

• **M.Tech Ag. Engg.(Ag. Process & Food Engg.)**

Basic Supporting Courses:

	Course Code	Course Title	L	T	P	Credit
1.	COMP 805	Computer Programming	2	0	2	3
2.	ECON 705	Research Methodology	2	0	2	3
3.	APFE 703	Instrumentation & Controls in Food Industry	3	0	0	3
4.	APFE 704	Optimization Techniques in Food Processing	3	0	0	3

Core Courses:

	Course Code	Course Title	L	T	P	Credit
1.	APFE 702	Quality Control	2	0	2	3
2.	APFE 802	Modern Fruits & Vegetables Processing Techniques	2	0	2	3
3.	APFE 803	Advanced Food Packaging	2	0	0	2
4.	APFE 804	Advanced Baking Technology	1	0	2	2
5.	APFE 806	Advanced Food Technology	3	0	0	3
6.	MBMT811	Food Microbiology	2	0	4	4
7.	CHEM 717	Advanced Food Chemistry	2	0	2	3

Specialized Courses:

	Course Code	Course Title	L	T	P	Credit
1.	APFE 801	Advanced Food Process Equipment Design	3	0	0	3
2.	APEF 805	Storage Engineering	3	0	0	3
3.	APFE 807	Advanced Extrusion Technology	3	0	0	3
4.	APFE 808	Processing of Livestock & Aquaculture Products	3	0	0	3
5.	APFE 809	Operations Management	3	0	0	3
6.	APFE 810	Food Plant Design	3	0	0	3
7.	APFE 811	Advanced Beverage Technology	3	0	0	3
8.	APFE 812	Entrepreneurship Development in Food Processing	3	0	0	3
9.	APFE 815	Thermal & Non-Thermal Processing	3	0	0	3
10.	APFE 818	Food Fermentation Technology	3	0	0	3

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.

ECON 705 Research Methodology

3 (2-0-1)

Social science – definition , goals and functions. Role of social research in agriculture. Agricultural economics – induction and deduction, sources of information, review of literature, identification of problem, and formulation of objectives and hypothesis. Types of hypothesis. Testing of hypothesis. Research Design. Type of data and their sources, methods of data collection- formal (sampling) and informal (PRA, RRA) survey techniques, preparation of questionnaire, interview method, mail order method, cost accounting method. Analysis of data – methods of analysis. Report writing – methods of reporting. Use of tables, graphs, diagram, etc. in reports using computers.

Practical : the student will identify a problem in agricultural economics and work on the problem during the semester as trained in theory classes by intensively using personal computers

APFE 703 Instrumentation & Controls in Food Industry

3 (3-0-0)

Instrumentation for food quality assurance. Instrumental measurements & sensory parameters. Inline measurement for the control of food processing operations: colour measurements of food; food composition analysis using infrared; microwave measurements of product variables; pressure & temperature measurement in food process control; level & flow measurement in food process control; ultrasonic instrumentation in food industry. Instrumental techniques in the quality control lab: rheological measurements of foods; water activity & its measurement in food ; conductance / impedance techniques for microbial assay; modern method of texture measurement. Chemo sensors, biosensors, immunosensors, electronic noses and tongues.

APFE 704 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.

Core Courses

APFE 702 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 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 animal 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 systems and standards.

APFE 804 Advanced Baking Technology

2(1-0-1)

Materials of baking : wheat types of wheat, composition of wheat, quality of wheat test of gluten quality, utilization of other grains, leaveners, yeast, shortenings, emulsifiers, antioxidants, sweeteners, malt syrup, water and salt, ingredients from milk and egg, other ingredients.

Unleavened bakery materials and leavened bakery products, cookies and crackers, cakes,

chemically leavened bread and rolls.

Yeast leavened bread and rolls – straight and sponge dough method. Reactions during mixing, fermentation, proofing, baking, trouble shooting. Equipment: weighting, Metering, mixing, dividing and backing equipment.

APFE 806 Advanced Food Technology

3(3-0-0)

Aseptic canning and ohmic heating, extrusion cooking, effect of process variable of the physio-chemical and nutritional characteristics of extruded foods. Refrigerated storage of fresh and processed food. Advances methods of food freezing, indicators for quality of frozen foods.

Fortification synthetic nutrients, functional foods, use of radiation and microwave in food processing. High pressure processing, supercritical gas extraction, Flavour Encapsulation.

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.

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 physio-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.

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 805 Storage Engineering 3(3-0-0)

Factors affecting shelf life of agriculture produce as well as products; storage of agricultural produce. Quality attributes of stored produce (physical and physico-chemical); testing of quality attributes – subjective as well as objective methods, Control Atmosphere (CA), Storage technology; Modified Atmosphere (MA) storage technology; Hypobaric storage; Packaging – nitrogen packaging, carbon-di-oxide packaging, plastics for food packaging, Design of storage bins – design of fans and air ducts; Design of cold storage for agricultural produce. Economics of storage of agricultural commodities.

APFE 807 Advanced Extrusion Technology 3(3-0-0)

Equipment: Single Screw Extruders- constructional and operational characteristics; Twin Screw Extruders- constructional and operational characteristics of co-rotating twin screw extruder; and Ancillary Equipment, Operating characteristics of extruders; Model and strategies for computer control of a twin screw extruder. Characteristics of various extruded food products: Rheological properties, textural properties. Sensory characteristics and nutritional value; Application: Cold extrusion; extrusion cooking ,New extrusion technology for confectionery product; Breakfast cereal products.

APFE 808 Processing of Livestock & Aquaculture Products 3(3-0-0)

Meat sources; slaughtering; skinning, grading, cutting; muscle structure, composition and quality criteria; post mortem changes; meat products processing; meat hygiene; meat analysis and deboning; after care of hides. Poultry meat processing; egg and egg products technology. Fish

technology; harvesting, storage, processing, preservation. Basic principles of meat, poultry and fish products quality control, marketing and distribution.

APFE 809 Operations Management

3(3-0-0)

Food Plant Operation Function, Operations Strategy, Products Design, Managing Quality, Quality Control and Improvement, Process Selection, Service Operations Design, Choice of Technology, Process Flow Analysis, Forecasting, Facilities Decisions, Aggregate Planning, Independent Demand Inventory, Performance Measurement, Supply Chain Management, Scheduling.

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 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 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) bacto-fugation, 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 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.