B SC FOOD PROCESSING AND MANAGEMENT
[3-year Regular Programme]
[For those who joined since 2021-2022]

Programme Outcomes:

PO1: **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.**Effective Communication:** Speak, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books ,media and technology.

PO3.**Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4.**Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5.**Ethics:** Recognize different value systems including one self, understand the moral dimensions of decisions, and accept responsibility.

Programme Specific Outcomes:

PSO 1: A knowledge and competence in the principles of quality assurance and quality management system as they are applied in the food manufacture and distribution to produce safe food and meet the quality and legal requirements.

PSO 2: An understanding of chemical, biological and physical principles which underlie food processing, package and storage.

PSO 3: Wide range of skills relating to administration, nutrition, sanitation, technology and communications to keep a food service business operating in the safest and most cost-efficient manner.

Programme Structure

Sem	Subject code	Part	Course	Subject	Hours/ Week	Credit	CIA	ESE	Total Marks
I	HBLT11/ HBLA11/ HBLIA11/ HBLH11	I	Language I	Tamil I Basic Arabic I/ Intermediate Arabic I Hindi I	6	6	40	60	100
	HBLG12/ HBLF12/	II	Language II	English- I General/English- I Functional	6	6	40	60	100
	HBFPC11		Core I	Food Science	6	5	40	60	100

	HBFPC12P	III	Core II	Food Science Practical	4	3	40	60	100
	HBFPA13		First ALLIED I	Principles of Food Processing	6	5	40	60	100
	HBFPE14P	IV	Skill Based Elective	Bakery and Confectionery Practical	2	2	-	50	50
				Total	**30**	**27**	**200**	**350**	**550**
II	HBLT21/ HBLA21/ HBLIA21/ HBLH21	I	Language I	Tamil II Basic Arabic II / Intermediate Arabic II/ Hindi II	6	6	40	60	100
	HBLG22/ HBLF22	II	Language II	English- II General/ English- II Functional	6	6	40	60	100
	HBFPC21	III	Core III	Food Chemistry	4	3	40	60	100
	HBFPC22P		Core IV	Food Chemistry Practical	4	3	40	60	100
	HBFPA23		First ALLIED II	Basic Horticulture	6	5	40	60	100
	HBFPE24P	IV	Skill based Elective	Basic Food Processing Practical	2	2	-	50	50
	HBES2		General Interest Course I	Environmental Studies	2	2	-	50	50
	HBFPX2/ HBFPX20	V	Extra Credit	Food Hygiene and Sanitation/ Online Certificate Course		2	-	100	100
				Total	**30**	**27+2**	**200**	**400+ 100**	**600+ 100**
III	HBFPC31	III	Core V	Technology of Milk and Milk Products	6	4	40	60	100
	HBFPC32P		Core VI	Technology of Milk and Milk Products Practical	6	4	40	60	100
	HBFPA33		Second ALLIED I	Food Microbiology	6	5	40	60	100
	HBFPE34P	IV	Skill based Elective	Food Microbiology Practical	3	2	-	50	50
			Non major elective		4	2	-	50	50
	HBHR3		General Interest Course II	Human Rights	3	2	-	50	50
	HBXTN3	V	Extension activities	NSS/CSS	2	2	100	-	100
	HBFPX3/ HBFPX30		Extra Credit	Food Adulteration/ Online Certificate	-	2	-	100	100

				Course					
				Total	**30**	**23+2**	**220**	**330+ 100**	**550+ 100**
IV	HBFPC41	III	Core VII	Food Quality and Safety Management	6	4	40	60	100
	HBFPC42		Core VIII	Food Fermentation Technology	5	4	40	60	100
	HBFPC43P		Core IX	Food Fermentation Technology Practical	4	4	40	60	100
	HBFPA44		Second ALLIED II	Technology of Fruits and Vegetables Processing	6	5	40	60	100
		IV	Non major elective	Food Preservation Theory	4	2	-	50	50
	HBFPE45P		Skill based Elective	Analysis of fruits and vegetables Practical	3	2	-	50	50
	HBVE4		General Interest Course III	Values and ethics	2	2	-	50	50
	HBFPX4/ HBFPX40	V	Extra Credit	Waste Management in Food Industries/ Online Certificate Course	-	2	-	100	100
				Total	**30**	**23+2**	**160**	**390+ 100**	**550+ 100**
V	HBFPC51	III	Core X	Grain Science Technology	5	4	40	60	100
	HBFPC52		Core XI	Theory of Packaging and Packaging materials	5	3	40	60	100
	HBFPC53P		Core XII	Cereal Processing Practical	3	3	40	60	100
	HBFPE5A/ HBFPE5B		Elective I	a] Post-Harvest Technology/ b] Processing of Traditional and Convenient Food	5	5	40	60	100
	HBFPE5C/ HBFPE5D		Elective II	a]Food Additives/ b] Food Product Development and Management Techniques	5	5	40	60	100
	HBFPE54	IV	Skill based Elective	Entrepreneurial Development	3	2	-	50	50
	HBWS5		General Interest Course	Women Studies	3	2	-	50	50

			IV						
				Library	1	-	-	-	-
	HBFPX5PW/ HBFPX50	V	Extra Credit	Mini Project / Online Certificate Course	-	2	-	100	100
				Total	**30**	**24+2**	**200**	**400+ 100**	**600+ 100**
VI	HBFPC61	III	Core XIII	Food Trade and Business Management	5	4	40	60	100
	HBFPC62		Core XIV	Technology of Spices and Plantation Crops	4	3	40	60	100
	HBFPC63		Core XV	Technology of Meat, Poultry, Sea food and Egg	5	4	40	60	100
	HBFPC64PW		Core XVI	Project	6	5	40	60	100
	HBFPE6A/ HBFPE6B		Elective III	a] Food Analysis and Instrumentation b] Emerging Technologies in Food Industry	5	5	40	60	100
	HBFPE65	IV	Skill based Elective	Unit Operations in Food Industry	3	2	-	50	50
				Library	2	-	-	-	-
	HBSED6	V	Extra credit	Skills for Employment Development		2	100	-	100
				Total	**30**	**23+2**	**200 +100**	**350**	**550+ 100**
				Grand Total	**180**	**145+ 10**	**1180 +100**	**2220+ 400**	**3400+ 500**

H/W- Hours/ Week CIA- Continuous evaluation assessment ESE- End Semester Examination
*For online certification credit alone will be assigned on submission of certificate obtained through appearing for online examination from spoken tutorial, EDX, NPTEL etc.

Core I Food Science
[For those who joined since 2021-2022]

Semester: I **Hours per week: 6**
Sub. Code: HBFPC11 **Credit: 5**

Course outcomes:
After successful completion of this course, students will be able to:
CO 1: Gain basic knowledge of the food groups, food compositions and their significance.
CO2: Learn different methods of cooking foods and gain experience in food preparations.
CO3: Acquire knowledge about the changes occurring in various foodstuffs as a result of processing and cooking.

CO4: Gain knowledge about principles of food preservation and its application in food processing industry.
CO5: Improve knowledge about the nutrients and their importance.
CO 6: Understand and improve their skills in different food groups.

Unit I **[18 hours]**

Introduction to Food: Concept of food, Nutrients, Classification of food, Food groups and uses. Methods of cooking: Objectives, Merits and demerits. Moist heat methods – Boiling, Steaming, Blanching, Poaching, Steaming, Simmering, Pressure cooking. Dry heat methods – Baking, Roasting, Grilling, Parching, Frying – Sautéing, Deep fat, Shallow fat, Microwave cooking and solar cooking**.**

Unit II **[18 hours]**

Cereals and Millets: Classification, Structure, composition and nutritive value of cereals and millets. Role of Cereals and millets

Cereal and millet cookery: Effect of moist heat- Hydrolysis, Gelatinization and factors affecting gelatinization, gel formation, retro gradation and syneresis, Effect of dry heat, Role of cereals in cookery**.**

Pulses, Nuts and Oilseeds: Pulses - Classification, Structure, Nutritional Composition, Toxicants and nut allergies. Processing – Soaking, Germination and fermentation and its advantages.

Pulses Cookery - Effect of cooking, factors affecting cooking quality, Role of pulses in cookery.

Unit III **[18 hours]**

Meat: Classification, Nutritional Composition, Post-mortem Changes, Changes during cooking.

Egg: Types of eggs, Structure, Nutritional Composition, Quality of Eggs, Role of egg in cookery.

Poultry: Classification of Poultry, Nutritional Composition, Cooking Methods.

Seafood: Classification of Fish, Nutritive value, Selection Factors and principles of fish cookery

Unit IV **[18 hours]**

Milk and Milk Products: Nutritional Composition, Types of milk. Processing – Pasteurization, Homogenization and Standardization of Milk.

Milk Products- Non fermented and fermented products**,** Changes during Cooking and Role of milk in cookery

Fats: Fats and oils - Composition, Smoking Temperature, Rancidity, Role of fats and oils in cookery. Different methods of oil Extraction from seeds and their comparison.

Sugars: Classification, Sources, Sugar cookery: Crystallization and factors affecting crystallization; Stages of sugar cookery; Role of sugar and Jaggery in cookery.

Unit V **[18 hours]**

Vegetables and Fruits: Classification, Nutritional Composition, Pigments - Water soluble and fat soluble. Selection and cooking methods, Changes during Cooking - Enzymatic Browning - Causes, Prevention and conservation of nutrients.

Beverages: Types of Beverages and its health benefits. Spices and their medicinal importance.

Text Books:

1. Shakuntala Manay. N, Shadaksharaswamy .M, **Food Facts and Principles**, New AgeInternationalPublishers, 2nd Edition, 2008.
2. Srilakshmi.B, **Food science,** New Age International Publishers, New Delhi, 8th Edition, 2019.

Reference Books:

1. Fellows P J, **Food Processing Technology: Principles and practice,** CRC Wood head PublishingLtd, Cambridge, 4thedition, 2016.
2. Berk.z **Food Process Engineering and Technology**, Elsevier Academic Press, New York, 3rd Edition, 2018.

Journals:

1. Journal of Food Science
2. Journal Nutrition and Food Science
3. Journal of Food Science and Technology.
4. Journal of Agricultural and Food Chemistry
5. Journal of Dairy Science

Web Resources:

1. http://www.netfind.com/FoodGroups
2. http://www.netfind.com/CookingMethods
3. http://www.NetFind.com/CerealsAndPulses
4. http://www.netfind.com/FleshFoods
5. http://www.organicfacts.net/health-benefits/beverage

CORE II Food Science Practical

[For those who joined since 2021-2022]

Semester: I **Hours per week: 4**

Sub. Code: HBFPC12P **Credit: 3**

Course outcomes:

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

CO1: Acquire skills in food preparation techniques.

CO2: Learn microscopic examination in starch foods.

CO3: Understand and improve their skills in food handling techniques.

CO4: Learn changes during cooking in different foods.

CO5: Improve their skills in different types of cookery.

CO6: Gain knowledge about the different types of beverages

List of Experiments

1. **Principles of Food Safety and Lab Management Techniques**: Measurement of Ingredients, Determination of Edible Portion.

2. **Cereal Cookery:** Microscopic Examination of Starches, Gelatinization of starch

3**. Preparation of Fermented Foods by using Cereals and Millets**: Idli, Appam, Dosai, Bajra Porridge.

4. **Preparation of Granules:** Gluten Formation, Methods of Cooking - coarse and fine cereals.

5.**Different types of cooking methods:** Cooking Quality of Raw and Parboiled Rice by different methods - Pressure Cooker, Straining, Absorption, Steaming and Microwave Cooking.

6. **Pulse cookery:** Factors affecting Pulse Cookery – Hard water, Soft water, Soaking, Addition of acid, Alkali, Enzyme, pressure cooking example- Any whole gram and any dhal

7. **Egg cookery:** Boiling and Parching, Omelet and Custard, Quality determination of Egg
8. **Meat, fish and poultry:** Methods of Cooking, Common Recipes, Tenderization.

9. **Milk cookery**: Problems in Milk Cookery and their Prevention, Milk preparations: Cheese, Curds, Paneer, Butter and Milk Kefir.

10. **Frying of Foods in Oil**: Smoking Temperature, Methods of Cooking.

11. **Stages of sugar cookery:** white Sugar, Jaggery, Palm Jaggery and crystallization of sugar and Sugar Products.

12. **Vegetables and Fruits:** Effect of acid, alkali and over cooking on vegetables containing different pigment and enzymatic browning in vegetables and fruits and any four methods of prevention, Color and Textural Changes on Cooking, Preparation of selected recipes.

13. **Beverages:** Types and Preparation of beverage under the following types- refreshing, nourishing, stimulating, soothing and appetizing.

14.**Fireless Cooking**- Puffed Rice, Peanut butter balls, Chocolate truffles, Veg Hung curd Sandwich, Fruit Sushi

Text Books:

1. Mohini Sethi and EramSRao**, Food Science – Experimentsandapplications**, CBSPublishers,

NewDelhi, 2nd Edition, 2002.
2. Srilakshmi.B, **FoodScience–LaboratoryManual**,ScitechPubPvtLtd,Chennai,6th Edition,2015.

Reference Books:

1. FellowsPJ,**FoodProcessingTechnology:PrinciplesandPractice**,CRCWoodheadPublishingLtd., Cambridge, 4thedition, 2016.
2. Brown A, **Understanding Food Principles and Preparation**, Wordsworth Publisher, London, 5th edition, 2014.

Journals:

1. InternationalJournalof FoodScience and Technology.
2. CurrentNutritionandFoodScience.
3. FoodScienceandBiotechnology.
4. JournalofFoodScienceEducation.
5. AdvanceJournalofFoodScienceandTechnology.

Web Resources:

1. http://www.eNow.com/FoodManagementSafety
2. http://www.yummly.com/recipes/cereal-cookies
3. http://www.myrecipes.com/recipe/cereal-milk-bars
4. http://www.cookinglight.com/food/recipe-finder/pulse-recipes
5. http://www.organicfacts.net/health-benefits/beverage

First Allied I Principles of Food Processing
[For those who joined since 2021-2022]

Semester: I **Hours per week: 6**
Sub. Code: HBFPA13 **Credit: 5**

Course Outcomes:

Upon completion of the course, students will gain knowledge on

CO 1: An overview of food processing, preservation and associated food processing unit operation.

CO 2: Understanding the principles of food processing and the choice of food preservation in relation to food composition.

CO 3: Relation between food processing and food preservation.

CO 4: Conversion of raw commodities into a value added product.

CO 5: Emerging technologies in food processing.

CO 6: Importance of value addition of foods.

Unit I **[18 hours]**

Introduction to Food Processing: Importance of food processing in value addition. Types of processing: primary, secondary and tertiary processing of foods. Need for food processing and preservation-Trends in Food industries.

Unit II **[18 hours]**

Food Preservation: Methods of Food preservation-Principles of food preservation- Asepsis/ Removal of Microorganisms- Maintenance of anaerobic conditions.

Unit III **[18 hours]**

Preservation by High and Low Temperature: Heat treatment employed in processing foods-Pasteurization- Heating at/above 100°C- Canning.

Low temperature treatments employed in food processing- Chilling- Freezing and its types-Changes during Freezing.

Unit IV **[18 hours]**

Preservation by Drying: Drying-Methods of drying-Convection drying, Drum drying, Freeze Drying, Microwave-vacuum drying, Shelf dryers, Spray drying and Infrared radiation drying-Treatments of foods before drying- Procedures after drying- Intermediate moisture foods and Individual Quick Freezing (IQF) – IQF technologies.

Unit V **[18 hours]**

Preservation by radiation and Food additives: Radiation – types of ionizing radiations – Effects of radiation on food- UV irradiation- Microwave processing.

Preservation by Food additives: Food Additive Definition-Use of Food additives`- Classification.

Text Book:

1. Fellows, P. J. **Food processing technology: principles and practice**. Elsevier, 2009.

Reference Books:

1. Ramaswamy, H. S &Marcotte, M. **Food processing: principles and applications**. CRC Press, 2005.
2. Smith, J. S., & Hui, Y. H. **Food processing: principles and applications**. John Wiley &Sons, 2008.
3. Potter, N. N., & Hotchkiss, J. H." **Food science.**" Springer Science & Business Media, 2012.

Web Resources:

1. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=795
2. https://ncert.nic.in/textbook/pdf/lehe105.pdf
3. http://mragheb.com/
4. http://www1.ccs.k12.in.us/teachers/downloads/cms_block_file/101361/file/137433
5. https://www.sciencedirect.com/topics/food-science/food-preservative

Skill Based Elective I Bakery and Confectionery Practical

[For those who joined since 2021-2022]

Semester: I **Hours per week: 2**

Sub. Code: HBFPE14P **Credit: 2**

Course Outcomes:

Upon completion of the course, students will gain knowledge on

CO 1: Various methods of dough mixing and factors involving during mixing

CO 2: Raw materials used in bakery & confectionery and its role.

CO 3: Scaling of ingredients for commercial baking.

CO 4: Faults and remedies of bakery products.

CO 5: Glazing cakes and pastries.

List of Experiments:

1. Preparation of white bread.
2. Preparation of pizza base.
3. Methods of cake mixing.
4. Preparation of sponge cake and cupcake.
5. Preparation of butter cookies.
6. Stages of sugar cookery.
7. Preparation of fondant icing, royal icing and marzipan.
8. Preparation of fudge and fondant.
9. Preparation of groundnut candy.
10. Preparation of chocolate.

Text Book:

1. YogambalAshokkumar, **Textbook of bakery and confectionery**, phi publisher**,** Second edition, 2012.

Reference Books:

1. Wayne GisslenJohn Wiley & SonBakers **handbook on practical bakingWheat associates**. New delhi, 1966.
2. Manley, Duncan. **Biscuit Doughs** Manual 2, Wood head Publishing Ltd., England. 2009.
3. Hui, Y.H, **Bakery products, Science and Technology**, Black Well publishing, 2006.
4. Bakery & Confectionery - Acharya ng ranga agricultural university,2012

Web Resources:

1. https://www.africanbites.com/groundnut-sweet-sugar-peanuts-aka-candied-nuts/
2. https://www.allrecipes.com/recipes/750/desserts/candy/fudge/
3. https://www.biggerbolderbaking.com/how-to-make-rolled-fondant/
4. http://www.craftybaking.com/howto/mixing-method-basics
5. https://www.sfu.ca/geog351fall03/groups-webpages/gp8/prod/prod.html

Core III Food Chemistry

[For those who joined since 2021-2022]

Semester: II **Hours per week: 4**

Sub. Code: HBFPC21 **Credit: 3**

Course Outcomes:

Upon completion of the course, students will gain knowledge on

CO 1: Understanding the food components and its role.

CO 2: Biochemical reactions that influence food quality.

CO 3: Identifying the nature of food components, its properties to assess the changes in the final products.

CO 4: Processing conditions that change the reactivity of food components.

Unit I **[12 hours]**

Water: Definition of water in food- structure of water and ice. Types of water. Interaction of water with solutes. Sorption phenomenon. Water activity and packaging. Water activity and spoilage.

Unit II **[12 hours]**

Lipids: Classification of lipids; Characteristics: Physical properties- melting point, softening point, specific gravity, refractive index, smoke, flash and fire point, turbidity point. Chemical properties- reichertmeissel value, polenske value, iodine value, peroxide value, saponification value. Effect of frying on fats. Changes in fats and oils- rancidity, lipolysis, flavor reversion. Auto-oxidation and its prevention.Putrefaction.Technology of edible fats and oils-Refining, Hydrogenation and Inter-esterification.

Unit III **[12 hours]**

Proteins: Protein classification and structure. Nature of food proteins [plant and animal proteins].Properties of proteins [electrophoresis, sedimentation, amphoterism and denaturation,]. Functional properties of proteins e.g. organoleptic, solubility, viscosity, binding gelation / texturization,emulsification, foaming.

Unit IV **[12 hours]**

Carbohydrates: Classification [mono, oligo and poly saccharides]. Structure of important polysaccharides [starch, glycogen, cellulose, pectin, hemicelluloses, and gums].Chemical reactions of carbohydrates. Modified celluloses and starches.

Unit V **[12 hours]**

Vitamins: Structure, Physiological Importance and Stability. Water soluble vitamins- Fat soluble vitamins - Antioxidants. Food applications of Vitamins. Effect of food processing on Vitamins.

Text Books:

1. DeMan, J. M. **Principles of food chemistry. 4th ed. New York**, 19: AVI Publishing Co., Inc., 2018.

Reference Books:

1. Velisek, J., Koplik, R., & Cejpek, K. (2020). **The chemistry of food**. John Wiley & Sons.

2. Damodaran, S., Parkin, K. L., & Fennema, O. R. (Eds.). (2007). **Fennema's food chemistry**. CRC press.
3. Lee, F. (2012). **Basic food chemistry**. Springer Science & Business Media.Belitz, H. D., Grosch, W., &Schieberle, P. **Food chemistry**, 4th revised and extended edn. Heidelberg, Germany. 2009.
4. Yildiz, Fatih [2009], "**Advances in Food Biochemistry**", CRC Press, New York.

Web Resources:

1. https://www.biochemden.com/carbohydrates-classifications/
2. http://egyankosh.ac.in/handle/123456789/1056
3. http://ecoursesonline.iasri.res.in/course/view.php?id=89
4. http://vle.du.ac.in/mod/book/view.php?id=13512&chapterid=30103
5. http://www1.lsbu.ac.uk/water/water_molecule.html
6. https://www.precisionnutrition.com/all-about-vitamins-minerals

Core IV Food Chemistry Practical
[For those who joined since 2021-2022]

Semester: II **Hours per week: 4**
Sub. Code: HBFPC22P **Credit: 3**

Course Outcomes:

Upon completion of the course, students will gain knowledge on

CO 1: Laboratory techniques common to basic and applied food chemistry.
CO 2: Principles behind analytical techniques associated with food.
CO 3: Food chemistry to control reactions in foods.
CO 4: Physical, Chemical and Biological changes of food ingredients.
CO 5: Chemistry underlying the properties and reactions of various food components.
CO 6: Understanding the reactions of food components during processing: Browning, Maillard reaction, Denaturation etc.

List of Experiments:

1. Estimation of total ash and acid insoluble ash.
2. Qualitative analysis of carbohydrates.
3. Qualitative analysis of lipids.
4. Qualitative analysis of proteins.
5. Estimation of Viscosity and refractive index of foods.
6. Estimation of Specific gravity and Oxidative rancidity of fat and oils.
7. Estimation of crude and dietary fiber.
8. Studies on gelling properties of starch.
9. Experiments on factors preventing enzymatic browning.
10. Determination of calorific value by direct calculation method.

Text Book:

1. Picó, Y. (Ed.). (2012). **Chemical analysis of food: Techniques and applications**. Academic Press.
2. Weaver, C. M., & Daniel, J. R. [2003]. **The food chemistry laboratory: a manual for experimental foods, dietetics, and food scientists, 2nd ed** CRC Press.

Reference Books:

1. Nielsen, S. S. (2017). **Introduction to food analysis**. In Food analysis (pp. 3-16). Springer, Cham.
2. Jayaram.J. [2005], **Laboratory Manual in Biochemistry**, New Age International Ltd, Publishers, New Delhi, Fifth Reprint.
3. Sadasivam, S and Manickam, A [2007] **Biochemical Methods**, New age International Pvt. Publishers, New Delhi, 2nd Edition.

Web Resources:

1. https://www.itwreagents.com/uploads/20180114/A173_EN.pdf
2. http://www.food-info.net/uk/colour/enzymaticbrowning.htm
3. http://www.rheosense.com/what-is-viscosity
4. https://www.feedipedia.org/node/8330
5. https://www.sciencedirect.com/topics/engineering/bomb-calorimeter

First Allied II Basic Horticulture
[For those who joined since 2021-22]

Semester: II **Hours per week: 6**
Sub. Code: HBFPA23 **Credit: 5**

Course outcome:

Upon completion of course, students will gain knowledge on

CO 1: To acquaint with importance, division and classification of horticultural crops.
CO 2: To understand the basic principles and types of plant propagation.
CO 3: To improve the knowledge about post harvesting techniques of horticultural crops.
CO 4: To Study the importance olericulture, and pomology science.

Unit I **[15 hours]**

Fundamentals of horticulture: Horticulture- Definition-Scope and Importance-Nutritive value and Global scenario of horticultural crops-Division and classification of horticultural crops-Horticultural zone in India.

Unit II **[15 hours]**

Propagation techniques: Propagation-Definition-Propagation methods- Seed propagation-Vegetative propagation-Cutting, Layering, Grafting and Budding methods-Specialized plants parts for propagation-Micro-propagation and Tissue Culture in propagation.

Unit III **[15 hours]**

System of production: Planting of systems including HDP and UHDP- Cropping system-protected cultivation-principles and structures used- Shade net houses,polyhouses-special structures are used for propagation-Mist chambers, Hot beds and Pre- cooling techniques- room cooling, Forced air cooling , Hydro cooling Hydro cooling, Top icing Evaporative cooling, Vacuum cooling and Hydrovac cooling.

Unit IV [**15 hours]**

Crop management practice: Weed management- irrigation and moisture conservation-nutrition of horticultural crops and application methods in horticultural crops-special practices-Training, Pruning, Ringing, Notching, Disbudding, and Pinching.

Unit V **[15 hours]**

Maturity, harvesting and physiological of ripening: Classification of fruits-climacteric fruits and non climacteric fruits; Horticultural maturity & maturity indices and its importance-harvesting methods; Post harvesting physiological and biochemical changes in fresh fruits and vegetables; Regulation of ripening- Role of ethylene, Post harvest treatment-Use of chemical preservatives to extend the shelf life of horticultural crops.

Text Books:

1. N Kumar **Introduction to Horticulture**, Eighth Edition**,**Medtech Publishers**,** 2018.

2. K.V.Peter, **Basics of Horticulture,** 2nd revised edition,2015.

3. George acquaah**, Horticulture- Principles and practices**,2005.

4. Martha C.Straus and Saron Pasters, **Basic Horticulture**, 2010.

Reference Books:

1. Bose, TK., Mitra, SK. and Sadhu, K. 1986.**Propagation of tropical and subtropical Horticulturalcrops**.NayaProkash, Calcutta.

2. Denixon, RI. 1979. **Principles of Horticulture**. Mac Millan, New York.

3. Edmond, JB., Sen, TD, Andrews, TS and Halfacre, RG. 1977. **Fundamentals of Horticulture**. Tata McGraw Hill, New Delhi.

4. Hartmann, HT. and Kester, DE.1986.**Plant propagation - Principles and Practices**. Prentice-Hall, New Delhi.

Web Resources:

1. http://www.cbseacademic.nic.in/web_material/publication/cbse/24BasicHorticulture-I-XI.pdf
2. https://agrimoon.com/fundamentals-of-horticultur-pdf-book/
3. http://www.agrilearner.com/basic-horticulture-pdf-download/

4. https://www.asps.org.au/wp-content/uploads/Chapter-11-Fruit-growth-ripening-and-post-harvest-physiology.pdf
5. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/crop-management

Skill Based Elective II Basic Food Processing Practical
[For those who joined since 2021-2022]

Semester: II **Hours per week: 2**
Sub. Code: HBFPE24P **Credit: 2**

Course Outcomes:
Upon completion of the course, students will gain knowledge on
CO 1: Showing the methods to extend the shelf life of the food.
CO 2: Defining the technology and theories for all unit operations that used food industries.
CO 3: Value addition of foods.
CO 4: Natural and chemical preservation of foods.

List of Experiments:
1. Extension of shelf life/ preservation of foods by use of low temperature.
2. Processing and preservation of Peas by use of high temperature.
3. Preservation and processing of vegetables by drying and different between natural and controlled drying process.
4. Osmotic concentration/dehydration of fruits and vegetables using concentrated sugar and salts solutions (reduction of water activity)
5. Preservation by sugar- Jam/Jelly preparation.
6. Preservation by spices/ vinegar or chemical preservatives -Preparation of tomato puree/ketchup.
7. Preservation by retort and sterilization in thermal processing- RTS preparation.
8. Preservation by salt & oil- pickle preparation.
9. Visit to any food processing plant.

Text Books:
1. Srilakshmi, B. **Food science.** New Delhi: New Age International., 2014.
2. Peter J. Fellows, **Food processing technology: principles and practice,** fourth edition, 2017.

Reference Books:
1. Desrosier.N.W. **The technology of food preservation**. The Av Publishing Co., Inc. West Poet, Connect cut 1973.
2. Srilakshmi, B. **Food science**. New Delhi: New Age International., 2014.
3. Potter, N. N., & Hotchkiss, J. H. . **"Food science."**Springer Science & Business Media, 2012.

Web Resources:

1. http://www.homefamily.net/2011/07/17/making-jam-and-jelly/
2. https://food.ndtv.com/lists/10-best-pickle-recipes-777887
3. http://foodviva.com/cooking-basics/tomato-puree/
4. http://krishna.nic.in/PDFfiles/MSME/Food/Tomato%20Sauce%20and%20Ketchup[1].pdf
5. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=19474

Extra Credit Food Hygiene and Sanitation
[For those who joined since 2021-22]

Semester: II **Hours per week:**
Sub. Code: HBFPX2/ HBFPX20 **Credit: 2**

Course Outcomes:
Upon completion of the course, students will have knowledge on
CO 1: The principles and practices of hygiene and sanitation applied to the food industry.
CO 2: Training of supervisory personnel in sanitation procedures.
CO 3: Identification and prevention of potential sources of food contamination.
CO 4: Proper standards and procedures for keeping the facilities and equipment sanitary.

Unit I
Introduction to sanitation and hygiene: Food Sanitation and Principles of Sanitation Personnel Hygiene.

Unit II
Personal hygiene & safety:
Necessity for personal hygiene, Health of staff,Personal appearance, Sanitary practice habits- Protective clothing- Safety at the work place.

Unit III
Sanitary procedures in food industry:
Importance of sanitary procedures in Food processing - Cleaning procedures – Cleaning in place cleaning out place. Cleaning & sanitizing and their importance and waste management -solid and liquid waste.

Unit IV
Pest control with respect to food safety:
Importance, Classification of pest, effect of pesticides on pest & their methods of application, pre caution to be taken while handling pesticides.

Unit V

Pre-requisite procedures in food industry: Good Manufacturing Practice [GMP], Good Hygienic Practice [GHP],Total Quality Management and Hazard Analysis and Critical Control Points [HACCP]

Text Books:

1. Roday. **Food Hygiene & Sanitation,** McGraw-Hill Education [India] Pvt Limited, 2nd edition, 2011.
2. Norman G. Marriott and Robert B. Gravani, **Principles of Food Sanitation**, Aspen publisher, 5th edition, 2006.
3. Jacob.M, **Safe food handling, a training guide for Manager,** WHO, Geneva, 1989.

Reference Books:

1. Forsythe, S.J. and Hayes, P.R. **Food Hygiene, Microbiology and HACCP**. Gaitersburg, Maryland: Aspen publisher, 1998.
2. Hui, Y.H., Bruinsma, B., Gorham, R., Nip, **Food Plant Sanitation.** New York: Marcel Dekker, 2003.
3. Rees, N. and D. Watson. **International Standards for Food Safety.** Gaitersburg, Maryland: Aspen publisher, 2000.

Web Resources:

1. http://vikaspedia.in/health/sanitation-and-hygiene/personal-hygiene
2. https://www.foodsafetymagazine.com/magazine-archive1/februarymarch-2007/sanitation-best-practices/
3. https://www.foodsafetymagazine.com/magazine-archive1/aprilmay-2005/basic-elements-of-effective-food-plant-cleaning-and-sanitizing/
4. http://www.foodqualityandsafety.com/article/7-steps-to-an-effective-pest-managemet-program/
5. https://online-training.registrarcorp.com/downloads/Basics-of-HACCP-and-Prerequisite-Programs.pdf

Core V Technology of Milk and Milk Products
[For those who joined since 2021-2022]

Semester: III **Hours per week: 6**
Sub. Code: HBFPC31 **Credits: 4**

Course Outcome: Upon completion of the course, students will be able to understand
CO 1: Importance and Nutritional value of milk and its products
CO 2: Preservation methods for dairy products
CO 3: Unit operations in milk processing
CO 4: Processing of various by products
CO 5: Safety and Quality of dairy products
CO 6: Transport and Storage of milk

Unit I **[18 Hours]**

General Introduction about Milk: Definition of milk, typical composition of milk of different species i.e. buffalo, cow, goat. Composition of milk, its constituents, Milk- physiochemical properties. Milk chilling- methods, Storage tanks and transportation of milk.

Unit II **[18 Hours]**

Milk Processing and Quality testing: Systems of collection of milk. Reception, Platform testing- Quality testing - Snf, fat , protein, MBRT test, phosphatase enzyme Test. Various stages of milk processing- process flow diagram - Filtration, Clarification, Standardization- Homogenization- Pasteurization - objectives and methods [LTLT,HTST,UHT] - advantages and disadvantages.

Unit III **[18 Hours]**

Milk Processing equipments: Pasteurization- functions of HTST & UHT pasteurizer –milk flow diagram - description and working of milk processing equipments – plate heat exchanger, homogenizer, clarifier, cream separator, Ice Cream Freezers, Vacuum Evaporators, Spray and Drum dryers, filtration - UF and RO

Unit IV **[18 Hours]**

Manufacture of Milk and Milk products: Milk - fluid milk - standardized - toned – reconstituted & recombined milk. Special Milks - Soft curd milk – Flavored milk - Vitaminized milk – sterilized milk - Imitation milk. Condensed milk, – manufacturing methods. Milk powder - spray drying- construction, powder recovery system, Butter, ghee manufacture –methods, Ice cream-Role of ingredients- processing,

Unit V **[18 Hours]**

Desi milk products – Fermented dairy products process flow diagram- Curd, Yoghurt, shrikhand, cheese processing – methods - Desi products – Paneer- khoa, desi milk sweets [Rasamalai, Basundi, Rabri and others].

Text Books:

1. Tufail Ahmed., "**Dairy Plant Engineering and Management**", Kitab Mahal Publishers, Allahabad, 2003.
2. De, Sukumar. **Outlines of dairy technology**. New Delhi: Oxford University Press, 2011.
3. Spreer, E. **Milk and dairy product technology**. Routledge. (2017).

Reference Books:

1. Robinson, R. K., [2012], "**Modern Dairy Technology: Volume 2 Advances in Milk Products**", Springer Science & Business Media Publishers.
2. Smit, Gerrit, ed. **Dairy processing: improving quality**. Elsevier, 2003.

3. Lampert, Lincoln M. "**Modern Dairy Products: Composition, Food Value, Processing, Chemistry, Bacteriology, Testing, Imitation Dairy Products**".3rd ed. Chemical Publishing Company, 1998.

Journals:

1. Dairy Technology Societies. Journal of Dairy Science, 45[1], Xii. doi:10.3168/jds.s0022-0302[62]89317-5, [1962].
2. Jelen, P. Dairy Education | Dairy Technology. Encyclopedia of Dairy Sciences, 6-12. doi:10.1016/b978-0-12-374407-4.00109-6, [2011].

Web Resources:

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=15
2. http://egyankosh.ac.in/handle/123456789/650
3. Dairy Technology by P. Walstra [eBook] - ebooks.com. [n.d.]. Retrieved from https://www.ebooks.com/en-us/216053/dairy-technology/walstra-p/
4. Milk and Dairy Product Technology [Food Science and Technology]. [n.d.]. Retrieved from https://www.amazon.com/Milk-Dairy-Product-Technology-Science/dp/0824700945
5. https://agritech.tnau.ac.in/postharvest/pht_anifoods_ls_milkva.html

Core VI Technology of Milk and Milk Products Practical
[For those who joined since 2021-2022]

Semester: III **Hours per week: 6**
Sub. Code: HBFPC32P **Credits: 4**

Course Outcome: Upon completion of the course, students will be able to understand
CO 1: Preparation of various milk products.
CO 2: Quality assessment of milk products.
CO 3: Microbial analysis of milk.
CO 4: Value addition of milk.
CO 5: Role of properties of milk.
CO 6: Knowledge on processing of milk at industrial level.

List of Experiments

1. Determination of viscosity, density and specific gravity of milk.
2. Determination of acidity and pH of milk.
3. Platform test - Methylene Blue Reduction Test, clot on boiling test, Phosphatase test
4. Preparation of fermented milk products yoghurt, Dahi [curd] etc.
5. Preparation of Shrikhand.
6. Preparation of butter and ghee.
7. Preparation of Sweetened and non – sweetened Khoa.
8. Preparation of Paneer.
9. Preparation of Flavored milk.
10. Testing of Adulteration in milk and milk products.
11. Visit to dairy plants.

Reference Books:

1. De, Sukumar. **Outlines of dairy technology.** New Delhi: Oxford University Press, 2006.
2. Tufail Ahmed., "**Dairy Plant Engineering and Management**", Kitab Mahal Publishers, Allahabad, 2003.
3. FSSAI **Manual Method of analysis of food products – Milk and Milk Products**, 2016

Journals:

1. Edgar, S. Milk Processing. Milk and Dairy Product Technology, 71-154. doi:10.1201/9780203747162-4, (2017).
2. Varnam, A. H., & Sutherland, J. P. (2001). Liquid Milk and Liquid Milk Products. Milk and Milk Products, 42-102. doi:10.1007/978-1-4615-2798-5_2

Web Resources:

1. FAO.org. (n.d.). Retrieved from **http://www.fao.org/dairy-production-products/processing/en/**
2. Foodsafety.gov. (2009, August 23). Milk, Cheese, and Dairy Products. Retrieved from **https://www.foodsafety.gov/keep/types/milk/index.html**
3. Dairy Technology by P. Walstra [eBook] - ebooks.com. [n.d.]. Retrieved from https://www.ebooks.com/en-us/216053/dairy-technology/walstra-p/
4. Milk and Dairy Product Technology [Food Science and Technology]. [n.d.]. Retrieved from https://www.amazon.com/Milk-Dairy-Product-Technology-Science/dp/0824700945
5. https://agritech.tnau.ac.in/postharvest/pht_anifoods_ls_milkva.html

Second Allied I Food Microbiology
[For those who joined since 2021-2022]

Semester-III **Hours per week: 6**

Sub. Code: HBFPA33 **Credits: 5**

Course Outcome: Upon completion of the course, students will be able to understand

CO 1: Need and Importance of food microbiology.

CO 2: Identify genera of microorganisms associated with food and their characteristics.

CO 3: Role of microbes in food processing -fermentation, spoilage and food borne diseases.

CO 4: Factors affecting the growth of microorganisms.

CO 5: New techniques of food preservations such as bio preservatives, hurdle technology, active packaging.

CO 6: Knowledge on food borne pathogens and its preventive measures.

Unit I **[18 Hours]**

Introduction to Food microbiology & Characteristics of Microorganisms in Food: History and Development of Food Microbiology -Definition and Scope of food microbiology. Classification of microorganisms and Nomenclature- Characteristics and morphology of

microorganisms- bacteria, fungi- Importance of microorganisms in food (bacteria, fungi).Significance of spores in food microbiology.

Unit II **[18 Hours]**

Microbial Growth in Food: Microbial Growth Characteristics- Bacterial growth curve- Microbial reproduction- Factors affecting the growth of microorganisms in food (intrinsic and extrinsic). Food Borne Disease. Principle of Thermal destruction of spoilage causing organism.

Unit III **[18 Hours]**

Microbial Food Spoilage: Sources of Microorganisms in foods- Introduction to Spoilage causing microorganism in food-Changes caused by micro-organisms during spoilage. Chemical changes by Microbes.

Unit IV **[18 Hours]**

Control of Microorganisms in Foods: Principles and methods of preservation- High temperature, low temperature, drying, Fermentation- Importance of LAB, Saccharomyces cerevisiae, Probiotics, Radiation, chemical preservatives, Bio preservatives, Hurdle technology, Active packaging, Novel processing technology.

Unit V **[18 Hours]**

Microbiology of food product: Contamination, preservation, spoilage of Milk and milk products- Meat- poultry and sea foods- Cereal and cereal products- Fruits and vegetables and canned products, Ready to serve foods spoilage.

Text Books:

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.

Reference Books:

1. Pelczar MJ, Chan E.C.S and Krieg, Noel R. **"Microbiology"**, 5th Ed., TMH, New Delhi, 1993.
2. G. J. Banwart: **"Basic Food Microbiology"**. 781 Seiten, zahlr. Abb. Und Tab. AVI Publishing Comp., Inc., Westport 1979. Preis 22.
3. Ray, Bibek, and ArunBhunia. **Fundamental food microbiology**. CRC press, 2007.

Journals:

1. Food Technology & Processing. (n.d.). Retrieved from **https://aggie-horticulture.tamu.edu/food-technology/food-processing-entrepreneurs/microbiology-of-food/**
2. Introduction to the Microbiology of Food Processing. (n.d.). Retrieved from **https://www.fsis.usda.gov/shared/PDF/SPN_Guidebook_Microbiology.pdf**

Web Resources:

1. International **Journal of Food Microbiology. (2015).** Food Microbiology, 47. doi:10.1016/s0740-0020(14)00320-7
2. Skovgaard, N. (2005). **Current topics in food microbiology. International Journal of Food Microbiology,** 99(1), 107-111. doi:10.1016/j.ijfoodmicro.2004.07.020
3. https://aggie-horticulture.tamu.edu/food-technology/food-processing-entrepreneurs/microbiology-of-food/
4. https://www.sciencedirect.com/topics/food-science/microbial-growth-in-food
5. https://www.open.edu/openlearncreate/mod/oucontent/view.php?id=194&printable=1

Skill Based Elective IV Food Microbiology Practical
[For those who joined since 2021-2022]

Semester: III **Hours per week: 3**
Sub. Code: HBFPE34P **Credits: 2**

Course Outcome: Upon completion of the course, students will be able to understand
CO 1: Knowledge on microbial analysis and its procedure.
CO 2: Handling of microbiology equipments
CO 3: Identification of food pathogens
CO 4: Methods for microbial analysis of food products
CO 5: Identify the morphology of bacteria using different staining techniques.
CO 6: Microbial examination of various food samples

List of Experiments:

1. Microscopy – compound and simple microscope-Working and care of Microscope
2. Preparation of solid and broth media.
3. Study of autoclave and sterilization of nutrient media and glass wares
4. Familiarization with common techniques for handling pure culture serial dilution
5. Dilution and Plating by spread plate, pour plate, streak plates and slant culture techniques.
6. Gram Staining and Study of morphology of bacterial cells.
7. Simple and differential staining of microorganisms and their examination.
8. Study of microbiological quality of milk by MBRT test.
9. Experiment on microbiological count method [SPC] for natural and processed foods and Determination of viable, and non-viable count of microorganisms.
10. Microbiological examination of potable water: Total and coliform count, MPN.

Reference Books:

1. Harrigan, W. F., & McCance, M. E. **Laboratory methods in microbiology**. Academic press. (2014).
2. Roberts, D., & Greenwood, M. **Practical food microbiology**. John Wiley & Sons. (2008).
3. https://old.fssai.gov.in/Portals/0/Pdf/15Manuals/MICROBIOLOGY%20MANUAL.pdf

4. Dubey, R.C. and Maheshwari, D.K. Practical microbiology, 5th ed. S.Chand and Company Limited, Ramnagar. New Delhi 2012.
5. Da Silva, N., Taniwaki, M. H., Junqueira, V. C., Silveira, N., do Nascimento, M. S., & Gomes, R. A. **Microbiological examination methods of food and water** (pp. 436-436). London: CRC Press. (2013).

Journals:

1. Odumeru, J. A. [n.d.]. Microbial Safety of Food and Food Products. Food Biochemistry and Food Processing, 689-704. doi:10.1002/9780470277577.ch30
2. Sample preparation for microbial analysis in foods. Trends in Food Science & Technology, 8[9], 315. doi:10.1016/s0924-2244[97]80268-3, [1997].

Web Resources:

1. Microbiological Examination of Foods: 7 Methods. [2016, October 17]. Retrieved from http://www.biologydiscussion.com/food-microbiology/microbiological-examination-of-foods-7-methods/59581
2. Testing Methods in Food Microbiology. [n.d.]. Retrieved from https://www.eolss.net/sample-chapters/c10/e5-08-06-06.pdf
3. https://aggie-horticulture.tamu.edu/food-technology/food-processing-entrepreneurs/microbiology-of-food/
4. https://www.sciencedirect.com/topics/food-science/microbial-growth-in-food
5. https://www.open.edu/openlearncreate/mod/oucontent/view.php?id=194&printable=1

Extra Credit Food Adulteration
[For those who joined since 2021-2022]

Semester: III **Hours per week:**
Sub. Code: HBFPX3/ HBFPX30 **Credits: 2**

Course Outcome: Upon completion of the course, students will be able to understand
CO 1: Testing methods for adulteration
CO 2: Identification of adulteration in food samples
CO 3: Comparison of food adulterated in our day-to-day life
CO 4: Consequences of adulteration.
CO 5: Permissive level of food additives to be used
CO 6: Assess the quality of food

Unit I

Food adulteration: Definition, Classification- Health hazards caused by various adulterants - Critical levels of metals in various foods-The prevention of Food Adulteration Act.

Unit II

Composition and quality criteria for plant foods: Oils and Fats-Spices and condiments - Food grains - Fruits & Vegetables - Beverages- Alcoholic & Non Alcoholic.

Unit III

Composition and quality criteria for animal foods: Milk and Milk Products -Flesh Foods – Egg.

Unit IV

Composition & quality criteria for sugar & preserves & tin foods: Sugar and Sugar products - Preserves - Tin Foods.

Unit V

Food additives: Introduction - Classification- Antioxidants, Preservatives, Emulsifiers, Stabilizers, sweeteners, thickening agents, chelating agents, curing agents, leavening agents, anti-caking agents, coloring agents, flavoring agents.

Text Books:

1. Pearson, David. The chemical analysis of foods. No. Ed. 7. Longman Group Ltd., 1976.
2. Reilly, Conor. Metal contamination of food: its significance for food quality and human health. John Wiley & Sons, 2008.
3. Madhavi, Dl L., S. S. Deshpande, and Dattajirao K. Salunkhe. Food antioxidants: Technological: Toxicological and health perspectives. CRC Press, 1995.

Reference Books:

1. Handbook of Analysis; QC for Fruits & Vegetable Products, [2012].
2. E.M.Master; Standard Methods for examination of Dairy Products, [2006].
3. Jacob; Chemical methods of Food Analysis, [2016].

Journals:

1. Kamruzzaman, M. Food Adulteration and Authenticity. Food Safety, 127-148. doi:10.1007/978-3-319-39253-0_7, [2016].
2. Stadler, R. H. Introduction to the Volume: Food Adulteration & Contamination. Encyclopedia of Food Chemistry, 317-319. doi:10.1016/b978-0-08-100596-5.21783-6, [2019].

Web Resources:

1. Food adulteration laws in India - Laws preventing food ... [n.d.]. Retrieved from https://blog.ipleaders.in/food-adulteration-laws-in-india/
2. Food Adulteration, Types of Food Adulteration and Mitigation Measures. [2018, August 05]. Retrieved from https://www.publichealthnotes.com/food-adulteration-types-of-food-adulteration-and-mitigation-measures/
3. https://ohioline.osu.edu/factsheet/hyg-5359
4. https://agritech.tnau.ac.in/postharvest/pht_anifoods_poul_eggvalue.html

5. https://foscos.fssai.gov.in/standard-product

Core VII Food Quality and Safety Management
[For those who joined since 2021-2022]

Semester: IV **Hours per week: 6**
Sub Code: HBFPC41 **Credits: 4**

Course outcome: Upon completion of the course, students will be able
CO1: Importance of quality assurance in food industry.
CO2: Analysis of hazards associated with food
CO3: Safety and quality assessment of food.
CO4: Hazard analysis and preventive measures
CO5: Sampling techniques for food analysis.
CO6: Food laws and regulations to be followed in food industries.
CO7: To understand the relationship between sensory and instrumental methods for the evaluation of food quality.
CO8: To acquire knowledge on statistical methods for sensory evaluation.

Unit I **[18 Hours]**

General Principles For Food Safety And Hygiene: Principles of food safety and quality –Food Safety System - Quality attributes- Total Quality Management. Introduction to Risk Analysis, Risk Management, Risk Assessment, Risk Communication. Background and Structure, GHP, GAP, GMP, PRP, OPRP, CP, CCP, Principles and Implementation of HACCP. Traceability and authentication, Certification and quality assurance.

Unit II **[18 Hours]**

General Principles For Food Safety Regulation At National/Regional Level: The Structure of Food Law, Laws and Regulations to Prevent Adulteration and Cross Contamination, Microbial Contamination, Hygienic Practice, Chemical and Environmental Contamination, Food Additives, Labeling, FSSAI Rules and Regulations.

Unit III **[18 Hours]**

National Standards & International Bodies Dealing In Standardization: PFA, FPO, MMPO, MPO, AGMARK, BIS, FSSAI Legal Metrology, Environment and Pollution Control Board, Factory License. International food standards. Trends in Food Standardization, An Overview and structure of 9001:2000/2008, Clause wise Interpretation of ISO 9001:2000,.Codex Alimentarius Commission [CAC],Other International Organizations Active in Food Standard Harmonization.

Unit IV **[18 Hours]**

Factors influencing sensory measurements: Attitudinal factors, motivation psychological errors in judgment, Correlation of sensory and instrumental analysis; Laboratory quality measurement: Types of tests ,panel selection and testing environment, serving procedures,

instruction to judges, difference tests, two-sample tests, three sample tests, multisampling tests, comparison of procedures, ranking, scoring, hedonic scaling, dilution procedures; Consumer measurement: Factors influencing acceptance and preference, types of questionnaires.

Unit V **[18 Hours]**

Quality of raw materials: Physical, chemical and microbial quality; Quality of products during processing and after processing: Color, taste, texture, flavor, appearance; Factors influencing the food qualities: Soil, field practices, harvesting practices, procedures, packaging, transportation, storage, conditions. Recording and reporting of quality. certification procedures, certifying bodies, accrediting bodies, international bodies.

Text Books:

1. Neal D. Fortin. **Food regulation**, Wiley Publishers. 2009.
2. Naomi Rees. David Watson. **International standards for food safety**, An Aspen Publications2000.
3. O'Rourke. **European Food law**, 3rd edition, Thomson, Sweet and Maxwell,2005.

Reference Books:

2. Khurana A D. "**Text Book of Food Safety**" by mohit publications [Unit I, II]. 2010.
3. Prakashsinha S., "**Principles of Food Processing**", by adhyayan publishers and distributors. 2009.
4. Bhuyan .M. **"Measurementand Control in Food Processing"**, CRC Press [1st ed], [Unit IV]. 2007.
5. Herbert Stone, Joel L. Sidel, [2012], **"Sensory Evaluation Practices**", Academic Press Publishers.
6. Maynard A. Amerine, Rose Marie Pangborn, Edward B. Roessler, [2013], **"Principles of Sensory Evaluation of Food**", Elsevier Publications.
7. Harry T. Lawless, HildegardeHeymann, [2010], **"Sensory Evaluation of Food: Principles and Practices"**, Springer Science & Business Media.

Journals

1. Barendsz, A. [1998]. Food safety and total quality management. Food Control, 9[2-3], 163-170. doi:10.1016/s0956-7135[97]00074-1
2. Manning, L., & Baines, R. [2004]. Effective management of food safety and quality. British Food Journal, 106[8], 598-606. doi:10.1108/00070700410553594

Web Resources:

1. https://www.researchgate.net/publication/267381371_food_quality_and_safety_management_systems_a_brief_analysis_of_the_individual_and_integrated_approaches
2. A MANUAL OF GOOD PRACTICES IN FOOD QUALITY MANAGEMENT. [n.d.]. Retrieved from http://toiduliit.ee/Upload/User/File/QUAMANCEEC manual.pdf

3. FOOD SAFETY & QUALITY AT FAO. [n.d.]. Retrieved from http://www.fao.org/food/food-safety-quality/home-page/en/
4. http://www.iaom-mea.com/wp-content/uploads/2016/07/Tech10-AGF-IAOM-Muscat-07.pdf
5. http://www.eolss.net/sample-chapters/c10/e5-08-03-01.pdf

Core VIII Food Fermentation Technology
[For those who joined since 2021-2022]

Semester: IV **Hours per week: 5**
Sub Code: HBFPC42 **Credits: 4**

Course outcome: Upon completion of the course, students will be able to understand
CO1: Knowledge on Principles and mechanism of fermentation
CO2: Importance of fermented foods
CO3: Food preservation by fermentation
CO4: Beneficial microbes for fermentation
CO5: Processing of various fermented foods
CO6: Chances of spoilage of fermented foods

Unit I **[15 Hours]**

Introduction to fermentation: Introduction to fermentation. Introduction to fermented foods. Biochemistry of Fermented Foods [glycolysis, gluconeogenesis and Krebs cycle].Types of fermentations - Batch fermentation - Feed batch fermentation – Sub batch fermentation – Continuous fermentation - Multiple fermentations -Multistage fermentations. Introduction of fermentor.

Unit II **[15 Hours]**

Bacterial fermentation: Primary and secondary fermentations. Lactic Acid Bacteria and starter cultures, bacteriocins and their importance, safety criteria of fermented foods. Manufacture of cheese, yoghurt, bottling / packaging, aging, storage and shelf life of cheese, yoghurt.

Unit III **[15 Hours]**

Yeast fermentations : Yeast starter culture maintenance Wine and beer fermentations, bread making, wine, beer, bread processes and equipment used for manufacture; bottling / packaging, aging, storage and shelf life of fermented foods; Prevention of spoilage of fermentations.

Unit IV **[15 Hours]**

Mould fermentations: soy based fermented foods – miso, tempeh, soy sauces Fermentation production of flavor components, pigments/colors. Processes and equipment used for

manufacture; packaging, aging, storage and shelf life of the products; Prevention of spoilage of fermentations.

Unit V **[15 Hours]**

Oriental Fermented Foods: Single Celled Protein. Meats, sausages, fish sauces, sauerkraut, idli, Manufacture of different types of sausages, fish sauces, sauerkraut, idli batter- processes and equipment used for manufacture; packaging, aging, storage and shelf life of the products.
Safety and public health of fermented foods. Prevention of spoilage of fermentation.

Text Books:

1. Stanbury, Peter F., Allan Whitaker, and Stephen J. Hall. Principles of fermentation technology. Elsevier, 2013.
2. Steinkraus, K. Handbook of Indigenous Fermented Foods, revised and expanded. CRC Press. (2018).

Reference Books:

1. Farnworth, Edward R. Ted, ed. **Handbook of fermented functional foods**, 2nd ed. CRC press, 2008.
2. Lea, Andrew GH, and John R. Piggott, eds. **Fermented beverage production**. Springer Science & Business Media, 2012.
3. Wood, Brian J. **Microbiology of fermented foods**. Springer Science & Business Media, 2012.
4. Ray, R. C., & Didier, M. (Eds.). **Microorganisms and fermentation of traditional foods**. CRC Press. (2014).
5. Soccol, C. R., Pandey, A., & Larroche, C. (Eds.). **Fermentation processes engineering in the food industry**. CRC Press. (2013).
6. Hui, Yiu H., LisbethMeunier-Goddik, JytteJosephsen, Wai-Kit Nip, and Peggy S. Stanfield, eds. Handbook of food and beverage fermentation technology. Vol. 134. CRC Press, 2004.
7. Deirdre Rawlings, "Fermented Foods for Health", Fair Winds Press. [2013].
8. Robert W. Hutkins, "Microbiology and Technology of Fermented Foods", John Wiley & Sons. [2008].

Journals:

1. Fermentation and enzyme technology. Food Processing Technology. doi:10.1201/noe0849308871.ch7, [2000].
2. Li, K. Fermentation. Handbook of Food and Beverage Fermentation Technology. doi:10.1201/9780203913550.ch33, [2004].

Web Resources:

1. Fermented Foods and Their Processing. [n.d.]. Retrieved from https://www.eolss.net/Sample-Chapters/C17/E6-58-07-01.pdf
2. Guest. [n.d.]. Handbook of Food and Beverage Fermentation Technology - PDF Free Download. Retrieved from https://epdf.tips/handbook-of-food-and-beverage-fermentation-technology.html

3. https://onlinelibrary.wiley.com/doi/10.1002/9780470277515.ch12
4. https://www.sciencedirect.com/science/article/abs/pii/S2214799318301012
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7466055/#:~:text=During%20fermentation%2C%20yeast%20cells%20convert,influence%20beer%20flavor%20%5B9%5D.

Core IX Food Fermentation Technology Practical
[For those who joined since 2021-2022]

Semester: IV **Hours per week: 4**
Sub. Code: HBFPC43P **Credits: 4**

Course Outcome: Upon completion of the course, students will be able to understand
CO1: Technologies and equipment used for the production of various fermented food products.
CO2: Processing of various fermented foods.
CO3: Processing of traditional fermented foods
CO4: Preservation of foods by fermentation
CO5: Comparison of different types of fermentation
CO6: Shelf life assessment of fermented foods

List of Experiments:

1. Production of starter, baker's yeast culture.
2. Barley steeping. Germination, malting mashing and brewing.
3. Preparation of wine.
4. Alcoholic fermentation from sugar molasses.
5. Acetic acid fermentation and alkaline fermentation- olive/ cucumber/dill pickles.
6. Lactic acid fermentation process.
7. Production of yoghurt/ curd, cultured butter milk using cultures.
8. Preparation of sauerkraut.
9. Preparation of cereal based fermented products idly/ Dosa.
10. Fermentor operation and measurement.
11. Production of fruit based Vinegar.

Journals:

1. Cagno, R. D., Filannino, P., &Gobbetti, M. **Fermented Foods: Fermented Vegetables and Other Products.** Encyclopedia of Food and Health, 668-674. doi:10.1016/b978-0-12-384947-2.00284-1, (2016).
2. **Probiotics and Fermented Products. Handbook of Animal-Based Fermented Food and Beverage Technology, Second Edition,** 739-740. doi:10.1201/b12084-48, (2012).

Web Resources:

1. All About Fermented Foods - Home - Organixx. (n.d.). Retrieved from https://organixx.com/wp-content/uploads/OX-Report-All-About-Fermented-Foods.pdf
2. Cultures for Health. (2016, May 16). Retrieved from https://www.culturesforhealth.com/learn/natural-fermentation/lacto-fermentation-method-food-preservation/
3. https://onlinelibrary.wiley.com/doi/10.1002/9780470277515.ch12
4. https://www.sciencedirect.com/science/article/abs/pii/S2214799318301012
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7466055/#:~:text=During%20fermentation%2C%20yeast%20cells%20convert,influence%20beer%20flavor%20%5B9%5D.

Second Allied II Technology of Fruits and Vegetable Processing
[For those who joined since 2021-2022]

Semester: IV **Hours per week: 6**
Sub. Code: HBFPA44 **Credits: 5**

Course Outcomes: Upon completion of the course, students will be able to understand
CO1: Importance of fruits and vegetable processing.
CO2: Value addition of fruits and vegetable
CO3: Preservation methods of fruit and vegetable processing
CO4: Specifications of fruit and vegetable products
CO5: Processing of various fruit and vegetable products
CO6: Comparison of traditional and conventional method of processing

Unit I **[18 HOURS]**

Introduction: Importance of fruits and vegetable. Objectives and scopes of Fruits and vegetable processing. Nutritive value- Climatic and non-climatic fruits, ripening process- need of preservation - Reasons of spoilage- Methods of preservation (short & long term).

Unit II **[18 HOURS]**

Canning and bottling of fruits and vegetables: Selection of fruits and vegetables – process of canning – factors affecting the Canning process. Types of containers – lacquering – syrups and brines for canning – spoilage in canned foods.

Unit III **[18 HOURS]**

Freezing & dehydration of fruits and vegetables: General pre-processing, different freezing methods; Dehydration – General pre-processing, different methods of drying including sun, tray, spray drying and low temperature, osmotic dehydration and other modern methods; Indian Food Regulation and Quality assurance. Packaging and storage of cut fruits and vegetables.

Unit IV **[18 HOURS]**

Processing of RTS: Introduction- Processing of fruit juices (selection, juice extraction, deaeration, straining, filtration and clarification) - preservation of fruit juices (pasteurization, chemically preserved with sugars, freezing, drying, tetra-packing, carbonation. High pressure processing, retort- thermal processing.

Unit V **[18 HOURS]**

Fruit And Vegetable Products: Processing- Ready to eat products- Jams/Jelly/Marmalades- Role of pectin - Theory of jelly/jam formation & defects , Squashes/cordials, Ketchup/sauces, Chutneys, Fruit Bar, Soup powders, Candied Fruits-FPO Specifications.

Text Books:

1. Srivastava, R.P. **Fruit & Vegetable Preservation – Principles and Practices**. International Book Distributing Co. CIBDC, New Delhi,2014
2. Singh, R. Paul and D.R. Heldman. **"Introduction to Food Engineering**". 4th Edition, AcademicPressElsevier, 2009.

Reference Books:

1. Manay, S. &Shadaksharaswami, M., **"Foods: Facts and Principles",** New Age Publishers, 2004.
2. Girdharilal, Siddappaa, G.S and Tandon, G.L., "**Preservation of fruits & Vegetables",** ICAR, New Delhi, 1998.
3. S.Chenna Kesava Reddy,**Fruit and Vegetable Processing**,2015

Web Resources:

1. https://www.davuniversity.org/images/files/study-material/1-Importance%20and%20scope%20of%20fruit%20crop%20industry-converted.pdf
2. http://courseware.cutm.ac.in/wp-content/uploads/2020/06/Practical-5-Canning-steps.pdf
3. http://www.fao.org/3/y5979e/y5979e03.htm
4. https://agritech.tnau.ac.in/postharvest/pht_fruits_intro.html
5. http://apeda.gov.in/apedawebsite/six_head_product/PFV_OPF.htm

Skill Based Elective IV Analysis of Fruits and Vegetables Practical
[For those who joined since 2021-2022]

Semester: IV **Hours per week: 3**
Sub. Code: HBFPE45P **Credits: 2**

Course outcome: Upon completion of the course, students will be able to understand
CO1: Procedure for analysis the important properties of fruit and vegetable
CO2: Processing of fruit and vegetable products

CO3: Determination of shelf life of fruit and vegetable products
CO4: Preservation of fruit and vegetable products

List of Experiments:
1. Estimation of total soluble solids (TSS) and Brix: acidity ratio.
2. Estimation of pH and acidity of products.
3. Estimation of ascorbic acid and effect of heat treatment on it.
4. The steps of can making process.
5. Preparation and evaluation of pectin products.
6. Drying of fruits and vegetables.
7. Preservation of fruits/vegetables by salt or salt and oil.
8. Experiment on peeling of Fruits and vegetables.
9. Extraction of fruit pulp and its shelf life estimation.
10. Visit to Food Processing Plant.

Reference Books:
1. https://**fssai.gov.in/Portals/0/Pdf/Manual_Fruits_Veg_25_05_2016**.pdf
2. L.R. Verma and V.K. Joshi, **"Post Harvest Technology of Fruits and vegetables**". Volume 1 and 2. Indus Publishing Company, New Delhi. 2006.

Extra Credit Waste Management in Food Industries
[For those who joined since 2021-2022]

Semester: IV **Hours per week:**
Sub. Code: HBFPX4/ HBFPX40 **Credits: 2**

Course outcomes: Upon completion of the course, students will be able to understand
CO1: Importance of waste management in food industries
CO2: Knowledge on waste treatment and safe disposal methods
CO3: By product utilization of wastes
CO4: Unit operations in waste treatment

Unit I
Introduction: Classification of waste and waste utilization. Characterization of food industrial wastes from Grain processing industry, Fruit and vegetable processing industry, Beverage industry; Fish, Meat & Poultry industry, Sugar industry and Dairy industry.

Unit II
Treatment methods for liquid wastes from food process industries; Design of Activated Sludge Process, Rotating Biological Contactors, Trickling Filters, UASB, Biogas Plant.

Unit III

Treatment methods of solid wastes: Biological composting, drying and incineration; Design of Solid Waste Management System: Landfill Digester, Vermicomposting Pit.

Unit IV

Bio filters and Bio clarifiers, Ion exchange treatment of waste water, Drinking-Water treatment, Recovery of useful materials from effluents by different methods.

Unit V

Waste disposal methods – Physical, Chemical & Biological; Economical aspects of waste treatment and disposal, recycling of waste.

Text Books:

1. Ram Lakhan Singh · Rajat Pratap Singh. **Advances in Biological Treatment of Industrial Waste Water and their Recycling for a Sustainable Future**.2018
2. PL, Rittmann BE & McCarty. " **Environmental Biotechnology: Principles and Applications**; " Mc-Grow- Hill International editions. 2001.
3. Bhattacharyya B C & Banerjee. In **Environmental Biotechnology**; Oxford University Press.2017

Reference Books:

1. Herzka A & Booth RG. " **Food Industry Wastes: Disposal and Recovery**. " Applied Science Pub Ltd., 1981.
2. Fair GM, Geyer JC & Okun DA. In **Water & Wastewater Engineering**. John Wiley & Sons, Inc., 1986.
3. RE, Bartlett. " **Wastewatertreatment**. " Processing Agricultural & Municipal Wastes; AVI. GE, Inglett; Applied Science Pub Ltd, 1973

Web Resources:

1. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/food-processing-wastes
2. http://www.effwa.co.in/blog/wastewater-treatment-food-processing-industry/#:~:text=This%20effluent%20is%20amicable%20to,requirement%20of%20Effluent%20Treatment%20Facility.
3. https://agritech.tnau.ac.in/org_farm/orgfarm_recycling%20of%20farm%20waste.html
4. http://www.bioteg.com/info/definition_biofilter.htm
5. https://www.bafu.admin.ch/bafu/en/home/topics/waste/info-specialists/waste-disposal-methods.html

Semester: V **Hours per week: 5**
Sub. Code: HBFPC51 **Credits: 4**

Course outcomes: Upon completion of the course, students will be able to understand
CO1: Technology involved in of cereal processing.
CO2: Value addition of cereals and pulses
CO3: Knowledge on properties of cereals
CO4: Processing of products from different cereal grains
CO5: Nutritive importance of pulses
CO6: Byproduct utilization of cereals and pulses

Unit I **[18 HOURS]**

Importance of cereals & processing techniques: Definitions, Grain structure- rice, wheat, corn. Nutritional value of cereals. Parboiling methods of paddy. Milling of rice-unit operations in milling. Wheat milling and its products. Dry and wet milling of corn-by products-waste utilization. HFCS processing and its uses.

Unit II **[18 HOURS]**

Technology of Oilseeds: Oil Extraction methods-Mechanical Extraction,
Chemical Extraction (Solvent Extraction) and Biological Extraction, Virgin Oil, Traditional, Mechanical and solvent extraction of oil- refining process. Malting process-Brewing.

Unit III **[18 HOURS]**

Technology of Pulses: Importance of legumes, toxic factors, Sources of protein [defatted flour, protein concentrates and isolates], properties and uses, protein texturization, Milling methods - Dry milling -Wet milling - Improved milling method. Milling of Black gram and Green gram. Milling equipment, secondary processing and its products, traditional and fermented products. Importance of soy bean products.

Unit IV **[18 HOURS]**

Millets: Importance of millets, Production of millets in India, Import and Export of Millet, unit Value Addition of Millets, by product utilization.

Unit V **[18 HOURS]**

Extruded products: Traditional extruded products from rice and millet-Flaked rice, expandedrice. Pasta- raw material selection-making process-advances in drying Noodles-types-White-salted-Alkaline-instant-buckwheat noodles. Types of Extruder- Single and Double.

Text Books:

1. Chakraborty., **"Post-Harvest Technology of Cereals, Pulses and Oilseeds",** revised ed., Oxford & IBH Publishing Co. Pvt Ltd, 1988
2. C. Eliasson, **"Starch in Food",** Woodhead Publishing, 2005.

3. Kent**, "Technology of Cereal",** 5th Ed. Pergamon Press, 2003.

Reference Books:

1. D.A.V. Dendy and B.J.Dobraszczyk, **"Cereals and Cereal products: Chemistry and Technology",** Vol.4, Springer, 2001.
2. G. Owens, **"Cereals Processing Technology",** Woodhead Publishing, 2001.
3. K. Kulp and J. G. Ponte. Jr., **"Hand Book of Cereal Science and Technology",** 2nd Ed, CRC, 2000.

Web Resources:

1. https://cftri.res.in/faculty_detail/2334
2. http://iifpt.edu.in/grain-science.php
3. https://www.solexthermal.com/resources/articles/oilseed-processing-conditioning-and-drying/#:~:text=Oilseeds%20are%20seeds%20in%20which,protein%20livestock%20and%20poultry%20feed.
4. https://kvk.icar.gov.in/API/Content/PPupload/k0217_5.pdf
5. https://agritech.tnau.ac.in/Issue%20No%2030%20-%20Extruded%20Foods.pdf

Core XI Theory of Packaging and Packaging Materials
[For those who joined since 2021-2022]

Semester: V **Hours per week: 5**
Sub. Code: HBFPC52 **Credits: 3**

Course Outcomes: Upon completion of the course, students will be able to understand
CO1: Importance and role of packaging in food
CO2: Different types of packaging materials
CO3: Shelf life extension of foods by different methods of packaging
CO4: Knowledge on properties of different packaging materials
CO5: Factors affecting the spoilage of foods
CO6: Labeling and printing techniques

Unit I **[15 HOURS]**

Introduction to Food Packaging: Definitions. Functions of packaging – Containment – protection – convenience – communication. Package Environments – Physical environment – ambient environment – human environment. The functions/ Environments Grid. Green & Food Grade packaging-Active packaging, Intelligent packaging, Aerosol packaging, Antimicrobial packaging. Types of packaging materials- Traditional [Gunny, Jute] and Conventional.

Unit II **[15 HOURS]**

Metal Packaging Materials: Container – Making Process: End Manufacture – Three – piece Can Manufacture – Two- piece can manufacture. Aluminum Foils and containers.

Unit III **[15 HOURS]**

Glass Packaging Materials: Introduction - Manufacture – mixing and melting. Forming process Blow and Blow [B&B], Press and Blow [P&B], Narrow Neck Press and Blow [NNPB]. Blister Packaging. Closures for Glass Containers: Closure functions – Food Container Closures: closure to retain internal pressure – closure to contain and protect contents- closure to maintain vacuum inside container – closure to secure contents inside container.

Unit IV **[15 HOURS]**

Modified Atmosphere Packaging: Introduction – definitions – principles – Gases used in MAP: carbon-dioxide, oxygen, nitrogen, carbon monoxide, noble gases, and gas mixtures. Methods for creating MA conditions- Equipment for MAP – Packaging for MAP applications – Microbiology of MAP- Safety of MAP. Controlled Atmospheric Storage [CAS], Vacuum packaging.

Unit V **[15 HOURS]**

Machineries for packaging: Granules and Powders, Liquid filling, Manual, Semi-automatic& Automatic packaging.

Bar coding and labeling: Printing of packages, bar codes, QR codes and other marking. Adhesives Sealing equipment's: labelling- types of labels. RFID. Package testing – Air and water permeability.

Standards for packaging and labeling: Packaging laws and Regulations.

Text Books:

1. Gordon L. Robertson, **"Food Packaging Principles & Practice",** CRC Press, 2006.
2. NIIR Board, **"Food Packaging Technology Handbook"**, National Institute of Industrial Research, New Delhi, 2004.
3. Ahvenainen, Raija. "**Novel Food Packaging Techniques".** Wood Head Publishing, 2003.

Reference Books:

1. M.L.Rooney, "Active Food Packaging", Blackie Academic & Professional Publisher, London, 2012.
2. Coles, R., Dowell, D.M., Kirwan, J. "Food Packaging Technology", Black Well Publishing Ltd., 2009.
3. Chiellini, E., "Environmentally Compatible Food Packaging", Wood Head Publishing Ltd., 2008.

Web Resources:

1. https://in.multivac.com/en/solutions/packaging-solutions/packaging-types/
2. http://ecoursesonline.iasri.res.in/course/view.php?id=28
3. https://www.researchgate.net/publication/338554897_FOOD_PACKAGING_GLASS_AND_PLASTIC

4. http://icpe.in/icpefoodnpackaging/pdfs/24_modified.pdf
5. https://uspackagingandwrapping.com/blog/25-packaging-machines-with-images-and-descriptions.html

Core XII Cereal Processing Practical
[For those who joined since 2021-2022]

Semester: V **Hours per week: 3**
Sub. Code: HBFPC53P **Credits: 3**

Course outcomes: Upon completion of the course, students will be able to understand
CO1: Technology of milling of various cereals.
CO2: Various processing of cereal products.
CO3: The aspect of cooking quality of rice.
CO4: Types of extrusion technology prevailing in our county.
CO5: The concept of gluten estimation.
CO6: The toxin content of legumes and its reduction techniques.

List of Experiments:

1. Physical characteristics of grains
2. Studies on Parboiling of paddy by normal –pressure, dry heating and accelerated aging.
3. Milling of Paddy and Millet.
4. Preparation of extruded foods[vermicelli/pasta]
5. Milling of black gram and red gram [Split, Wet/Dry milling]
6. Processing of soybean into secondary products.
7. Estimation of Moisture content of various grains
8. Determination of cooking quality of rice.
9. Flaking or Puffing of grains
10. Visit to cereal processing plant.

Reference Books:

1. http://old.fssai.gov.in/Portals/0/Pdf/15Manuals/CEREALS%20AND%20CEREAL%20PRODUCTS.pdf
2. Chakraborty., **"Post-Harvest Technology of Cereals, Pulses and Oilseeds",** 3rd ed., Oxford & IBH Publishing Co. Pvt Ltd, 2019
3. Serna-Saldivar, S. O. **Cereal grains: laboratory reference and procedures manual.** CRC Press. (2012).
4. Serna-Saldivar, S. O. **Cereal grains: properties, processing, and nutritional attributes**. CRC press. (2016).

Web Resources:

1. http://egyankosh.ac.in/handle/123456789/45280
2. http://egyankosh.ac.in/handle/123456789/45842

3. https://www.solexthermal.com/resources/articles/oilseed-processing-conditioning-and-drying/#:~:text=Oilseeds%20are%20seeds%20in%20which,protein%20livestock%20and%20poultry%20feed.
4. https://kvk.icar.gov.in/API/Content/PPupload/k0217_5.pdf
5. https://agritech.tnau.ac.in/Issue%20No%2030%20-%20Extruded%20Foods.pdf

Elective I a] Post-Harvest Technology
[For those who joined since 2021-2022]

Semester: V **Hours per week: 5**
Sub. Code: HBFPE5A **Credits: 5**

Course outcomes: Upon completion of the course, students will be able to understand
CO1: The principle underlying Post-Harvest Technology.
CO2: The importance and methods of post-harvest conservation of foods.
CO3: Post-Harvest losses happening in India.
CO4: Post-harvest processing of various food products.
CO5: The shelf stability of product during storage.
CO6: The quality parameters of products during Post-harvest operations.

Unit I **[15 HOURS]**

Introduction to Post harvest technology: Introduction to post harvest technology of agricultural produce; Perishable and Non-Perishable; Status of Production, Losses, Need, Scope and Importance.

Unit II **[15 HOURS]**

Unit Operations: Introduction to various post-harvest operations such as Primary, Secondary and TertiaryOperation, Cleaning, grading, Harvesting, Transportation, Handling and storage. Post-Harvest treatments- Pre-Cooling, Curing, Inhibition of Sprouting and Fungicide Application and Ripening

Unit III **[15 HOURS]**

Post-harvest processing of cereals, legumes and oil seeds: Introduction, need and importance, general principles of storage. Temperature and moisture changes during storage i.e. influence of moisture content, relative humidity, temperature, fungi etc. on stored product. Fungi, insect and other organism / Infections associated with stored grains. Types of storage structures. Deep and shallow bins. Traditional and modem storage structures. Management of storage structures. Losses during storage and their control, space requirement of bag storage structure.

Unit IV **[15 HOURS]**

Post-Harvest Processing of fruits and vegetables: Methods of Harvesting and Post-harvest losses in fruits and vegetables. Introduction to the storage of fruits and vegetables. Principle of

storage of fruits and vegetables. Recommended storage operation conditions for some important fruits and vegetables and their storage life. Introduction to Packaging of fruits and vegetables and types of packaging. Concept of modified atmosphere packaging.

Unit V **[15 HOURS]**

Post-Harvest Processing of Spices, condiments and Plantation crops: Methods of Harvesting; Cleaning, grading Threshing, Blanching, Drying of Black pepper, Curing and Garbling of Cardamom, Peeling, drying and polishing of Ginger, Post harvesting operations of Chilies, Nutmeg and Mace, Cinnamon, Seed spices- Stage of harvesting. Grading of tea; wet and dry method of coffee Processing- Packaging and storage. Post-harvest losses

Text Books:

1. Chakraborty.**"Post-Harvest Technology of Cereals, Pulses and Oilseeds",** 3rd ed., Oxford & IBH Publishing Co. Pvt Ltd, 2019.
2. Verma, L. R., and V. K. Joshi. **"Postharvest technology of fruits and vegetables**: an overview [2000]
3. Siddiqui, M. W. (Ed.). (2015). **Postharvest biology and technology of horticultural crops: principles and practices for quality maintenance**. CRC Press.
4. Sahay,K.M., Singh, K.K., **Unit Operations of Agricultural Processing**, 2nd ed., Vikas Publishing House, Private Limited, New Delhi, 2005, pp219-287.

Reference Books:

1. J.S.Purthi, [2003], "**Minor Spices and Condiments: Crop Management and Post-Harvest Technology**", ICAR publication, 1st Edition,
2. Taylor, S. (2012). **Postharvest handling: a systems approach**. Academic Press.
3. Chakraverty, A., & Singh, R. P. (2014). **Postharvest technology and food process engineering.** CRC Press.
4. Patel, K. K., Khan, M. A., Kumar, Y., & Yadav, A. K. (2019). Novel techniques in post-harvest management of mango—an overview. South Asian J Food Technol Environ, 5(2), 821-835.

Web Resources:

1. http://ecoursesonline.iasri.res.in/course/view.php?id=164
2. http://www.fao.org/3/x5672e/x5672e08.htm
3. https://www.agrifarming.in/post-harvest-technology-of-cereals-pulses-and-oilseeds
4. https://onlinecourses.swayam2.ac.in/cec20_ag02/preview#:~:text=Post%2Dharvest%20technologies%20constitute%20an,food%20and%20nutritional%20requirements%20of
5. https://agritech.tnau.ac.in/postharvest/pht_spices.html

Semester: V **Hours per week: 5**
Sub. Code: HBFPE5B **Credits: 5**

Course outcomes: Upon completion of the course, students will be able to understand
CO1: Scope, processing and production of various traditional food products.
CO2: Processing methods for value addition of different regional commodities.
CO3: Unit operations in traditional processing
CO4: Value addition of food commodities
CO5: Preservation techniques of foods
CO6: Processing of snack foods

Unit I **[15 Hours]**

Unit operations involved in snack products: Technology for grain-based snacks: whole grains – roasted, toasted, puffed, popped, malted and flakes, coated grains-salted, spiced and sweetened. Its Equipments and maintenance.

Unit II **[15 Hours]**

Indian snack foods: Flour based – batter and dough based products; savory and farsans; formulated chips and wafers, papads,Poha, Murmure, Khakra, Roasted Gram, Roasted peanuts, Roasted dal, Rice papad, Kurdaya, Vadam, Shev, Ganthia;Instant premixes of traditional Indian snack foods- Chakli, Kadboli, Muruku, Thengul. Its Equipments and maintenance.

Unit III **[15 Hours]**

Snack food with nuts, Fruits and vegetables: Technology for fruit and vegetable based snacks: Chips; Technology for coated nuts – salted, spiced and sweetened; chikkis.Its Equipment and maintenance.

Unit IV **[15 Hours]**

Extruded snack foods: Definition of extrusion technology, types of extruders. Cold Extrusion and Hot Extrusion. Formulation and processing technology, coloring, flavoring and packaging.

Unit V **[15 Hours]**

Internship training of extruded products at any incubation center

Text Books:

1. Matz, S. A. (2012). **Snack food technology**. Springer Science & Business Media.
2. Edmund WL. **Snack Foods Processing**. AVI Publ. 2001
3. Gordon BR**. Snack Food.**AVI Publ. 2011.
4. Maskan, M., & Altan, A. (Eds.). (2012). **Advances in food extrusion technology** (p. 130). Taylor and Francis group, Florida, USA: CRC press.

Reference Books:

1. Mudambi, S.R. &Rajagopal, M.V. [2001]. **Snack Foods of India. Snack Foods Processing**. 477-491. 10.1201/9781420012545.ch18.
2. Kulp, K. (Ed.). (2000**). Handbook of Cereal Science and Technology, revised and expanded.** CRC Press.
3. Tainter, D. R., & Grenis, A. T. (2001). **Spices and seasonings: a food technology** handbook. John Wiley & Sons.
4. Lebovka, N., Vorobiev, E., & Chemat, F. (Eds.). (2012). **Enhancing extraction processes in the food industry**. Boca Raton: CRC Press.

Journals:

1. Brennan, M. A., Derbyshire, E., Tiwari, B. K., & Brennan, C. S. (2013**). Ready- to- eat snack products: the role of extrusion technology in developing consumer acceptable and nutritious snacks.** International Journal of Food Science & Technology, 48(5), 893-902.
2. Ye, J., Hu, X., Luo, S., Liu, W., Chen, J., Zeng, Z., & Liu, C. (2018). **Properties of starch after extrusion:** a review. Starch- Stärke, 70(11-12), 1700110.
3. Nikmaram, N., Leong, S. Y., Koubaa, M., Zhu, Z., Barba, F. J., Greiner, R.,& Roohinejad, S. (2017). E**ffect of extrusion on the anti-nutritional factors of food products**: An overview. Food control, 79, 62-73.

Web Resources:

1. https://link.springer.com/chapter/10.1007%2F978-1-4615-4985-7_5
2. https://wholegrainscouncil.org/sites/default/files/atoms/files/ConfTechReport.pdf
3. https://link.springer.com/chapter/10.1007%2F978-0-387-69940-0_15
4. https://www.researchgate.net/publication/317381619_DRIED_VEGETABLES_SNACKS_-_REVIEW_OF_THE_PROCESS_TECHNOLOGIES_AND_CONSUMPTION_PREFERENCES_AMONG_STUDENTS
5. https://www.sciencedirect.com/science/article/abs/pii/S092401361400452X

Elective II a] Food Additives
[For those who joined since 2021-2022]

Semester: V **Hours per week: 5**
Sub. Code: HBFPE5C **Credits: 5**

Course outcomes: Upon completion of the course, students will be able to understand
CO1: Permitted food additives & non-permitted additives
CO2: Food safety aspects & regulations
CO3: Recommended application of additives
CO4: Identification, determination of additives by qualitative & quantitative methods
CO5: Standards for permissible limits of food additives
CO6: Consequences of food additives and its toxicity level.

Unit I **[15 Hours]**

Introduction to additives: Introduction: What are Food Additives - Role of Food Additives in Food Processing - functions – Classification - Intentional & Unintentional Food Additives. Toxicology and Safety Evaluation of Food Additives – Beneficial effects of Food Additives / Toxic Effects - Food Additives generally recognized as safe (GRAS) – Tolerance levels& Toxic levels in Foods - LD 50 Values of Food additives. Naturally occurring Food Additives - Classification - Role in Food Processing – Health Implications.

Unit II **[15 Hours]**

Preservatives Color and antioxidant: Food colors - What are food colors - Natural Food Colors - Synthetic food colors - types - their chemical nature- their impact on health.. Preservatives - What are preservatives - natural preservation- chemical preservatives –their chemical action on foods and human system. Anti-oxidants & chelating agents - what are anti-oxidants - their role in foods - types of antioxidants - natural & synthetic - examples - what are chelating agents – their mode of action in foods.

Unit III **[15 Hours]**

Surface active agent's role in food: Surface active agents - What are surface active agents - their mode of action in foods - examples. Stabilizers &thickeners - examples - their role in food processing. Bleaching & maturing agents: what is bleaching -Examples of bleaching agents - what is maturing - examples of maturing agents – their role in food processing.

Unit IV **[15 Hours]**

Starch modifiers: Starch modifiers: what are starch modifiers - chemical nature - their role in food processing. Buffers - Acids &Alkalis - examples - types - their role in food processing. Sweeteners - what are artificial sweeteners & non-nutritive sweeteners - special dietary supplements & their health implication - role in food processing. Anti-Nutritional Factors.

Unit V **[15 Hours]**

Flavoring agents used in food: Flavoring agents - natural flavors & synthetic flavors - examples & their chemical nature - role of flavoring agents in food processing. Anti-caking agents - their role in food processing. Humectants - definition on their role in food processing. Clarifying agents - definition examples - their role in food processing.

Text Books:

1. Srivastava, R.P. **Fruit & Vegetable Preservation – Principles and Practices**. International Book Distributing Co. CIBDC, New Delhi, 2014
2. Joint FAO/WHO Expert Committee on **Food Additives**. Meeting and World Health Organization. Safety evaluation of certain food additives. No. 56.World Health Organization, 2006.

Reference Books:

1. Belitz. **Food Chemistry**.3rd Revised Edition. Springer International.
2. Deshpande, S.S**. Hand book of Food Toxicology**. Marcel and Dekker CRC Publishers.

3. ShakuntalaManay and ShadaksharSwamy. **Food Facts and Principles**. New Age International Publishers, New Delhi.

Elective II b] Food Product Development and Management Techniques
[For those who joined since 2021-2022]

Semester: V **Hours per week: 5**
Sub. Code: HBFPE5D **Credits: 5**

Course outcomes: Upon completion of the course, students will be able understand
CO1: Food product development procedure and feasibility
CO2: Selection of demand based product
CO3: Concept of new product development.
CO4: Exploring the marketing strategy of various food products.
CO5: Cost analysis of food product
CO6: Focus on factors to Scale up the production

Unit I **[15 Hours]**

Introduction to New product Development: Definition, Classification, Need and importance for developing a new product, current trends – organic foods, health foods, therapeutic foods, functional foods, nutraceutical and diabetic foods, types of new products, challenges, failure of new product. Process Outline for New Product Development.

Unit II **[15 Hours]**

Product formulation: Market survey, Consumer survey to identify new products in terms of line extension, repositioning existing product, new forum or reformulation, New packaging of existing products, innovative products, Creative products.

Unit III **[15 Hours]**

Market Feasibility: Identification of concept and product for development, market research for the concept and selected product, identification of products, selection of one product and its standardization improving success, patenting of new product.

Unit IV **[15 Hours]**

Consumer preference towards new Product: Formulation of new food products for infants, preschool children, adolescents, pregnant and nursing mothers, old age, sports persons, armed sources personnel and therapeutic uses. Sensory evaluation - Selection and training of judges, Development of Score Card and analysis of data, Role of advertisement and Technologies in promotion of new products.

Unit V **[15 Hours]**

Globalization of products and economic feasibility: Conditions for sale, license and identification and quality processing, conditions for distribution, storage and sanitation, studying

the global market status, Role of export promoting agencies, Economic feasibility of new products. Exercise on Development of new Food Product and marketing.

Text Books:

1. Gordon W. Fuller. **New Food Product Development: From Concept to Marketplace**, Third Edition,2011
2. Kumar, S., and P. Phrommathed. **"Research methodology** (pp. 43-50)." US: Springer 2005.
3. Ulrich, Karl T. **Product design and development**. Tata McGraw-Hill Education, 2003.

Reference Books:

1. Sivaramaprasad.A. **Agricultural Marketing in India**-Mittal Publications, New Delhi. 1985.
2. Acharya, S. S. **"NL Agarwal Agricultural Marketing in India**–Oxford and IBH Publishing Co." Pvt. Ltd., New Delhi 3 (1992)
3. Brody, Aaron L., and John B. Lord, eds. **developing new food products for a changing marketplace.** CRC Press, 2007.

Web Resources:

1. https://www.cdss.ca.gov/agedblinddisabled/res/VPTC2/9%20Food%20Nutrition%20and%20Preparation/Types_of_Therapeutic_Diets.pdf
2. http://cbseacademic.nic.in/web_material/Curriculum/Vocational/2018/Marketing/XI/marketing%20XI%20c.pdf
3. https://www.thebalancesmb.com/how-to-write-a-market-feasibility-study-in-4-easy-lessons-3515137
4. https://www.tvu.edu.in/wp-content
5. https://www.un.org/en/development/desa/policy/wess/wess_current/2010wess_chapter6.pdf

Skill Based Elective V Entrepreneurial Development
[For those who joined since 2021-2022]

Semester: V **Hours per week: 3**
Sub. Code: HBFPE54 **Credits: 2**

Course outcomes: Upon completion of the course, students will be able to understand

CO1: Importance of entrepreneurship skills.
CO2: Functions of entrepreneur.
CO3: Risk assessment of entrepreneur.
CO4: Creation of new business plans.
CO5: Creation of employment opportunity.
CO6: Management of all levels workers from managerial level to casual labor level.

Unit I **[9 Hours]**

The nature and importance of entrepreneurs – Definition of entrepreneur and entrepreneurship – Role of entrepreneurship in economic development – Future and drawbacks of entrepreneurship. Advantages and drawbacks of pursing entrepreneurship as a career. Partnership and its classification.

Unit II **[9 Hours]**

Classification and functions of entrepreneur –procedures for startups- Business Partnership-MOU. Characteristics and traits of entrepreneur. Male Vs female entrepreneurship. Rural entrepreneurship – Social entrepreneurship.

Unit III **[9 Hours]**

Managerial vs. Entrepreneurial decision making – Intrapreneurship – Climate for Intrapreneurship – Establishing Intrapreneurship in organization.

Unit IV **[9 Hours]**

Creating and starting the venture – creativity and business idea – the business plan – sources of capital (Funding sources) – managing the enterprise – Buying an existing business – Franchising.

Unit V **[9 Hours]**

Strategies for growth and managing the implications of growth – Accessing resources for growth from external sources – Going public – Ending the venture - Financial support by the government, development banks and public sector banks Global aspects of entrepreneurship Contemporary issues.

Text Books:

1. Charantimath, Entrepreneurship Development, Pearson Education.
2. Mohanty, Fundamentals of Entrepreneurship, Prentice Hall of India.
3. Kanka S.S., Entrepreneurial Development, S. Chand & Co.

Reference Books:

1. Hisrich, Peters and Sheperd, Entrepreneurship, Sixth edition, Tata McGraw Hill,
2. Peter Drucker Innovation and Entrepreneurship, Colins[Reprint]
3. Zimmerer and Scarborough, Essentials of entrepreneurship and small business management, fourth edition, Prentice Hall of India.

Extra Credit-Mini Project

[For those who joined since 2021-2022]

Semester: V **Hours per week:**

Sub. Code: HBFPX5PW **Credits: 2**

Course Outcomes: Upon completion of the course, students will be able to understand

CO1: Importance of food industries.

CO2: Knowledge on product development.
CO3: By product utilization.
CO4: Unit operations for making industries.

Objectives – To mentor the students to design and conduct original and ethical research. They should be able to write a dissertation in the APA format. The research done can either be empirical/data based [quantitative, qualitative, or mixed-methods] or it can be in the form of a critical review of research and theory.

Recommended Readings:
APA manual for dissertation
Evaluation: Viva jointly by one internal and one external examiner.

Core XIII Food Trade and Business Management
[For those who joined since 2021-2022]

Semester: VI **Hours per week: 5**
Sub. Code: HBFPC61 **Credits: 4**

Course Outcomes: Upon completion of the course, students will be able to understand
CO1: Basic principles and practices of Food Trade
CO2: Concept of trade under national level and international level
CO3: Knowledge on governing bodies to support trade globally
CO4: Consumer preference, sales and marketing promoting factors
CO5: Export opportunities in Food processing
CO6: Marketing Techniques

Unit I **[15 Hours]**
Business: Principles, Practices and Policies of Food trade. Mechanism of foreign exchange, foreign trade. WTO, GATT, International Trade in Agriculture, world consumption of food, pattern and types of food consumption APEDA, MOFPI, Spices Board, BIS etc. License registration and certification requirements for FSSAI & ISO.

Unit II **[15 Hours]**
Food Marketing: classification, Consumer behavior, demand and forecasting demand and marketing pigmentation. Product planning and linear programming, Sales promotion, break even analysis, Programme Evaluation and Review Technique.

Unit III **[15 Hours]**
Social aspects of food marketing: Advertisings, features, objectives, effectiveness and components of advertisement. Laws governing of food products. Role of Government, consumers and role of food business people in formulation and selling of products.

Unit IV **[15 Hours]**

Food plant layout & Process planning: for the product establishing the food product unit. Creativity and innovation problem solving, personnel management. Salaries, wages and incentives, performance appraisal, quality control.

Unit V **[15 Hours]**

Food Marketing and Sales management: Marketing strategy, Packaging, Advertising, label intervention, pricing after sales services. Legislations, Licensing, Registration, Municipal laws, business ethics, income law, labor law application. Consumer complaint redressal. Management of export – import organization, Registration, Documentation, Case studies, Export – Import policies related to Horticultural sector.

Text Books:

1. Ottman, J., & Books, N. B. **Green marketing: opportunity for innovation**. The Journal of Sustainable Product Design, 60. 1998.
2. Scarborough, N. M. **Essentials of entrepreneurship and small business management**. Pearson. (2016).

Reference Books:

1. D. David and S. Ericson, Principles of Agri. Business Management, Tata McGraw Hill Book Co., New Delhi.
2. P.K. Srivastava, Marketing Management, Himalaya Publishing House, New Delhi
3. G.S. Batra and Narinder Kumar, GATT implications of Denkel proposal, Azmol Publications, New Delhi.
4. Smith, H. (2003). Business process management—the third wave: business process modelling language (bpml) and its pi-calculus foundations. Information and Software Technology, 45(15), 1065-1069.

Web Resources:

1. https://apeda.gov.in/apedawebsite/
2. https://food-guide.canada.ca/en/healthy-eating-recommendations/marketing-can-influence-your-food-choices/#:~:text=Food%20marketing%20is%20advertising%20that,fat%20to%20our%20eating%20patterns.
3. https://www.researchgate.net/publication/322089863_Social_responsibility_in_marketing_of_the_food_industry_and_its_distributors
4. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=124501#:~:text=Plant%20layout%20problem%20is%20defined,of%20the%20best%20structure%20to
5. http://www.fao.org/3/w3240e/W3240E00.htm

Core XIV Technology of Spices and Plantation Crops
[For those who joined since 2021-2022]

Semester: VI **Hours per week: 4**

Sub. Code: HBFPC62 **Credits: 3**

Course outcomes: Upon completion of the course, students will be able to understand

CO1: Production and processing scenario of spices and plantation crops and its scope

CO2: Value addition of spices and spice products with different processing methods

CO3: Standards and specifications of spices, packaging of spices and spice products, market value of spices in India

CO4: Marketing of spices, adulteration, specifications for marketed products, packaging and different grades.

CO5: Harvesting post-harvest technology and treatments, processing and extraction, adulteration, specifications for marketed products, packaging.

CO6: Opportunities to overcome the demerits in processing of spices and plantation crops.

Unit I **[12 Hours]**

Introduction to spices: Introduction to Spices and condiments, production and processing scenario of spices and plantation crops. Value addition of spices and spice products with different processing methods. Classification of spice. Different technologies involved in the preparation of spice powders, spice oils, oleoresins and micro encapsulated products. Standards and specifications of spices, packaging of spices and spice products,Clove and Coriander, and, Cumin, Saffron, Vanilla and Annatto, Garlic: harvesting, post-harvest technology and treatments, processing into marketed products, adulteration, specifications for marketed products, packaging and different grades, storage requirements.

Unit II **[12 Hours]**

Post- harvest technology of Turmeric, Onion, Pepper, Ginger, Chili : Turmeric, Onion, Pepper,Ginger,Chili - Introduction, harvesting, post-harvest technology and treatments, processing into marketed products, adulteration, specifications for marketed products, packaging and different grades, storage requirements.

Unit III **[12 Hours]**

Introduction plantation crops: Definition of plantation crops, Commercial value of plantation crops that are grown in India.Coffee, Clove, Tea, and Rubber - Introduction, harvesting, post-harvest technology and treatments, processing into marketed products, adulteration, specifications for marketed products, packaging and different grades. Tea -Introduction, harvesting, post-harvest technology and treatments, processing into marketed products, adulteration, specifications for marketed products. Types of tea packaging and different grades.

Unit IV **[12 Hours]**

Post-harvest technology of Betel vine, Cocoa, Oil palm, and Cashew nut: Betel vine, Cocoa, Oil palm, and Cashew nut: Introduction, harvesting, post-harvest technology and treatments, processing into marketed products, adulteration, specifications for marketed products, packaging and different grades.

Unit V **[12 Hours]**

Post-harvest technology of Areca nut, Coconut, Bamboo, and Palmyra : Areca nut, Coconut, Bamboo, and Palmyra - Introduction, harvesting, post-harvest technology and treatments, processing and extraction, adulteration, specifications for marketed products, packaging and different grades.

Text Books:

1. Acharya N. G. Ranga, **Processing Of Spices And Plantation Crops**,2015
2. Gupta S. **Hand Book of Spices and Packaging with Formulae. Engineers**. India Research Institute, New Delhi, 2000.
3. Chakraverty, Amalendu, Arun S. Mujumdar, and Hosahalli S. Ramaswamy, eds. **Handbook of postharvest technology: cereals, fruits, vegetables, tea, and spices.** Vol. 93. CRC Press, 2003.

Reference Books:

1. Purseglave J.W., Brown E.G., Green C.L., and Robins. **Spices Vol.1 and Vol.II** SRJ Academic Press. New Delhi.2004.
2. Thampan P.K. **Hand Book of Coconut Palm**. IBA Publishing Company, New Delhi.2005.
3. Kumar, N. J. B. M. **Introduction to spices, plantation crops, medicinal and aromatic plants**. Oxford and IBH Publishing, 2006.

Web Resources:

1. https://vignan.ac.in/subjects/food/Processing%20of%20spices%20and%20plantation%20crops.pdf
2. http://jnkvv.org/PDF/05042020135013plantation_crops.pdf
3. https://agritech.tnau.ac.in/postharvest/pht_spices.html
4. https://www.researchgate.net/publication/346192162_Processing_Methodologies_for_Few_Plantation_Crops_in_India_Arecanut_Betelvine_Cashew_Cocoa_and_Oil_Palm
5. http://www.agritech.tnau.ac.in/pdf/2013/cpg_horti_2013.pdf

Core XV Technology of Meat, Poultry, Sea Food and Egg
[For those who joined since 2021-2022]

Semester: VI **Hours per week: 5**
Sub. Code: HBFPC63 **Credits: 4**

Course outcomes: Upon completion of the course, students will be able to understand

CO1: Importance of livestock and poultry industry
CO2: Nutritional importance of animal products
CO3: Processing and preservation of meat products
CO4: Spoilage of meat products and its prevention
CO5: Byproduct utilization of meat products

CO6: Processing of seafood and its importance

Unit I **[15 Hours]**

Meat quality: Effects of feed, breed and environment on production of meat animals and their quality. Meat structure, meat quality-color, flavor, texture, Water-Holding Capacity [WHC], Emulsification capacity of meat.

Unit II **[15 Hours]**

Types of Meat and its sources-Ante mortem handling, slaughtering of animals, Mechanical deboning, inspection and grading of meat. Post-mortem changes of meat, A Generic HACCP model, dressing of carcasses, post-mortem examination of meat.

Unit III **[15 Hours]**

Preservation of meat: Refrigeration and freezing, thermal processing- canning of meat, retort pouch, dehydration, irradiation, and RTE meat products, meat curing. Sausages processing, types and defects.

Unit IV **[15Hours]**

Preservation of eggs: Refrigeration and freezing, thermal processing, dehydration, coating. **Quality identification of shell eggs**: Factors affecting egg quality and measures of egg quality.

Unit V **[15 Hours]**

Sea Food Processing: Types of Seafood [Fish, Crab, Prawn, oyster, seaweed], Inland seafood processing, spoilage factors of fish. Post-mortem changes in fish. Handling and transportation of fish. Freezing and Individual quick freezing, Processing- Salting-drying-pickling-Canning-smoking operations.

Text Books:

1. Stadelman WJ, Owen J Cotterill. **"Egg Science and Technology"**, 4th Ed. CBS Publication New Delhi, 2002.
2. Owens, Casey M. **Poultry meat processing**. CRC Press, 2010.
3. ShaiBarbut, **"Poultry Products Processing"**, CRC Press 2005.

Reference Books:

1. Parkhurst&Mountney, **"Poultry Meat and Egg Production"**, CBS Publication, New Delhi, 1997.
2. Pearson &Gillet. **"Processed Meats"**, 3 edition, CBS Publication, New Delhi, 1997.
3. Lawrie R A, Lawrie's, **"Meat Science"**, 5th Ed, Woodhead Publisher, England, 1998.

Core XVI Project
[For those who joined since 2021-2022]

Semester: VI **Hours per week: 6**
Sub. Code: HBFPC64PW **Credits: 5**

Course Outcomes: Upon completion of the course, students will be able to understand
CO1: Importance of food industries.
CO2: Knowledge on product development.
CO3: By product utilization.
CO4: Unit operations for making industries.

Objectives – To mentor the students to design and conduct original and ethical research. They should be able to write a dissertation in the APA format. The research done can either be empirical/data based [quantitative, qualitative, or mixed-methods] or it can be in the form of a critical review of research and theory.

Recommended Readings:
APA manual for dissertation
Evaluation: Viva jointly by one internal and one external examiner.

Elective III a] Food Analysis and Instrumentation
[For those who joined since 2021-2022]

Semester: VI **Hours per week: 5**
Sub. Code: HBFPE6A **Credits: 5**

Course Outcomes: Upon completion of the course, students will be able to understand
CO1: Instrumentation for food analysis
CO2: Analysis of food products
CO3: Analytical Instruments for assessing the food quality
CO4: Principle and Procedure for instrument analysis of food
CO5: Quality parameters of food
CO6: Identification of food adulterants

Unit I **[15 Hours]**

Introduction to food analysis: Introduction to food analysis, types of samples and sampling techniques, storage and preservation of samples, expression of results. Proximate analysis of foods: Energy/Calorie, moisture, fat, protein, carbohydrates, crude fiber, vitamins and minerals in foods.

Unit II **[15 Hours]**

Sensory evaluation: Sensory analysis of foods: overview of the sensory principles and practices, selection and screening of the sensory panel, types of panel [trained, semi trained], methodology

of sensory evaluation: discriminative tests: difference tests, paired comparison, duo trio, triangle; descriptive tests.

Unit III **[15 Hours]**

Instrumentation in food analysis: Instrumentation in food analysis: Principles, types and applications of colorimetry and spectroscopy, photometry, electrophoresis; chromatography – TLC, HP-TLC, GC, LC, HP-LC, and atomic absorption spectrophotometry.

Unit IV **[15 Hours]**

Instrumentation in food analysis: color measurement in foods; X-ray analysis of foods and its applications; mass spectroscopy; nuclear magnetic resonance [NMR]; differential scanning calorimetry [DSC], NIR, FTIR.

Unit V **[15 Hours]**

Instrumentation in food analysis: Refractometry and ultrasonic in food analysis; texture analysis in foods, sensory versus instrumental analysis of texture, rapid methods of microbial analysis; immunoassays methods.

Text Books:

1. Pomeranz, Y. (Ed.). **Food analysis: theory and practice**. Springer Science & Business Media. (2013).
2. Amerine, M. A., Pangborn, R. M., &Roessler, E. B. **Principles of sensory evaluation of food.** Elsevier. (2013**).**
3. Jha, S. N. (Ed.). **Nondestructive evaluation of food quality: theory and practice**. Springer Science & Business Media**.** (2010).

Reference Books:

1. Nollet, Leo ML, and Fidel Toldrá, eds. Food analysis by HPLC. CRC Press, 2012.
2. Mehrotra, Ranjana. **Infrared spectroscopy, gas chromatography/infrared in food analysis.** John Wiley & Sons, Ltd, 2000.
3. Nielsen, S.S. **Introduction to the chemical analysis of foods.** Jones and Bartlett Publishers, Boston, London. 2003.

Web Resources:

1. https://www.sciencedirect.com/topics/chemistry/preservation-technique
2. https://link.springer.com/chapter/10.1007%2F978-1-4419-7452-5_19
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3658041/
4. https://lab-training.com/2014/04/02/what-are-the-differences-between-gc-and-hplc/
5. https://www.researchgate.net/publication/329270791_Nuclear_Magnetic_Resonance_NMR_Spectroscopy_in_Food_Science_A_Comprehensive_Review_NMR_spectroscopy_in_food_science

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Elective III b] Emerging Technologies in Food Industry
[For those who joined since 2021-22]

Semester: VI **Hours per week: 5**
Sub. Code: HBFPE6B **Credits: 5**

Course Outcomes: Upon completion of the course, students will be able to understand
CO1: To understand about new developments in the food industry and to impart knowledge about the importance and applications of the technology.
CO2: To enable the student to understand: Emerging / alternative technologies applied to food processing.
CO3: Relative advantages / disadvantages over existing technologies.
CO4: Economics and commercialization of newer technologies. Syllabus Content

Unit I **[15 Hours]**
Membrane separation process: Membrane Technology-process- Micro-filtration, Ultra-filtration, Nano-filtration and Reverse Osmosis-advantages-equipment

Unit II **[15 Hours]**
High pressure processing and microwave heating: Microwave heating of foods- Mechanism of Heat Generation-Working of microwave oven, High Pressure processing: Concept-Equipment for HPP Treatment-Mechanism of Microbial Inactivation and its Application in Food, dielectric heating of foods

Unit III **[15 Hours]**
Irradiation and PEF and ohmicheating: Pulsed electric field – equipment –mechanism of PEF-advantages, Ohmic heating of foods- mechanism- principle-advantages, applications. Irradiation- principle- types of irradiation-advantages-applications

Unit IV **[15 hours]**
Osmotic dehydration of foods and minimal processing: Principle – Mechanism of osmotic dehydration – Effect of process parameters on mass transfer – Methods to increase the rate of mass transfer – Applications – Limitations of osmotic dehydration – Management of osmotic solutions. Minimal processing-principle- methods- advantages

Unit V **[15 Hours]**
Nanotechnology and antimicrobial technology: Role of Antimicrobial agents in food –Plant and animal derived antimicrobials – Antimicrobial enzymes, antimicrobial food packaging, nanotechnology-application of nanotechnology in food industry

Text Books:
1. Boye, J., & Arcand, Y. (Eds.). G**reen technologies in food production and processing**. Springer Science & Business Media. (2012).

2. Rai, M., Ribeiro, C., Mattoso, L., & Duran, N. (Eds.). **Nanotechnologies in food and agriculture** (Vol. 33). Cham/Heidelberg/New York/Dordrecht/London: Springer. (2015).

Reference Books

1. Leistner, L., & Gould, G. W. **Hurdle technologies: combination treatments for food stability, safety and quality.** Springer Science & Business Media. (2012).
2. Sun, D. W. **Emerging technologies for food processing**. Elsevier. (2014).
3. Barbosa-Cánovas, G. V., Tapia, M. S., & Cano, M. P. (Eds.). **Novel food processing technologies**. CRC press. (2004).
4. P Richardson,"**Thermal Technologies in Food Processing**", Campden and Chorleywood Food Research Association, UK, Woodhead Publishing Limited. [2001].

Journals:

1. Ekezie, F. G. C., Sun, D. W., Han, Z., & Cheng, J. H. **Microwave-assisted food processing technologies for enhancing product quality and process efficiency**: A review of recent developments. Trends in Food Science & Technology, 67, 58-69. (2017**).**
2. Wang, C. Y., Huang, H. W., Hsu, C. P., & Yang, B. B. **Recent advances in food processing using high hydrostatic pressure technology**. Critical Reviews in Food Science and Nutrition, 56(4), 527-540. (2016**).**
3. Majid, I., Nayik, G. A., & Nanda, V. **Ultrasonication and food technology**: A review. Cogent Food & Agriculture, 1(1), 1071022. (2015).
4. Sun, J., Zhou, W., Huang, D., Fuh, J. Y., & Hong, G. S. **An overview of 3D printing technologies for food fabrication. Food and bioprocess technology**, 8(8), 1605-1615. (2015).

Web Resources:

1. https://www.safewater.org/fact-sheets-1/2017/1/23/ultrafiltrationnanoandro
2. https://www.comsol.co.in/multiphysics/microwave-heating#:~:text=One%20obvious%20example%20of%20microwave,and%20a%20rise%20in%20temperature.
3. https://medcraveonline.com/JNHFE/pulsed-electric-field-technology-in-food-preservation-a-reviewnbsp.html#:~:text=Pulsed%20electric%20field%20(PEF)%20technology,quality%20foods%20to%20the%20consumers.
4. http://www.ifrj.upm.edu.my/19%20%2801%29%202011/%282%29IFRJ-2011-168%20Phisut.pdf
5. https://www.microban.com/antimicrobial-solutions/overview/safer-than-nanotechnology#:~:text=What%20Is%20Antimicrobial%20Nanotechnology%3F,of%20less%20than%20100%20nm.

Skill Based Elective VI Unit Operations in Food Industry
[For those who joined since 2021-22]

Semester: VI **Hours per week: 3**
Sub. Code: HBFPE65 **Credits: 2**

Course Outcomes: Upon completion of the course, students will be able to understand

CO1: To provide in-depth knowledge in basic concepts of various unit operations in a food industry.

CO2: To understand the different operations performed in food industry

CO3: To know details of working of different equipments

Unit I **[7 Hours]**

Heat Transfer in Food Processing: Modes of heat transfer-conduction, convection and radiation- heat exchangers- plate heat exchanger-tubular heat-scraped surface heat exchanger – Equipment maintenance

Unit II **[7 Hours]**

Evaporation : Basic principle, need for evaporation, single effect, multiple effect, heat economy, type of evaporator-long tube, short tube, agitated film evaporator - Equipment maintenance

Unit III **[7 Hours]**

Distillation and crystallization: Simple distillation, flash distillation, steam distillation, fractional distillation Crystallization -theory, tank crystallizer and scraped surface crystallizer - Equipment maintenance

Unit IV **[7 Hours]**

Extraction and extrusion: Solid Liquid extraction-leaching, Liquid-Liquid extraction, Supercritical fluid extraction, single screw extruder, twin screw extruder – Software for food processing- Equipment maintenance

Unit V **[7 Hours]**

Mechanical separation and material handling: Sedimentation, Centrifugal separation, filtration, Mixing, Material handling-Belt conveyor, Screw Conveyor, bucket elevator and pneumatic conveyor- Equipment maintenance

Text Books:

1. Sahay, K. M., & Singh, K. K. **Unit operations of agricultural processing**, 2nd ed., Vikas Publishing House Pvt. Ltd... [2001].
2. Earle, R. L. **Unit operations in food processing**. 2nd ed., Elsevier. [2013].

Reference Books:

1. Kreith, F., & Manglik, R. M. (2016). **Principles of heat transfer**. Cengage learning.
2. Y.H.Hui, "**Handbook of Food Science, Technology and Engineering**" [vol.1-4], Marcel Dekker Publishers. [2005],
3. M.A.Rao, S.S.H.Rizvi and A.K.Dutta, **"Engineering properties of Foods**", 3rd ed., Marcel Dekker Publishers. [2005],

4. H.Pandey, H.K. Sharma, R.C.Chouhan, B.C. Sarkar and M.C. Bera, "**Experiments in Food Process Engineering**", CBS Publishers and Distributors. [2004],
5. R.P.Singh and D.R.Heldman, [2001], "**Introduction to Food Engineering**", 3rd ed., Academic Press.
6. S.K.Sharma, S.J.Mulvaney and S.S.H.Rizvi, **"Food Process Engineering: Theory and Laboratory Experiments",** Wiley and S,[2000],
7. Sun, D. W. **Emerging technologies for food processing.** Elsevier. (2014).

Journal:

1. Drioli, E., Ali, A., & Macedonio, F. **Membrane distillation: Recent developments and perspectives. Desalination,** 356, 56-84. (2015).
2. Rastogi, N. K. **Opportunities and challenges in application of forward osmosis in food processing. Critical reviews in food science and nutrition**, 56(2), 266-291. (2016).

Web Resources:

1. https://nzifst.org.nz/resources/unitoperations/index.htm
2. https://onlinecourses.nptel.ac.in/noc19_ag06/preview
3. https://nptel.ac.in/courses/103/107/103107088/
4. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3A_How_to_be_a_Successful_Organic_Chemist_(Sandtorv)/02%3A_COMMON_ORGANIC_CHEMISTRY_LABORATORY_TECHNIQUES/2.02%3A_Distillation
5. https://nzifst.org.nz/resources/unitoperations/documents/UnitopsCh10.pdf