MANGALORE UNIVERSITY

B.Sc. Food Technology

(Choice Based Credit System)

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)

CHOICE BASED CREDIT SYSTEM - 2018

SEMESTER - 1								
Group	**Course Code**	Title of the Course	Instruction Hours / week	Duration of Exam (Hours)	Marks			Credits
					IA	Exam	Total	
Group I Core Courses	BFTFTC 131	Food and Nutrition	4	3	20	80	100	2
	BFTFTC 132	Principles of Food Science	4	3	20	80	100	2
	BFTFTC 133	Food Microbiology	4	3	20	80	100	2
	BFTFTP 134	Food and Nutrition Practical - 1	3	3	10	40	50	1
	BFTFTP 135	Principles of Food Science Practical - 2	3	3	10	40	50	1
	BFTFTP 136	Food Microbiology Practical - 3	3	3	10	40	50	1
Group II Elective Courses a) Supportive to the discipline of study	Out of 3 Courses any ONE to be opted							
	BFTFCE 137	Food flavours	2	2	10	40	50	1
	BFTFCE 138	Nutrition through life cycle						
	BFTFCE 139	Post-harvest management						
Group III Foundation Courses	a. Compulsory Foundation	English	4	3	20	80	100	2
		Kannada/Hindi/Malayalam	4	3	20	80	100	2
	b. Elective Foundation	i. Constitution of India	2	2	10	40	50	1
Group IV	EC & CC	A). NSS/NCC/Rovers and Rangers B). Sports and Games C). Other extra and co-curricular activities as prescribed by the University	2	2	50	-	50	1
	Total		**35**		**800**			**16**

SEMESTER - II								
Group	**Course Code**	Title of the Course	Instruction Hours / week	Duration of Exam (Hours)	Marks			Credits
					IA	Exam	Total	
Group I Core Courses	BFTFTC 181	Food Chemistry	4	3	20	80	100	2
	BFTFTC 182	Food Preservation	4	3	20	80	100	2
	BFTFTC 183	Fundamentals of Food Processing	4	3	20	80	100	2
	BFTFTP 184	Food Chemistry Practical - 4	3	3	10	40	50	1
	BFTFTP 185	Food Preservation Practical - 5	3	3	10	40	50	1
	BFTFTP 186	Fundamentals of Food Processing Practical - 6	3	3	10	40	50	1
Group II Elective Courses b) Providing an expanded scope	Out of 3 Courses any ONE to be opted							
	BFTFCE 187	Technology of Spices	2	2	10	40	50	1
	BFTFCE 188	Research and Development of New Product						
	BFTFCE 189	Total Quality Management						
Group III Foundation Courses	a. Compulsory Foundation	English	4	3	20	80	100	2
		Kannada/Hindi/Malayalam	4	3	20	80	100	2
	b. Elective Foundation	ii. Human Rights	2	2	10	40	50	1
Group IV	EC & CC	A). NSS/NCC/Rovers and Rangers B). Sports and Games C). Other extra and co-curricular activities as prescribed by the University	2	2	50	-	50	1
	Total		**35**		**800**			**16**

SEMESTER – 1II								
Group	**Course Code**	Title of the Course	Instruction Hours / week	Duration of Exam (Hours)	Marks			Credits
					IA	Exam	Total	
Group I Core Courses	BFTFTC 231	Technology of Plant Products	4	3	20	80	100	2
	BFTFTC 231	Technology of Animal Products	4	3	20	80	100	2
	BFTFTC 233	Technology of Fermentation Products	4	3	20	80	100	2
	BFTFTP 234	Technology of Plant Products Practical - 7	3	3	10	40	50	1
	BFTFTP 235	Technology of Animal Products Practical - 8	3	3	10	40	50	1
	BFTFTP 236	Technology of Fermentation Products Practical - 9	3	3	10	40	50	1
Group II Elective Courses a) Nurturing students proficiency/skill	Out of 3 Courses any ONE to be opted							
	BFTFCE 237	Entrepreneurship Development	2	2	10	40	50	1
	BFTFCE 238	Role of Sensory Panel Members in food industries						
	BFTFCE 239	Pest Management of Stored Foods						
Group III Foundation Courses	a. Compulsory Foundation	English	4	3	20	80	100	2
		Kannada/Hindi/Malayalam	4	3	20	80	100	2
	b. Elective Foundation	iii. Gender & Equity	2	2	10	40	50	1
Group IV	EC & CC	A). NSS/NCC/Rovers and Rangers B). Sports and Games C). Other extra and co-curricular activities as prescribed by the University	2	2	50	-	50	1
	Total		**35**		**800**			**16**

SEMESTER - IV								
Group	**Course Code**	Title of the Course	Instruction hours / week	Duration of Exam (hours)	Marks			Credits
					IA	Exam	Total	
Group I Core Courses	BFTFTC 281	Bakery, Confectionary and Extruded foods	4	3	20	80	100	2
	BFTFTC 281	Technology of Fat and Oil Products	4	3	20	80	100	2
	BFTFTC 283	Food Biotechnology	4	3	20	80	100	2
	BFTFTP 284	Bakery, Confectionary and Extruded foods Practical -10	3	3	10	40	50	1
	BFTFTP 285	Technology of Fat and Oil Products Practical - 11	3	3	10	40	50	1
	BFTFTP 286	Food Biotechnology Practical - 12	3	3	10	40	50	1
Group II Elective Courses a) Enabling an exposure to some other domain	Out of 3 Courses any ONE to be opted							
	BFTFOE 287	Food flavours	2	2	10	40	50	1
	BFTFOE 288	Nutrition through life cycle						
	BFTFOE 289	Post-harvest management						
Group III Foundation Courses	a. Compulsory Foundation	English	4	3	20	80	100	2
		Kannada/Hindi/Malayalam	4	3	20	80	100	2
	b. Elective Foundation	iv. Environmental Studies	2	2	10	40	50	1
Group IV	EC & CC	A). NSS/NCC/Rovers and Rangers B). Sports and Games C). Other extra and co-curricular activities as prescribed by the University	2	2	50	-	50	1
	Total		**35**		**800**			**16**

SEMESTER - V								
Group	**Course Code**	Title of the Course	Instruction Hours / week	Duration of Exam (Hours)	Marks			Credits
					IA	Exam	Total	
Group I Core Courses	BFTFTC 331	Food Engineering	4	3	20	80	100	2
	BFTFTC 332	Food Packaging and Storage Technology	4	3	20	80	100	2
	BFTFTC 333	Techniques of Food Analysis	4	3	20	80	100	2
	BFTFTC 334	Quality Control in Food Processing Industries	4	3	20	80	100	2
	BFTFTC 335	Emerging Technologies in Food Processing	4	3	20	80	100	2
	BFTFTC 336	Waste Management of Food Industries	4	3	20	80	100	2
	BFTFTP 337	Food Engineering and Packaging Technology Practical - 13	3	3	10	40	50	2
	BFTFTP 338	Food Analysis and Quality Control Practical - 14	3	3	10	40	50	2
	BFTFTP 339	Emerging Technologies and Waste Management Practical - 15	3	3	10	40	50	2
	Total		**36**		**900**			**18**

SEMESTER - VI								
Group	**Paper Code**	Title of Paper	Instruction Hours / week	Duration of Exam (Hours)	Marks			Credits
					IA	Exam	Total	
Group I Core Courses	BFTFTC 381	Nutraceuticals and Functional Foods	4	3	20	80	100	2
	BFTFTC 382	Utilization of Food Industry Wastes	4	3	20	80	100	2
	BFTFTC 383	Enzyme Technology	4	3	20	80	100	2
	BFTFTC 384	Food Plant Sanitation	4	3	20	80	100	2
	BFTFTC 385	Bioethics, Biosafety and IPR	4	3	20	80	100	2
	BFTFTC 386	Food Certification	4	3	20	80	100	2
	BFTFTP 387	Nutraceuticals, Functional Foods, Food Waste Utilization Practical - 16	3	3	20	80	100	2
	BFTFTP 388	Enzyme Technology and Sanitation Practical - 17	3	3	20	80	100	2
	BFTFTP 389	Project work	6	-	20	80	100	2
	Total		**36**		**900**			**18**

IA = Internal Assessment
Total Credits: 100

SYLLABUS for B.Sc.-FOOD TECHNOLOGY-2018
CBCS
Group I – Core Courses
BFTFTC 131 Food and Nutrition
SEMESTER-1

(48 hours)

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 **(5 hours)**

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 **(5 hours)**

Functions of food-physiological, psychological and social, Concept of Balanced Diet, Malnutrition – over and under. Basic Food Groups, Food Pyramid.

3. Concepts of Meal Planning **(2 hours)**

Factors affecting meal planning, understanding specific considerations for planning meal for different groups of people.

UNIT II

4. Carbohydrates **(4 hours)**

Classification, digestion, functions, dietary sources, requirement, Clinical manifestations of deficiency and excess and factors affecting absorption of carbohydrates.

5. Proteins **(4 hours)**

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 hours)**

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 hours)**

Classification, digestion, functions, dietary sources, requirement, effects of deficiency (Vitamin A, D, K).

8. Minerals **(4 hours)**

Classification, digestion, functions, dietary sources, requirement, effects of deficiency (Iodine, Sodium and Potassium).

9. Pigments and colloids (4 hours)

Chlorophyll, Flavanoids, Anthocyanins, Anthoxanthins, Colloidal chemistry, Properties of solutions, Sols & Suspensions, Food colloids.

UNIT IV

10. Enzymes (5 hours)

Classification of enzymes, Source of enzymes in food, Use of enzymes in food, Enzymatic and non-enzymatic reactions during storage.

11. Methods of Cooking (5 hours)

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 hours)

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 Publishers, 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

BFTFTC 132 Principles of Food Science

(48 hours)

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. Food Chemistry (2 hours)

Introduction to different food groups and importance of food chemistry. Characteristics of protein, carbohydrates, lipids, pigments, colloids, and enzymes.

2. Colloidal chemistry (5 hours)

Characteristics and stabilization of colloidal system, properties and formation of emulsions, formation, stability and destruction of foam, application of colloidal chemistry to food preparation.

3. **Sensory evaluation of food (5 hours)**

Objectives, type of food panels, characteristics of panel member, layout of sensory evaluation laboratory, sensitivity tests, threshold value, paired comparison test, duotrio test, triangle test, hedonic scale, chemical dimension of basic tastes, Amoore's classification of odorous compounds. Sherman and Sczezniak classification of food texture.

UNIT II

4. Growth of microorganisms in foods (4 hours)

Food as a substrate for microorganism, factors affecting growth of microbes: pH, water activity, O-R potential, nutrient contents, inhibitory substance and biological structure**.**

5. Hurdle technology (4 hours)

Principles and applications, Hurdle effect in fermented foods, shelf stable products, intermediate moisture foods, application of hurdle technology.

6. Minimal processing (4 hours)

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

UNIT III

7. Ohmic heating and High Pressure processing (6 hours)

Principles, equipment and processing, effect heat and pressure on food.

8. Water disposal (3 hours)

Waste water, hardness of water, break point chlorination, physical and chemical of impurities, BOD, COD, waste water treatment,

9. **Water disposal (3 hours)**

Sanitization of food processing plants and equipments, CIP system, sanitizers used in food industry.

UNIT IV

10. Shelf life of food material (3 Hours)

Objectives of packaging, packaging requirements of all major food groups, food contact materials,

11. Packaging materials (6 Hours)

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

12. Packed storage (3 Hours)

Design and analysis of shelf life experiments and the shelf life estimation of foods, Factors effecting shelf life of the material during packed storage.

References

1. Coles R, McDowell D and Kirwan MJ, Food Packaging Technology, CRC Press, 2003
2. De S, Outlines of Dairy Technology, Oxford Publishers, 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. Publishers, 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

BFTFTC 133 Food Microbiology

(48 hours)

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 hours)

History and Development of Food Microbiology, Definition and Scope of food microbiology, Inter-relationship of microbiology with other sciences.

2. Microscopy (4 hours)

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. **Characteristics of Microorganisms in Food (4 hours)**
   Types of microorganisms associated with food, their morphology and structure, Significance of spores in food microbiology.

UNIT II

4. **Evolution of Microorganisms in foods (2 hours)**
   Theory of spontaneous generation, Germ theory of disease, Koch's postulates, Pure culture concept
5. **Microbial Growth in Food (4 hours)**
   Bacterial growth curve and microbial growth in food, Factors affecting the growth of microorganisms in food, Sources of Microorganisms in foods,
6. **Microbial Food Spoilage (6 Hours)**
   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 hours)**
   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.
8. **Food borne Diseases (3 hours)**
   Types – food borne infections, food borne intoxications and toxic infections, Common and Recent Examples
9. **Cultivation of Microorganisms (4 hours)**
   Pure culture technique, Methods of isolation and cultivation, Enumeration of microorganisms- qualitative and quantitative.

UNIT IV

10. **Concepts of microbial control (5 hours)**
    Principles and methods of preservation, Introduction to Hurdle concept and Non Thermal methods, Probiotic concept.
11. **Control of Microorganisms in Foods (5 hours)**
    Physical Methods of Food Preservation- Dehydration, Freezing, Cool Storage, Heat Treatment, Irradiation, Biopreservation,
12. **Trends in Food Microbiology (2 hours)**
    Rapid Methods of Detection, 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

BFTFTP 134 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.

1. Identification of food sources for various nutrients using food composition tables.
2. Record diet of self using 24 hours dietary recall.
3. Nutritional analysis of diet of self using 24 hours 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.

BFTFTP 135 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 constitutents 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 asses 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

BFTFTP 136 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 broth
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. Morphological study of fungi using permanent slides
9. Simple staining
10. Gram's staining
11. Slide culture of the fungus
12. Motility of the bacteria using hanging drop method

SEMESTER-II
BFTFTC 181 Food Chemistry

(48 hours)

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 hours)**

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. Lipids **(4 hours)**

Classification of lipids, 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

3. Proteins **(4 hours)**

Protein classification and structure, Nature of food proteins (plant and animal proteins, Properties of proteins, Functional properties of proteins.

UNIT II

4. Carbohydrates **(4 hours)**

Classification of carbohydrates, Structure of important polysaccharides, Chemical reactions of carbohydrates, Modified celluloses and starches.

5. Vitamins (**4 hours)**

Importance and Stability, Water soluble vitamins, Fat soluble vitamins,

6. Flavour **(4 hours)**

Definition and basic tastes, Description of food flavours, Flavour enhancers

UNIT III

7. Minerals **(4 hours)**

Major and minor minerals, Metal uptake in canned foods, Toxic metals

8. Natural Food Pigments **(4 hours)**

Introduction and classification, Food pigments (chlorophyll, carotenoids, anthocyanins and flavonoids, beet pigments, caramel)

9. Browning Reactions in Food **(4 hours)**

Enzymatic browning, Non-Enzymatic browning, Maillard reaction, Caramelization reaction, Ascorbic acid oxidation,

UNIT IV

10. Enzymes **(4 hours)**

Introduction, General characteristics, Enzymes in food processing, Industrial Uses of Enzymes, Immobilized enzymes

11. Changes occurring during food processing treatments **(4 hours)**

Drying and dehydration, Irradiation, Freezing, Canning

12. New product development **(4 hours)**

Definition, Importance, Need of product development, Steps of product development-Product development tools Reasons for failure

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, NewYork, 1980
6. DeMan, J.M., Principles of Food Chemistry, 3rd Ed., Springer 1999
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8. Fuller, Gordon W, New Product Development from Concept to Marketplace, CRC Press, 2004.
10. Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002
11. Krishna Prasad Nooralabettu. Enzyme Technology, Pace Maker of Biotechnology, PHI Learning Private Limited, New Delhi. 2011

BFTFTC 182 Food Preservation

(48 hours)

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 hours)**
   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 hours)**
   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 hours)**
   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 hours)**
   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 hours)**
   Principle and application of heat preservation methods: Sterilization, commercial sterilization, Pasteurization, ultrahigh temperature sterilization, aseptic processing and blanching.
6. **Drying and Dehydration** **(4 hours)**
   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 hours)**
   Definition and principle of evaporation, factors affecting evaporation, names of evaporators used in food industry.
8. **Food Preservation by Irradiation** **(4 hours)**
   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 hours)**
   Principles of fermentation, Types of fermentation, curing and pickling; Hurdle technology, Advantages

UNIT IV

10. **Modified atmosphere** **(4 hours)**
    History of Controlled Atmosphere Storage, Modified Atmosphere Packaging techniques, Equilibrium Modified Atmosphere Packaging techniques, gas-flushing and compensated vacuum techniques

11. **Chemical Preservatives** **(4 hours)**
Natural Preservatives-Mode of action, Chemical preservatives- Sulphur dioxide, Benzoic acid, Sorbic acid, Antioxidants
12. **Recent Trends** **(4 hours)**
Biopreservatives, Pulsed electric fields, High pressure technology, Ohmic heating, Microwave heating, Hurdle technology

References

1. Srilakshmi, B. Food science, New Age Publishers, 2002
2. Meyer, Food Chemistry, New Age, 2004
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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.

BFTFTC 183 Fundamentals of Food Processing

(48 hours)

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 hours)**
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 hours)**
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 hours)**
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 hours)**

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 hours)**
Fish - Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish, spoilage of fish- microbiological, physiological, biochemical. 6.

6. **Compositional, Nutritional and Technological aspects of poultry meat (4 hours)**
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 hours)**
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 hours)**
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 hours)**
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 hours)**
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 hours)**
Functional foods, Prebiotics, Probiotics, Nutraceuticals, organic foods, GM foods

12. **Compositional, Nutritional & Technological aspects of spices (3 hours)**
Definition, Classification, Chemical composition, use of spices

References

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4. Meyer, Food Chemistry, New Age, 2004
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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

BFTFTP 184 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. Estimation of total protein content of food sample.
2. Estimation of total solid content of the sample.
3. Estimation of total lipids in the food sample.
4. Estimation of saponification value.
5. Estimation of reducing sugars.
6. Estimation of non-reducing sugars.
7. Estimation of total ash.
8. Estimation of iodine value.
9. Estimation of peroxide value.
10. Determination of carotenoids.
11. Extend of non-enzymatic browning by extraction methods.
12. Estimation of non protein nitrogenous substances in the food.

BFTFTP 185 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. Methods of Sampling.
2. Concept of shelf life of different foods
3. To study the concept of Asepsis and sterilization
4. Plotting drying curve.
5. Study quality characteristics of foods preserved by drying/dehydration/ freezing.
6. To perform pasteurization of fluids using different methods.
7. To perform blanching of different plant foods.
8. Pasteurization of the milk.
9. Dry salting and wet Salting of fish samples.
10. Artificial drying of vegetables.
11. Iced storage of fish samples.
12. Chilled storage of fish samples.

BFTFTP 186 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. Estimation of total bacterial count before and after washing of the fish samples.
3. Determination of pH of the food products using pH meter.
4. Estimation of drip loss 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. Changes in proteolytic bacterial in perishable food.
9. Changes in proteolytic mold count in perishable food.
10. Organoleptic characteristics of the perishable foods at room temperature.
11. Changes in lipolytic bacterial in perishable food.
12. Changes in lipolytic mold count in perishable food.

SEMESTER-III
BFTFTC 231 Technology of Plant Products

(48 hours)

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 **(2 hours)**

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 **(5 hours)**

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 bottles foods**.**

3. Fruits juices and tomato pulps **(5 hours)**

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**.**

UNIT II

4. **Fruit squashes, Jams, Jellies, Marmalades and candies (4 hours)**
   Selection of fruits, Processing, essential constituents, types, technology and defects in Fruit squashes, Jams, Jellies, Marmalades and candies
5. **Pickles, Chutneys and Sauces (4 hours)**
   Processing of pickles, chutneys and squashes, Types of pickles, chutneys and squashes, Causes of spoilage in pickling**.**
6. **Drying of Foods and Vegetables (4 hours)**
   Sun drying and mechanical drying of Food and Vegetables, process variation for fruits and vegetables, packing and storage**.**

UNIT III

7. **Spices (5 hours)**
   Processing and properties of major and minor spices, essential oils & oleoresins, adulteration**.**
8. **Tea, Coffee and Cocoa (5 hours)**
   Processing of Tea, Coffee and Cocoa, Variety Tea, Coffee and Cocoa and its products**.**
9. **Browning (2 hours)**
   Enzyme activity enzymic browning Non enzymic browning, its prevention.

UNIT IV

10. **Technology of Cereals (4 hours)**
    Introduction, Properties, types, milling, treatment, product and byproducts of wheat, rice
11. **Technology of Pulses (4 hours)**
    Milling of pulses, Dry milling, Wet milling, Improved milling method
12. **Technology of Oilseeds and alcoholic beverages (4 hours)**
    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, Siddappaa, G.S and Tandon, G.L.1998. Preservation of fruits & Vegetables, ICAR, New Delhi
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3. Manay, S. & Shadaksharaswami, M.2004. Foods: Facts and Principles, New Age Publishers
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9. Manay, S. and Sharaswamy, M. 1987. Food Facts and Principles. Wiley Eastern Limited

BFTFTC 232 Technology of Animal Products

(48 hours)

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 food microbiology** **(2 hours)**
Status and development of fishery, meat, poultry and dairy industries in India and its need in nation's economy.
2. **Processing of meat** **(4 hours)**
The meat processing industry, its techniques of working, general management, structure, composition. Slaughter, inspection and grading.
3. **Preservation of meat** **(6 hours)**
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 hours)**
The egg industry, its techniques of working, General management, structure, composition and nutritive value of egg and its products.
5. **Preservation of eggs** **(4 hours)**
Refrigeration and freezing, thermal processing, dehydration, coating.
6. **Quality identification of shell eggs** **(2 hours)**
Factors affecting egg quality and measures of egg quality.

UNIT III

7. **Processing of fish** **(6 hours)**
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.
8. **Fishery by-products** **(4 hours)**
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.
9. **Fermented fish** **(2 hours)**
Principles of fermentation of fishery products, Flowchart of Indigenous products- Fish sauce and Paste

UNIT IV

10. **Physical properties of milk** **(4 hours)**

Color, taste, pH and buffering capacity, refractive index, viscosity, surface tension, freezing, boiling point, specific heat, electrical conductivity. Properties and significances of lactose in dairy industry.

11. Milk fat (4 hours)

Composition and structure, factors affecting melting point, boiling point, solubility and Refractive Index, fat constants. Chemical reactions of fat (hydrolysis, auto-oxidation), condition favouring autooxidation, prevention, measurement of auto-oxidation.

12. Market milk industry and milk products (4 hours)

Systems of collection of milk, Reception, Platform testing, Various stages of processing, Description and working of clarifier, cream separator, homogenizer and plate heat exchanger. Butter, ghee, flavored milk, yoghurt, dahi, shrikhand, ice-cream, condensed milk, milk powder, channa, paneer, cheese (cheddar).

References

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2) Parkhurst & Mountney, Poultry Meat and Egg Production, CBS Publication, New Delhi, 1997
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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 Publishers Inc., NY, 1992
8) Sen DP, Advances in Fish Processing Technology, Allied Publishers 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 Publishers, New Delhi 1988

BFTFTC 233 Brewing and Fermentation Technology

(48 hours)

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 hours)**
   Introduction, Malts, Brewing liquors, Milling and Mashing, Processing of Beer, types of beer, malting.
2. **Science of Mashing** **(4 hours)**
   Introduction, Mashing schedules, Altering Mashing Conditions, Mashing Biochemistry, Mashing and Beer flavor, Spent Grains, Preparation of grists, Mashing technology.
3. **Wort Boiling** **(4 hours)**
   Introduction, Chemistry of wort boiling, Clarification, Cooling and Aeration.

UNIT II

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

UNIT III

7. **Malt Whiskies** **(4 hours)**
   Raw materials and processing of Scotch Whiskey, Irish Whiskey, North American Whiskies, Japanese Whiskey, Malt whiskies,
8. **Grain Whisky** **(4 hours)**
   Raw materials, wheat-wheat breeding, Grain distillery processing, Gelatinization, Milling, Cooking Conversion, Wort Separation,
9. **Yeast and Fermentation** **(4 hours)**
   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 hours)**
    Design, Wash Still Operation, Sprit Still Operation, Continuous Distillation, Design and Operation of grain whisky stills,
11. **Regulations** **(3 hours)**
    Whiskies of world and their regulations, Scotch Whisky, Canadian Whisky, Marketing Scotch Whisky
12. **Whisky Analysis** **(3 hours)**
    Major Volatile Congeners, Whisky, Age- Sensory analysis, Whisky authenticity.

References

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2. Champbell G., Fermented Foods of the world-A Dictionary & Guide, Platt, Butterworths, London, 1987.
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11. Pollock, J.R.A., and ed.: Brewing science vol. 1. London, Academic Press, 1979

BFTFTP 234 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 the occur during preservation processes

1. Estimation of total soluble solids (TSS).
2. Physical characteristics of Wheat.
3. Estimation of brix: acidity ratio
4. Estimation of ascorbic acid and effect of heat treatment on it.
5. To study the steps of artificial drying of vegetables.
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.
11. Brining of vegetables.
12. Organoleptic changes during dehydration of vegetables and fruits.

BFTFTP 235 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. To perform acidity in milk.
2. To perform acidity COB in milk.
3. To perform acidity MBRT in milk.
4. To perform acidity specific gravity in milk.
5. To perform acidity SNF in milk.
6. To estimate milk fat by Gerber method.
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)

BFTFTP 236 Brewing and Fermentation Technology (Practical 9)

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 Heamocytometer.
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

SEMESTER-III

BFTFTC 251 Bakery, Confectionery and Extruded Foods

(48 hours)

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 **(4 hours)**

Global status of Baking industry, Introduction to baking, Bakery ingredients and their functions, traditional bakery products; Modern bakery product.

2. Baking methods **(4 hours)**

Various methods of production and effect of ingredients, formulations and process parameters on quality, machinery used in baking industry.

3. Bakery Products (4 hours)

Bread, bread rolls, sweet yeast dough products, biscuits, wafer, cookies and crackers, Multi grain bread and gluten free products,

UNIT II

4. Bakery Product Quality (3 hours)

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 (3 hours)

Bakery hygiene and sanitation including control of rodents and pests. Bread faults – causes and remedies; Bread staling – theory, manifestation, retardation measures

6. Cakes (6 hours)

Cakes – flour specifications; ingredients, manufacturing process and quality evaluation; Basic methods of cake preparations, variety cakes and doughnuts, rusks, crackers, buns, muffins, pizza; Icings, glazers, creams, fondants, frostings; Cake recipe balancing, faults and remedies; Preparation of basic custards, pudding; Mousse.

UNIT III

7. Confectionery industry (4 hours)

Global status of confectionery industry; Raw materials, quality parameters; production, types, applications.

8. Confectionary manufacture (4 hours)

Raw materials and processing; cocoa, sugar, special fats, dried milk products, emulsifiers; chocolate processing- compound coatings, candy bars, tempering, enrobing technology, chocolate shells.

9. Sugar confectionery (4 hours)

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

UNIT IV

10. Extruded food product industry (4 hours)

Objectives and importance of extrusion in food product development; Advantages and disadvantages. Components, functions and classification of extruder.

11. Extruded food product (4 hours)

Change of functional properties of food components during extrusion; Pre and post extrusion treatments; Use of extruder as bioreactor; Manufacturing process of extruded products; Application of extrusion technologies in food industries.

12. Cost consideration (4 hours)

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 Publishers, 2008.
2. Stanley Cauvain and Linda Young, Baked Products- Science, Technology and practice, Blackwell Publishing, 2006.

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BFTFTC 252 Technology of Fat and Oil Products

(48 hours)

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 hours)**
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 hours)**
Chemical, physical and functional properties of fats and oils, Importance of fats and oils in human nutrition Commercial oil resources
3. **Edible fats and oil products** **(4 hours)**
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 hours)**
Rendering, pressing, solvent extraction, supercritical fluid extraction, enzyme-derived oil extraction.

5. **Processing of fats and oils** **(4 hours)**
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 hours)**
Breeding, Hydrogenation, Fractionation, Emulsification, Interesterification, Crystallization, Blending and Calculation

UNIT III

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

UNIT IV

10. **Shortening** **(4 hours)**
Introduction into shortening, manufacturing and uses of shortening, types of shortening.
11. **Value added products** **(4 hours)**
Margarine-manufacturing process and its uses. Mayonnaise and salad dressings. Confectionery coatings. Imitation dairy products - peanut butter and vegetable ghee.
12. **Packaging of fat and oil products** **(4 hours)**
Packing, storage and transportation of fats and oils, cocoa butter, fat substitutes.

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.

BFTFTC 253 Food Biotechnology

(48 hours)

Course Objectives:

1. To enable students to understand the use of biotechnological methods developed to produce foods and food ingredients.
2. To provide students adequate knowledge to evaluate the pros and cons of the use of biotechnology in the production of foods.

Course Outcomes:

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

CO 1. Analyze the difference between modern and traditional biotechnological tools used in the food production sector.

CO 2. Apply the knowledge of emerging tools of biotechnology such as microbial, algal and plant technology in the food processing industries.

CO 3. Diagnose the pathological conditions of cultivable organisms as intervention in the biotechnological approach.

CO 4. Gain insights in the use of genetically modified organisms and ethical implications for animal and food sciences.

UNIT I

1. Scope of Food Biotechnology (4 hours)

Scope of Food biotechnology, Difference between the modern biotechnology and the traditional biotechnology, Difference between Food technology and Food biotechnology.

2. Tools of the trade (4 hours)

Foods produced through indigenous and modern biotechnical tools. Future prospects of such foods, merits and demerits of genetically modified foods, Use of Genetic Engineering, nucleotide sequencing, DNA hybridization, gene cloning and PCR in food industry.

3. Recombinant proteins (4 hours)

Introduction of gene expression and protein production, Manipulation of gene expression in prokaryotic system and prokaryotic system, Large-scale production of proteins from recombinant microorganisms, Application of recombinant proteins.

UNIT II

4. Microbial Biotechnology in foods (4 hours)

Isolating DNA from one organism, Using restriction enzymes to cut the DNA into fragments, Joining a cloning vector with DNA ligase, Incorporation into a host, Detection and purification of the desired clone, Production of large numbers of cells, making a gene product, importance of gene cloning in food production,

5. Algal technologies in food (4 hours)

Identification and mass production of Blue-green algae and Azolla for food and feed, Mycorrhizae - importance in agriculture and forestry. Algae as a source of food, feed, single cell protein, Mass cultivation of commercially valuable marine macroalgae for alginates.

6. Plant biotechnology in foods (4 hours)

Introduction to cell and tissue culture, induction to Plant Genetic Engineering, Generation and maintenance of transgenic plants, Production of fermented cereal food products.

UNIT III

7. Animal biotechnology in foods (4 hours)

Concepts of tissue culture and engineering, Chromosome manipulation in Aquaculture, Genetic engineering of animals and birds meant for food: DNA cloning, protoplast fusion & cell culture methods for trait improvement.

8. Diagnostic systems (4 hours)

Molecular tools for the identification of diseases in aquatic species. Tools for disease diagnosis in cultivable organisms, Enzyme immuno assays, Dot immunobinding assay, Western blotting, Latex agglutination test, Monoclonal antibodies, DNA based diagnosis.

9. Cell culture and food-Brewing, dairy Biotechnology and additives (4 hours)

Genetic engineering of bacteria and animals intended for dairy-based products, Enzymes in dairy industry & production by whole cell immobilization. Biotechnology of dairy effluent treatment.

UNIT IV

10. Industrial cell culture (4 hours)

Enzyme generation of flavor and aroma compounds, use of genetically modified microorganisms to produce organic acids, single cell proteins.

11. Ethics and safety of food biotechnology products (4 hours)

Ethical issues relating to genetic modification of dairy, microbes and milk-yielding, Food safety assessment procedures for food derived from genetically modified plants- Description of the rDNA plant, Description of the host plant and its use as food, Description of the donor organism, Description of the genetic modifications, and Characteristics of the genetic modification.

12. Regulations of Genetically modified foods and issues (4 hours)

Regulatory agencies at national and international level- FDA, USDA, EPA, FSIS, EEC, BRAI, responsibilities of regulatory agencies, Issues of Genetically modified foods –public health concern, labeling, religious practice, environmental issues, liabilities, International trade issues.

References

1. Anthony Pometto, Kalidas Shetty, Gopinadhan Paliyath, Robert E. Levin, Food Biotechnology, CRC Press, 2005.
2. Byong H. Lee, Fundamentals of Food Biotechnology, Wiley-Blackwell, 2014.
3. Hui Y H, George G., Food Biotechnology: Microorganisms, Wiley-VCH, 1995.
4. Joshi VK and Singh RS, Food Biotechnology-Principles and Practice, 2012
5. Aneja K R, Laboratory Manual of Microbiology and Biotechnology, MEDTECH, 2014.
6. Lisa A S, Cynthia JM, Basic Laboratory Methods for Biotechnology (2nd Ed.),

BFTFTP 254 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.

BFTFTP 255 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, oils and fatty acids.
3. Extraction of oil from different sources using different techniques.
4. Debumming of oil sample.
5. Refining of oil sample.
6. Bleaching of oil sample,
7. Hydrogenation of oils sample.
8. Interesterification of oil sample.
9. Tempering of oil sample.
10. Preparation of peanut butter.
11. Objective parameters of fat and oils
12. Subjective characteristics of fats and oil.

BFTFTP 256 Food Biotechnology (Practical 12)

Course Outcomes:

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

CO 1. Use biotechnical tools and advanced approaches to work in food industry
CO 2. Produce various food indigenous condiments using appropriate food groups.
CO 3. Understand the production of curd and cheese
CO 4. Analyze food pathogens which is a rising problem in various food industry by using biotechnological techniques

1. Microscopic examination of various plant and animal cells
2. Production of cheese
3. Production of curd.
4. Production of food indigenous condiment using rice.
5. Production of food indigenous condiment using wheat.
6. Production of food indigenous condiment using rice.
7. Production of food indigenous condiment using pulses.
8. Production of food indigenous condiments using fruits
9. Food pathogens related -genes, marker and single nucleotide polymorphism (SNP) analysis using online tools
10. Genomic DNA isolation and purification from food samples.
11. Spectrophotometric Determination (DNA quantification and purity)
12. Agarose gel electrophoresis of DNA.

SEMESTER - V

BFTFTC 331 Food Engineering

(48 hours)

Course Objectives:

1. To facilitate the understanding of basic engineering aspects of the food industry and enhance knowledge in practical aspects such as design, layout structuring, etc.,
2. To emphasize on various production aspects of food industry, overcome the shortcomings by modified and practical solutions to the existing problems.

Course Outcomes:

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

CO 1. Comprehensively understand and apply the knowledge on basic unit functions and different layout designs in food industry and create smart plan for the smooth functioning of the food industry.

CO 2. Efficiently overview cold storage and practical application aspects such as design, energy efficiency, etc., to be utilized for production of food products and storage purpose.

CO 3. Successfully be able to apply purification methods such as Reverse osmosis, Ultrafiltration, electrodialysis, etc., in food industries in treatment of water and other similar products.

CO 4. Comprehend basic water removal processes such as evaporation, drying, etc., and apply them practically.

UNIT I

1. Introduction **(2 hours)**

Concept of Unit operation, Units and dimensions, Unit conversions, dimensional analysis, Mass and Energy Balance. Related numericals.

2. Design of food plant **(6 hours)**

Design considerations of food plants, Types of layout, Installation of cold storage, evaporators, dryers, freezers, Seaming machine; Sterilizers & other accessories used in canning industries; Engineering aspects of pasteurizer; homogenizer, evaporators and concentrators.

3. Grinding and mixing **(4 hours)**

Principle of grinding and mixing, Different types of grinders and mixers used in food industry, application of grinders and mixers in food industry

UNIT II

4. Fluid Flow in food Processing **(5 hours)**

Liquid Transport systems, Properties of Liquids, Newton's Law of Viscosity, Principle of Capillary tube and rotational viscometer, Properties of Non-Newtonian fluids, Flow characteristics, Reynolds Number, Bernoulli's Equation, Concept of Flow Measurement devices.

5. Refrigeration and Freezing **(5 hours)**

Concept and selection of a refrigerant, Description of a Refrigeration cycle, Pressure Enthalpy charts and Tables, Mathematical expressions useful in analysis of vapour compression refrigeration cycle, Numericals based on VCR system, Freon 12 and R-717, superheating and sub cooling, Freezing time calculation using Plank's Equation, Frozen food storage, Related basic numericals.

6. Cold Storages **(2 hours)**

Construction of cold storages, types of cold storages, requirement of cold storages, machineries and utensils in cold storages.

UNIT III

7. Heat and Mass Transfer **(5 hours)**

Systems for heating and cooling food products, Thermal Properties of Food, Modes of heat transfer, Application of steady state heat transfer- estimation of conductive heat transfer coefficient, convective heat transfer coefficient, overall heat transfer coefficient and, design of tubular heat exchanger. Related basic numerical, Fick's Law of Diffusion,

8. Membrane separation systems **(5 hours)**

Electrodialysis system, Reverse Osmosis, Membrane System, and Ultrafiltration Membrane System, Membrane devices used for RO and UF: Plate and Frame, Tubular, Spiral wound and hollow fiber devices.

9. Psychrometrics **(2 hours)**

Properties of Dry Air Properties of Water Vapour, Properties of air Vapour mixture, Psychrometric Chart, Related basic numerical.

UNIT IV

10. Steam **(4 hours)**

Generation of steam, Construction and functions of fire tube and water tube boilers, Thermodynamics of Phase change, Steam tables, Boiling point elevation, Related basic numerical

11. Evaporation **(4 hours)**

Principle of evaporation, Types of evaporations, Design of single effect evaporators, Related basic numerical

12. Dehydration **(4 hours)**

Basic Drying Process, Moisture content on wet basis and dry basis, Dehydration systems, Dehydration system Design. Related basic numerical.

References

1) Rao DG. Fundamentals of food engineering. PHI learning Private Ltd. 2010.
2) Singh RP and Heldman DR. Introduction to food engineering. Academic press 4th edition, 2009
3) Rao C G, Essentials of food process engineering. B S Publications, 2006
4) Fellow P. Food processing technology, 1988

BFTFTC 332 Food Packaging and Storage Technology

(48 hours)

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 (3 hours)

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 (6 hours)

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 hours)

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 hours)

Characteristics of food stuffs that influence packaging selection: physical chemical and biological.

5. Packaging requirement (5 hours)

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 (5 hours)

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 (4 hours)

Packaging and temperature changes: intelligent packaging; Packaging for microwave heating; Printing techniques; Package labeling: functions and regulations; Environmental aspect of food packaging, ecobalances.

8. Cold Storage design and construction (4 hours)

Small and large commercial storages, cold room temperatures, insulation, properties of insulating materials, air diffusion equipment, doors and other openings.

9. Refrigeration (4 hours)

Refrigeration cycles, vapour compression and vapor absorption cycles, refrigerants, characteristics of different refrigerants. Ton of refrigeration, components of refrigeration system.

UNIT IV

10. Storage of food products (4 hours)

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.

11. Changes during storage (4 hours)

Storage of grains - biochemical changes during storage - production, distribution and storage capacity estimate models, factors affecting losses, storage requirements, preventive method.

12. Controlled and modified atmospheric storages (4 hours)

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 Publishers 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.

BFTFTC 333 Techniques of Food Analysis

(48 hours)

Course Objectives:

1. To provide knowledge and skills in the applications, principles and practices of food analysis.
2. To understand the methods used to assess the accuracy and precision of analytical techniques.

Course Outcomes:

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

CO 1. Apply sampling techniques to food materials having widely diverse properties and volumes

CO 2. Use principal analytical methods for quantifying the composition and reactions of food components.

CO 3. Choose appropriate analytical techniques for foods and know when or how to use them in a food processing environment.

CO 4. Apply modern instrumental methods to analyse chemical and physical properties of foods.

UNIT I

1. **Acceptance Sampling** **(4 hours)**
   Various methods of sampling, operational characteristics, risks, attribute sampling plans, administration of attribute sampling plans, sampling error.
2. **Food Analysis** **(4 hours)**
   Role of analysis, analysis of results. Techniques of analysis: gravimetric, titrimetric, colorimetric, spectrophotometric, fluorimetric, chromatographic.
3. **Physio-chemical basis of identification** **(4 hours)**
   Physical, chemical and rheological properties of food; Principles of analysis of various food constituents and subsequent changes on packaging.

UNIT II

4. **Sensory Attributes** **(4 hours)**
   Sensory attributes of foods: mechanisms of sensation and perception of colour, taste, odour, and flavour;
5. **Sensory evaluation methods** **(4 hours)**
   Importance and use of sensory evaluation methods; facilities required for sensory evaluation; selection of trained panelists.
6. **Affective and analytical methods** **(4 hours)**
   discrimination methods, preference and ranking; rating with use of scales, magnitude determination, sensory profiling, flavour profile.

UNIT III

7. **Descriptive methods** **(4 hours)**
   Quantitative Descriptive Analysis and Spectrum techniques; texture profile.
8. **Selection of trained panelist** **(4 hours)**
   Selection of trained panelists: type of panelists suitable for different tasks and methods; conditions for sensory analysis: room, serving and preparation of samples.
9. **Consumer tests** **(4 hours)**
   Application of consumer tests; control of factors affecting accuracy and precision of sensory data.

UNIT IV

10. **Advanced techniques of food analysis** **(7 hours)**
    Principles and application of flame photometry, atomic absorption, X-ray analysis, electrophoresis-applications, Mass spectroscopy, Nuclear magnetic resonance (NMR), chromatography, refractometry.
11. **Rheological measurements** **(3 hours)**
    Rheology measurements. Enzymatic methods DSC, SEM, rapid methods of microbial analysis, immunoassays, ESR, (electron spin resonance).

12. Analysis of sensory data **(2 hours)**

Statistical testing; correlating instrumental and sensory measurements.

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 Publishers, 2003
3. Wood R, Foster L, Damant A and Key P, Analytical Methods for Food Additives, Woodhead Publishing, 2004
4. Pomeranz Y. and Meloan CE, Food Analysis: Theory and Practice, 3rd ed Chapman & Hall, 1994
5. AOAC, Official Methods of Analysis and AOAC International, 2005
6. Wrolstad RE, Acree TE, Decker EA Penner MH and Reid DS, Handbook of Food Analytical Chemistry, John Wiley & Sons, 2004

BFTFTC 334 Quality Control in Food Processing Industries

(48 hours)

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 **(4 hours)**

Organization and management; quality, quality assurance, quality control, total quality management

2. Current Food Good Manufacturing Practices **(4 hours)**

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 hours)**

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 **(4 hours)**

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** **(4 hours)**
   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 hours)**
   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** **(4 hours)**
   Identification of adulterants both qualitative and quantitative; additives in foods; types, names, uses, maximum permissible limits.
8. **Sanitation in food processing facilities** **(4 hours)**
   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** **(4 hours)**
   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** **(3 hours)**
    Quality control aspect of processing plant for milk, meat, fish, poultry, foods, vegetables and cereals; customers service; complaint handling, product recall.
11. **Statistical analysis** **(6 hours)**
    Introduction, Types of data; variation, series data, randomness, definition of probability, sampling, summary statistics. Frequency distributions; histogram, normal distribution curve, probability plots, capability indices. Basic rules of probability, binomial & poisson distributions.
12. **Quality standards** **(3 hours)**
    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 Publishers, 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 Publishers, 2003
7. Pearson AM and Dutson TR, Kluwer HACCP in Meat, Poultry and Fish Processing, Academic Press Publishers, 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 and On-line Instrumentation for Food Quality Assurance, Woodhead Publishing, 2003
11. Nielsen SS, Food Analysis Laboratory Manual, Kluwer Academic Publishers, 2003

BFTFTC 335 Emerging Technologies in Food Processing

(48 hours)

Course Objectives:

1. To impart knowledge about the emerging technologies used in food processing.
2. To evaluate the technologies used in non-thermal processing of foods.

Course Outcomes:

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

CO 1. Illustrate the principle, mechanism and application of minimal processing of foods.
CO 2. Assess the effect of emerging technologies on overall qualities of food.
CO 3. Apply knowledge of the various processing technologies used in food processing.
CO 4. Define and describe the non-thermal processing of food.

UNIT I

1. **High Pressure Processing** **(4 hours)**
   Principles of high pressure processing (HPP), use of high pressure to improve food safety and stability. Effects of high pressure on food quality.
2. **Modeling High Pressure Processing** **(4 hours)**
   Pressure effects on microorganisms, enzyme, texture and nutrients of food. Modeling HP processes.
3. **Pulsed electric fields processing** **(4 hours)**
   Historical background, PEF treatment systems, main processing parameters. PEF for processing of liquid foods and beverages, PEF Processing for solid foods.

UNIT II

4. **Food Safety aspects** **(4 hours)**
   Mechanisms of microbial and enzyme inactivation by HPP and PEF, Food safety aspects of pulsed electric fields, and high pressure processing.
5. **Osmotic dehydration** **(4 hours)**
   Mechanism of osmotic dehydration, effect of process parameters on mass transfer, determination of moisture and solid diffusion coefficient, application of osmotic dehydration.
6. **Athermal membrane concentration** **(4 hours)**
   Athermal membrane concentration of liquid foods and colours: osmotic membrane distillation, direct osmosis, membrane modules, Applications of membrane concentration.

UNIT III

7. **Radio frequency electric fields** **(4 hours)**
   Processing by radio frequency electric fields s equipments, RFEF non-thermal inactivation of yeasts, bacteria and spores, electrical costs.
8. **Ultrasound processing** **(4 hours)**
   Fundamentals of ultrasound, ultrasound as a food preservation and processing aid, effects of ultrasound on food properties.
9. **Alternate thermal processing:** **(4 hours)**

Microwave heating: dielectric properties of foods, heat and mass transfer in microwave processing, application of microwave processing for foods;

UNIT IV

10. Radio frequency electric fields (3 hours)

Dielectric heating, material properties, radio-frequency heating and drying applications;

11. Ohmic heating (3 hours)

Fundamentals of ohmic heating, electrical conductivity, modeling, treatment of products.

12. Hybrid drying technologies (6 hours)

Combined microwave vacuum drying, combining microwave vacuum drying with other processes, equipment for microwave vacuum drying, product quality degradation during dehydration.

References

1. Sun, Da-Wen, Emerging Technologies for Food Processing, Academic Press, 2005
2. Barbosa-Canovas, Tapia and Cano, Novel Food Processing Technologies, CRC Press, 2004
3. Ohlsson, Minimal Processing technologies in the food industry, Woodhead Publishing Limited, 2002
4. Rao E. S. Food Quality Evaluation. Variety Books. 2013.
5. Pomeranz Y and Meloan CE. Food Analysis – Theory and Practice, CBS Publishers and Distributors, New Delhi. 2002.
6. Meilgard, Sensory Evaluation Techniques, 3rd ed. CRC Press LLC, 1999.
7. Amerine, Pangborn & Roessler, Principles of Sensory Evaluation of food, Academic Press, London, 1965.

BFTFTC 336 Waste Management of Food Industries

(48 hours)

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 (4 hours)

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 hours)

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 hours)

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. Economic aspects (4 hours)

Waste treatment economics in Fruit and Vegetable processing industry, Beverage industry, Fish, Meat & Poultry industry, Sugar industry and Dairy industry

5. Effluent treatment methods (4 hours)

Treatment methods for liquid wastes from Fruit and Vegetable processing industry, Beverage industry, Fish, Meat & Poultry industry, Sugar industry and Dairy industry;

6. Waste treatment plant design (4 hours)

Design of Activated Sludge Process, Rotating Biological Contactors, Trickling Filters, UASB, Biogas Plant.

UNIT III

7. Treatment methods of solid wastes (4 hours)

Treatment methods of solid wastes from meat, fish, vegetable, sugar industry- Biological composting, drying and incineration;

8. Design of Solid Waste Management System (4 hours)

Design of Solid Waste Management System such as Landfill Digester, Vermicomposting Pit.

9. Biofilters and Bioclarifiers (4 hours)

Examples of Biofilters and Bioclarifiers, treatment methods- solid phase, liquid phase and gaseous phase, types of filter media, advantages and disadvantages

UNIT IV

10. Treatment of waste water (4 hours)

Ion exchange treatment of waste water, Recovery of useful materials from effluents by different methods.

11. Waste regulations (4 hours)

Waste regulations- national and international scenario, Solid waste policy in India, Municipal Solid waste rules,

12. Environmental protection acts (4 hours)

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.

BFTFTP 337 Food Engineering and Packaging Technology (Practical-13)

Course Outcomes:

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

CO 1. Plan and design suitable layouts of various sectors in the food industry
CO 2. Evaluate various processing techniques in the food industry
CO 3. Identify different packaging material and measurement of its thickness and chemical resistance behavior
CO 4. Understand the design, construction and working of a cold storage unit

1. Plant layout design
2. Determination of drying characteristics
3. Study of effect of temperature on viscosity
4. Study of evaporation process.
5. Study of dehydration process.
6. Study of distillation process.
7. Study of solvent extraction process
8. Freezing time calculation
9. Identification of different types of packaging.
10. Measurement of thickness of packaging materials.
11. Testing of chemical resistance of packaging materials.
12. Visit to cold storages.

BFTFTP 338 Food Analysis and Quality Control (Practical-13)

Course Outcomes:

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

CO 1. Determine the specific gravity in various oils and stability
CO 2. Evaluate meat tenderizing effects and various process that are involved in coloring the meat and vegetables.
CO 3. Identify lysine in the meat; determine starch and the pectin component and evaluate the food sample by Organoleptic method.
CO 4. Identify common testing methodologies for food adulterants and various pathogen tests

1. Sample preparation.
2. Study of emulsion stability
3. Determination of specific gravity of oils.
4. Hydration capacity of dehydrated foods.
5. Study of effect of meat tenderizers,
6. Effect of processing on colour of meat, vegetables
7. Determination of available lysine in processed meat
8. Determination of starch and pectins;
9. Organoleptic evaluation of food.
10. Analysis of rancidity in food.
11. Simple food adulterant tests.

12. Food pathogen tests.

BFTFTP 339 Emerging Technologies and Waste Management (Practical-13)

Course Outcomes:

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

CO 1. Evaluate textures of various food products using the texture analyzer
CO 2. Analyze levels of solid and liquid waste present in waste water by checking BOD and COD levels
CO 3. Apply various dehydration methods to achieve dried foods
CO 4. Determine the enzymatic activity in waste products and different food flavors

1. Dehydration of the vegetables in microwave oven.
2. Recognition tests for various food flavors.
3. Osmotic dehydration.
4. Texture evaluation of various baked foods.
5. Texture evaluation of various fish products.
6. Texture evaluation of various blanched foods.
7. Textural measurement of various food products using Texture Analyzer.
8. Measuring the BOD level of the waste water.
9. Measuring the COD level of the waste water.
10. Measuring solid waste and liquid waste from the waste water.
11. Measuring the microbial flora in industrial waste water.
12. Enzyme activity in waste products.

SEMESTER VI

BFTFTC 381 Nutraceuticals and Functional Foods

(48 hours)

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 hours)**

Classification of nutraceuticals, Scope involved in the industry, Indian and global scenario

2. Concept, Biochemistry of nutrition and dietetics (5 hours)

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 (5 hours)

Diseases and disorders related to Excess and deficiency of Carbohydrates, Protein, Fat Metabolic disorders, 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 (4 hours)**

Classification, recover and application of alkaloids, phenols, terpenoids with special reference to skin, hair, eye, bone, muscle, heart, brain, liver, kidney, general health and stimulants.

5. Concept of cosmoceuticals and aquaceuticals. (4 hours)

Sources, extraction and application of chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides of animal origin

6. **Microbial and algal nutraceuticals (4 hours)**

Concept of prebiotics and probiotics -principle, mechanism, production and technology involved, applications-examples of bacteria used as probiotics, use of prebiotics in maintaining the useful microflora-extraction from plant sources.

UNIT III

7. Synbiotics for maintaining good health. (2 hours)

Algae as source of omega-3 fatty acids, antioxidants and minerals-extraction and enrichment.

8. Phytonutraceutical biotechnology (6 hours)

Role of medicinal and aromatic plants in nutraceutical industry–propagation-conventional and tissue culture, cultivation, post-harvest technology and strategies for crop improvement, development of high yielding lines and yield enhancement.

9. Product development and clinical trials (4 hours)

Activity screening, formulations, toxicology, bioavailability, bioequivalence; use of animal models and pre-clinical and clinical trials involved.

UNIT IV

10. Functional Foods (4 hours)

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 (4 hours)

Health benefits and role of fermented foods in conditions like cardiovascular diseases, hypertension, diabetes etc.

12. Scope of functional foods and nutraceuticals (4 hours)

Future prospects of functional foods and nutraceuticals and their potential for use in improving health. Development in processing 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 Publishers & Distributors, 2007.

5. Fellows PJ, Food process Technology by Woodhead Publishing Ltd, 2009.

BFTFTC 382 Utilization of Food Industry Wastes

(48 hours)

Course Objectives:

1. To understand and gain knowledge on minimising the wastage produced by applying suitable technology and also treat the waste derived from food.
2. To apply available and new technologies to reduce the economic pit falls of waste generation and management, by-product utilisation from various food industries.

Course Outcomes:

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

CO 1. Demonstrate comprehensive application-oriented knowledge on minimizing of food waste, applying technology to minimize the waste and also treat the waste appropriately for alternate economy generation.

CO 2. Assess management of waste generated by fruit juice processing, vegetable processing, fish processing and meat processing industries.

CO 3. Discuss various waste utilization from poultry, starch processing, rice mill and related industries.

CO 4. Identify and use by-products from industries like dairy, coffee and tea processing

UNIT I

1. Introduction (3 hours)

Food industry wastes, economics of food waste treatment, necessity of food waste utilization, environmental best- practice technologies for waste minimization.

2. Characteristics of industrial wastes (4 hours)

Moisture content, ferment ability, nutrient status, inert contaminants such as stones, plastics, salt content, organic materials such as proteins, carbohydrates and lipids, suspended solids, biochemical oxygen demand.

3. By product utilization from fruit juice processing waste (5 hours)

Production of pectin, vitamins, ethanol, natural gas, citric acid, activated charcoal, fibre extract from apple pomace, Production of citrus oil from peels of citrus fruits, Manufacture of candied peel and pectin from albedo of citrus fruits.

UNIT II

4. By product utilization from vegetable processing waste (3 hours)

Production of single cell protein by the use of potato wastes; Recovery of Protein from potato starch plant waste.

5. By product utilization from Fish processing waste (6 hours)

Production of fish meal; Fish protein concentrate; Animal feed; Shell product; Glue from seafood processing waste, Texturised fish, protein concentrate, Marketable products like chitin, chitosan, fertilizer, nutritional enhancer animal feed from shells.

6. By product utilization from meat processing waste (3 hours)

Utilization of organs and glands of animal as human food. Production of human food from animal blood and blood protein.

UNIT III

7. By product utilization from poultry processing waste (4 hours)

Utilization of organs and glands of animal as human food. Production of human food from animal blood and blood protein;

8. **By product utilization from starch processing waste (4 hours)**
   Feed for livestock from wheat and corn bran and germ. Starch, modified starch and industrial alcohol from non-usable cereals; Extraction of plolamin (Zein & katirin); Protein from sorghum; Beer spent graining.
9. **By product utilization from rice mill waste (2 hours)**
   Extraction of oil & wax from rice bran, Puffed cereals from broken rice; Silica from rice husk; Feed for livestock from rice bran.

UNIT IV

10. **By product utilization from dairy industrial waste (4 hours)**
    Fermentation products from whey, Condensed & dried, products from whey; Production of lactose and protein from whey
11. **By product utilization from coffee and tea processing waste (5 hours)**
    Utilization of tea waste as feed for livestock and poultry, production of plastics from coffee grounds, extraction of oil from coffee grounds, coffee ground as organic material.
12. **Composting of food processing wastes (3 hours)**
    Prospects and limitations of Biogas production form food processing industrial waste, Solid state bioconversion,

References

1. Oreopoulou V, Russ W, Utilisation of by-products and treatment of waste in the food industry, Vol, 3., Springer, 2007.
2. Waldron K. Handbook of waste management and co-product recovery in food processing. CRC, 2007.
3. Smith R, Klemes J, Kim JK, Handbook of water and energy management in food processing, CRC, 2008.
4. Yapijakis C,Wang L, Yung Tse- Hung, LO H, Waste treatment in the food processing industry, CRC, 2005.
5. Hanx W. Von Loesecke, Outlines of Food Technology - Agrabios (India) 2nd Ed, 2001

BFTFTC 383 Enzyme Technology

(48 hours)

Course Objectives:

1. To facilitate an overview of enzyme structure, recoveries and derivations of enzyme kinetics and various techniques of enzymes which are applicable in the food industry.
2. To study various aspects of enzymes and utilize them in the food development and its betterment.

Course Outcomes:

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

CO 1. Define and describe enzymes, their properties, enzyme kinetics, factors affecting activity, selection of a suitable recovery method and comprehend derivation of enzyme.

CO 2. Apply various enzyme techniques in the industry and evaluate importance of enzymes along with the application of immobilized enzymes.

CO 3. Use enzymes in diverse fields such as starch hydrolysis, bakery and brewing industry.

CO 4. Utilize enzymes in processing of dairy products, fruit and vegetables and meat.

UNIT I

1. **Enzymes – overview** **(4 hours)**
   Structure and properties of enzymes, Classification and nomenclature of enzymes, Sources of enzymes, Mechanism of enzymes action, Factors effecting enzymes action
2. **Recovery of enzymes** **(4 hours)**
   Strategies of enzyme purification, Selecting suitable homogenization method, Selecting suitable recovery method, Selecting suitable analytical method, Measuring Enzyme activity,
3. **Enzyme kinetics.** **(4 hours)**
   Bioenergetics, Initial velocity, Order of the reaction, Enzyme-substrate complex, Kinetic of enzyme catalysed reaction involving a single substrate, inhibition, Enzyme regulation, Factors responsible for rate enhancement

UNIT II

4. **Significant features of enzymes** **(4 hours)**
   Advantages of biocatalysts over chemical catalysts, Advantages of isolated enzymes and whole cell system, Advantages of free enzymes and immobilized enzymes. Active sites of enzymes, Enzyme specificities
5. **Enzymatic Techniques.** **(4 hours)**
   Basic principles of enzyme assays, Standardization and optimization of enzyme assays, Measurement of enzyme activity-Fixed Incubation or direct method and Kinetic method.
6. **Immobilised enzymes.** **(4 hours)**
   Enzyme immobilization techniques, Design and configuration of immobilized enzyme reactors, Application of immobilized enzyme technology in food industry, Economic arguments for enzyme immobilization

UNIT III

7. **Enzymes in Starch hydrolysis** **(4 hours)**
   Advantages of enzyme hydrolysis over acid hydrolysis, enzymatic saccharification process, different types of enzymes used in the industry, source of enzyme- α-amylase, Saccharifying α-amylase, Glucoamylase, Pullulanase, β-amylase, mechanism of action.
8. **Enzymes in Bakery** **(4 hours)**
   Different types of the enzymes- α-amylase, Xylanase, Cellulase, Oxidase, Protease, Lipase, Pentasanase, role of enzymes in the backing process, conventional methods and enzymatic methods, source of enzyme, mechanism of action
9. **Enzymes in Brewing** **(4 hours)**
   Role, source, mechanism and results of Bacterial amylase, Heat stable α-amylase, Protease, Cellulase, β-Glucanase and Pectinase in brewing and wince making process, conventional methods and enzymatic methods,

UNIT IV

10. **Enzymes in Dairy** **(4 hours)**
    Role of lipase and protease in cheese making, source of lipase and protease, mechanism of action of lipase and protease in cheese making, production of lactose free milk, processing whey
11. **Enzymes in Fruit and vegetables** **(4 hours)**

Source, mechanism and results of use of Catalase, Glucose oxidase, Acid proteases, Glucoamylase, Polygalacturonase, Pectin esterases, Pectin lyase, Hemicellulase, Carbohydrase. Fruit and vegetable processing

12. Enzymes in Meat (4 hours)

Use of enzymes such as Acid protease, Tyrosinases, Glutaminase, Elastase, Papain, Ficin, Bromelain, Transglutaminase, Lipases, in meat processing with their source and benefits

References

1. Nooralabettu KP. Enzyme Technology, Pace Maker of Biotechnology, PHI Learning Private Limited, New Delhi. 2011
2. Baily JE and Ollis K, Biochemical Engineering Fundamentals. MGH, 1990
3. Samuel Cate Prescott, Prescott & Dunn's Industrial Microbiology, A V I Publishing Company, 1987
4. Stanbury PF, Whitaker A, and Hall SJ, and Principles of Fermentation Technology, Butterworth Heinemann, 2003.
5. Cornish-Bowden A, Analysis of Enzyme Kinetic Data, Oxford University Press, Oxford, 1995.
6. Copeland RA, Enzymes: A practical introduction into structure, Mechanism and Data analysis, Wiley-VCH, New York, 1999.

BFTFTC 384 Food Plant Sanitation

(48 hours)

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 (4 hours)

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 hours)

Size Reduction, mixing, separation, extraction, filtration, centrifugation, distillation and, gas absorption equipments

3. Food hygiene and safety during procurement (4 hours)

Food hygiene and safety during then 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 hours)

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 hours)

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 (4 hours)

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 hours)

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 (4 hours)

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

9. Food hygiene and safety in Cold Chain (4 hours)

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

UNIT IV

10. Control measures (4 hours)

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 (4 hours)

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 (4 hours)

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

BFTFTC 385 Bioethics, Biosafety and IPR

(48 hours)

Course Objectives:

1. To facilitate understanding of industrial and societal aspects of food safety, hazards and risk, issues with modern technology, ethical and non-ethical practices in food industry.
2. To enable students to understand international and national regulations regarding the intellectual properties such as trade mark, copyright, patents, etc. and laws that govern intellectual properties and protect their rights

Course Outcomes:

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

CO 1. Demonstrate the acquired knowledge in relevance on science and technology in society, various industrial processes that are not sustainable and the solutions for the same.

CO 2. Apply and expand the knowledge of biomedical ethics to modern day food technology with rational and subjective perspectives of risks and benefits and their assessment

CO 3. Understand the difference between Hazard and risk, different types of risk and risk management in food industries and pply different protocols to the same to help better safety in food industry.

CO 4. Understand national and international guidelines and laws on intellectual property, economic aspects of economic development through intellectual property rights, relevant judiciary laws, patent laws and rights, patent infringement and the consequences, and different international and national bodies which regulate and manage intellectual property.

UNIT I

1. Introduction **(4 hours)**

Relevance of Science, Technology, Society and Environment in science curriculum, technology and social responsibility, public acceptance of modern technology and products.

2. Issues of modern technology **(4 hours)**

Issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs. private funding, technology in international relations, globalization and development divide.

3. Bioethics **(4 hours)**

The principles of bioethics Legality, morality and ethics, autonomy, human rights, beneficence, privacy, justice, equity etc.

UNIT II

4. Bioethics and food biotechnology **(4 hours)**

The expanding scope of ethics from biomedical practice to modern food technology, ethical conflicts in food biotechnology - interference with nature, fear of unknown, unequal distribution of risks and benefits of food biotechnology, bioethics vs. business ethics

5. **Biosafety concepts and issues (4 hours)**
   Biosafety concepts and issues, Rational vs. subjective perceptions of risks and benefits, relationship between risk, hazard, exposure and safeguards, biosafety concerns at the level of individuals, institutions, society, region, country and the world.
6. **Biosafety in the laboratory and process industry (4 hours)**
   Laboratory associated infections, bioprocess industrial hazards, assessment of biological hazards and levels of biosafety, prudent biosafety practices in the laboratory and process industry, Biosafety assessment procedures in India and abroad

UNIT III

7. **Food Biotechnology and food safety (4 hours)**
   The GM-food debate and biosafety assessment procedures for biotech foods & related products, including transgenic food crops, case studies of relevance.
8. **Hazards and risk (4 hours)**
   Difference between hazard and risk, risk management, risk groups, different biosafety levels, protocols, containment
9. **General Principles of International dimensions of IPR (4 hours)**
   Introduction to Intellectual Property, Philosophical Justification of Intellectual Property, Western Theories on Private and IP, Indian Theory on Private Property, International Scenario, Economic Development and IPR Protection

UNIT IV

10. **Law Relating to Patents (4 hours)**
    Introduction to Patents, Patentable subject-Matter, Procedure for Obtaining of Patents, Working of Patents, Infringement –Compulsory License.
11. **Intellectual Property Rights and WTO (4 hours)**
    GATT and WTO, WTO and Economic Development, TRIPs Agreement and Its relation with other International IPR Treaties, TRIPs Agreement TRIPs and Environment.
12. **Biotechnology and IPR (4 hours)**
    Biotechnology and Law, Patenting Biological Invention, Plant Varieties Protection, Food Security, Genetic Engineering and Biotechnology, Biotechnology and International Treaties-UPOV, Convention on Biological Diversity, TRIPs, ITPGRFA

References

1. Thomas JA, Fuch RL, Biotechnology and Safety Assessment, 3rd Ed, Academic Press. 2002
2. Fleming DA, Hunt DL, Biological safety Principles and practices, 3rd Ed, ASM Press, Washington. 2000
3. William H. Lesser and Robert T. Masson, An Economic Analysis of the Plant Variety Protection Act, 1983
4. Carlos M. Correa, Oxford Commentaries on The GATT. WTO Agreements, Oxford University Press. 2007.
5. Alfredo Ilardi and Michael Blakeney (Ed.), International Encyclopedia of Intellectual Property Treaties (2004), Oxford University Press.

BFTFTC 386 Food Certification

(48 hours)

Course Objectives:

1. To facilitate the understanding of food quality certification, food laws in India and the world, HACCP systems followed in the food industry.
2. To familiarise the students with quality certificate systems, work behaviours in the company, ethics intellectual property rights, Indian Patent Act etc.

Course Outcomes:

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

CO 1. Demonstrate the acquired knowledge in food certification, Indian food laws, Food Safety standards in India, USFDA, EPA and their relevance to the food industry

CO 2. Apply the knowledge of HACCP, the seven point HACCP system and the appropriate industrial mechanisms to train personnel in the implementation of HACCP

CO 3. Differentiate between various quality certification systems / ISOs and the role of leadership and employee in quality council

CO 4. Internalize national and international guidelines and laws on ethical business practices including IPR, Indian Patent Act, TRIPS, geographical indicators and industrial design

UNIT I

1. Introduction **(12 hours)**

Introduction to food quality certification – Definition of quality, quality concepts, quality perception, quality attributes. Indian Food Laws – Voluntary and mandatory, Food Safety and and Standards Act India 2006; Prevention of Food Adulteration Act, India, 1954. Roles of USFDA, USDA and EPA. Responsibilities of the Food service operator, consumer protection, food audit.

UNIT II

2. Hazard Analysis Critical Control Points (HACCP) **(12 hours)**

Definition; Purpose; origins of HACCP; Developing the HACCP plan; Preliminary steps – The five-step process – HACCP team assembly, Defining the product and its usage; Constructing the flow diagrams; On-Site confirmation of flow diagram, etc. the seven-point HACCP system. Top-Management Commitment and involvement; Training of personnel; Implementation and integrating HACCP system with ISO, TQM etc.

UNIT III

3. Quality Certificate Systems **(12 hours)**

Need for ISO 9000 – ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing – QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Quality Council – Leadership, Employee involvement, Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

UNIT IV

4. Ethics and Intellectual Property Rights **(12 hours)**

The importance and the needs of ethics: Ethical business practices; Laws and ethics; Environmental protection; Creating awareness and safeguarding health of consumers. History and evaluation of IPR; Copyrights and related rights. Distinction among various forms of

IPR. Patent rights/protection and procedure; Infringement or violation; Remedies against infringement; Indian Patent act 1979 and TRIPS; Geographical indication and Industrial design Introduction to Patents, Patentable subject-Matter, Procedure for Obtaining of Patents, Working of Patents, Infringement.

References

1. Food Safety and Standards Authority of India portal, Government of India
2. Blackburn CDW and Mc Clure PJ. Food borne pathogens. Hazards, risk analysis and control, CRC Press, Washington, USA, 2005
3. Besterfield DH et al., Total Quality Management, 4th Edition, Pearson Education Asia, 2006
4. Evans JR and Lindsay WM, The Management and Control of Quality, 6th Edition, South-Western (Thomson Learning), 2005.
5. Fortin ND, Food Regulation: Law, Science, Policy and Practice, John Wiley, 2009
6. Santaniello V, Evenson RE, Zilberman D, Carlson GA (Ed.) Agriculture and Intellectual Property Rights, University Press, 1998
7. Chakraborty SK, Values and Ethics in Organization, Oxford University Press.
8. Intellectual property rights in Agricultural Biotechnology, Edited by Erbisch, Maredia, CABI

BFTFTP 387 Nutraceuticals, Functional Foods, Food Waste Utilization (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.
10. Proteolytic activity of gut waste of fish.
11. Isolation of pectin from citrus fruit peel.
12. Isolation of chitin from shrimp shells.

BFTFTP 388 Enzyme 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

1. Assay of alpha amylase in the germinating barley.
2. Assay of proteolytic activity in the papaya fruit.
3. Assay of lysine activity in egg.
4. Assay of alkaline phosphatase in the hepatopancreas of shrimps
5. Design and layout of various food processing systems and food service areas.
6. Effect of pH on enzyme activity.
7. Effect of temperature on enzyme activity.
8. Effect of inhibitors on enzyme activity.
9. Determining K_m value and V_{max} value of an enzyme.
10. Tenderization of meat using protease.
11. Preparation of a sanitation schedule for food preparation area.
12. Study of Phenol coefficient of sanitizers.

BFTFTP 389 Project Work

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 food technology as profession

Model Question Paper (Theory – Group I Courses)

CBCS 1 semester B.Sc. (Food Technology) Degree
Examination Month & Year
COURSE CODE AND TITLE

Time: 3 Hours Max. Marks: 80

PART – A

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

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

(4+4+7=15)

OR

7.
a)
b)
c)

(4+4+7=15)

UNIT – 4

8.
a)
b)
c)

(3+5+7=15)

OR

9.
a)
b)
c)

(4+4+7=15)

****

Model Question Paper (Theory – Group II Courses)

CBCS 1 semester B.Sc. (Food Technology) Degree
Examination Month & Year
COURSE CODE AND TITLE

Time: 1½ Hours 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

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