

## Appendix "L" Item No.20

### **B.Sc. (Honors)+1 Year M.Sc. Food Science & Technology Food, Nutrition & Dietetics**

4 Year B.Sc. (Honors)+1 Year M.Sc. Food Science & Technology Programme(Multiple Entry and Exit Mode)

on first year completion (2 semesters) certificate Programme, on first two years completion (4 semesters) diploma Programme, on first three years completion (6 semesters) B.Sc. Programme, on first four years completion (8 semesters) B.Sc. Hons. Programme and,first five years completion (10 semesters) M.Sc. Programme, (with effect from the admitted batch of 2022-23 onwards), Framed According to the National Educational Policy (NEP 2020), To be implemented from the Academic Year 2022-2023

#### **I Year - I Semester**

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Credits	
			L	T			Marks	Marks
CH-1101	BS	Maths – I	4	0	30	70	100	3
CH-1102	BS	Physics	4	0	30	70	100	3
CH-1103	ES	Organic Chemistry	4	0	30	70	100	3
CH-1104	ES	Mechanical Engineering	4	0	30	70	100	3
CH-1105	ES	Basic Electrical Engineering	4	0	30	70	100	3
CH-1106	ES	Organic Chemistry Lab.	0	3	50	50	100	1.5
CH-1107	BS	Physics Lab	0	3	50	50	100	1.5
CH-1108	ES	General Engineering Lab. (Mechanical Engineering & Electrical Engineering)	0	3	50	50	100	1.5
Total Credits								19.5

#### **REGULATIONS & STRUCTURE OF THE PROGRAMME**

1.0 ADMISSIONS : Admissions into B.Sc. (Hons.) Food Science & Technology Programme are governed by Andhra University admission regulations.

#### 2.0 ELIGIBILITY CRITERIA :

2.1 A pass in Intermediate or +2 with Physics, Chemistry and Mathematics or Biology with a minimum aggregate of 50% marks or any other equivalent examinations.

2.2 Admissions into B.Sc. (Hons.) Food Science & Technology will be based on the marks obtained in Intermediate following the rule of reservation.

#### 3.0 CHOICE BASED CREDIT SYSTEM :

Choice Based Credit System (CBCS) is introduced on UGC guidelines in

order to promote:

- \* Student centered learning
- \* Cafeteria approach
- \* Inter-disciplinary learning

Learning goals/objectives and outcomes are specified leading to what a student should be able to do at the end of the program.

#### 4.0 STRUCTURE OF THE PROGRAM :

4.1 The program consists of:

- (i) Ability enhancement compulsory core courses (AECC)
- (ii) Core courses (compulsory) (CC)
- (iii) Discipline specific electives (DSE)
- (iv) Generic electives (GE)
- (v) Skill enhancement courses (SEC) are of general nature either related or unrelated to the discipline
- (vi) Practical Proficiency Courses (PPC): Laboratory work

4.2 Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.

4.3 In general, credits are assigned to the courses based on the following contact hours per week per semester as specified in the syllabi

5.0 MEDIUM OF INSTRUCTION: The medium of instruction (including examinations and project reports) shall be English.

6.0 REGISTRATION: Every student has to register himself/herself for each year individually at the time specified by the University.

7.0 TOTAL NO. OF SEATS: 40 + 4 (EWS):

8.0 FEES: Annual fees is Rs.65,000/- (for both semesters)

#### 9.0 ATTENDANCE REQUIREMENTS

9.1 A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the end - semester examination and he/she will not be allowed to register for subsequent semester of study. He /She has to repeat the semester along with his / her juniors.

9.2 However, the Vice Chancellor on the recommendation of the Principal/ Director of the University College / Institute may condone the shortage of attendance to the students whose attendance is between 66% to 74% on genuine medical grounds and on payment of prescribed fee.

#### 10.0 EVALUATION :

10.1 The assessment of the student's performance in a Theory course shall be based on two components: Continuous Evaluation (30 marks) and Semester-end examination (70 marks).

10.2 A student has to secure an aggregate of 40% in the course in the two components put together to be declared to have passed the course.

#### 11.0 STRUCTURE OF THE PROGRAMME

Students are provided with various options for entry and exit to the course under NEP program.

Course	Years/ Semester	Exit option with an award
Bachelor of Science in Food Science & Technology	1 (I – II semester)	Certificate
	2 (I – IV semester)	Diploma
	3 (I – VI semester)	Bachelor's Degree
	4 (I – VIII semester)	Bachelor's Degree with Honours
M.Sc. Food Science & Technology	5 (IX – X semester)	Master's Degree

#### Program Outcomes (POs)

- PO1 Encompass exceptional knowledge in core areas of Food Science, Food Processing Technology, Food Preservation, Food Analysis and Food Product development
- PO2 Achieve cognizance in interdisciplinary fields of Food Microbiology, Food Biotechnology, Food safety, Quality control and Molecular biology through knowledge fortification
- PO3 Develop multidisciplinary proficiency in contemporary domains through Skill Enhancement and Vocational courses
- PO4 Accomplish dexterity in all the fields under the umbrella of Food Science and Technology to attain practical competency
- PO5 Impregnate adept expertise and hands on experience through Dissertation, project work, industrial training, field trips, food institutional and industrial visits
- PO6 Amass exploratory research skills with innovative ideas, lab to field food technology and systemic approach towards achieving sustainable nutrition goals
- PO7 Employ critical thinking towards innovation, synthesis of novel ideas, knowledge dissemination and community interaction for the benefit of the community and society at large
- PO8 Develop problem solving, decision making and communication skills to emerge as a potential leader
- PO9 Evolve as a professionally sound wellbeing with societal responsibility fortified with moral and ethical values well equipped for nation building

Program Specific Outcomes (PSOs)

- PSO1 Emanate as an adept in all the core spheres of Food Science, Food Processing and Preservation theory as well as practical aspects
- PSO2 Competent to pursue career in integrated areas of Food Biotechnology, Food Microbiology and Nutraceutical technology
- PSO3 Become a successful professional and entrepreneur to start a food industry and food business
- PSO4 Ability to create value added products, synthesize novel approaches relating to diet formulations in the prevention and management of disease
- PSO5 Well-equipped with current scenario in the field of Food Science & Technology with reference to nutrigenetics and Bioinformatics and take up research
- PSO6 Acquire exhaustive skills in planning, monitoring and evaluation of Food safety assessment programs
- PSO7 Capability to develop distinctive functional food based products for different age groups to nurture healthy society
- PSO8 Take up professions in food quality control and regulations
- PSO9 Transcend as Academicians and Researchers in reputed academic and research institutions

**B.Sc. (Honors) Food Science & Technology Course structure**

**SEMESTER I**

Category	Course Code	Course Marks	Total	Internal	Sem End Exam	Teaching Hours	Credits
Ability Enhancement compulsory Courses	FSTL1.1	First Language (Telugu/Hindi)	100	30	70	3	3
	FSTL1.2	Second Language English	100	30	70	3	3
DSCC (Discipline Core Course)	FST1.1	Fundamentals of Food Technology (Th)	100	30	70	4	4
	FST1.2	Principles of Food Science (Th)	100	30	70	4	4
	FST1.3	Sensory Evaluation of Food (Th)	100	30	70	4	3
	FST1.4	Fundamentals of Food Technology (Pr)	50	15	35	3	2
	FST1.5	Principles of Food Science (Pr)	50	15	35	3	2
Open Elective Skill Enhancement Courses	OE1	Food Safety (Th)	100	30	70	4	3
	SEC1	Digital Fluency	50	15	35	2	2

Total 750 30 26

**Semester II**

Category	Course Code	Course Marks	Total	Internal	Sem End Exam	Teaching Hours	Credits
						L T P	
Ability Enhancement compulsory Courses	FSTL1.1	First Language (Telugu/Hindi)	100	30	70	3	3
	FSTL2.2	Second Language English	100	30	70	3	3
Multi-Disciplinary DSCC (Discipline Core Course)	MD1	Environmental Studies	50	15	35	2	2
	FST2.1	Food Chemistry (Th)	100	30	70	4	4
	FST2.2	Technology of Food Processing & Preservation (Th)	100	30	70	4	4
	FST2.3	Food Chemistry (Pr)	50	15	35		3 2
	FST2.4	Technology of Food Processing & Preservation (Pr)	50	15	35		3 2
Skill Enhancement Courses	SEC 2	Solar Energy	50	15	35	2	2
Value added	VA1	Human Values & Professional Ethics	50	15	35	2	2
<b>Total</b>			<b>650</b>			<b>20</b>	<b>6 24</b>

(Exit Option with \*Certificate in Food Science & Technology with 50 Credits)

\* Certificate: Students who opt to exit after completion of the first year and have secured 50 credits will be awarded a certificate if, in addition, they complete one vocational course/One month Internship of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.

L- Lecture, T- Tutorial, P- Practical

**Semester III**

Category	Course Code	Course Marks	Total	Internal	Sem End Exam	Teaching Hours	Credits
						L T P	
Ability Enhancement compulsory Courses	FSTL3.1	First Language (Telugu/Hindi)	100	30	70	3	3
	FSTL3.2	Second Language English	100	30	70	3	3

Multi-Disciplinary DSCC (Discipline Core Course)	MD2	Indian Constitution	50	15	35	2	2
	FST3.1	Technology of Plant Foods (Th)	100	30	70	4	4
	FST3.2	Technology of Sea Foods (Th)	100	30	70	4	4
	FST3.3	Technology of Plant Foods (Pr)	50	15	35		3 2
	FST3.4	Technology of Sea Foods (Pr)	50	15	35		3 2
Skill Enhancement Courses	SEC3	Mushroom cultivation technology	50	15	35	2	2
Total			600			18	6 22

L- Lecture, T- Tutorial , P- Practical

#### Semester IV

Category	Course Code	Course Marks	Total	Internal	Sem End Exam	Teaching Hours			Credits
						L	T	P	
Multi-Disciplinary DSCC (Discipline Core Course)	MD3	Cyber Security	50	15	35	2			2
	FST4.1	Food Analysis (Th)	100	30	70	4			4
	FST4.2	Food Product Development (Th)	100	30	70	4			4
	FST4.3	Food Analysis (Pr)	50	15	35				3 2
	FST4.4	Food Product Development (Pr)	50	15	35				3 2
Discipline Specific Elective	DSE1A	Technology of Meat, poultry & egg (Th)	100	30	70	4			4
Skill Enhancement Courses	SEC4	Food Packaging & Labelling	50	15	35	2			2
Value added	VA2	Organic farming	50	15	35	2			2
Total			550				18	6	22

(Exit Option with JG Diploma in Food Science & Technology with 94 Credits)

UG Diploma: Students who opt to exit after completion of the second year and have secured 94 credits will be awarded the UG Diploma if, in addition, they complete one vocational course / One month Internship for 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

#### Semester V

Category	Course Code	Course Marks	Total	Internal	Sem End Exam	Teaching Hours			Credits
						L	T	P	
Multi-Disciplinary DSCC (Discipline Core Course)	MD4	Artificial Intelligence	50	15	35	2			2
	FST 5.1	Food Microbiology & Toxicology(Th)	100	30	70	4			4
	FST 5.2	Bakery & Confectionary Technology (Th)	100	30	70	4			4
	FST5.3	Food Microbiology& Toxicology Pr	50	15	35				3 2
	FST5.4	Bakery & Confectionary Technology Pr	50	15	35				3 2
Discipline Specific Elective	DSE2A	Food Biotechnology	100	30	70	4			4
Skill Enhancement Courses	SEC5	Nutrition for healthy living(Th)	50	15	35	2			2
Value added	VA3	Entrepreneurship & management of start ups	50	15	35	2			2
Total			550	-	-	18	6	22	

#### Semester VI

Category	Course Code	Course Marks	Total	Internal	Sem End Exam	Teaching Hours			Credits
						L	T	P	
DSCC (Discipline Core Course)	FST 6.1	Processing of oils and fats (Th)	100	30	70	4			4
	FST 6.2	Dairy Technology (Th)	100	30	70	4			4
	FST6.3	Processing of Oils and Fats (Pr)	50	15	35				3 2
	FST6.4	Dairy Technology(Pr)	50	15	35				3 2
	FST6.5	Internship*	100		100				4
Discipline Specific Elective	DSE3A	Beverage Technology	100	30	70	4			4
MOOC's		MOOC's 1	50		50				2
Total			550	-			12	6	22

A student who completes, Summer Internship /Industrial training for 45 days (which is mandatory) and having secured 138 credits, after completion of third year, will be awarded B.Sc Food Science & Technology

### Semester VII

Category	Course Code	Course Marks	Total	Internal	Sem End Exam	Teaching Hours			Credits
						L	T	P	
DSCC (Discipline Core Course)	FST 7.1	Unit operations in Food Industry(Th)	100	30	70	4			4
	FST 7.2	Enzymes in Food Processing (Th)	100	30	70	4			4
	FST7.3	Research Methodology(Th)	100	30	70	4			4
	FST7.4	Unit operations in Food Industry(Pr)	50	15	35			3	2
	FST7.5	Enzymes in Food Processing(Pr)	50	15	35			3	2
Community engagement & Service	FST7.6	Community engagement & Service	50		50			3	2
Field based project work	FST7.7	Field based project work	50		50			3	2
Total			500			12	12	20	

### Semester VIII

Category	Course Code	Course Marks	Total	Internal	Sem End Exam	Teaching Hours			Credits
						L	T	P	
DSCC (Discipline Core Course)	FST8.1	Applied Statistics (Th)	100	30	70	4			4
	FST8.2	Dissertation based on Project work	200	-	200			24	12
	FST8.3	Comprehensive Viva-voce	50		50				2
MOOC's		MOOC's 2	50		50				2
Total			400		400	4		24	20

A student who completes, Dissertation based on Project work (which is mandatory) and having secured 178 credits, after completion of Fourth year, will be awarded Bachelor of Honours Degree in B.Sc Food Science & Technology. These students are eligible to pursue One year M.Sc program in Food Science & Technology

### ANNEXURE-1A

#### DISCIPLINE SPECIFIC ELECTIVE(DSE)

\*Student has to choose Any Three DSEs (one each from DSE-1, DSE2 & DSE-3 in semester IV, V and VI respectively)

DSE-1: (Any One) (Semester -IV)

DSE-1A: Technology of Meat, poultry & egg

DSE-1B: Fermentation Technology

DSE-1C: Food Laws and Standards

DSE-2: (Any One) (Semester -V)

DSE-2A: Food Biotechnology

DSE-2B: Food Sanitation Hygiene & Waste Management

DSE-2C: Food Adulteration

DSE-3: (Any One) (Semester -VI)

DSE-3A: Beverage Technology

DSE-3B: Food Plant Layout & Design

DSE-3C: Food Extrusion Technology

#### M.Sc. Food Science & Technology (Two Semesters)

#### Semester IX

Category	Course Code	Course Marks	Total	Internal	Sem End Exam	Teaching Hours			Credits
						L	T	P	
DSCC (Discipline Core Course)	PGFST9.1	Cereal, Legume, and Oilseed Processing Technology (Th)	100	30	70	4			4
	PGFST9.2	Fundamentals of molecular biology & Bioinformatics (Th)	100	30	70	4			4
	PGFST9.3	Nutraceuticals & Functional foods	100	30	70	4			4
	PGFST9.4	Cereal, Legume, and Oilseed Processing Technology (Pr)	50	15	35	3			2
	PGFST9.5	Fundamentals of molecular biology & Bioinformatics (Pr)	50	15	35	3			2
Discipline Specific Elective	PGDSE1	Any One to be chosen A. Snack Food Technology/ B. Industrial Microbiology/ C. Flavour chemistry & Technology	100	30	70	4			4
Total			500			22			20

## Semester X

Category	Course Code	Course Marks	Total	Internal	Sem End Exam	Teaching Hours	Credits
DSCC (Discipline Core Course)	PGFST10.1	Advanced Processing Technology of Animal foods (Th)	100	30	70	4	4
	PGFST10.2	Fruit and Vegetable Processing Technology (Th)	100	30	70	4	4
	PGFST10.3	Diet Design & Formulation of Special Foods (Th)	100	30	70	4	4
	PGFST10.4	Advanced Processing Technology of Animal foods (Pr)	50	15	35	3	2
	PGFST10.5	Fruit and Vegetable Processing Technology (Pr)	50	15	35	3	2
	PGFST10.6	Research Project	100	0	100	6	6
Total			500			24	22

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### B.Sc. (Honors) Food Science & Technology Course structure

#### THEORY : SEMESTER I

##### FST1.1. FUNDAMENTALS OF FOOD TECHNOLOGY

###### Course Outcomes

- CO1. To enable the students to understand the importance of food technology
- CO2. To understand the relationship between Food technology and Food science
- CO3. Comprehend the structure, composition and nutritive value of different types of food
- CO4. Comprehensive know how of changes during cooking
- CO5. Understand the newer applications of food technology

###### Course Specific Outcomes

- CSO1. Inculcate knowledge about different properties of food
- CSO2. To study the structure and composition food grains
- CSO3. Discuss the composition and Classification of fruits and vegetables
- CSO4. To study the structure and composition of various animal foods
- CSO5. Understand the composition of sugars

###### Learning Outcomes

- LO1. Enable students to understand the applications of food technology

in food industry

- LO2. Apply the concepts of food technology in food preparation
- LO3. Familiarise students with how changes in food impacts quality
- LO4. Understand the importance of millets and their composition
- LO5. Explore the nuances in food technology applications

#### THEORY : SEMESTER I

##### FST1.1. FUNDAMENTALS OF FOOD TECHNOLOGY

###### Course Content

Unit I : Introduction to food technology, definition, history, growth and scope, role of food technology in food processing industries, relationship between food technology and food science, properties of food - physical, rheological, thermal, mass transfer and electrical properties.

Unit II : Composition and nutritive value of plant foods – Cereals -types, Structure of wheat and types, Composition & Nutritive value, Rice- Structure, Composition & Nutritive value. Millets – types, structure, composition & nutritive value, ragi, sorghum, maize, bajra, kodo, proso and foxtail. Pulses and legumes: Types, Composition, Nutritive value, Antinutritional factors. Nuts & Oil-seeds: types, Composition and nutritive value

UNIT III : Fruits and vegetables: Classification, structure - tissue systems, types of cells, structural constituents – cellulose, hemicellulose, pectic substances and lignin. Composition & Nutritive value, pigments – chlorophyll, carotenoids, flavonoids and flavour compounds. Spices- Definition, Classification, Chemical composition, uses of spices. Beverages – Classification, Tea, Coffee & Cocoa, Composition & Nutritive value

Unit IV : Meat – Classification, Structure – muscle tissue, connective tissue, adipose tissue, pigments, Composition & Nutritive value. Poultry- Desi birds, structure, classification, composition and nutritive value. Fish: Structure, Types, Composition & Nutritive value.

Unit V : Milk – Types, structure, composition – milk fat, milk proteins, milk sugar, ash and salts, enzymes, flavour components, nutritive value. Eggs: formation of egg, Structure, Composition, egg white proteins, egg yolk proteins. Sugars – types – jaggery, honey and its composition.

###### Recommended References

1. Bawa. AS, O.P Chauhan et al. (2013) Food Science. New India Publishing agency
2. RodayS (2011) Food Science, Oxford publication
3. B. Sri Lakshmi (2002) Food science, New Age Publishers
4. Meyer (2004) Food Chemistry, New Age International Pbs
5. De Sukumar (2007) Outlines of Dairy Technology, Oxford University Press

## THEORY : SEMESTER I

### FST1.2. PRINCIPLES OF FOOD SCIENCE

#### Course Outcomes

1. Understand the food groups and their and functions
2. Acquire knowledge on principles of cereal cookery
3. Gain knowledge on changes during cooking of pulses
4. Comprehend the knowledge on use of meats in cooking
5. Acquire knowledge on solar and micro wave cooking

#### Course Specific Outcomes

1. List and classify foods based on its nutritive value and understand the properties of food
2. Criticize the factors affecting cooking quality
3. Understand the importance of stages of sugar cookery
4. Evaluate the nutrient losses during cooking
5. Learn methods of preparing milk products

#### Learning Outcomes

1. Enable students to use the theoretical knowledge in various food preparations
2. Develop skills in cooking and apply the scientific principles while making new recipes
3. Familiarise students with changes occurring during cooking.
4. Design and create novel value-added products and recipes
5. Learn about factors affecting selection of fish

## THEORY : SEMESTER I

### FST1.2. PRINCIPLES OF FOOD SCIENCE

#### Course Content

UNIT-I : Food Science- Introduction, scope, Different Food groups, food in relation to health, evolution of cooking techniques. Cooking media, General Methods of cooking- dry and moist heat methods, microwave and solar cooking, advantages and disadvantages, Nutrient losses during cooking.

UNIT-II : Cereals & Millets- Cereal and millet cookery and changes during cooking, gelatinization, dextrinization, retrogradation and syneresis. Principles of baking, different types of flours for baking, Role of leavening agents in baking, methods of preparation of breads, biscuits, cakes and pastry. Sugar cook-

ery- stages of sugar cookery, amorphous and crystalline candies, Sugar related products.

UNIT-III : Pulses- Pulse cookery and changes during cooking. Milk & Milk products- Coagulation, types of milk, Milk cookery, Changes during cooking, methods of preparation of milk products- cheese, butter, cream.

UNIT-IV : Fats and Oils- Types, energy value, Composition, sources, role of fats & oils in cookery, composition of unconventional oils. Fruits and Vegetables- Cooking methods and effect of cooking on plant pigments. Methods of preparation of different types of beverages – tea coffee, cocoa.

UNIT-V : Eggs: Selection, egg quality – evaluation of egg quality, grading, deterioration of egg, storage, methods of cooking & changes during cooking, role of egg in cookery. Egg foams – egg beating, factors influencing foaming. Flesh Foods: Meat & Poultry- Cuts and grades of meat, ageing and post-mortem changes. Methods of cooking, factors affecting tenderness. Fish: Selection of fish & cooking methods.

#### Recommended References

1. Meyers LH. (1969) Food Chemistry, Van Nostrand Reinhold Co.
2. Sri Lakshmi L (2004) Food Science. New Age Int.
3. Pecham GG, Foundation of food preparation.1972. Mac millanPbs.
4. Swami Nathan M (1992) Handbook of Food Science and Experimental foods. 2<sup>nd</sup> Ed. Bangalore.
5. Potter NH and Hotchkiss JH (1996) Food Science. 5<sup>th</sup>ed.. New Delhi, CBS pbs.
6. Sethi M and Rao SE (2001) Food science experiments and application. CBS pbs. New Delhi.
7. Principles of Food science- A Practical Manual (2013) EramS.Rao
8. Food Quality Evaluation (2013) EramS.Rao

## THEORY : SEMESTER I

### FST1.3. SENSORY EVALUATION OF FOOD

#### Course Outcomes

- CO1. Enable the students to provide theoretical background of sensory evaluation
- CO2. Understand the role of sensory evaluation in food quality evaluation
- CO3. Comprehend the sensory evaluation methods for assessing food quality
- CO4. Comprehensive know how of assessment of texture of foods
- CO5. Analyse and interpret the sensory evaluation data.

### Course Specific Outcomes

- CSO1. Inculcate knowledge about consumer acceptability of foods  
CSO2. To study the panel selection and training methods  
CSO3. Learn about specific methods of assessment of quality attributes of food  
CSO4. To study the texture profile analysis of food  
CSO5. Understand the applications of questionnaires and score boards in sensory evaluation

### Learning Outcomes

- LO1. Enable students to understand the sensory attributes in consumer acceptability  
LO2. Apply the concepts of sensory attributes in food preparation  
LO3. Familiarise students with rating for sensory profile  
LO4. Understand the importance of sensory applications in food  
LO5. Explore the statistical analysis in sensory evaluation

## THEORY : SEMESTER I

### FST1.3. SENSORY EVALUATION OF FOOD

#### Course Content

UNIT - 1 : Sensory Evaluation of Foods- Introduction, importance of sensory evaluation in relation: to consumer acceptability and economic aspects. Physiological basis of sensory evaluation – olfactory receptors, taste receptors, visual receptors. Sensory characteristics of food – appearance, aroma, flavour & texture. Factors affecting acceptance of food.

UNIT – 2 : Anatomy and physiology of tongue and nose. Taste organs- tongue, papillae, taste buds, salivary glands. Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami. Factors affecting taste quality, reaction time, taste modification. Mechanism of taste perception. Odour classification, chemical specificity of odour. Mechanism of odour perception. Odour measurement using different techniques – primitive to recent techniques. Gustatory and olfactory abnormalities. Novel technologies in sensory evaluation, e-tongue, e-nose

UNIT - 3 : Evaluation of Sensory qualities, Laboratory Set-up and equipment. Types of sensory panelists. Screening, tests for selection, training of panelists. Objective evaluation – Physical and chemical methods. Comparison between subjective & objective evaluations.

UNIT – 4 : Sensory evaluation tests - Threshold and dilution test for trained/untrained panelists; Difference (Qualitative) test - paired comparison test for trained panelists and untrained panelists, duo-trio test for trained panelists and triangle (triad) test for trained panelists. Rating (Quantitative differences)

test - ranking test, single sample (monadic) test, two sample difference test, multiple sample and quality difference test, hedonic test, numerical scoring test and composite test for trained/semi-trained/untrained panelists. Descriptive Tests: Rating for sensory profile, consensus profiling, conventional profiling, free choice profiling.

UNIT – 5 : Measurement of texture- Mechanical and geometrical characteristics of texture. Texture analysis - TPA test - parameters measured by texture profile analysis test (Hardness, Elasticity, Adhesiveness, Cohesiveness, Brittleness, Chewiness and Gumminess). Instrumental measure of viscosity, Rheology and texture of various foods- dough, pastry, baked products, fruits, vegetables, dairy products, meat and meat products.

#### Recommended References

1. Ranganna S. 2001. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2<sup>nd</sup> Ed. Tata-McGraw-Hill.
2. Amerine MA, Pangborn RM & Rossles EB. 1965. Principles of Sensory Evaluation of Food. Academic Press.
3. Lawless HT & Klein BP. 1991. Sensory Science: Theory and Applications in Foods. Marcel Dekker.
4. Maslowitz H. 2000. Applied Sensory Analysis of Foods. Vols. I, II. CRC Press.
5. Rai SC & Bhatia VK. 1988. Sensory Evaluation of Agricultural Products.

## PRACTICAL : SEMESTER I

### FST1.4. FUNDAMENTALS OF FOOD TECHNOLOGY

1. Survey of locally available plant foods in the market
2. Survey of locally available animal foods in the market
3. Microscopic observation of food grains and starches
4. Microscopic observation of tissue systems
5. Identification of pigments in fruits and vegetables and influence of pH on them.
6. Gluten content of various flours
7. Market survey of locally available meat, poultry and eggs in the market
8. Market survey of different types of fish and their local names
9. Market survey of different types of milks and their composition
10. Survey of different types of sugars available in the market
11. Estimation of salt content of butter

12. Survey of beverages available in the market

### **FST1.5.PRINCIPLES OF FOOD SCIENCE**

1. Preparation of recipes using different cooking methods- Boiling, pressure cooking, grilling, simmering, poaching, stewing, frying, roasting and baking
2. Factors affecting Gelatinization & Dextrinization of cereal starches. Preparation of recipes based on gelatinization & Dextrinization
3. Preparation of bread, cookies and cakes
4. Study of Stages of sugar cookery. Preparation of recipes using different stages of sugar cookery.
5. Study of malting and germination of whole pulses.
6. Fermentation in cereals and pulses. Preparation of recipes using fermentation method
7. Factors affecting coagulation of milk proteins. Recipes using milk and preparation of milk products
8. Gel formation in foods, preparation of recipes using gelatine and egg protein
9. Effect of different methods of cooking on flavour, colour, texture and palatability of flesh foods
10. Study of cuts of meat
11. Recognition and sensory tests for four basic tests
12. Preparation of casein and calculation of yield

### **THEORY : SEMESTER I**

#### **OE1. FOOD SAFETY**

#### **Course Outcomes**

- CO1. Understand the concept and meaning of Food Safety
- CO2. Acquire knowledge on Food Laws & Regulations
- CO3. Gain knowledge on HACCP and its role in Food Safety
- CO4. Comprehend knowledge on prevention of contamination
- CO5. Acquire knowledge on Food safety Assessment

#### **Course Specific Outcomes**

- CSO1. List and classify food borne diseases
- CSO2. Criticize the factors affecting safety of water
- CSO3. Understand the safety features of food processing equipment
- CSO4. Understand the principles of Sanitation
- CSO5. Learn food safety management procedures

#### **Learning Outcomes**

- LO1. Enable students to understand the sensory attributes in consumer acceptability
- LO2. Develop skills in Hazard analysis of foods
- LO3. Familiarise students with Food standards
- LO4. Design protocols for food workers education and training
- LO5. Develop skills in safety assessment of pesticide residues

### **THEORY : SEMESTER I**

#### **OE1. FOOD SAFETY**

#### **Course Content**

UNIT 1 : Introduction to food safety, Concept, meaning, scope and factors affecting food safety, Historical aspects of food safety, epidemiologic investigations and surveillance: Origins and contribution of epidemiology, public health and disease surveillance. Classification of food borne diseases and etiologic agents, risk factors.

UNIT II : Food laws and regulations related to food safety – National (FSSAI) food laws, newer approaches to food safety. PFA, FPO, Food Safety and Standards Bill 2005, International Laws and Agreements - FAO, WHO, Codex Alimentarius, Governing bodies. Current National and International food safety issues.

UNIT III : HACCP– History, hazards - types, critical point, control points, critical control points (CCP), principles of HACCP, benefits of HACCP – to consumers, industry & government, difficulties and barriers for implementation of HACCP, Risk analysis- risk management, risk assessment and risk communication.

UNIT IV : Food contamination and principles of prevention: Types of food contamination, principles of prevention: reduction of microbial contamination and growth, elimination of source of contamination from chemical pollutants and toxins, principles and purposes of sanitation, Importance of personal hygiene of food handlers, significance of educating and training food workers. Safety aspects of water and beverages, Safety assessment of food contaminants and pesticide residues.

UNIT V : Food Safety Assessment, importance of food safety, Food safety management procedures, Terms relating to process and product, characteristics and conformity, Terms relating to documentation, examination and audit. Role of food safety officer.

#### **Recommended References**

1. Motarjemi Y. Lelieveld H. Food Safety Management, A Practical Guide for the Food Industry, Academic Press, ISBN:9780123815040,

2. Forsythe S J, Hayes P R (2012) Food Hygiene, Microbiology & HACCP. Springer
3. Schmidt R.H., Rodrick G.E. (2003) Food Safety Handbook, John Wiley & Sons, Inc.,
4. Bryan, F.L. (2007) Hazard Analysis Critical Control Point Evaluations- A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. WHO
5. Mortimore, S., and Wallace, C., (2005) HACCP: A practical approach, 2nd Ed, Aspen Publication

**THEORY : SEMESTER I**  
**SEC1. DIGITAL FLUENCY**

**Course Outcomes**

- CO1. Understand the importance of digital fluency
- CO2. Be aware of different parts of computer and their uses
- CO3. Understand the importance of internet usage at present

**Course Specific Outcomes**

- CSO1. Learn the importance of use of computers in current world
- CSO2. Get insights into word processing of documents
- CSO3. Know about web browsing

**Learning Outcomes**

- LO1. Learn the functions of different components of a computer
- LO2. Get insights into document formatting and manipulation
- LO3. Learn about popular search engines

**THEORY : SEMESTER I**  
**SEC1. DIGITAL FLUENCY**

**Course Content**

UNIT I : Fundamentals of Computer: Introduction – Objectives - Computer, history and Generations of computer. Components of a Computer System - Central Processing Unit- Common Input & Output devices - USB ports and Pen Drive - Connecting Power cord, Keyboard, Mouse, Monitor and Printer to CPU. Applications of computer. Mobile/ Tablet and their application. Operating system and its functions, basics of popular operating system (Linux, Windows).

UNIT II : Word Processor: Introduction – Objective -Word Processing Basic - Opening Word Processing Package - Title Bar, Menu Bar, - Toolbars & Sidebar - Creating a New Document - Opening and Closing Documents Opening Documents - Save and Save As - Closing Document - Using The Help -

Page Setup –Print Preview - Printing of Documents - PDF file and Saving a Document as PDF file –Document manipulation& Formatting - Text Selection - Cut, Copy and Paste - Font, Colour, Style and Size selection - Alignment of Text - Undo & Redo - Spelling & Grammar - Shortcut Keys.

UNIT 3 : Internet: Introduction – Objectives – Internet - protocols: HTTP, HTTPS, FSTP, Concept of Internet & WWW -Website Address and URL - Applications, advantages and disadvantages internet - Modes of Connecting Internet (Hotspot, Wi-Fi, LAN Cable, Broadband, USB Tethering) - Popular Web Browsers (Internet Explorer/Edge, Chrome, Mozilla Firefox.) - Exploring the Internet - Surfing the web - Popular Search Engines - Searching on Internet.

**Recommended References**

1. Rajaraman V, Adabala N. Fundamentals of Computers
2. Manoj Wadhwa, Fundamentals of Computers
3. Rohit Khurana, Learning MS-Word and MS-Excel
4. Joan Lambert, MicrosoFSTWord 2019 Step by Step
5. Ernest C. Ackerman (1995) Learning to Use the Internet: An Introduction with Examples and Exercises. Paperback

**Semester II**

(Exit Option with \*Certificate in Food Science & Technology with 50 Credits)

\* Certificate: Students who opt to exit after completion of the first year and have secured 50 credits will be awarded a certificate if, in addition, they complete one vocational course/One month Internship of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.

L- Lecture, T- Tutorial, P- Practical

**THEORY : SEMESTER II**  
**MD1. ENVIRONMENTAL STUDIES**

**Course Outcomes**

- CO1. Understand the importance and scope of environmental studies
- CO2. Be aware of the concept of Biodiversity
- CO3. Understand the environment pollution issues and management

**Course Specific Outcomes**

- CSO1. Learn about bio geographical classification of India
- CSO2. Get insights into different environment movements
- CSO3. Know about the global warming and its consequences

**Learning Outcomes**

- LO1. Understand the segregation of domestic waste and create consumer awareness
- LO2. Get insights into impact of plastic on human health
- LO3. Learn the skills of rain water harvesting

**THEORY : SEMESTER II**  
**MD1. ENVIRONMENTAL STUDIES**

**Course Content**

Unit I : Environmental Studies – Introduction, Importance and scope. Ecosystems – Concept, structure and function; Pond ecosystem. Bio-geographical classification of India. Biodiversity – Meaning; Hotspots of biodiversity in India, Threats to biodiversity, Endangered and endemic species. Environment movements – Chipko, Appiko, Narmada Bachao Andolan. Individual and community initiatives, Concept of Sacred Groves

Unit II : Environmental pollution and its management: Air pollution, water pollution, noise pollution, - Cause, effect and control measures. Global Warming – Meaning, causes and effects. Solid waste management - biodegradable and non-biodegradable waste. Segregation of domestic waste at source; Impact of plastic on human and animal health. National Environmental Policy, 2006 – Provisions and importance. Swachh Bharat Mission – Objectives. Environmental ethics - Issues & possible solutions.

Unit III : Natural resources and management: Types of natural resources and energy resources. Water conservation - rain water harvesting; water shed management – Meaning and importance. Wasteland reclamation, soil conservation, afforestation – Meaning and importance. Disaster – Definition and types (Natural and Man-made); Self-protection during disasters (Fire, Floods, Earth quakes)

**Recommended References**

1. Agarwal KC (2001) Environmental Biology, Bikaner, Nidhi Pub.
2. Erach Bharucha (2013) Text book of Environmental Science. Orient Black Swan
3. Odum EP (1983) Basic Ecology, W.B. Saunders Co. USA
4. Pandey GN (1997) Environmental Management. Vikas Publishing House
5. Pashupati Kumar Roy and Arvind Kumar (2008) Environmental Resource Management. Daya Pub.,

**THEORY: SEMESTER II**  
**FST2.1. FOOD CHEMISTRY**

**Course Outcomes**

- CO1. Assimilate the synergistic integration of food physics and food chemistry

- CO2. Acquire knowledge on carbohydrate, fruit and vegetable chemistry
- CO3. Gain knowledge on chemistry of plant and animal foods
- CO4. Comprehensive know-how on the identification of rancidity of oils and fats
- CO5. Explore the molecular mechanisms in perception of flavours and colours

**Course Specific Outcomes**

- CSO1. Understand the molecular composition and chemistry of major and minor components in foods
- CSO2. Understand the uses of novel enzymes in food industry
- CSO3. Perceive the importance of gums and non-nutritive sweeteners in food and health industry
- CSO4. Evaluate and compare the industrial uses of plant and animal proteins
- CSO5. Grasp the current innovative technologies for structured lipids

**Learning Outcomes**

- LO1. Enable students to better understand the role of chemistry in food
- LO2. Apply the concepts of food chemistry in food preparation
- LO3. Familiarise students with how chemistry impacts quality and highlights its role in creating novel foods
- LO4. Understand the interaction of food and medium of cooking
- LO5. Explore the importance of phytochemicals in food industry

**THEORY : SEMESTER II**  
**FST2.1. FOOD CHEMISTRY**

**Course Content**

UNIT I : Introduction to Food Chemistry- Moisture in foods, Free & bound water, states of water, factors influencing boiling point and freezing point of water. Physics and Food- Solids, liquids and gases. Dispersions- True solutions, colloidal solutions & suspensions, Gels, emulsions and foams. Types of enzymes in foods, functions and use of enzymes in Food Industry.

UNIT II : Carbohydrate chemistry – Classification, chemical reactions of carbohydrates, structure, Types of starches, physical and chemical properties of starches, structure, Modified starches, non-starch polysaccharides- Cellulose, hemicellulose, pectin & Gums, types of gums and their uses in food industry, Commercial sugars & Non-nutritive sweeteners, non enzymatic browning.

UNIT III : Protein Chemistry - Chemical and physical properties of proteins, structure, denaturation & coagulation, theories of gel formation, collagen and gelatine, extraction of pure proteins from foods, Plant proteins, Animal Proteins. Mechanism of post mortem changes, colour of meat, tender-

ness and juiciness. Pigments in Animal tissues – Haemoglobin, myoglobin and effect of cooking on animal pigments

UNIT IV : Lipid chemistry- Fatty acids, structures, fatty acids in edible fats and oils, crystallinity of solid fats, physical and chemical properties of fats, flavour changes, rancidity, methods of evaluation of rancidity, reversion, shortening value of fats, Fat substitutes & Structured lipids

UNIT V : Vegetables and fruits: Changes during maturation, changes in structure of pectic substances, effect of cooking on structure of pigments - chlorophyll, carotenoids and flavonoids, post-harvest changes, browning reactions, Phytochemical constituents in food and its role in food industry.

#### Recommended References

1. Meyers LH. (1969) Food Chemistry, Van Nostrand Reinhold Co.
2. Sri Lakshmi L (2004) Food Science. New Age Int.
3. Pecham GG, Foundation of food preparation.1972. Mac millanPbs.
4. Potter NH and Hotchkiss JH (1996) Food Science. 5<sup>th</sup>ed.. New Delhi, CBS pbs.
5. Sethi M and Rao SE (2001) Food science experiments and application. CBS pbs. New Delhi.
6. Fennema's Food Chemistry, 4<sup>th</sup> edition, Srinivasan Damodaran, Kirk L Parkin, Owen R.Fennema
7. Food Chemistry A Laboratory Manual, Dennis D.Miller (1998)
8. Principles of Food science- A Practical Manual (2013) EramS.Rao

### **THEORY : SEMESTER II**

#### **FST2.2. TECHNOLOGY OF FOOD PROCESSING AND PRESERVATION**

##### **Course Outcomes**

- CO1. Understand the principles of Food Processing & preservation Technology.
- CO2. Understand the objectives of food preservation
- CO3. Acquire knowledge on methods of processing and preservation
- CO4. Gain awareness on shelf life of foods
- CO5. Get insights into newer concepts of technology of food preservation

##### **Course Specific Outcomes**

- CSO1. Gain expertise in recent food processing and preservation technologies
- CSO2. Ability to choose appropriate food preservative techniques for better preservation
- CSO3. Evaluate the advantages of different processing and preservative methods

CSO4. Comprehend the knowledge on food preservatives and limits prescribed by FSSAI

CSO5. Elucidate the nutritional and safety aspects of food irradiation

##### **Learning Outcomes**

- LO1. Apply the Knowledge of basic and applied aspects of food preservation in preserving of foods
- LO2. Choose appropriate food processing and preservative method suitable for specific foods
- LO3. Relate the theoretical Knowledge of Preservation Techniques in food product development
- LO4. Compare the novel technologies with the traditional methods in food processing and preservation
- LO5. Knowledge of potential use of chemical preservatives

### **THEORY : SEMESTER II**

#### **FST2.2. TECHNOLOGY OF FOOD PROCESSING AND PRESERVATION**

##### **Course Content**

UNIT I : Introduction to technology of food preservation and processing, difference between Food Processing and Food Preservation; Benefits and Drawbacks of Food Processing. Status of food processing industries in India and abroad, magnitude, prospects for future growth in India. Basic Processing Techniques – dicing, slicing, mincing, macerating, liquefaction, emulsification, Various techniques of food preservation.

UNIT II : Ambient temperature processing: Raw material preparation - cleaning – types, Sorting - types, Grading, Peeling –types. Size reduction of solid and liquid foods - concept, Equipment and effect on foods. Mixing and forming - Mixing - concept of solids and liquids mixing, equipment and effect on foods. Forming: Bread moulders, pie and biscuit formers, confectionery moulders. Separation and concentration of food components - centrifugation, expression and extraction using solvents, Post processing operations – coating or enrobing – coating materials, enrobers, dusting or breading

UNIT III : Food processing and preservation by high temperature: Thermal Processing- Commercial heat preservation methods - Sterilization, Pasteurization, evaporation, distillation, extrusion and blanching. Heat processing by using hot air – dehydration, baking and roasting; heat processing using hot oils; heat processing by using direct and radiated energy – dielectric, ohmic and infrared heating. Drying - factors affecting rate of drying, normal drying curve, types of driers used in the food industry. Canning as a preservation method, steps in canning, spoilage in canned foods

UNIT IV : Food processing and preservation by Low temperature: Chilling, Freezing and Refrigeration: Introduction to refrigeration, cool storage and freezing, definition, principle of freezing, freezing curve, changes occurring during freezing, types of freezing i.e. slow freezing, quick freezing, introduction to thawing, changes during thawing and its effect on food.

UNIT V : Food Irradiation - Introduction, Modules of radiation, kinds of ionizing radiations used in food irradiation, mechanism of action, uses of radiation processing in food industry, Preservation by fermentation - curing and pickling. Preservation by Food additives- types of food additives, food preservatives, classification and uses

#### Recommended References

1. Desrosier NW and Desrosier JN (1998) The Technology of Food Preservation, CBS Publication, New Delhi
2. Bawa AS, Chauhan OP et al. (2013) Food Science. New India Publishing agency
3. Potter NH (1998) Food Science, CBS Publication, New Delhi
4. Ramaswamy H and Marcott M (2006) Food Processing Principles and Applications, CRC Press
5. Rao PG (2010) Fundamentals of Food Engineering, PHI Learning Pvt Ltd, New Delhi

### **PRACTICAL : SEMESTER II**

#### **FST2.3. FOOD CHEMISTRY**

1. Qualitative tests for identification of different sugars
2. Experiment on Properties of Starch and dextrin
3. Gelatinization temperature range and % sag of various cereal starches
4. Experiment on Hydrolysis of starch from different sources
5. Precipitation reactions of proteins, colour reactions of proteins, Reactions of Albumin, Casein and Gelatine.
6. Determination of Specific gravity and acidity of foods (Milk & Oils)
7. Quality /Platform tests in Milk ( Alcohol test, COB, MBRT, SNF)
8. Estimation of Fat, Protein and Lactose in milk
9. Study different types of browning reactions- enzymatic and non enzymatic
10. Estimation of Chlorophyll, carotenoids and lycopene content in vegetables
11. Estimation of Pectin content of fruits and vegetables
12. Estimation of COD, BOD & hardness in water

### **FST2.4. TECHNOLOGY OF FOOD PROCESSING AND PRESERVATION**

1. Determination of shelf life of different foods
2. Water activity measurement of different foods
3. Determination of pH of different foods using pH meter.
4. Quality characteristics of foods preserved by drying/dehydration/ freezing (Freezing of yolk, fruits)
5. Pasteurization of fluids using different methods.
6. Blanching of different plant foods and observation
7. Preparation of dehydrated products using traditional methods& solar drier
8. Preparation of fruit and vegetable based preserved products
9. Preparation of food products by adding preservatives
10. Preparation of products by curing &pickling
11. Preservation of foods by non thermal process
12. Preservation of foods by coating

#### **THEORY : SEMESTER II**

#### **SEC 2. SOLAR ENERGY**

##### **Course Outcomes**

- CO1. Understand the concept of solar radiation.
- CO2. Understand the applications of solar energy
- CO3. Learn about measurement of solar radiation

##### **Course Specific Outcomes**

- CSO1. Acquire knowledge on solar radiation principles.
- CSO2. Get familiarised with various collecting techniques of solar energy and its storage
- CSO3. Learn about collectors used for solar thermal system

##### **Learning Outcomes**

- LO1. Learn the solar photovoltaic technology principles and applications.
- LO2. Learn about different types of solar cells for energy conversion
- LO3. Understand the working principles of several solar appliances

#### **THEORY: SEMESTER II**

#### **SEC 2. SOLAR ENERGY**

##### **Course Content**

UNIT I : Solar Radiation: Sun as a source of energy. Solar Radiation, Solar

radiation at the Earth's surface, Measurement of Solar radiation, Pyrheliometer, Pyranometer, Sunshine recorder, prediction of available solar radiation, Solar Energy-Importance, Storage of solar energy, Solar Pond

UNIT II : Solar Thermal systems: Principle of conservation of solar radiation in to heat, Collectors used for solar thermal conversion, Flat plate collectors and concentrating collectors, Solar thermal power plant, Solar cookers, Solar hot water systems, Solar dryers, Solar distillation, Solar green houses.

UNIT III : Solar Photovoltaic systems: Conversion of Solar energy in to Electricity- Photo voltaic effect, Solar photovoltaic cell and its working principle, Different types of solar cells, series and parallel connections, photo voltaic applications, battery chargers, domestic lighting, street lighting and water pumping

Co-curricular activities(Hands on exercises)

1. Plot sun chart and locate the sun at your location for a given time of the day
2. Analyse shadow effect on incident solar radiation and find out contributors
3. Connect solar panels in series and parallel and measure voltage and current
4. Measure intensity of solar radiation using Pyranometer and Radiometers
5. Construct a solar lantern using solar PV panel
6. Assemble Solar cooker
7. Designing and constructing photo voltaic system for a domestic house requiring 5kVA power
8. Get hands on experience in handling solar drier
9. Assignments

Recommended References

1. Solar Energy Utilization, GD Rai, Khanna Publishers.
2. Solar Energy – Fundamentals, design, modelling and applications, GN Tiwari, Narosa Pub.2005
3. Solar Energy- Principles of thermal energy collection and storage, SP Sukhatm, Tata McGraw Hill Publishers, 1999
4. Solar Photovoltaics- Fundamentals, technologies and applications, Chetan Singh Solanki, PHI learning Pvt. Ltd
5. Science and Technology of Photovoltaics, P Jayarama Reddy, BS Publication, 2004

## THEORY : SEMESTER II

### VA1. HUMAN VALUES AND PROFESSIONAL ETHICS

#### Course Outcomes

- CO1. Understand the significance of value inputs in a classroom.
- CO2. Understand the value of harmonious relationship based on trust and respect in life and profession
- CO3. Understand the Self and the Body, Intention and Competence of an individual, etc

#### Course Specific Outcomes

- CSO1.Understand the significance of practical applications of ethics and values in real life
- CSO2.Distinguish between values and skills, happiness and accumulation of physical facilities
- CSO3.Get an insight in to comprehensive human goals

#### Learning Outcomes

- LO1. Understand the role of a human being in ensuring harmony in society and nature.
- LO2. Distinguish between ethical and unethical practices
- LO3. Start working out the strategy to actualize a harmonious environment in work place

## THEORY : SEMESTER II

### VA1. HUMAN VALUES AND PROFESSIONAL ETHICS

#### Course Content

UNIT I : Introduction – Definition, Importance, Process & Classifications of Value Education - Understanding the need, basic guidelines, content and process for Value Education, Understanding the thought-provoking issues; need for Values in our daily life, Choices making – Choosing, Cherishing & Acting, Classification of Value Education: understanding Personal Values, Social Values, Moral Values & Spiritual Values.

UNIT II : Harmony in the Family – Understanding Values in Human Relationships, Understanding harmony in the Family- the basic unit of human interaction, Understanding the set of proposals to verify the Harmony in the Family; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Present Scenario: Differentiation (Disrespect) in relationships on the basis of body, physical facilities, or beliefs. Understanding the Problems faced due to differentiation in Relationships, Understanding the harmony in the society (society being an extension of family: Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal

Order (Sarvabhaum Vyavastha )- from family to world family.

UNIT II : Professional Ethics in Education- Understanding about Professional Integrity, Respect & Equality, Privacy, Building Trusting Relationships, Understanding the concepts; Positive co-operation, Respecting the competence of other professions, Understanding about Taking initiative and Promoting the culture of openness, Depicting Loyalty towards Goals and objectives.

**Co curricular Activities:**

1. Visit to an Old Age Home and spending with the inmates for a day.
2. Conduct of Group Discussions on the topics related to the syllabus.
3. Participation in community service activities.
4. Working with a NGO like Rotary Club or Lions International, etc

**Recommended References**

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
2. Bhatia, R. & Bhatia, A (2015) Role of Ethical Values in Indian Higher Education.
3. A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.
4. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
5. A N Tripathy, 2003, Human Values, New Age International Publishers.

**THEORY : SEMESTER III  
MD2. INDIAN CONSTITUTION**

**Course Outcomes**

- CO1. Gain knowledge on Indian Constitution
- CO2. Understand the Government of Union and State
- CO3. Understand the features of judicial systems in India

**Course Specific Outcomes**

- CSO1. Outline of the salient features of Indian Constitution
- CSO2. Get insights into Election of Prime minister and Chief Minister
- CSO3. Know about the structure and Jurisdiction of Supreme court and high court

**Learning Outcomes**

- LO1. Understand the Fundamental Rights and Directive Principles
- LO2. Learn about the composition and powers of Lok Sabha and Rajya Sabha
- LO3. Learn about the functions of Election Commission of India

**THEORY : SEMESTER III  
MD2. INDIAN CONSTITUTION**

**Course Content**

Unit I : Constitution – Structure and Principles, Meaning and importance of Constitution, Making of Indian Constitution – Sources, Salient features of Indian Constitution. Fundamental Rights and Directive Principles, Fundamental Rights, Fundamental Duties, Directive Principles.

Unit II : Government of the Union: President of India – Election and Powers, Prime Minister and Council of Ministers, Lok Sabha – Composition and Powers, Rajya Sabha – Composition and Powers

Government of the States: Governor – Powers, Chief Minister and Council of Ministers, Legislative Assembly – Composition and powers, Legislative Council – Composition and powers

Unit III : Features of judicial system in India, Supreme Court –Structure and jurisdiction, High Court – Structure and jurisdiction. Federalism in India – Features, Local Government -Panchayats –Powers and functions; 73<sup>rd</sup> and 74<sup>th</sup> amendments, Election Commission – Organisation and functions, Citizen oriented measures – RTI and PIL – Provisions and significance

**Recommended References**

1. Durga Das Basu (2018) Introduction to the Constitution of India, Gurgaon; LexisNexis. 23<sup>rd</sup>edn.
2. M.V.Pylee (2017) India's Constitution, New Delhi; S. Chand Pub., 16<sup>th</sup> edn.
3. J.N. Pandey (2018) The Constitutional Law of India, Allahabad; Central Law Agency, 55<sup>th</sup> edn.
4. Constitution of India, India.gov.in., National Portal of India,
5. Durga Das Basu (2015) Bharatada Samvidhana Parichaya, Gurgaon; LexisNexis Butterworths Wadhwa,

**THEORY : SEMESTER III  
FST3.1. TECHNOLOGY OF PLANT FOODS**

**Course Outcomes**

- CO1. Understand the Knowledge of structure and composition of plant foods
- CO2. Understand the processing technologies of cereals
- CO3. Comprehend the processing technologies of legumes and oil seeds
- CO4. Get awareness on processing technologies of fruits and vegetables
- CO5. Get insights into processing technologies of spices and plantation products

**Course Specific Outcomes**

- CSO1. Gain expertise in utilization of plant products
- CSO2. Ability to choose appropriate plant processing techniques for better preservation
- CSO3. Evaluate the advantages of different plant processing methods
- CSO4. Comprehend the knowledge on physico chemical properties of fruits and vegetables
- CSO5. Elucidate the nutritional aspects of extrusion technology in foods

### Learning Outcomes

- LO1. Apply the Knowledge of basic and applied aspects of plant processing and technology
- LO2. Choose appropriate processing methods suitable for plant products
- LO3. Relate the theoretical Knowledge of Processing Techniques in food product development
- LO4. Compare the novel technologies with the traditional methods in plant processing
- LO5. Knowledge of potential use of various by-products of plant foods

## THEORY : SEMESTER III

### FST3.1. TECHNOLOGY OF PLANT FOODS

#### Course Content

UNIT-I : Production and utilization of cereals and cereal products. Processing technology for Cereals - Rice - Types and physicochemical characteristics; nutritive value, rice milling. Wheat - Types and physicochemical characteristics; nutritive value, wheat milling; whole wheat atta; production of starch and vital wheat gluten and bakery products. Breakfast cereal foods: flaked, puffed, expanded, extruded and shredded. Millets and millet processing.

UNIT-II : Processing technology of pulses - Production and utilization of pulses, Processing – soaking, germination, fermentation, flaking, decortication, milling types, technology of pulse products – dal, puffed legumes, convenience foods - papad, cereal pulse mixes, protein concentrates and isolates. Traditional and non-traditional soya products in India. Extrusion cooking technology.

UNIT-III : Processing technology of nuts and oil seeds - Production and utilization of coconut, groundnut and cashewnut. Methods of processing, dehydrated coconut, dessicated coconut. Processing for production of edible oil, preparation of edible cake and oil, cleaning and dehusking, different types of pressing, oil extraction process, mechanism, solvent, SCE, oil refining; utilization of by-products of nut and oil seeds

UNIT-IV : Processing technology of fruits and vegetables – Production and processing of fruits and vegetables; freezing, dehydration, canning, preparation of juices and concentrates. Different products of fruits and vegetables-

jams, marmalades, squashes, cordials, ketch up and sauces. Fruit and vegetable fibres. Fruit candies and crystallized fruits. Pickles and chutneys- types, preparation, shelf life and quality control. Commercial processing of fruits and vegetables for production of value-added products. By-products of fruit and vegetable processing industry.

UNIT-V : Processing technology of spices and plantation products - Production and utilization. Spices - processing of pepper, cardamom, ginger, chilli, turmeric, oleoresin and essential oils, Manufacture methods, sterilization of spices, spice extracts. Coffee - harvesting, fermentation of beans and manufacture of coffee powder, instant coffee technology. Chicory - chemistry, quality grading of coffee. Tea - harvesting, types of tea - Green, Oolong and CTC. Quality evaluation and grading of tea. Cocoa - processing of bean, cocoa powder, cocoa liquor manufacture.

#### Recommended References

1. Kent, N.L (2003) Technology of Cereals, 5th Ed. Pergamon Press.
2. Chakraverty (1988) Post Harvest Technology of Cereals, Pulses and Oilseeds, Oxford Pbs
3. Haard, NF & Salunkhe, DK (1975). Postharvest Biology and Handling of Fruits and Vegetables. AVI.
4. Jagtiani, J., Chan, H.T., Sakal, W.S. (1988). Tropical Fruit Processing Academic Press, London.
5. Kumar N, Abdul K, Rangaswamy P & Irullappan I (2010) Introduction to Spices, Plantation crops, Medicinal & aromatic crops, Oxford & IBH Pbs.

## THEORY : SEMESTER III

### FST3.2. TECHNOLOGY OF SEA FOODS

#### Course Outcomes

- CO1. Understand the need and importance of fishery industry
- CO2. Know the compositional and technological aspects of fish
- CO3. Gain knowledge on processed fish products
- CO4. Understand about the status of fishery in India
- CO5. Comprehend different storage options for the fishes.

#### Course Specific Outcomes

- CSO1. Understand the processing of fish by curing agents, drying and salting
- CSO2. Acquire skills in fish quality management
- CSO3. Understand preserving fish by smoking.
- CSO4. Gain knowledge about processing of fish by canning
- CSO5. Understand about fish by-products processing and potential benefits.

### Learning Outcomes

- LO1. Potential to comprehend research and development in fish processing
- LO2. Relate the climate change aspects to fish processing
- LO3. Learn about fish industry waste management
- LO4. Acquire the knowledge on handling of fish
- LO5. Recognise the factors affecting quality of fish

### THEORY : SEMESTER III

#### FST3.2 TECHNOLOGY OF SEA FOODS

##### Course Content

UNIT I : Sea foods - Introduction – Sources, commonly cultivated fish, shrimp and prawns, Per capita consumption of fish. Importance and status of fishery industry in India. Present scenario in National and International economy. Research and development activities on fishery products. Blue revolution in India. Entrepreneurship opportunities in sea food industry

UNIT II : Selection, Grading and Procurement of fish, Shrimp and Prawns– Shipboard operations. Fishery techniques – Fishing practices, Fish catching methods, fish handling, grading. Fishery economics and marketing, global fisheries resource. Climate change and its impact on fisheries.

UNIT III : Present status of Fish, Shrimp and Prawns processing in India. Processing and preservation of fish, shell fish and their products sun drying, Canning, smoking, freezing, curing, salting & pickling and dehydration of fish. by-products - Production of fish meal, fish protein concentrates, fish protein extracts (FPE), fish protein hydrolysates (FPH), fish liver oil. Value Added Sea Food Products.

UNIT IV : Structure, post-mortem changes in fish. Advanced freezing technology for fish storage and deodorization of transport system. Types of contamination of fish. Waste management-utilization of fish waste such as fish silage, compost, sauces, protein hydrolysates, fish meal etc. Packaging of fishery products, FSSAI regulations on packaging and labelling.

UNIT V : Sanitary and Phyto-sanitary requirements for maintenance of fish quality, quality management of fish and fishery products. Cleaning and sanitizing agents used in fish processing unit. Regulations and standards for maintaining safety and quality of fish products – FSSAI and International standards, GMP, GHP and GLP practices relevant to fish and marine food processing. HACCP implementation for fishery products, quality assessment of fishery products – notified by NABL labs and reference labs in India for fishery products.

##### Recommended References

1. Hall GM, Fish Processing Technology, VCH Publishers Inc., NY, 1992
2. Sen DP, Advances in Fish Processing Technology, Allied Publishers Pvt. Limited 2005
3. Shahidi F and Botta JR, Seafoods: Chemistry, Processing, Technology and Quality, Blackie Academic & Professional, London, 1994
4. Ioannis S. Bozaris (2014) Seafood Processing: Technology, Quality and Safety
5. Yesim Ozogul (2019), Innovative Technologies in Seafood Processing, CRC Press

### PRACTICAL : SEMESTER III

#### FST3.3. TECHNOLOGY OF PLANT FOODS

1. Physical characteristics of Wheat, corn, Barley & oats, millets, pulses and oilseeds
2. Physicochemical tests and evaluation of cooking quality of cereals, millets, pulses and oilseeds
3. Estimation of Pelshenke Value, Hagberg's Falling number & Potassium Bromate in flour
4. Milling and parboiling of paddy
5. Determination of percentage impurities in grain by aspirator and seed blower
6. Pre-treatments for milling of pulses a) Application of water b) Application of oil c) Application red earth slurry d) Application of steam
7. Dhal milling and visit to dhal mills
8. Experiments on anti-nutritional factors in pulses and preparation of pulse based extruded products.
9. Solvent extraction of selected oilseeds, Visit to oil extraction & refining units
10. Detection of adulteration in fats and oil.
11. Canning of fruits and vegetables
12. Estimation of capsaicin content in chillies & curcumin content in Turmeric

#### FST3.4. TECHNOLOGY OF SEA FOODS

1. Quality evaluation of fish/prawn.
2. Subjective evaluation of Fresh Fish.
3. Cut out examination of canned fish (Sardine, Mackerel, Tuna)
4. Fish product formulation/canning.

5. Determination of total volatile bases in frozen fish
6. Determination of moisture in dried fish
7. Determination of sodium chloride in dried fish
8. Determination of Ash insoluble in dilute hydrochloric acid
9. Determination of total volatile acids in fish product
10. Dressing of Fish.
11. Preparation of value-added fish products
12. Visit to Fish processing industry

### **THEORY: SEMESTER III**

#### **SEC3. MUSHROOM CULTIVATION TECHNOLOGY**

##### **Course Outcomes**

- CO1. Gain knowledge of cultivation of different types of edible mushrooms  
 CO2. Understand the importance and problems in mushroom cultivation  
 CO3. Gain knowledge on Composting

##### **Course Specific Outcomes**

- CSO1. Gain the knowledge of spawn production  
 CSO2. Acquire skills in managing the diseases and pests of mushrooms  
 CSO3. Comprehend the technical aspects of Packaging, Storing and grading of mushroom

##### **Learning Outcomes**

- LO1. Ability to identify edible and poisonous mushrooms  
 LO2. Gain hands on training for the preparation of bed for mushroom cultivation and spawn production  
 LO3. Get industrial exposure in understanding the establishment and functioning of mushroom farm

### **THEORY: SEMESTER III**

#### **SEC3. MUSHROOM CULTIVATION TECHNOLOGY**

##### **Course Content**

Unit I : Commercial Mushroom Cultivation- Present scenario and prospects for Mushroom Cultivation, Description of edible types, natural growth aspects and climatic requirements, Selection of types of Mushroom and Sites, Methods used for commercial cultivation – mushroom substrate selection, substrate soaking, pasteurization etc. Design and construction of Mushroom farm

Unit II : Composting in Mushroom cultivation- Role of composting in Mushroom cultivation, Appropriate materials to prepare different types of com-

post, Methods of composting – preparation and pasteurization, Determination of quality of compost, Hazards & risks associated with composting and how to control injury to self, Mushroom cultivation – methods, preparation of spawn substrate, process of spawn culture, selection of correct spawn, culture maintenance, mother spawn production and storage of spawn.

Unit III : Harvesting of Mushroom- Identification of right stage of Mushroom, Methods of harvesting, use of approved cutting techniques for harvesting, Packaging storing and grading of Mushroom & post harvest procedures, Packaging Mushrooms with labels, Use of spent Mushroom in vermin-composting and in organic farming, Preparation of value added products of Mushroom, Disease control and pest Management

##### **Co-curricular activities (Hands on exercises)**

1. Study of external, Internal characters and identification of edible mushroom
2. Nutritional values & Medicinal usages of mushrooms
3. Field Visit & Interaction with Mushroom cultivators and other Support Agencies
4. Learn Media preparation for Spawn culture, Preparation of different types of compost , Seeding technique of spawn in compost , Packaging and labelling process
5. Preparation of recipes and Value added mushroom products
6. The standard specifications in the designing and construction of mushroom farm

##### **Recommended References**

1. Nita Bhal. (2000). Handbook on Mushrooms. 2nd ed. Vol. I and II. Oxford and IBH Publishing
2. Tripathi, D.P. (2005) Mushroom Cultivation, Oxford & IBH Publishing Co. PVT.LTD, New Delhi.
3. V.N. Pathak, Nagendra Yadav and Maneesha Gaur, Mushroom Production and Processing Technology/ VedamsEbooks Pvt Ltd., New Delhi (2000).
4. National Horticulture Board : Cultivation Technology and Technical Standards of Components of Integrated Button Mushroom Unit; Protected production under NHB Scheme (Technical Standard o. NHB-BM- Type 01-2011 9.
5. Anupam Mishra, SRK Singh and MP Thakur: Training Manual on Cultivation of Tropical Mushroom and its Value addition. Agricultural Technology Application Research Institute – ICAR - Zone VII, JNKVV, Jabalpur

**THEORY : SEMESTER IV**  
**MD3. CYBER SECURITY**

**Course Outcomes**

- CO1. Understanding the key issues associated with protecting information assets
- CO2. Overview of the field of information security and assurance
- CO3. Acquire knowledge on the cyber security practices

**Course Specific Outcomes**

- CSO1. Understand the broad set of technical, social & political aspects of Cyber Security.
- CSO2. Appreciate the vulnerabilities and threats posed by criminals
- CSO3. Understand the importance of ethical hacking tool.

**Learning Outcomes**

- LO1. Learn the ethical hacking process.
- LO2. Comprehend cyber laws
- LO3. Decipher cyber security strategies and policies.

**THEORY : SEMESTER IV**  
**MD3. CYBER SECURITY**

UNIT I : Introduction to Cyber Security - Importance and challenges in Cyber Security, Cybercrime and different modes of attacks, Cyber Laws - E-Commerce and E-Governance - Certifying Authority and Controller - Offences under IT Act- Computer Offences and its penalty under IT Act 2000. Cyberspace - Cyber threats - Cyber warfare - CIA Triad - Cyber Terrorism - Cyber Security of Critical Infrastructure - Cyber security -Organizational Implications. Intellectual Property Rights in Cyberspace.

UNIT II : Types of Hackers - Hackers and Crackers - Cyber-Attacks and Vulnerabilities - Malware threats - Sniffing - Gaining Access - Escalating Privileges - Executing Applications - Hiding Files – Covering Tracks - Worms - Trojans - Viruses - Backdoors

UNIT III : Ethical Hacking Concepts and Scopes - Threats and Attack Vectors - Information Assurance - Threat Modeling - Enterprise Information Security Architecture - Vulnerability Assessment and Penetration. Cyber security initiatives in India. Cyber security strategies and policies.

**Recommended References**

1. Donaldson S, Siegel S, Williams CK, Aslam, A (2015) Enterprise Cyber security -How to Build a Successful Cyber defense Program against Advanced Threats, Apress, 1<sup>st</sup> Edition
2. Nina Godbole, Sumit Belapure (2011) Cyber Security, Wiley

3. Roger Grimes (2017) Hacking the Hacker, Wiley, 1<sup>st</sup> Edition
4. Cyber Law (2000) Bare Act, Govt of India
5. Scott Augenbaum (2019) The Secret to Cybersecurity

**THEORY : SEMESTER IV**  
**FST4.1. FOOD ANALYSIS**

**Course Outcomes**

- CO1. Obtain knowledge in various methods of food analysis
- CO2. Learn the analysis of carbohydrates and fats
- CO3. Understand basic principles of protein and vitamin analysis
- CO4. Comprehend various aspects of food analysis
- CO5. Understand the principles of spectroscopy and chromatography in food analysis

**Course Specific Outcomes**

- CSO1. Analyse the nutritional quality of the food products.
- CSO2. Understand the need for analysis and instrumentation
- CSO3. Decipher the methods of fiber component analysis in foods
- CSO4. Have an insight into instrumental measure of texture of foods
- CSO5. Update knowledge on analytical instruments by visiting laboratories

**Learning Outcomes**

- LO1. Identify an appropriate technique for analysing specific components in food substances
- LO2. Hands on experience in analysis of nutritional quality of food products.
- LO3. Competent to estimate vitamins and minerals in food sample
- LO4. Have an insight into the advanced techniques in food and nutrient analysis
- LO5. Apply the knowledge of food analysis in establishing standards for food quality

**THEORY: SEMESTER IV**  
**FST4.1. FOOD ANALYSIS**

**Course Content**

UNIT-I : Introduction to Food Analysis-Steps in food analysis, criteria for choice of food analysis methods, General principles of sampling of foods for analysis, Sampling methods and sample preparation. Principles and methods of estimation of moisture, Methods of estimation of Ash, Estimation of Calcium, phosphorus & iron from ash solution.

UNIT-II : Carbohydrates- qualitative and quantitative methods of estimation of sugars – titration methods, colorimetry methods and physical methods. Methods and principles of starch determination. Crude fibre and fibre fractions- methods of determining fibre fractions, soluble, insoluble and neutral detergent fibre estimation.

UNIT-III : Total Proteins- principles and methods of determination of Protein nitrogen and non-protein nitrogen. Principles in Micro and Macro determination of nitrogen by Kjeldahl method, other methods of protein estimation- biuret method, lowry Method, dye binding method and enhanced Duma's method, advantages and disadvantages.

UNIT IV : Total fat- methods and principles of estimation of fats, methods of separation of lipid fraction and determination of neutral glycerol, fatty acids, phospholipids and cholesterol in foods.

Vitamins - General methods of estimation of Vitamins from foods, Estimation of Vitamin A, thiamine, riboflavin and Vitamin C.

UNIT V: Food analysis Instrumentation- Principles and application of colorimetry, spectroscopy, flame photometry, atomic absorptiometry, Principles and Application of Chromatographic procedures in food analysis: Ion exchange, thin layer, solid, liquid, gas, column, paper and high-performance liquid chromatography with suitable examples.

#### Recommended References

1. Raghuramulu, N., Madhavan, N. K. & Kalyanasundaram, S. 2003. A Manual of Laboratory Techniques. National Institute of Nutrition. Indian Council of Medical Research, Hyderabad
2. CliFSTon. E. Meleon, Food analysis 3<sup>rd</sup> edition (Theory & practice) Yeshajahu Pomerrauz. Techniques. National Institute of Nutrition. Indian Council of Medical Research, Hyderabad-500 007, India. pp: 56
3. Seemayadav (1997) Food Chemistry, publication of Anmol Pvt. Ltd., New Delhi
4. Sathe AYA (1999) First Course In Food Analysis
5. S. Ranganna S (2017) Handbook of Analysis and Quality Control for Fruit and Vegetable Products

### THEORY : SEMESTER IV

#### FST4.2. FOOD PRODUCT DEVELOPMENT

##### Course Outcomes

- CO1. Understand the need for new food product development
- CO2. Acquire systematic knowledge on product design
- CO3. Understand Food Product commercialization and Marketing
- CO4. Decipher basics of development of health-related food products
- CO5. Understand the factors affecting Food Product development

##### Course Specific Outcomes

- CSO1. Understand the classification of new food products
- CSO2. Insight into prototype development and scale up
- CSO3. Acquire knowledge on designer foods
- CSO4. Know the importance of product performance testing
- CSO5. Understand the ethics in Food Product development

##### Learning Outcomes

- LO1. Potential to differentiate existing products and new food products
- LO2. Learn about success and failure of new food products
- LO3. Learn about shelf-life testing of food products
- LO4. Acquire the knowledge on product life cycle
- LO5. Recognise the importance of healthy food products

### THEORY: SEMESTER IV

#### FST4.2. FOOD PRODUCT DEVELOPMENT

##### Course Content

UNIT-I : New food product - Definition, Characteristics, Need for New food product development. Classification of new food products: Line extensions, Repositioning of existing products, new form of existing product, Reformulation, Innovative products - Creative products and Value-added products. Food choice models and new product trends.

UNIT-II : New Food product development in Food Industry - Idea generation, Consumer research, Product design and Formulation. Process development - Prototype development and scale up. Quality assessment of new developed products, Evaluation of Shelf-Life. Packaging and labelling. Development of products for food service and ingredient industries. Quality and Safety of the products.

UNIT-III : Food Product Commercialization and Marketing: Costing and Pricing, Test Market, Consumers and Customers, marketing of new products. Advertising and promotions, Product life cycle. Entrepreneurship, concept, Types, qualities and functions of an entrepreneur. Ethics in Food product development and Intellectual property/ Patents in food product development.

UNIT-IV : Food Products with reference to Health - Medical foods, Therapeutic foods, Herbal foods, Fortified foods, Infant foods, Geriatric foods, Sports drink, defence foods, functional foods, Designer foods and Nutraceuticals. Probiotics, Prebiotic and Symbiotics.

UNIT V : Factors affecting Food Product Development – corporate factors, market factors, technological pressures, government issues and legislations. Creating brand value for the Product. The SWOT analysis, Steps in product launch, Evaluation of the Launch, product performance testing, developing test market strategies, Case Studies of some successes and failures.

#### Recommended References

1. M Earle , R Earle , A Anderson (2001) Food Product Development: Maximising Success (Woodhead Publishing Series in Food Science, Technology and Nutrition) Paperback
2. Gordon W.Fuller (2011), New Food Product development, 3rd edition, CRC press, New York.
3. Graf, E. and Saguy, I.S. (1991). Food Product Development: From Concept to the Market Place, Van Nostrand Reinhold New York.
4. Howard R. Moskowitz,(2009), An integrated approach to new product development, CRC press, New York.
5. Man, C.M.D. and Jones, A.A. (1994). Shelf-life Evaluation of Foods, Blackie Academic, London.

### **PRACTICAL: SEMESTER IV**

#### **FST4.3. FOOD ANALYSIS**

1. Determination of moisture in different foods
2. Estimation of Ash value in different foods and preparation of Ash solution
3. Estimation of Fibre in foods
4. Estimation of Protein content in foods by different methods
5. Estimation of Fat content in foods by Soxhlet method
6. Estimation of total sugars and reducing sugars
7. Estimation Calcium, Phosphorus and Iron content of foods
8. Estimation of Vitamin A/Beta carotene in foods
9. Estimation of Vitamin C in foods
10. Determination Saponification value Iodine value, Free fatty acid value and Peroxide value of fats
11. Determination of Lipid peroxidation in fats and oils by ThioBarbituric Acid reactive substances assay
12. Estimation of Phospho lipid and cholesterol content of foods

#### **FST4.4. FOOD PRODUCT DEVELOPMENT**

1. Survey on types of convenience foods / consumer behaviour / food labelling
2. Market & literature survey to identify the concepts of new products based on special dietary requirements, functionality, convenience and improvisation of existing traditional Indian foods
3. Screening of product concept on the basis of techno-economic feasibility

4. Development of design and Product Specification
5. Development of prototype product and Standardization of formulation process
6. Sensory Evaluation of new product
7. Proximate Analysis of new Product
8. Packaging and labelling design
9. Shelf-life studies of new product
10. Cost analysis and Final Project Report

### **THEORY : SEMESTER IV**

#### **DSE1A. TECHNOLOGY OF MEAT, POULTRY & EGG**

##### **Course Outcomes**

- CO1. Understand need and importance of livestock, egg and poultry industry
- CO2. Study structure, composition and nutritional quality of animal products
- CO3. Study processing and preservation of animal foods
- CO4. To understand technology behind preparation of various animal food products.
- CO5. To understand technology behind by-product utilization.

##### **Course Specific Outcomes**

- CSO1.Understand the sources and developments of meat and poultry industries in India
- CSO2. Acquire skills in meat quality management
- CSO3 . Know about the importance of meat production in national economy.
- CSO4. Gain knowledge about muscle structure, chemical composition and
- CSO5. Understand about physico-chemical properties of meat

##### **Learning Outcomes**

- LO1. Comprehend the developments of meat and poultry industry in India
- LO2. Learn about FSMS compliance for meat products
- LO3. Learn about processing and preservation of meat
- LO4. Acquire the knowledge on post-harvest handling of poultry
- LO5. Recognise the factors affecting egg quality

### **THEORY: SEMESTER IV**

#### **DSE1A. TECHNOLOGY OF MEAT, POULTRY & EGG**

##### **Course Content**

Unit – I : Livestock and poultry population in India, Development of meat

and poultry industry in India and its importance in nation's economy. Sources of meat and meat products, microscopic structure of meat. Physico-chemical properties of meat, Effect of feed and breed on meat production and quality, Conversion of muscle to meat.

Unit – II : Premortem inspection and care of animals, slaughtering of animals, inspection and grading of meat, stunning types, slaughtering types, Slaughter house operations, dressing, ante and postmortem changes in carcass composition, grading of meat and meat cuts. Factors affecting post-mortem changes, properties and shelf-life of meat. Meat quality evaluation. MFPO /Kosher/Halal, Comminuted and non- comminuted meat products. FSSAI guidelines on FSMS compliance for meat and meat products.

Unit – III : Processing and preservation of meat– characteristics of meat for processing – water holding capacity, protein and emulsifying capacity. PSE and DFD meat, ingredients in meat processing. canning, freezing, salting, Dehydration, Aging, pickling and smoking of meat, Spoilage and its control, Meat by- products

Unit – IV : Poultry: Classes of poultry meat, Commercial methods of slaughtering, dressing, pre and post-slaughter handling, poultry carcass evaluation, poultry packaging, quality characteristics of poultry products, chemical residues in poultry, HACCP in poultry slaughter house, Poultry related food borne diseases, storage, preservation of poultry meat, Spoilage and its control, Freezing of poultry (whole and cuts)

Unit – V : Eggs - Factors affecting egg quality and measures of egg quality. Handling, candling, washing, Refrigeration and freezing, thermal processing, dehydration, coating, packaging and storage, Egg processing (Egg powder manufacturing), Spoilage and its control. The egg industry, its techniques of working, General management

#### Recommended References

1. Lawrie, R.A (1975) "Meat Science", 2<sup>nd</sup>Edn. Pergamon Press, Oxford UK.
2. Lavie A (1980) "Meat Handbook". 4<sup>th</sup>Edn. AVI, Westport
3. Sharma Bd (2011) Outlines Of Meat Science And Technology, Paperback
4. Stadelmen, W.J. and Cotterill, O.J. (1977) "Egg. Science and Technology". 2<sup>nd</sup> Edn.AVI,
5. Shai Barbut (2005) Poultry Products Processing, CRC Press 2005

### **THEORY : SEMESTER - IV**

#### **DSE 1B.FERMENTATION TECHNOLOGY**

##### **Course Outcomes**

CO1. Understand the history and development of fermentation technology

- CO2. Understand the fermentation media  
CO3. Comprehend the fermenter designs  
CO4. Acquire knowledge on scale up of fermentation  
CO5. Gain knowledge on fermented foods

##### **Course Specific Outcomes**

- CSO1. Acquire the knowledge on types of fermentation systems  
CSO2. Understand the basic components of fermentation medium  
CSO3. Comprehend the technology of solid-state Fermentation  
CSO4. Acquire skills on development of fermentation products  
CSO5. Comprehend the concept of solid-state fermentation

##### **Learning Outcomes**

- LO1. Learn about isolation and screening of industrially important microorganisms.  
LO2. Get knowledge on problems associated with strain improvement  
LO3. Assess the quality standards of fermented foods  
LO4. Understand Bioreactor for specialized applications  
LO5. Learn about preparation of traditional fermented products

### **THEORY : SEMESTER IV**

#### **DSE 1B. FERMENTATION TECHNOLOGY**

##### **Course Content**

UNIT-I : Introduction to Fermentation technology - History, scope and development of fermentation technology, Fermentation kinetics, types of fermentation systems- batch, fed batch& continuous systems. Isolation and screening of industrially important microorganisms - primary and secondary metabolites

UNIT-II : Fermentation media - Natural and synthetic media, basic components of a medium - carbon &nitrogen sources, vitamins, minerals, anti-foaming agents, role of buffers in media, process of aeration and agitation. Maintenance of strains, Strain improvement, Problems associated with strain improvement. Mutant selection and Recombinant DNA technology

UNIT-III : Fermenter design - Basic design of Fermenter, body construction, agitator, sparger, baffles, stirrer glands and bearings. Direct, dual or multiple fermentations. Type of fermenter - tower, deep jet, cyclone column, packed tower and airlift fermenter. Bioreactor for specialized applications, stirred tank reactors, packed bed reactors, fluidized bed reactors & trickle flow reactor. Overview of Solid-State Fermentation (SSF) - Advantages and applications

UNIT-IV : Scale-up of fermentation and product development, Down-stream processing and product recovery, evaporation and crystallization, regulation and safety. Assay of fermentation products. Industrial production of amino

acids, enzymes, alcohols, antibiotics. General methods of industrial production; basic calculations, analysis of the final product. Types of contaminants, removal of contaminants from the product stream, product potency.

UNIT-V : Fermented foods of importance - Benefits, safety and side effects of fermented food. Fermented vegetables (olives, cucumbers), meat, poultry, fish products, beverage (cocoa and coffee), bread, idli, sauerkraut, Dairy foods (cheese, srikhand). Production methods of Kefir, Yogurt, Acidophilus milk, Fermented foods as Nutraceuticals – mineral enriched yeast.

#### Recommended References

1. Abawari, R.A. (2017). Food and Beverage Fermentation Technology Edition, Auris Publishing
2. Doran, P.M. (2010). Bioprocess Engineering Principles, Academic Press.
3. Doyle, M.P., Buchanan, R.L. (2013). Food Microbiology: Fundamentals and Frontiers, 4<sup>th</sup> Edition.
4. Hutkins, R.W. (2019). Microbiology and technology of fermented foods, Blackwell publishing.
5. James, M.J. Loessner, MJ. and David, A.G. (2008). Modern food microbiology (8<sup>th</sup> Ed.)

### THEORY : SEMESTER IV

#### DSE1C. FOOD LAWS & STANDARDS

- CO1. Understand the history of food regulations in India
- CO2. Acquire knowledge on Food laws and standards in controlling quality
- CO3. Gain insight on International Laws and regulation in establishing quality
- CO4. Decipher food safety regulations to ensure quality
- CO5. Understand the importance of other regulatory agencies

#### Course Specific Outcomes

- CSO1. Know different food laws and their importance
- CSO2. Insight into FDA functioning
- CSO3. Acquire knowledge on international food laws and their implementation criteria
- CSO4. Know the guidelines with respect to food safety
- CSO5. Understand the concepts and trends in food legislation

#### Learning Outcomes

- LO1. Amass knowledge on food regulations of India
- LO2. Learn about Licensing and Registration of Food Units
- LO3. Learn about role of International organisations working for food safety
- LO4. Comprehend the functions of FSSAI

LO5. Recognise the Nutrition labelling guidelines

### THEORY : SEMESTER IV

#### DSE1C. FOOD LAWS & STANDARDS

#### Course Content

UNIT I : History of food regulations in India. Legislations- Prevention of Food Adulteration act 1954, Food product order (1955), Solvent Extracted Oil, De-oiled Meal and Edible Flour (Control) Order, 1967, Meat Food Products Order (1973), Edible Oils Packaging, 1998, Vegetable Oil Products Order, 1998, Milk & Milk Product Amendment Regulations – 2009.

UNIT II : FDA - Structure and Function, Administrative Set-up, Roles and Responsibilities of Staff. FSSAI – Structure and Function, Administrative Set-up at the State Level, Licensing and Registration of Food Units – Central and State Licensing Authorities, Codex India

UNIT III : International food laws, organizations and affiliations: FAO & WHO – Role and Functions. World Animal Health Organization, World Trade Organization, European Committee for Standardization, European Union on Food Safety, EFSA, Euro-Asian Council for Standardization, COPANT and ASEAN, ISO – special emphasis on ISO 9001:2000/2008; ISO 22000:2005; ISO 45001; ISO 14001, Rapid Alert System

UNIT IV : Food Laws and Standards in India - Food Safety and Standards (FSS) Act, 2006, FSS Rules and Regulations, Agricultural Produce Act, 1937 (Grading and Marketing), Bureau of Indian Standards relevant to food safety, Regulations and Standards & Guidelines with regard to Food Safety: CODEX (SPS/TBT), OIE, IPPC.

Unit-V : Export and import laws and regulations – Salient features of Foreign Trade Development and Regulation Act, 1992 (FSTDR 1992), Foreign trade policy, export (quality control and inspection) Act, 1963 and Rules. Promotion bodies, Export promotion schemes, plant and animal quarantine, customs act and import control regulations.

#### Recommended References

1. The training manual for Food Safety Regulators. Vol.II- Food Safety regulations and food safety management. (2011) FSSAI.
2. Patricia A. Curtis (2005) Guide to Food Laws and Regulations, Wiley-Blackwell
3. Jessica Vapnek, Melvin Sprei (2005) Perspectives and guidelines on food legislation, with a new model food law, FAO
4. Neal D. Fortin (2022) Food Regulation, 3<sup>rd</sup> edition, Wiley
5. Dudeja, P., & Singh, A. (2017). Role of government authorities in food safety. In Food Safety in the 21st Century. Academic Press.

**THEORY : SEMESTER IV**  
**SEC4. FOOD PACKAGING & LABELLING**

**Course Outcomes**

- CO1. Understand the scientific and technical aspects of food packaging
- CO2. Instil knowledge on packaging machinery & systems
- CO3. Preparation of edible packaging of food samples

**Course Specific Outcomes**

- CSO1. Gain expertise in working of different packaging machinery and systems
- CSO2. Ability to choose smart packaging materials
- CSO3. Evaluate the advantages of intelligent packaging system

**Learning Outcomes**

- LO1. Relate the theoretical Knowledge of packaging Techniques for food safety
- LO2. Compare the novel technologies with the traditional methods of food packaging
- LO3. Learn about appropriate suitable packaging designs for various foods

**THEORY : SEMESTER III**  
**SEC4. FOOD PACKAGING & LABELLING**

**Course Content**

UNIT I : Food packaging– functions and design of packaging, Packaging materials - types, collapsible tubes, plastic films, laminations, metallized films, co extruded films& tetra packs, testing of packaging material. Packaging system - Vacuum packaging, controlled atmospheric packaging (CAP), modified atmospheric packaging (MAP), retort processing, microwave packaging, active packaging, intelligent packaging, edible packaging, shrink and stretch packaging, biodegradable packaging

UNIT II : Packaging fresh and processed food - Packaging fruits and vegetables, fats and oils, meat, poultry and sea foods, dairy products, bakery, beverages, dehydrated and frozen food. Liquid and powder filling machines - aseptic system, form and fill (volumetric and gravimetric) bottling machines. Seal (FFS) and multilayer aseptic packaging machines, Packaging design - Packaging aesthetics and graphic design. material

UNIT III : Safety aspects of packaging material- Sources of toxic material in packaging and migration of toxins into food, Environmental and economic issues. Recycling and waste disposal of packaging Nutrition labelling- Importance, nutritional labelling in India, Recent developments in Food Labelling. Nutrition label format, bar coding, FSSAI and codex guidelines. Labelling requirements as per Food Safety Standards (Packaging and Labelling) Regula-

tions 2011. Health claims, nutrition claims, Misleading health claims, consumer understanding of nutrition labels, effect of nutrition labelling on food choice and diet.

**Recommended References**

1. Preeti Singh et al. (2017), Food Packaging Materials: Testing & Quality Assurance
2. Robertson GL (2012) Food Packaging – Principles and Practice, CRC Press Taylor and Francis
3. Paine FA and Paine HY (1992)A Handbook of Food Packaging, Blackie Academic
4. Coles R, McDowell D, Kirwan MJ (2003) Food Packaging Technology. Blackwell, 2003
5. P Ganesan and K Rathnakumar (2022) , Textbook on Packaging Technology, NPH Pbs.

**THEORY : SEMESTER IV**  
**VA2. ORGANIC FARMING**

**Course Outcomes**

- CO1. Gain knowledge on various principles Organic Farming
- CO2. Get insight in to cultivation practices for various crops cultivated using organic farming methods
- CO3. Understand the importance of soil microbes in farming

**Course Specific Outcomes**

- CSO1. Ability to design, execute and manage an organic farm for a crop
- CSO2. Ability to identify and control different pests and diseases of plants in an organic farm
- CSO3. Understand the production and use of biofertilizers and biopesticides

**Learning Outcomes**

- LO1. Ability to cultivate crops using principles of organic farming
- LO2. Develop competency to become an employ in the Organic farming sector
- LO3. Develop expertise to become an entrepreneur by taking up organic farming

**THEORY : SEMESTER IV**  
**VA2. ORGANIC FARMING**

**Course Content**

UNIT I : Introduction to Organic farming- Detrimental effects of chemical dependant farming, Types of Farming Advantage & disadvantage of each system, Pure Organic Farming , Integrated Farming system& Mixed Farming4.

Organic Farming (Process), Concept of farming system, Developing organic farms , Important steps & methods , Soil types and Soil conditioners

UNIT II : Plant Nutrients- Functions of Nutrients in plant growth and Development of crops, Nutrient uptake and Utilization by plant, Sources of nutrients for Organic Agriculture, Organic Manure, FYM/Rural compost, City compost, Oil cakes, Animal wastes, Vermi composts , Green Manure – Green Manure with Leguminous crops in crop rotation. In-situ incorporation of crop residues -Benefits, Other Nitrogen contributing plants. Liquid Manure. Importance of Bio fertilizers in soil productivity- Nitrogenous, Phosphatic and Potassic

UNIT II : Preparation of Compost: Different Methods , Enrichment of compost, Preparation of vermincompost, , Pit construction, Raw materials , Availability of specific species of earth worm, Method of preparation, Quality improvement of finished vermin compost, Preparation of seed bed and raising of seedlings

Recommended References

1. Organic farming-Theory and Practice by S.P. Palaniappan and K. Annadurai
2. Organic crop production (Principles and practices Vol-I: Principles and General Aspects) by J. P. Sharma
3. Kannaiyan, S., 2003. Bioethnology of Biofertilizers, CHIPS, Texas.
4. Mahendra K. Rai, 2005. Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
5. Reddy, S.M. et. al., 2002. Bioinoculants for sustainable agriculture and forestry, Scientific Publishers, Jodhpur Panda, S.C., 2006. Agronomy, Agribios Publication, New Delhi.

#### Co-curricular activities (Hands on exercises)

1. Field Visit & Interaction with organic farmers
2. Learn methods of organic farming
3. Growing crops using organic farming
4. Learn the preparation of vermi compost
5. Learn how to prepare seed beds and raising of seedlings

### Semester V

#### THEORY : SEMESTER - V

#### MD4. ARTIFICIAL INTELLIGENCE

##### Course Outcomes

- CO1. Gain knowledge on key AI technologies
- CO2. Be aware of the concept of cyber security
- CO3. Understand the cyber security practices

##### Course Specific Outcomes

- CSO1. Outline of the application of cyber security in national security
- CSO2. Get insights into Characteristics of Intelligent Agents
- CSO3. Know about the Architecture for Intelligent Agents

##### Learning Outcomes

- LO1. Understand the Future of Artificial Intelligence
- LO2. Analyze the different Problem-Solving Approaches.
- LO3. Evaluate the security issues of web applications, services and servers.

### THEORY SEMESTER V

#### MD4. ARTIFICIAL INTELLIGENCE

##### Course Content

UNIT I : Introduction to Artificial Intelligence (AI)–Definition – brief History, current trends in AI, Future of Artificial Intelligence – structure, components and Characteristics of Intelligent Agents– Typical Intelligent Agents, types of agents: simple reflex agents, goal-based agents, utility-based agents. Problem Solving Approach to Typical AI problems-Algorithms and Optimization Problems - Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games.

UNIT II : SoFSTware agents and applications: Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems- AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition. Robot, characteristics, advantages and disadvantages. Hardware –Perception – Planning – Moving.

UNIT III : Ethics of artificial intelligence: role of artificial intelligence in Human life, ethical considerations of AI, current initiatives in AI and ethics. Ethics of AI in Military, Biomedical research, Patient care, Public health, Robot teaching, Pedagogy, Policy, Smart City Ethics.

Recommended References

1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, 2010.
2. Wang, P. Z. (1983). Fuzzy sets and its applications. Shanghai Science and Technology Press, Shanghai, 55-58.
3. Chen, S. L., Li, J. G., & Wang, X. G. (2005). Fuzzy set theory and its application. Beijing, Science publish company.
4. rank A, Asuncion A (2010) UCI machine learning repository [Online]. <http://archive.ics.uci.edu/ml>

5. Pawlak Z (1991) Rough sets: theoretical aspects of reasoning about data. Kluwer Academic Publishers, Dordrecht

## **THEORY : SEMESTER V**

### **FST5.1. FOOD MICROBIOLOGY & TOXICOLOGY**

#### **Course Outcomes**

- CO1. Understand the field of Food Micro biology and its relevance to every-day life
- CO2. Understand the microorganisms involved in food spoilage
- CO3. Comprehend the methods of isolation of microorganisms
- CO4. Acquire knowledge on food toxicity and implications on health
- CO5. Understand various plant and environmental toxins

#### **Course Specific Outcomes**

- CSO1. Acquire the knowledge on the basic concepts of microbes in food and human welfare.
- CSO2. Understand the relevance of microbial spoilage of various foods
- CSO3. Learn about contamination of water
- CSO4. Ability to relate the theoretical knowledge with the microbes in environment
- CSO5. Understand the viral diseases of humans

#### **Learning Outcomes**

- LO1. Prevent food borne infections and food poisonings.
- LO2. Relate the knowledge of probiotics in prevention of diseases
- LO3. Assess the microbial safety of drinking water
- LO4. Understand the severity of fungal and marine toxins
- LO5. Identify the newer toxicants in foods and methods to control

## **THEORY: SEMESTER V**

### **FST5.1. FOOD MICROBIOLOGY & TOXICOLOGY**

#### **Course Content**

UNIT I : Introduction to food microbiology- Microorganisms of importance in food and their general characteristics- fungi (moulds and yeast), bacteria and viruses. Intrinsic and extrinsic factors affecting microbial growth.. Food poisoning and food infections- causative agents, symptoms and food involved and prevention.

UNIT II : Food Safety-Sources of contamination and spoilage of different kinds of food and their products (cereals, pulses, fruits and vegetables, milk and milk products, egg, meat and meat products, fish). Contamination of water – Microorganisms in contaminated water, standards for drinking water

UNIT III : Microbiological techniques-Sterilisation and disinfection: Sterilisation by physical agents- heat, moist heat, fractional sterilisation, pasteurisation, other types of sterilisations, chemical sterilisation. Methods of Isolation and detection of microorganisms in food and water (general outline of different methods).

UNIT IV : Toxicology Definition, classification of food toxicants, Factors effecting toxicity of foods and disease out breaks. Food toxins and implications on human health: Neurotoxicity, Hepato toxicity, Nephron toxicity, Haemotoxicity, skeletal toxicity, reproductive toxicity, allergenicity, Teratogenic effects,

UNIT V : Non-organic and organic metallic contaminants, Endogenous toxicants in food derived from plants: classification of toxic plant metabolites in food, cyanogenic glycosides, Vasoactive amines, Psychoactive compounds, Lathyrogens,. Toxic mushrooms and other macro fungi, Toxicology of marine foods: Molluscs, Fish and marine algae.

#### **Recommended References**

1. Bharucha FD and Mehta A (2000) Handbook of microbiological methods and media. Sevak pbs.
2. Frazier WC and Westh of DC (1978) Food Microbiology. New Delhi. Tata Mc Graw Hill
3. James MJ (1996). Modern Food Microbiology. 4<sup>th</sup> edition, New Delhi CBS (pbs)
4. Food Toxicology, Part-A. Principles and concepts by Jose M.Concon, Mareel Dekker, Inc., New York, 1988.
5. Hand Book of Food Toxicology by Deshpande, 2002

## **THEORY : SEMESTER V**

### **FST5.2. BAKERY & CONFECTIONARY TECHNOLOGY**

#### **Course Outcomes**

- CO1. Understand the concepts of baking technology
- CO2. Get the knowledge on bread manufacturing process
- CO3. Comprehend the method of production of biscuits and cakes
- CO4. Acquire knowledge on confectionary products
- CO5. Gain knowledge on quality control of bakery products

#### **Course Specific Outcomes**

- CSO1. Acquire the knowledge on raw material required for baking
- CSO2. Understand the stages in processing of bread
- CSO3. Comprehend the problems of baking
- CSO4. Acquire skills on preparation of bakery and confectionary products
- CSO5. Comprehend the functional tests for bakery products

## Learning Outcomes

- LO1. Learn about baking equipment
- LO2. Get knowledge on faults and remedies in baking
- LO3. Assess the quality standards of fermented foods
- LO4. Learn Good manufacturing practices of baking and confectionary industries
- LO5. Learn about specifications of baking and confectionary products

## THEORY: SEMESTER V

### FST5.2. BAKERY & CONFECTIONARY TECHNOLOGY

#### Course Content

UNIT-I : Baking technology – Introduction, raw materials required for bread making and their functional properties, essential and other ingredients. Types of flours, Additives in baking - yeast, shortenings, emulsifiers antioxidants & sweeteners. Leavening agents – types, role in baking. Baking equipment: types of equipment and ovens, bulk handling of ingredients, dough mixing and mixers, dividing, rounding, sheeting and laminating. Fermentation enclosures and brewing equipment. Packing materials and equipment.

UNIT-II : Bread manufacturing process - Straight dough & sponge dough fermentation, accelerated processing, Chorley wood bread process, dough retarding and freezing. Stages in processing of bread and bread making methods, advantages and disadvantages. Types of bread. Characteristics of quality bread- internal and external characters, bread defects, faults and remedies. Spoilage of bread- causes, detection and prevention. Pizza– types, ingredients and preparation.

UNIT-III : Biscuits and Cakes - Production of biscuits, cookies and cakes, types of biscuit doughs, developed dough, short dough, semi-sweet, enzyme modified dough and batters. Importance of consistency of dough. Ingredients, their function and structure, builders, tenderizers, moisteners and flavour enhancers. Selection and preparation of mould temperature and time for making different types of cakes. Problems of baking.

UNIT-IV : Confectionary products - Definition, importance of sugar confectionary and flour confectionary. Types of confectionary products– chocolate, boiled sweets, caramels, toffees, fondants and their manufacturing process, spoilage of confectionary products, quality control, sanitation and safety.

UNIT-V : Quality control for bakery and confectionary products-, Standards, regulations and quality control, Good Manufacturing Practices, specifications for bakery ingredients. BIS/FSSAI standards for ingredients and products. Significance of functional tests in relation to bread, biscuits, cakes, pastries, chocolates and other products of bakery and confectionary.

#### Recommended References

1. Stanley CP & Linda YS (2005). Technology of Bread Making, 2<sup>nd</sup> ed. Aspen pbs. Maryland.
2. Dubey, S.C. (2007). Basic Baking 5th Ed. Chanakya Mudrak Pvt. Ltd.
3. Fuller GW (2011) New Food Product Development: From Concept to Market, 3rd ed, CRC Press.
4. Duncan, M. (2009). Biscuit Doughs Manual 2, Wood head Publishing Ltd., England.
5. Samuel, M.A. (2006). Bakery Technology and Engineering, 3<sup>rd</sup> Edition, Chapman & Hall, London.

## PRACTICAL : SEMESTER V

### FST5.3. FOOD MICROBIOLOGY

1. Introduction to the Basic Microbiology Laboratory Practices and Equipment
2. Study of principles and types of compound microscope.
3. Preparation of common laboratory media for cultivation of bacteria, yeast and moulds.
4. Inoculation techniques and different methods of isolation of microorganisms.
5. Staining of bacteria: Gram's staining acid fast,
6. Staining of yeasts and moulds.
7. Study of microbiological analysis in the food preparation area.
8. Study of microbiological flora of both processed and unprocessed foods like vegetables and fruits, cereals, spices and canned foods.
9. Bacteriological analysis of water and milk: total count and MPN coli form count.
10. Compare the growth of microorganisms: -
  - (a) In jams/ sauces (hypotonic).
  - (b) Temperature zones (cold, hot and room temperature).

### FST5.4. BAKERY & CONFECTIONARY TECHNOLOGY

1. Quality tests on wheat flour for baking (Moisture, gluten content and Sedimentation value)
2. Experiment on leavening action of baking powder, sodium bicarbonate and ammonium bi carbonate
3. Determination of yeast-ferment test and dough rising capacity of atta and maida.

4. Preparation of Bread by different methods and assessment of quality
5. Preparation of cakes and assessment of quality
6. Quality tests of fat/butter for different parameters for bakery applications
7. Preparation of different types of biscuits & cookies and assessment of faults and quality
8. Preparation of various types of toffees and sensory evaluation
9. Preparation of sugar boiled confectionary and sensory evaluation
10. Preparation of candies and chocolates and sensory evaluation

**THEORY: SEMESTER V**  
**DSE2A.FOOD BIOTECHNOLOGY**

**Course Outcomes**

- CO1. Understand the concept of Food Biotechnology
- CO2. Understand the impact of biotechnology on the nutritional quality of foods
- CO3. Understand the application of enzyme technology
- CO4. Gain knowledge in Animal Cell Cultures methods
- CO5. Comprehend tissue and bacterial cultures

**Course Specific Outcomes**

- CSO1. Understand the Biotechnology in food production
- CSO2. Gain knowledge on regulatory aspects for biotechnological methods
- CSO3. Acquire knowledge on Single cell protein
- CSO4. Comprehend the knowledge on microbial lipases
- CSO5. Gain knowledge in genetic engineering

**Learning Outcomes**

- LO1. Recognize the scientific advancements in biotechnology and its applications
- LO2. Learn different fermentation technologies for the production of enzymes
- LO3. Acquire skill in tissue culture methods
- LO4. Acquire skills in genetic engineering
- LO5. Learn the applications of transgenic fish technology

**THEORY : SEMESTER V**  
**DSE2A. FOOD BIOTECHNOLOGY**

**Course Content**

UNIT – I : Food Biotechnology – introduction, history, applications of ge-

netics to food production. Impact of biotechnology in food industry and nutritional quality of foods. Regulatory aspects for biotechnological methods. GMO/ GEO role in Food industries. Institutions involved in biotechnological research in India. Applications of Biotechnology in Agriculture - post harvest technology, plants at their genetic level, To develop nitrogen fixation, production of disease resistant plants

UNIT – II : Cell and Tissue culture- Animal cell culture, Media and propagation of cell lines, primary cell lines, secondary cell lines, Minimal essential medium, Amino acid assay medium. Plant cell culture, Plasticity, Totipotency, MSmedium, micro propagation, callus formation, Organ development, tissue transformation, uses of tissue culture

UNIT – III : Biomass production- recycling of waste, Agricultural & industrial treated sewage for single cell protein (SCP) production, advantages, Source of SCP, SCP microorganisms, production of bacterial biomass, Nutritive value of SCP, Consumption of SCP. Energy production methods – Commercial production of biogas, factors affecting methanogenesis, advantages of Bio gas

UNIT – IV : Enzyme technology - Microbial enzymes - production of enzymes - Solid state fermentation- Fermenters - Medium - Advantages and disadvantages - Submerged fermentation- Steps of enzyme production - Factors affecting Submerged culture, Microbial lipases Organic acids- citric acid, acetic acid, lactic acid – production methods. Traditional and novel fermented foods

UNIT-V : Recent developments in food biotechnology and applications – production of vitamins, minerals, essential amino acids, phytochemicals, non nutritive sweeteners. Bioengineered animals and transgenic poultry, application of transgenic fish technology in sea food production, biotechnological approaches to improve nutritional quality and shelf life of fruits and vegetables.

**Recommended References**

1. Dietrich Knorr (1982) Food Biotechnology, Marcel Decker Publishers, New York
2. Bailey and Ollis, Biochemical Engineering Fundamentals, Mc Graw Hill Publications.
3. Shule and Kargi (2002) Bio process Engineering Basic Concepts, Prentice Hall- India
4. Vedpal M and Padma Sreedhar (1992) Industrial Biotechnology, Oxford & IBH, Delhi
5. Lea AGH and Piggott J R (1995) Fermented beverage Production, Blackie Academic and Professional, London.

## THEORY: SEMESTER V

### DSE2B. FOOD SANITATION HYGIENE & WASTE MANAGEMENT

#### Course Outcomes

- CO1. Assimilate the synergistic integration of food sanitation, hygiene and waste management
- CO2. Acquire knowledge on poor food safety practices
- CO3. Gain knowledge on hygiene and sanitation in food service institutions
- CO4. Comprehensive know-how on hygiene and sanitation in food industries
- CO5. Explore the sanitization methods in food processing units

#### Course Specific Outcomes

- CSO1. Understand the symptoms of food borne illnesses
- CSO2. Understand the importance of personal hygiene
- CSO3. Perceive the importance of cleaning and disinfection
- CSO4. Evaluate the requirement of sanitation in storage areas
- CSO5. Grasp the current technologies in waste management

#### Learning Outcomes

- LO1. Enable students to better understand food safety management procedures
- LO2. Apply the principles of safety for high-risk foods
- LO3. Familiarise students with good hygienic practices
- LO4. Understand the importance of food plant sanitation
- LO5. Explore the nuances in waste management

## THEORY : SEMESTER V

### DSE2B. FOOD SANITATION HYGIENE & WASTE MANAGEMENT

#### Course Content

UNIT I : The importance of food safety, Food safety management procedures, causes & symptoms of food borne illness, effects of food borne illness on consumers and retailers, effect of poor safety practices on food products, Food safety procedures in retail stores, Preventing food borne illness, Food hazards, The four C's, Record keeping, Due diligence, Reporting procedures, Legal responsibilities.

UNIT II : Personal Hygiene - Importance of personal hygiene, Basic rules regarding personal hygiene, hygienic food handling, employee health, training, principal food safety hazards on the human body, Appropriate protective clothing, Effective personal hygiene practices, Good Manufacturing Practice.

UNIT III : Sanitation in Food industries and Service Institutions - Plant maintenance - Hygiene and sanitation requirement in food processing and

fermentation industries; Cleaning, sanitizing and pest control in food processing; storage and service areas. Cleaning compounds, choosing, handling and storage of cleaning compounds, food spoilage and food handling. Special requirements for high-risk foods, Safe food cooking temperature and pest control methods.

UNIT IV : Waste water treatment and disposal – sources of waste, pre-treatment processes, treatment methods– primary treatment – sedimentation, flotation; secondary treatment – BOD removal and sludge production – anaerobic and aerobic systems; tertiary treatments – chemical, precipitation and sedimentation filtration, carbon adsorption, ion exchange, reverse osmosis and chlorination; land treatment.

UNIT V : Solid waste from food processing industry– introduction, treatment methods. Waste management of cereals, fruits & vegetables, dairy, meat and fish processing industries.

#### Recommended References

1. Norman G. Marriott and Robert B. Gravani. (2006). Principles of Food Sanitation, 5<sup>th</sup> edition
2. Rao, D. G. (2010). Fundamentals of Food Engineering, PHI learning Private Ltd.
3. Fellows P. (2000). Food Processing Technology, 2<sup>nd</sup> Ed. Woodhead Publishing Limited and CRC Press LLC
4. James A (2013) The supply chain handbook, distribution group.
5. FAO, US (1984) Design and operations of cold store in developing

## THEORY : SEMESTER V

### DSE2C. FOOD ADULTERATION

#### Course Outcomes

- CO1. Gain knowledge on common adulterants present in food
- CO2. Be aware of the methods of detection of adulterants
- CO3. Understand the present laws on adulteration
- CO4. Outline of the different standards of quality for food products
- CO5. Get insights into the modes of consumer protection

#### Course Specific Outcomes

- CSO1. Understand the impact of food adulterants on health
- CSO2. Gain knowledge on common foods which are adulterated
- CSO3. Know about the consumer's problems with respect to Food Adulteration
- CSO4. Have an insight into the standards of quality for different food products
- CSO5. Familiarize various organizations involved in prevention of food adulteration

### Learning Outcomes

- LO1. Learn about types of food adulteration
- LO2. Distinguish between additives and adulterants.
- LO3. Correlate the consumption of adulterated food on health of consumers
- LO4. Apply techniques of detection of adulterants in assuring safety of food products
- LO5. Learn about procedures to complain and compensation to victims

### THEORY: SEMESTER III DSE2C. FOOD ADULTERATION

#### Course Content

UNIT I : Food adulteration – Introduction, definition, Adulterant, Stages at which food adulteration occurs, methods of food adulteration – mixing, substitution, concealing quality, decomposed foods, misbranding/false labels, addition of toxicants. Reasons for food adulteration. Impact of adulteration on economic sector, adverse effects of adulteration on Human Health. Prevention of food adulteration.

UNIT II : Types of adulteration – Intentional – sand, marble chips, chalk powder, talc. Incidental – pesticide residues, droppings of rodents, larvae in foods. Metallic – arsenic, lead, mercury, cadmium, tin and packaging hazards. Newer adulterants. Notable incidents adulteration. Central food laboratory, CFTRI

UNIT-III : Common food adulterants found in cereals, pulses, milk & milk products, oils & fats, spices & condiments, sweetening agents, soft drinks, beverages, miscellaneous products.

UNIT – IV : Methods of Detection of adulteration in foods – physical tests, chemical tests. Detection Adulterants in the following Foods –Dhatura seeds in food grains, excess bran in wheat flour, rhodamine 'B' in ragi, malachite green in bitter gourd, green chillies, green peas. Milk & milk products – detection of added water, starch, cellulose, glucose, ammonium salts, sulphates, detergents, gelatine. Oil & fats – rancidity, argemone oil, cotton seed oil, mineral oil, castor oil in edible oils. Spices and condiments – lead salts, metanil yellow, chalk powder in turmeric; brick powder, rhodamine 'B' in chili powder, papaya seeds in black pepper. Detection of sugar solution in honey, Clay and chicory powder in coffee, iron fillings in tea leaves.

UNIT V : Present Laws and Procedures on Adulteration: Highlights of Food Safety and Standards Act 2006 (FSSAI) –Food Safety and Standards Authority of India–Rules and Procedures of Local Authorities. Consumer education, Consumer's problems rights and responsibilities, COPRA 2019 - Offenses and Penalties – Procedures to Complain – Compensation to Victims. Consumer protection; role of voluntary agencies such as, Agmark, I.S.I. Quality

control laboratories of companies, private testing laboratories, Quality control laboratories of consumer co-operatives.

#### Recommended References

1. A.Y. Sathe (1999) A first course in Food Analysis, New Age International (P) Ltd.
2. Ramesh. V. Bhat (1992) Food Safety, case studies, NIN
3. DART, FSSAI
4. Akalank Kumar Jain (2016) Food Safety And Standards Act Rules and Regulations FSSAI
5. Pulkit Mathur (2018) Food Safety and Quality Control, The Orient Blackswan, Pbs.

### THEORY : SEMESTER V SEC5. NUTRITION FOR HEALTHY LIVING

#### Course Outcomes

- CO1. Understand the relationship between food, nutrition and health.
- CO2. Understand the functions of food.
- CO3. Learn about various food groups and balanced diet.
- CO4. Understand digestion, absorption and function of various nutrients and their sources.
- CO5. Understand the knowledge on functions of food

#### Course Specific Outcomes

- CSO1. Understand the role of different nutrients in normal health.
- CSO2. Comprehend the functions of vitamin like molecules
- CSO3. Understand the importance of RDA in nutrition
- CSO4. Comprehend the deficiencies and symptoms of vitamins
- CSO5. Comprehend the deficiencies and symptoms of minerals

#### Learning Outcomes

- LO1. Relate metabolism of macro and micro nutrients with health
- LO2. Understand the reasons for malnutrition, under nutrition and over nutrition
- LO3. Associate knowledge of nutrients with their deficiencies.
- LO4. Apply the knowledge in determining the nutritional requirements
- LO5. Acquire skills to overcome nutritional deficiency diseases

### THEORY: SEMESTER V SEC5. NUTRITION FOR HEALTHY LIVING

#### Course Content

UNIT I : Introduction to Food, Nutrition and Health, Balanced Diet, Food

groups, Food Pyramid, food exchange list. Menu planning- principles, factors to be considered, Food security, Standardization of recipes and portions. BMR, Factors affecting BMR, energy requirements for various age groups ,Therapeutic diets- Modification of normal diet to suit special needs

UNIT II : Macro and Micro Nutrients, Carbohydrates, Proteins & Fats, Vitamins and Minerals, classification, food sources, Function in human body, Recommended Daily Allowance (RDA), deficiency symptoms, Importance of fibre.

UNIT III : Nutritional Requirements and diet management through life cycle- Infancy, Preschool, School going, Adolescence, Adults, old age, Expectant and Lactating Mothers, Importance of Colostrum, Advantages of Breast feeding & Complementary feeding, Nutrition related problems in different age groups, Assessment of nutritional status, Nutrition education, different methods of nutrition education, importance of nutrition education for improving the nutrition status of community.

Recommended References

1. Bamji MS, Krishnaswamy K, Brahmam GNV (2009). Textbook of Human Nutrition, 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.
2. Srilakshmi (2007). Food Science, 4th Edition. New Age International Ltd.
3. Srilakshmi,(2005), Dietetics, Revised 5th edition. New Age International Ltd.
4. Wardlaw MG, Paul M Insel Mosby 1996). Perspectives in Nutrition, Third Edition
5. Gopalan, C., (1990). NIN, ICMR. Nutritive Value of Indian Foods.

#### **Co-curricular activities (Hands on exercises)**

1. Learn to standardise recipes and calculate nutritive value
2. Learn menu planning principles and plan menus for different age groups
3. Visit to Anganwadi centres
4. Preparation of questionnaire to assess dietary intakes
5. Conducting nutrition education sessions to vulnerable groups

### **THEORY : SEMESTER V**

#### **VA3. ENTREPRENEURSHIP AND MANAGEMENT OF STARTUPS**

##### **Course Outcomes**

- CO1. Understanding the dynamic role of entrepreneurship and small businesses.
- CO2. Acquire knowledge on Organizing and Managing a Small Business.
- CO3. Understand a New Product or Service Development

##### **Course Specific Outcomes**

- CSO1. Get insights in to Business Plan Creation.
- CSO2. Gain knowledge on Small Business Growth and Performance
- CSO3. Evaluate the process of becoming a start-up with current trends and Regulatory environment

##### **Learning Outcomes**

- LO1. Understand entrepreneurial behaviours and entrepreneurial motivation
- LO2. Understand managerial problems of new enterprises: production, financing and labour & marketing
- LO3. Ability to create a business plan for a food business idea

### **THEORY: SEMESTER V**

#### **VA3. ENTREPRENEURSHIP AND MANAGEMENT OF STARTUPS**

UNIT I : Entrepreneurial traits, types and significance, Definitions, characteristics of entrepreneurial types, qualities and functions of entrepreneurs, entrepreneurial behaviours and entrepreneurial motivation, Entrepreneurial success in rural area, Mechanics of setting of new enterprises – size and location, industrial location factors determining the industrial location. Search for business idea, Business plans: Components and Preparation of business plans, Sources of finance.

UNIT II : Feasibility Studies: Technical, marketing and financial: managerial problems of new enterprises: production, financing and labor and marketing problems, Preparation of Feasibility reports and legal process and documentation, establishing entrepreneur systems.

UNIT III : The new model of Entrepreneurship- Business incubators and startups, Start up's- Concepts, models, characteristics, startup communities, startup terminologies and funding options of start-up's. Startups in India: Profile, Causes, Effects, Process of becoming a startup, Current trends, Regulatory environment, Budget, Plans and Policies. Government initiatives- assistance towards Startup's, women initiatives and other backward groups. Startup India program

Recommended References

1. Barringer, Bruce R. (2015) Preparing Effective Business Plans : An Entrepreneurial Approach. 2<sup>nd</sup> ed., Pearson Education.
2. Barringer, Bruce R., and Ireland,R. Duane ( 2008) Entrepreneurship : Successfully Launching New Ventures, Second Edition, Pearson Education.
3. Blank, Steven G., and Dorf, Bob (2012). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company.KetS Ranch, Inc.
4. Drucker, Peter Ferdinand (2007). Innovation and Entrepreneurship: Practice and Principles. Harper & Row.

5. Kuratko, Donald F., and Welsch, Harold P. (2004) Strategic Entrepreneurial Growth. , Second edition, Thomson/South-Western

### **THEORY : SEMESTER VI**

#### **FST 6.1. PROCESSING OF OILS AND FATS**

##### **Course outcomes**

- CO1. Gain knowledge on edible oils and fats from animal and vegetable sources
- CO2. Understand the physico- chemical characteristics of oils and fats
- CO3. Acquire knowledge on utilization of oils fats
- CO4. Gain knowledge of processing techniques of oils and fats ‘
- CO5. Decipher the applications of plastic fats in food industry

##### **Course Specific Outcomes**

- CSO1. Assess the suitability of individual oils/fats for edible purpose
- CSO2. Analyse the composition of oils & fats for their Nutrition value
- CSO3. Understand the specifications of oils and fats
- CSO4. Acquire knowledge on storage and handling of oils and oil-seeds
- CSO5. Understand the relevance of oil technology innovation in economy boosting

##### **Learning Outcomes**

- LO1. Analyse the application of individual oils/fats for industrial application
- LO2. Learn the extraction techniques of oils
- LO3. Comprehend the refining process of oils
- LO4. Understand the specifications of refined oils
- LO5. Learn about hydrogenation of oils and fats

### **THEORY: SEMESTER VI**

#### **FST 6.1. PROCESSING OF OILS AND FATS**

##### **Course Content**

UNIT-I : Introduction to oils and fats and their nomenclature. Sources and Engineering Properties for Quality evaluation of Fats and Oilseeds. Functions of oils and fats in food processing, frying, cooking and baking, Global and National production of oilseed and oils, Import and export of oils, Role of Oils, Fats & oil seed cakes in human nutrition.

UNIT-II : Characteristics, composition and utilization of oilseeds and oils from plant sources -Coconut, palm, palm kernel, olive, sunflower, safflower, sesame, groundnut, mustard, soybean, linseed, rice-bran & unconventional oils. Characteristics, composition and utilization of fats & oils from animal sources- Milk fats, butter, lard, tallow and other animal fats, Fish and marine oils: halibut, herring, shark, menhaden, whale, sardine, fish liver oils and krill oil.

UNIT-III : Expression and extraction of oil-bearing seeds- Raw material preparation, handling, drying, storage. production of oil by hydraulic press, Ghanis, mechanical expression- types of mechanical press, advantages and disadvantages. Solvent extraction techniques, advantages and limitations, de-solventization of meals, equipment employed, recovery of solvent from miscella and storage. Processing technology of animal - types of Rendering, Utilization of Oil Seed Meal and cake in Food Formulations, production of protein products, concentrates and isolates.

UNIT-IV : Refining of Oils-chemical and physical methods, mechanism, methods of degumming of oils and fats, de-acidification of oils and fats- use of alkalis, batch and continuous methods, washing & drying, bleaching- choice of adsorbent, batch and continuous bleaching, dewaxing and deodorization. Use of membrane technology, biotechnology and other separation processes for refining oils. Specifications of refined oils as per FSSAI, permissible limits of additives.

UNIT-V : Hydrogenation of oils- Principle and mechanism, Hydrogenation of palm stearin. Oil blending, Inter-esterification, molecular distillation, plasticizing, tempering, fractionation and winterization. Application of plastic fat- in bakery, confectionary, cocoa butter replacers & shortenings, types of shortening. Margarine, mayonnaise and salad dressings- manufacturing process and uses. Confectionery coatings. Imitation dairy products - peanut butter and vegetable ghee.

##### **Recommended References**

1. Meyer LH (2006) Food Chemistry , CBS Publisher, New Delhi
2. Potter NN (2006) Food Science, 5<sup>th</sup>ed, CBS Publisher, New Delhi
3. Lawson H (1995) Food Oils & Fats: Technology, Utilization and Nutrition , CBS Pbs.
4. Modern Technology in Oils and Fats Industry, Vol-II, OTAI (NZ)
5. Handbook of Oil Technology by AOCS
6. Bailey's Industrial Oils and Fats products(1982) Volume 1- 5 by Ed. Sworn D, Wiley Pbs.

### **THEORY: SEMESTER VI**

#### **FST 6.2. DAIRY TECHNOLOGY**

##### **Course Outcomes**

- CO1. Know the need and importance of dairy industry
- CO2. Understand the compositional aspects of milk and Processed milk products.
- CO3. Understand the technological aspects of Processed milk products.
- CO4. know the utilization of by-product of dairy industry
- CO5. Develop young entrepreneurs for self-employment through dairy technology

### Course Specific Outcomes

- CSO1. Understand the recent developments in dairy industry in India
- CSO2. Decipher the information about equipment in dairy industry
- CSO3. Understand the stages of milk processing
- CSO4. Knowledge on methods of preparation of milk products
- CSO5. Familiarize the technological aspects of quality control in milk

### Learning Outcomes

- LO1. Perceive physico-chemical properties of milk
- LO2. Gain knowledge on cold storage of milk
- LO3. Learn about thermal processing of milk
- LO4. Learn about preparation of milk products
- LO5. Gain knowledge on new technologies in dairy by-product utilization

## THEORY : SEMESTER VI FST 6.2. DAIRY TECHNOLOGY (THEORY)

### Course Content

UNIT I : Dairy development – Dairy development in India and its importance. Systems of collection of milk- Reception, Platform testing. Physico-chemical properties of milk. Nutritional Importance of mil. Preservatives, Neutralizers and Adulterants in Milk and their Detection. Milk production- National & International status. Recent development in dairy technology research

UNIT II : Equipment and Cold storage: Equipment used in dairy industry- Equipment for Fluid Milk Processing, Equipment for Milk Products Processing. Cleaning and maintenance of equipment. Refrigeration System-Basic Principles and Components of Refrigeration System. Different Cooling Systems for Milk and Milk Products.

UNIT III : Processing of milk- Thermal Processing, Various stages of processing, Clarification, separation, bactofugation, homogenization, Pasteurization and Ultra-high temperature Processing. Packaging- materials, process and machinery. Storage and Distribution Systems. Different types of fluid milks produced commercially.

UNIT IV : Processing of milk products: Composition, Standards, Manufacturing - Flow diagram of the following milk products, - Butter, ghee, flavoured milk, yoghurt, dahi, shrikhand, ice-cream, channa, paneer, cheese. defects during manufacturing of milk products. Storage of curd, Yoghurt, Shrikhand, Cheese (cheddar). Quality control and sensory evaluation of the products.

UNIT V : Dairy By products- Skimmed Milk, Condensed milk, Casein and Caseinates. Whey, Whey based Beverages, Whey Powder, Whey Protein Concentrates, Lactose and Ghee Residue. New Technologies in By-product Utilization- Membrane Processing – Reverse Osmosis and Ultra Filtration

### Recommended References

1. De Sukumar (2007) Outlines of Dairy Technology, Oxford University Press, Oxford
2. Webb and Johnson (1988) Fundamentals of Dairy Chemistry, 3<sup>rd</sup> ed., CBS Publishers
3. Eram S. Rao. (2011) Food Science Experiments and Applications. CBS Pbs. 2<sup>nd</sup> Edition
4. Frazier WC and Westhoff DC. (1995) Food Microbiology. Tata McGraw-Hill Pbs.
5. Knechtges LI. (2012) Food Safety-Theory and Practice, USA: Jones and Barlette Learning
6. The Food Safety and Standards Act along with Rules and Regulations. (2011) Delhi: Commercial Law Publishers (India) Pvt Ltd.

## PRACTICAL: SEMESTER VI

### FST 6.3. PROCESSING OF OILS AND FATS

1. Analysis of oilseeds and cakes as per FSSAI methods- Moisture Content, Ash Content
2. Analysis of oilseeds and cakes as per FSSAI methods -Oil Content, Nitrogen/ Protein Content, Crude fiber
3. Determination of physical characteristics of oils and fats as per BIS-Specific gravity, Refractive Index, Colour, & Viscosity
4. Determination of chemical characteristics of oils and fats as per FSSAI - Acid value, Saponification value, Iodine Value, & Peroxide value
5. Degumming of oils
6. Refining of oils - alkali neutralization
7. Bleaching of vegetable oils
8. Determination of DOBI value for palm oil
9. Preparation of peanut butter and Cocoa butter substitute
10. Preparation of mayonnaise and salad dressings

## PRACTICAL : SEMESTER - VI

### FST 6.4. DAIRY TECHNOLOGY

- 1) To conduct the platform Test of Milk and its products
- 2) Determination of physico-chemical properties of milk
- 3) Testing efficiency of
- 4) Detection of adulteration of milk
- 5) Separation of cream

- 6) Standardization of milk
- 7) Preparation of flavored
- 8) Preparation of all Indian Traditional Dairy Products
- 9) Preparation of White and Salted butter and ghee
- 10) To assess suitability of milk for heat processing

### **FST 6.5. INTERNSHIP**

Every candidate shall undergo professional training for 45 days in a Food Industry during Sixth semester of the course. At the end of professional training the student has to submit a report for which Viva will be conducted both by internal and external examiner.

### **THEORY : SEMESTER VI DSE3A. BEVERAGE TECHNOLOGY**

#### **Course Outcomes**

- CO1. Acquire knowledge on basic raw materials applied in the beverage production.
- CO2. Understand various technologies of beverage making
- CO3. Evaluate various methods of water treatments in food industry
- CO4. Acquire knowledge on types of sweeteners and adjuncts in beverages
- CO5. Understand the difference between alcoholic and non-alcoholic beverages

#### **Course Specific Outcomes**

- CSO1. Understand the processing of fruit-based beverages
- CSO2. Decipher the technologies involved in making carbonated beverages
- CSO3. Differentiate between various fruit beverages
- CSO4. Knowledge on additives in beverage production
- CSO5. Familiarize the technological phases of alcoholic and non-alcoholic beverages.

#### **Learning Outcomes**

- LO1. Describe the functions and types of sweeteners in beverages
- LO2. Gain knowledge on fortified beverages and food adjuncts
- LO3. Compare and contrast natural sweeteners from artificial sweeteners
- LO4. Learn the processing of honey
- LO5. Able to classify beverages

### **THEORY: SEMESTER VI DSE3A. BEVERAGE TECHNOLOGY**

#### **Course Content**

UNIT I : Beverages- Functions, classification, nutritive value, health benefits, role of water in beverages, laboratory standards of water, water treatments in food industry – distillation, reverse osmosis, membrane filtration, deionization, ozonation, irradiation, activated charcoal, chemical treatment, technology and chemical constituents of bottled water

UNIT II : Fruit based beverages– fruit juice, fruit drink, cordials, fruit nectars, squash, concentrates, fruit punch, carbonated fruit beverages. Processing of Fruit based beverages. Carbonated non – alcoholic soFST drinks- ingredients and manufacturing.

UNIT III : Alcoholic beverages: Starter cultures, Role of yeast, beer- raw materials, technology of brewing, Wine-technology of wine making, types of wine. Distilled spirits- whisky, rum, gin and brandy. Traditional alcoholic beverages: toddy, chang, kaomak, takju, feni and madhuka.

Unit IV : Coffee -bean processing, blending, roasting, grinding, brewing. Caffeine – effect on health. Decaffeinated coffee: methods of decaffeination, Instant coffee processing. Tea- types of tea, chemical constituents, processing and packaging. Instant tea processing.

Unit V : Role of sweeteners, types of sweeteners-Sucrose, invert sugar, High fructose corn syrup, high glucose corn syrup, honey. Artificial sweeteners- types, safe levels in foods, effect on health, Food adjuncts- types, sources. Fortified beverages- Production, Packaging, labeling and storage considerations

#### **Recommended References**

1. Vijayakhader(2001) Text book of Food Science and Technology
2. Srilakshmi (2007). Food Science, 4th Edition. New Age International Ltd.
3. P. R. Ashurst ,Chemistry and Technology of SoFST Drinks and Fruit Juices, 2<sup>nd</sup> Edition
4. A. Varnam, J.M. Sutherland (1994) Beverages: technology, chemistry and microbiology
5. Richard Coles (2011 )Food and Beverage Packaging Technology
6. P Paquin (2009)Functional and Speciality Beverage Technology

### **THEORY: SEMESTER VI DSE 3B. FOOD PLANT LAYOUT AND DESIGN**

#### **Course Outcomes**

- CO1. Awareness regarding equipment used in food industries

- CO2. Design the plant layout for different food processing units
- CO3. Evaluate the problems faced during construction of a food processing plant
- CO4. Incorporate the safety standards during building a process plan
- CO5. Comprehend techniques of project planning

#### Course Specific Outcomes

- CSO1. Understand stages of plant design
- CSO2. The processes involved in layout design
- CSO3. Understand factors involved in the site selection for food plant.
- CSO4. The concept of preparing cost estimate and economics
- CSO5. The development and design consideration in different food industries

#### Learning Outcomes

- LO1. Execute the concepts, principles and theories for the location of food processing plant
- LO2. Demonstrate plant layout problems by using different tools and techniques
- LO3. Execute techniques of project planning by using scheduling methods
- LO4. Implement the knowledge of materials applied for construction of food equipment
- LO5. Design and setting up of new food processing plant as entrepreneur and/or consultant

### THEORY : SEMESTER VI

#### DSE 3B. FOOD PLANT LAYOUT AND DESIGN

##### Course Content

UNIT I : Introduction to plant design - Plant design concepts, General design considerations for food processing industries, stages of plant design, general plant design procedure, feasibility study and analysis, sales planning for plant design, various equipment and machineries for food processing plant.

UNIT II : Plant Location- levels of Plant location, Location of layout- location factors, plant site selection, Territory and site-specific factors, Influence of location on plant layout, Subjective, qualitative and semi-quantitative techniques for evaluating plant location, Location Theory and models, Classification of Dairy and Food Plants, farm level collection and chilling centre

UNIT III : Plant Layout - Importance, objectives, classical types of layouts. Evaluation of Plant Layout. Tools and techniques for plant layout- process charts, process flow diagram, Travel chart, machine data cards, material movement patterns. Space requirement for machines, work stations and storage,

symbols used for plant design and layout, plant layout procedures. Layout of different industries- Considerations in different types of food industries such as cereal, pulses and oilseed industry, dairy, Bakery, soft drinks and Canning

UNIT IV : Project planning, Techniques of project planning, Project scheduling, Methods of project scheduling: Gantt charts and Network scheduling, Basic terms, objectives and advantages of Network analysis, various Network techniques like PERT and CPM and related numerical problems. Cost analysis, Classification of costs, analysis of production costs, depreciation and different methods of calculation, break-even analysis

UNIT V : Plant Equipment and Buildings- Materials of construction of food equipment: Characteristics of suitable construction material like Stainless steel, Aluminium, Nickel and Plastic Materials; Hygienic construction and design concepts; Types of factory buildings, Consideration in building design, drainage, ventilation and illumination in food processing industries,

##### Recommended References

1. A.W. Faral Rebert E (1980) Engineering for Dairy and Food Products., Kriger Pub Co.,
2. James M.Moore(1971) Plant Layout and Design, Mac Millan, New York
3. Textbook of Dairy Plant Layout and Design,2010, ICAR, New Delhi
4. Sean Moran (2015) Applied guide to process and plant design Elsevier
5. Chandrashekar H (2017) Facility Planning and Layout Design Technical Publications

### THEORY: SEMESTER VI

#### DSE3C. FOOD EXTRUSION TECHNOLOGY

##### Course Outcomes

- CO1. Understand fundamentals of food extrusion technology
- CO2. Understand processing of different extruded products
- CO3. Comprehend design considerations of different extruded products
- CO4. Gain knowledge on methods of extrusion technology
- CO5. Understand the applications of extrusion technology

##### Course Specific Outcomes

- CSO1. Gain knowledge on selection of food extrusion equipment
- CSO2. Gain insight in to extruder types and its impact on extrusion process
- CSO3. Understand suitability of raw materials for extrusion technology
- CSO4. Learn chemical and nutritional changes occurring in extrusion process
- CSO5. Comprehend packaging requirement of extruded products.

### Learning Outcomes

- LO1. Inculcate skills in extrusion technology
- LO2. Learn the extrusion technology of breakfast cereals
- LO3. Acquire the skills on quality testing of pasta products
- LO4. Understand the hurdles in application of extrusion technology
- LO5. Gain knowledge on recent trends and future prospects of food extrusion

### THEORY : SEMESTER VI

#### DSE3C. FOOD EXTRUSION TECHNOLOGY

##### Course Content

UNIT I : Extrusion: definition, Extruder Selection, Design, and Operation for Different Food Applications, Rheological properties of materials during the extrusion Process, effect of extrusion on food products: Chemical and nutritional changes in food during extrusion, factors affecting extrusion, Net Flow, Packaging materials for extruded product

UNIT II : Introduction to extruders, principles and types, Components, functions and classification of extruder, Uses of extruders in the food industry, Single screw extruder- principle of working, net flow, factors affecting extrusion process, Twin screw extruder- counter rotating and co-rotating, process characteristics, pre-conditioning of raw materials used in extrusion process. Use of dry extruders in extrusion

UNIT III : Extruded food product development- Objectives and importance of extrusion in food product development, advantages and disadvantages, Extruded food product, Change of functional properties of food components during extrusion, Pre and post extrusion treatments, use of extruder as bioreactor, manufacturing process of extruded products, Application of extrusion technologies in food industries

UNIT IV : Breakfast cereals by extrusion technology- Classification of Breakfast cereals, Raw materials, process and quality testing of vermicelli, spaghetti- Raw materials, process and quality testing of pasta and macaronic products, Ready to eat breakfast cereals by extrusion cooking.

UNIT V : Texturized vegetable protein: Definition, processing techniques, Manufacturing process and quality parameters of TVP Recent Advances in extrusion technology, Carbon dioxide or Nitrogen assisted extrusion technology, Extrusion in confectionary technology, Non-thermal Extrusion of Protein Products

##### Recommended References

1. Matza S (2000) Extruded foods. Springer
2. N.D. Frame (2012) Technology of Extrusion Cooking Springer
3. Riaz M.N (2000) Extruders in Food Application. CRC Press
4. Maskan and Altan(2000) Advances in Food Extrusion Technology CRC Press

5. Berk Z (2013) Food Process Engineering and Technology. Academic Press

### Semester VII

#### THEORY: SEMESTER VII

##### FST 7.1 UNIT OPERATIONS IN FOOD INDUSTRY

##### Course Outcomes

- CO1. Understand the principles of Unit operations
- CO2. Acquaint with fundamentals of food engineering and its processes
- CO3. Get technical know-how on refrigeration and freezing
- CO4. Understand the basics of distillation
- CO5. Comprehend the concept of filtration techniques

##### Course Specific Outcomes

- CSO1. Inculcate knowledge about size reduction.
- CSO2. Acquire the skills needed for material handling systems
- CSO3. Understand the usage of refrigerants
- CSO4. Able to apply the knowledge of unit operations in food processing
- CSO5. Get hands on experience in use of solar driers

##### Learning Outcomes

- LO1. Know about the concept and utility of unit operations in food processing
- LO2. Learn about the theory of mixing
- LO3. Learn about the principles of fluid flow
- LO4. Know about heat transfer technologies
- LO5. Get skills in steam and flash distillations

### THEORY : SEMESTER VII

#### FST 7.1 UNIT OPERATIONS IN FOOD INDUSTRY

##### Course Content

UNIT I : Screening; types of screens ; Grizzly; Revolving screen; Shaking screen; Rotary screen; Vibratory screen; Horizontal screen; Perforated metal screens; wire mesh screen; Ideal and Actual screen; Effectiveness of screen; Air screen cleaners;

UNIT II : Definition and Introduction to Separation; Types of Separator-Disk, Indented cylinder, Spiral, Specific Gravity, Destoner, Inclined Draper, Velvet roll, Pneumatic & aspirator, separation based fluidisation technique, Magnetic and Cyclone Separator.

UNIT III : Size reduction procedures- Crushing, Impact, Shearing, Cutting; Cereal grinding, Degree of grinding; Size reduction machinery- crusher, grinder, attrition mills, hammer mill, ball mills, rietz mill & oil expression and extractions- hydraulic press, screw press

UNIT IV : Utilities of Drying; thermal properties; Equilibrium moisture content (EMC); Drying theories; methods of drying;- Contact drying, Convective drying, freeze drying, radiation drying, Superheated steam, Drying rate period; types of dryers-Deep bed, Flat bed, Continuous, Recirculating, LSU, Fluidised bed, Rotary, Tray, Tunnel and solar, Etc. Evaporation Basic principle, need for evaporation, thermodynamics of evaporation; boiling point elevation ,heat transfer during evaporation, heat transfer coefficients, design of evaporation system; retention time; single effect evaporator, multiple effect evaporator ,thermo compression system.

UNIT V : Material handling & transportation- Belt conveyor, bucket elevator, screw conveyor, pneumatic conveyor; transportation. Applications of Unit operations to the food industry. Distillation: Theory and principles, liquid vapor equilibrium, distillation of binary mixtures, simple distillation, steam distillation, vacuum distillation, and fractional distillation. Crystallization: Principle, nuclei formation- equipment and applications in food industries.

#### Recommended References

1. Sahay KM & Singh KK 1994. Unit Operation of Agricultural Processing. Vikash Publication House.
2. Fellos PJ 2005 Food Processing Technology: Principle &Practice 2nd Ed. CRC.
3. Potter NN & Hochkiss 1997 Food Science 5th Ed. CBS.
4. Potty VH & Mulky MJ 1993 Food Processing. Oxford & IBH.
5. Ramaswamy H & Marcotte M. 2006 Food Processing: Principles & Applications. Taylor & Francis

### **THEORY: SEMESTER VII**

#### **FST 7.2. ENZYMES IN FOOD PROCESSING**

##### **Course Outcomes**

- CO1. Gain knowledge on the concept of enzymes in food
- CO2. Understand the role of enzymes in dairy industry
- CO3. Acquire knowledge on enzymes used in baking industry
- CO4. Attain knowledge on enzymes used in Meat industry
- CO5. Understand the role of enzymes in sugar industry

##### **Course Specific Outcomes**

- CSO1. Acquire knowledge in undesirable enzyme reactions in food
- CSO2. Understand the mechanism of action of enzymes
- CSO3. Learn about synergistic effect of enzymes
- CSO4. Ability to relate the theoretical knowledge on enzymes to food industry applications
- CSO5. Comprehend the role of lipases in meat processing

##### **Learning Outcomes**

- LO1. Learn about purification and assay of enzymes.
- LO2. Learn about enzymes in fruit and vegetable processing
- LO3. Acquire skills on use of enzymes in beverage production
- LO4. Understand the application of enzymes in oil and fat industry
- LO5. Learn the application of immobilized enzyme technology in food industry

### **THEORY: SEMESTER VII**

#### **FST 7.2. ENZYMES IN FOOD PROCESSING**

##### **Course Content**

UNIT I : Introduction- classification, properties and nomenclature, Sources of enzymes, mechanism of enzyme action, factors affecting the rate of enzymic reactions, Enzyme Kinetics: enzyme concentration, substrate concentration, environmental conditions, inhibitors, co-enzymes & cofactors, Undesirable and desirable enzymic reactions in foods, extraction, purification and assay of enzymes

UNIT II : Enzymes in dairy industry- natural enzymes in milk, Role of lipase and protease in cheese making, sources & mechanism of action. Production of lactose free milk, role of enzymes in processing of whey. Enzymes in production of fruit juices – Sources & mechanism of Catalase, Glucose oxidase & other enzymes. Enzymes in Fruit and vegetable processing

UNIT III : Enzymes in Bakery – role of enzymes in the baking process, conventional methods and enzymatic methods, mechanism of action. Enzymes for bread making, anti-staling, dough conditioning, synergistic effect of enzymes. Enzymes in production of beverages- tea, cocoa, wine, beer, whiskey and cider

UNIT IV : Enzymes in Meat industry- Effect of enzymes on meat, enzymes in meat tenderization, egg processing, use of enzymes in meat processing with their source, mechanism of action and benefits. Application of enzymes in fat and oil industry

UNIT V : Enzymes in sugar industry- Types of enzymes in sugar industry, sources- mechanism of action, isolation, purification and assay of enzymes, Enzymes for production of maltodextrins and corn syrup solids - liquefaction, saccharification, dextrinization, isomerization, production of high-fructose-corn-syrup, fructose and fructo- oligosaccharides. Enzyme immobilization techniques and its application in food industry

##### Recommended References

1. G.A. Tucker and L.F.J. Woods (2009) Enzymes in Food Processing, Springer

2. Muthuswamy C (2015) Enzymes in Food and Beverage Processing. CRC Press

3. Panesar PS, Marwaha SS & Kumar H (2010) Enzymes in Food Processing – Fundamentals and potential application. IK International Publishing House

4. Khan M.Y. and Khan F (2015) Principles of Enzyme Technology. PHI Publication

5. Ray RC & Rosell CM (2017) Microbial Enzyme Technology in Food Applications. CRC Press

6. Whitehurst R & Law B. 2002. Enzymes in Food Technology. Blackwell Publ

### **THEORY : SEMESTER VII**

#### **FST 7.3. RESEARCH METHODOLOGY**

##### **Course Outcomes**

- CO1. Comprehend the current research areas in Food Technology
- CO2. Understand various tools of data collection
- CO3. Comprehend the role of research methodology in Food science research
- CO4. Gain competence in formulating research designs
- CO5. Interpret and understand the applications of computers in research

##### **Course Specific Outcomes**

- CSO1. Inculcate knowledge about essentials of high-quality research.
- CSO2. Introduce students to the skills needed in conduct research
- CSO3. Understand the publication of research findings by adhering to research ethics
- CSO4. Able to master documentation of research findings
- CSO5. Conduct quantitative research in the field of Food science and Technology

##### **Learning Outcomes**

- LO1. Apply measurement & scaling techniques in research
- LO2. Analyse the criteria to select an appropriate sampling method
- LO3. Translate the knowledge on research techniques in conducting research
- LO4. Understand the concept of IPR and Patent filing
- LO5. Explore the new software and journals in professional and academic endeavours

### **THEORY : SEMESTER VII**

#### **FST 7.3. RESEARCH METHODOLOGY**

##### **Course Content**

UNIT I : Meaning, significance and objectives of research, criteria of good research, merits and demerits, Different types of research, Current research areas in Food science and Technology, Research process- selection and statement of research problem, statement of hypothesis and types of hypotheses, principles and formulation of hypothesis, formulation of research designs.

UNIT II : Research data collection and presentation- Techniques and methods of data collection., Tabulation of Research Data, Graphical Presentation of Data, Sampling, types of sampling methods, merits and demerits of sampling methods, Research variables- meaning and their significance in research, types of variables

UNIT III : Research Design, Need for a research design, features of a good design, Types of research designs- Explorative/ descriptive/ experimental/ Survey/ Case Study, Measurement and scaling techniques- Measurement scales: Nominal, Ordinal Interval, Ratio, Validity, Reliability and Practicality, Scaling, scaling techniques, Rating scales (paired comparison, rank order), Likert scales

UNIT IV : Writing a research thesis and paper: Characteristics of good thesis, outline of a thesis, effective technical writing. Scientific paper writing. Effective literature study approaches, Ethics in research and plagiarism

UNIT V : IPR- meaning and scope, Patent- Concept of Patent, Product / Process Patents & Terminology, Preparation of Patent Documents, Process for Examination of Patent Application, Procedure for Filing of Patent Application and types of Applications, Assignment and licensing of Patents, Patent Infringement

##### **Recommended References**

1. Jackson SL. 2012. Research Methods and Statistics: A Critical Thinking Approach. 4<sup>th</sup> Ed. Wadsworth Cengage Learning.
2. Krishnan V. 2011. Statistics for Beginners. Atlantic Publishers and Distributors (P) Ltd.
3. Singh YK. 2006. Fundamentals of Research Methodology and Statistics. New Age International Publishers.
4. Kothari CR. (1997) Research Methodology. New Age International Pbs.
5. Shanti Bhushan Mishra & Shashi Alok (2017) Handbook of Research Methodology, Educreation Pbs.

## **PRACTICAL : SEMESTER VII**

### **FST 7.4. UNIT OPERATIONS IN FOOD INDUSTRY**

1. Determination of density and porosity of food grains.
2. Determination of Size reduction in Ball Mill
3. Determination of particle size of granular foods by sieve analysis.
4. Estimation of thermal conductivity.
5. Analysis of flow rate through flow through pipes.
6. Estimation of Diffusion Coefficient
7. Estimation of vaporization efficiency and thermal efficiency of Steam Distillation
8. Visit to food processing industries

## **PRACTICAL : SEMESTER VII**

### **FST 7.5. ENZYMES IN FOOD PROCESSING**

#### **Practical**

1. To study the effect of temperature & pH on enzyme activity.
2. To study the effect of substrate concentration on enzyme activity.
3. Determination of enzyme activity of  $\alpha$ -amylase in starch hydrolysis.
4. Determination of lipase activity of lipids.
5. To demonstrate the effects of papain enzymes in meat tenderization.
6. Determination of catalase activity of hydrogen peroxide production.
7. Determination of oxidase activity of given sample.
8. Clarification of juices using enzymes.
9. To determine the adequacy of pasteurization in milk.
10. Assay of alpha amylase in the germinating barley

## **SEMESTER VII**

### **FST 7.6. COMMUNITY ENGAGEMENT AND SERVICE**

The curricular component of 'community engagement and service' seeks to expose students to the socio-economic issues in society related to the field, so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems. This can be part of summer term activity or part of a major or minor course depending upon the major discipline. Student has to undertake 2 activities and submit a report towards end semester

#### **Any Two activities from the following**

1. Teaching hygiene and sanitation to food handlers

2. Teaching food safety and FSSAI regulations to local food vendors
3. Understand the technical problems of food vendors
4. Study the problems in food storage faced by small scale food industries
5. Any other related activity

### **FST 7.7. FIELD BASED PROJECT WORK**

The field-based learning/minor project will attempt to provide opportunities for students to understand the different socio-economic contexts. It will aim at giving students exposure to development-related issues in rural and urban settings. It will provide opportunities for students to observe situations in rural and urban contexts, and to observe and study actual field situations regarding issues related to socioeconomic development.

A minor Project work may be undertaken in the relevant field preferably on current issues and students are expected to submit a report

## **Semester VIII**

### **THEORY : SEMESTER VIII**

#### **FST 8.1. APPLIED STATISTICS**

##### **Course Outcomes**

- CO1. Understand the Significance of statistics in food technology
- CO2. Acquire skill to apply the statistical tools in Food science and technology.
- CO3. Study the basic statistical techniques in relation to food analysis
- CO4. Understand the applications of computers in Statistics
- CO5. Interpret the applications of statistical packages in research

##### **Course Specific Outcomes**

- CSO1. Inculcate knowledge about measures of central value.
- CSO2. Learn the skills needed to test hypothesis by different statistical tests
- CSO3. Understand the graphical representation of data
- CSO4. Develop skills in statistical analysis of data
- CSO5. Apply statistical knowledge for interpretation of data

##### **Learning Outcomes**

- LO1. Able to analyse statistical data using statistical tests
- LO2. Use control charts to interpret problems in statistical quality control.
- LO3. Apply statistical techniques in food analysis
- LO4. Understand the compilation of data using latest statistical software
- LO5. Explore the innovative methods of data representation

**THEORY : SEMESTER VIII**  
**FST 8.1. APPLIED STATISTICS**

**Course Content**

UNIT I : Applied Statistics- Introduction, Meaning and scope, origin and growth of statistics, functions of statistics, applications of statistics, statistical methods vs Experimental methods, role of statistics in research, significance and applications of statistics in food technology, Statistical data analysis in food technology, Variability, Accuracy and Precision.

UNIT II : Statistical representation of data- Meaning, types and objectives of classification, Discrete and continuous frequency distribution, tabulation of data, difference between classification and tabulation, Parts of a table, types of tables, general rules of tabulation, Diagrammatic and graphical representation - significance, types of diagrams & graphs, graphs of frequency distribution

UNIT III : Measures of central tendency- Introduction, Calculation of Arithmetic mean, Median & Mode. Merits and limitations of Mean, Median and Mode. Measures of dispersion and variation- significance, methods of studying variation, Tests of skewness and kurtosis, concept of probability and normal distribution

UNIT IV : Analysis and Interpretation of statistical data- Testing of hypothesis, Parametric tests, Chi-square test, application of Students 't' test, Correlation, Regression and prediction, ANOVA- Analysis of variance- One way and two-way classification, Non parametric tests- Sign test, Wilcoxon signed-ranks test, Mann-Whitney U test and Kruskal-Wallis test

UNIT V : Statistics and Computer – Fundamentals of computer, History of computer, Generation of computer, Language, Components, Applications of Computers. Operating System & Internet: MS-DOS, MS-Windows, and Internet, MS-Office: MS-Word, MS Excel and Power Point. Introduction to Data-base, Application of modern tools such as statistical packages (SPSS, Lotus 123, Access, Excel, Visual Fox pro etc.) in research

**Recommended References**

1. S.C. Gupta and V.K. Kapoor (2002) Fundamentals of Mathematical statistics, Sulthan Chand & Sons, New Delhi. 2002.
2. V.K. Kapoor (2000) Problems and solution in statistics, 3rd eds., Sulthan Chand & Sons
3. Mukhopadhyay P (1999): Applied Statistics, New Central Book Agency, Calcutta.
4. Gun, A.M., Gupta, M.K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II, 9<sup>th</sup> Edition World Press, Kolkata.
5. Montgomery, D. C. (2009) Introduction to Statistical Quality Control, Wiley Pvt. Ltd.

**PRACTICAL : SEMESTER - VIII**

**FST 8.2. DISSERTATION BASED ON PROJECT WORK**

Project work may be undertaken in the relevant field preferably on current issues. The Dissertation should be typed in Times New Roman in 12 font size with 1.5 line spacing from the beginning including titles to the chapters and sections. Bold font may be used where ever necessary. The students are expected to follow scientific grammar for writing *in vivo* etc. which should be in italics.

Guidelines for writing the Dissertation: The Dissertation should have the following pages in order:

- \* Title page highlighting the title, name of the candidate, Reg.no. Guide name, College name and month and year of submission and the inner title page containing the same details on white background.
- \* Certificate from the Head of the institute & Guide
- \* Certificate from the ethical committees for approval of study, if any
- \* Declaration by the student
- \* Acknowledgements
- \* Index highlighting chapter titles and sections titles
- \* Index for tables, figures and plates, if any
- \* Abbreviations and symbols
- \* Materials used in the investigation with their procurement details like name of the company, batch number etc.
- \* Equipment used in the study with the model number and other details.
- \* Aim and objectives of the investigation.
- \* Introduction and literature survey
- \* Materials & Methods
- \* Result
- \* Discussion
- \* Summary and conclusion
- \* References

**FND 8.3. COMPREHENSIVE VIVA-VOCE**

Viva-voce will be conducted to test the knowledge gained by the student in all the four semesters (both theory & practical) and other relevant issues in the area of specialization

## M.Sc. Food Science & Technology (Two Semesters)

### Semester IX

#### THEORY: SEMESTER IX

#### PGFST 9.1. CEREAL, LEGUME AND OILSEED PROCESSING TECHNOLOGY

##### Course Outcomes

- CO1. Understand technology of milling of various cereals
- CO2. Technical knowhow of pulses and oilseeds refining
- CO3. Comprehend production of different processed products and by-products
- CO4. In-depth understanding of the technology associated with post-harvest technology
- CO5. Get insights in to advanced processing technologies

##### Course Specific Outcomes

- CSO1. Gain knowledge about basic composition of cereal grains, pulses and oil Seeds.
- CSO2. Acquire the skills needed in processing of cereals, pulses and oil-seeds
- CSO3. Understand machinery and tools required for processing of cereals, pulses and oilseeds
- CSO4. Ability to operate and handle the equipment of processing
- CSO5. Gain knowledge on the production of different processed products and by-products

##### Learning Outcomes

- LO1. Know about the various processing steps of major cereals after harvesting.
- LO2. Prepare various food products including the by-products of cereal, pulses & oil Seeds.
- LO3. Learn about the various processing steps and methods of major legumes after harvesting
- LO4. Know about the production of different processed products and fermented products.
- LO5. Learn about the various processing steps of major oil seeds after harvesting

## THEORY: SEMESTER IX

### PGFST9.1. CEREALS, LEGUME AND OILSEED PROCESSING TECHNOLOGY

#### Course Content

UNIT I : Processing Technology of cereals- Production & utilization of cereals, traditional methods of cereal processing-advantages & disadvantages. Physicochemical properties and application of advanced processing technologies for cereal and cereal products –Radiofrequency, Microwave, Irradiation, High pressure processing and novel extrusion technologies. By-products of rice milling - husk & rice bran stabilization, canned&instant rice, flaked, puffed, expanded, extruded & shredded products. By-products of wheat milling, starch & gluten separation from corn, By products of Corn, Sorghum, Barley, oats, Rye & Triticale.

UNIT II : Processing Technology of Millets – Production & utilization of Millets, Composition & Physicochemical properties of commonly consumed Millets - Traditional & advanced processing methods of Millets, By-products of millets, Millets as functional foods, Value addition &Health benefits of millets. Processing Technology of Pseudo cereals- Amaranth seeds, Buck Wheat, Quinoa & Chia seeds, general characteristics, Composition, traditional & advanced processing methods, Health benefits of Pseudo cereals.

UNIT III : Technology of Legumes and pulses -Composition, production and utilization of pulses, advanced pre-treatment techniques, milling of pulses, Dry milling, Wet milling, advanced processing methods of pulses, equipment involved, Effect of processing on pulses, By-products& Value-added products. Soya bean – Processing, grits, nuggets, soya isolates, soya concentrates & soya products. Bioactive components and health benefits of processed & whole pulses.

UNIT IV : Technology of oil seeds- Composition, production & utilization of oilseeds, traditional processing methods, Alternative extraction and green extraction techniques- Principle & advantages, supercritical fluid extraction, liquefied gases, aqueous extraction, enzymatic extraction, microwave-assisted & ultrasonic-assisted extraction. Microencapsulation techniques for oils, Vegetable oil powders, Technologies for valorization of de-oiled cakes, formulation of oilseeds based dairy analogues, Food safety and standards for oils, fats and oilseeds.

UNIT V : Post-Harvest Technology of cereals, legumes and oilseeds- Post harvest losses, spoilage, causative factors, prevention & control measures, Grain storage, transportation& handling. Changes occurring during storage -chemical, physical & biological. Effect of pests on food grains and their control, detection of insect infestation, Fumigation-principles, properties and applications, rodenticides for rats and mice. Quality control standards for Cereals, Legumes&Oil seeds.

#### Recommended References

1. Kent, N.L (2003) Technology of Cereals, 5th Ed. Pergamon Press.
2. Chakravarty (1988) Post Harvest Technology of Cereals, Pulses and Oilseeds, Oxford Pbs.
3. Marshall, Rice Science and Technology. 1994. Wadsworth Ed., Marcel Dekker, New York.
4. Michael Bockisch (2015) Handbook of Oil Technology, AOCS, Elsevier
5. Anil K, Manoj KT, Dinesh J & Vishnu K (2021) Millets and Millet technology, Springer

### **THEORY: SEMESTER IX**

#### **PGFST 9.2. FUNDAMENTALS OF MOLECULAR BIOLOGY & BIOINFORMATICS**

##### **Course Outcomes**

- CO1. Understand advanced knowledge of cell biology
- CO2. Comprehend the concepts of molecular biology.
- CO3. Get technical state of the art technologies in Bioinformatics
- CO4. Understand the basics of Genomics
- CO5. Understand the basics of Proteomics

##### **Course Specific Outcomes**

- CSO1. Comprehend the basics of nucleus and chromosome
- CSO2. Get insights into biochemical basis of Inheritance
- CSO3. Understand the concept of Gene expression
- CSO4. Acquire skills in bioinformatics
- CSO5. Comprehend the applications of bioinformatics in food technology research

##### **Learning Outcomes**

- LO1. Develop basic knowledge and skills in cell & molecular biology
- LO2. Become aware of the complexity and harmony of the cells.
- LO3. Conduct research in the frontier and multi-disciplinary areas of modern biology
- LO4. Conduct research in the multi-disciplinary areas of Genomics
- LO5. Apply the knowledge of Proteomics in Food science and technology research

### **THEORY : SEMESTER IX**

#### **PGFST 9.2. FUNDAMENTALS OF MOLECULAR BIOLOGY & BIOINFORMATICS**

##### **Course Content**

UNIT – I : The nucleus, chromatin and the chromosome: structure and function of nucleus; organization of genetic material – Packing of DNA into chromatin, Nucleosome organization; Chromosome structure; Cell cycle – Check points, Cdks and regulation.

UNIT – II : The biochemical basis of Inheritance: DNA as the genetic material, DNA structure and replication in prokaryotes and eukaryotes – Enzymes involved and mechanism, including replication at telomere. Genetic code: properties of genetic code, Wobble hypothesis.

UNIT – III : Gene Expression: Transcription in prokaryotic and eukaryotic systems – enzymes and factors involved and mechanism; RNA processing in eukaryotes – capping, addition of poly(A) and removal of introns; Translation in prokaryotes and eukaryotes – machinery involved and mechanism; Regulation of gene expression in prokaryotes – Lac operon concept in E.coli ; regulation of gene expression in eukaryotes by promoters, enhancers, silencers and transcription factors.

UNIT – IV : Introduction to Bioinformatics – Genomics and Proteomics. Bioinformatics – Online tools and offline tools. Biological databases. Types of data bases – Gen bank, Swiss port, EMBL, NCBL, and PDB.

UNIT-V : Genome organization and evolution, alignment and Phylogenetic trees, Applications of Bioinformatics in various fields: Environment, biotechnology, molecular biology, neurobiology, agriculture, drug designing, biomedical genome medicines, medical microbiology.

##### **Recommended References**

1. Lodish et.al (2021) Molecular cell biology. 9<sup>th</sup> edition, Freeman Publications
2. De.Roberties. E.D.P (2017) Cell & Molecular Biology, International Edition
3. Friefelder D (2004) Molecular Biology, Narosa publications
4. J.D.Watson et.al.(2013) Molecular Biology of the Gene, Pearson Pbs.
5. Mount DW (2001) Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor

### **THEORY : SEMESTER IX**

#### **PGFST 9.3. NUTRACEUTICALS AND FUNCTIONAL FOODS**

##### **Course Outcomes**

- CO1. To develop comprehensive understanding of different nutraceuticals
- CO2. To understand the potential of various functional foods in promoting

human health

- CO3. Get knowledge on phytochemicals in plant foods
- CO4. Decipher the recent developments in nutraceutical research
- CO5. Interpret and understand the applications of nutraceuticals in disease conditions

#### Course Specific Outcomes

- CSO1. Understand the market for nutraceutical products
- CSO2. Able to differentiate nutraceuticals from functional foods
- CSO3. Comprehend the classification of nutraceuticals
- CSO4. Acquire skills on formulation of functional foods
- CSO5. Explore the methods of testing stability of nutraceutical compounds

#### Learning Outcomes

- LO1. Learn about Nutrigenomics and its relation to nutraceuticals.
- LO2. Comprehend the dosage of nutraceuticals for effective control of disease
- LO3. Understand the importance of Fermented foods as functional foods
- LO4. Comprehend the Microbial and algal nutraceuticals
- LO5. Explore the research on meat analogues as nutraceuticals

### THEORY : SEMESTER IX

#### PGFST 9.3. NUTRACEUTICALS AND FUNCTIONAL FOODS

##### Course Content

UNIT I : Introduction- Nutraceutical and functional foods, definition, difference between nutraceuticals and functional foods, market for nutraceuticals, Indian and global scenario, Recent developments and advances in the research area of Nutraceuticals and functional foods, Nutrigenomics and its relation to nutraceuticals.

UNIT II : Nutraceutical compounds- Classification of nutraceuticals, Antioxidants, Phytochemicals, natural pigments, phytoestrogens, phytosterols, peptides and proteins, carbohydrates- dietary fibers, oligosaccharides & resistant starch, prebiotics, probiotics and synbiotic, structured lipids, Conjugated Linoleic Acid, omega-3 fatty acids, fat replacers, vitamins and minerals, Sources of nutraceuticals and role in promoting human health, dosage for effective control of disease

UNIT III : Plant based Functional Foods - Cereal and cereal products, , nuts and oilseeds, functional fruits and vegetables, herbs and spices, beverages (tea, coffee etc), Fermented foods –health benefits and role in conditions like cardiovascular diseases, hypertension, diabetes etc. Future prospects of functional foods and their potential for use in improving health. Formulation and fabrication of functional foods.

UNIT IV : Animal based Functional Foods - Milk and milk products, egg, meat and products, sea foods- , sources, extraction and application of chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides of animal origin, health benefits of animal based functional Foods and role in conditions like cardiovascular diseases, hypertension, diabetes etc. Microbial and algal nutraceuticals

UNIT V : Stability of nutraceuticals, Safety, Consumer acceptance and assessment of health claims, labelling, marketing and regulatory issues related to nutraceuticals and functional foods, Legal aspects of Nutraceuticals & Functional foods Effects of processing and storage, interaction of various environmental factors with nutraceuticals and functional foods

##### Recommended readings

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

### PRACTICAL : SEMESTER IX

#### PGFST 9.4. CEREALS, LEGUME AND OILSEED PROCESSING TECHNOLOGY

1. Physical characteristics of Cereals, Pseudo cereals, millets, pulses and oilseed
2. Determination of sedimentation value, alcoholic acidity, water absorption capacity and NaHCO<sub>3</sub> in wheat flour/ Maida
3. Determination of amylase content of selected cereals and germinated grains
4. Fermenting power of yeast.
5. Rice bran stabilisation
6. Estimation of protein content of Cereals, Pseudo cereals, millets, pulses and oilseeds
7. Assessment of market samples of Cereals, Pseudo cereals, millets, pulses and oilseeds for conforming to some PFA /FSSAI specifications
8. Storage studies of cereal and legume grains having different moisture levels
9. Preparation of expanded & puffed rice from raw and parboiled materials and assessment of quality of products including expansion in volume.

10. Preparation of noodles and its quality evaluation
11. Visit to working rice mill, collection of samples at various steps of milling and analysis for efficiency of cleaning, shelling, paddy separation, and degree of polish
12. Visit to a working modern roller flour mill and FCI godowns

### **PRACTICAL : SEMESTER IX**

#### **PGFST 9.5. FUNDAMENTALS OF MOLECULAR BIOLOGY & BIOINFORMATICS**

1. Isolation of DNA from microbial, plant and animal source
2. Estimation of DNA using diphenylamine reagent and by UV spectrophotometry.
3. Digestion of plasmid DNA with restriction endonucleases.
4. Separation of DNA fragments by Agarose gel electrophoresis
5. Amplification of a specific region on DNA by PCR
6. Genome Map viewer from NCBI.
7. Searching Data from NCBI Database.
8. Retrieving nucleotide sequence from NCBI Database.
9. Working on EMBL.
10. Searching structural data from PDB.

### **THEORY: SEMESTER IX**

#### **PGDSE1.A. SNACK FOOD TECHNOLOGY**

##### **Course Outcomes**

- CO1. Understand the principle involved in the manufacture of commercial snack foods
- CO2. Ability to handle the equipment of importance in the snack food industry
- CO3. Understand the processing techniques used to make snack foods
- CO4. Comprehend the use of additives in preparation of snack foods
- CO5. Comprehend the packaging requirements for snack foods

##### **Course Specific Outcomes**

- CSO1. Inculcate knowledge about technological aspects of traditional snacks
- CSO2. Introduce students to the skills needed in preparation of modern snack foods.
- CSO3. Acquaint students with processing techniques utilized for snack foods
- CSO4. Familiarize students with evaluation methods for the quality of snack foods

- CSO5. Comprehend the snack food market in India

##### **Learning Outcomes**

- LO1. Comprehend snack food consumption patterns in India
- LO2. Acquire the knowledge of preparation of nutraceutical-based snacks
- LO3. Understand the preparation of horticulture-based snacks
- LO4. Comprehend the technology of healthy snacks
- LO5. Acquire skills in determination of quality of snacks

### **THEORY: SEMESTER IX**

#### **PGDSE1.A. SNACK FOOD TECHNOLOGY**

##### **Course Content**

UNIT I : Introduction to Snack food technology, Snack food consumption patterns, factors driving the newer snack food trends, Classification of snacks, methods and equipments used in processing and preparation of snack foods, snack food market in India. Packaging and labelling requirements of snack foods in India

UNIT II : Technology for Whole Grains based Snacks – Whole Grains roasted, toasted, puffed, popped, flaked, technology for Coated Grain Snacks – salted, spiced, sweetened, technology for Batter-Based and Dough-Based Products, technology of savoury and farsans, formulated products – chips, wafers, papads, instant premixes and traditional snack foods

UNIT III : Technology of horticulture-based snacks - Technology for Fruit-Based Snacks, Technology for Vegetable-Based Snacks, chips, wafers, Technology for Coated Nut, salted, spicy and sweetened, Chikkis and snack bars, functional properties, processing and packing

UNIT IV : Extruded snacks -Types, Formulation and Processing Technology, common ingredients used, Coloring and Flavoring, other extruded snacks- Expanded snacks, fried and baked collets, Third generation snacks, coextruded snacks, popularity of extruded snacks among consumers, , packaging, Machinery and Equipment

UNIT V : Development of functional food-based snacks- Characteristics, functional ingredients for development of snacks, nutrient composition, health uses, processing methods, Determination of Shelf-Life and Quality

##### **Recommended References**

1. Edmund WL (1994) Snack Foods Processing. AVI Publ.
2. Gordon BR.( 1997 )The Technology of Extrusion Cooking. Blackie Academic.
3. Booth, R. G. (1997). Snack Food: CBS, New Delhi.
4. Raymond, W. L. & Rooney, L. W. (2001). Snack Foods Processing: CRC. London.

5. Lusas, E. W. & Rooney, L. W. (2015). *Snack Foods Processing*: CRC. London.

6. Riaz, M. N. (2000). *Extruders in Food Applications*: Technomic, Lanchester.

**THEORY: SEMESTER IX**  
**PGDSE1.B. INDUSTRIAL MICROBIOLOGY**

**Course Outcomes**

- CO1. Comprehend the history of Industrial microbiology
- CO2. Learn about Industrial sterilizations
- CO3. Understand the types of fermenters in food industry
- CO4. Gain knowledge on industrially important secondary metabolites
- CO5. Gain knowledge on industrially important bacteriocins

**Course Specific Outcomes**

- CSO1. Comprehend knowledge on Microbial screening.
- CSO2. Gain knowledge on preparation of alcoholic beverages
- CSO3. Get insights into production of microbial enzymes
- CSO4. Gain knowledge on production of citric acid
- CSO5. Understand the preparation of bio colours.

**Learning Outcomes**

- LO1. Learn about downstream processing Cell disruption methods
- LO2. Learn about extraction of enzymes
- LO3. Comprehend the microbial cell products
- LO4. Learn about purification of enzymes
- LO5. Explore the methods of production and assay of nisin from lactic acid bacteria

**THEORY : SEMESTER IX**  
**PGDSE1.B. INDUSTRIAL MICROBIOLOGY**

**Course Content**

UNIT I : History & scope of industrial microbiology, Primary and secondary metabolites produced by the microorganisms, Preservation of microorganisms. Exploitation of microorganisms and their products, screening, strain development strategies, immobilization methods, fermentation media, raw material used in media production, antifoaming agents, buffers, downstream processing

UNIT II : Fermentation equipment and its uses, fermentor design, Components of a fermentor, parts of fermentors, peripheral parts and accessories Types of fermentors and fermentations- single, batch, continuous, multiple,

surface, submerged and solid state. Industrially important secondary metabolites and microorganisms involved

UNIT III : Production of microbial enzymes; Downstream processing Cell disruption methods: Mechanical disruption methods and non-mechanical disruption methods; Extraction; Purification; Concentration; Product recovery. Enzymes from microbes: amylase, protease. Organic acids – production and applications of citric acid, fumaric acid, lactic acid, benzoic acid, gluconic acid, kojic acid, itaconic acid & acetic acid

UNIT IV : Industrial products from microorganisms- antibiotics: production of penicillin, streptomycin. Interferons, vaccines, hormones, vitamins, biopesticides, biopolymers, steroids, biomers, Isolation, identification of cultures producing bio-colours, Production and assay of nisin from lactic acid bacteria, beneficial effects of bacteriocins and Nisin

UNIT V : Ethanol production from lignocellulosic waste (feedstocks to fermentable sugars-sugars, starches and cellulose, Sugars to alcohol-Yeast, substrate range, substrate utilization. Ethanol tolerance, Use of *Zymomonas mobilis* and *Clostridium* for ethanol production-advantages and drawbacks. Production of industrial alcohol, acetone-butanol fermentation, glycerol from yeasts and bacteria, Microbial polysaccharides (xanthan, dextran, alginate, gellan, cellulose, curdlan, pullulan, scleroglucan) and polyesters - bioplastics (polyhydroxyalkanoates)

**Recommended Readings**

1. Adams and Moss (1995) *Food Microbiology*. Cambridge.
2. Casida. *Industrial Microbiology*. Tata McGraw Hill.
3. Frazier and Westhoff. *Food Microbiology*. Tata McGraw Hill.
4. M J Pelczar, E C S Chan and N R Krieg.(2004) *Microbiology*. Tata McGrawHill.
5. Whitaker and Stanbury. *Principles of Fermentation Technology*
6. Patel AH (2001) *Industrial Microbiology* , 2<sup>nd</sup> edition, Lakshmi Pbs

**THEORY: SEMESTER IX**  
**PGDSE1.C. FLAVOUR CHEMISTRY & TECHNOLOGY**

**Course Outcomes**

- CO1. Understand mechanisms of flavor perception
- CO2. Be familiar with analytical methods of flavor analysis
- CO3. Understand non-enzymatic mechanisms of flavor formation
- CO4. Explain metabolic routes leading to flavor formation in plants
- CO5. Recognize off-flavor defects in foods and strategies of identification

### Course Specific Outcomes

- CSO1. Describe procedures used to produce the common food flavoring materials.
- CSO2. Understand mechanisms of flavor release
- CSO3. Be familiar with analytical methods of policing flavor adulteration
- CSO4. Ability to learn the method of extraction of flavour from Vanilla
- CSO5. Comprehend the concept of flavour potentiation

### Learning Outcomes

- LO1. Understand the problems in flavour research.
- LO2. Relate the knowledge of flavour technology to food industry
- LO3. Assess the applications of spice essential oils
- LO4. Acquire skills in instrumental analysis of flavour
- LO5. Identify the adulterants in flavour

## THEORY : SEMESTER IX

### PGDSE1.C. FLAVOUR CHEMISTRY & TECHNOLOGY

#### Course Content

UNIT I : Introduction to flavour technology- Flavour Definition and Perception, Importance of food flavours, Classification of food flavours. chemical compounds responsible for flavour. Recent developments in food flavour industry, problems in flavour research, Perception of flavours- anatomy of the chemical senses, neural development of the chemical senses, receptor mechanisms and neural coding

UNIT II : Flavour development during biogenesis- Mechanism of flavour-food interactions, flavour development during food processing, flavours during roasting of cocoa, non-enzymatic and enzymatic methods of flavour formation- Butter and cheese. Flavours made by fermentation – Biotechnological production of aroma chemicals, Lipid Oxidation methods of flavour formation, Objectionable flavour in foods and methods of detection

UNIT III : Natural flavouring materials – Herbs and spices, classification, standards of purity and sensory assessment. Spice processing- milling, gas sterilization of spices, gamma irradiation, Heat treatment, Distillation or Extraction. Distillation of volatile oils, Spice essential oils. Content in spices and food industry applications. Oleoresins-Extraction, quality and application of oleoresins.

UNIT IV : Plants as source of essential oils - Citrus essential oils, Composition, processed citrus oils, methods of de-terpenization, Citrus leaf and Flower oils. Mints- Peppermint, Corn mint, & Spearmint – Cultivation, Distillation & Rectification, Demethylation., Blended Peppermint, Composition of Mint oils. Vanilla – Classification, Chemistry of Vanilla flavour, Curing Process, Precursors and the Development of Flavour

UNIT V : Flavour potentiators, Chemical properties, sensory properties, flavour potentiation in foods. Flavour Analysis- Subjective versus Objective methods of analysis, psychophysics and sensory evaluation. sample handling and artifacts. Instrumental Analysis of Flavour, adulteration of Flavours and its monitoring

#### Recommended References

1. Fisher, Carolyn and Thomas R. Scott (1997) Food Flavours: Biology and Chemistry. The Royal Society of Chemistry
2. Heath, H.B. and G. Reineccius (1996) Flavour Chemistry and Technology". CBS Publishers,
3. Reineccius, Gary (2006) Flavour Chemistry and Technology". 2nd Edition, Taylor & Francis
4. Shahidi, Fereidoon& Chi-Tang Ho (1999) Flavour Chemistry of Ethnic Foods". Kluwer Pbs
5. Ashurst, Philip R. (1999) Food Flavourings. 3rd Edition, Aspen Publications
6. Hofmann, Thomas (2004) Challenges in Taste Chemistry and Biology. ACS SocietyPbs
7. Charalambous, G (1995) Food Flavors: Generation, Analysis and Process Influence, Elsevier

## Semester X

### THEORY: SEMESTER X

#### PGFST 10.1. ADVANCED PROCESSING TECHNOLOGY OF ANIMAL FOODS

#### Course Outcomes

- CO1. Understand the need and importance of meat, egg, dairy and fishery industry
- CO2. Learn the compositional aspects of meat, egg, milk and fish
- CO3. Learn the technological aspects of meat, egg, milk and fish
- CO4. Empower in the field of value addition
- CO5. Understand the by-products from animal food processing

#### Course Specific Outcomes

- CSO1. Get insights into developments in meat industry
- CSO2. Understand the advanced technologies in poultry processing
- CSO3. Understand the advanced technologies in Egg processing
- CSO4. Understand the advanced technologies in Milk processing
- CSO5. Gain the knowledge in by-product utilization

### Learning Outcomes

- LO1. Understand modern abattoir practices
- LO2. Acquire knowledge in commercial poultry products
- LO3. Technical knowhow of dehydrated egg powders
- LO4. Understand the packaging and labelling requirements in meat industry
- LO5. Explore the small scale start up endeavours in this area

### THEORY : SEMESTER X

#### PGFST 10.1. ADVANCED PROCESSING TECHNOLOGY OF ANIMAL FOODS

##### Course content

UNIT – I : Introduction to meat processing industry- Development of meat industry in India. Its need in national economy, Slaughtering, inception, grading- Anti mortem examination of Meat animals- cattle, buffalo, sheep, goat and pigs. Dressing carcasses. Modern abattoir practices. Advanced meat processing methods, Post-mortem examination of meat, retail and whole sale cuts, grading, factors influencing quality of fresh and cured meat. mechanical deboning, ageing of meat, meat tenderization, meat emulsions, restructured meat products

UNIT – II : Poultry processing- Effect of feed, breed and environment on poultry meat and its quality, preparing poultry for consumption-ready to cook chicken. By-products-meat fat, feeds, hides, skins natural casings and feathers, miscellaneous by-products. Commercial Poultry Meat Products- Emulsion products like chicken meat blocks, nuggets, slices and patties, Processing of Sausages, restructured/Low Fat Chicken Products, enrobed/ Coated Products

UNIT – III : Egg and Egg products: Composition and production of eggs, Traditional methods of processing and preservation of eggs, Advanced technologies to enhance egg shelf life - high hydrostatic pressure, pulsed electric fields, ultrasound, pulsed light, cold plasma and ozonation. Egg products- Dehydrated egg powder- whole, albumin and yolk powders, frozen liquid egg, Nutraceutical egg products, Designer eggs, novel applications of egg by-products- food additives, feeds, food packaging materials and nutraceuticals

UNIT – IV : Fish and shell fish processing technology- traditional processing and preservation methods. Advantages and disadvantages. Advanced processing technologies- high-pressure processing, pulsed light technology, ohmic heating, irradiation, application of bio preservatives-LAB, Modern preservation methods- vacuum packaging, gas packaging, ethanol vapour generation, hurdle barrier concept. Preservation and processing of Shell fishes, Value added fish products, fish food standards

UNIT – V : Dairy Technology– FSSAI Definition of Milk, Types of Market Milk, Biological and Physico-chemical aspects of milk processing, processing of Milk, Concept of Filtration, Clarification, Homogenization, Pasteurization, Dairy product technology-: Butter, ghee, flavoured milk, yoghurt, dahi, shrikhand, ice-cream, condensed milk, milk powder, channa, paneer & cheese

Recommended readings

1. Sharma BD (1999) Meat and meat products technology including poultry products technology, Jaypee Brothers, New Delhi.
2. Sharma BD (2003) Modern abattoir practices and animal by-product technology, Jaypee Brothers
3. Daniela Borda, Anca I. Nicolau & Peter Raspor (2017) Trends in Fish Processing Technologies, CRC Press
4. Cutting CL (2002) Fish processing and preservation. Agribios Publishers.
5. Sukumar De (2001) Outlines of Dairy Technology, Oxford Publishers
6. Taneja RP (2002) Indian Milk and Milk products, TataMcGraw Hill Publishing Ltd.

### THEORY: SEMESTER X

#### PGFST 10.2. FRUIT AND VEGETABLE PROCESSING TECHNOLOGY

##### Course Outcomes

- CO1. Comprehend knowledge of different methods of fruits and vegetable processing
- CO2. Learn the FSSAI standards for fruit and vegetable products
- CO3. Comprehend the non thermal processing methods of fruit processing
- CO4. Get acquaintance on post-harvest handling technologies of fruits and vegetables
- CO5. Explore methods to reduce post-harvest losses and their value addition

##### Course Specific Outcomes

- CSO1. Inculcate knowledge on recent advances in preservation
- CSO2. Acquire knowledge on canning of vegetables
- CSO3. Acquire skills in preparation of fruit products
- CSO4. Learn about dehydration technologies
- CSO5. Comprehend bioactive components in fruits and vegetables

##### Learning Outcomes

- LO1. Learn about prevention of spoilage in canned foods
- LO2. Acquire skills in processed tomato products

- LO3. Acquire skills in preparation of fruit jams
- LO4. Understand the skills in preparation of fruit preserves
- LO5. Explore the opportunities for start-ups in fruits and vegetable processing

### THEORY: SEMESTER X

#### PGFST 10.2. FRUIT AND VEGETABLE PROCESSING TECHNOLOGY

UNIT – I : Technology of Fruits and Vegetables- Introduction and importance of fruit and vegetable preservation, history and need of preservation. FSSAI standards for fruits and vegetable products. Canning and bottling of fruits and vegetables: Selection of fruits and vegetables, process of canning, containers of packing, spoilage in canned foods.

UNIT – II : Fruits beverages: Introduction, process and preservation of Jams, jellies and marmalades: Processing and technology, defects in jelly. Pickles, chutneys and sauces: Processing, types, causes of spoilage in pickling. Tomato products: Selection of tomatoes, processing of tomato juice, tomato puree, paste, ketchup, sauce and soup,

UNIT – III : 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), processing of squashes, cordials, nectars, concentrates and powders.

UNIT –IV : Dehydration of Fruits and Vegetables - Sun drying & mechanical dehydration, process variation for fruits and vegetables, packing and storage. Pectin – chemistry, its related compounds, manufacturing process and various uses in food industry. Vinegar – General properties, types, preparation, industrial method of manufacturing, various uses of Vinegar.

UNIT-V : Advanced technologies in fruit and vegetable processing- Non thermal and energy saving technologies in fruit and vegetable processing, types, advantages and disadvantages. Impact of non thermal technologies on nutrient and phyto chemical composition of fruits and vegetables. Equipment, Safety and quality standards, Role of ozonation in fruit processing and preservation. By products of fruits and vegetable processing and their utilization-pomaceutilization, Bio active components from fruit and vegetable products.

#### Recommended Readings

1. Girdharilal, Siddappa GS &Tandon GL (1998) Preservation of fruits & Vegetables, ICAR
2. Crusess WB (2004) Commercial Unit and Vegetable Products, Agrobios Pbs.
3. Manay, S. & Shadaksharaswami, M (2004) Foods: Facts and Principles, New Age Publishers
4. Ranganna S (1986) Handbook of analysis and quality control for fruits

and vegetable products, 2<sup>nd</sup> Edition, Tata Mc Graw-Hill publishing company Ltd.

5. Srivastava RP & KumarS (2006) Fruits and Vegetables Preservation- Principles and Practices. 3<sup>rd</sup> Ed. International Book Distributing Co.

### THEORY: SEMESTER X

#### PGFST 10.3. DIET DESIGN AND FORMULATION OF SPECIAL FOODS

#### Course Outcomes

- CO1. Comprehend the concept of special foods
- CO2. Learn about RDA for different age groups
- CO3. Understand the concept of diet planning
- CO4. Gain knowledge on therapeutic diets
- CO5. Gain knowledge on specific consumer-oriented foods

#### Course Specific Outcomes

- CSO1. Comprehend knowledge on low cost foods
- CSO2. Gain knowledge on concept of food groups
- CSO3. Get insights into principle and objectives of diet therapy
- CSO4. Gain knowledge on safety of genetically modified foods
- CSO5. Understand the preparation of foods in emergencies

#### Learning Outcomes

- LO1. Learn about diet planning and nutrient calculations
- LO2. Learn about planning menus for different age groups meeting requirements
- LO3. Learn about planning menus for different disease conditions
- LO4. Understand the role of food in space
- LO5. Explore the importance of organic foods

### THEORY: SEMESTER X

#### PGFST 10.3. DIET DESIGN AND FORMULATION OF SPECIAL FOODS

UNIT I : Introduction to diet design & diet therapy, Menu planning- principles, factors to be considered, Balanced diet, Food security, Standardization of recipes and portions. Therapeutic diets- Modification of normal diet to suit special needs. Routine hospital diets, special feeding methods, Enteral and parenteral nutrition, tube feeds, home-made blenderized and commercial formula feeds, pre- and post-operative diets,

UNIT II : Nutritional Requirements and diet management through life cycle- Infancy, Preschool, School going, Adolescence, Adults, old age, Expect-

ant and Lactating Mothers, Importance of Colostrum, Advantages of Breast feeding & Complementary feeding. Special diets for sports persons. Nutrient requirements and menu planning for sports persons

UNIT III : Therapeutic diets – Principles & objectives of diet therapy, special diets for patients suffering from fevers, gastrointestinal disorders, Diabetes mellitus, Obesity, liver disorders, cardiovascular disorders and kidney disorders. Diet planning and use of exchange list in nutrient calculation. Recent trends in food formulation, antioxidant rich food products Functional foods and nutraceuticals for different disorders.

UNIT IV : Specialty foods based on Innovative process technology, Food additives basis, Bioactive components, Novel nutraceuticals products, Packaging techniques, Adaptable technology basis, Fast foods. Specialty food based on genetics- Genetically modified foods, Transgenic foods. Proprietary foods & Supplementary foods. Specialty food based on ease in preparation, cost, health benefits & Convenience. Specialty foods based on growing condition-organicfarming & Organic foods, Micro greens

UNIT V : Special foods and nutrition in emergency conditions- Defence foods, Extreme temperatures - low and high temperatures, nutrition in high altitudes, Space nutrition and food systems, Nutrition in Emergency situations- Famine, drought, flood, earthquake and cyclones.

Recommended Readings

1. Mahan LK & Ecott- Stump S (2000): Krause's Food, Nutrition and Diet therapy, 10<sup>th</sup> ed. WB Saunders Ltd.
2. Anderson L, Dibble M, Mitchell N (1982) Nutrition in health and disease (17<sup>th</sup> ed). Philadelphia: JB. Lippincott co.
3. Bamji M, Prahlad Rao N, Reddy V (2000). Text book of Human Nutrition. Oxford and lbH publishing Co. Pvt.Ltd..
4. Srilakshmi B (2005) Dietetics, 5<sup>th</sup> ed. New age International (P) Ltd. Pbs.
5. Gopalan C and Narasinga Rao B(1988) Dietary Allowances for Indians. NIN

### **PRACTICAL : SEMESTER X**

#### **PGFST 10.4. ADVANCED PROCESSING TECHNOLOGY OF ANIMAL FOODS**

1. Study the structure of the muscle under compound microscope.
2. Study the effect of low and high oxygen atmosphere on meat colour
3. Perform the slaughtering of the poultry birds, Identification of different internal organs of poultry birds and their utilization for product preparation.
4. Estimation of moisture, protein & fat content of meat, eggs and fish
5. Evaluation of eggs for quality parameters (market eggs, branded eggs)

6. Quality evaluation of fish/shell fish and meat
7. Cut out examination of canned meats, canned fish (Sardine, Mackerel, Tuna)/Meat.
8. Processing of animal foods – freezing, canning, curing, smoking, drying and pickling
9. Meat, Egg & Fish product formulations
10. Platform tests for milk
11. Adulteration tests for milk and milk products
12. Preparation of milk products

### **PRACTICAL : SEMESTER X**

#### **PGFST 10.5. FRUIT AND VEGETABLE PROCESSING TECHNOLOGY**

1. Anatomy and structure of fruits and vegetables
2. Quantitative analysis of cut fruits and vegetable yields
3. Preparation of fruit and synthetic beverages
4. Effect of pre-treatment and process variables on quality of preserve/candied fruits
5. Comparison of juice/pulp extraction methods on quality and yield of tomato pulp, ketchup/Tomato soup
6. Canning and cut out analysis of fruit and vegetable 15. 16. Visit to fruit, vegetable and cereal processing Industry
7. Estimation of total soluble solids (TSS).
8. Estimation of pH , acidity and brix: acidity ratio of products.
9. Estimation of ascorbic acid and effect of heat treatment on it.
10. Preparation and evaluation of pectin products
11. Dehydration and rehydration of commonly available vegetables and fruits
12. Antioxidant assays- FRAP, DPPH, ABTS for fruits and vegetables

### **PRACTICAL : SEMESTER X**

#### **PGFST 10.6. RESEARCH PROJECT**

Dissertation based on Project work may be undertaken in the relevant field preferably on current issues. The dissertation should be typed in Times New Roman in 12 font size with 1.5 line spacing from the beginning including titles to the chapters and sections. Bold font may be used where ever necessary. The students are expected to follow scientific grammar for writing in vivo etc. which should be in italics.

Guidelines for writing the Dissertation:

The Dissertation should have the following pages in order:

\* Title page highlighting the title, name of the candidate, Reg.no. Guide

name, College name and month and year of submission and the inner titlepage containing the same details on white background.

- \* Certificate from the Head of the institute & Guide
- \* Certificate from the ethical committees for approval of study, if any
- \* Declaration by the student
- \* Acknowledgements
- \* Index highlighting chapter titles and sections titles
- \* Index for tables, figures and plates, if any
- \* Abbreviations and symbols
- \* Materials used in the investigation with their procurement details like name of the company, batch number etc.
- \* Equipment used in the study with the model number and other details.
- \* Aim and objectives of the investigation.
- \* Introduction and literature survey
- \* Materials & Methods
- \* Result
- \* Discussion
- \* Summary and conclusion
- \* References

