

Program Outcomes (POs)

At the end of the program, Food technology graduates will be able to:

1. Scientific Knowledge: Apply knowledge of science, mathematics, engineering, and technology to solve complex food processing and quality assurance problems.
2. Design and Development of Solutions: Design food processing and plan quality assurance strategies as per the specified requirement of regulatory bodies, health, society and environment.
3. Problem Analysis: Identify, formulate, rationalise, and analyse food processing problems reaching substantiated conclusions using the principles of food sciences and technology.
4. Modern tool usage: Create, select, and apply modern food processing and quality assurance techniques, resources and tools of relevance in food processing industries.
5. Environment and Sustainability: Learn the food science and technology in the context of societal and environmental sustainability.
6. Individual and teamwork: Function objectively as an individual and as a member in diverse teams.
7. Communications: Effectively document and communicate complex food technology activities with society at large.
8. Lifelong learning: Independently engage in learning the changes in food processing technology and consumer requirement.

Program Specific Outcomes (PSOs):

At the end of the program, Food Technology graduates will be able to:

- Define and have an overview on composition of various food materials, particularly lipids and protein composition which are applicable in the commercial field.
- Classify carbohydrates, vitamins and flavours and understand their importance in food products.
- Apply the knowledge of minerals and various natural food pigments at the industrial level and application of browning reactions in food products.
- Apply food processing technology skills of planning and processing for assessing and analysing food in a sustainable manner.
- Apply knowledge of principles and techniques of food processing and quality assurance for higher studies.
- Build their own products in innovative ways and increase their production area.
- Have a clear idea about the various changes that occurs during food development and use of enzyme technology in food production.
- Apply skills of food science and technology for research, development, and entrepreneurship.

MANGALORE UNIVERSITY

Scheme and Syllabus for B.Sc. (Food Technology) 2024-25 onwards

Title of the Course	Instruction Hrs / week	Duration of Exam (Hrs)	Marks			Credits
			IA	Exam	Total	
SEMESTER I						
Food and Nutrition	4	3	20	80	100	3
Principles of Food Science	4	3	20	80	100	3
Food Microbiology	4	3	20	80	100	3
Food and Nutrition Practical - 1	3	3	10	40	50	2
Principles of Food Science Practical - 2	3	3	10	40	50	2
Food Microbiology Practical - 3	3	3	10	40	50	2
	21				450	15
SEMESTER II						
Food Chemistry	4	3	20	80	100	3
Food Preservation	4	3	20	80	100	3
Fundamentals of Food Processing	4	3	20	80	100	3
Food Chemistry Practical - 4	3	3	10	40	50	2
Food Preservation Practical - 5	3	3	10	40	50	2
Fundamentals of Food Processing Practical - 6	3	3	10	40	50	2
	21				450	15
SEMESTER III						
Technology of Plant Products	4	3	20	80	100	3
Technology of Animal Products	4	3	20	80	100	3
Dairy Technology	4	3	20	80	100	3
Technology of Plant Products Practical - 7	3	3	10	40	50	2
Technology of Animal Products Practical - 8	3	3	10	40	50	2
Dairy Technology Practical - 9	3	3	10	40	50	2
Sensory analysis in food industry / Food adulteration (Elective)	2	2	10	40	50	2
	21				500	17
SEMESTER IV						
Bakery, Confectionary and Extruded foods	4	3	20	80	100	3
Technology of Fat and Oil Products	4	3	20	80	100	3
Food Additives and Preservatives	4	3	20	80	100	3
Bakery, Confectionary and Extruded foods Practical -10	3	3	10	40	50	2
Technology of Fat and Oil Products Practical - 11	3	3	10	40	50	2
Food Additives and Preservatives Practical - 12	3	3	10	40	50	2
Pest management of stored foods / Post harvest handling (Domain Elective/Optional)	2	2	10	40	50	2
NEW PRODUCT DEVELOPMENT (Compulsory Practical Knowledge/Skill-based Course)	2	-	10*	40**	50	2
	25				550	19

*Continuous Internal Assessment = 10 Marks

**Work carried out (20 marks); Report (10 marks); Presentation and Viva-voce (10 marks) = 40 Marks

Title of the Course	Instruction hrs / week	Duration of Exam (hrs)	Marks			Credits
			IA	Exam	Total	
SEMESTER V						
Food Refrigeration and Cold Storage	3	3	20	80	100	3
Food Packaging and Storage Technology	3	3	20	80	100	3
Quality Control in Food Processing Industries	3	3	20	80	100	3
Waste Management in Food Industries	3	3	20	80	100	3
Spices and plantation crop processing technology	3	3	20	80	100	3
Food Laws and Food Safety	3	3	20	80	100	3
Food Refrigeration and Packaging Technology Practical - 13	4	3	10	40	50	2
Quality Control and Waste Management Practical - 14	4	3	10	40	50	2
Spices and Plantation Crop Processing Technology Practical - 15	4	3	10	40	50	2
INTERNSHIP in FOOD INDUSTRY (Compulsory Skill-based Course)	-	-	10*	40*	50	2
	27				800	26
SEMESTER VI						
Nutraceuticals and Functional Foods	3	3	20	80	100	3
Extrusion Technology	3	3	20	80	100	3
Food Plant Sanitation	3	3	20	80	100	3
Food Preservation Techniques	3	3	20	80	100	3
Fermentation Technology	3	3	20	80	100	3
Enzymes in Food Technology	3	3	20	80	100	3
Nutraceuticals, Functional Foods Practical - 16	4	3	10	40	50	2
Extrusion Technology and Sanitation Practical - 17	4	3	10	40	50	2
Fermentation Technology Practical - 18	4	3	10	40	50	2
MINI PROJECT IN FOOD TECHNOLOGY (Compulsory Skill based-Course)	-	-	10 [#]	40 ^{##}	50	2
	27				800	26

IA = Internal Assessment

Marks Allotment for skill-based practical in IV Semester:

*Continuous Internal Assessment = 10 Marks

**Preparation and Presentation (30 marks); Viva-voce (10 marks) = 40 Marks

Marks Allotment for Internship in V Semester & Mini Project in VI Semester:

[#]Continuous Internal Assessment = 10 Marks

^{##}Work carried out (20 marks); Report (10 marks); Presentation and Viva-voce (10 marks) = 40 Marks

Internship of minimum 1 month duration to be undertaken in Food Industries and may be carried out between IV and V Semesters with credits accruing to V Semester.

Mini Project may be carried out In-house with credits accruing to VI Semester.

SYLLABUS for B.Sc. FOOD TECHNOLOGY (2024-25 onwards)

SEMESTER-I FOOD AND NUTRITION (THEORY)

(48 hrs)

Course Objectives:

1. To be familiar with nutritional and compositional aspects of various food groups.
2. To identify and understand the methods and their effects in processing of foods.

Course Outcomes:

At the end of the Course, students will be able to

- CO 1. Apply the knowledge in maintenance of good health for individual and community.
- CO 2. Understand the types and importance of various food nutrients and requirement of vitamins and minerals in foods.
- CO 3. Assess the methods and its effects on foods used in cooking.
- CO 4. Enumerate codex FSSAI guidelines for nutritional labeling of foods

UNIT I

1. **Introduction** (4 hrs)
Basic terms used in study of food and nutrition, Body Mass Index (BMI) and Nutritional Status, Understanding Relationship between food, nutrition and health. Definition of calorie & Joule, Measurement of basic nutrients.
2. **Balanced Diet** (4 hrs)
Functions of food-physiological, psychological and social, Concept of Balanced Diet, Malnutrition – over and under. Basic Food Groups, Food Pyramid. Classification of food – ICMR 2020
3. **Concepts of Meal Planning** (2 hrs)
Factors affecting meal planning, understanding specific considerations for planning meal for different groups of people.

UNIT II

4. **Carbohydrates** (4 hrs)
Classification, digestion, functions, dietary sources, requirement, Clinical manifestations of deficiency and excess and factors affecting absorption of carbohydrates.
5. **Proteins** (4 hrs)
Classification, digestion, functions, dietary sources, requirement, evaluation of protein quality, Clinical manifestations of deficiency and excess and factors affecting absorption of proteins
6. **Lipids** (4 hrs)
Classification, digestion, functions, dietary sources, requirement, essential fatty acids, PUFA, Cholesterol, Clinical manifestations of deficiency and excess and factors affecting absorption of Lipids.

UNIT III

7. **Vitamins** (4 hrs)
Classification, digestion, functions, dietary sources, requirement, effects of deficiency (Vitamin A, D, K).
8. **Minerals** (4 hrs)
Classification, digestion, functions, dietary sources, requirement, effects of deficiency (Iodine, Sodium and Potassium).
9. **Pigments and colloids** (4 hrs)
Chlorophyll, Flavonoids, Anthocyanins, Anthoxanthins, Colloidal chemistry, Properties of solutions, Sols & Suspensions, Food colloids.

UNIT IV

10. **Enzymes** (4 hrs)
Classification of enzymes, Source of enzymes in food, Use of enzymes in food, Enzymatic and non-enzymatic reactions during storage.
11. **Methods of Cooking** (4 hrs)
Dry, moist, frying and microwave cooking, Advantages, disadvantages and the effect of various methods of cooking on foods, Changes in food during cooking using dry heat, moist heat, heated oil and microwave.
12. **Nutritional Labeling** (2 hrs)
Importance, global trends, codex guidelines, nutritional labeling in India, FSSAI guidelines.

References

- 1) Bamji MS, Krishnaswamy K, Brahmam GNV. Textbook of Human Nutrition, 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd. 2009
- 2) Srilakshmi. Food Science, 4th Edition. New Age International Ltd, 2007.
- 3) Srilakshmi. Dietetics, Revised 5th edition. New Age International Ltd. 2005.
- 4) Wardlaw MG, Paul M Insel Mosby. Perspectives in Nutrition, 3rd Edition, 1996.
- 5) Codex Guidelines on Nutrition Labeling (CAC/GL 2_1985) (Rev.1_1993). Rome, Food and Agriculture Organisation of the United Nations / World Health Organisation, 1993.
- 6) Food Safety and Standards Authority of India portal, Government of India
- 7) Gopalan, C. NIN, ICMR. Nutritive Value of Indian Foods. 1990
- 8) Seth V, Singh K. Diet planning through the Life Cycle: Part 1. Normal Nutrition. A Practical Manual, Fourth edition, Elite Publishing House Pvt Ltd. 2005
- 9) Gibney et al (ed.), Introduction to Human Nutrition, Blackwell Publ., 2005
- 10) Khanna K, Gupta S, Seth R, Mahna R, Rekhi T. The Art and Science of Cooking: A Practical Manual, Revised Edition. Elite Publishing House Pvt Ltd., 2004
- 11) ICMR. Nutrient Requirements and Recommended Dietary Allowances for Indians, 2010.
- 12) Krishna Prasad Nooralabettu. Enzyme Technology, Pace Maker of Biotechnology, PHI Learning Private Limited, New Delhi, 2011

PRINCIPLES OF FOOD SCIENCE (THEORY)

(48 hrs)

Course Objectives:

1. To understand the importance of food chemistry, sensory evaluation process of food and study various microorganisms and their importance in industrial food technology
2. To have an in-depth understanding of water disposal, shelf life of the food material, packaging materials and food storage.

Course Outcomes:

At the end of the Course, students will be able to

- CO 1. Differentiate between the characteristics of various molecules, develop sensory evaluation skills and understand use of colloidal substance at the industrial level
- CO 2. Understand and apply beneficial microorganisms in food technologies in the industry
- CO 3. Comprehend utility of water source in the production area and approaches for waste water treatment.
- CO 4. Develop various packaging methods to sustainably improvise its outcome in the food development process.

UNIT I

1. **Introduction** (2 hrs)
Concepts of food science, importance, scope, history, properties of food (physical, chemical and sensory) .
2. **Growth of microorganisms in foods** (4 hrs)
Food as a substrate for microorganism, factors affecting growth of microbes: pH, water activity, O-R potential, nutrient contents, inhibitory substance and biological structure.

3. **Sensory evaluation of food** (5 hrs)
Subjective and Objective evaluation, type of food panels, selection of panel members, characteristics of panel member, layout of sensory evaluation laboratory, sensitivity tests, threshold value, paired comparison test, duo trio test, triangle test, hedonic scale.

UNIT II

4. **Hurdle technology** (4 hrs)
Principles and applications, Hurdle effect in fermented foods, shelf stable products, intermediate moisture foods, application of hurdle technology.
5. **Minimal processing** (4 hrs)
Minimal processing of foods with thermal methods and non thermal methods-safety criteria in minimally processed foods-Minimal processing in practice-fruits and vegetables-seafood-effect on quality-Future developments
6. **Ohmic heating and High Pressure processing** (6 hrs)
Principles, equipment and processing, effect heat and pressure on food.

UNIT III

7. **Water disposal** (4 hrs)
Waste water, hardness of water, break point chlorination, physical and chemical impurities, BOD, COD, waste water treatment,
8. **Sanitation and hygiene** (3 hrs)
Sanitization of food processing plants and equipments, CIP system, sanitizers used in food industry.
9. **Shelf life of food material** (3 Hrs)
Objectives of packaging, packaging requirements of all major food groups, food contact materials,

UNIT IV

10. **Packaging materials** (6 Hrs)
Properties of the following packaging materials, edible, biobased and biodegradable food packaging materials, flexible packaging, New and active packaging technologies, food packaging closures and sealing systems, as well as optical, mechanical, and barrier properties of thermoplastic polymers
11. **Packed storage** (3 Hrs)
Design and analysis of shelf life experiments and the shelf life estimation of foods, Factors effecting shelf life of the material during packed storage.
- 12 **New product development** (4 hrs)
Definition, Importance, Need of product development, Steps of product development-Product development tools Reasons for failure

References

- 1) Coles R, McDowell D and Kirwan MJ, Food Packaging Technology, CRC Press, 2003
- 2) De S, Outlines of Dairy Technology, Oxford Publ., 1980
- 3) Deman JM, Principles of Food Chemistry, 2nd ed. Van Nostrand Reinhold, NY 1990
- 4) Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi, 2004
- 5) Jenkins WA and Harrington JP, Packaging Foods with Plastics, Technomic Publishing Company Inc., USA, 1991
- 6) Manay NS and Shadaksharaswamy M, Food-Facts and Principles, New Age International (P) Ltd. Publ., New Delhi, 1987
- 7) Meyer LH, Food Chemistry, CBS Publication, New Delhi, 1987
- 8) Potter NH, Food Science, CBS Publication, New Delhi, 1998

- 9) Ramaswamy H and Marcott M, Food Processing Principles and Applications CRC Press, 2006
- 10) Ranganna S, Handbook of Analysis and Quality Control for Fruits and Vegetable Products, 2nd ed. TMH Education Pvt. Ltd, 1986

FOOD MICROBIOLOGY (THEORY)

(48 hrs)

Course Objectives:

1. To provide the knowledge of microorganisms involved in spoilage, fermentation and diseases associated with foods, their origin and role.
2. To identify and understand methods and technologies used for controlling microorganisms in foods.

Course Outcomes:

At the end of the Course, students will be able to

- CO 1. Express the characteristics of microorganisms using various types of laboratory microscopes.
- CO 2. Know the factors involved in the growth of microorganisms and their in the spoilage of various food groups.
- CO 3. Apply in-depth knowledge of microorganisms in fermentation and understand food-borne diseases.
- CO 4. Use techniques, skills and modern trends in controlling microorganisms in foods.

UNIT I

1. **Introduction to food microbiology** **(4 hrs)**
History and Development of Food Microbiology, Definition and Scope of food microbiology, Inter-relationship of microbiology with other sciences.
2. **Microscopy** **(4 hrs)**
Light microscope - Resolving power, Limits of resolution, Refractive index, Magnification. Parts of microscope. Types of microscopy - Bright field, Dark field, Electron microscope - Transmission Electron microscope, Scanning electron microscope.
3. **Evolution of Microorganisms in foods** **(2 hrs)**
Theory of spontaneous generation, Germ theory of disease, Koch's postulates, Pure culture concept

UNIT II

4. **Microbial Growth in Food** **(4 hrs)**
Bacterial growth curve and microbial growth in food, Factors affecting the growth of microorganisms in food, Sources of Microorganisms in foods,
5. **Characteristics of Microorganisms in Food** **(4 hrs)**
Classification on microorganism (yeast, mould and bacteria), Prokaryotes, Eukaryotes, Importance of microorganisms in food, Significance of spores in food microbiology.
6. **Microbial Food Spoilage** **(6 Hrs)**
Some important food spoilage microorganisms, Spoilage of specific food groups- Milk and dairy products, Meat, poultry and seafoods, Cereal and cereal products, Fruits and vegetables and Canned products.

UNIT III

7. **Food Fermentations** **(5 hrs)**
Fermentation – definition and types, Microorganisms used in food fermentations, Dairy Fermentations - starter cultures and their types, Fermented Foods-types, methods of manufacture for traditional fermented foods – dairy-based, cereal-based and vegetable-based.
8. **Food borne Diseases** **(3 hrs)**
Types – food borne infections, food borne intoxications and toxic infections, Common and Recent Examples

9. **Cultivation of Microorganisms** (4 hrs)
Pure culture technique, Methods of isolation and cultivation, Enumeration of microorganisms- qualitative and quantitative.

UNIT IV

10. **Concepts of microbial control** (5 hrs)
Principles and methods of preservation, Introduction to Hurdle concept and Non Thermal methods, Probiotic concept.
11. **Control of Microorganisms in Foods** (5 hrs)
Physical Methods of Food Preservation- Dehydration, Freezing, Cool Storage, Heat Treatment, Irradiation, Biopreservation,
12. **Trends in Food Microbiology** (2 hrs)
Rapid Methods of Detection – Nucleic-acid based; Biosensor-based; Immunological techniques-based methods and Recent Advances

References

- 1) Frazier William C and Westhoff, Dennis C. Food Microbiology, TMH, New Delhi, 2004
- 2) Jay, James M. Modern Food Microbiology, CBS Publication, New Delhi, 2000
- 3) Garbutt, John. Essentials of Food Microbiology, Arnold, London, 1997
- 4) Pelczar MJ, Chan E.C.S and Krieg, Noel R. Microbiology, 5th Ed., TMH, New Delhi, 1993

FOOD AND NUTRITION (PRACTICAL-1)

Course Outcomes:

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

- CO 1. Understand balanced diet and its components.
 - CO 2. Know the different food groups and their nutritive value.
 - CO 3. Gain experience in planning and calculation of diet.
 - CO 4. Develop recipes by applying knowledge on cooking methods and properties of food.
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1. Identification of food sources for various nutrients using food composition tables.
 2. Record diet of self using 24 hrs dietary recall.
 3. Nutritional analysis of diet of self using 24 hrs dietary recall.
 4. Introduction to meal planning,
 5. Concept of food exchange system.
 6. Planning of meals for adults of different activity levels for various income groups.
 7. Planning of nutritious snacks for different age and income groups.
 8. Preparation of nutritious snacks using various methods of cooking.
 9. Nutritional labeling of food products.
 10. Estimation of BMI and other nutritional status parameters.
 11. Collection of nutritional components of the various vegetables and fruits available.
 12. Collection of nutritional components of fish, poultry and meat.

PRINCIPLES OF FOOD SCIENCE (PRACTICAL-2)

Course Outcomes:

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

- CO 1. Use techniques, instruments and equipment to analyse biochemical constituents found in food products
- CO 2. Evaluate food products based on sensory attributes
- CO 3. Estimate the microbiological content of food samples
- CO 4. Use Hand Refractometer and assess the nutritive qualities of food samples

1. Sensory evaluation of seafood on 10-point hedonic scale.
2. Sensory evaluation of vegetables.
3. Sensory evaluation of fruits.
4. Total bacterial count of the food sample.
5. Total mould count of the food sample
6. Determination of Free Fatty acids.
7. Determination of Peroxide value.
8. Determination of Total Volatile Base Nitrogen.
9. Determination of TBA.
10. Estimation of total salt content in butter.
11. Estimation of total ash content of the food
12. Preparation of brix solution and checking by hand refractometer

FOOD MICROBIOLOGY (PRACTICAL-3)

Course Outcomes:

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

- CO 1. Utilize laboratory techniques common to food microbiology.
- CO 2. Evaluate the morphology of microorganisms.
- CO 3. Evaluate the different method of cultivation of microorganisms.
- CO 4. Determine the microorganisms by using different staining methods.

1. Introduction to the Basic Microbiology Laboratory Practices and Equipments
2. Functioning and use of compound microscope
3. Cleaning and sterilization of glassware
4. Preparation and sterilization of nutrient agar
5. Cultivation and sub-culturing of microbes
6. Preparation of slant, stab and plates using nutrient agar
7. Morphological study of bacteria using permanent slides
8. Study of bacterial growth curve
9. Simple staining
10. Gram's staining
11. Fungal staining
12. Negative staining

SEMESTER-II
FOOD CHEMISTRY (THEORY)

(48 hrs)

Course Objectives:

1. Comprehensive study on definition, composition of food, water-food relation, macronutrients, vitamins and flavours.
2. Study of various natural food pigments, enzymatic reactions, changes taking place and new product development and browning reactions in food required at industrial level.

Course Outcomes:

At the end of the Course, students will be able to

- CO 1. Define and have an overview on food chemistry including composition and the importance of water.
- CO 2. Classify the carbohydrates, lipids, proteins, vitamins and flavour, minerals and natural food pigments used in food products.
- CO 3. Apply the knowledge of browning reactions in food products
- CO 4. Build own product in innovative way by understanding changes that occurs during food development and use of enzyme technology.

UNIT I

1. **Introduction** (4 hrs)
Definition, Composition of food, Definition of water in food, Structure of water and ice, Types of water, Sorption phenomenon, Water activity and packaging, Water activity and shelf-life
2. **Carbohydrates** (4 hrs)
Structure of important polysaccharides, Chemical reactions of carbohydrates, Modified celluloses and starches.
3. **Lipids** (4 hrs)
Physical properties of lipids. Chemical properties of lipids. Effect of frying on fats, Changes in fats and oils and its prevention, Technology of edible fats and oils- Refining, Hydrogenation and Interesterification, Fat Mimetics

UNIT II

4. **Proteins** (4 hrs)
Protein structure, Nature of food proteins (plant and animal proteins, Properties of proteins, Functional properties of proteins.
5. **Vitamins** (4 hrs)
Importance and Stability, Water soluble vitamins, Fat soluble vitamins,
6. **Flavour** (4 hrs)
Definition and basic tastes, Description of food flavours, Flavour enhancers

UNIT III

7. **Minerals** (4 hrs)
Major and minor minerals, Metal uptake in canned foods, Toxic metals
8. **Natural Food Pigments** (4 hrs)
Introduction and classification, Food pigments (chlorophyll, carotenoids, anthocyanins and flavonoids, beet pigments, caramel)
9. **Browning Reactions in Food** (4 hrs)
Enzymatic browning, Non-Enzymatic browning, Maillard reaction, Caramelization reaction, Ascorbic acid oxidation

UNIT IV

10. **Enzymes** (4 hrs)
Introduction, General characteristics, Enzymes in food processing, Industrial Uses of Enzymes, Immobilized enzymes
11. **Changes occurring during food processing treatments** (4 hrs)
Drying and dehydration, Irradiation, Freezing, Canning
12. **Colloidal chemistry** (4 hrs)
Characteristics and stabilization of colloidal system, properties and formation of emulsions, formation, stability and destruction of foam, application of colloidal chemistry to food preparation.

References:

- 1) Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York, 1996
- 2) Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002
- 3) Wong, Dominic WS, Food Enzymes, Chapman and Hall, New York, 1995
- 4) Potter, N.N. and Hotchkiss, J.H, Food Science, 5th Ed., Chapman & Hall, 1995
- 5) DeMan, J.M., Principles of Food Chemistry, AVI, New York, 1980
- 6) DeMan, J.M., Principles of Food Chemistry, 3rd Ed., Springer 1999
- 7) Desrosier, Norman W. and Desrosier., James N., The technology of food preservation, 4th Ed., Westport, Conn.: AVI Pub. Co, 1977.
- 8) Fuller, Gordon W, New Product Development from Concept to Marketplace, CRC Press, 2004.
- 9) Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002
- 10) Krishna Prasad Nooralabettu. Enzyme Technology, Pace Maker of Biotechnology, PHI Learning Private Limited, New Delhi. 2011

FOOD PRESERVATION (THEORY)

(48 hrs)

Course Objectives:

1. To familiarize students with different types of modern technology used in the field of food preservation
2. Learning and understanding the principles and technology and its application.

Course Outcomes:

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

- CO 1. Understand principles of food preservation and types of foods
- CO 2. Discern working principles, application and technology used in freezing, thermal processing and drying
- CO 3. Define, describe and give the working principle behind evaporation, irradiation, fermentation
- CO 4. Describe the evolution of modified atmosphere packaging and various chemical preservatives used to preserve the food and recent technology used

UNIT I

1. **Principles of Food Preservation** (5 hrs)
Principle, objectives and techniques of food preservation, Water activity of food and its significance in food preservation, microbial and autolytic degradation of food items, oxidative degradation.
2. **Food Microbiology** (5 hrs)
Microorganisms associated with foods- bacteria, yeast and mold, Importance of bacteria, yeast and molds in foods. Classification of microorganisms based on temperature, pH, water activity, nutrient and oxygen requirements, typical growth curve of micro-organisms.

3. **Types of foods** (2 hrs)
Classification of food based on pH, Food infection, food intoxication, definition of shelf life, perishable foods, semi perishable foods, shelf stable foods.

UNIT II

4. **Freezing and Refrigeration** (4 hrs)
Introduction to refrigeration, cool storage and freezing, definition, principle of freezing, freezing curve, changes occurring during freezing, types of freezing i.e. slow freezing, quick freezing, introduction to thawing, changes during thawing and its effect on food.
5. **Thermal Processing** (4 hrs)
Principle and application of heat preservation methods: Sterilization, commercial sterilization, Pasteurization, ultrahigh temperature sterilization, aseptic processing and blanching.
6. **Drying and Dehydration** (4 hrs)
Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), factors affecting rate of drying, normal drying curve, names of types of driers used in the food industry.

UNIT III

7. **Evaporation** (4 hrs)
Definition and principle of evaporation, factors affecting evaporation, names of evaporators used in food industry.
8. **Food Preservation by Irradiation** (4 hrs)
Introduction, units of radiation, kinds of ionizing radiations used in food irradiation, mechanism of action, uses of radiation processing in food industry.
9. **Fermentation** (4 hrs)
Principles of fermentation, Types of fermentation, curing and pickling; Hurdle technology, Advantages

UNIT IV

10. **Modified atmosphere** (4 hrs)
History of Controlled Atmosphere Storage, Modified Atmosphere Packaging techniques, Equilibrium Modified Atmosphere Packaging techniques, gas-flushing and compensated vacuum techniques
11. **Chemical Preservatives** (4 hrs)
Natural Preservatives-Mode of action, Chemical preservatives- Sulphur dioxide, Benzoic acid, Sorbic acid, Antioxidants
12. **Recent Trends** (4 hrs)
Bio-preservatives, Pulsed electric fields, High pressure technology, Ohmic heating, Microwave heating, Hurdle technology

References

- 1) Srilakshmi, B. Food science, New Age Publ., 2002
- 2) Meyer, Food Chemistry, New Age, 2004
- 3) Bawa, A.S, Chauhan O.P. Food Science. New India Publishing agency, 2013
- 4) Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi, 2004
- 5) Krishna Prasad Nooralabettu, Downstream processing-A new horizon in biotechnology, PHI publication, New Delhi, 2010.
- 6) Robertson, G. L., Food Packaging: Principles and Practice, 3rd edition, 2013.

FUNDAMENTALS OF FOOD PROCESSING (THEORY)

(48 hrs)

Course Objectives:

1. To familiarize students with the compositional, nutritional and technological aspects of various food groups.
2. To identify and understand the methods and technology used in processing various food groups.

Course Outcomes:

At the end of the Course, students will be able to

- CO 1. Define and describe the evolution of food processing from prehistoric times till date.
- CO 2. Describe compositional, nutritional and the rationale for use of each raw material in processing.
- CO 3. Apply knowledge of the various processing technologies used in industries.
- CO 4. Analyse the methods used to assess and classify the specific use of technologies applied for processing.

UNIT I

1. **Introduction** (2 hrs)
Historical development of food Science and technology, Evolution of Food Processing from prehistoric times till date.
2. **Compositional, Nutritional and Technological aspects of cereals & millets** (5 hrs)
Composition, Nutritive value and Structure of cereal grain. Toxins, Malting, Gelatinization of starch, Changes during cooking, Changes during germination.
3. **Compositional, Nutritional and Technological aspects of pulses & legumes** (5 hrs)
Composition, Nutritive value, and Structure of pulses and legumes, Antinutritional factors, Factors effecting cooking time, Changes during cooking, Changes during germination.

UNIT II

4. **Compositional, Nutritional and Technological aspects of animal meat** (4 hrs)
Definition of carcass, concept of red meat and white meat, composition of meat, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat.
5. **Compositional, Nutritional and Technological aspects of Fish** (4 hrs)
Fish - Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish, spoilage of fish- microbiological, physiological, biochemical.
6. **Compositional, Nutritional and Technological aspects of poultry meat** (4 hrs)
Structure of hen's egg, composition and nutritive value, egg proteins, characteristics of fresh egg, deterioration of egg quality.

UNIT III

7. **Compositional, Nutritional and Technological aspects of fruits** (4 hrs)
Classification, general composition and nutritional values, Post-harvest changes in fruits– Climacteric rise, physiological changes, physical changes, chemical changes, and pathological changes during the storage of fruits.
8. **Compositional, Nutritional and Technological aspects of vegetables** (4 hrs)
Classification, general composition and nutritional values of vegetables, Post-harvest changes in vegetables–Climacteric rise, horticultural maturity, physiological maturity, physiological changes, physical changes.
9. **Compositional, Nutritional & Technological aspects of Milk & Milk Products**(4 hrs)
Definition of milk, chemical composition of milk, its constituents, processing of milk, pasteurization, homogenization. An overview of types of market milk and milk products.

UNIT IV

10. **Compositional, Nutritional & Technological aspects of nuts & oilseeds** (6 hrs)
Classification of lipids, types of fatty acids - saturated fatty acids, unsaturated fatty acids, essential fatty acids, trans fatty acids. Refining of oils, types- steam refining, alkali refining, bleaching, steam deodorization, hydrogenation. Rancidity –Types- hydrolytic and oxidative rancidity and its prevention.
11. **Compositional, Nutritional & Technological aspects of health foods** (3 hrs)
Functional foods, Prebiotics, Probiotics, Nutraceuticals, organic foods, GM foods
12. **Compositional, Nutritional & Technological aspects of spices** (3 hrs)
Definition, Classification, Chemical composition, use of spices

References

- 1) Bawa. A.S, O.P Chauhan et al. Food Science. New India Publishing agency, 2013
- 2) Roday, S. Food Science, Oxford publication, 2011.
- 3) Srilakshmi, B. Food science, New Age Publ., 2002
- 4) Meyer, Food Chemistry, New Age, 2004
- 5) De Sukumar, Outlines of Dairy Technology, Oxford University Press, 2007
- 6) Manay Shakuntala N, M Shadakshara Swamy Foods: Facts and Principles -, New Age International Publ., New Delhi 2001
- 7) Srilakshmi B, Food Science - New Age International Publ., New Delhi 2005
- 8) Swaminathan M, Food science, Chemistry & Experimental Foods, The Bangalore Print and Publishing Company Ltd, 1995.
- 9) Shafiur Rahman M., Handbook of Food Preservation, CRC Press, 2007
- 10) Rui M. S. Cruz, Igor Khmelinskii, Margarida Vieira, Methods in Food Analysis, CRC Press, 2014
- 11) Picó Y, Chemical Analysis of Food: Techniques and Applications, Academic Press, 2012
- 12) Maynard Joslyn, Methods in Food Analysis, Elsevier Inc, 1950

FOOD CHEMISTRY (PRACTICAL 4)

Course Outcomes:

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

- CO 1. Test the principles underlying analytical techniques of food products.
- CO 2. Evaluate quantitatively total protein, total sugar and total lipid content in different food samples.
- CO 3. Estimate food contents using different methods.
- CO 4. Understand the non-enzymatic process by extraction process and estimate the non-protein nitrogenous substances in the various food samples

1. Qualitative analysis of carbohydrates.
2. Estimation of vitamin C.
3. Determination of acid value.
4. Estimation of saponification value.
5. Estimation of calcium using EDTA method.
6. Estimation of total ash.
7. Estimation of iodine value.
8. Estimation of peroxide value.
9. Determination of moisture content in food samples.
10. Estimation of non-enzymatic browning by extraction methods.
11. Estimation of non protein nitrogenous substances in the food.

FOOD PRESERVATION (PRACTICAL-5)

Course Outcomes:

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

- CO 1. Assess the various methods of food preservation for extended shelf life
- CO 2. Estimate the moisture content using graphical representation
- CO 3. Determine the qualitative characteristics of preserved foods
- CO 4. Perform different preservation methods and study the shelf-life characteristics

1. Food preservation techniques.
2. Concept of shelf life of different foods
3. Determination of acidity of fruit juices
4. Effect of heat on vegetables and fruits.
5. Characteristics study of foods preserved by drying/dehydration/ freezing.
6. Effect of Ph in cooking of vegetable samples.
7. To perform blanching of different food sample.
8. Effect of enzymatic browning in food sample.
9. Dry salting and wet Salting of fish samples.
10. Artificial drying of vegetables.
11. Preparation of pickle and shelf life study.
12. Preparation of jams/jellies/marmalades by concentration method

FUNDAMENTALS OF FOOD PROCESSING (PRACTICAL-6)

Course Outcomes:

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

- CO 1. Estimate the nutritional characteristics during food processing.
- CO 2. Determine the moisture content changes during processing of food.
- CO 3. Determine the organoleptic characteristics of food.
- CO 4. Evaluate the action of microorganisms on food.

1. Estimation of total yield during the processing of vegetables.
2. Effect of cooking on pulses.
3. Determination of pH of the food products using pH meter.
4. Estimation of drip loss of meat during frozen storage.
5. Moisture change during artificial drying of vegetables.
6. Moisture change during sundrying of vegetables.
7. Moisture change during salting of fishes.
8. Determination of specific gravity of fats and oils.
9. Determination of acidity of milk sample.
10. Detection of adulterants in turmeric, pepper, chillies, coffee .
11. Preparation of value added products from millets.
12. Visit to a food processing industry .

SEMESTER-III
TECHNOLOGY OF PLANT PRODUCTS (THEORY)

(48 hrs)

Course Objectives:

1. To learn about the processing of plant products undertaken at the industrial level
2. To gain knowledge about post-harvest technologies and novel technologies in the processing of plant products

Course Outcomes:

At the end of the Course, students will be able to

- CO 1. Comprehend the need for preservation, canning and bottling process for vegetable and fruit products.
- CO 2. Understand the rationale behind processing and drying techniques of fruits and vegetables leading to a final product with enhanced characteristics and shelf life.
- CO 3. Evaluate the reactions and changes taking place in fruits and vegetables, beverages and spices during overall processing.
- CO 4. Apply the technological ideas and methodologies to preserve the harvest and turn it into multiple uses.

UNIT I

1. **Introduction** (6 hrs)
Importance of fruits, vegetable, cereals and pulses, History and need of preservation, reasons of spoilage, method of preservation.
2. **Canning and bottling of Fruits and vegetable** (6 hrs)
Selection of fruits and vegetables, process of canning, factors affecting the process- time and temperature, containers of packing, lacquering, syrups and brines for canning, spoilage in canned foods, Process of bottling, factors affecting the sterilization, factors affecting the quality of the bottled foods.

UNIT II

3. **Fruits juices and tomato pulps** (6 hrs)
Selection of fruits, Processing of fruit juices, preservation of fruit juices. Selection of tomatoes, pulping& processing of tomato juice, tomato puree, paste, ketchup, sauce and soup.
4. **Fruit squashes, Jams, Jellies, Marmalades and candies** (6 hrs)
Selection of fruits, Processing, essential constituents, types, technology and defects in Fruit squashes, Jams, Jellies, Marmalades and candies

UNIT III

5. **Pickles, Chutneys and Sauces** (6 hrs)
Processing of pickles, chutneys and sauces, Types of pickles, chutneys and sauces, Causes of spoilage in pickling.
6. **Drying of Foods and Vegetables** (6 hrs)
Sun drying and mechanical drying of Food and Vegetables, process variation for fruits and vegetables, packing and storage.

UNIT IV

7. **Technology of Cereals** (4 hrs)
Introduction, Properties, types, milling, treatment, product and byproducts of wheat, rice
8. **Technology of Pulses** (4 hrs)
Milling of pulses, Dry milling, Wet milling, improved milling method
9. **Technology of Oilseeds and alcoholic beverages** (4 hrs)
Introduction, Extraction of oil and refining, Sources of protein, properties and uses, protein texturization, fibre spinning, Processing of Beer, Wine, Distilled Spirits

References

- 1) Girdharilal, Siddappa, G.S and Tandon, G.L.1998. Preservation of fruits & Vegetables, ICAR, New Delhi
- 2) Crussess W B.2004. Commercial Unit and Vegetable Products, W.V. Special Indian Edition, Pub: Agrobios India
- 3) Manay, S. & Shadaksharaswami, M.2004. Foods: Facts and Principles, New Age Publ.
- 4) Ranganna S.1986. Handbook of analysis and quality control for fruits and vegetable products, Tata Mc Graw-Hill publishing company limited, 2nd edition.
- 5) Srivastava, R.P. and Kumar, S. 2006. Fruits and Vegetables Preservation- Principles and Practices. 3rd Ed. International Book Distributing Co.
- 6) Kent, N.L. 2003. Technology of Cereal, 5th Ed. Pergamon Press.
- 7) Chakraverty. 1988. Post Harvest Technology of Cereals, Pulses and Oilseeds, revised Ed., Oxford & IBH Publishing Co. Pvt Ltd.
- 8) Marshall, Rice Science and Technology. 1994. Wadsworth Ed., Marcel Dekker, New York.
- 9) Manay, S. and Sharaswamy, M. 1987. Food Facts and Principles. Wiley Eastern Limited

TECHNOLOGY OF ANIMAL PRODUCTS (THEORY)

(48 hrs)

Course Objectives:

1. To understand the various processes and technologies relevant to animal products at the industrial level.
2. To identify and evaluate the various preservation technologies used

Course Outcomes:

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

- CO 1. Understand processing of meat and various preservation techniques used
- CO 2. Evaluate egg production practices and the various quality identification analysis parameters
- CO 3. Differentiate between different types of fishery byproducts and fermented fish products
- CO 4. Assess the different techniques used in production of market milk products

UNIT I

1. **Introduction to Meat and Meat products** **(2 hrs)**
Status and development of fishery, meat, poultry industries in India and its need in nation's economy. Introduction & Importance of meat products in India, Chemical composition, Nutritional value & microscopic structure of meat, Pre-slaughter inspection of animal, Transportation, feeding of animal before slaughtering. Post-mortem muscle chemistry
2. **Processing of meat** **(4 hrs)**
The meat processing industry, its techniques of working, general management, structure, composition. Slaughter, inspection and grading.
3. **Preservation of meat** **(6 hrs)**
Effects of feed, breed and environment on production of meat animals and their quality, quality of the meat, Refrigeration and freezing, thermal processing- canning of meat, retort pouch, dehydration, irradiation, meat curing. Sausages-processing, types and defects, byproducts.

UNIT II

4. **Egg Industry and Egg Production Practices** **(6 hrs)**
The egg industry, its techniques of working, General management, structure, composition and Nutritive value of egg and its products.
5. **Preservation of eggs** **(4 hrs)**
Refrigeration and freezing, thermal processing, dehydration, coating.
6. **Quality identification of shell eggs** **(2 hrs)**

Factors affecting egg quality and measures of egg quality.

UNIT III

7. **Processing of sea foods** (6 hrs)
Post-harvest change in fish, changes during chilled storage, various techniques of fish processing and preservation: chilling, freezing, canning, irradiation, curing, smoking, fermentation, salting, brining, and drying. Quality changes due to improper handling and processing. Processing of Crustaceans and Molluscs.
8. **Fishery by-products** (4 hrs)
Surimi- Introduction, fish muscle proteins, the surimi process, traditional and modern surimi production lines, quality of surimi products, comparison of surimi and fish mince products. Fish protein concentrates (FPC), fish protein extracts (FPE), fish protein hydrolysis, fish oil, glue, gelatin.
9. **Fermented fish** (2 hrs)
Principles of fermentation of fishery products, Flowchart of Indigenous products- Fish sauce and Paste

UNIT IV

10. **Animal meat handling and by-products:** (4 hrs)
Modern abattoirs, Typical layout and features, Ante-mortem handling and design of handling facilities, Hoisting rail and traveling pulley system, Stunning methods, Steps in slaughtering and dressing, Offal handling and inspection, Inedible by-products, Operational factors affecting meat quality, Effects of processing on meat tenderization, Abattoir equipment and utilities.
11. **Meat alternatives** (4 hrs)
History of meat alternatives, Plant based meat, Market for plant-based alternatives, Meat alternatives - health benefits
12. **Spoilage and test methods in meat** (2 hrs)
Color, microbiology and spoilage factors of meat and meat products, Factors affecting post-mortem changes, properties and shelf-life of meat. The spoilage of meat by infecting organisms — Test methods: Physical, Chemical and microbiological testing of meat, Sensory evaluation

References

- 1) Lawrie R A, Lawrie's Meat Science, 5th Ed, Woodhead Publisher, England, 1998
- 2) Parkhurst & Mountney, Poultry Meat and Egg Production, CBS Publication, New Delhi, 1997
- 3) Pearson & Gillet Processed Meats, 3rd Ed, CBS Publication, New Delhi, 1997
- 4) Shai Barbut, Poultry Products Processing, CRC Press 2005
- 5) Stadelman WJ, Owen, J Cotterill, Egg Science & Technology, CBSP, New Delhi, 2002
- 6) Sukumar D E, Outlines of Dairy Technology, Oxford University Press, Oxford.2007.
- 7) Hall GM, Fish Processing Technology, VCH Publ. Inc., NY, 1992
- 8) Sen DP, Advances in Fish Processing Technology, Allied Publ. Pvt. Limited, 2005
- 9) Shahidi F and Botta JR, Seafoods: Chemistry, Processing, Technology and Quality, Blackie Academic & Professional, London, 1994.
- 10) Webb and Johnson, Fundamentals of Dairy Chemistry, 3rd Ed., CBS Publ., New Delhi 1988

DAIRY TECHNOLOGY (THEORY)

(48 hrs)

Course Objectives:

1. To learn about the varied processing of dairy products undertaken in an industrial level
2. To gain the knowledge about the post-harvest technology and the novel technologies in the processing of the products

Course Outcomes:

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

- CO 1. Acquire the basic knowledge of developments in dairy industries.
- CO 2. Comprehend the recent advances in processing of dairy products.
- CO 3. Acquire the knowledge in manufacturing of different dairy products.
- CO 4. Understand about types of dairy plants and working principles of dairy instruments.
- CO 5. Gain knowledge regarding hygiene and sanitation practices in the milk and milk products industry

UNIT I

(12 hrs)

Dairy industry: Review of dairy development in India. Dairy industry in India and abroad. Co-operative dairying, Market survey; milk production & consumption pattern, national and global markets. Clean milk production & hygienic handling of raw milk. Milk collection/procurement and pricing. **Milk Testing:** Qualitative and quantitative analysis of milk.

UNIT II

(12 hrs)

Dairy products: Fluid milk: Full cream, standardized, toned & double toned milk, reconstituted, rehydrated, and recombined milk, flavoured milk, condensed milk, lactose-free milk, fortified milk, skimmed milk, valorised milk. Traditional dairy products – paneer, lassi, kulfi. Fat-rich dairy products, Heat and acid coagulated milk products, Cheese (types – processed, Mozzarella, Cheddar and manufacture process), fermented milk products (kefir, buttermilk); yoghurt; milk powders; value added dairy products, ice-cream and frozen desserts, imitation dairy products, By-products Technology (Processing and utilization of whey, ghee residue, casein – classification and applications).

UNIT III

(12 hrs)

Recent developments in dairy sector: Dehydration, LHT, HTST, UHT processing, types of UHT plants, aseptic fillers, heat stability and deposit formation aspects, retort processing, use of bio-protective factors for preservation of raw milk and their effects on physicochemical, microbial, and nutritional properties of milk and milk products. Packaging of dairy products.

UNIT IV

(12 hrs)

Dairy Plant Management: Principles of dairy plant design, classification of dairy plants, Instrumentation and process control, microbial quality and safety in dairy industry, HACCP, FSSAI regulations, cGMP/GHP practices in dairy processing. Waste Disposal and Pollution Abatement, Current trends in cleaning and sanitization of dairy equipment.

References

- 1) Products. Dairy India Yearbook Publications, New Delhi. 2002.
- 2) Gupta P. R., Dairy India, 5th Ed., New Delhi. 1997.
- 3) Robinson R. K., Modern dairy Technology, 2nd Ed., Chapman and Hall, New York. 1994.
- 4) Subbulaksmi G and Shobha A. Udiipi, Food processing and preservation, New age international, 2008.
- 5) D.B. Puranik, Dairy plant management, New India Publishing Agency. 2014
- 6) De Sukumar, Outlines of dairy: Technology, 1st edition, Oxford, 2001.

TECHNOLOGY OF PLANT PRODUCTS (PRACTICAL-7)

Course Outcomes:

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

- CO 1. Estimate the composition and nutritional content of fruits and vegetables.
- CO 2. Evaluate the characteristics on cooking of food.
- CO 3. Assess different preservation techniques.
- CO 4. Analyze changes that occur during preservation processes

1. Estimation of total soluble solids (TSS).
2. Preparation of marmalades
3. Determination of gluten content in wheat
4. Effect of heat treatment on vegetables and fruits.
5. Preparation of tomato ketchup/sauce.
6. Cooking characteristics of rice.
7. Adulteration of spices.
8. Dehydration of fruits and vegetables.
9. Rehydration of fruits and vegetables.
10. Salting of vegetables / Brining of vegetables
11. Identification and description of common pulses
12. Physical characteristics of wheat
13. Do It Yourself (DIY) – Innovative plant product development

TECHNOLOGY OF ANIMAL PRODUCTS (PRACTICAL 8)

Course Outcomes:

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

- CO 1. Describe the various acidity methods in milk sample.
- CO 2. Identify the presence of milk fat by Gerber method.
- CO 3. Perform various methods of evaluation of fish samples.
- CO 4. Evaluate moisture and protein content in meat; lipid content in fish and use various quality parameters to compare various brands of eggs.

1. Estimation of tenderization of meat.
2. Pickling of meat/ fish.
3. Estimation of lipid content of egg yolk.
4. Determination of water holding capacity of meat and extract release volume.
5. Determination of pH of meat fish and poultry samples.
6. Determination of moisture content of meat and fish samples.
7. Quality evaluation of fish/prawn.
8. Subjective evaluation of Fresh Fish.
9. Estimation of moisture content of meat.
10. Estimation of protein content of meat.
11. Estimation of lipid content of fish sample.
12. Evaluation of eggs for quality parameters (market eggs, branded eggs)
13. Do It Yourself (DIY) – Innovative animal product development

DAIRY TECHNOLOGY (PRACTICAL 9)

Course Outcomes:

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

- CO 1. Acquire the skills to assess milk quality
- CO 2. Perform chemical analysis of milk
- CO 3. Prepare quality milk products

CO 4. Innovate on new milk products

1. Rapid tests for evaluation of milk quality- Clot on boiling test, alcohol test, alizarin alcohol test, phosphatase, acidity, turbidity
2. Chemical analysis of milk and determination of its components like fat, SNF, protein and TSS.
3. Preparation and quality evaluation of milk products:
4. Heat desiccated/ Heat – acid Coagulated milk products,
5. Cultured milk products, Fat rich products, Puddings / desserts
6. By product utilization experiments (Whey and ghee residue)
7. Adulteration of milk and milk products
8. Estimation of free fatty acids in ghee
9. Preparation of pudding/desserts
10. Visit to dairy plant.
11. Do It Yourself (DIY) – Innovative milk product development /milk testing

SENSORY EVALUATION OF FOOD PRODUCTS (ELECTIVE COURSE)

30 hrs

Course Outcomes (COs):

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

- CO 1. explain the importance of sensory evaluation in the food industry and its role in product development and quality control.
- CO 2. demonstrate an understanding of human sensory perception, including the functioning of sensory organs, the concept of thresholds, and sensory adaptation.
- CO 3. apply different sensory evaluation techniques, such as discrimination tests, descriptive analysis, hedonic evaluation, and consumer tests, to assess and analyse food products.
- CO 4. gain practical skills in designing and conducting sensory evaluation experiments, including sample preparation, panel selection and training, experimental design, and statistical analysis of sensory data.

UNIT 1

15 hrs

Introduction to Sensory Evaluation of Food Products: Definition and Importance of Sensory Evaluation – Understanding the role of sensory evaluation in food product development and quality control. Exploring the significance of sensory attributes in consumer acceptance. Sensory Evaluation Methods – Discrimination tests: paired comparison, triangle test, duo-trio test. Descriptive analysis: profiling sensory attributes using trained panels. Hedonic evaluation: determining consumer preference and liking. Consumer tests: focus groups, surveys, and preference mapping. Sensory Evaluation Experimental Design: Sample preparation and presentation. Randomization and balancing. Control of extraneous variables. Sample size determination.

UNIT II

15 hrs

Sensory Evaluation in Food Industry: Quality Control and Product Development – Sensory evaluation in quality assurance programs. Monitoring product consistency and identifying sensory defects. Using sensory data for product reformulation and improvement. Shelf-Life Studies – Sensory evaluation techniques for determining product stability over time. Sensory attributes affected by storage conditions. Sensory testing protocols for shelf-life determination. Consumer Acceptance and Preference – Understanding consumer preferences and drivers of product acceptance. Application of consumer tests and preference mapping. Consumer research techniques and data analysis. Sensory Evaluation in Marketing – Sensory branding and product positioning. Sensory claims substantiation.

References:

- 1) Sensory Properties of Foods by Brich G; Brennan J., & Parker K.J., Applied Science Publisher 1977.
- 2) Food Science by Charley H., Macmillan Publishing Company.
- 3) Evaluation of food principle & Practice by Lawlers H.T., & Heymann, Chapman & Hall.
- 4) Sensory Evaluation of food: Statistical methods & procedures by Mahony M.
- 5) Food Science by Srilakshmi B., New Age International (p) Ltd. Publ., 2000.
- 6) Food Science, Chemistry & Experimental Foods by Swaminathan M., Bappco, Ganesh & Company, Madras.

OR

FOOD ADULTERATION (ELECTIVE COURSE)

30 hrs

Course Outcomes (COs):

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

- CO 1. Understand the adulteration of common foods and their adverse impact on health
- CO 2. Understand the concept of toxicants in foods
- CO 3. Comprehend certain skills of detecting adulteration of common foods.
- CO 4. Able to extend their knowledge to other kinds of adulteration, detection and remedies.
- CO 5. Know the basic laws and procedures regarding food adulteration and consumer protection.

UNIT I

15 hrs

Introduction to Food Adulteration: Definition. New adulterants in foods. Common Foods subjected to Adulteration - Adulteration – Definition – Types, Poisonous substances, Natural toxins in food: natural toxins of importance in food- toxins of plant and animal origin; microbial toxins (e.g., bacterial toxins, fungal toxins and Algal toxins); Heavy metals and radioactive materials; Foreign matter, Cheap substitutes, Spoiled parts. Adulteration through Food Additives – Intentional and incidental. General Impact on Human Health. Methods of Detection of Adulterants in the following Foods: Milk, Oil, Grain, Sugar, Spices and condiments, Processed food, Fruits and vegetables. Additives and Sweetening agents (at least three methods of detection for each food item).

UNIT II

15 hrs

Laws and Procedures on Adulteration: Highlights of Food Safety and Standards Act 2006 (FSSAI) – Food Safety and Standards Authority of India–Rules and Procedures of Local Authorities. Role of voluntary agencies such as AGMARK, ISI. Quality control laboratories of companies, Private testing laboratories, Quality control laboratories of consumer co operatives. Consumer education, Consumer's problems rights and responsibilities, COPRA 2019 – Offences and Penalties – Procedures to Complain – Compensation to Victims

References:

- 1) A first course in Food Analysis by A.Y. Sathe, New Age International (P) Ltd., 1999
- 2) Food Safety, case studies by Rames V. Bhat, NIN, 1992
- 3) DART- Detect adulteration with rapid test. FASSAI, Imprinting Trust, assuring safe and nutritious food, Ministry of Health and Family Welfare, Government of India.
- 4) Rapid detection of food adulterants and contaminants Theory and Practice by S. N. Jh, Kindle Edition, 2016
- 5) Food Safety and Standards Act, 2006. Bare ACT, Commercial law Publ., 2020.
- 6) Food Toxicology by Helferich, W., and Winter, C.K, CRC Press, LLC. Boca Raton, FL. 2007.
- 7) Introduction to Food Toxicology by Shibamoto, T., and Bjeldanes, L., 2nd Edition. Elsevier Inc., Burlington, MA. 2009
- 8) Natural Toxicants in Food by Watson, D.H., CRC Press, LLC. Boca Raton, FL 1998.

SEMESTER-IV
BAKERY, CONFECTIONERY AND EXTRUDED FOODS (THEORY)

(48 hrs)

Course Objectives:

1. To enable students to understand the bakery, confectionary and extruded industry.
2. To enable students to examine the technologies used in different industries.

Course Outcomes:

At the end of the Course, students will be able to

- CO 1. Understand and identify methods and products used in bakery industry.
- CO 2. Apply the knowledge of the various technologies in bakery industries.
- CO 3. Define and describe the manufacturing methods and general technical aspects of confectionary industry.
- CO 4. Identify and explain about the extruded food product industry

UNIT I

1. **Baking Industry** (6 hrs)
Historical development and status of bakery industry in India; Introduction and definition of bakery products as per FSSAI — bread, biscuit, cake, pastries, rusk, crackers, bun and their specifications. Present status and future prospects
2. **Bakery Ingredients** (6 hrs)
Classification of bakery products. Bakery ingredients and their functions-Essential ingredients. Flour, yeast and sour dough, water, salt- Other ingredients Sugar, color, flavor, fat, milk, milk powder and bread improvers. Leaveners and yeast foods. Shortenings, emulsifiers and antioxidants.

UNIT II

3. **Baking methods** (4 hrs)
Various methods of production and effect of ingredients, formulations and process parameters on quality, machinery used in baking industry.
4. **Bakery Product Quality** (4 hrs)
Rheological testing of dough- Farinograph, mixograph, extensograph, amylograph/ rapid visco analyser, Falling number; Microbiological aspects of different bakery products – prevention of bacterial rope and mold infection
5. **Bakery plants sanitation** (4 hrs)
Bakery hygiene and sanitation including control of rodents and pests. Bread faults – causes and remedies; Bread staling – theory, manifestation, retardation measures

UNIT III

6. **Cakes, Biscuits and Breads** (6 hrs)
Flour specifications, ingredients, manufacturing process and quality evaluation of cakes, biscuits and breads. Basic methods of cake preparations, variety cakes, biscuits, breads, rusk, cracker and bun. Cake recipe balancing, faults and remedies; Preparation of basic custards, pudding; Mousse.
7. **Confectionery industry** (6 hrs)
Definition, importance of sugar confectionery. Types of confectioneries-classification. Raw materials-types of sugar-role of sugar-alternative, bulk sweeteners –syrup production, quality parameters, faults and corrective measures. Spoilage of confectionery products.

UNIT IV

8. **Confectionary manufacture** (4 hrs)
Raw materials and processing of cocoa, and its products, chocolate processing- processing steps, types of chocolates, tempering, enrobing technology.
9. **Sugar confectionery** (4 hrs)
General technical aspects, manufacture of boiled sweets, lollipops, lozenges, gums and jellies, chewing gums, caramel, toffee, fudge. Indian Confectionery – Types, role of sugar in preparation, other ingredients and their role in preparation
10. **Extruded bakery products** (4 hrs)
Scope, costing economics & marketing of processes and products, including energy required and auditing; Project Preparation for Baking Unit and Layout; Bakery management and marketing

References

- 1) Matz, Samuel A, Bakery Technology and Engineering, 3rd Ed, CBS Publ., 2008.
- 2) Stanley Cauvain and Linda Young, Baked Products- Science, Technology and practice, Blackwell Publishing, 2006.
- 3) Amendola, Joseph and Nicole Rees, The Baker's Manual, 5th Ed, Wiley, 2003.
- 4) Hamed Faridi and Jon M. Faubion, Dough Rheology and Baked Product Texture, CBS Publ., 1997.
- 5) Duncan, Manley. Biscuit, Cookie and Cracker Manufacturing Manuals. Vol.1-6. Woodhead Publishing Harper JM. Extrusion of Food, Vol 2, CRC Press 1981.
- 6) Matz SA. Bakery Technology & Engineering. AVI Pub. 1960.
- 7) Fance WJ and Wrogg BH. Up to-date Bread Making; Maclasen & Sons Ltd. 1968,
- 8) Kent-Jones DW and Amos AJ, Modern Cereal Chemistry, Food Trade Press Ltd. 1967
- 9) NIIR Board of Consultants & Engineers, The Complete Technology Book on Bakery Products (Baking Science with Formulation & Production) 3rd Ed., 2014
- 10) Ashokkumar Y, Textbook of Bakery and Confectionery, PHI India Pvt. Ltd., 2012
- 11) Stanley Cauvain and Linda Young, Baked Products- Science, Technology and practice, Blackwell Publishing, 2006.
- 12) Amendola, Joseph and Nicole Rees, The Baker's Manual, 5th Edition, Wiley, 2003.
- 13) Hamed Faridi and Jon M. Faubion, Dough Rheology and Baked Product Texture, CBS Publ., 1997.

TECHNOLOGY OF FAT AND OIL PRODUCTS (THEORY)

(48 hrs)

Course Objectives

1. To enable students to understand the production and processing technologies of fats and oils.
2. To evaluate the diverse technologies and the consequent chemical and physico-chemical modifications on oils and fats.

Course Outcomes

At the end of the Course, students will be able to

- CO 1. Identify sources, composition, importance and properties of fats and oils.
CO 2. Apply various methods of extraction and processing of fats and oils.
CO 3. Assess the processing of fat in various food industries.
CO 4. Analyse the methods used for production, packaging, storage and distribution of fats and oils.

UNIT I

1. **Edible fats and oil processing industry** (4 hrs)
Global status of edible fat and oil industry, Introduction to edible fat and oil production, , traditional edible fat and oil products; Modern fat and oil products.

2. **Properties of fat and oil products** (4 hrs)
Chemical, physical and functional properties of fats and oils (coconut, sunflower),
Importance of fats and oils in human nutrition Commercial oil resources
3. **Edible fats and oil products** (4 hrs)
Importance of fats and oils in foods; Sources, composition and properties of fats and oils of
plant and animal origin; Reversion and rancidity of fats and oils.

UNIT II

4. **Extraction of fats and oils** (4 hrs)
Rendering, pressing, solvent extraction, supercritical fluid extraction, enzyme-derived oil
extraction.
5. **Processing of fats and oils** (4 hrs)
Basic processing of fats and oils - oil extraction, degumming, refining, bleaching,
hydrogenation, fractional crystallization, interesterification, glycerolysis, molecular
distillation, plasticizing and tempering
6. **Modification of fats and oils** (4 hrs)
Breeding, Hydrogenation, Fractionation, Emulsification, Interesterification, Crystallization,
Blending and Calculation

UNIT III

7. **Plastic fats** (4 hrs)
Application of plastic fat in bakery, confectionary and cocoa butter replacers, shortenings,
8. **By-products of fat and oil processing industry** (4 hrs)
Oil seed protein isolates; Quality standards of fats and fatty foods; Antioxidants and its
mechanism of application.
9. **Chemical adjuncts** (4 hrs)
Chemical adjuncts-lecithins, monoglycerides and derivatives, propylene glycol esters,
polyglycoesters.

UNIT IV

10. **Shortening** (4 hrs)
Introduction into shortening, manufacturing and uses of shortening, types of shortening.
11. **Value added products** (4 hrs)
Margarine-manufacturing process and its uses. Mayonnaise and salad dressings.
Confectionery coatings. Imitation dairy products - peanut butter and vegetable ghee.
12. **Packaging and testing of fat and oil products** (4 hrs)
Packing, storage and transportation of fats and oils, cocoa butter, fat substitutes. Quality
Control: Peroxide value, FFA, sensory evaluation, shelf-life, testing.

References

- 1) Swern D, Bailey's Industrial Oil and Fat Products, Vol 1 & 2; 4th ed, John Wiley & Sons, 1982.
- 2) Devine J & Williams PN, The Chemistry & Technology of Edible Oils and Fats, Pergamon Press, 1961.
- 3) Weiss TJ. Food Oils and their Uses. AVI, 1983,
- 4) Torrey S, Edible Oils & Fats: Developments since 1978 (Food Technology Review # 57); NDC, 1983.
- 5) Hamilton RJ and Bharti A, Fats and Oils: Chemistry and Technology, Applied Science, London, 1980.
- 6) Salunkhe OK, Chavan JK, Adsule RN and Kadam SS, World Oilseeds: chemistry, Technology and Utilization, VNR, New York, 1992.
- 7) Wolf IA, Handbook of Processing and Utilization in Agriculture, (2 vol. set), CRC Press, Florida, 1983.

FOOD ADDITIVES AND PRESERVATIVES (THEORY)

(48 hrs)

Course Outcomes:

At the end of the Course, students will be able to

- CO 1. Understand the chemical and technological properties of relevant food additives used as food improvement.
- CO 2. Know the food additives, the reasons of their use in foods and toxicological evaluation.
- CO 3. Be competent in the proper use of additives in safe food production.

UNIT I

(12 hrs)

Food additives: Definitions, classification, and function. Role of Food Additives in food preparation and uses in processed food products. Chemical, technological, and toxicological aspects of food additives, pH controllers, salts and chelating/sequestering agents, leavening agents, antioxidants, emulsifying and stabilizing agents, anti-caking agents, thickeners, firming agents, Proteins, starches and lipids as functional ingredient; isolation, modification, specifications, functional properties and applications in foods

UNIT II

(12 hrs)

Health and safety aspects of food additives: Present status of various food additives. Controversial food additives Saccharin, history, function, aspartame, nitrite and nitrate compounds, nitrosamines. Additives to improve acceptability, permitted food colors, natural and artificial sweeteners composition, uses, emulsifiers, enzymes, fat replacers, gelling agents, leavening agents, stabilizers, surfactants, tenderizers, texturizers, thickeners, vitamins, nutraceuticals, essential oils and oleoresins viscosity modifiers, whipping agents.

UNIT III

(12 hrs)

Food Flavors: Types of flavours, classification, flavoring constituents, stability of flavours during food processing, analysis of flavours, extraction techniques of flavours, flavours emulsions; flavours Spices and flavors in food industries. Functional role and safety issues,

UNIT IV

(12 hrs)

Food adulteration, definition, reasons for food adulteration, common adulterants, methods of adulteration, and methods of detection. Normal food adulterants in coffee, tea leaves, edible oil, milk, cereals, spice powders. Adverse effects of food adulterants. Testing, regulations and QC for food additives and preservatives.

BAKERY, CONFECTIONERY, AND EXTRUDED FOODS (PRACTICAL 10)

Course Outcomes:

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

- CO 1. Prepare recipes and create formulations used in baking and confectionery.
 - CO 2. Create a variety of baked goods and confectionery
 - CO 3. Assess and select ingredients for baking and pre-preparation of the products.
 - CO 4. Evaluate factors that affect quality of baked products and confectionery.
-
- 1. Introduction to bakery equipments
 - 2. Determination of ash content of the given sample of white wheat flour
 - 3. Estimation of water absorption power and gluten content of the given flour.
 - 4. Determination of alcoholic acidity of the given sample of wheat flour.
 - 5. Determination of sedimentation value of white wheat flour
 - 6. Determination of yeast quality by its dough rising capacity

7. Preparation of plain biscuit in laboratory
 8. Preparation of egg less cake.
 9. Preparation of bread by straight dough method.
 10. Microbial flora of aging bakery items.
 11. Sensory characteristics of the baked products.
 12. Objective characteristics of biscuits.
- Do It Yourself (DIY) – Innovative bakery/confectionary product development

TECHNOLOGY OF FAT AND OIL PRODUCTS (PRACTICAL 11)

Course Outcomes:

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

- CO 1. Analyse physical and chemical parameters of fats and oils by using different techniques
- CO 2. Understand various refining processes carried out at industrial level
- CO 3. Prepare peanut butter.
- CO 4. Evaluate using subjective parameters
-
1. Determination of physical characteristics of fats, and oils.
 2. Chemical analysis of fats and fatty acids.
 3. Determination of acid value in oil sample.
 4. Preparation of peanut butter.
 5. Estimation of specific gravity of oil samples.
 6. Processing methods of oil
 7. Determination of peroxide value of oil.
 8. Determination of free fatty acid of oil.
 9. Adulteration of fats and oils.
 10. Preparation of mayonnaise.
 11. Objective parameters of fat and oils
 12. Subjective characteristics of fats and oil.
 13. Do It Yourself (DIY) – Innovative oil/fat product development

FOOD ADDITIVES AND PRESERVATIVES (PRACTICAL 12)

Course Outcomes:

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

- CO 1. Students will understand the chemical and technological properties of relevant food additives used as food improvement.
- CO 2. Students learnt the knowledge of the food additives, the reasons of their use in foods and toxicological evaluation.
- CO 3. Students will acquire competence in the proper use of additives in safe food production.
-
1. E-Numbers for different food additives.
 2. Qualitative tests for presence of Benzoic acid in food.
 3. Role of leavening agents in baked food products.
 4. Study of effect of stabilizers/thickeners on quality of foods.
 5. Detection of chemical preservatives in foods.
 6. Detection of common adulterants present in the food sample.
 7. Study of emulsion stability.
 8. Study of effect of clarifying agents on fruit juices.
 9. Isolation of pectin from food sample.

10. Effect of tenderizing agents on the various food samples.
11. Quantitative estimation of glucose.

References

- 1) Branen, A.L., Davidson PM & Salminen S. 2001. Food Additives. 2nd Ed. Marcel Dekker.
- 2) George, A.B. 1996. Encyclopedia of Food and Color Additives. Vol. III. CRC Press
- 3) George, A.B. 2004. Fenaroli's Handbook of Flavor Ingredients. 5th Ed. CRC Press.
- 4) Madhavi, D.L., Deshpande, S.S & Salunkhe, D.K. 1996. Food Antioxidants: Technological, toxicological and Health Perspective. Marcel Dekker
- 5) Mahindru, S N (2000) Food Additives- Characteristics Detection and Estimation. Tata Mc Graw Hill Publishing Co. Ltd.

PEST MANAGEMENT OF STORED FOOD (ELECTIVE COURSE)

30 hrs

Course Outcomes (COs):

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

- CO1. Understand storage structures
- CO2. Discuss mode of action of integrated pest management
- CO3. Apply the method of fumigation

UNIT I

(15 hrs)

Principles of construction of scientific metallic; non-metallic storage structures; their specifications. Mode of Action of insecticides, rodenticides; fungicides. Tolerance limit of pesticide residues, antidotes and precautions and safe handling of pesticides. Insect pest of stored grain and milled products, Integrated Insect Pest Management, Sources and detection of infestation in stored food grains. Identification of rats and Management. Termite and their control, Control of household pests. Toxic contaminants in food grains, their ill effect and prevention.

UNIT II

(15 hrs)

General Principles of fumigation, different type of fumigations with MBr, Alp and Precautions in their use. Insecticide Act, Consumer protection Act; Stress Management. Role and function of Warehousing Development and Regulatory Authority and negotiability of Warehouse Receipt. Role of regulation agencies; responsibilities of fumigation operators. Stack/Container/Ship fumigation. Maintenance of Fumigation records.

References

- 1) Chattopadhyay SB. 1985. Principles and Procedures of Plant Protection. Oxford & IBH, New Delhi.
- 2) Dhaliwal GS & Arora R. 2001. Integrated Pest Management: Concepts and Approaches. Kalyani Publ., New Delhi.
- 3) Duntson PA. 2004. The Insects: Structure, Function and Biodiversity. Kalyani Publ., New Delhi.
- 4) Evans JW. 2004. Outlines of Agricultural Entomology. Asiatic Publ., New Delhi.
- 5) Jerry Heeps (2006) Insect Management for Food Storage and Processing, Second Edition, Elsevier, eBook ISBN: 9780128104293.
- 6) Patnaik BD. 2002. Physiology of Insects. Dominant, New Delhi.
- 7) Saxena AB. 2003. Biological Control of Insect Pests. Anmol Publ., New Delhi.

OR

POST HARVEST MANAGEMENT (ELECTIVE COURSE)

30 hrs

Course Outcomes (COs):

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

- CO1. Understand the importance of post harvest management
- CO2. Differentiate between pre and post-harvest changes
- CO3. Comprehend role of plant growth regulators
- CO4. Produce products from fruits and vegetables.

UNIT I

(15 hrs)

Fruits and vegetables as living products: Chemical composition, pre and post harvest changes, desirable characteristics of fruits and vegetables for processing.

Plant growth regulators: Role in relation with storage, physical and chemical treatment to increase shelf life conditions.

UNIT II

(15 hrs)

Fruits and vegetable juices: preparation of juice, syrups, squashes. Concentration and drying of juices, packaging of dried fruits and vegetables.

Vinegar: methods of preparations, food standards and quality control.

References

- 1) Haard, N.F. and Salunke, D.K. 1975, Post harvest biology and handling of fruits and vegetables, AVI, Westport.
- 2) Jacob John P., 2012. A Handbook on Post Harvest Management of Fruits and Vegetables
- 3) Saraswathy S; T L Preethi; S Balasubramanyan; J Suresh; N Revathy and S Natarajan, 2008. Post Harvest Management of Horticultural Crops, 10: 8177543229 / ISBN 13: 9788177543223, Published by Agrobios.
- 4) Verma L.R and Joshi, 2000, Post harvest technology of fruits and vegetables, vols 1 & 2

NEW PRODUCT DEVELOPMENT

(PRACTICAL KNOWLEDGE/COMPULSORY SKILL-BASED COURSE)

2hrs/week

Course Outcomes (COs):

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

- CO1. Undertake market research for new product development
- CO2. Undertake survey for new product development
- CO3. Undertake new product development for age-groups/stages/disease condition etc.
- CO4. Innovate and become an entrepreneur

New Product Development could include the following aspects: Designing of new product – types and drawing forces, need for product development, stages of product development, success in product development, consumer research, role of sensory evaluation in consumer product acceptance, consumer behaviour, market place acceptance, factors influencing new product acceptance.

Students shall undertake lab/skill-based mini project including market survey towards developing a new product.

SEMESTER – V
FOOD REFRIGERATION AND COLD STORAGE (THEORY)

Course Outcomes (COs):

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

CO1: Demonstrate the operations in different Refrigeration and cold storage systems

CO2: Design Refrigeration and cold storage systems.

UNIT I

10 hrs

Terminology & laws of thermodynamics applied to refrigeration: Principles of refrigeration, Work, Heat, Specific Heat, Sensible heat, Latent heat, First and Second Laws of Thermodynamics, Carnot Refrigeration Systems, Refrigerator and Heat Pump, Coefficient of Performance (COP), Units of refrigeration: Ton of refrigeration, Refrigerants, desirable properties of refrigerants, types of refrigerants characteristics of different refrigeration's, ozone-depletion potentials, green house potential refrigerants, use of non-polluting refrigerants, net refrigerating effect. Refrigeration methods, Refrigeration cycles- Vapour Compression and Vapour Absorption cycles

UNIT II

10 hrs

Chilling of Foods: Introduction, Chilling equipments, Direct expansion techniques in chilling. Chilled foods transport and display cabinets, Basics of Chilled foods microbiology – Hygienic design considerations for chillers and chilled storages. Chilling injury, cook-chilling systems; cold – shortening; PPP and TTT concepts; Temperature monitoring; -Critical temperatures; Temperature -time indicators (TTI); Cold Chain- Need for the chain for chilled / frozen food item, various links of the chain; importance of shelf- life.

UNIT III

10 hrs

Freezing of Foods: Introduction, Freezing rates, Freezing Curve, Freezing types , Freezing of Foods: Freezing equipment (Mechanical Freezers, Cooled air freezers Cooled liquid freezer Cooled surface freezer, Cryogenic Freezers, Dehydro-Freezing, Freeze-drying, Individual quick freezing), Freezing practice as applied to different food products. Freezer Storages, Freezer room temperatures, insulation of freezer rooms: Pre-cooling and pre freezing.

UNIT IV

10 hrs

Cold Storage Design and Construction: Functional Requirements of cold Storage, Condition of Storage for Perishable Products, Calculation of Cooling Load, Insulation, Properties of insulating materials, Air diffusion equipment, Doors and other openings. Prefabricated systems, walk-in coolers and refrigerated container truck. Cold storage practice, Stacking and handling of material in and around cold rooms, Optimum temperatures of storage for different food materials. Cold storage and their applications. Evaporative cooling and its applications.

References

- 1) Refrigeration, Air Conditioning and Cold Storage by Raymond R. Gunther, Chilton Company, Philadelphia, USA 1957
- 2) Cold and Chilled Storage Technology by Clive D.J. Dellino, Kluwer Academic Publisher 1997
- 3) A Course in Refrigeration and Air Conditioning by S. Domkundwar and Subhash Arora, Dhanpat Rai and Sons, Publ., New Delhi, 1994
- 4) Refrigeration and Air Conditioning Goodheart by Andrew D Althouse and others, Willcox Company Inc. 1982
- 5) Cold Storage and Freezer Storage Manual by E.R. Hollowell, AVI Publishing Co. 1980

- 6) Frozen Food Technology by C.P. Mallet (Ed.) Blackie Academic and Professional, 1993
- 7) Cooling Technology in the Food Industry by Aurel Gobaneu and Gabriela Lasesha and others, Abacus Press, Tunbridge Wells, U.K, 1976
- 8) Refrigeration and Air-Conditioning, by Manohar Prasa, Wiley Eastern Publ., New Delhi, India.
- 9) Heating, Ventilation and Air-Conditioning, by McQuiston and W. Tauker, Wiley Eastern Publ., New Delhi, India.
- 10) Refrigeration and Air-Conditioning, by C. P. Arora, Tata McGraw Hill Book Co. Ltd, New Delhi, India.
- 11) Principles of Refrigeration, by Roy J. Dossat, Wiley Eastern Publ., New Delhi, India.

FOOD PACKAGING AND STORAGE TECHNOLOGY (THEORY)

(40 hrs)

Course Objectives:

1. To undertake effective learning on the packaging techniques, labelling and printing process and understand the environmental concerns.
2. To gain knowledge on construction, maintenance and storage technology in building an effective cold storage

Course Outcomes:

At the end of the Course, students will be able to

- CO 1. Define and describe various packaging materials and their characteristics
- CO 2. Assess packaging requirement for various food groups and working of packaging machineries
- CO 3. Apply the knowledge in designing and construction of cold storage and refrigeration systems and environmental concerns related to packaging materials
- CO 4. Understand changes during cold storage, controlled atmospheric storage and modified atmospheric storage.

UNIT I

1. **Introduction** **(2 hrs)**
Introduction to packaging: definition, importance and scope of packaging of foods, Protective role of packaging; Principle in the development of protective packaging,
2. **Packaging material** **(5 hrs)**
Origin, types, chemistry, morphology and physical characteristics, advantages, defects and risks
Forms of packaging-wooden boxes, crates, plywood, wire bound boxes, corrugated and fiber board boxes, bottle, tetra, retortable, flexible and laminated pouches, shrink, vacuum, gas, CAP, MAP, wrappers, textile bags, aseptic etc.
3. **Characteristics of packaging materials** **(3 hrs)**
Introduction to WVTR, GTR, bursting strength, tensile strength, tearing strength, drop test, puncture test, impact test, etc.

UNIT II

4. **Effect of food stuff on packaging material** **(2 hrs)**
Characteristics of food stuffs that influence packaging selection: physical chemical and biological.
5. **Packaging requirement** **(4 hrs)**
Packaging requirements and their selection for raw and processed foods; meat, fish, poultry and egg, milk and dairy products, fruits and vegetables, cereal grains and cereal products, baked products, beverages, ready to eat snacks.
6. **Packaging machinery** **(4 hrs)**

Bottling, canned former, form fill and sealed machine, bags- their manufacturing and closing, vacuum pack units, shrink pack units, tetra pack units, temper evident and child resistant packaging and box coding.

UNIT III

7. **Packaging techniques** (5 hrs)
Packaging and temperature changes: intelligent packaging; Packaging for microwave heating; Printing techniques; Package labeling: functions and regulations; Environmental aspect of food packaging, ecobalances.
8. **Storage of food products** (5 hrs)
Cold load estimation; prefabricated systems, walk-in coolers, and refrigerated container trucks; Freezer storages, freezer room temperatures, insulation of freezer rooms. Pre-cooling and pre freezing. Stacking and handling of material in and around cold rooms.

UNIT IV

9. **Changes during storage** (5 hrs)
Storage of grains - biochemical changes during storage - production, distribution and storage capacity estimate models, factors affecting losses, storage requirements, preventive method.
10. **Controlled and modified atmospheric storages** (5 hrs)
Principles and basics of their construction, operation and maintenance, cleanliness, defrosting practices, preventive and safety measures. Optimum temperatures of storage for different food materials: meat and poultry products, marine products, fruits and vegetables, spices and food grains.

References

- 1) Coles R, McDowell D and Kirwan MJ, Food Packaging Technology, CRC Press, 2003
- 2) Ahvenainen R., Novel Food Packaging Techniques, Woodhead Publishing, 2003
- 3) Robertson GL, Food Packaging: Principles and Practices, 2nd ed, CRC, 2005
- 4) Yam KL, Lee DS and Piergiovanni L, Hand Book of Food Packaging, CRC Press, 2006
- 5) Gosling CT, Applied Air conditioning and refrigeration. Applied Science Publ. Ltd. London. 1980.
- 6) Holowell ER, Cold Storage and Freezer Storage Manual, AVI Pub. Co. 1980.
- 7) Ciobanu A, and Lasku G, Bersescu V, Cooling Technology in the Food Industry, Abacus Press, 1976
- 8) Koelet PC, Industrial refrigeration, Principles, Design and Applications. CRC, 1992
- 9) Mascheroni RH. Operations in Food Refrigeration, CRC, 2009.
- 10) Stoecker WF, Industrial Refrigeration Handbook, McGraw Hill Professional, 1998.
- 11) Arvanitoyannis I, Modified Atmosphere and Active Packaging Technologies. CRC, 2009.

QUALITY CONTROL IN FOOD PROCESSING INDUSTRIES (THEORY)

(40 hrs)

Course Objectives:

1. To understand the importance of quality control, assurance and total quality management in the food industries
2. To learn and implement various national and international laws and standards applied in food processing industries.

Course Outcomes:

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

- CO 1. Apply the knowledge of quality control, assurance, TQM, the current GMPs and HACCP in food processing industries.
- CO 2. Classify the various hazards and international standards used in industries as well as assess the problems related to quality in food areas.

- CO 3. Apply the knowledge of adulteration in foods, additives used, sanitation and hygiene maintained in food processing industries.
- CO 4. Analyse the various quality control aspects in different food plants, analyse the quality using statistical solutions and use the standards, characteristics and measurements in a product or service during a quality process.

UNIT I

1. **Overview** (2 hrs)
Organization and management; quality, quality assurance, quality control, total quality management
2. **Current Food Good Manufacturing Practices** (4 hrs)
Basic principles, Provisions- General Provisions, Buildings and Facilities, Equipment, Production and Process Controls, Defect Action Levels, cGMP for Dietary fibers
3. **Hazard Analysis Critical Control Point** (4 hrs)
Principles of HACCP-Conduct a Hazard Analysis, Identify the Critical Control Points, Establish a maximum or minimum limit, Establish Critical Limits, Establish Monitoring Procedures, Establish Corrective Actions, Establish Record Keeping Procedures, and Establish Verification Procedures.

UNIT II

4. **Hazard in food** (3 hrs)
Overview of biological, chemical and physical hazard in foods, designing safety into food and processes; grades and standard of identity, Codex Alimentarius, safety, hazards, risk.
5. **Quality standards** (3 hrs)
ISO:9000 series and ISO:14000 series, national laws and regulations: PFA, FPO, BIS and Agmark and international laws and regulations, Food Safety Act.
6. **Quality Testing** (4 hrs)
Objective analysis, sensory assessment, rapid microbiological techniques; acceptance sampling; operational characteristics, risks, attributes, sampling plan, variables sampling plan, administration of acceptance sampling.

UNIT III

7. **Adulteration of food** (3 hrs)
Identification of adulterants both qualitative and quantitative; additives in foods; types, names, uses, maximum permissible limits.
8. **Sanitation in food processing facilities** (4 hrs)
Definition, important and application; laws and regulation governing sanitation; establishment of SOPs; sanitization methods; waste disposal; solid and liquid; waste control.
9. **Personal hygiene and hygienic food handling** (3 hrs)
Personal hygiene and hygienic food handlings, employee health, cleaning compounds; choosing of cleaning compounds, handling and storing of cleaning compounds.

UNIT IV

10. **Quality Control** (5 hrs)
Quality control aspect of processing plant for milk, meat, fish, poultry, foods, vegetables and cereals; customers service; complaint handling, product recall.
11. **Quality standards** (5 hrs)
Relationship between standards and measurement in a quality process, Identification of quality characteristics of a product or service, effect of instrument characteristics on measurement results.

References

- 1) Sathe AV, A First Course in Food Analysis, New Age International Pvt. Ltd. 1999

- 2) Nielsen SS, Food Analysis, 3rd ed., Kluwer Academic Publ., 2003
- 3) Wrolstad RE, Acree TE, Decker EA, Penner MH and Reid DS, Handbook of Food Analytical Chemistry, John Wiley & Sons, 2004
- 4) Ali I, Food Quality Assurance: Principles and Practices, CRC Press, 2003
- 5) Vasconcellos JA, Quality Assurance in Food Industry: a Practical Approach, CRC Press, 2003
- 6) Hubbard MR, Statistical Quality Control for the Food Industry, Kluwer Academic/ Plenum Publ., 2003
- 7) Pearson AM and Dutson TR, Kluwer HACCP in Meat, Poultry and Fish Processing, Academic Press Publ, 1995
- 8) D'Mello J P F, Food Safety Contaminants and Toxins, Oxford University Press, 2003
- 9) Shasidi F, Spanier AM, Chi-Tang Ho and Braggins T, Quality of Fresh and Processed Foods, Kluwer Academics/ Plenum Publishing, 2004
- 10) Jotbill I, Rapid & On-line Instrumentation for Food Quality Assurance, Woodhead Publ, 2003
- 11) Nielsen SS, Food Analysis Laboratory Manual, Kluwer Academic Publ., 2003

WASTE MANAGEMENT IN FOOD INDUSTRIES (THEORY)

(40 hrs)

Course Objectives:

1. To know and learn more about the management of waste, its policies and the effective methods of waste management
2. To undertake effective learning on all the processes of managing different forms of waste arising from different areas detrimental to health.

Course Outcomes:

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

- CO 1. Categorize waste into different forms of physical, chemical and biological for the ease of the management and also for its treatment process.
- CO 2. Know more about the different methods to manage the liquid waste and benefit the economy.
- CO 3. Treat solid waste from the different areas using the best methods ensuring reduce, reuse, and recycle.
- CO 4. Use the policies, guidelines, rules, regulations and acts put up by the governing bodies so as to ease the overall waste management process.

UNIT I

1. **Introduction** **(2 hrs)**
Classification of food industrial wastes from Fruit and Vegetable processing industry, Beverage industry, Fish, Meat & Poultry industry, Sugar industry and Dairy industry
2. **Characteristics of industrial waste** **(4 hrs)**
Physico-chemical characteristics of wastes from Fruit and Vegetable processing industry, Beverage industry, Fish, Meat & Poultry industry, Sugar industry and Dairy industry
3. **Physical, Chemical & Biological aspects** **(4 hrs)**
Physical, Chemical & Biological aspects of waste from Fruit and Vegetable processing industry, Beverage industry, Fish, Meat & Poultry industry, Sugar and Dairy industry

UNIT II

4. **Effluent treatment methods** **(5 hrs)**
Treatment methods for liquid wastes from Fruit and Vegetable processing industry, Beverage industry, Fish, Meat & Poultry industry, Sugar industry and Dairy industry;

5. **Waste treatment plant design** (5 hrs)
Design of Activated Sludge Process, Rotating Biological Contactors, Trickling Filters, UASB, Biogas Plant.

UNIT III

6. **Treatment methods of solid wastes** (4 hrs)
Treatment methods of solid wastes from meat, fish, vegetable, sugar industry- Biological composting, drying and incineration;
7. **Design of Solid Waste Management System** (2 hrs)
Design of Solid Waste Management System such as Landfill Digester, Vermicomposting Pit.
8. **Biofilters and Bioclarifiers** (4 hrs)
Examples of Biofilters and Bioclarifiers, treatment methods- solid phase, liquid phase and gaseous phase, types of filter media, advantages and disadvantages

UNIT IV

9. **Treatment of waste water** (4 hrs)
Ion exchange treatment of waste water, Recovery of useful materials from effluents by different methods.
10. **Waste regulations** (2 hrs)
Waste regulations- national and international scenario, Solid waste policy in India, Municipal Solid waste rules,
11. **Environmental protection acts** (4 hrs)
Salient features and provisions of Environmental protection act (1986), The Ozone Depleting Substances (Regulation and Control) Rules, 2000

References

- 1) Herzka A & Booth RG, Food Industry Wastes: Disposal and Recovery, Applied Science Pub Ltd. 1981.
- 2) Fair GM, Geyer JC and Okun DA, Water & Wastewater Engineering, John Wiley & Sons, Inc. 1986
- 3) Inglett GE, Symposium: Processing Agricultural & Municipal Wastes, AVI. 1973.
- 4) Green JH and Kramer A, Food Processing Waste Management, AVI, 1979.
- 5) Rittmann BE and McCarty PL, Environmental Biotechnology: Principles and Applications, Mc-Graw-Hill International editions, 2001.
- 6) Bhattacharyya BC and Banerjee R, Environmental Biotechnology, Oxford University Press, 2007.

SPICES AND PLANTATION CROP PROCESSING TECHNOLOGY (THEORY)

Course Outcomes (COs):

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

- CO 1. Understand the principles and importance of processing technologies for spices and plantation crops.
- CO 2. Acquire knowledge and skills in pre-processing techniques including cleaning, grading, sorting, and drying of raw materials.
- CO 3. Gain practical experience in processing methods such as grinding, extraction, and distillation for the production of value-added spice and plantation crop products.
- CO 4. Develop competencies in quality assurance, food safety practices, packaging, and marketing strategies for spices and plantation crop products

UNIT I**10 hrs**

Spices and Plantation Crops: Introduction, definition, classification, importance, and historical significance. Major spices and plantation crops: characteristics and cultivation practices. Post-harvest handling and quality control and an overview of processing technologies

UNIT II**10 hrs**

Pre-processing Techniques for Spices and Plantation Crops: Harvesting and transportation methods. Cleaning and grading of raw materials: principles and techniques Sorting, winnowing, and destoning methods. Drying techniques: sun drying, mechanical drying, and other methods. Storage and preservation: principles and practices

UNIT III**10 hrs**

Processing Technologies for Spices and Plantation Crops: Curing, grinding and milling operations: principles, equipment, and techniques, Extraction and distillation processes for essential oils and oleoresins. Processing methods for value-added products.

UNIT IV**10 hrs**

Quality Assurance of Spices and Plantation Crop Products: Quality evaluation and control of process, Food safety and hygiene practices, Packaging technologies, labelling requirements, regulations and certifications.

References

- 1) Postharvest Technology of Horticultural Crops by Adel A. Kader, University of California, Division of Agriculture and Natural Resources; 2002
- 2) Spices and Seasonings: A Food Technology Handbook by Donna R. Tainter and Anthony T. Grenis, John Wiley & Sons; 2001
- 3) Plantation Crops: Plugs & Stalks by Shashi Singh and Ajit Singh, Daya Publishing House; 2011
- 4) Spices, Condiments, and Seasonings by Kenneth T. Farrell, Springer; 2016
- 5) Spices and Plantation Crops: Recent Advances in Botany, Horticulture, and Pharmacology by Akhilesh Kumar Pandey, Prasanta Kumar Nayak, and Manish Kumar Dubey, Springer; 2018
- 6) Spice Science and Technology by Kenji Hirasa and Mitsuo Takemasa, CRC Press; 2000
Plantation Crops: Biology and Management by S. Rajan, Springer; 2020
- 7) The Encyclopedia of Herbs and Spices by P. N. Ravindran, CABI Publishing; 2016
- 8) Processing of Spices and Plantation Crops by P. C. Stephen, Oxford & IBH Publishing Co. Pvt. Ltd.; 2003
- 9) Plantation Crops and Organic Farming by K. V. Peter, New India Publishing Agency; Publication, 2007

FOOD LAWS AND FOOD SAFETY (THEORY)**(40 hrs)****Course Objectives:**

1. To learn the principles and importance of food safety
2. To familiarize with the existing food laws and regulations

Course Outcomes (COs):

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

- CO 1. Understand the principles and importance of food safety.
- CO 2. Implement analytical techniques to assess food quality
- CO 3. Have the knowledge of and follow food laws and regulations at both national and international levels

UNIT I (10 hrs)

Principles of Food Safety: Food Sanitation and safety: Factors contributing to physical, chemical and biological contamination in food chain, prevention and control of food borne hazards, definition and regulation of food sanitation, sources of contamination, personal hygiene-food handlers, cleaning compounds, sanitation methods, waste disposal strategy (solid and liquid waste) and pest control.

UNIT II (10 hrs)

Analytical Techniques for Food Quality: Analytical methods used for quality determination: chemical and physical, microbiological, biochemical and sensory analysis. Analytical methods of determination of basic food components: protein, saccharides, lipids, vitamins, water, minerals and trace elements, sensory active compounds, anti-nutritive and natural toxic compounds, food additives and food contaminants.

UNIT III (10 hrs)

Analytical Techniques for Food Quality: Basic principles of chromatography - Paper Chromatography. Spectrophotometric techniques: Spectrophotometry introduction and principle. **Food Laws and Regulations Food Safety Systems:** Quality systems standards including ISO; Good Manufacturing Practice and HACCP. Food Laws & Implementing Agencies-National: COPRA, FSSAI.

UNIT IV (10 hrs)

International Scenario in Food Regulation USFDA, EFSA, UK, Canada, A & NZ, Japan, Malaysia, Singapore; Consumer Movements; Intellectual Property Rights and Trade Marks: Protection of investment and efforts in research and development by patenting; Criteria of patentability; National and international patent; Terms of patents; Copyright. International Agencies in Food Regulation: Food Codex Alimentarius: Various aspects and relation with domestic laws; FAO, WHO, WTO.

References

- 1) Food Safety and Standards Authority of India portal, Government of India
- 2) Blackburn CDW and Mc Clure P.J. Food borne pathogens. Hazards, risk analysis & control. CRC Press, Washington, U.S.A, 2005
- 3) Besterfield, Dale H. et al., Total Quality Management, 4th Edition, Pearson Education Asia, 2006.
- 4) Evans, James R. and William M. Lindsay, The Management and Control of Quality. 6th Edition South-Western (Thomson Learning), 2005.
- 5) Fortin, N.D. Food Regulation : Law, Science, Policy, and Practice. John Wiley, 2009.
- 6) Santaniello, Evenson, Ziberman, Carlson – Agriculture and Intellectual Property Rights, Univ. Press, 1998
- 7) S. K. Chakraborty : Values and Ethics in Organization, OUP
- 8) Intellectual property rights in Agricultural Biotechnology; Edited by Erbisich, Maredia; CABI

FOOD REFRIGERATION AND PACKAGING TECHNOLOGY (PRACTICAL 13)

Course Outcomes:

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

- CO 1. Design and understand the functioning of cold storage facilities
- CO 2. Calculate freezing time
- CO 3. Identify different packaging material and measurement of its thickness and chemical resistance behavior

1. Design and construction of cold storage.
2. Freezing time calculation
3. Identification of different types of packaging.
4. Measurement of thickness of packaging materials.
5. Testing of chemical resistance of packaging materials.
6. Visit to cold storages.

QUALITY CONTROL AND WASTE MANAGEMENT (PRACTICAL 14)

Course Outcomes:

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

- CO 1. Determine the rancidity in various foods and stability
- CO 2. Identify lysine in the meat; determine starch and the pectin component and evaluate the food sample by Organoleptic method.
- CO 3. Identify common testing methodologies for food adulterants and various pathogen tests
- CO 4. Analyze levels of solid and liquid waste present in waste water by checking BOD and COD levels

1. Study of emulsion stability
2. Effect of processing on colour of meat, vegetables
3. Determination of available lysine in processed meat
4. Determination of starch and pectins in fruits and vegetables
5. Organoleptic evaluation of food.
6. Analysis of rancidity in food.
7. Simple food adulterant tests.
8. Food pathogen tests.
9. Recognition tests for various food flavors.
10. Measuring the BOD level of the waste water.
11. Measuring the COD level of the waste water.
12. Measuring solid waste and liquid waste from the waste water.
13. Measuring the microbial flora in industrial waste water.
14. Proteolytic activity of gut waste of fish.
15. Isolation of pectin from citrus fruit peel.
16. Isolation of chitin from shrimp shells.

SPICES AND PLANTATION CROP PROCESSING TECHNOLOGY (PRACTICAL 15)

Course Outcomes:

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

- CO 1. Determine the rancidity in various foods and stability
- CO 2. Identify lysine in the meat; determine starch and the pectin component and evaluate the food sample by Organoleptic method.
- CO 3. Identify common testing methodologies for food adulterants and various pathogen tests
- CO 4. Analyze levels of solid and liquid waste present in wastewater by checking BOD and COD levels
- CO 5. Recognize different food flavors

1. Familiarization with Spice Processing Equipment
Introduction to various processing equipment

- Demonstration of cleaning, grading, sorting, and drying equipment
- Hands-on practice in operating and maintaining processing equipment
- 2. Familiarization with Plantation Crop Processing Equipment
 - Introduction to various processing equipment
 - Demonstration of cleaning, grading, sorting, and drying equipment
 - Hands-on practice in operating and maintaining processing equipment
- 3. Study on characteristics of various plantation crops
- 4. Chemical analysis of spices: Moisture, Valuable oil, Specific gravity, Refractive index, Acid value
- 5. Cleaning and Grading Techniques
 - Identification and removal of foreign matter and impurities
 - Cleaning and grading
- 6. Drying Methods and Techniques
 - Demonstration and Hands-on experience of different drying methods (traditional and modern methods), Monitoring and controlling drying parameters
- 7. Grinding and Milling Operations
 - Demonstration and Hands-on experience of different grinding and milling methods (traditional and modern methods)
 - Introduction to grinding and milling equipment
 - Hands-on practice in grinding and milling of spices and plantation crops
 - Evaluation of particle size distribution and quality of ground materials
- 8. Extraction of Oils
 - Extraction techniques for oils and essential oils
 - Hands-on extraction using steam distillation, solvent extraction, or cold pressing methods
 - Extraction of virgin coconut oil
 - Analysis of extracted oils for quality and yield
- 9. Product Development
 - Formulation of recipes and standardization of product parameters
 - Evaluation of sensory attributes, Packaging and Labelling
 - Preparation of curry powder and Chocolates

(PRACTICAL KNOWLEDGE/COMPULSORY SKILL-BASED COURSE)
INTERNSHIP IN FOOD INDUSTRY

Course Outcomes:

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

- CO 1. Apply various techniques of food analysis
- CO 2. Develop new products with nutritional benefits
- CO 3. Improve the existing food nutrients and enhance them
- CO 4. Use of newer methods and discovery of environmentally safe food processing techniques
- CO 5. Apply quality aspects and use of advanced technologies
- CO 6. Develop skills of quality control
- CO 7. Take up food technology as profession

SEMESTER VI
NUTRACEUTICALS AND FUNCTIONAL FOODS (THEORY)

(40 hrs)

Course Objectives:

1. To understand concepts of food modulating to medicines
2. To develop and enhance food using cosmeceuticals, nutraceuticals, aquaceuticals and functional foods.

Course Outcomes:

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

- CO 1. Assess new concepts of nutraceuticals, functional foods, disease and disorders related to nutrition
- CO 2. Formulate medicines derived from the food, know the uses and benefits related to a particular disease.
- CO 3. Set up higher benchmarks in the field of food by understanding the uses of food towards maintaining good health, developing new products and contributing towards tissue culture, post-harvest technology
- CO 4. Analyse functional uses of food, such as fermented foods, fruits and vegetables, beverages, dairy, future prospects and their potential to improve health.

UNIT I

1. **Introduction** (2 hrs)
Classification of nutraceuticals, Scope in the industry, Indian and global scenario
2. **Concept, Biochemistry of nutrition and dietetics** (4 hrs)
Introduction of Balanced Diet, Basic Five Food Groups, Food Pyramid, Classification of Nutrients, Dietary Fibre, Components, physiological effects, potential health benefits.
3. **Nutrition related diseases and disorders** (4 hrs)
Diseases and disorders related to excess or deficiency of Carbohydrates, Protein, Fat. Metabolic disorders, Concept of antioxidants, Role of nutraceuticals in the prevention and treatment of disease and disorders.

UNIT II

4. **Nutraceuticals of plant and animal origin** (2 hrs)
Classification, recovery and application of alkaloids, phenols, terpenoids
5. **Cosmoceuticals and aquaceuticals.** (4 hrs)
Sources, extraction and application of chitin, chitosan, glucosamine, chondroitin sulphate and other animal polysaccharides
6. **Microbial and algal nutraceuticals** (4 hrs)
Prebiotics and probiotics: principle, mechanism, production and technology involved, applications-examples of bacteria used as probiotics, use of prebiotics in maintaining the useful microflora

UNIT III

7. **Synbiotics for maintaining good health.** (2 hrs)
Algae as source of omega-3 fatty acids, antioxidants and minerals-extraction and enrichment.
8. **Phytonutraceuticals** (4 hrs)
Role of medicinal and aromatic plants in nutraceutical industry, nutraceutical products of commercial importance – Indian, Asian scenario.
9. **Product development and clinical trials** (4 hrs)
Activity screening, formulations, toxicology, bioavailability, bioequivalence; use of animal models and pre-clinical and clinical trials involved.

UNIT IV

- 10. Functional Foods (4 hrs)**
Cereal and cereal products, Milk and milk products, egg, oils, meat and products, sea foods, nuts and oilseeds, functional fruits and vegetables, herbs and spices, beverages such as tea and wine.
- 11. Fermented foods as functional foods (2 hrs)**
Health benefits and role of fermented foods in conditions like cardiovascular diseases, hypertension, diabetes etc.
- 12. Scope of functional foods and nutraceuticals (4 hrs)**
Future prospects of functional foods and nutraceuticals and their potential for use in improving health. Development of functional foods. Formulation and fabrication of functional foods.

References

- 1) Wildman REC, Handbook of Nutraceutical and Functional Foods, CRC Press 2001.
- 2) Ghosh D et al, Innovations in Healthy and Functional Foods, CRC Press 2012.
- 3) Pathak YV, Handbook of nutraceuticals Volume 2, CRC Press 2011.
- 4) Hotchkiss JH, Potter NN, Food Science (5th Ed.), CBS Publ. & Distributors, 2007.
- 5) Fellows PJ, Food process Technology by Woodhead Publishing Ltd, 2009.

EXTRUSION TECHNOLOGY (THEORY)

(40 hrs)

Course Outcomes:

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

- CO 1. Understand fundamentals, design considerations, processing of different extruded products and selection of food extrusion equipments.
- CO 2. Understand suitability of raw materials, preconditioning, process variables and extruder types for extrusion and its impact on extrusion process, rheological behaviour, and product quality.
- CO 3. Understand chemical and nutritional changes occurring in extrusion process and packaging requirement of extruded products.
- CO 4. Know recent trends and future aspects of food extrusion.

UNIT I

10 hrs

Food extrusion: Definition, introduction to extruders, principles and types, Uses of extruders in the food industry, Pre-conditioning of raw materials used in extrusion process, Extruder Selection, Design, and Operation for Different Food Applications. Recent Advances in extrusion technology: Carbon dioxide or Nitrogen assisted extrusion technology, Extrusion in confectionary technology, Non-thermal Extrusion of Protein Products

UNIT II

10 hrs

Screw extruder: Single screw extruder: working Principle, Net Flow, Operations, manufacturing of pasta, Macaroni, Spaghetti and vermicelli. Twin screw extruder: Counter rotating and co-rotating twin screw extruder, Process characteristics of the twin screw extruder, Rheological Properties of Materials During the Extrusion Process, advantages and disadvantages of Twin Screw Extruder

UNIT III

10 hrs

Extrusion food products: Effect of extrusion on food products: Chemical and nutritional changes in food during extrusion, factors affecting extrusion, Net Flow, Packaging materials for extruded product. Breakfast cereals by extrusion technology: Classification of Breakfast cereals: Raw materials, process and quality testing for Ready to eat breakfast cereals.

UNIT IV

10 hrs

Extrusion Process: Material characteristics and selection criteria, Types of Extrusion process: Dry and Wet, Melting process, Equation of output, Process variables. Start-up and Shut-down of extruder, Post extrusion techniques, Trouble shooting of Manufacturing Process, Applications – Products of Extrusions.

References

- 1) Extruded foods by S. Matza, Springer
- 2) Technology of Extrusion Cooking by N.D. Frame, Springer
- 3) Extruders in Food Application by Riaz M.N., CRC Press
- 4) Extrusion of Foods by J.M. Harper, CRC Press
- 5) Advances in Food Extrusion Technology by Maskan and Altan, CRC Press

FOOD PLANT SANITATION (THEORY)

(40 hrs)

Course Objectives:

1. To enable students to identify potential routes of contamination and their control measures in the processing of food.
2. To equip students with key sanitary practices that can be implemented and maintained at different levels of production to minimize the identified risks involved in food processing.

Course Outcomes:

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

- CO 1. Illustrate the importance of food plant sanitation and factors influencing sanitation in food industry.
- CO 2. Demonstrate the ability to explore and apply proper sanitary techniques associated with water sources, contact surface area, and production house that will eliminate possible risk associated with production.
- CO 3. Apply correct sanitary procedures for receiving, preparing, serving and storing of food products to eliminate associated risks.
- CO 4. Focus on cold chain management process (quality system) necessary to meet product and regulatory requirements during processing of food

UNIT I

1. **Food Plant Layout and Equipment Design** **(2 hrs)**
General principles of food plant Design and layout, Importance of the food plant sanitations, Factors influencing the sanitation of the food industry.
2. **Design of food processing equipments** **(4 hrs)**
Size Reduction, mixing, separation, extraction, filtration, centrifugation, distillation and, gas absorption equipments
3. **Food hygiene and safety during procurement** **(4 hrs)**
Food hygiene and safety during the procurement of the raw materials, ingredients, chemicals and packaging materials, Physico-chemical changes and handling practices affects the conditions of the raw materials, ingredients, chemicals and packaging materials and its prevention.

UNIT II

4. **Food hygiene and safety in water supply** **(4 hrs)**
Source of water contamination, factors contributing the water contamination, cross contamination, measures to prevent the water contamination, water treatment
5. **Food hygiene and safety of contact surface area** **(4 hrs)**

Cross contamination through food contact surface area, cleaning and sanitation of food contact surface area such as vessels, reactor, utensils tables etc. Standard sanitation operating procedures to sanitize food contact surface

6. Food hygiene and safety in production house (2 hrs)

Food hygiene and safety in during processing activity, Personnel hygiene and practices that influence the sanitation of the production unit, control measures to prevent the risks.

UNIT III

7. Food hygiene and safety in warehouse (4 hrs)

Aerated, refrigerated and controlled atmospheric storage, Conventional & Modern control measures, storage structures for fruits, vegetables, meat and marine products, design of warehouses

8. Food hygiene and safety during transportation (3 hrs)

Cross-contamination, Time and temperature effect on the sanitation of the transporting vehicle. Handling practices and Personnel hygiene effects on sanitation during transportation.

9. Food hygiene and safety in Cold Chain (3 hrs)

Physicochemical changes in stored products, Handling practices and Personnel hygiene practices effects on sanitation during cold chain management of the raw material and the product.

UNIT IV

10. Control measures (4 hrs)

Safe food storage, transportation and display at shopping outlets: use of coolers/chillers/freezers, length of time in storage, Waste disposal, Control methods using Physical and Chemical Agents, Pest and Rodent, Control, ETP Design and Layout.

11. Scope of Cold Chain (3 hrs)

Scope of cold chain for enhancing marketing potentials of perishables in domestic and international markets, Principles of Cold Chain Creation and Management.

12. Wastewater and solid waste treatment (3 hrs)

Waste-types-solid and liquid waste characterization, physical, chemical, biological, aerobic, anaerobic, primary, secondary and tertiary (advanced) treatments.

References:

- 1) Norman G. Marriott and Robert B. Gravani, Principles of Food Sanitation, 5th ed, 2006.
- 2) Rao, DG, Fundamentals of Food Engineering, PHI learning Private Ltd, 2010
- 3) Fellows P, Food Processing Technology, 2nd Edition. Woodhead Publishing Limited and RC Press LLC, 2000
- 4) James A, The supply chain handbook, distribution group, 2013
- 5) FAO, US, Design and operations of cold store in developing countries, 1984
- 6) Hui YH, Bruinsma B, Gorham R, Nip WK, Food Plant Sanitation, Marcel Dekker, New York, 2003
- 7) Rees, N. and D. Watson, International Standards for Food Safety. Aspen Gaitersburg, Maryland, 2000

FOOD PRESERVATION TECHNIQUES (THEORY)

(40 hrs)

Course Outcomes:

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

CO1. To know the importance and need of food preservation.

CO2. To familiarize with various type of food preservation techniques, principle behind those techniques and its practical application

CO3. To learn about advanced methods which are being used in food processing sector.

UNIT I**10 hrs**

Modern concepts in Food Preservation: Classification of food in relation to shelf life: Spoilage in food and its control: spoilage caused by microorganism (bacteria, fungi and virus), enzymes, pests and rodents

UNIT II**10 hrs**

Preservation Techniques: Preservation by Irradiation: technology and application. Preservation by Chemicals – Types, safety of preserved foods. High pressure processing (in brief). Preservation by dehydration and concentration: methods of drying and concentration, types of dryers, Factors affecting drying process

UNIT III**10 hrs**

Preservation by Heat and Cold Techniques: Preservation by Heat - Types: Sterilization, Pasteurization, Blanching, Canning, Mechanism of action, methods of application to foods (Equipments), effect on food and micro-organisms.

UNIT IV**10 hrs**

Cold preservation techniques - Types of Refrigeration, Chilling, Freezing, freeze drying, Refrigerated gas storage. Mechanism of action, methods of application to foods (equipments), effect on food and microorganisms.

References:

- 1) Prakash Triveni : Food Preservation, Aadi Publication, Delhi.
- 2) M. Shafiur Rahman : Hand Book of Food Preservation, Marcel Dekker Inc, New York.
- 3) McWilliams and Paine : Modern Food Preservation, Surjeet Publication

FERMENTATION TECHNOLOGY (THEORY)**(40 hrs)****Course Objectives:**

1. To enable students to learn about the compositional, nutritional and technological aspects of distilled and undistilled alcoholic beverages.
2. To enable students to predict the differences between the distilled and undistilled alcoholic beverages along with the technologies used in production of both.

Course Outcomes:

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

- CO 1. Describe major steps involved in beer making (undistilled alcoholic beverage) along with the description of what happens at each step.
- CO 2. Compare and contrast the different types of fermentation of beer and the way in which the taste and flavour of beer are modified.
- CO 3. Identify different categories of whiskey, their key ingredients, production steps and recognize the operations used in distilleries.
- CO 4. Categorize the regulatory policies involved in the marketing of whisky and its authenticity.

UNIT I**1. Outline of Brewing****(4 hrs)**

Introduction, Malts, Brewing liquors, Milling and Mashing, Processing of Beer, types of beer, malting.

2. Science of Mashing**(3 hrs)**

Introduction, Mashing schedules, Altering Mashing Conditions, Mashing Biochemistry, Mashing and Beer flavor, Spent Grains, Preparation of grists, Mashing technology.

3. Wort Boiling**(3 hrs)**

Introduction, Chemistry of wort boiling, Clarification, Cooling and Aeration.

UNIT II

4. **Wort Fermentation** (4 hrs)
Basic principles, Bottom and top Fermentation Systems, Continuous Fermentation, Fermentation Control Systems, Beer Maturation, flavour and aroma changes,
5. **Beer Treatment** (3 hrs)
Stabilization against non-biological haze, Carbonation, Clarification and filtration, Special beer treatments.
6. **Chemical and Physical Properties of Beer** (3 hrs)
Chemical Composition, Nutritive value, Colour, Haze, Viscosity, foam Characteristics, gurgling flavor, Semors analysis, Packaging.

UNIT III

7. **Malt Whiskies** (3 hrs)
Raw materials and processing of Scotch Whiskey, Irish Whiskey, North American Whiskies, Japanese Whiskey, Malt whiskies,
8. **Grain Whisky** (3 hrs)
Raw materials, wheat-wheat breeding, Grain distillery processing, Gelatinization, Milling, Cooking Conversion, Wort Separation,
9. **Yeast and Fermentation** (4 hrs)
Yeast for alcohol fermentation, Yeast biochemistry, Yeast Structure, carbohydrate metabolism, Nitrogen metabolism, Fatty acid and ester production.

UNIT IV

10. **Batch and Grain Whisky Distillation** (6 hrs)
Design, Wash Still Operation, Sprit Still Operation, Continuous Distillation, Design and Operation of grain whisky stills,
11. **Regulations** (2 hrs)
Whiskies of world and their regulations, Scotch Whisky, Canadian Whisky, Marketing Scotch Whisky
12. **Whisky Analysis** (2 hrs)
Major Volatile Congeners, Whisky, Age- Sensory analysis, Whisky authenticity.

References

- 1) Briggs D. E., C. A. Boulton, P. A. Brookers and R. Sterens, Brewing – Science and Practice, Wood head Publishing Limited, 2004.
- 2) Campbell G., Fermented Foods of the world-A Dictionary & Guide, Platt, Butterworths, London, 1987.
- 3) Miller B.M. & W. Litsky, Industrial Microbiology by. MGH, 1976
- 4) Russell I, G. Stewart, C. Bamforth, Whisky- Technology, Production and Marketing, Elsevier, 2003.
- 5) American society of brewing chemists, U.S.A.: Methods of analysis of American Society of Brewing Chemists. (8th rev.) U.S.A. American society of brewing chemists, 1996.
- 6) Arntzen, C.J., ed.: Encyclopedia of agricultural science, vol. 1: - A - D. N. York, Academic Press, 1994
- 7) Birch G.G.: Alcoholic beverages. London, Elsevier Applied Science Pub., 1985
- 8) Government of India.: Technical Excise Manual.
- 9) Hardwick, W.A., ed.: Handbook of brewing. N. York, Marcel Dekker, Inc., 1995.
- 10) Hough, J.S., Briggs, D.E., Stevens, R., Young, T.W.: Malting & brewing science, vol. 2: hopped wort & water. London, Champman & Hall, 1982.
- 11) Pollock, J.R.A., and ed.: Brewing science vol. 1. London, Academic Press, 1979

ENZYMES IN FOOD TECHNOLOGY (THEORY)

Course Outcomes:

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

- CO 1. Demonstrate a comprehensive understanding of the practical applications of enzymes in food processing and production.
- CO 2. Understand the specific enzymes used in different food sectors and their respective functions.
- CO 3. Identify and analyse enzyme-related challenges in the food industry.
- CO 4. Engage in projects related to enzyme technology and effectively communicate their ideas and solutions related to enzyme technology in the food industry

UNIT I

10 hrs

Introduction to Enzymes in the Food Industry: Overview of enzymes: definition, characteristics, and functions. Enzymes as catalysts: their role in food processing and production. Sources of enzymes: microbial, animal, and plant-derived enzymes. Enzyme classification and nomenclature. Enzyme kinetics: understanding enzyme-substrate interactions and reaction rates. Factors influencing enzyme activity: pH, temperature, substrate concentration, and inhibitors.

UNIT II

10 hrs

Enzymes in Food Processing and Production: Enzymes in baking: amylases, proteases, and lipases for dough fermentation, gluten modification, and flavor development. Enzymes in brewing and distilling: amylases, cellulases, and glucanases for starch and cellulose degradation. Enzymes in dairy processing: lactases, lipases, and proteases for lactose hydrolysis, flavor enhancement, and cheese ripening.

UNIT II

10 hrs

Enzymes in Food Processing and Production: Enzymes in fruit and vegetable processing: pectinases, cellulases, and invertases for juice clarification, texture modification, and preservation. Enzymes in meat processing: proteases and transglutaminases for tenderization, flavor development, and binding. Enzymes in beverage production: carbohydrases and proteases for flavor modification, clarification, and stability enhancement

UNIT IV

10 hrs

Enzyme Technology and Innovation in the Food Industry: Enzyme immobilization techniques: advantages, methods, and applications in food processing. Enzyme production and purification: fermentation processes, downstream processing, and quality control. Enzyme formulation and application: considerations for enzyme stability, dosage, and delivery in food systems. Enzymes in functional foods and nutraceuticals: application of enzymes in the production of health-promoting ingredients and supplements. Safety considerations and regulations for enzyme use in the food industry

References

- 1) Enzymes in Food Processing by Gulzar Singh Sangha and D.N. Gandhi, CRC Press, 2017
- 2) Enzymes in Food Technology by Robert J. Whitehurst and Maarten van Oort, Wiley-Blackwell, 2010
- 3) Enzymes in Food and Beverage Processing by Alexandre L. Silva, Aline M. Silva, and Juliano Lemos Bicas Apple Academic Press, 2016
- 4) Food Enzymes: Structure and Mechanism by Alphons G.J. Voragen, Willem M. de Vos, and Gerard Beldman, CRC Press. 2019

- 5) Industrial Enzymes for Food and Feed Applications by Dietmar Haltrich, Roland Ludwig, and Herwig K. Schottenberger, Springer, 2017
- 6) Enzymes in Food Biotechnology: Production, Applications, and Future Prospects by Mohamed Essam El Houri, Nova Science Publ., 2021
- 7) Enzymes in Food and Feed Processing by Ramesh C. Ray, 3rd Ed., CRC Press, 2019
- 8) Enzymes in Food Technology by R. John Whitaker, Alphons G.J. Voragen, and Dominic W.S. Wong, 2nd Ed., Wiley-Blackwell, 2002
- 9) Enzymes in Food Technology by Robert J. Whitehurst, Maarten van Oort, and Robert J. Whitehurst, 3rd Ed., Wiley-Blackwell, 2019

NUTRACEUTICALS AND FUNCTIONAL FOODS (PRACTICAL-16)

Course Outcomes:

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

- CO 1. To identify different nutraceuticals and functional foods available in the market
- CO 2. To prepare various probiotic and prebiotic foods and their evaluation.
- CO 3. To estimate the concentration of nutraceuticals compounds present in different foods.
- CO 4. To isolate compounds like chitin and pectin and thereby understand its role and importance

1. Identification of various nutraceuticals available in the markets
2. Identification of functional foods available in the market.
3. Estimation of chlorophyll content of green vegetable.
4. Determination of lycopene in fruit/vegetable.
5. Determination of total pectin in plant material.
6. Estimation of crude fibre/dietary fibre content in cereals and their products.
7. Estimation of anthocyanins in food sample.
8. Preparation and evaluation of probiotic/prebiotic foods.
9. Isolation of Lactic acid bacteria from curd.

EXTRUSION TECHNOLOGY AND SANITATION (PRACTICAL 17)

Course Outcomes:

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

- CO 1. Understand the role of enzymes and microbes in food industry
- CO 2. Assess effect of various factors on enzyme activity.
- CO 3. Evaluate activity during processing of food.
- CO 4. Prepare a sanitation schedule

Determination of:

1. Piece density, solid density and bulk density
2. Porosity of extruded foods
3. Moisture content in extrudates
4. Crude ash contents in extrudates
5. Water solubility index of the extrudates
6. Hydration characteristics of extrudates
7. Lateral and longitudinal expansion ratio
8. Tenderization of meat using protease.
9. Preparation of a sanitation schedule for food preparation area.
10. Study of Phenol coefficient of sanitizers.

FERMENTATION TECHNOLOGY (PRACTICAL 18)

Course Outcomes:

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

- CO 1. Prepare alcoholic beverages such as wine from grapes.
 - CO 2. Determine various factors such as reducing sugars, pH, acidity, and ethanol content of the wine.
 - CO 3. Evaluate effect of temperature, pH, alcohol and substrate concentration on the growth and activity of yeast
 - CO 4. Quantify and assess yeast
-
- 1. Count the yeast in the fermentation broth using Hemacytometer.
 - 2. Check the viability of the yeast by staining with Methylene Blue.
 - 3. Determination of ethanol content in the given fermentation broth.
 - 4. Determination of fermentation efficiency of yeast growing on molasses medium.
 - 5. Preparation of wine from grapes.
 - 6. Determination of total reducing sugar of wine production.
 - 7. Determination of pH & total acidity of wine.
 - 8. Determination of Volatile acidity of wine.
 - 9. Effect of temperature of yeast growth.
 - 10. Effect of pH on yeast growth.
 - 11. Effect of Substrate concentration on yeast growth
 - 12. Effect of alcohol on yeast growth

(PRACTICAL KNOWLEDGE/COMPULSORY SKILL-BASED COURSE) MINI PROJECT

Course Outcomes:

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

- CO 1. Assess and gain knowledge on the present scenario using theoretical agenda
- CO 2. Apply various techniques of food analysis for the food components and to analyze their benefits for public health
- CO 3. Develop new products with nutritional benefits
- CO 4. Improve the existing food nutrients and enhance them
- CO 5. Use of newer methods and discovery of environmentally safe food processing techniques
- CO 6. Apply quality aspects and use of advanced technologies
- CO 7. Replace high calorific components of food with beneficial food ingredients focusing on present major deficiencies
- CO 8. Improve and create awareness of safe food to the public
- CO 9. Plan, prepare and apply procedures through research methodology aspects and develop skills of quality control
- CO 10. Take up food technology as profession

Model Question Paper (Theory)

**I Semester B.Sc. (Food Technology) Degree
Examination Month & Year
COURSE CODE AND TITLE**

Time: 3 Hrs

Max. Marks: 80

PART – A

1. Answer in brief on any **ten** of the following: (10x2=20)

- | | |
|----|----|
| a) | g) |
| b) | h) |
| c) | i) |
| d) | j) |
| e) | k) |
| f) | l) |

PART – B

Answer any four of the following choosing one full question from each unit: (4x15=60)

UNIT – 1

2.

- a)
- b)
- c)

(3+5+7=15)

OR

3.

- a)
- b)
- c)

(3+5+7=15)

UNIT – 2

4.

- a)
- b)
- c)

(4+4+7=15)

OR

5.

- a)
- b)
- c)

(4+4+7=15)

UNIT – 3

6.

- a)
- b)
- c)

7.
a)
b)
c)

OR

$$(4+4+7=15)$$

8.
a)
b)
c)

UNIT – 4

$$(4+4+7=15)$$

9.
a)
b)
c)

OR

$$(3+5+7=15)$$

$$(4+4+7=15)$$

Model Question Paper (Theory)

**I Semester B.Sc. (Food Technology) Degree
Examination Month & Year
COURSE CODE AND TITLE**

Time: 1½ Hrs

Max. Marks: 40

PART – A

1. Answer in brief on any five of the following: (5x2=10)

- a)
- b)
- c)
- d)
- e)
- f)

PART – B

Answer any two of the following choosing one full question from each unit: (2x15=30)

UNIT – 1

- 2.
- a)
 - b)
 - c)

(3+5+7=15)

OR

- 3.
- a)
 - b)
 - c)

(3+5+7=15)

UNIT – 2

- 4.
- a)
 - b)
 - c)

(4+4+7=15)

OR

- 5.
- a)
 - b)
 - c)

(4+4+7=15)

MODEL QUESTION PAPER
I Semester B.Sc. (Food Technology) Degree Practical Examination Month & Year
COURSE CODE AND TITLE

Time:	Max. Marks: 40
I. Major:	10 marks
1.	
2.	
3.	
II. Minor:	5 marks
1.	
2.	
III. Procedure writing:	5 marks
1.	
2.	
3.	
4.	
IV. Spotters:	5×2=10 marks
a.	
b.	
c.	
d.	
e.	
V. Viva.	5 marks
VI. Record.	5 marks
