TECHNOLOGY (BFST-5003)

**Course Objectives**

- To understand the chemistry and functionality of bakery ingredients.
- To study the technology of bakery products and bakery processing operations.
- To understand quality evaluation, defects, packaging and storage of bakery products.
- To develop practical skills in the preparation of bakery products.

**THEORY**

UNIT I: Introduction to Bakery Technology

- History and growth of bakery industry, Classification of bakery products, Bakery plant layout, Bakery equipment and machinery, Sanitation and hygiene in bakery industries

UNIT II: Bakery Ingredients and Their Functions

Wheat Flour: Composition and structure of wheat grain, Types of wheat flour, Gluten and its importance. Other Ingredients: Water, Yeast, Sugar, Salt, Fats and oils, Eggs, Milk and milk products, Emulsifiers, Oxidizing and reducing agents, Enzymes and improvers

Functional Properties: Dough development, Dough rheology, Ingredient interactions

UNIT III: Bread Technology

Principles of bread making, Bread manufacturing process: Mixing, Fermentation, Moulding, Proofing, Baking, Cooling, Packaging, Types of bread, Bread quality characteristics, Bread defects and remedies.

UNIT IV: Sugars. Sugars – Types and Sources, Sugar Manufacturing: Jaggery, Khandsari, Raw sugar, Refined sugar, Quality and Properties, Principles of sugar cookery: Crystalline candies, non-crystalline candies. Specialty Products: Crackers, Pastries, Doughnuts, Muffins, Pizza base, Wafers

UNIT V: Confectionery Products

Confectionery Products: Cake icings, Hard-boiled candies, Toffees, Fruit drops, Chocolates, Other confectionery products

Product Aspects: Ingredients, Equipment, Manufacturing processes, Product quality parameters, Faults and corrective measures

Chocolate Technology: Cocoa butter, rendering of cocoa butter, Polymorphism of cocoa fat, Properties of fats required for chocolate manufacture, Cocoa butter replacers

**Practical content**

1. Determination of flour quality characteristics.
2. Estimation of gluten content in flour.
3. Preparation of bread.
4. Preparation of biscuits and cookies.
5. Preparation of cakes.
6. Evaluation of bakery products for physical and sensory quality.
7. Study of bakery equipment and plant layout.
8. Packaging and storage studies of bakery products.
9. Estimation of sugar solubility
10. Determination of acidity of sugar and jaggery

**References:**


1. Dubey, S.C. (2007). *Basic Baking Science and Technology*.
2. Cauvain, S.P. & Young, L.S. (2007). *Technology of Breadmaking*.
3. Pyler, E.J. & Gorton, L.A. (2008). *Baking Science and Technology*.
4. Manley, D. (2011). *Manley's Technology of Biscuits, Crackers and Cookies*.
5. Beckett, S.T. (2009). *Industrial Chocolate Manufacture*. Ch. 6, pp. 130–139; Ch. 12–13, pp. 261–316.

## FOOD SAFETY AND QUALITY ASSURANCE (BFST-5004)

**Course Objectives:**

1. To introduce students to the fundamental concepts of food safety, hygiene, and sanitation in the food industry.
2. To examine the role of microorganisms, contaminants, and foodborne pathogens in food safety.
3. To understand food safety regulations, standards, and practices in the context of global food systems.
4. To explore risk management techniques in the prevention of foodborne diseases.
5. To equip students with practical knowledge on the implementation of food safety and hygiene systems in food production, handling, and distribution.

UNIT I: Introduction to Food Safety
Definition of safe food,Types of hazards, Factors affecting food safety, Importance of safe foods, Role of communication and training in food safety
UNIT II: Hazards Associated with Food
Mode of Entry of Hazards in Food: Physical Hazards, Chemical Hazards, Biological Hazards
UNIT III: Management of Hazards
Control of Critical Parameters: Design of food plants, Temperature danger zone, Storage of food, Role of food handlers, Personnel hygiene, Quality of water and water analysis
Hygiene and Sanitation in Food Service Establishments: Sources of contamination, General principles of hygiene, Sanitation practices, Control using physical and chemical agents, Waste disposal, Pest and rodent control, Effluent Treatment Plant (ETP) system
UNIT IV: Food Safety Management Tools
Basic concepts, Prerequisite programs, HACCP, ISO series, TQM and its components: Risk analysis, Accreditation, Auditing
UNIT V: Food Laws and Standards
Standards and Regulations: Introduction to standards, specifications and limits
National Food Regulations: FSSA, FSSAI, BIS, APEDA
International Regulatory Scenario: Codex Alimentarius, WHO, FAO, ICMSF
UNIT VI: Trends in Food Safety
New and emerging pathogens: GM foods / Transgenics, Organic foods and labelling, Food frauds, newer approaches to food safety

**Practical content**

1. Preparation of different types of media (complex, differential and selective).
2. Enumeration of aerial microflora using PDA.
3. Identification of molds by lactophenol cotton blue staining.
4. Negative staining technique.
5. Microbiological examination of foods.
6. Bacteriological analysis of water by MPN method.
7. Assessment of surface sanitation by swab and rinse method.
8. Assessment of personal hygiene.

## SENSORY EVALUATION OF FOOD (BFST-5005)

**COURSE OBJECTIVES**

To understand sensory organs and their role in sensory evaluation
To obtain a basic knowledge of objective and subjective evaluation of food
To know the importance of sensory panels and testing methods.
Understanding the application of sensory evaluation in food industry.

**THEORY**

UNIT I: Introduction to Sensory Evaluation: Definition and importance of sensory evaluation, Historical development of sensory science, Applications of sensory evaluation in food industry, Sensory attributes of foods: Appearance, Colour, Flavour, Taste, Aroma, Texture, Mouthfeel

UNIT II: Physiology of Sensory Perception: Sense Organs and Perception: Physiology of taste, smell, vision, hearing, touch

Taste Perception: Basic tastes: Sweet, Sour, Salty, Bitter, Umami, Taste interactions

Factors Affecting Sensory Perception: Age, Gender, Health, Environment, Psychological factors

UNIT III: Sensory Testing Methods, Discrimination Tests: Paired comparison test, Triangle test, Duo-trio test, Ranking test, Descriptive Tests: Flavor profile analysis, Texture profile analysis, Quantitative descriptive analysis (QDA), Affective Tests: Hedonic rating scale, Preference ranking, Consumer acceptance tests

UNIT IV: Sensory Panels and Laboratory Design, Types of sensory panels: Expert panel, Trained panel, Consumer panel, Selection of panelists, Training of panelists, Sensory laboratory design, Sample preparation and presentation, Elimination of bias

UNIT V: Measurement and Analysis of Sensory Data: Sensory scales and score cards, Threshold values, Difference threshold, Recognition threshold, Statistical analysis of sensory data, Interpretation of results, Reporting sensory data

UNIT VI: Applications of Sensory Evaluation: Product development, Product optimization, Shelf-life evaluation, Quality control, Consumer research, Market acceptability studies, Sensory evaluation of traditional and novel foods

**Practical content**

1. Recognition of basic tastes.
2. Determination of taste threshold values.
3. Difference testing using paired comparison test.
4. Triangle test.
5. Duo-trio test.
6. Ranking test.
7. Hedonic rating test.
8. Sensory evaluation of bakery products.
9. Sensory evaluation of dairy products.
10. Development and use of sensory score cards.

**Compulsory Readings**


1. Stone, H. & Sidel, J.L. (2004). *Sensory Evaluation Practices*, 3rd Edition.
2. Lawless, H.T. & Heymann, H. (2010). *Sensory Evaluation of Food: Principles and Practices*.
3. Meilgaard, M., Civille, G.V. & Carr, B.T. (2016). *Sensory Evaluation Techniques*.


**COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT (BFST-5006)- Syllabus will follow according to BSc. Agriculture**

**INTELLECTUAL PROPERTY RIGHTS (BFST-5007)- Syllabus will follow according to BSc. Agriculture**

# Semester: VI

## EXTRUSION TECHNOLOGY (BFST-6001)

**Course Objectives**

1. To introduce the principles and fundamentals of extrusion technology used in food processing.
2. To understand the design, operation, and performance of extrusion equipment.
3. To study the effects of extrusion processing variables on food quality and functionality.
4. To familiarize students with the manufacture of various extruded food products.
5. To develop practical knowledge of extrusion applications in cereal, snack, texturized, and value-added food products.

**THEORY**

UNIT I: Introduction to Extrusion Technology

Definition and principles of extrusion, Advantages and limitations of extrusion processing, Basic concepts of extrusion cooking, Applications of extrusion in food industries, Extrusion as a High Temperature Short Time (HTST) process, Components of an extrusion system

UNIT II: Extrusion Equipment and Processing Variables

Extrusion Equipment: Single-screw extruders, Twin-screw extruders, Co-rotating and counter-rotating extruders, Extruder barrel and screw configuration, Feed systems, Dies and die design, Cutting systems

Processing Variables: Feed moisture content, Temperature profile, Screw speed, Feed rate, Pressure development, Residence time

Effect of Processing Variables: Product expansion, Density, Texture, Color, Nutritional quality

UNIT III: Raw Materials and Physicochemical Changes During Extrusion

Raw Materials for Extrusion: Cereals and millets, Legumes and pulses, Oilseed meals, Starches, Proteins, Dietary fibers

Physicochemical Changes: Starch gelatinization, Starch dextrinization, Protein denaturation, Protein texturization, Lipid modifications, Changes in dietary fiber, Flavor and color development

Nutritional Changes During Extrusion: Vitamin losses, Protein digestibility, Reduction of anti-nutritional factors

UNIT IV: Extruded Food Products

Breakfast Cereals, Snack Foods, Texturized Products: Texturized vegetable proteins (TVP), Meat analogues, Plant-based protein products

Other Extruded Products: Pasta products, Infant foods, Pet foods, Aquaculture feeds, Functional and fortified foods

Quality Evaluation: Expansion ratio, Bulk density, Water absorption index, Water solubility index, Texture analysis

**PRACTICALS**

1. Study of extrusion equipment and components.
2. Determination of extrusion process parameters.
3. Preparation of expanded cereal snack products.
4. Preparation of extruded pulse-based products.
5. Effect of moisture content on extrusion characteristics.
6. Effect of screw speed on product quality.
7. Determination of expansion ratio of extruded products.
8. Measurement of bulk density and texture of extrudates.
9. Determination of water absorption index (WAI) and water solubility index (WSI).
10. Development of value-added extruded food products.

11. Quality evaluation of commercial extruded foods.
12. Industrial visit to an extrusion processing unit.

**Recommended Readings**


1. Guy, R. (2001). Extrusion Cooking: Technologies and Applications. Woodhead Publishing.
2. Riaz, M.N. (2000). Extruders in Food Applications. Technomic Publishing.
3. Harper, J.M. (1989). Food Extrusion. CRC Press.
4. Frame, N.D. (1994). The Technology of Extrusion Cooking. Springer.
5. Fellows, P.J. (2017). Food Processing Technology: Principles and Practice. Woodhead Publishing.
6. Singh, R.P. and Heldman, D.R. (2009). Introduction to Food Engineering. Academic Press.

# ENZYME TECHNOLOGY (BFST-6002)

**Course Objectives**

1. To introduce enzyme structure, classification, and catalytic mechanisms.
2. To study enzyme production, purification, and characterization.
3. To understand enzyme kinetics and factors affecting enzyme activity.
4. To familiarize students with enzyme immobilization techniques and industrial applications.
5. To develop practical knowledge of enzyme utilization in food processing and biotechnology.

**THEORY**

UNIT I: Introduction to Enzymes

History and scope of enzyme technology, Classification and nomenclature of enzymes, Structure and properties of enzymes, Active site and mechanism of enzyme action, Coenzymes, cofactors and prosthetic groups

UNIT II: Enzyme Kinetics: Michaelis-Menten kinetics, Factors affecting enzyme activity, pH, temperature and substrate concentration, Enzyme inhibition, Allosteric enzymes

UNIT III: Enzyme Production and Purification: Sources of enzymes, Microbial enzyme production, Fermentation techniques, Enzyme extraction and purification, Enzyme assay methods

UNIT IV: Enzyme Immobilization: Principles and advantages, Methods of immobilization, Entrapment, adsorption, covalent binding, Immobilized enzyme reactors, Applications in food industry

UNIT V: Industrial Applications of Enzymes: Enzymes in dairy industry, baking industry, fruit and vegetable processing, brewing and fermentation, Recent advances in enzyme engineering

**PRACTICALS**

1. Assay of amylase activity.
2. Assay of protease activity.
3. Effect of temperature on enzyme activity.
4. Effect of pH on enzyme activity.
5. Determination of enzyme kinetics.
6. Immobilization of enzymes.
7. Application of enzymes in juice clarification.
8. Study of commercial food enzymes.

**Recommended Readings**


1. Whitaker, J.R. Principles of Enzymology for Food Sciences.
2. Palmer, T. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry.
3. Rao, M.B. Enzyme Technology.
4. Trevan, M.D. Immobilized Enzymes.

## FUNCTIONAL FOODS AND NUTRACEUTICALS (BFST-6003)

**Course Objectives**

- To understand the concepts of nutraceuticals and functional foods.
- To study bioactive food components and their health benefits.
- To understand the role of nutraceuticals in disease prevention and health promotion.
- To gain knowledge of development, evaluation and regulation of functional foods.

**THEORY:**

**UNIT I:** Introduction to Nutraceuticals and Functional Foods

- Definitions and concepts, Historical development, Nutraceuticals, functional foods and dietary supplements
- Classification of nutraceuticals
- Scope and future prospects
- Market trends and economic importance

**UNIT II:** Bioactive Components of Foods

Phytochemicals: Polyphenols, Flavonoids, Carotenoids, Glucosinolates, Phytosterols

Functional Components: Dietary fibre, Omega-3 fatty acids, Prebiotics, Probiotics, Synbiotics

Antioxidants: Natural antioxidants, Mechanism of antioxidant action

**UNIT III:** Nutraceuticals and Health

Cardiovascular Health: Role of omega-3 fatty acids, Plant sterols, Dietary fibre

Gastrointestinal Health: Probiotics, Prebiotics, Synbiotics

Metabolic Disorders: Obesity, Diabetes mellitus

Other Health Benefits: Cancer prevention, Bone health, Immune enhancement, Cognitive health

**UNIT IV:** Functional Foods

Concept and classification: Functional beverages, Fortified foods, Designer foods, Fermented functional foods, Dairy-based functional foods, Cereal-based functional foods, Functional foods of plant origin

**UNIT V:** Development and Evaluation of Nutraceutical Products

Selection of ingredients, Product formulation, Stability studies, Bioavailability of nutraceuticals, Safety evaluation, Clinical evaluation, Quality control parameters

**UNIT VI:** Regulations and Future Trends (8 Hrs)

Regulatory Aspects: FSSAI regulations, Codex guidelines, Labeling requirements, Claims and substantiation

Emerging Trends: Personalized nutrition, Functional ingredients, Nanonutraceuticals , Novel delivery systems

Practical content

1. Estimation of antioxidant activity in foods.
2. Estimation of total phenolic content.
3. Development of a functional beverage.
4. Preparation of probiotic food products.
5. Preparation of prebiotic-enriched food products.
6. Evaluation of nutraceutical products for sensory quality.
7. Study of labeling requirements of nutraceutical products.
8. Market survey of nutraceutical and functional food products.
9. Extraction of bioactive compounds from plant sources.
10. Product development using functional ingredients.

**Compulsory Readings**


1. Wildman, R.E.C. (2006). *Handbook of Nutraceuticals and Functional Foods*.
2. Goldberg, I. (1994). *Functional Foods: Designer Foods, Pharmafoods and Nutraceuticals*.

3. Gibson, G.R. & Williams, C.M. (2000). *Functional Foods: Concept to Product*.
4. Shi, J., Ho, C.T. & Shahidi, F. (2007). *Functional Foods of the East*.

Additional Resources

1. Roberfroid, M.B. (2002). *Functional Foods: Concepts and Applications*.
2. Bagchi, D. (2010). *Nutraceutical and Functional Food Regulations in the United States and Around the World*.
3. Shahidi, F. (2009). *Nutraceutical and Specialty Lipids and Their Co-products*.

## FOOD LAWS AND REGULATIONS (BFST-6004)

**Course Objectives**

- To provide knowledge of food laws, standards, and regulatory systems.
- To understand national and international food regulations.
- To study food labeling, certification, and inspection procedures.
- To develop awareness regarding food safety legislation.
- To familiarize students with regulatory compliance in food industries.

**THEORY**

UNIT I: Introduction to Food Laws

Need and importance of food laws, Historical development of food legislation, Food standards and specifications, National and international regulatory agencies

UNIT II: Food Safety and Standards Act (FSS Act), 2006

Structure and functions of FSSAI, Licensing and registration, Food business operators, Food product standards

UNIT III: International Food Regulations

Codex Alimentarius Commission, ISO standards, WTO, SPS and TBT agreements, Export and import regulations

UNIT IV: Food Labeling and Certification

Labeling requirements, Nutritional labelling, Claims and advertisements, AGMARK, BIS, Organic certification, Geographical indications

UNIT V: Food Inspection and Enforcement

Food inspection procedures, Sampling and analysis, Food recalls, Consumer protection, Current regulatory challenges

**PRACTICALS**

1. Study of FSSAI regulations.
2. Food label analysis.
3. Preparation of regulatory documentation.
4. Study of food standards.
5. Case studies on food law violations.
6. Inspection report preparation.
7. Export documentation procedures.
8. Certification systems in food industries.

Recommended Readings


1. Potter and Hotchkiss. Food Science.
2. FSSAI Manuals and Regulations.
3. Codex Alimentarius Standards.
4. Roday, S. Food Hygiene and Sanitation.

## FOOD WASTE MANAGEMENT AND SUSTAINABILITY (BFST-6005)

**Course Objectives**

1. To understand the generation and impact of food waste across the food supply chain.
2. To study sustainable food systems and resource conservation practices.
3. To explore technologies for food waste reduction and valorization.
4. To examine circular economy concepts in food industries.
5. To develop sustainable approaches for food processing and waste management.

**THEORY**

UNIT I: Introduction to Food Waste and Sustainability Concept of food waste and food loss, Magnitude and causes of food waste, Sustainable food systems, Environmental impacts of food waste

UNIT II: Food Waste Generation Across Supply Chain Production stage losses, post-harvest losses, Processing losses, Retail and consumer-level waste, Waste quantification methods

UNIT III: Food Waste Reduction Strategies Waste minimization approaches, Lean manufacturing, Resource efficiency, Circular economy concepts, Sustainable processing practices

UNIT IV: Food Waste Valorisation By-product utilization, Composting technologies, Anaerobic digestion, Biofuel production, Recovery of bioactive compounds, Animal feed applications

UNIT V: Sustainability Assessment and Future Perspectives Carbon footprint, Life cycle assessment (LCA), SDGs, Green technologies, Policies and regulations, Future trends in sustainable food systems

**PRACTICALS**

1. Food waste audit.
2. Quantification of food waste generation.
3. Compost preparation from food waste.
4. Assessment of biodegradable packaging.
5. Valorization of food processing by-products.
6. Carbon footprint estimation.
7. Sustainability assessment of food products.
8. Industrial case studies on waste management.

**Recommended Readings**


1. Papargyropoulou et al. Food Waste Management.
2. Gustavsson et al. Global Food Losses and Food Waste (FAO).
3. Fellows, P.J. Food Processing Technology.
4. FAO Sustainability Guidelines.
5. Handbook of Waste Management and Co-Product Recovery.