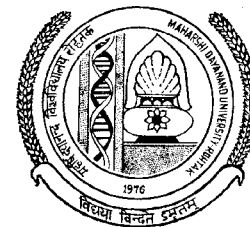


# Maharshi Dayanand University Rohtak



## Ordinance Syllabus and Courses of Reading of M.Sc. (Food Processing Technology) Examination

2009

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**Scheme of Examination for M.Sc. Food Processing Technology  
(Two year course) 2009-2010**

**1<sup>st</sup> Semester**

Sr. No.	Course No.	Subject	Periods			Evaluation Scheme Sessional			Total
			L	Tu	P	Th	IA	Total	
1.	FPT-121	Food Microbiology	3	0	4	80	20	100	
2.	FPT-122	Food Chemistry	3	0	4	80	20	100	
3.	FPT-123	Nutrition and health	3	0	4	80	20	100	
4.	FPT-124	Technology of Cereals, Pulses & Oil Seeds	3	0	4	80	20	100	
5.	FPT-125	Food Analysis and instrumentation	3	0	4	80	20	100	
6.	FPT-126	Seminar and communication Skill	2	0	0	25		25	
7.	FPT-127	Lab Course - I						100	
8.	FPT-128	Lab Course-II						100	

**2<sup>nd</sup> Semester**

Sr. No.	Course No.	Subject	Periods			Evaluation Scheme Sessional			Total
			L	Tu	P	Th	IA	Total	
1.	FPT-221	Computer application and Statistics	3	0	4	80	20	100	
2.	FPT-222	Basic Principles of food processing and preservation	3	0	4	80	20	100	
3.	FPT-223	Technology of Fermented Food & Beverage	3	0	4	80	20	100	
4.	FPT-224	Principles Food Engineering	3	0	4	80	20	100	
5.	FPT-225	Food Quality Assurance	3	0	4	80	20	100	
6.	FPT-226	Seminar and communication Skill	2	0	0	25		25	
7.	FPT-227	Lab Course - I						100	
8.	FPT-228	Lab Course-II						100	

**M.Sc. Food Processing Technology -2010-2011**

**3<sup>rd</sup> Semester**

Sr. No.	Course No.	Subject	Periods			Evaluation Scheme Sessional			Total
			L	Tu	P	Th	IA	Total	
1.	FPT-321	Unit operations in food engineering	3	0	4	80	20	100	
2.	FPT-322	Packaging Technology	3	0	4	80	20	100	
3.	FPT-323	Technology of Meat, Fish & Poultry Products	3	0	4	80	20	100	
4.	FPT-324	Nutraceuticals & Probiotics	3	0	4	80	20	100	
5.	FPT-325	Advanced techniques in food processing and preservation	3	0	4	80	20	100	
6.	FPT-326	Seminar	2	0	0	25		25	
7.	FPT-327	Lab Course - I						100	
8.	FPT-328	Lab Course-II						100	

**4<sup>th</sup> Semester**

Sr. No.	Course No.	Subject	Periods			Evaluation Scheme Sessional			Total
			L	Tu	P	Th	IA	Total	
1.	FPT-421	Technology of Fruits & Vegetables	3	0	4	80	20	100	
2.	FPT-422	Food Biotechnology	3	0	4	80	20	100	
3.	FPT-423	Technology of Milk and Milk Products	3	0	4	80	20	100	
4.	FPT-424	Industrial organization and business management	3	0	4	80	20	100	
5.	FPT-425	Term Paper Writing & R & D Visit, Dissertation (Presentation & Viva-Voce)	3	0	4	80	20	100	
6.	FPT-426	Seminar	2	0	0	25		25	
7.	FPT-427	Lab Course - I						100	
8.	FPT-428	Lab Course-II						100	

**Semester - I****Course No. FPT 121****M.M. : 80****Course Title : Food Microbiology****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

**Unit 1**

History and development of food microbiology; Cellular organization - eukaryotic and prokaryotic organisms; A brief account of classification of microorganisms; source of microorganisms in food

**Unit 2**

Growth pattern in microbes; Biochemical activities and survival of microorganisms of foods; Extrinsic and intrinsic factors affecting growth and destruction of microbes.

**Unit 3**

Biochemical changes caused by microorganisms in foods- fermentation, putrefaction, lipolysis; the microbiology of food preservation- heat processing, irradiation, low temperature storage, chemical preservatives, high-pressure processing, control of water activity.

**Unit 4**

Foods microbiology and public health : Food poisoning, types of food poisonings, Indicator organisms; Detection and quantification of microbes and their products including toxins; A brief account of various organisms related with food poisoning, food poisoning by clostridium, salmonella, E.coli, bacillus etc.

**Unit 5**

Food spoilage and microbes of milk, meats, fish and various plant products, spoilage of canned foods. Rapid methods of microbial analysis; Immunoassays, nucleic acid probes & PCR in food analysis.

**Practical**

Microscopic examination of foods for bacteria and yeast and molds; standard plate count; yeast and mould count; spore count; MPN of coliform; Enumeration of physiological groups- Psychrophile, thermodyrics, osmophiles and halophiles, Detection of aflatoxin.

**Semester - I****Course No. FPT 122****M.M. : 80****Course Title : Food Chemistry****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

**Unit 1**

Food chemistry- definition, scope and importance;

Water in food, water activity and shelf life of food;

chemistry and stability of water and fat soluble vitamins; chemical properties of minerals and their bioavailability, enrichment and fortification; Natural pigments in food and their retention in processed foods; flavoring constituents in foods; development of process and reaction flavour volatiles.

**Unit 2**

Carbohydrates-classification, physical and chemical properties of sugars, functional properties and uses of pectic substances, gums and dietary fiber in food; selection of natural or modified carbohydrates for incorporation into processed food.

Browning reaction in food : Enzymatics and non-enzymatic browning, their occurrence and applications in food.

Starches : Functionality of starch in foods, gelatinization and retrogradation of starches, modified starches, resistant starches.

**Unit 3**

Lipids classification, properties- lipolysis, auto-oxidation, thermal decomposition and effect of ionizing radiations, modification of fats and oils, role of food lipids in flavour, nutritional aspects of natural and modified fats; fat mimetics.

**Unit 4**

Proteins : Structures of protein and amino acids; physical and chemical and functional properties of proteins, functional properties of food proteins, modification of food protein in processing and storage and its implications, texturized, denaturation of protein, gel formation.

Enzymes- sources, isolation & purification, specificity, reactivity and stability; Enzyme reactors; Enzymes in food processing and food industries.

**Unit 5**

Allergens, toxic constituents and anti nutritional factors of foods (enzyme inhibitors, trypsin and chymotrypsin inhibitor, amylase inhibitor, flatulence causing sugars, phytolectins).

**Practical**

Analysis of water for portable and food purposes. Moisture content in foods in relation to their stability. Non-enzymatic browning reactions and its determination. Determination of rate/extent of hydrolysis of sucrose/starch. Date of rate/extent of hydrolysis of sucrose/starch. Determination of free fatty acid content in fats and oils. Detection and estimation of oxidative rancidity in fats/oils. Determination of heat stability of vitamin c. Study of some reactions proteins. Study of some processing changes in proteins. Study of some functional properties of proteins. Detection/estimation of some additives in foods. Detection/estimation of adulterants in some foods.

**Course No. FPT 123****M.M. : 80****Course Title : Nutrition and health****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

**Unit 1**

Foods and nutrients : Basic definitions, Levels of nutritional status, changing concepts of nutrition;

Nutrition and metabolism of macronutrients and micronutrients, vitamins, trace-elements, carbohydrates, and fibres.

**Unit 2**

Basal metabolic rate (B.M.R.), Factors affecting B.M.R., Measuring B.M.R., Energy requirements and its estimation;

Obesity and its causes, Body composition, B.M.I., Weight for height measures, Health implications of obesity, Problems of weight management.

Glycemic index of foods : Control its importance

Satiety index of foods : Control and importance

Recommended dietary allowances (R.D.A.), ICMR standards, Food guide, Exchange lists, Health promotion guidelines.

**Unit 3**

Hormones-chemistry, mechanisms of action and physiological effects on nutrition and digestion.

**Unit 4**

Fats: Function of Essential Fatty Acids (EFA), Role of n-3, n-6 fatty acids in health and disease. Trans fatty acids and prostaglandins, essential fatty acids, cholesterol, LDL and HDL and their health importance.

Proteins : Nature and essentiality of amino acids and proteins, Functions of protein, the concept of protein balance, Comparative quality of food proteins, Biological value, Net protein utilization, Protein efficiency ratio, Therapeutic applications of specific amino acids.

### Unit 5

Functional foods : Concept and categories of functional foods and their importance  
Food security : Problem and prospects.

**Course No. FPT 124**

**M.M. : 80**

**Course Title : Technology of Cereals, Pulses & Oil Seeds**

**Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

### Unit 1

Production and utilization trends of various cereals like wheat, rice, barley, oats, sorghum, pearl millet and maize; Structure and nutrient composition of cereal grains like wheat, rice, maize and oat etc.

Technology of wheat and wheat products : Wheat types, criteria for wheat grain quality, Wheat milling- general principles and operations; cleaning, conditioning and roller milling systems, Flour extraction rates and various flour grades, Flour treatment and criteria of flour quality., Dough rheology and various instruments used for dough rheology measurement; Functionally of wheat proteins, carbohydrates, lipids and enzymes in bread making.

### Unit 2

Functionality of wheat proteins, carbohydrates, lipids and enzymes in bread making. Bread making processes, importance of critical unit operations, development in bread making methods, functions of ingredients/ additives such as fat, emulsifiers, oxidants, reducing agents and conditioners. Bread faults and staling. Technology of biscuit, cake, cookie and cracker manufacturing. Baking powders as leavening agents in bakery industry. Technology of pasta products and noodles.

### Unit 3

Rice grains types, milling of rice - types of rice mill; huller mill, Sheller-cum-cone polisher mill. Modern rice milling unit operation-dehusking,

paddy separation, polishing and grading. Factors affecting rice yield during milling. By-products of rice milling. Rice parboiling technology. CFTRI process of parboiling. Properties of parboiled rice, Changes during parboiling. Advantages and disadvantages of parboiling, aging of rice, rice enrichment and fortification, golden rice, Rice milling byproducts : rice bran, rice bran oil-extraction, properties and uses. Rice based convenience foods.

#### **Unit 4**

Composition and anti-nutritional factors in legumes, technologies for Dhal milling; fermented and traditional products; legume based snack foods; Processing and utilization of soyabean in various soya fortified foods; Soya protein concentrates and isolates; Value added instant products;

Wet and dry milling of corn, products of wet and dry milling of corn, Corn sweeteners and their uses.

Malting of barley : steeping, germination and drying. Different types of malts and their food applications.

Chemical technological and milling aspects of sorghum, oats and millets.

#### **Unit 5**

Oil sources; Classes of oil and fats; Typical composition and physico-chemical properties of oils & fats; Oilseed processing; Conditioning and oil extraction; Expeller press & solvent extraction of oils and fats; Oil refining and processing- degumming; refining, bleaching, hydrogenation, fractionation, inter-esterification, molecular distillation, deodorization, plasticization & tempering; Shortening- types, manufacture and use; Margarine- manufacture & use; Mayonnaise and salad dressing; confectionery coating; Imitation dairy products- peanut butter, vegetable ghee; packaging and storage of fats & oils; Cocoa butter; Fat substitutes and replacers.

#### **Practical**

Physico-chemical tests for quality evaluation of cereals; Assessment of flour quality; Parboiling of paddy, drying and storage; Puffing and roasting of grains; Milling of wheat and rice; Fractionation of products; Pearling and polishing of grain; Rheological properties of dough; Baking biscuits, cakes and breads; Evaluation of baked products; Extrusion products; Standardization of cereal based products. Milling of pulses; Preparation of protein concentrates and isolates : Assay of antinutritional factors in pulses. Determination of fat content by Soxhlet methods; Determination of physical and chemical parameters of fats and oils refractive index, density, titre value, flash point, smoke point, acid value, saponification value, iodine value; Winterization and fractionation of oil, Interesterification, Determination of solid fat index, Oxidative stability and peroxide value; Determination of fatty acid composition by GLC; Detection of adulteration in fats and oils, PFA standards.

**Course No. FPT 125****M.M. : 80****Course Title : Food analysis and instrumentation Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

### **Unit 1**

Introduction to food analysis, type of samples and sampling techniques, storage and preservation of samples, expression of results.

Proximate analysis of foods : Principles of moisture, fat, protein, carbohydrates, crude fibres and vitamins in foods.

### **Unit 2**

Instrumentation in food analysis : Principles, types and applications of colorimetry and spectroscopy, photometry, electrophoresis and chromatography; atomic absorption spectrophotometry.

### **Unit 3**

Instrumentation in food analysis : Color measurement in foods. X-ray analysis of foods and its applications, Mass spectroscopy, Nuclear magnetic resonance (NMR), differential scanning calorimetry (DSC) and scanning electron microscopy (SEM) in food analysis and identification.

### **Unit 4**

Polarimetry; Potentiometry; polarography; conductometry; Refractometry; Ultrasonics and other instruments for determination of physical and rheological properties of foods.

### **Unit 5**

Texture analysis in foods, sensory versus instrumental analysis of texture, rapid methods of microbial analysis, immunoassays; Techniques for estimation and analysis of toxins and pesticides in food.

### **Practical**

Use of Atomic absorption/emission Spectrophotometry; Fluorimetry; Radiometry; Flame photometry; Polarimetry; Potentiometry; Conductometry; Refractometry; Ultrasonics and other instruments for determination of physical and rheological properties of foods : Separation of food components by chromatography.

**Course No. FPT 221****M.M. : 80****Course Title : Biostatistics and computers****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

### Unit 1

An overview of computers, Microcomputers, VDUs and printer. Algorithm, Languages and packages : Introduction to MS Office, MS Access, Front Page Introduction to C, Java and SQL (structured query language)

Handling arrays, Procedures, Colour, sound and graphics. Use of standards packages.

### Unit 2

Derivative and its physical significance, Basic rules of differentiation (without derivation) Maxima and Minima, Partial differentiation.

Basic rules for integration (without derivation), definite and indefinite integrals, geometric meaning of integration, Differential Equations Separable variable, homogeneous, exact and linear equations, equations of second order, applications of differential equations in chemistry.

### Unit 3

Tabular and graphical Representation Types of Data, Types of graphics, relative frequency, cumulative frequency, grouped and ungrouped data.

Measure of central tendency, Measure of dispersion, Measure of skewness of coefficient Measures of Skewness and Kurtosis.

Probability and its applications, Laws of Addition and Multiplication, Compound probability, Baye's Theorem.

### Unit 4

Concept of Random Variables and Probability Distribution. Binomial, Poisson and Normal distribution and their applications.

Statistical population, sample from population, random sample.

Hypothesis Testing Types of errors, standard errors, Confidence Intervals Test of significance for proportion, means and standard deviations, F- and t-test and chi-square tests. Nonparametric tests.

### Unit 5

Methods of average and least squares, curve fitting.

Correlations product-moment coefficient, Spearman's rank coefficient. Linear regression, associated test of significance.

Analysis of variance for one and two-way classification Design of experiments, randomization, randomized block design.

### Practical

Descriptive statistics : Systematic tabular summarization of data (before analysis), measures of central tendency, measures of dispersion, measures of skewness (using calculators).

Correlations (product-moment coefficient, Spearman's rank coefficient) and regression (linear regression, curve fitting).

Data presentation (tables/figures) : 1-D and 2-D bar charts, pie diagrams, graphs (using computer software packages).

Statistical distributions : fitting discrete uniform, binomial, Poisson and normal probability distributions to given data

Testing of hypotheses : Tests of significance (mean, standard deviation, correlation coefficient), chi-squared test for goodness of fit, test for independence of attributes, non-parametric tests (run test) using calculators and printed tables and using Minitab sampling (drawing random samples using random numbers, tables, charts, computer programmes for random number generation), design of experiments, ANOVA (one-way and two-way)



**Course No. FPT 222**

**M.M. : 80**

**Course Title : Basic Principles of food processing and preservation**

**Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

### **Unit 1**

Introduction and historical developments in food processing and preservation.

Food spoilage : Microbial, physical, chemical & miscellaneous.

Heat preservation and processing : Heat resistance of microorganisms, thermal death curve, types of heat treatments and effects on foods, canning of foods, cans and container types, spoilage of canned foods, heat penetration, different heating processing methods; blanching, roasting, frying pasteurization etc.

### **Unit 2**

Dehydration : Drying, dehydration and concentration, Drying curves, Drying methods and type of dryers, food concentration, methods of concentration of fruit juices, liquid food concentrates, changes in food during dehydration and concentration.

### **Unit 3**

Refrigeration storage : Requirements of refrigeration storage, changes of foods during refrigeration storage, refrigeration load.

Freezing and frozen storage : Freezing curves, slow and quick freezing, factors determining freezing rate, freezing methods, changes in food during freezing, frozen food storage, freeze during in food processing.

### **Unit 4**

Water activity : Role of water activity in food preservation, Intermediate moisture foods (IMF), Principles, characteristics, advantages and problem of IM foods.

Food frying : general principles, frying process; shallow frying and deep frying, frying oils, potato chips and potato crisp production, factors affecting oil uptake during frying.

### **Unit 5**

Emulsification in food processing : principles, examples of emulsification in food; milk, ice-cream mix, coffee/tea whiteners, salad dressings, meat sausages, margarine and spreads.

House hold preservation methods : Pickling, salt curing, oil and smoking.

Chemical preservation : types, uses and effects of class I and class II preservatives in foods.

### **Practical**

Dehydration, freezing and concentration of different foods; Estimation of water activity, Determination of process time of heat processing; Can reforming, seaming and canning of fruits and vegetables; Microwave cooking of foods; Extrusion cooking; Use of food enzymes; Frozen storage of foods; Pasteurization and sterilization of foods.

**Course No. FPT 223****M.M. : 80****Course Title : Technology of Fermented Food & Beverages****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

### **Unit 1**

Introduction to fermentation : Rate of microbial growth and death. Fermentation kinetics, Fermentor design, operation measurement and control and types of fermenters, Batch/continuous fermentation, scale up in fermentation, Principle and use of biosensors.

Food fermentations; Lactic acid fermentation of milk, vegetable, cereals and meat : Alcoholic fermentation of fruit juices, sugar and starch substrates; Leavening and baking process; Vinegar fermentation.

### **Unit 2**

Mixed fermentation in cereals, legumes and milk; *fermented soya* and other legume based foods; Role of fermentation in processing of tea, coffee and cocoa; Microbial polysaccharides production in foods; Indigenous fermented foods *like* Dahi, Raabri, Idli, Dosa, Jalebi, etc.

### **Unit 3**

Production of vitamins, amino acids, organic acids, enzymes and antibiotics, alcohols.

Brewing technology of alcoholic beverages- wine, cider, brandy, mead, perry, toddy, sake; Fermentation, distillation and blending.

### **Unit 4**

Beverages : Definition, types, importance of beverages in our diets, soft drinks and hard drinks, treatment of water for food industry.

Technology of soft drinks, mineral water, carbonated and non-carbonated beverages.

Whey beverages and utilization of whey in development of fortified drinks, use of low calorie sweeteners in beverages.

### **Unit 5**

Production, processing and chemistry of tea manufacturing, types of tea, tea products such as soluble tea, tea concentrate, instant tea, decaffeinated and flavoured tea; Production, processing, roasting and brewing of coffee, soluble coffee manufacture, standards and specifications of coffee products, decaffeinated coffee, monsoon coffee coffee brew concentrate and chicory;

Cocoa processing, cocoa beverages and chocolate.

### **Practical**

Lactic acid fermentation of milk and vegetables (dahi, pickles and sauerkraut); Alcoholic fermentation of fruit juices; Acetic acid fermentation; Baker's yeast activity; Alkaline fermentation (natto). Barley steeping, germination, malting, mashing and brewing of malt; preparation of wine and mead; distillation of wines; Preparation of whey beverages, chemical and Microbiological analysis of water for mineral content, turbidity, reaction, hardness, plate count and coliform counts; Millipore filtration; Treatment of water for food industry.

**Course No. FPT 224****M.M. : 80****Course Title : Principles of food engineering****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

### **Unit 1**

Engineering units, thermodynamic systems (closed, open and isolated), equilibrium state intensive and extensive properties, equilibrium state, density, concentration, temperature pressure, enthalpy, entropy; Material balances : Basic principles, process flow diagrams, total mass balance, component mass balance, material balance problems involved in dilution, concentration and dehydration.

Energy balances : Basic principles, energy terms, specific heat of solids and liquids, properties of saturated and superheated steam, heat balances.

### **Unit 2**

Fluid flow in biomass processing, liquid transport system, properties, handling system for Newtonian liquids, energy equation for steady flow of fluids, pump selection and performance, flow measurement, Bernoulli's equation, concept of viscosity, Newtonian and non Newtonian fluids, streamline and turbulent flow, Reynold's number flow.

### **Unit 3**

Heat transfer : Modes of heat transfer, conductive, convective and radiative heat transfer, thermal properties of foods, conductive heat transfer in a rectangular slab, tubular pipe and multilayered systems, estimation of convective heat transfer coefficient, forced convection and free convection, estimation of overall heat transfer coefficient; Heat exchangers : plate, tubular, scraped surface and steam infusion.

### **Unit 4**

Thermal process calculations: Commercially sterile concept, concept of D, F and Z values, reference F value, effect of temperature on thermal inactivation of micro organisms, lethality function, thermal process calculation for canned foods. Calculation of processing time in continuous flow systems. Thermal process calculation for canned foods.

### **Unit 5**

Psychrometrics : Properties of dry air ; composition of air, specific heat of dry air, enthalpy of dry air and dry bulb temperature.

Properties of water vapor : specific volume of water vapor, specific heat of water vapour, Gibbs-Dalton law, Dew point temperature, relative humidity, humidity ratio, wet bulb temperature.

Study of Psychrometric chart.

### **Practical**

Concentration of extract through rotary vacuum evaporator, Concentration of extract through falling film evaporator, Concentration of extract through raising film evaporator, Separation of molecule through Reverse osmosis, microbial filtration to concentration broth.

**Course No. FPT 225****M.M. : 80****Course Title : Food quality Assurance****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

### **Unit 1**

Objectives, importance and functions of quality control. Principles of food quality control and quality assurance, quality control and assessment in food materials-fruits, vegetables, cereals, dairy products, meat, poultry, egg and processed food products.

### **Unit 2**

Total quality management (TQM) - good manufacturing practices, good hygienic practices, good lab practices, general awareness and role of management practices in quality control.

Microbial quality control : determination of microorganisms in foods by cultural, microscopic, physical, chemical, immunological and bioassay methods;

Statistical quality control.

### **Unit 3**

Food regulations, grade and standards, concepts of Codex Alimentarius, HACCP, USFDA, ISO 9000 series etc. Food laws and standards, IPR and patents, Food standards and safety Act : salient provisions and prospects, role of various national and international agencies.

### **Unit 4**

Food adulteration, nature of adulteration, methods of evaluation of food adulterants and toxic constituents of dairy, meat, spices and other products.

### **Unit 5**

Sensory quality evaluation : Introduction, methods, panel screening, selection methods, Sensory and instrumental analysis in quality control, hedonic scale testing of flavour, aroma, taste, texture and overall acceptability of food products.

### **Practical**

Techniques of quality assessment of fruits, vegetable, cereals, dairy products, meat, poultry, milk and other processed products, selection and training of sensory panel.

Hedonic rating of food. Identification and ranking of food product attributes, Sensory and instrumental methods for measuring food attributes.

**SEMESTER-III****Course No. FPT 321****M.M. : 80****Course Title : Unit operations in Food engineering****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

**Unit 1**

Material handling : Conveyors and elevators, types of conveyors and elevators. Cleaning : Dry-cleaning, screening, aspiration and magnetic cleaning, wet cleaning, soaking, spray washing, ultrasonic washing, sorting and grading : methods, advantages. Sorting and grading.

**Unit 2**

Size reduction : Benefits, criteria for size reduction, size reduction of solid, fibrous and liquid foods, size reducing machines.

Mixing : Mixing terminology, mixers for dry solids (tumbler and vertical screw mixers). Mixers for high viscosity pastes (dough mixer), mixers for low viscosity pastes, effect of mixing on foods.

**Unit 3**

Filtration : Filtration terminology (feed slurry, filtrate, filter medium, filter cake), filtration equipments.

High temperature operations : Pasteurization, pasteuriser and its functioning.

Evaporation : Single effect evaporator, multiple effect evaporators and plate evaporators, batch type pan evaporators, natural circulation, forced circulation, rising film, falling film and agitated thin film evaporators.

**Unit 4**

Dehydration : Terminology, dehydration systems; tray drier, tunnel drier, spray drier, fluidized bed drying, vacuum drying and drum driers.

Low temperature operations : Refrigeration, components of refrigeration system, compressors, condensers and expansion valve, selection of refrigerant, cooling load, coefficient of performance, refrigerant flow rate.

Freezing systems : Direct contact and indirect systems, freezing load calculations. Freeze drying : Conventional drying versus freeze drying, Basic principle, freeze dryer and its components.

**Unit 5**

Downstream Processing : Introduction, Removal of microbial cells and solid mater, foam separation, precipitation filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, Effluent treatment and disposal of effluents.

**Practical**

Isolation of industrially important microorganisms for microbial processes.

Determination of thermal death point (TDP) and thermal death time (TDT) of microorganism for design of a sterilizer, (a) Determination of growth curve of a supplied microorganisms and also determine substrate degradation profile. (b) Compute specific growth rate ( $\mu$ ), growth yield ( $Y_x/s$ ) from the above. Comparative studies of Ethanol production using different substrates. Microbial production of Citric acid using *Aspergillus niger*. Microbial production of antibiotic (Penicillin). Production and estimation of Alkaline Protease. Sauer Kraut fermentation.

**Course No. FPT 322****M.M. : 80****Course Title : Packaging Technology****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

### **Unit 1**

Introduction to packaging; Package-functions and design; Principle in the development of protective packaging; Deteriorative changes in foodstuff and packaging methods for prevention; primary food packaging and secondary packaging, factors involved in the evolution and selection of a food package, Food pack ages-bags, types of pouches, wrapper, carton and other traditional package, Retortable pouches.

Paper and paper based packaging materials : Types of paper (Kraft, bleached, greaseproof) paper products (proper bags, cartoons, drums and molded paper containers), functional properties of paper, testing of paper packaging materials.

### **Unit 2**

Plastic packaging materials : Classification of polymers, functional and mechanical Properties of thermoplastic polymers, processing and converting of thermoplastic polymers (extrusion, blow molding, injection molding, compression molding, lamination and heat sealing), testing of plastic packages.

Metal packaging materials : Functional properties of metal containers, tin plate containers-quality control tests, can manufacturing and protective/decorative coatings.

### **Unit 3**

Shelf life of packaged foodstuff, methods to extend shelf-life; Packaging of perishables and processed foods; Special problems in packaging of food stuff; Packaging requirements for selected foods-cereal and snack foods, beverages, milk and dairy products, poultry & eggs, red meat, frozen foods, horticultural products and microwavable foods; CA

(Controlled atmosphere) and MAP (Modified atmosphere packaging), Biodegradable packaging; Shrink packaging;

### **Unit 4**

Active food packaging : Definition, physical and chemical principles involved.

Edible films and coatings as active layer : Concept, different edible films used, use of edible active layers to control water vapor transfer and gas exchange, modification of surface conditions with edible with edible active layers.

Oxygen absorbents : Classification and main type of oxygen absorbents, factors influencing the choice of oxygen absorbents, application of oxygen absorbents for shelf-life extension of foods, disadvantages of oxygen absorbents.

Ethanol vapor : Ethanol vapor generator, uses of ethanol for shelf- life extension of foods, effect of ethanol vapors on food spoilage/food poisoning bacteria, disadvantages of ethanol/vapor generators.

### **Unit 5**

Glass packaging materials : Composition and manufacturing of glass containers, glass container nomenclature, mechanical and optical properties of glass containers, testing of glass containers.

Aseptic packaging of foods : Sterilization of packaging material, food contact surfaces & aseptic packaging systems, report pouches.

Safety considerations in food packaging : Food safety problems associated with package, package labeling and standards and food safety, recycling of packaging materials.

### **Practical**

Thickness, substance weight, water absorption capability of flexible packaging materials; Strength properties of packaging materials; Water vapour and gas transmission rate of flexible packaging materials; Identification and chemical resistance of plastic films; Packaging of fruits/vegetable; Estimation of shelf-life of packaged food stuff; Familiarization of types of packaging materials.

**Course No. FPT 323****M.M. : 80****Course Title : Technology of Meat, Fish & Poultry Products****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

### **Unit 1**

Status and scope of meat industry in India.

Structure and physico-chemical properties of muscle.

Source of meat animals and fishes, importance in national economy;

Meat : Composition and nutritive and value, Slaughtering and dressing of meat animal; Quality evaluation of eviscerated carcasses; conversion of muscle into meat, environmental and animal production factors that affect meat quality, post mortem changes in meat, rigor mortis, cold shortening, prerigor processing.

### **Unit 2**

Processing and preservation methods of meat, Aging of meat, meat tenderization-natural and artificial methods, Various color changes in muscle and meat, color stabilization by curing, Cooking methods for meat : roasting, frying and braising, Storage and preservation of meat : Chilling, Freezing, Curing, Smoking, Dehydration, Freeze-drying, Irradiation, Canning and Glazing of fish.

### **Unit 3**

Cooking, palatability and eating quality of meat, microbial spoilage of meat, Restructured meat products, meat analogs, Meat industry of products : Importance and applications, Plant sanitation and waste disposal.

### **Unit 4**

Fish : Factors affecting quality of fresh fish, fish dressing, chilling, freezing, salting and canning of fish, Manufacturing of fish paste, fish sauces, fish oil, fish protein concentrate, fish meal, By-products of fish industry, their technology of utilization.

### **Unit 5**

Egg : Structure, composition, nutritive and functional properties.

Quality of egg : Internal quality evaluation, egg canning, egg grading, microbial spoilage of eggs, preservation and storage methods for eggs.

Egg products : Egg powder, boiled egg, scrambled eggs.

Packaging and transportation of eggs.

Poultry products : Types, chemical and nutritive value of poultry meat, Slaughtering and evaluation of poultry carcasses; Poultry cut-up parts and meat : bone ratio; preservation, grading and packaging of poultry meat.

### **Practical**

Slaughtering and evaluation of animal carcasses; Dressing of fish; Meat cutting, curing, smoking, freezing & drying of meat and fish : Development of various meat and fish products and byproducts. Ready to cook Poultry; Grading and evaluation of poultry and eggs : meat : bone ratio : Preparation and evaluation of poultry and shell egg products and byproducts.

**Course No. FPT 324****M.M. : 80****Course Title : Nutraceuticals & Probiotics****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

### **Unit 1**

Concept on nutraceutical : nutraceutical and functional foods, nutraceutical as new dietary ingredients, biological significance of Nutraceuticals, Nutraceuticals and dietary supplement, world market for Nutraceuticals.

### **Unit 2**

Nutraceuticals in food and beverage industry : non caretonid terpenoids, flavonoids and other polyphenolic compound, natural pigments (chlorophyll, chlorophyllin, xanthophylls, beta caretonoides).

### **Unit 3**

Antioxidants, organic acids terpenoids, alkaloids amino acids. Current technology for production of Nutraceuticals : anti-inflammatory, anti-virals and antibacterial, antioxidants, and natural pigments.

### **Unit 4**

Concept and opportunities on probiotics, prebiotic and synbiotic, biological significance and use of probiotics for human, for cattle, poultry and for aquaculture. World market for probiotics current technologies., Commercial production, current technology in probiotics production.

### **Unit 5**

Probiotic foods, resistant starch, fructo-oligosaccharides as probiotic food components, Efficacy of probiotic foods, standards and regulation for probiotic foods.

### **Practical**

Quantitation in Nutraceuticals in fruits and vegetables. Isolation of flavonoids from apple pomace, calorimetric quantitation of Nutraceuticals, separation of pigments TLC. Separation and quantifications of - pigments by column chromatography.



**Course No. FPT 325****M.M. : 80****Course Title : Advanced techniques in food processing and preservation****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

**Theory :**

### **Unit 1**

Extrusion technology :

General principles, extrusion process, advantages of extrusion, extrusion equipment, single screw extruders and twin screw extruders, effect of extrusion on food properties, extrusion of starch based foods.

Hydrostatic Pressure Technology;

General principles, effect of hydrostatic pressure on microorganisms-possible mode of action, application of hydrostatic pressure technology in food industry.

### **Unit 2**

Hurdle Technology :

Principles and basic aspects of hurdle technology, different hurdles, hurdle effect, application of hurdle technology in dairy products, intermediate moisture foods, fermented products, heated foods and chilled foods.

Membrane Technology : Introduction of membrane, their classification and function, principles of reverse osmosis and ultrafiltration, nanofiltration and microfiltration, applications of membranes in food processing industry, modules for using membrane filters.

### **Unit 3**

High intensity electric field pulses (HIEFP) :

Principles, generation of electric field pulses, application in foods, effect on bread making and wheat dough and bread making properties, effect of HIEFP on microorganisms.

Food Irradiation Technology :

General aspects of irradiation, ionizing radiation, irradiation process, units, mechanism, advantages and disadvantages of irradiation process, recent studies, wholesomeness of irradiated foods, general purposes of irradiation process; inactivation of micro-organisms, inhibition of sprouting, delay of ripening and senescence and miscellaneous effects on food properties.

### **Unit 4**

Ultrasound in food processing and preservation : Introduction, ultrasound instrumentation, ultrasound processing for enhancement of mass transfer, heat transfer and homogenization and emulsification.

Microwave Processing :

Microwave, properties, heating mechanism, difference between conventional and microwave heating, microwave oven, factors affecting the heating of food in microwave oven, applications of microwave in food processing, effect of microwave on food nutrient, recent studies.

### **Unit 5**

Immobilized enzyme technology : concept, methods of immobilization and use of immobilized enzymes in food processing industry.

Formulated Foods :

Recent advances in formulated and value added foods, seafoods, and infant and weaning foods, emergency foods, soy fortified products, complementary foods.

**SEMESTER-IV**

**Course No. FPT 421** **M.M. : 80**  
**Course Title : Technology of Fruits & Vegetables** **Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

**Unit 1**

Classification and composition of fruits and vegetables and their nutritional significance. Preharvest factors influencing post-harvest physiology, post harvest handling, precooling methods, post harvest treatments, edible coatings;

Physical and chemical indices of fruit maturity, crop maturity and ripening, bio-chemical changes during maturation, ripening, processing and storage.

**Unit 2**

Post harvest handling procedures and treatments- hot and cold treatment, preservatives and chemicals, protective coatings, irradiation; commercial cooling systems; packaging and packing house operations; Different storage systems for fruits and vegetables, modified atmospheric storage/ packaging (MAP), cold storage, controlled storage (CS) etc.; Minimal processing of fruits and vegetables; Quality, safety factors and export standards.

**Unit 3**

Preprocessing operations; Washing, balancing, peeling, sorting and grading of raw materials. Minimal processing of fruits and vegetables, quality factors by processing, fruit product order (FPO), Technology of jam, jellies, marmalades, specifications, role of pectin and theories of gel formation.

**Unit 4**

Technology for juice pressing, juice extraction and clarification, methods of bottling, enzymatic clarification and debittering of juices, physiological and enzymological aspect of fruit juice production, fruit juice powders- preparation and specifications, packaging.

Fruit juice beverages, squash cordial, crush, RTS, nectar, syrups, their types and production, blending of juices.

Mushroom technology: Types of edible mushrooms, production of mushrooms, processed products from mushrooms.

Chemical composition, processing technology of cashew and coconut.

**Unit 5**

Technology of tomato products : Sauce, puree, ketchup and tomato paste

Fruit preserves and candied fruits, dehydrated fruits & vegetables, Intermediate moisture fruits and vegetables; spoilage of processed products.

Canning of fruits and vegetables, preparation of syrups and brines, method and spoilage of canned fruits and vegetables.

By products from unit and vegetable wastes

**Practical**

Determination of maturity indices for fruits and vegetables : Harvesting, sorting grading, Post harvest treatments for packaging and storage; Practices in packaging house operation~; packaging for domestic and distant markets; Quality evaluation of fruits and vegetables. Processing of fruit juices and beverages; Canning and bottling; Preparation of Jam, Jelly, Marmalade, Preserves, Candies, Fruit cheese, Leather, IMF slices, potato and tomato products, Pickling and other fermented products : Dehydration; Freezing.

**Course No. FPT 422****M.M. : 80****Course Title : Food Biotechnology****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

**Theory :****Unit 1**

Introduction to Food biotechnology, basic principles of genetic engineering, Application of genetic to food production improvement of the processing of various crops by genetic engineering, food safety and biotechnology.

Transgenic plants and their contribution to food production enhancement.

**Unit 2**

Methods of molecular cloning, immobilization of microbial cultured plant cells. Bacterial starter culture, Methods of inoculum and medium preparation, slurry processing and product isolation.

Technological aspect of industrial production of beer, wine, enzymes amylase, pectinase, proteases, organic acids, amino acids, vitamins, antibiotics, baker's yeast, Biogums, fats, oils, fatty acids and oilseed crops, fat substituted, natural and modified starches.

**Unit 3**

Natural antimicrobials for food preservation : Phytoalexins, essential oils and their components, bacteriocins, nisin, pediocins etc, applications of bacetriocins in food systems. Aflatoxins- production, control and reduction using molecular strategy.

Protein engineering in Food technology - methods, applications of protein engineering (e.g. glucose isomerase, Lactobacillus Beta-galactosidase and peptide antibiotic nisin) single cell protein.

**Unit 4**

Fermented food : origin, scope and development, saukraut, younghurt, cheese, misotempeh, Regulatory and social aspects of biotechnology of foods, production of food flavour and colours.

**Unit 5**

Biomangement of food industry wastes.

Organic foods : Concept, scope, certification and regulation.

Nanotechnology in food processing

Golden rice : Concept, characteristics and importance of golden rice.

**Practical**

Method of plant cell culture, Preparation of starter culture, Preparation of beer, wine, tempeh, youghurt, vinegar. Production of amylase, pectinase, proteases, flavour, colour by fermentation. Immobilization of enzymes.

**Course No. FPT 423****M.M. : 80****Course Title : Technology of milk and products****Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

### **Unit 1**

Dairy industry in India & its future prospects.

Composition and properties of milk, liquid milk handling operations : Collection and Testing; Filtration and Clarification, Skimming, Standardization; Homogenization, Pasteurization (LTHT, HTST, UHT) Sterlization, Packaging, Storage and distribution of fluid milk;

### **Unit 2**

New Concept in milk processing- UHT, Membrane processing, Microwave and irradiation treatments; aseptic packaging.

Microbiology of milk, sources of milk contamination.

### **Unit 3**

Technology of indigenous dairy products : Dahi, butter, ghee, channa, paneer etc.

Technology of cream, butter, margarine and ghee manufacture.

Technology of condensed and evaporated milk : Composition, nutritive value, process of manufacture, defects (their causes and prevention).

Technology of yoghurt, Acidophilus milk, Bufgaricus milk, Kumiss, Kefir; Manufacturing of Cheddar, Mozzarella, cottage and processed cheese.

### **Unit 4**

Technology of milk powders (WMP, SMP) : Composition, nutritive value, process of manufacture, defects (their causes and prevention),

instantization of milk powder. Milk and milk product standards and legislations in India : Grading of milk and criterion of grading, reconstituted milk, synthetic milk.

Milk adulteration and quality control in dairy industry.

By products of dairy industry and their utilization.

### **Unit 5**

New concepts in technology of dairy products, cream powder, sterilized cream, butter spread, butter powder, cheese spread; packaging and distribution of various milk products; Defects in milk products and their remedies; Milk based infant foods; Manufacturing of casein, Caseinate, Coprecipitates, WPC, Lactose; National and International Organizations in dairy Industry.

### **Practical**

Platform tests, Determination of fat, SNF, TS Protein, lactose and ash contents of milk. Layout plan for setting up of milk plant, Preparation of Paneer, Chhanna, Ghee Dahi, Khoa, Kulfi etc., evaluation of different types of milk and milk products. Preparation of butter, ice cream, cheese, yoghurt, casein, caseinate, coprecipitates; evaluation of dairy products.

**Course No. FPT 425**

**M.M. : 80**

**Course Title : Industrial organization and business management**

**Time : 3h**

**Note : In all ten questions will be set two from each unit. Students are required to attempt five questions i.e. one from each unit.**

### **Unit 1**

Management : Meaning, nature, scope, significance, functions and principles; levels of management, process of management co-ordination as an essence of management.

Planning : Meaning and importance of planning; planning Process; limitations, considerations in planning; methods of planning; types of plans.

Decision Making : Concept and techniques, steps in decision making process.

### **Unit 2**

Organising : Meaning and importance, process of organizing, principles of effective organisation; key elements in organizing process; formal v/ s informal organization departmentation, decentralisation, delegation of authority Relationship- Line, Staff and Functional.

Motivation, leadership and communication : Concept and significance of motivation; determinants of behaviour; Maslow's theory of motivation; Meaning and importance of leadership; leadership styles; qualities of leadership.

### **Unit 3**

Principles of marketing and business administration, patents and trade marks statutory rules, health regulations, Indian and foreign regulations. Export regulations, Trade, Act regulation relating to maintaining hygienic conditions. Export and inspection agencies.

### **Unit 4**

Nature, objectives and scope of financial management, financial planning and control, capital structure, recent developments in financial management, planning, Organizing, Leading & Controlling.

### **Unit 5**

Concepts and characteristics of information; Importance of MIS; Communication- type, channels & barriers; Characteristics of agricultural products; Problems of processed food marketing; Procurement & distribution systems; Location factors and other problems in processing of agricultural products;

International trade in foods; Patents and trade marks; Export regulations; WTO; Inspections agencies.