

**CENTRAL UNIVERSITY OF PUNJAB, BATHINDA**



**M. Sc. Food Science and Technology**

**Session 2018-20 Onwards**

**Department of Applied Agriculture  
School of Basic and Applied Sciences**

**Course structure and Syllabus**  
**M.Sc. Food Science and Technology (Session 2018-20 onwards)**

<b>Semester-I</b>						
<b>Course code</b>	<b>Course Title</b>	<b>Hours</b>			<b>Credits</b>	
		L	T	P		
CST.501	Computer Applications	2	-	-	2	
CST.502	Computer Applications (Practical)	-	-	4	2	
FST.506	Food Chemistry and Microbiology	4	-	-	4	
FST.507	Food Packaging	4	-	-	4	
FST.508	Lab-Food Chemistry and Microbiology (Practical)	-	-	4	2	
FST.509	Lab- Food Packaging (Practical)	-	-	2	1	
FST.510/ FST.511	Food Biotechnology/ Nutrition, Nutraceutical and Functional Foods	4	-	-	4	
IDC	Interdisciplinary Course	2	-	-	2	
<b>Total</b>		<b>16</b>	<b>-</b>	<b>8</b>	<b>20</b>	
<b>Semester-II</b>						
VAC	Value Added Course	1	-	-	1	
FST.521	Food Processing and Preservation	4	-	-	4	
FST.522	Processing of Cereals, Pulses and Oilseeds	4	-	-	4	
FST.523	Food Engineering and Unit Operations	4	-	-	4	
FST.524	Processing of Fruits and Vegetables	4	-	-	4	
FST.525	Lab-Cereals, Pulses and Oilseeds (Practical)	-	-	2	1	
FST.526	Lab-Food Engineering (Practical)	-	-	2	1	
FST.527	Lab-Fruits and Vegetable Processing (Practical)	-	-	2	1	
FST.528/ FST.529	Fermented Foods / Beverage Technology	4	-	-	4	
IDC	Interdisciplinary course	2	-	-	2	
<b>Total</b>		<b>23</b>	<b>-</b>	<b>6</b>	<b>26</b>	
<b>Semester-III</b>						
VAC	EF	Value Added Course-II	1	-	-	1
STA-503	CF	Basic Statistics for Sciences	2	-	-	2
FST.551	C	Processing of Milk and Milk Products	4	-	-	4
FST.552	C	Application of Enzymes in Food Processing	4	-	-	4
FST.553	C	Lab-Milk and Milk Processing (Practical)	-	-	4	2
FST.543	SBE	Seminar-I	-	-	-	1
FST.599	SBE	Project	-	-	12	6
<b>Total</b>			<b>12</b>	<b>-</b>	<b>16</b>	<b>20</b>

<b>Semester-IV</b>						
FST.571	C	Food Safety, Regulation and Policy	4	-	-	4
FST.572	C	Poultry, Meat and Fish Processing	4	-	-	4
FST.573	C	Technology of Spices, Sugar and Chocolate	4	-	-	4
FST.574	C	Lab-Food Quality (Practical)	-	-	2	1
FST.575	DEC	Advances in Food Processing	-	2	-	2
FST.576	DEC	Analytical Techniques - Principles and Application	-	-	4	2
FST.544	SBE	Seminar-II	1	-	-	1
FST.599	SBE	Project	-	-	12	6
<b>Total</b>			<b>13</b>	<b>2</b>	<b>18</b>	<b>24</b>
<b>Total Credits = 20 + 26 + 20 + 24 = 90</b>						

C = Core; CF = Compulsory Foundation; DE = Discipline Elective; IDC = Interdisciplinary; EF = Elective Foundation/ Value Added; SBE = Skill-Based Elective; DEC = Discipline Enrichment Course

**In addition, students are required to pass two Massive Open Online Courses (MOOCs) of minimum 2 credits as mandatory Elective Foundation Courses during the programme preferably in I and III semesters.**

**Interdisciplinary courses (IDC) to be offered to the students of other Departments**

S. N.	Course Code	Course Title	Semester of the academic year the course is to be offered	Hours			Credits
				L	T	P	
1.	FST.512	Food Regulation, Quality and Safety Assessment	1 <sup>st</sup>	2	-	-	2
2	FST.529	Introduction to Nutrition and Specialty Foods	2 <sup>nd</sup>	2	-	-	2

**Course Name: Computer Applications**

**Course Code: CST.501**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
2	-	2	3

**Objective/Learning Outcome:**

1. Upon successful completion of this course, the student will be able to:
2. Use different operating system and their tools easily.
3. Use word processing software, presentation software, spreadsheet software and latex.
4. Understand networking and internet concepts.
5. Use computers in every field like teaching, industry and research.

**Course Contents:**

**Unit-I**

**(6 hours)**

**Computer Fundamentals:** Introduction to Computer, Input devices, Output Devices, Memory (Primary and Secondary), Concept of Hardware and Software, C.P.U., System bus, Motherboard, Ports and Interfaces, Expansion Cards, Ribbon Cables, Memory Chips, Processors, Software: Types of Software, Operating System, User Interface of popular Operating System, Introduction to programming language, Types of Computer.

**Unit-II**

**(10 hours)**

**Computer Network:** Introduction to Computer Network, Types of Network: LAN, WAN and MAN, Topologies of Network, Internet concept, WWW.

**Word Processing using MS Word:** Text creation and Manipulation; Table handling; Spell check, Hyper-linking, Creating Table of Contents and table of figures, Creating and tracking comments, language setting and thesaurus, Header and Footer, Mail Merge, Different views, Creating equations, Page setting, Printing, Shortcut keys.

**Unit-III**

**(10 hours)**

**Presentation Tool:** Creating Presentations, Presentation views, Working on Slide Transition, Making Notes Pages and Handouts, Drawing and Working with Objects, Using Animations, Running and Controlling a Slide Show, Printing Presentations, Shortcut keys.

**Spread Sheet:** Entering and editing data in cell, Basic formulas and functions, deleting or inserting cells, deleting or inserting rows and columns, printing of Spread Sheet, Shortcut keys.

**Unit-IV****(4 hours)**

**Use of Computers in Education and Research:** Data analysis tools, e-Library, Search engines related to research, Research paper editing tools like Latex.

**Readings**

- Goel, A., Ray, S. K. 2012. Computers: Basics and Applications. Pearson Education India.
- Microsoft Office Professional 2013 Step by Step  
<https://ptgmedia.pearsoncmg.com/images/9780735669413/samplepages/9780735669413.pdf>
- Sinha, P.K. Computer Fundamentals. BPB Publications.

IQAC

**Course Code: FST.506**

**Course Title: Food Chemistry and Microbiology**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
4	-	-	4

**Objective**

*To provide an understanding of structure, reactions and functional properties of different food components*

*To provide an understanding of significance of microorganisms with respect to food processing and safety*

16  
hours

**Unit I**

Water in foods: Function; Types; Relevance to deteriorative processes in foods; Methods for measurement of total and available water in foods

Mono, Oligo and Polysaccharides; Occurrence; Properties and applications of important polysaccharides e.g. starch, cellulose, guar gum, xanthan gum, pectin, etc.; Starch digestibility and Glycaemic Index; MCC, CMC, MC and HPMC

Proteins: Classification; Physicochemical properties of proteins; Protein structure; Forces involved in stability of protein structure; Denaturation; Functional properties; Methods of protein analysis; Nutritional properties; Chemical and biological methods for evaluation of protein quality; Processing induced changes

**Unit II**

14  
hours

Lipids: Classification; Physicochemical properties of lipids; Functions of lipids in foods; Rancidity and flavour reversion; Measurement of lipid oxidation; Role of fats in body; Health problems associated with fats; Trans fats; Recommendations for fat intake; Fat replacement strategies.

Vitamins: Sources, requirements and functions of different vitamins.

Minerals: General functions of minerals; Specific functions and requirements of Ca, P, Mg, Fe, Cu, Zn and Se; Plant pigments-effect of processing

**Unit III**

16  
hours

Historical development in Food Microbiology; Microorganisms important in Food Microbiology; Intrinsic and extrinsic factors affecting the growth of microorganisms in foods; Sources of microorganisms in foods their prevention and control; Pasteurization and sterilization methods for food and media; Chemical/Biochemical changes caused by microorganisms in foods.

Microbial spoilage, prevention and control of milk and milk products, cereals and cereal products; meat and meat products, fish and fish products, poultry and eggs, sugars, salt and canned foods; Indicators of microbial food spoilage

**Unit  
IV**

14  
hours

Food borne illnesses: Food poisoning Vs. intoxications; Bacterial food born pathogen and toxins in foods; Non-bacterial food infection and intoxication; Mycotoxins; Control and prevention of food born diseases; Food sanitation and public health; Good laboratory practices (GLP); Good housekeeping practices (GHP); Good Manufacturing practices (GMP) and their roles in production of quality and safe food

**Suggested readings**

- Adams MR et al. (2016). *Food Microbiology*. RSC.
- Chakraborty MM (2003). *Chemistry and Technology of Oils and Fats*. Prentice Hall.
- Cheung P (2015). *Handbook of Food Chemistry*. Springer Science.
- Chopra HK and Penesor PS (2010). *Food Chemistry*. Narosa Publication.
- Cooper G et al. (2017) *Food Microbiology*.
- Damodaran S (2008). *Fennema's Food Chemistry*. CRC Press.
- Doyle MP and Buchanan RL (2007). *Food Microbiology: Fundamentals and Frontiers*. ASM Press.
- Foster WM (2016) *Food Microbiology*. CBS Publishers.
- Frazier WC et al. (2015). *Food Microbiology*. Mcgraw-Hill.
- Garg N. (2013). *Laboratory Manual of Food Microbiology*. I.K. International Publishing House.
- Hettiarachchy (2012). *Food Proteins and Peptides*. CRC Press.
- Jay JM (2005). *Modern Food Microbiology*. Golden Food Science Text Series.
- Khetrappaul N (2016). *Food Microbiology*. Daya Publishing House
- Kumari S (2012). *Basics of Food Biochemistry and Microbiology*. Koros Press.
- *Manuals* published by Food Safety and Standard Authority, GOI.
- Montville TJ et al. (2012). *Food Microbiology: An Introduction*. ASM Press.
- Msagati TAM (2013). *Chemistry of Food Additives and Preservatives*. John Wiley and Sons.
- Owusu K et al. (2015). *Introduction to Food Chemistry*. CRC Press.
- Pelczar MJ and Michael J (1999). *Microbiology*. McGraw-Hill.
- Ray B (2014). *Fundamental Food Microbiology*. CRC Press.
- Sohler D. (2016). *Food and Industrial Microbiology*. Intelliz Press.
- Ustunol Z (2015). *Applied Food Protein Chemistry*. John Wiley and Sons.
- Velisek J et al. (2014). *The Chemistry of Food*. Wiley Blackwell.

**Course Code: FST.507**  
**Course Title: Food Packaging**

L	T	P	Cr
4	-	-	4

### **Objective**

*This course aims to provide an understanding of different packaging materials and their use in food industry. The students will learn about the packaging requirements of different foods.*

#### **Unit I**

**14  
hours**

Definition; Package environment; Functions of packaging; Importance and scope of packaging; Classification of packages; Labelling laws  
Glass as packaging material: Composition; Physical properties of glass; Advantages and disadvantages of glass packaging materials; Types of glass containers; Parts of glass container; Manufacture, annealing and surface treatments

#### **Unit II**

**16  
hours**

Metal packaging materials: Tin plate; Chromium coated steel; Aluminium containers and foil; Corrosion of metal containers; Corrosiveness of foods; Effect of processing on corrosion of cans; External corrosion of cans  
Paper and paper-based packaging materials: Manufacture (pulping, digestion, bleaching, beating, refining, paper making and converting); Types of paper; Physical properties of papers; Paper bags; Cartons; CFB boxes, Advantages and disadvantages of paper and paper-based packaging materials  
Plastic and plastic-based packaging materials: Classification of polymers; Properties and application of different plastics; Laminates: Types and properties. Coating on paper and films; Types and methods of coating

#### **Unit III**

**15  
hours**

Aseptic packaging: Definition; Reasons of aseptic packaging; Sterilization of packages and food contact surfaces; System of aseptic packaging  
Packaging of microwavable foods; Retortable pouch technology  
Mechanical and functional tests on packages: Measurement of thickness, weight, water absorption, bursting strength, tear resistance, puncture resistance, OTR, WVTR and tensile strength of packaging materials. Measurement of grease resistance of paper.



#### **Unit IV**

Packaging of specific foods: Fruits and vegetables; Dairy products; Cereal products; Snacks; Whole eggs; Meat and meat products; Water; Fruit juices; Beer; Wine; Carbonated beverages

**15  
hours**

Novel Packaging (antimicrobial food packaging, non-migratory bioactive polymers, active and intelligent packaging).

#### ***Suggested readings***

- Brody A (2017). *Active Packaging for Food Applications*. CRC Press.
- Cha DS & Chinnan M S (2004). *Biopolymer-based antimicrobial packaging: a review. Critical reviews in food science and nutrition, 44, 223-237.*
- Han JH (2014). *Innovations in Food Packaging*. Academic Press.
- *Handbook of Frozen Food Processing and Packaging* Oxford Book Company (2018).
- Kadoya T. (2014). *Food Packaging*. Academic Press.
- Lee DS and Yam KL (2008). *Food Packaging Science and Technology* by. CRC Press Taylor & Francis.
- Omre PK (2016). *Food packaging systems*. Biotech Books.
- Robertson GL (2005). *Food Packaging Principles and Practice*. CRC Press.
- Sanches-Silva A, Costa D, Albuquerque TG et al. (2014). *Trends in the use of natural antioxidants in active food packaging: a review. Food Additives & Contaminants: Part A, 31, 374-395.*
- Yam KL and Lee DS (2015). *Emerging Food Packaging Technologies: Principles and Practice*. Woodhead Publishing.

**Course Code: FST.508**

**Course Title: Lab-Food Chemistry and Microbiology**

L	T	P	Cr
-	-	4	2

**S.N. Practical**

1. Determination of moisture content of foods using different methods.
2. Determination of total, soluble and insoluble ash content of different foods.
3. Determination of chlorophyll content.
4. Determination of crude proteins using Kjeldhal method.
5. Determination of crude fat content of different foods.
6. Determination of acid value and saponification value of fat/oil.
7. Determination of ascorbic acid content using dye method.
8. Determination of sugar content.
9. Determination of total phenolic content and antioxidant activities of plant foods.
10. Determination of oil stability by using rancimat.
11. Study methods for eliminating enzymatic browning of fruits and vegetables
12. To study staining techniques
13. Media preparation
14. Total Plate count
15. Dye reduction tests
16. Microbial examination of water-potable and water used in food industry, cereal products, fruits and vegetables, canned foods and milk and milk products.

*Lab practical may be added/modified depending on the availability of materials and facilities as well as latest advancements.*

**Evaluation criteria:** The course shall be evaluated on the basis of attendance (10% weightage), lab record (20% weightage), oral viva-voce (20% weightage) and written and practical performance in end semester examination (20% and 30% weightage, respectively).

**Course Code: FST.509**

**Course Title: Lab-Food Packaging**

L	T	P	Cr
-	-	2	1

**S. N. Practical**

1. Identification of different types of packaging material.
2. Spotting-Packaging symbols.
3. Determination of WVTR in different packaging materials.
4. Determination of Grammage weight of paper.
5. Determination of uniformity and amount of wax coating.
6. Determination of grease resistance of packaging material.
7. Determination of water absorption of paperboard and CFB.
8. To conduct drop test of different packaging material.
9. Determination of tin coating weight and porosity.

*Lab practical may be added/modified depending on the availability of materials and facilities as well as latest advancements.*

**Evaluation criteria:** The course shall be evaluated on the basis of attendance (10% weightage), lab record (20% weightage), oral viva-voce (20% weightage) and written and practical performance in end semester examination (20% and 30% weightage, respectively).

IQAC

**Course Code: FST.510**

**Course Title: Food Biotechnology**

L	T	P	Cr
4	-	-	4

**Objective**

*The objective of this course is to acquaint the students with the fundamentals and application of biotechnology in relation to raw materials for food processing, nutrition and food fermentation.*

**Unit I**

Overview of biotechnology; Present scenario and future prospects of food biotechnology; Applications of biotechnology in the food industry; Biotechnology and food safety 15 hours

**Unit II**

Fermenter design; Parts of fermenter and their functions; Types of fermentation processes, aeration and agitation 15 hours  
Media for industrial fermentation; Downstream processing (centrifugation, filtration, precipitation, extraction, drying, cell disruption); Membrane technology and its application in fermentation industry

**Unit III**

Biotechnology in the production of bio-colours, flavours, vitamins, bio-preservatives, antibiotics and industrial alcohol 15 hours  
Single cell proteins: Definition; Advantages; Nutritional value; Microorganisms used as SCP; Production of SCP; Fungi and algae as food  
Probiotics and prebiotics: Definition; Composition; Health effects; Safety consideration; Future trends

**Unit IV**

Genetically modified foods: Definitions; Advantages; Indian and global market and value; Effect on environment, farming structure, biodiversity and soil ecosystem; Safety; Future prospects. Golden rice: Need, history and production. 15 hours

**Suggested readings**

- K Shetty, *Functional Foods and Biotechnology*. CRC Press Taylor & Francis (2015).
- KL Benson, *Industrial Microbiology*. CBS Publishers (2016).
- PS Panesar and SS Marwaha, *Biotechnology in Agriculture and Food Processing*. CRC Press (2013).
- S Skariyachan et al., *Introduction to Food Biotechnology*. CBS Publisher (2012).
- SS Kariyachan, *Food Biotechnology*. CBS Publisher (2012).
- SS Marwaha and JK Arora, *Biotech Strategies in Agro processing*. Asiatech (2003).

- VK Gupta et al. *Biotechnology of Bioactive Compounds*. Wiley-Blackwell (2015).
- VK Joshi and RS Singh, *Food Biotechnology: Principles and Practices*. IK International Publishing House (2012)
- W Clarke, *Biotechnology of Industrial Microbiology*. CBS Publishers (2016).
- YH Hui, *Food Biotechnology*. Wiley-Blackwell (2014).
- O Paredes-López et al. Food biotechnology review: Traditional solid-state fermentations of plant raw materials—application, nutritional significance, and future prospects. *Critical Reviews in Food Science & Nutrition*, 1988, 27, 159-187.

IQAC

**Course Code: FST.511**

**Course Title: Nutrition, Nutraceuticals and Functional Foods**

L	T	P	Cr
4	-	-	4

**Objective**

*This paper aims to acquaint the newly emerging area of nutraceuticals with respect to the types, mechanisms of action, manufacture of selected nutraceuticals and product development aspects.*

**Unit I**

Definitions (food, diet, nutrients, nutrition, adequate/good nutrition, nutritional status, malnutrition, nutritional care, health, nutraceuticals, functional foods and dietary supplements); Functions of food; Food types and groups; Concept of balanced diet

**15  
hours**

Nutritional requirements during life cycle: Nutritional requirements and RDA for infants, school children, adolescents, pregnant and lactating mother and elderly people; Alcoholism and nutrition: Nutritional problem among alcoholics; Health problems from alcohol abuse; Benefits of moderate alcohol use.

**Unit II**

Classification of nutraceuticals; Reasons for taking supplements; Sources and health benefits of nutraceuticals like phytosterols, polyphenols, phyto-oestrogens, lycopene, dietary fibre, non-digestible oligosaccharides, etc.; Probiotics and prebiotics (Definitions, Characteristics, Possible probiotics and prebiotics, health benefits); Omega-3 fatty acids and oils (Sources; Applications; Health benefits); Conjugated linoleic acids (biological actions and health benefits); Chitin and chitosan (Production and application of bioactive chitosan oligosaccharides as nutraceuticals); Glucosamine (Production and Health Benefits); Bioactive peptides (examples, productions and functions)

**15  
hours**

**Unit III**

Processing technologies for functional food bioactive components and nutraceutical products; Application of supercritical fluid and membrane technology in the production of nutraceuticals; Impact of processing on the bioactivity of functional and nutraceutical ingredients in foods

**15  
hours**

Incorporation of nutraceutical ingredients in baked foods; Regulation of nutraceuticals and functional foods; Food label claim guidelines and marketing issues for nutraceuticals and functional foods and product positioning.

**Unit IV**

Nutraceuticals in disease prevention; prevalence and risk factors for coronary heart diseases, Diet and coronary heart diseases relationship, probiotics, prebiotics and omega 3 fatty acids for prevention of coronary heart diseases; Prevalence and causes of obesity; measurement of obesity (body mass index), dietary and

**15  
hours**

non-dietary approaches for treatment of severe obesity (VLCD and Gastroplasty); Foods and cancers: anti-tumour action of phytochemicals, antioxidants and dietary fibres

### **Suggested readings**

- C Galanakis, *Nutraceutical and Functional Food Components: Effects of Innovative Processing Techniques*. Academic Press (2017).
- EC Robert, *Handbook of Nutraceuticals and Functional Foods*. CRC Press (2006).
- G Subbulakshmi, *Functional Foods and Nutrition*, Daya Publishing House (2014).
- GR Gibson and CM Williams, *Functional Foods: Concept to Product*. Woodhead Publishing (2000).
- H Dominguez *Functional Ingredients from Algae for Foods and Nutraceuticals*. Woodhead Publishing (2013).
- J Boye, *Nutraceutical and Functional Food Processing Technology*. Wiley Blackwell (2015).
- J Gilbert, *Bioactive Compounds in Foods*. Wiley India (2014).
- J Shi, *Functional Food Ingredients and Nutraceuticals: Processing Technologies*. CRC Press (2006).
- M Saarela, *Functional Foods: Concept to Product*. Woodhead Publishing (2014).
- M. Swaminathan, *Essentials of Food and Nutrition*, Volumes 1-2. Ganesh Publisher (1974).
- NN Potter, *Food Science*. CBS Publishers (2007).
- RR Watson, *Fruits Vegetables and Herbs: Bioactive Foods in Health Promotion*. Academic Press, (2016).
- S Riar et al., *Functional Foods and Nutraceuticals: Sources and Their Developmental Techniques*. New India publishing agency (2015).
- Subbulakshmi S and Subhadra M, *Nutrition in Traditional Therapeutic Foods*. Daya Publishing House (2015).
- V Vaclavik and CW Elizabeth, *Essentials of Food Science*. Springer (2014).
- Y Zhao, *Specialty Foods: Processing Technology, Quality and Safety*. CRC Press (2012).

**Course Code: FST.521**

**Course Title: Food Processing and Preservation**

L	T	P	Cr
4	-	-	4

**Objective**

*This course is designed to integrate the knowledge and provide an understanding of scientific aspects of conventional and innovative techniques used in processing and preservation of foods*

**Unit I**

Scope of food processing; Principles of food processing and preservation; Water activity and its relation with the chemical and microbial spoilage of foods; Causes of food deterioration 16 hours

Processing and preservation by heat: Heat resistance of microorganisms; Protective effect of food constituents; Blanching; Pasteurization; Sterilization and UHT processing; Ohmic heating; Microwave heating, etc.

**Unit II**

Processing and preservation by low temperature: Refrigeration; Freezing; Differences between refrigeration and freezing; Freezing curve; Factors affecting freezing rate; Freezing methods and equipment; Changes in foods during refrigeration and frozen storage 15 hours

Processing and preservation by drying and dehydration: Drying curve; Drying methods and equipment; Changes in food due to drying; Intermediate moisture foods (IMF)

**Unit III**

Novel/emerging technologies for food preservation: High pressure processing; Pulsed electric field; Hurdle technology; Nanotechnology; Ozone application; Technologies for sous-vide ready meals 14 hours

Application of membrane technology in food processing: RO, NF, UF, MF and Electrodialysis; Membrane materials; Configuration and modules

**Unit IV**

Concentration: Applications/purposes; Concentration methods and equipment; Changes in Food during concentration 15 hours

Irradiation in food preservation: Source; Direct and indirect effects responsible for death/inactivation of microorganisms; Dose determination; Effect on foods

**Suggested readings**

- AK Haghi, *Food Science: Research and Technology*. Academic Press (2011).
- D Singh, *Food Processing and Preservation*. Shree Publisher (2015).
- G Saravakos and AK Kostaropoulos, *Handbook of Food Process Equipment*. Springer (2016).
- GV Barbosa-canovas and GW Gould, *Innovation in Food Processing*. CRC Press (2017).



- H W Xiao et al., Recent developments and trends in thermal blanching - A comprehensive review. *Information Processing in Agriculture*. Volume 4, 2017, 101-127
- HS Ramaswamy and M Marcotte, *Food Processing Principle and Application*. Taylor and Francis (2006).
- JS Smith and YH Hui, *Food Processing*. Wiley (2014).
- K Kai, *Innovative Food Processing Technologies*. WP Publisher (2016).
- M Regier, *The Microwave Processing of Foods*. Academic Press, (2017).
- MC Knirsch et al., Ohmic heating—a review. *Trends in Food Science & Technology*, 21, 2010, 436-441.
- NN Potter, *Food Science*. CBS Publishers (2007).
- P Fellows, *Food Processing Technology Principles and Practice*. CRC Press (2005).
- RL Shewfelt, *Introducing Food Science*. CRC (2013).
- T Varzakas and C Tzia, *Handbook of Food Processing*. CRC Press (2016).

IQAC

**Course Code: FST.522**

**Course Title: Processing of Cereals, legumes and Oilseeds**

L	T	P	Cr
4	-	-	4

**Objective**

*The objective of this course is to gain an understanding and acquaint with the structure, composition, quality evaluation, processing and value addition of various cereals, legumes and oilseeds*

**Unit I**

Production, composition, structure and usage of major cereals like wheat, rice, maize, barley and oats. 16 hours

Wheat: Classification; Cleaning; Conditioning; Milling; Air fractionation of flours; Flour treatment; Quality tests for analysis of flour: physicochemical and rheological tests (farinograph, mixograph, extensiograph, alveograph, pasting profile, etc.) for wheat flour analysis; Yeast fermentation tests (fermentograph, rheofermentometer, maturograph, etc); Bakery ingredients and their roles in bakery products; Manufacturing and evaluation of bakery products; Biochemical changes during bread making; Durum wheat processing(milling and manufacturing of pasta products); Production of wheat starch and vital wheat gluten; Manufacturing of chapatti.

**Unit II**

Rice: Rice quality and grading; Aging - Changes during aging, methods for accelerated aging; Milling; Parboiling - Methods, changes during parboiling, advantages and disadvantages; Technology of quick cooking rice and sake; Stabilization of rice bran. 14 hours

Maize: Dry and wet milling; Processing of by-products from dry and wet milling; Production of starch-based syrups and sweeteners (HFCS, Dextrose, high maltose syrups, maltodextrins, etc.); Alkaline cooked products; Processing of maize germ oil and flakes.

Oats: Composition and processing of rolled oats; Health benefits of oats and beta glucan.

**Unit III**

Legumes/pulses: Legumes *vs.* pulses; Production, structure, constituents and classification of pulses; Anti-nutritional factors in legumes and methods of elimination; Milling; Technology of legume/pulse flours, proteins (concentrates and isolates) and starches; Cooking properties of pulses and Hard-to-cook defect; Technology of soy milk, tofu, proteins (soy flour, concentrates and isolates) and TVP; Application of soy proteins. 16 hours

## Unit IV

Oilseeds: Production and trade of oils and oilseeds; Components of vegetable oils; Oilseed processing: drying, storage, cleaning, grading, dehulling, flaking, heat treatment/ extrusion, oil extraction (mechanical and solvent extraction); Physical and chemical refining of crude vegetable oils; Modification of vegetable oils (hydrogenation, winterization/fractionation and interesterification); Utilization of de-oiled cake/meal; Tests for evaluation of oils and fats (melting point, smoke point, saponification value, acid value, iodine value, acetyl value, Reichart-Meissl number, tests for stability of oils and fats, etc.); Non-food uses of oils and fats

14  
hours

### **Suggested readings**

- A Chakraverty and RP Singh, *Postharvest Technology and Food Process Engineering*. CRC Press (2014)
- A Chakraverty et al. *Handbook of Postharvest Technology*. Marcel Dekker (2003).
- B Richards, *Oils Fats and Fatty Foods*. Biotech Books (2014).
- BK Tiwari and N Singh, *Pulse Chemistry and Technology*. RSC (2012).
- BK Tiwari et al., *Pulse Foods*. Wiley Publication (2011).
- BK Tiwari, *Pulse Foods: Processing Quality and Nutraceutical Applications*. Academic Press (2014).
- BO Juliano, *Rice: Chemistry and Technology*. AACC (1985).
- Bolton, Richards ER, *Oils, Fats and Fatty Foods: Their Practical Examination*. Biotech Books (2014).
- CW Wrigley, *Cereal Grains: Assessing and Managing Quality*. Woodhead Publishing (2015).
- K Liu, *Soybeans: Chemistry, Technology, and Utilization*. Springer (1997).
- KK Rajah, *Fats in Food Technology*. John Wiley & Sons (2014).
- MM Chakrabarty, *Chemistry and Technology of Oils and Fats*. Allied Publishers (2012).
- N Khetarpal et al., *Fats and Oils in Health and Nutrition*. Astral Publishing House (2014).
- NL Kent, *Technology of Cereals*. Pergamon Press (1984).
- PS Belton, *Physical chemistry of Foods*. (2005).
- SA Watsan and PE Ramsat, *Corn: Chemistry and Technology*, AACC (1987).
- Y Pomeranz, *Wheat: Chemistry and Technology*. AACC (1990).

**Course Code: FST.523**

**Course Title: Food Engineering and Unit Operations**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
4	-	-	4

### **Objective**

*The main objective of this course is to make students familiar with engineering aspects of food processing and acquaint them with recent advances of food engineering and unit operations*

### **Unit I**

Engineering properties of foods and their applications in food processing 14 hours  
Material and energy balance: Basic principles, total mass balance and component mass balance. Material balance calculations involved in dilution, concentration and dehydration. Heat balance calculations  
Fluid flow: Nature and classification of fluids; Newtonian and Non-Newtonian fluids, streamline and turbulent flow; Viscosity and its measurement; Flow measurement devices (Pitot tube, Orifice meter, Venturimeter). Pressure and its measurement (Simple and Differential manometers)  
Raw material preparation: Cleaning; Sorting; Grading; Peeling

### **Unit II**

Size reduction: Size reduction in food processing; Forces applied for size reduction; Equipment. Mixing: Theory; Mixers for liquids of low or moderate viscosity (Paddle agitators, turbine agitators and propeller agitators); Mixers for high viscosity pastes (Pan Mixer, horizontal mixer and dough mixer); Mixers for dry solids (tumbler mixer and vertical screw mixer). Screening: Definitions; Types of screens; Factors affecting screening. 16 hours  
Filtration and centrifugation: Filtration theory; Types of filtration (pressure filtration, vacuum filtration and centrifugal filtration); Filtration methods (bed filters, plate and frame filters, leaf filters, continuous rotary filters); Centrifuge equipment (Liquid-liquid centrifuges, centrifugal clarifiers, desludging and dewatering centrifuges).

### **Unit III**

Heat transfer in food processing: Thermal properties of foods; Modes of heat transfer; Systems for heating and cooling (steam injection and steam infusion, tubular, scrapped surface, plate heat, shell and tube heat exchangers). 14 hours  
Refrigeration and freezing: Refrigeration system and its components; Refrigeration cycle and refrigeration load; Freezing curve; Food Freezing systems (Indirect and direct contact freezers e.g. Plate freezers, Air blast freezers, and immersion freezing); Freezing time calculation.

### **Unit IV**

Evaporation and dehydration: Parts of an evaporator; Types of evaporators (Batch type pan evaporator, Natural circulation evaporator, Rising film evaporator, Falling film evaporator, Rising/Falling film evaporator, Forced circulation type evaporator, Agitated thin film evaporator). Vapour recompression systems; Free moisture content; Bound moisture content; Critical moisture content; Equilibrium moisture content; Constant and falling rate drying period; Types of dryers (tray drier, tunnel drier, roller or drum drier, fluidized bed drier, spray drier, pneumatic drier, rotary drier, trough drier, bin drier, vacuum drier and freeze drier).  
Distillation: Classification of distillation; Equilibrium or Flash distillation; Simple batch or Differential distillation; Simple steam distillation; Distillation with reflux  
Leaching: Rates of leaching; Leaching equipment (fixed bed leaching, moving bed leaching, agitated solid leaching). 16 hours

### **Suggested readings**

- A Chakraverty and RP Singh, *Postharvest Technology and Food Process Engineering*. CRC Press (2014)
- DR Heldman and DB Lund, *Handbook of Food Engineering*. CRC (2017).
- G Saravakos and AK Kostaropoulos, *Hand Book of Food Process Equipment*. Springer (2002).
- J Brennan, *Food Processing Handbook*. Wiley (2006)
- K Marwaha, *Food Process Engineering: Theory and Laboratory Experiments*. Genetech Books (2015).
- L Mathur, *Food Science Engineering and Technology*. SBS Publisher (2016).
- LJ Callisto, *Essentials in Food and Control Engineering*. Reference New York (2015).
- McCabe et al, *Unit Operations of Chemical Engineering*. McGraw-Hill (2014).
- RP Singh and DR Heldmann, *Introduction to Food Engineering*. Academic Press (1993).
- RT Toledo, *Fundamentals of Food Process Engineering*. CBS Publisher (1993).
- Z Berk, *Food Process Engineering and Technology*. Elsevier (2013).

**Course Code: FST.524**

**Course Title: Processing of Fruits and Vegetables**

L	T	P	Cr
4	-	-	4

**Objective**

*The objective of this course is to expose the learner to various aspects of handling technologies and methods of preservation of fruits and vegetables to reduce their post-harvest losses*

**Unit 1**

Current status of fruits and vegetable processing in India. Post-harvest handling of fruits and vegetables: Classification and composition of fruits and vegetables and their nutritional value; Respiration (RQ, climacteric and Non climacteric fruits), Assessment of maturity indices; Biochemical changes during ripening; Post harvest handling operation of common fruits and vegetables; Edible coatings; Methods of storage (refrigerated, CAS, MAS, ZECC and hypobaric storage);

15 hours

**Unit 2**

Canning of fruits and vegetables; Impact of canning on nutritional value of fruits and vegetables; Aseptic canning of fruits and vegetables: Operation; Equipment; Specifications. Spoilage of canned fruits and vegetable; Minimal processing of fruits and vegetables; Fresh cut fruits and vegetables (produce for the fresh-cut processing, treatments to ensure safety, additives to preserve quality)

15 hours

**Unit 3**

Juice Processing: Method of juice extraction; Equipment; Preservation; Enzymatic maceration; Juice concentration (methods, processing and flavour retention); Specifications; Preparations of jams, jellies, preserves and candied fruits: Pectin and related compounds; Role of pectin and theories of gel formation; Preparation of dietetic jellies

15 hours

**Unit 4**

Manufacturing of preserves and candied fruits; Specifications; Processing of tomato products: Puree; Paste; Ketchup; Soup; Specifications; Processing of potato products: Flour; Chips; Fries; Nutritive value of potato products; Acrylamide in potato products; Production and properties of potato starch

15 hours

### **Suggested readings**

- AK Jaiswal, *Food Processing Technology: Impact on Product Attributes*. CRC Press (2017)
- G Lal, *Preservation of Fruits and Vegetables*. ICAR (2015).
- J Jethro, *Tropical Fruit Processing*. AP Publisher (2014).
- LR Verma and VK Joshi, *Post-harvest Technology of Fruit and Vegetables*. Indus Publishing Company (2016).
- NS Rathore, *Post-harvest Management and Processing of Fruits and Vegetables*. ICAR (2012).
- S Thaper, *Home Presentation of Fruits and Vegetables*. Punjab Agricultural University (2007).
- SK Chattopadhyay, *Handling Transportation and Storage of Fruits and Vegetable*. Gene Tech Books (2015).
- WV Cruses, *Commercial Fruit and Vegetables Processing*. Agribios (2012).

**Course Code: FST.525**

**Course Title: Lab-Cereals, Legumes and Oilseed Analysis**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
-	-	2	1

### **S.N. Practical**

1. Determination of physicochemical properties of cereals, legumes and oilseeds.
2. Determination of husk content of covered cereals.
3. Determination of physicochemical properties of wheat flour and whole wheat meal.
4. Determination of cooking properties of rice.
5. Isolation of wheat starch and gluten.
6. Determination of amylose content of starches.
7. Morphological properties of different cereal starches.
8. Determination of germination capacity of barley.
9. Laboratory milling of wheat and rice.
10. Manufacturing of different baked products and their quality evaluation.
11. Stabilization of oats and tetrazolium test for germ viability.
12. Preparation and evaluation of legume protein concentrates/isolates.
13. Parboiling of paddy and quality evaluation of parboiled rice.
14. Rheological properties of wheat flour dough.
15. Determination of viability of barley using tetrazolium test
16. Extraction and evaluation of oil from oilseeds

*Lab practical may be added/modified depending on the availability of materials and facilities as well as latest advancements.*

**Evaluation criteria:** The course shall be evaluated on the basis of attendance (10% weightage), lab record (20% weightage), oral viva-voce (20% weightage) and written and practical performance in end semester examination (20% and 30% weightage, respectively).

**Course Code: FST.526**  
**Course Title: Lab-Food Engineering**

L	T	P	Cr
-	-	2	1

**S.N. Practical**

1. Determination of viscosity of liquid foods.
2. Study the working principle and operation of various types of grinders.
3. Study the working principle and operation of various types of crushers.
4. Study components and working principle of domestic refrigerator.
5. Determination of particle size distribution and average particle size (sieve analysis).
6. Working principle and operation of belt conveyor, screw conveyor, bucket elevator
7. Determination of freezing time of selected foods.
8. Study the working principles and operation of an evaporator.
9. Study the working principle and operation of a spray freeze drier
10. Determination of drying time of various foods

*Lab practical may be added/modified depending on the availability of materials and facilities as well as latest advancements.*

**Evaluation criteria:** The course shall be evaluated on the basis of attendance (10% weightage), lab record (20% weightage), oral viva-voce (20% weightage) and written and practical performance in end semester examination (20% and 30% weightage, respectively).



**Course Code: FST.527**

**Course Title: Lab-Fruits and Vegetable Processing**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
-	-	2	1

**S.N. Practical**

1. Morphological characteristics of fruits
2. Preparation and analysis of syrups
3. Determination of PLW by the use of different packaging materials and temperature.
4. Cut out examination of fruit cans
5. Preparation and quality evaluation of fruit juice concentrates
6. Preparation and quality evaluation of jam and jellies
7. Dehydration of fruits and vegetables
8. Freezing of fruits and vegetables
9. To determine change in characteristics of fruit during storage at low temperature.

*Lab practical may be added/modified depending on the availability of materials and facilities as well as latest advancements.*

**Evaluation criteria:** The course shall be evaluated on the basis of attendance (10% weightage), lab record (20% weightage), oral viva-voce (20% weightage) and written and practical performance in end semester examination (20% and 30% weightage, respectively).

IQAC

**Course Code: FST.528**  
**Course Title: Fermented Foods**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
4	-	-	4

**Objective**

*This course has been designed to acquaint the students with the processing technology of fermented foods and relevance of fermentation in food processing.*

**Unit I**

Microorganisms used in food fermentation; Beneficial uses of microorganisms in foods; Fermentation; Classification of food fermentations (alcoholic, lactic and acetic acid fermentations); Advantages of fermentation; General methods of fermentation (aerobic fermentation, anaerobic fermentation, solid state fermentation and submerged fermentation) 14 hours

**Unit II**

Starter cultures: Introduction, history, concentrated cultures, starter culture problems, yeast and mold cultures 16 hours  
Fermented milk and milk products (cheese, cultured cream, curd/dahi, kefir; kumis; yogurt, bulgarian milk, acidophilus milk, etc.); Health benefits of fermented milk products  
Fermented fruits and vegetables (pickles; kimchi; sauerkraut, etc.)  
Soy-based fermented foods (miso, natto, temph, soy sauce, sofu, etc.)

**Unit III**

Fermented indigenous products (dosa; idli; dhokla, wari, bhatura, utppam, jabeli, wada, etc.) 14 hours  
Alcoholic beverages based on fruit juices (wine, vinegar, etc), cereals (whisky, beer, vodka, etc.) and sugar cane (rum)  
Fermented meat and fish products (sausage, pickle, fish paste, sauce, etc.); Bioactive compounds in fermented foods

**Unit IV**

Fermentative production: Baker's yeast; Aminoacids (glutamic acid, lysine); Organic acids (citric and lactic acid); Enzymes; Polysaccharides (dextran, xanthan, pullulan, alginate, etc.); Single cell proteins. 14 hours

**Suggested readings**

- B Ray and A Bhunia, *Fundamental Food Microbiology*. CRC Press (2018)
- D Montet, *Fermented Foods: Biochemistry and Biotechnology*. CRC Press (2016).
- DJ Owens, *Indigenous Fermented Foods of Southeast Asia*. CRC Press (2015)
- J Frias, *Fermented Foods in Health and Disease Prevention*. Academic Press (2017).
- PF Stanbury, *Principles of Fermentation Technology*. Elsevier (2017).
- PS Panesar and SS Marwaha, *Biotech in Agriculture and Food Processing*. Taylor and Francis (2014).
- SC Prescott and CG Dunn, *Industrial Microbiology*. Agrobios (2011).
- SS Marwaha and JK Arora, *Biotech Strategies in Agro-processing*. Asiatech (2003).
- SS Marwaha and JK Arora, *Food Processing Biotech: Application*. Asia Tech Publication (2000).

IQAC

**Course Code: FST.529**  
**Course Title: Beverages Technology**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
4	-	-	4

**Objective**

*Through the study of this course the students shall understand the processing technology of alcoholic and non-alcoholic beverages*

**Unit I**

Types of beverages and their importance; Status of beverage industry in India 15 hours  
Packaged drinking water: Definition; Technology; Quality evaluation; Methods of water treatment, BIS quality standards of bottled water;  
Soft drinks: Types; Role of various ingredients of soft drinks; Technology of carbonated soft drinks, synthetic beverages and sports drinks; Microbial stability of carbonated beverages  
Tea: Types; Technology of black tea, green tea, pickled tea, instant tea and decaffeinated tea; Quality evaluation and grading

**Unit II**

Coffee: Cultivation; Technology; Fermentation of coffee beans; Changes during fermentation; Drying; Roasting; Process flow sheet for the manufacture of coffee powder, instant coffee; Decaffeination; Quality grading 15 hours  
Cocoa and chocolate-based beverages: Fermentation; Drying; Storage and transport; Cleaning and roasting of beans; Nibs, alkalizing, roasting and sterilizing (NARS) process; Kibbling and winnowing; Grinding; Deodorization; Alkalization; Pressing; Packaging; Cocoa-based beverages; Changes during procession of cocoa

**Unit III**

Beer: Ingredients of beer; Characteristics of barley for malting and brewing; Problem of dormancy and water sensibility; Steeping techniques; Germination of barley; Kilning techniques; Changes during malting; Quality evaluation of malt; Mashing; Beer adjuncts; Filtration and boiling of wort; Changes during wort boiling; Hops; Fermentation; Lagering (objectives and techniques); Spoilage of beer; Chill haze 15 hours

#### **Unit IV**

Wine: Types; Production of the must and pressing; 15 hours  
Fermentation; Maturation; Filtration, clarification and  
bottling; Special wines; Colouring and flavouring  
compounds in wine; Quality evaluation and control  
Distilled alcoholic beverages: Types; Principle of  
distillation; Manufacturing of distilled alcoholic  
beverages like whisky, brandy, rum, gin, vodka, etc.;  
Flavour and aroma compounds in whisky, rum, brandy,  
gin and vodka

#### **Suggested readings**

- B Escher, *Bioanalytical Tools in Water Quality Assessment*. Iwa Publishing (2012).
- JG Woodroof and GF Phillips, *Beverages: Carbonated and Non-Carbonated*. AVI Publication (1974).
- MJ Lewis and TW Young, *Malting and Brewing Science* (1981).
- NN Potter, *Food Science*. CBS Publishers (2007).
- P Quevauviller, *Analytical Methods for Drinking Water*. John Wiley (2006).
- PS Panesar and SS Marwaha, *Biotech in Agriculture and Food Processing*. Taylor and Francis (2013).
- V Vaclavik and CW Elizabeth, *Essentials of Food Science*. Springer (2014).
- Varnam and S Sutherland, *Beverages: Technology, Chemistry and Microbiology*. Chapman and Hall (1994).

**Course Code: STA-503**  
**Course Title: Basic Statistics for Sciences**

L	T	P	Cr
2	0	0	2

**Objectives:** To provide the understanding and use of Statistical techniques for students of other departments.

**Unit I** 8 hours  
**Descriptive Statistics:** Meaning, need and importance of statistics. Attributes and variables. Measurement and measurement scales. Collection and tabulation of data. Diagrammatic representation of frequency distribution: histogram, frequency polygon, frequency curve, ogives, stem and leaf plot, pie chart.

**Unit II** 8 hours  
**Measures:** Measures of central tendency, dispersion (including box and whisker plot), skewness and kurtosis. Linear regression and correlation (Karl Pearson's and Spearman's) and residual plots.

**Unit III** 8 hours  
**Random variables and Distributions:** Discrete and continuous random variables. Discrete Probability distributions like Binomial, Poisson and continuous distributions like Normal, F and student-t distribution.

**Unit IV** 8 hours  
Differences between parametric and non-parametric statistics. Confidence interval, Errors, Levels of significance, Hypothesis testing. **Parametric tests:** Test for parameters of Normal population (one sample and two sample problems) z-test, student's t-test, F and chi-square test and Analysis of Variance (ANOVA). **Non-Parametric tests: One sample:** Sign test, signed rank test, Kolmogrov-Smirnov test, run test. Critical difference (CD), Least Significant Difference (LSD), Kruskal-Wallis one-way ANOVA by ranks, Friedman two-way ANOVA by ranks.

**Recommended Books:**

1. P. L. Meyer, *Introductory Probability and Statistical Applications*, Oxford & IBH Pub, 1975.
2. R. V. Hogg, J. Mckean and A. Craig, *Introduction to Mathematical Statistics*, Macmillan Pub. Co. Inc., 1978.

**Suggested Readings:**

1. F. E. Croxton and D. J. Cowden, *Applied General Statistics*, 1975.
2. P. G. Hoel, *Introduction to Mathematical Statistics*, 1997.

**Course Code: FST.551**

**Course Title: Processing of Milk and Milk Products**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
4	-	-	4

**Objective**

*This course will acquaint the students with fundamental and applied aspects of milk and milk products*

**Unit I**

Definition of milk; Composition of milk of various milk animals; Factors affecting composition of milk; Physicochemical and nutritional properties of milk; Factors affecting quality and quantity of milk produced by milk animals; Sources of milk contamination; Quality evaluation and testing of milk; Procurement and transportation of market milk 15 hours

**Unit II**

Aseptic and Membrane processing of milk and whey (applications of RO, UF and MF); Processing technology and regulations agencies, standards/specifications for full-cream, standardized, toned, double-toned, skim, reconstituted, recombined, toned, double-toned, standardized; flavoured, filled-milk, etc. Cream: Types of creams; Composition of cream; Production methods; Neutralization of cream; Ripening of cream for butter making (natural ripening, ripening with starter cultures) 15 hours

**Unit III**

Butter: Types; Composition; Preparation of butter; Churning theories; Defects (causes and prevention) 15 hours  
Condensed and evaporated milk: Standards; Composition; Nutritive Value; Manufacture; Defects (causes and prevention)  
Milk powders: Standards; Composition; Nutritive value; Process of manufacture; Defects (causes and prevention); Instantisation

**Unit IV**

Cheese: Classification, Composition; Nutritive value; Process of manufacture of cheddar, mozzarella and processed cheese 15 hours  
Ice cream: Standards; Composition; Nutritive value, Process of manufacture, Ingredients and their roles; Defects (causes and prevention)  
Indigenous milk products: Ghee, Dahi, Desi Butter, Chhanna, Khoa, Srikhand, rabri, etc.

**Suggested readings**

- *Analysis of Milk and Milk Products* by Milk Industry Foundation (2014).

- BK Mishra, *Dairy and Food Product Technology*. Biotech Books (2016).
- C Shortt, *Handbook of Functional Dairy Products*. CRC Press (2014).
- D Ward, *Dairy Science and Technology*. Larsen & Keller (2017).
- H Subrota, *Dairy Product Technology*. Astral (2015).
- J Coimbra, *Engineering Aspects of Milk and Dairy Products*. CRC Press (2010).
- M Sararela and TM Sandholm, *Functional Dairy Products*. Woodhead Publishing Ltd. (2014).
- P Gangasagare, *A Textbook of Traditional Dairy Products*. Oxford Book Company (2018).
- R Early, *The Technology of Dairy Products*. Springer Science (2010)
- R Sharma, *Production Processing & Quality of Milk Products*. International Book Distributing Co. (2006).
- RC Chnadan and A Kilara, *Dairy Ingredients for Food Processing*. Wiley (2011).
- RD Boer, *From Milk By Products to Milk Ingredients*. John Wiley & Sons (2014).
- RK Robinson, *Modern Dairy Technology Volume 1, 2 Advances in Milk Processing*. Springer (1994).
- S De, *Outlines of Dairy Technology*. Oxford University Press (2015).

IQAC



**Course Code: FST.552**

**Course Title: Application of Enzymes in Food Processing**

L	T	P	Cr
4	-	-	4

**Objective**

*The course will educate the students about fundamental principles of enzymes and their applications in food processing for quality enhancement of various foods*

**Unit I**

Nomenclature; General properties; Classification; 15  
Sources of enzymes; Production and purification of hours  
enzymes; Factors affecting enzymatic activity;  
Mechanism of enzyme inhibition; Immobilization of  
enzymes  
Enzymes in cereal processing: Enzymatic production of  
modified starches, corn syrups containing glucose,  
maltose, glucose, fructose, etc.; Significance of enzymes  
in baking industry (amylases, protease, gluco-oxidases,  
lipase, xylanases and transglutaminase)

**Unit II**

Enzymes in dairy industry: Indigenous enzymes 15  
involved in antimicrobial and antiviral activity of milk; hours  
Exogenous enzymes in dairy industry (proteinases,  
lipase, beta-galactosidase, lysozyme, glucose-oxidase,  
superoxide dismutase, sulfhydryl oxidase, catalyse,  
lacto-peroxidase and transglutaminase);Hydrolysis of  
lactose in milk and whey; Use of enzymes for  
determining milk quality; Production and use of  
microbial enzymes for dairy processing; Enzymes in  
cheese production (coagulant technology, rennin and its  
formation, enzymes in cheese preservation)

**Unit III**

Importance and application of enzymes in fruits 15  
processing: Distribution of pectic substances and pectin hours  
enzymes in fruits; Commercial pectinases; Specific  
applications of enzymes in juice technology like  
clarification, debittering, etc.  
Enzymes in meat industry: Enzymes used for meat  
processing (proteases and peptidases, lipases,  
transglutaminase, oxidative enzymes and glutaminase);  
Enzymatic tenderization of meat; Enzymatic generation  
of flavours in meat products

#### **Unit IV**

Enzymes in brewing: Brewing with high and very high levels of adjuncts; Improving filtration; Chill-proofing; Making new and special beers; Extending shelf life of packaged beer 15 hours

Enzymatic modification of proteins and lipids (production, isolation, purification, hydrolysis, esterification, application of lipase in fats and oils); Enzyme as analytical tool (importance, biosensor, transducer)

#### **Suggested readings**

- AN Shukla, *Industrial Enzymology*. Discovery Publishing House (2009).
- JR Whitaker *Handbook of Food Enzymology*. CRC press (2016).
- PS Panesar et al., *Enzymes in Food Processing: Fundamentals and Potential Applications*. I.K. International Publishing House (2013).
- RJ Whitehurst and MV Oort, *Enzymes in Food Technology*. Wiley-Blackwell (2010).
- S Shanmugam and K Kumar, *Enzyme Technology*. I.K. International Publishing (2009).
- T Nagodawithana and G Reed, *Enzymes in Food Processing*. Academic Press (1993)

**Course Code: FST.553**  
**Course Title: Lab-Milk and Milk Products**

L	T	P	Cr
-	-	4	2

**S.N. Practical**

1. Platform tests of milk (Acidity, Clot on boiling, Alcohol test, MBR test).
2. Determination of milk fat content.
3. Determination of specific gravity using lactometer.
4. Determination of SNF and TS content of milk using lactometer.
5. Detection of common adulterants and preservatives of milk.
6. Preparation and quality evaluation of butter.
7. Preparation of and quality evaluation of ghee from cream and butter.
8. Preparation of flavoured milk.
9. Preparation and quality evaluation of Khoa.
10. Preparation and quality evaluation of chhanna/paneer.
11. Preparation and quality evaluation of curd and yoghurt.

*Lab practical may be added/modified depending on the availability of materials and facilities as well as latest advancements.*

**Evaluation criteria:** The course shall be evaluated on the basis of attendance (10% weightage), lab record (20% weightage), oral viva-voce (20% weightage) and written and practical performance in end semester examination (20% and 30% weightage, respectively).

**Course Code: FST.543**  
**Course Title: Seminar-I**

L	T	P	Cr
1	-	-	1

**Objective**

*To improve scientific aptitude and presentation skills of students, they will present credited seminars on a relevant subject specific topic. They will prepare and submit a report on the same.*

**Evaluation criteria:** Seminars shall be evaluated based on report submission, contents, presentation skills, innovation and interaction session (equal weightage).

**Course Code: FST.599**

**Course Title: Project work**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
-	-	12	6

**Objective**

*To provide students the opportunity to put into the competences acquired through study of various courses in order to improve scientific aptitude and ability to work independently. In addition, upon successful completion students will learn how to review the literature and write a project report.*

**Evaluation criteria:** Students are required to carry out one project work of 12 credits in III and IV semesters (6 credits in each) as per the course structure. In the III semester, students shall search the research problem/idea and finalize the tentative outline of the same which shall be evaluated through a presentation to committee constituted as per the University rules applicable from time to time. In the IV semester, the project work shall be completed as outlined/planned in the III semester and the project report shall be submitted to the Department before the start of the end semester examination. The report shall be evaluated by committee constituted for the purpose as per the University rules.

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**Course Code: FST.571**

**Course Title: Food Safety, Regulation and Policy**

L	T	P	Cr
4	-	-	4

**Objective**

*This course has been designed to educate students about various quality attributes of foods and aspects of food safety. They will also learn about various regulating agencies and food laws being implemented in India. Further, they will be introduced with Govt. policies relevant to food processing industry.*

**Unit I**

Food safety: Definition; Need; Factors affecting food safety 15 hours  
Concept of quality control: Objectives, importance and functions of quality control; Quality attributes of foods: Size and shape; Colour and gloss; Viscosity and consistency; Texture; Taste; Objective methods for measurement of colour, texture and consistency

**Unit II**

Methods of quality assessment of fruits and vegetables, cereals and cereal products, dairy product, fats and oils, meat and meat products, poultry and eggs, oils and fats, spices, etc. 15 hours  
Sensory characteristics of food (colour, taste, aroma, texture), Panellist (Types, ideal panellist requirement), sensory test (testing laboratory, sample preparation, Types of sensory test-difference, rating, sensitivity, testing time, design of sensory experiment-evaluation card)

**Unit III**

Food laws and regulations: Importance and application of food regulatory system; Food Safety and Standards Act, 2006 (transition from PFA, FPO, MMPO, MFPO); AGMARK; BIS; QCI; Export promotion bodies and inspection council; International Food Regulation/Authorities (WTO, SPS, TBT Bilateral agreement, Codex Alimentarius, ISO) 15 hours

**Unit IV**

Food safety management and quality control systems: Total Quality Management; ISO 22000; Quality assurance; GMP; GLP; Sanitary and hygienic practices; HACCP 15 hours  
Food Policy: Category management in Retail; Company Act; Corporate Social Responsibility in India; Public Distribution System in India; Policy initiatives by the Government in food processing sector; Agricultural Export Zone of India; Mega Food Parks scheme, etc

### **Suggested readings**

- A Kramer and BA Twigg, *Quality Control for the Food Industry*. AVI Publishing Company (1990).
- A Vasconcellos, *Quality Assurance for the Food Industry: A Practical Approach*. CRC Press (2003).
- CW Wrigley, *Cereal Grains: Assessing and Managing Quality*. Woodhead Publishing (2015).
- H Lawless, *Quantitative Sensory Analysis: Psychophysics Models and Intelligent Design*. Wiley Blackwell (2013).
- K Kapisiris, *Food Quality*. Intech Publisher (2014).
- L Nollet, *Handbook of Food Analysis*. CRC Press (2015).
- M Clute, *Food Industry Quality Control Systems*. CRC Press (2017).
- N Khetarpaul, *Food Analysis*. Daya Publishing House (2016).
- R Marsili, *Flavour Fragrance and Odour Analysis*. CRC Press (2012).
- RC Beier, *Pre-harvest and Postharvest Food Safety*. Wiley India (2016).
- RMS Cruz et al., *Methods in Food Analysis*. CRC Press (2014).
- S Otles, *Methods of Analysis of Food Components and Additives*. CRC Press (2012).
- S Sehgal, *A Laboratory Manual of Food Analysis*. Panima Educational Book (2016).
- Sohrab, *A Practical Guide for Implementation of Integrated ISO-9001 HACCP System for the Food Processing Industry*. Allied Publishers Ltd. (2001).
- Y Motarjemi, *Food Safety Management: A practical Guide for the Food Industry*. Academic Press (2014).
- YC Daniel, *Instruments Methods for Quality Assurance in Foods*. Marcel Dekker Inc (2017).

**Course Code: FST.572**

**Course Title: Poultry, Meat and Fish Processing**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
4	-	-	4

**Objective**

*The course will provide students with an understanding of scientific aspects of processing and applications of egg, poultry, meat and fish and their products in the food industry*

**Unit I**

Eggs: Structure; Composition; Nutritive value; Grading; Internal quality (evaluation and factors affecting egg quality); Preservation of whole eggs; Packaging of whole eggs; Functional properties; Microbial spoilage; Freezing and pasteurization of liquid eggs; Mechanism and factors affecting gelation and foaming properties of eggs; Technology of egg products (egg powders and frozen egg products) 15 hours

**Unit II**

Poultry: Status of poultry and meat industry in India; Types; Composition; Nutritive value; Factors affecting quality of poultry meat; Poultry slaughtering and dressing (operation and equipment); Changes during freezing and thawing of poultry meat 15 hours  
Meat: Chemical composition and nutritive value of meat; Structure of meat tissue; Pre-mortem condition and their effect on post mortem quality; Post-mortem biochemical changes; Factors affecting post-mortem changes; Muscle concentration and relaxation; Eating properties of meat; Cooking quality of meat; Pre-slaughter operations and slaughtering operations

**Unit III**

Principles, equipment and applications of mechanical deboning; Preservation of meats by chilling, freezing, freeze drying, pickling, curing, cooking and smoking, dehydration, irradiation, chemical and biological preservatives; Tenderization 15 hours  
Preparation, preservation and equipment for manufacture of meat Comminuted/minced meat product; Quality evaluation of sausages  
Fish: Type and Classification; Quality; Storage; Products (fish pickle, dried fish & fish protein hydrolysate, surimi, etc.)

#### **Unit IV**

Sanitation and safety in meat industry: Food safety management in meat industry; Inspection and safety standards in meat industry; Pesticide and drug residue in poultry meat; Pathogenic microorganisms on processed poultry; Factors affecting microbial growth in poultry; Effects of processing on pathogen load; Application of HACCP in poultry meat processing industry 15 hours

#### ***Suggested readings***

- AM Pearson and TA Gillett, *Processed Meats*. CBS Publishers (1996).
- GC Mead, *Poultry Meat Processing and Quality*. Woodhead Publishing Ltd. (2004).
- I Guerrero-Legarreta, *Handbook of Poultry Science and Technology*. Wiley (2010).
- *Lawrie's Meat Science* Woodhead Publishing (2017).
- LS Bozaris, *Seafood Processing: Technology, Quality and Safety*. John Wiley and Sons Ltd. (2014).
- NN Potter, *Food Science*. CBS Publishers (2007).
- R Fernandes, *Microbiology Handbook of Meat products*. Medtech (2017).
- SC Ricke, *Organic Meat Production and Processing*. Wiley-Blackwell (2012).
- Sohrab, *A Practical Guide for Implementation of Integrated ISO-9001 HACCP System for the Food Processing Industry*. Allied Publishers Ltd. (2001).
- YH Hui, *Handbook of Meat and Meat Processing*. CRC Press (2012).
- YH Hui, *Meat Science and Applications*. Marcel Dekker (2001).



**Course Code: FST.573**

**Course Title: Technology of Spices, Sugar and Chocolate**

L	T	P	Cr
4	-	-	4

**Objective**

*Upon the study of this course, the students shall have understanding of the composition, processing technology of spices, essential oils, sugars and chocolate confectionary.*

**Unit I**

Classification; Composition; Health benefits; Forms, functions and applications of spices; Processing technology of major spices (black pepper, small cardamom, ginger, chilli and turmeric); Processing of white pepper; Technology of onion, ginger and garlic pastes and powders; Other spices: Fennel, celery, dill, onion, clove, nutmeg, saffron, cumin, coriander, cinnamon, fenugreek, garlic, mace, clove, mint and vanilla; Organic spices: Concept, standard and quality 15 hours

**Unit II**

Oleoresins and Spice emulsions (method of manufacture, chemistry of the volatiles); Cryo-milling of spices; Microbial contamination and insect infestation in spices and its control; Fumigation and irradiation of spices 15 hours  
Essential oils: Sources; Production; Adulteration; Analysis; Biological activities; Phototherapeutic and industrial uses

**Unit III**

Cane sugar technology: Composition of cane and cane juice; Manufacturing of sugar (process and equipment); Cane preparation and juice extraction; Screening, Clarification; Evaporation; Sugar boiling; Crystallization; Centrifugal separation; Drying and storage; Deterioration of sugar during storage and its prevention; By-products of sugar industry and their utilization 15 hours

**Unit IV**

History of chocolate; Cocoa beans and production; Ingredients in chocolate (crystalline and amorphous sugar; lactose, glucose and fructose; milk and other dairy ingredients); Cocoa butter properties; Processing of cocoa beans (cleaning, roasting and winnowing; grinding of nib, production of cocoa butter and cocoa powder); Refining; Conching; Chocolate; Tempering; Moulding; Enrobing and panning; Packaging requirements and material used for packaging of chocolate; Health effects of chocolate confectionary 15 hours

**Suggested readings**

- A Chakraverty et al., *Handbook of Postharvest Technology*, Marcel Dekker (2003).
- DA Patil, *Spices and Condiments: Origin, History and Applications*. Astral Publishing House (2013).
- JG Woodroof et al., *Hand Book of Sugars for Processors, Chemists and Technologists*. AVI Publication (1973).
- K Husnu Can Baser and G Buchbauer, *Handbook of Essential Oils: Science, Technology, and Applications*. CRC Press (2016).
- KV Peter, *Handbook of Herbs and Spices*, CRC Press (2000).
- NN Potter, *Food Science*. CBS Publishers (2007).
- R Lees and B Jackson, *Sugar Confectionery and Chocolate Manufacture*. Blackie Academic and Professional (1992).
- S Raghavan, *Handbook of Spices, Seasonings and Flavorings*. CRC Press (2007).
- V Vaclavik and CW Elizabeth, *Essentials of Food Science*. Springer (2014).
- VB Singh, *Spices*. New Age International (2008).

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**Course code: FST.574**  
**Course Title: Lab-Food Quality**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
-	-	2	1

**S.N. Practical**

1. Test for assessment of quality of milk -estimation and fat and SNF
2. Test for assessment of quality of cereals
  - a) Estimation of Amylose content in rice
  - b) Estimation of gluten content in dough
  - c) Estimation of 1000kernel weight, porosity, bulk density, density, Angle of repose
  - d) Quality and safety of rice-mycotoxins determination
3. Test for assessment of quality of pulses
  - a) Evaluation of cooking quality of legume
  - b) Estimation of 1000-grain weight, porosity, bulk density, density, Angle of repose
4. Test for assessment of quality of fats and oils-physical and chemical parameters.
5. Determination of different components of egg (albumin content, yolk content and shell content)
6. Sensory test - difference test (paired comparison test, duo trio test, triangle test); Rating test -Ranking test, Hedonic test, Single sample difference test, Two sample difference test.

*Lab practical may be added/modified depending on the availability of materials and facilities as well as latest advancements.*

**Evaluation criteria:** The course shall be evaluated on the basis of attendance (10% weightage), lab record (20% weightage), oral viva-voce (20% weightage) and written and practical performance in end semester examination (20% and 30% weightage, respectively).

**Course Code: FST.575**

**Course Title: Competitive Exam Preparatory Course**

L	T	P	Cr
-	2	-	2

**Objective**

*The students shall be trained to compete in various national level examinations for getting opportunity in academics and research and development.*

- The syllabus of various national competitive examinations (e.g. ICAR, FSSAI, FCI, etc) would be discussed with the students.
- Mock test schedule will be shared and test will be conducted accordingly.
- Four mock tests will be conducted in the semester. Each test shall comprise of 50 MCQs of 25% weightage from the syllabus of the competitive examination.

**Evaluation Criteria:** The marks obtained by the students in all 4 mock tests counted/added for the final course result.

**Course Code: FST.576**

**Course Title: Analytical Techniques - Principles and Applications**

L	T	P	Cr
-	-	4	2

**Objective**

*Upon the study of this course, the students will have understanding of basics of analytical techniques and how they are used for analysis of various foods.*

- Basics and analytical applications of UV/Vis Spectrophotometer, Atomic Absorption Spectrometer and FTIR in food industry
- Basics and analytical application of chromatographic techniques in food analysis/fractionation
- Principles and applications of viscometers for the determination of viscosity of different foods
- Basics and analytical separation/purification applications of centrifugal equipment in food processing
- Morphological characterization of different food samples

*Lab practical may be added/modified depending on the availability of materials and facilities as well as latest advancements.*

**Evaluation criteria:** The course shall be evaluated on the basis of attendance (10% weightage), lab record (20% weightage), oral viva-voce (20% weightage) and written and practical performance in end semester examination (20% and 30% weightage, respectively).

**Course Code: FST.544**  
**Course Title: Seminar-II**

L	T	P	Cr
1	-	-	1

**Objective**

*To improve scientific aptitude and presentation skills of students, they have to present credited seminars on a relevant subject specific topic. The students are also required to prepare and submit a report on the same.*

**Evaluation criteria:** Seminars shall be evaluated based on report submission, contents, presentation skills, innovation and interaction session (equal weightage).

**Course Code: FST.599**  
**Course Title: Project**

L	T	P	Cr
-	-	12	6

**Objective**

*To provide students the opportunity to put into the competences acquired through study of various courses in order to improve scientific aptitude and ability to work independently. In addition, upon successful completion students will learn how to review the literature and write a project report.*

**Evaluation criteria:** Students are required to carry out one project work of 12 credits in III and IV semesters (6 credits in each) as per the course structure. In the III semester, students shall search the research problem/idea and finalize the tentative outline of the same which shall be evaluated through a presentation to committee constituted as per the University rules applicable from time to time. In the IV semester, the project work shall be completed as outlined/planned in the III semester and the project report shall be submitted to the Department before the start of the end semester examination. The report shall be evaluated by committee constituted for the purpose as per the University rules.

## Interdisciplinary courses offered to other Departments

**Course No. FST.512**

**Course Title: Food regulation, quality and Safety Assessment**

L	T	P	Cr
2	-	-	2

**To be offered in 1<sup>st</sup> semester of the academic year**

### **Objective**

*To educate students about the quality attributes of foods and food laws and their relevance in food industry*

<b>Unit I</b>	<b>Lectures</b>
Food regulatory bodies in India; Food Safety and Standards Act, 2006 and various other regulations/agencies dealing with inspection, certification and quality assurance in India (PFA, FPO, MMPO, MPO, AGMARK, BIS); Labelling rules	8
<b>Unit II</b>	
Food safety management and quality control systems: Total Quality Management; Quality assurance; GMP; GLP; Sanitary and hygienic practices; HACCP; Export import policy	7
<b>Unit III</b>	
Concept of quality control: Objectives, importance and functions of quality control Quality attributes of foods: Size and shape; Colour and gloss; Viscosity and consistency; Texture; Taste; Objective methods for measurement of colour, texture and consistency	7
<b>Unit IV</b>	
Sensory evaluation: Difference test (paired comparison, duo-trio, triangle tests); Determination of threshold value for various odours; Selection of judging panel; Training of judges for recognition of certain common flavour and texture defects using different types of sensory tests	8

### **Suggested readings**

- A Kramer and BA Twigg, *Quality Control for the Food Industry*. AVI Publishing Company (1990).
- A Vasconcellos, *Quality Assurance for the Food Industry: A Practical Approach*. CRC Press.
- K Kapiris, *Food Quality*. Intech Publisher (2014).
- M Clute, *Food Industry Quality Control Systems*. CRC Press (2017).
- RC Beier, *Pre-harvest and Postharvest Food Safety*. Wiley India (2016).

- Sohrab, *A Practical Guide for Implementation of Integrated ISO-9001 HACCP System for the Food Processing Industry*. Allied Publishers Ltd. (2001).
- Y Motarjemi, *Food Safety Management: A practical Guide for the Food Industry*. Academic Press (2014).

**Course No. FST.529**

**Course Title: Introduction to Nutrition and Specialty Foods**

L	T	P	Cr
2	-	-	2

**To be offered in semester 2<sup>nd</sup> of the academic year**

**Objective**

*To provide an understanding about the speciality foods and their requirements*

**Unit I**

Definitions (food, diet, nutrients, nutrition, adequate/good nutrition, nutritional status, malnutrition, nutritional care, health); Functions of food; Food types and groups; Concept of balanced diet  
Nutrition values of food constituents - Carbohydrates, proteins, lipids, minerals and vitamins

**Lectures**

8

**Unit II**

Therapeutic nutrition; Foods and diets recommended and restricted in blood, circulatory and cardiac diseases, coeliac disease, diabetes and obesity  
Introduction to speciality foods: Specialty foods for gluten and lactose intolerants, heart patients and obese people and their potential in India viz a viz developed world

7

**Unit III**

Types of lactose intolerance; Symptoms; Causes; Prevalence; Approaches for preparation of low lactose and lactose-free milk products- Probiotic and non-probiotic techniques  
Types, symptoms, causes and prevalence of gluten intolerance and coeliac disease; Approaches for preparation of gluten-free baked foods; Allowed and restricted ingredients; Gluten-free labelling

7

**Unit IV**

Prevalence and risk factors for coronary heart diseases; Diet and coronary heart diseases relationship; Probiotics, prebiotics and role of omega 3 fatty acids in their prevention. Prevalence and causes of obesity; measurement of obesity - body mass index (BMI); Dietary and non-dietary approaches for treatment of severe obesity (VLCD and Gastroplasty); Natural and synthetic non-nutritive sweeteners

8

**Suggested readings**

- G Subbulakshmi, *Functional Foods and Nutrition*, Daya Publishing House (2014).
- GR. Gibson and CM. Williams, *Functional Foods: Concept to Product*. Woodhead Publishing (2000).
- M. Swaminathan, *Essentials of Food and Nutrition*, Volumes 1-2. Ganesh Publisher (1974).
- NN Potter, *Food Science*. CBS Publishers (2007).
- S Riar et al., *Functional Foods and Nutraceuticals: Sources and Their Developmental Techniques*. New India Publishing Agency (2015).
- Y Zhao, *Specialty Foods: Processing Technology, Quality and Safety*. CRC Press (2012).

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