

## M. Tech in Food Technology (**Food Process Engineering**)

### Basic Supporting Courses:

	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
1.	COMP 805	Computer Programming	2	0	1	3
2.	MAS 713	Advanced Engg. Statistics	3	0	0	3
3.	APFE 705	Optimization Techniques in Food Technology	3	0	0	3
4.	CHEM 717	Advanced Food Chemistry	2	0	1	3

### Core Courses:

	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
1.	APFE 706	International Food Legislations & Standards	2	0	0	2
2.	APFE 707	Food Quality Control	2	0	1	3
3.	APFE 708	Meat & Marine Technology	2	0	1	3
4.	APFE 802	Modern Fruits & Vegetables Processing Techniques	2	0	1	3
5.	APFE 803	Advanced Food Packaging	2	0	0	2
6.	APFE 811	Advanced Beverage Technology	3	0	0	3
7.	APFE 823	Modern Baking & Confectionary Technology	2	0	1	3
8.	DT 820	Processing of Milk & Milk Products	2	0	1	3
9.	MBMT811	Food Microbiology	2	0	2	4

### Specialized Courses:

#### Food Processing Engineering:

	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
	APFE 801	Advanced Food Process Equipment Design	3	0	0	3
	APFE 810	Food Plant Design	3	0	0	3
	APFE 812	Entrepreneurship Development in Food Processing	3	0	0	3
	APFE 815	Thermal & Non-Thermal Processing	3	0	0	3
	APFE 816	Food Biosensors	3	0	0	3
	APFE 817	Food Process Modeling	3	0	0	3
	APFE 818	Food Fermentation Technology	3	0	0	3
	APFE 821	Functional Foods	3	0	0	3
	APFE 824	Food Safety Analysis	2	0	0	2

## **Basic Supporting Courses:**

### **COMP 805 Computer Programming**

**3(2-0-1)**

Algorithms & Flow Charts, C. Programming, Preliminaries, Constant & Variables, Arithmetic Expressions Input-Output Statements, Control Statements, Do-Statements, Subscripted Variables, Elementary Format Specifications, Logical Statement & Decision Tables, Functions & Subroutines, Arrays & structure, Computer Oriented Numerical Methods, Solution of Non Linear Equation. Bisection Method, Newton Method, Numerical Integration, Trapezoidal Method, Simpson's 1/3 & 3/8 rule, Curve Fitting, Construction of forward, backward, backward difference table, Interpolation, Application of Statistical packages.

### **MAS 713 Advanced Engineering Statistics**

**3(3-0-0)**

Sample size, data collection, design of experiments, LSD, RBD, split plot design, factorial design, CRD, CCRD, testing of hypothesis, Analysis of variance, t-test, z-test, f-test,  $\chi^2$ -test.

### **APFE 705 Optimization Techniques in Food Technology**

**3 (3-0-0)**

Principles of modelling; Linear programming-concepts, graphical and algebraic solution; Simplex method; Duality theory; Post-optimality analysis; Sensitivity analysis; Transportation and assignment models; Computer applications to LP, queuing theory; Project scheduling and management by PERT-CPM; Integer programming; Non-linear programming; Simulation; Goal programming; Decision theory; Markov chains; Sequencing problem.

### **CHEM 717 Advanced Food Chemistry**

**3(2-0-1)**

Water:- Water binding and chemical mediated water. Food protein: Classification, physico-chemical properties. Reactions involved in processing. Reactions with alkali. Enzyme catalyzed reactions involving hydrolysis and proteolysis. . theories of formation of texturised proteins.

Lipids :- Reactions involved during deep frying of foods viz., autoxidation of saturated acyl lipids and polymerization. Lipoprotein and membrane; definition, classification and involvement in the formation of biological membrane. Unsaponifiable matter contents in various fats and oils. Edible oil classification and chemical composition.

Carbohydrates:- Legumes, jam and jellies polysaccharide. Viz., linear, branched and modified. Properties and utilization of common polysaccharides, viz. Cellulose, glycogen, hemicellulose and pectin. Enzymatic degradation of polysaccharides, viz. agar, alginate, carrageenan, gums and starch. Production of dextrans and malto dextran.

Food Enzymes:- Hydrolases and lipases, utilization in food industry, effect of inhibitors, pH and temperature.

Minerals in food :- Main elements, trace elements in eggs, cereal and cereal products, vegetables and fruits.

Aroma compounds in foods:- Threshold value, off flavours.

Food additives:- Vitamins, amino acids, minerals, Aroma substance, flavour enhancers-sodium glutamate, 5-nucleotides. Sugar substitutes, sorbitol. Sweeteners-saccharin, cyclamate. Food colour. Anti-nutritional factors and food contaminant: Toxic-trace elements, radio nuclides.

Cereals and cereal products:- Individual constituents, like proteins, lipids, carbohydrates and vitamins in cereals, flour and their relationship in dough making. Types of flours, bread making and non-bread making, chemical composition, influence of additives/minor ingredients on baking properties.

Legumes:- Classification, composition and physico-chemical properties.

Vegetables and fruit: Classification general composition, chemical changes during ripening and storage. Jams, jellies and pickles: Classification, composition and preservation.  
Beverages: Classification, coffee, tea and cocoa-gradation, composition, chemical changes during processing, volatile compounds. Preservation of foods: General principles of food preservation, chemical preservation, preservation through irradiation.

## **Core Courses**

### **APFE 706 International food Legislation & Standards** **2 (2-0-0)**

Concepts and trends in food legislation. International and federal standards: Codex alimentarius, ISO series, food safety in USA. Legislation in Europe: Directives of the official journal of the EU, council regulations, food legislation in UK. Regulating methods for food analysis, case studies. Enforcers of Food Laws Approval Process for Food Additives Nutritional Labeling.

### **APFE 707 Food Quality Control** **3(2-0-1)**

Quality factors: appearance, texture and flavor, Appearance factors – size and shape, colour and gloss, consistency. Textural Factors – measuring texture, texture changes. Flavour Factors – influence of colour and texture on flavor. Taste Panels. Food – related hazards – biological hazards, chemical hazards, physical hazards, trace chemicals. Microbiological considerations in food safety. Food additives – preservatives, antioxidants, sequestrants, surface active agents, stabilizers and thickeners, bleaching and maturing agents, starch modifiers, buffers, acids, alkalis, food colours, artificial sweeteners, nutritional additives, flavouring agents. Food laws: Federal Food Drug and Cosmetic Act (1938), Good Manufacturing Practices (Code of GMP), Fair Packaging and Labeling Act (1966), Federal Meat Inspection Act (1906), International Food, Standards and Codex Alimentarius, HACCP and ISO 9000 series.

### **APFE 708 Meat & Marine Technology** **3(2-0-1)**

Sources of meat and meat products in India, its importance in national economy. Chemical composition and microscopic structure of meat. Effect of feed, breed and management on meat production and quality. Slaughtering of animals and poultry, inspection and grading of meat. Factors affecting post-mortem changes, properties and shelf-life of meat. Meat quality evaluation. Mechanical deboning, meat tenderization. Aging, pickling and smoking of meat. Meat plant sanitation and safety, Byproduct utilization. Recent trends in meat processing. Structure, composition, nutritive value and functional properties of eggs and its preservation by different methods. Factor affecting egg quality and measures of egg quality. Types of fish, composition, structure, post-mortem changes in fish. Handling of fresh water fish. Canning, smoking, freezing and dehydration of fish. Fish sausage and home making. MMPO, MFPO, radiation processing meat safety.

**Practical:** Slaughtering and dressing of meat animals, Study of post-mortem changes, Meat cutting and handling, Evaluation of meat quality. Experiments in dehydration, freezing, canning, curing, smoking and pickling of fish and meat, Shelf-life studies on processed meat products, Evaluation of quality and grading of eggs, Preservation of shell eggs, Estimation of meat: bone ratios, Preparation of meat products, canned, dehydrated, barbecued sausages, loaves, burger, fish finger.

### **APFE 802 Modern Fruits and Vegetables Processing Techniques** **3(2-0-1)**

Principles and methods of fruit and vegetable preservation. Composition and related quality factors for processing. Principles of storage of fruits and vegetables. Types of storage: natural, ventilated low temperature storage, DA and MA storages. Preservation of fruits and vegetables by

heat, chemicals, sugar, salt, fermentation, drying etc. Canning of fruits and vegetables, tin cans, glass containers seaming technology, aseptic canning technology. Fruit and vegetable juices, preparation of syrups, cordials and nectars, juice concentrates, pectin and related compounds, jams, jellies, marmalades, preserves. Theory of gel formation, quality control, pickles, chutneys and vinegar production, tomato products. Drying and dehydration of fruits and vegetables, problems related to storage of dehydrated products. Freezing and freeze-drying of food and frozen products, Fruit product order and quality control.

**Practicals:** Equipment for fruits and vegetable processing, plant-layout, can seaming operation, preparation of fruit juices, squashes, syrups and ready-to-serve beverages. Canning of fruits and vegetables. Preparation of jams, jellies, marmalade, preserves, and candies. Preparation of pickles, chutneys, and tomato products, Drying of fruits and vegetables, quality control of processed products. Visit to fruit and vegetables processing factories, freezing of foods, Processing of mushroom.

### **APFE 803 Advanced Food Packaging**

**2(2-0-0)**

Introduction to principals of Food Packaging, Types of packaging , Special packaging methods (vacuum, gas and shrink packaging), Function of a package, packaging materials, their structural qualities and performance including moisture and gas transmission, interaction of food and the packaging material, methods of package testing, performance evaluation and design of packaging systems for plant and animals products. Food packaging and law, shelf life testing, modern and traditional packaging material, physical and chemical properties, production, storage and recycling of packaging materials, regulation and equipment analysis of various existing packaging system and standards.

### **APFE 811 Advanced Beverage Technology**

**3(3-0-0)**

Introduction: classification, production and consumption of beverages. Alcoholic beverages: concept of fermentation for production of beer, wine and distilled beverages including their packaging and maturation. Non-alcoholic beverages: carbonated and non-carbonated. Raw materials, equipment, quality control and legislation of beverage products. Mini-projects on traditional production of beverages.

### **APFE 823 Modern Baking & Confectionary Technology**

**3(2-0-1)**

Introduction: Status of bakery and confectionery industries in India- Raw materials for bakery and confectionery products-Essential and optional. PFA Specification of raw materials. Bakery products technology: Dough rheology – Bread making- methods-process- specification for various types of breads- Biscuit manufacturing process- Cookies- Crackers- Cakes- Buns- preservation of bakery products. Bakery machinery and equipment: Weighing Equipment- Manual scale, Automatic weigh, liquid measuring. Mixing- blenders, Horizontal and vertical planetary, continuous. Make up equipment- Divider, Rounder, Proofer, moulder. Baking equipment – different oven, slicer.

Confectionery products: chocolate, fondant, caramels, fudge and toffee. Equipment and process. Safety and sanitation: Health and safety- safety rules- safe practices in the work places- sanitation-duties of the sanitation equipments- Code for hygiene condition in bakery and biscuit manufacturing unit.

**DT 820 Processing of Milk and Milk Products****3(2-0-1)**

Sources, and composition of milk, processing of market milk, standardization, toning of milk, homogenization, pasteurization, sterilization, storage, transportation and distribution of milk. Milk product processing-cream, butter, , condensed milk, evaporated milk, whole and skimmed milk powder. Instantization of milk and milk products, ice cream, khoa, channa, paneer, milk sweets. Judging and grading of milk and its products. Fermented milk products. cheese, cheese spread, Youghurt, dahi shrikhand and similar products. Dairy equipments and sanitization.

**MBMT 811 Food Microbiology****4(2-0-2)**

History of microbiology of food. Microbial growth pattern, physical and chemical factors influencing destruction of micro-organisms. Types of micro-organism normally associated with food-mold, yeast, and bacteria. Micro-organisms in natural food products and their control. Contaminants of foods-stuffs, vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing. Biochemical changes caused by micro-organisms, deterioration of various types of food product. Food poisoning and microbial toxins, microbial food fermentation, standards for different foods. Food borne intoxicants and mycotoxins.

**Practicals :** Microscopy and micrometry. Preparation of nutrient media, sterilization and inoculation techniques, Isolation of pure culture, microbial examination of natural food products, identification of food pathogen in water, milk, cereals, pulses, oilseeds, meat and poultry. Microbial production of alcohol (cereal based), acetic acid and lactic acid.

**Specialized Courses****APFE 801 Advanced Food Process Equipment Design****3(3-0-0)**

Design considerations of agricultural and food Processing Equipments. Design of Food Processing equipments, Dryers, design of dryers PHTC, RPEC, LSU and Drum Dryer. Determination of heat and air requirement for drying grains. Types of heat exchanger. Design of heat Exchangers and Evaporators. Design of material handling equipments like belt conveyor, screw conveyor, bucket elevator and pneumatic conveyors.

**APFE 810 Food Plant Design****3(3-0-0)**

Food Plant Location, Food Plant Layout, Process Selection, Forecasting methods, Facilities & Aggregate Planning, Scheduling Food Plant Operations, Financial Analysis, Process Flow Analysis, PERT/CPM Models, Decision Analysis, Computer Simulation, Feasibility Studies of Food Plant; Design of a Food Processing Plant.

**APFE 812 Entrepreneurship Development in Food Processing****3(3-0-0)**

Entrepreneurship Concept, Selection of Potential Entrepreneurs, Business opportunity Identification and Guidance Business Plant: Market, Assessment, Technical Analysis, and Financial Analysis, Choice of Technology, Project Scheduling, Forecasting, Facilities and Aggregate Planning. Guide lines to commercial food commodity selection; equipment survey; capital and production costing; enterprise financing; legal aspect of enterprise

operation; marketing logistics; sources of technical services; commissioning and licensing; basic business law. Project proposal. Technical law standards.

**APFE 815 Thermal & Non - Thermal Processing**

**3(3-0-0)**

Thermal destruction of microbial cells and bacteria spores; kinetics of microbial death; heat penetration into foods; method of determining lethality of thermal processes; thermal destruction of enzymes; mechanisms of heat transfer in food; blanching, pasteurization, and sterilization; thermal processing of foods in containers and outside containers; principle of aseptic technology; thermal destruction of nutrients and quality factors; optimization of the thermal processes for nutrient retention; thermal processing equipment and technology.

Use of non-thermal technologies (micro filtration (UF & MP) bactofugation, ultra high voltage electric fields, irradiation, thermosonication), alternate-thermal technologies (ohmic heating, dielectric heating, infrared and induction heating) & biological technologies (antibacterial enzymes, proteins & peptides) in food processing.

**APFE 816 Food Biosensors**

**3(3-0-0)**

Introduction to biosensors, Enzyme biosensor, optical affinity biosensors, stabilization of the biological component of the biosensor, enzyme electrode sensor for carbohydrate analysis, application of the sensors in the food industries, electronic noses for food control. Biosensors for food analysis.

**APFE 817 Food Process Modelling**

**3(3-0-0)**

The principles of Modelling, kinetic Modelling, the Modelling of heat and mass transfer; introduction diffusion equation, the Navier-stokes equations, heat and mass transfer in porous media Luikov's equation. Modelling thermal processes: cooling and freezing, introduction Modelling product heat load during cooling & freezing. Modelling foods with complex shapes, numerical solution of the heat conduction equation with phase change. Modelling thermal processes : heating, introduction, processing of packed and solid foods, continuous heating and cooling processes, Modelling food quality and microbiological safety.

**APFE 818 Food Fermentation Technology**

**3(3-0-0)**

Introduction to fermentation: Rate of microbial growth and death. Fermentation kinetics, Types of fermentation sub-merged/solid state, Batch /continuous fermentation. Fermenter design, operation, measurement and control in fermentation, Aeration and agitation in fermentation: Oxygen requirement, measurement of adsorption coefficients, sterilization of air and media; scale up in fermentation.

Production of beer, wine and vinegar, Traditional fermented foods like idli and dosa. Principles of down stream processing and Product recovery. Production of alcohols, organic acids, enzymes and immobilization of enzymes. Biological waste treatment.

**APFE 821 Functional Foods**

**3(3-0-0)**

Functional foods, vitamin- and mineral-enriched products, products containing added fibre, pre-, pro-, and synbiotics, and omega-3 fatty acids/oils, fortified beverages with calcium or omega-3 oils, muffins with beta-glucan, yogurts with probiotics and drinks with herb blends as well as

omega-3 eggs, meat and canola oil high in carotenoids or wheat with enhanced lutein level or rice with other carotenoids, natural health products; beta-glucan isolated from oats, antioxidants from blueberries, sterols and stanols from wood pulp and oils from marine and algal sources. Sensory Aspects And Delivery Of Functional Food Ingredients

**APFE 824 Food Safety Analysis**

**3(3-0-0)**

Principles of food safety – Historical developments - causes of major failure – clothing and personal hygiene – source of contamination –test for food safety. Quality control tools. Quality control chart –Quality factors in food – Nutritional labeling – Specification – Rules and Regulations - need for food plant sanitation — cleaning and cleaners – Water supply- Good Manufacturing Practice. Metal contaminants- Sources of health hazard of metallic contaminants – Assessment of food safety – General and acute toxicity – Mutagenicity and carcinogenicity. Additives (Intention – direct) – Preservatives – antioxidants, sweeteners, flavors, colours, vitamins, stabilizers – indirect additives – organic residues – inorganic residues and contaminants. Food allergy, food intolerance, contaminants of processed foods, solvent residue, contaminants of smoked foods. Cleaner production is food industry-fruit and vegetable processing, sea food processing, brewing and wine processing.