

# M.SC. IN (FOOD SCIENCE & TECHNOLOGY)

## SEMESTER- I

Course Code	Course Title	L-T-P	Credits
FST-701	Principles of Food Processing	(2-0-2)	3
FST- 702	Food Chemistry	(2-0-2)	3
FST-703	Instrumentation & Analytical Techniques	(2-0-2)	3
MAS-711	Statistics- I	(2-0-2)	3
COMP-705	Computer Orientation	(2-0-2)	3
MAS-312	Elementary Mathematics*	(3-1-0)	4

## SEMESTER- II

Course Code	Course Title	L-T-P	Credits
DT-820	Processing of milk & milk products	(2-0-2)	3
FST-801	Principle of food Engineering	(2-0-2)	3
FST-704	Food Microbiology	(2-0-2)	3
FST-802	Processing of cereals, pulses & oil seeds	(2-0-2)	3
MAS-715	Statistics- II	(2-0-2)	3

## SEMESTER- III

Course Code	Course Title	L-T-P	Credits
FST- 803	Post Harvest Tech. of Horticulture Crops	(2-0-2)	3
FST-804/ FST-805	Technology of meat & allied products / Technology of Bakery & Confectionary products**	(2-0-2)	3
FST-806	Quality control, food standards & food laws	(2-0-2)	3
FST-705	Packaging of food materials	(2-0-2)	3
APFE-810	Food plant design	(2-0-2)	3

## SEMESTER- IV

Course Code	Course Title	L-T-P	Credits
FST-880	Seminar	0-0-2	1
FST-899	Dissertation	0-0-30	15

\* Deficiency course for the students coming from B. Sc. Agriculture/ Horticulture/ Home Science streams

\*\*Optional Course

# SYLLABUS OF MASTERS OF SCIENCE IN FOOD SCIENCE & TECHNOLOGY

## SEMESTER- I

**FST- 701**

**PRINCIPLES OF FOOD PROCESSING**

**2-0-2= 3**

### **Unit – I**

**Introduction:** Definition and scope of food Science and Technology, historical development of food processing and preservation, general principles of food preservation.

Preservation by heating: Principles of the method, thermal resistance of the microorganisms and enzyme.

Microwave heating: Principles and application in food processing.

### **Unit – II**

**Baking:** Milling, General principles of baking. Various types of baked products. Radiations: Sources of radiations. Mode of action, effect on microorganisms and different nutrients; dose requirements for radiation preservation of foods.

### **Unit – III**

**Refrigeration and freezing preservation:** Refrigeration and storage of fresh foods, major requirements of a refrigeration plant, controlled atmospheric storage, refrigerated storage of various foods, freezing point of selected food, influence of freezing and freezing rate of the quality of food products, methods of freezing, storage and thawing of frozen foods.

### **Unit – IV**

**Chemical Preservation:** Preservation of foods by use of sugar, salt, chemicals and antibiotics and by smoking.

**Concentration:** Application in food industry processes and equipment for manufacture of various concentrated foods and their keeping quality.

**Fermentation:** Applications in preservation of food; pickling; curing etc.

### **Unit – V**

**Drying and dehydrations:** Sun drying of various foods, water activity and its effect on the keeping quality, sorption, isotherms and their use. Characteristics of food substances related to their dehydration behavior, drying phenomenon, factors affecting rate of drying, methods of drying of various food products, type of driers and their suitability for different foods; intermediate moisture foods

**FST- 702**

**FOOD CHEMISTRY**

**2-0-2= 3**

### **Unit – I**

**Carbohydrates:** Classification, structure and properties of carbohydrates. Role of carbohydrates in food industry. Sugar, starch, cellulose, glucans, hemicelluloses, gums, peptic substances, polysaccharides. Modified starch.

**Lipids:** Classification and physico-chemical properties of food lipids. Refining of crude oils, hydrogenation and winterization. Vegetable and animal fat, margarine, lard, butters. Frying and shortening. Flavor changes in fats and oils, lipid oxidation, factors affecting lipid oxidation.

### **Unit – II**

**Proteins:** Classification, structure, properties, purification and denaturation of proteins. Protein interaction and degradation, protein-protein interaction, protein-lipid complexes and protein-carbohydrate complex. Major protein systems and factors affecting them, the nature of interaction in proteins derived from milk. Egg proteins, meat proteins, fish muscle proteins, oil seed proteins and cereal proteins. Metabolic antagonist and allergens associated with food proteins. Modified protein.

### **Unit – III**

**Vitamins:** Role of vitamins in food industry, effect of various processing treatments and fortification of foods.

**Minerals:** Role of minerals in food industry, effect of various processing treatments.

### **Unit – IV**

**Biological Changes in Food:** Plant Pigments and their role in Food Industry: Bitter substance and tannins.

**Enzymes:** Nature, classification and properties of food enzyme, enzyme activity in different food systems, commercial availability. Food enzyme technology, immobilization of enzymes, removal of toxicants through enzymes, flavor production by enzymes.

### **Unit – V**

**Browning reaction in foods:** Enzymatic and Non-Enzymatic browning in foods of vegetable and animal origin during storage and processing of foods. Single cell Protein.

### **Practical**

Preparation of Reagents (Standard Solutions).

Determination of moisture,  
Determination of protein,  
Determination of fat,  
Determination of total ash,  
Determination of crude fiber and  
Determination of carbohydrate.  
Determination of minerals.  
Estimation of reducing, non-reducing, total sugars  
Estimation of starch.  
Determination of ascorbic acid.  
Determination of pH and acidity of foods.

#### **Unit – I**

**Scientific Approach to Research:** Meaning, significance, and types of research studies. Research process: Formulating the problem, objectives, hypothesis, research design, sample design, collecting data, analysis of data, interpretation, preparation of report. **Sampling design:** Census vs. sample survey. Steps, types.

#### **Unit – II**

Methods of data collection: Observation, interview, questionnaire, case study, focus group discussion. Processing of data Measurements: Nature of measurements, types of measurement scale, Frequency distribution, graphical presentation of data.

### **FST- 703**

### **INSTRUMENTATION AND ANALYTICAL TECHNIQUES**

**2-0-2= 3**

#### **Unit – I**

Preparation of Chemical solutions: Concept of molar, molal, and normal solutions, pH and Buffers; importance and measurement of pH.

Chromatographic Techniques: General principles. Partitions and adsorption chromatography. Paper, thin layer, gas liquid, ion exchange and affinity chromatography. Gel filtration. Introduction to high pressure liquid chromatography.

#### **Unit- II**

**Electrophoretic Techniques:** General principles. Paper and Gel Electrophoresis. Polyacrylamide Gel Electrophoresis.

**Colorimetry:** Beers and Lambert's law. General principles of Colorimeters and Spectrophotometers

**Photometry:** Spectrofluorometers.

#### **Unit – III**

**Flame photometry: atomic absorption spectrophotometry**

**Carbohydrates:** Qualitative and quantitative measures for reducing and non-reducing sugars, starch and fiber.

**Fats:** Physicochemical-extraction and separation procedures, quantitative measures for various lipids.

#### **Unit – IV**

**Proteins:** Physico-chemical properties, extraction and separation procedures, and quantitative measures for total proteins, amino acids and enzymes.

**Vitamins:** Colorimetric, Fluorimetric, Microbiological, Chromatographic and other methods for estimation of various vitamins.

**Minerals:** processing samples of analysis, colorimetric, spectroscopic and other methods for estimation of various minerals.

#### **Unit – V**

Total Quality Management in Food Industry (TQM), ISO certifications, Hazard Analysis and Critical Control Point (HACCP), Intellectual property Right and Patent

### **MAS 711**

### **Statistics I**

**(2-0-2) 3 Cr.**

Standard Deviation, Coefficient of variation, standard error of mean.

Theory of Probability: equally likely, mutually exclusive events, definition of probability, addition & multiplication theorems of probability & problems on theorems of probability & problems based on them.

Normal & Binomial Distributions.

Simple correlation and regression, Multiple- regression, Multiple & partial –correlation.

Testing of Hypothesis: Concepts of Hypothesis, Degrees of freedom, Level of significance, Type I & Type II errors.  $X^2$ , t, F- tests (definition, applications & problems based on these tests)

**Computer Applications:** Use of computers for preparing and presenting documents, spreadsheets. Appropriate statistical and other relevant packages, Internet. Use of MS Office. Library documentation and scientific literature searching, Use of internet in Food Industry, Fortarn, C++

**Practical**

Use of word processing software for creating reports statistical analysis.

Introduction to computer using PC tutor

Operating system practice using DOS commands

Problem solving using spread sheets.

## Semester - II

DT- 820

Processing of Milk & Milk Products

2-0-2= 3

### Unit – I

**Importance of milk industry in India: Status of Dairy Industry, MMPO, Milk cooperative system, NDDDB,** Collection, chilling, transportation, cream separation, standardization, pasteurization, bacto-fugation, sterilization, UHT, homogenization, packaging, storage and distribution of fluid milk.

**Butter:** Manufacture, packaging, storage and marketing of butter; butter defects and their control, margarine.

### Unit – II

**Technology of fermented milk products:** Principles and practices of manufacture, packaging, storage and marketing of Dahi, yoghurt, Shrikhand etc.

**Sanitary aspects:** sanitation of dairy plant building, equipment and their maintenance. Effluent treatment plant.

### Unit – III

**Technology of frozen milk products:** Classification, manufacture, packaging, storage and marketing of ice cream, ices, sherbets etc. defects of frozen products and their control.

**Technology of indigenous milk:** products: Principles and practices of manufacture, packaging, storage and marketing of ghee, khoa, Paneer channa and milk based foods.

### Unit – IV

**Technology of evaporated and dried milk:** Manufacture of evaporated milks and milk powders. Packaging storage defects and their control

**Technology of Dairy by- products:** Utilization of skim milk, buttermilk and way for the manufacture of casein, lactose etc.

### Unit – V

**Cheese:** Manufacture of hard, semi hard, soft and processed cheeses, Storage, grading and marketing of cheese, Cheese defects and their control.

### Practical

Platform test of milk

Test of adulteration,, Fat, SNF, ash, Fat protein, AC, FFATBA value, Lactose contain, Solubility Standardization numerical based on Pearson's squire.

Preparation of toned milk

Fortified, reconstituted and flavored milks

Preparations of Yogurt

Preparation of Lassi and Srikhand

Manufacture of ice cream, ices, sherbets and Softy.

Preparation of cheese, Cheddar cheese, Mozzarella cheese, Cottage cheese, Processed Cheese.

Manufacture of casein,

Ghee,

Khoa,

Preparation of paneer, chhanna and chhanna product

FST- 801

Principles of Food Engineering

2-0-2= 3

### Unit – I

Introduction: General concepts, essential and optional processing, scenario and scope.

Size reduction process: Principles, theories and laws, energy considerations, equipments.

Mixing and forming: Theory and applications, mixing indices, equipments for solid and liquid, fluid flow, Laminar , turbulent and transitional ranges, velocity distribution profiles, basic equations, thermal velocity calculations.

### Unit – II

**Thermal processing:** Types of microorganisms, bacterial load, sterilization and commercial sterility. Death kinetics, thermal death curve, decimal reduction time. Z-factor, heat penetration curve, process time calculations, mathematical curve. Mathematical and graphical solutions, exhausting and sealing, retorting, ultra-high temperature processes.

**Pasteurization:** Theory and application, pasteurization of packaged and unpacked foods, pasteurization calculations, and equipments.

**Irradiation:** Radiation units and doses for foods, safe limits, irradiation mechanism and survival curve, irradiation of packaging materials.

### Unit – III

**Evaporation:** Properties of liquid, heat and mass balance, single and multiple effect evaporation, steam economy, heat recovery, efficiency, process calculations, equipments and systems.

### Unit – IV

**Food dehydration:** Mechanism of drying, moisture and drying rate curves, constant and falling rate periods, spray, drum, cabinet, tunnel, fluidized bed dryers, batch and continuous operational, osmotic dehydration and Freeze Drying

**Chilling, refrigeration and freezing:** Shelf life extension requirements for various products, theories, characteristics curve, cooling rate calculations. Chilling and freezing equipments, cryogenics.

#### **Unit – V**

**Separation processes:** Filtration and centrifugation, theories and mathematical descriptions, constant rate and constant pressure filtration, equipment.

**Extrusion Cooking:** Theory and applications, extrusion cookers and cold extrusion, single and twin-screw extruders, design considerations.

#### **Practical**

Determination of water activity.

Canning of fruits and vegetables (Beverages).

Dehydration of fruits and vegetables

Use of flame photometry in the estimation of trace metals

Use of Refract meter for determination of TSS

Numerical Problem based on Mass balanced

Size determination

### **FST- 704**

### **Food Microbiology**

**2-0-2= 3**

#### **Unit – I**

**General characteristics of microorganisms:** Classification and identification of yeasts, molds and groups of bacteria important in food industry.

**Source of contamination:** Air, water, soil, sewage, post processing contamination.

#### **Unit – II**

Intrinsic and extrinsic factors influencing growth of microorganisms in foods.

Classification of foods and general principles involved in their preservation:

#### **Unit – III**

**Effects on Microbes:** Low temperature preservation, lethal effects of chilling, freezing and thawing; high temperature preservation. Heat resistance of microorganisms, heat penetration and thermal processing.

Pasteurization, sterilization, canning and dehydration; chemical preservation and its toxic effects, irradiations.

**Food Fermentation:** Bacterial, yeast and mold cultures; single and mixed cultures, propagation, maintenance and evaluation of cultures; factors effecting activity of cultures, bacteriophages, residual antibiotics and chemicals.

#### **Unit – IV**

**Microbiology of Fermentation:** Fermented milks. Cereal foods, vinegar, oriental foods, alcoholic beverages.

Therapeutic value of fermented foods.

Technology of Alcoholic beverages

Food Spoilage: Spoilage of fresh and processed fruit and vegetables, spoilage of meat, fish, eggs and poultry products. Microbial toxins.

#### **Unit – V**

**Pathogens in foods:** Microbial infections and intoxications, Growth and survival of pathogens in food.

**Food borne diseases:** Investigations and control.

Role of Biotechnology in Food Microbiology.

Role of Oligosaccharide in Food Microbiology

Probiotics and Prebiotics.

Practical

Determination of microbial counts:

Total viable,

Psychrotrophic,

Thermophilic,

Thermoduric,

Proteolytic lipolytic

Aerobic & Anaerobic spore farmers,

Coliform counts,

Yeast and mold count.

Detection of pathogen/ toxins and antibiotic

Dye reduction Test & MBRT.

Determination of thermal resistance of enzymes and microorganisms.

**Unit – I**

**Processing of Wheat:** Composition of grain and environmental effects on its processing quality, enzymes of wheat and their role in the manufacture of wheat products; principles of wheat milling and its effect on composition of flour, aging of flour, by products, chemical improvers bleaching and maturing agents, property of dough and its theology, manufacture of wheat products bread, biscuits etc; processed cereal foods for infants.

**Unit – II**

**Processing of Rice:** Composition, type of proteins, starch content, amylase and amylopectin fractions; presence and effect of lipases; distribution of vitamins; minerals, and; proteins in rice grain and its relation to milling. Rice milling operations, & its effective value, cooking quality rice milling and their utilization, processed and prepared mixes based on rice.

**Unit – III**

**Processing of Corn:** Composition, processing of corn for and corn grits, meal and flour, manufacture of corn flakes, corn syrup, corn starch, corn steep liquor, corn oil and canned corn.

**Processing of Sorghum:** Chemical composition, refining and nutritive value.

**Unit – III** Processing of Sugar crops and tuber: (Sugarcane, Sugar beet crops). Sugar production and manufacturing, Types and Grades of sugars, Products of Sugars (Alcohol, Beer and Wine, Sugar syrups). Carbonated beverage Industry.

**Unit – V**

Processing of Legumes: Composition, anti-nutritional factors, processing methods, methods of cooking.

**Processing of Oilseeds:** Composition, processing of oilseeds as protein concentrations, properties and uses of oil seed meals, technology vegetable protein isolates; Barrier compounds in the utilization of oil seed proteins. Low cost protein foods from oilseeds.

**Practical**

Physic-chemical and rheological examination of wheat and its products

Test weight, kernal hardness,

Gluten content,

Milling tests,

Amylographic farinographic and extensiographic tests.

Evaluation of rice amylose and amylopectin

**MAS-715****STATISTICS II****(2-0-2) 3 Cr.**

Analysis of variance techniques, Definitions and assumptions, One way classification, two way classification with more than one observation per cell.

Designs of experiment, principles of experimental design, randomized block design (R.B.D)

Latin square design (L.S.D.), missing plot technique in R.B.D. and L.S.D., critical difference (C.D.), split plot design

Factorial experiment 2 x 2 x 3 and 3 x 2, factorial design (Yates method of analysis) 2 x 3 & 2x 4 factorials,

Duncan's multiple range test, Newman's kuel test

Sampling techniques, simple random sampling, stratified random sampling and systematic sampling

## SEMESTER - III

FST- 803

Post Harvest Technology of Horticultural Crops

2-0-2= 3

### Unit – I

**Introduction:** Role and Status of Post Harvest Technology, Fruits and vegetables as living products: Chemical composition; pre and post harvest changes, maturity standards for storage, desirable characteristics of fruits and vegetable of processing. Post harvest handling of fresh fruits and vegetables: Role of plants growth regulators in relation to storage; physical and chemical treatment to increase the shelf-life, conditions for transportation and storage; disease and injuries during marketing.

### Unit – II

Fruit and vegetable juices: Preparation of juice, syrups, squashes, cordials, and nectars; concentrations and drying of juice, packaging and storage and Concentrations and powders; fortified and soft drinks. Preservation by freezing: General methods for freezing of fruits and vegetables; problem relating to storage of frozen products.

### Unit – III

**Dehydration of fruits and vegetables:** Methods; packaging, storage, Quality control

Storage of fresh fruits and vegetables: Containers: tin, glass and other packaging materials used in fruits and vegetables preservations. Canning and bottling; Quality of raw materials, preparation of materials, syrups and brines, effect of canning and bottling on nutritive value, spoilage of canned foods, detection and control.

### Unit - IV

**Pickles and chutneys:** Preparation of various types of pickles-theory and practice; preparation of sauces and chutneys; problems relating to the shelf life of pickles and chutneys; quality control.

**Tomato products:** Preparation of various tomato products, food standards and quality control.

**Pectin:** Raw materials; processes and uses of pectin; products based on pectin manufacture and quality control.

### Unit – V

**Food additives:** Use in fruit and vegetable preservation.

**Vinegar:** General methods of preparation, food standards and quality control. Utilization of waste from fruit and vegetables processing plant, Tea, Coffee and Cocoa Production and Manufacturing

Technology of non alcoholic beverages

### Practical

Preparation of tomato products (Sauces, Soup, ketch up, )

Preparation of marmalade, Pickles, Jam, Jelly and fruit candy

Pectin determination

Determination of chemical preservatives in fruits and vegetables products.

FST- 804

Technology of Meat & Allied Products

2-0-2= 3

**Unit – I** Fresh and processed meat technology:

**Livestock:** Slaughter and census of meat animals. Components of carcass viz. muscles, postmortem glycolysis. Conversion of muscle of meat, pre and post slaughter factors affecting quality of meat, color, texture, WHC, organoleptic characteristics, PSE and DFD conditions.

Preservation of meat and meat products, Meat analogue and their processing. Effect of processing parameters on product constituents, viz. lipid, protein, carbohydrates and flavor, sensory evaluation guidelines, different tests, hedonic testing etc

### Unit – II

Status of poultry industry in India and abroad. Pre slaughter care, antemortem examination slaughter, dressing and postmortem. Composition and chemistry of chicken muscle, pre and post slaughter factors affecting poultry meat quality.

### Unit – III

**Preservation of poultry meat:** Chilling and freezing of poultry meat; packaging and grading of poultry meat. Preparation of poultry products: cured, smoked, canned barbecue and curried; poultry

### Unit – IV

**Eggs:** Structure, composition and nutritive value of egg, egg proteins and functional properties of egg white and yolk. Factor affecting egg quality and their measurements. Industrial uses of eggs. Collection, grading, cleaning, washing, packaging and transportation of eggs, preparation of egg products. Preservation of shell egg. Microbial spoilage of egg and egg; products.

Preparation of meat, fish and poultry products.

### Practical

Water standards and analysis, physical, chemical and microbiological characteristics of water analysis. Quality determination of Raw materials and finished product quality

Quality parameter and evaluation procedure. Appearance, color texture, viscosity, consistency flavor defects, bacterial contamination and foreign matter

Food adulteration: Definition, common adulteration in different foods, contamination, and methods of detection.

Sensory evaluation: Selection of panel of judges, sensory characteristics of foods, types of tests.

Naturally occurring food toxins: Gossypol, hemagglutinins, trypsin inhibitors, lathyrins etc.

ISO 9000 managements, HACCP, FPO, PFA, CAC, Food labeling, Integrated food Laws,

#### Unit – V

**Food Standards and Laws:** International and national food laws, Prevention of food adulteration Act. Food additives; coloring mater, preservatives, poisonous metals, antioxidants and emulsifying and stabilizing agents, insecticides. PFA specification for food products.

#### Unit – I

**Introduction:** Functions (containment, protection, convenience, communication), Principles in development of protective packaging, terminology, and operations.

Different forms of food packages: Primary Packaging: Pouches, bags, sacks, wraps, shrinkage, cans, bottles, cartons, tubes, glass containers. Secondary Packaging-Boxes Solid and Fiberboard),

#### Unit – II

**Materials used for Packaging:** Different types of paper, paperboard, plastics, cellulose films, metalised films, co extrusion, lamination, and thermo formed semi rigid containers, tin plates, steel, aluminium containers, glass containers and PET. Process of Packaging and Equipment: Material handling, filling, air removal, sealing, retorting, modified atmosphere packaging, vacuum and gas packaging. Package sterilization techniques and cushioning.

#### Unit – III

**Process of Secondary Packaging:** Shipping container, wooden containers, corrugated fiber boxes, inserts and cushioning materials, pallets, containerization (refrigerated and non-refrigerated containers), containers used in Road, rail, Sea and Air transport.

#### Unit – IV

**Quality control:** Evaluation of Packaging materials, toxicity, corrosion prevention, shelf life testing, minimization of transport losses, Hazards in handling and storage and packaging and their minimization.

Packaging laws and Regulations: Standards of Weights and Measures Act.

Advance food packaging

#### Unit – V

Industrial Economics: Inventory of raw materials, storage, Types of cost involves and cost analysis of food products. Latest advancement in food packaging

**Unit – I** Plant design concepts: General design considerations, feasibility analysis, plant location and location theory models, economic plant size

Requirements in respect of building and building materials

**Product and process design:** Flowcharts and their design, equipment selection, plant layout development and evaluation, planning and design of service facilities.

#### Unit – II

**Human resource planning:** Planning and design of marketing system, worker's safety and plant hygiene.

**Analysis of plant costs and profitability:** Network analysis of planning, scheduling and management activities.

#### Unit – III

Introduction to Marketing and economics: Demand, Supply, Sample survey techniques, marketing information, consumer trends and behaviour.

Introduction to Operations Research: Definition, applications, Inventory control, Linear Programming.

## **SEMESTER - IV**

<b>FST-880</b>	<b>Seminar</b>	<b>(0-0-2)1 Cr.</b>
<b>FST-899</b>	<b>Dissertation</b>	<b>(0-0-30) 15 Cr.</b>