

# **Mugberia Gangadhar Mahavidyalaya**

**[College with Potential for Excellence (By UGC);  
Star College (By DBT, Govt. of India);  
Affiliated to Vidyasagar University]**



**Syllabus for**

**M.Voc (Food Technology, Nutrition and Management)**

**Effective from 2020-2021 session**

**Bhupatinagar, Purba Medinipur,  
West Bengal, India, Pin-721425**

**Syllabus outline and marks distribution for evaluation of M.Voc (Food Technology, Nutrition and Management)**

Sem	Job role; NSQF level	Code	Th & Pr	Papers	Tot. Cr. (Th+ Pr)	Full mark	End sem exam (T+P)	Int	Atte n.
I		FTNM11	T&P	Fundamentals of Food Technology –I	5(3+2)	100	40+20	35	5
		FTNM12	T&P	Fundamentals of Food Technology –II	5(3+2)	100	40+20	35	5
		FTNM13	T&P	Advances in Food Bio-chemistry and Nutrition	3(2+1)	100	40+20	35	5
		FTNM14	T&P	Advances in Food Microbiology and Food Biotechnology	4(2+2)	100	30+30	35	5
		FTNM15	T&P	Functional Foods and Nutraceuticals	4(2+2)	100	30+30	35	5
		FTNM16	P	Communication Skill Development	3(0+3)	100	0+60	35	5
		FTNM17	P	Computer Skill Development	3(0+3)	100	0+60	35	5
		FTNM18	P	Industrial Training/Excursion	3(0+3)	100	0+100	0	0
				<b>Total</b>	<b>30(12+18)</b>		<b>520(180+340)</b>		
II	Quality control Executive, Supply Chain and Logistics, Professionals Supervisor and Others, Technical Officer and Food Consultant; Level-8	FTNM21	T&P	Advances in Food Processing –I	4(2+2)	100	30+30	35	5
		FTNM22	T&P	Advances in Food Processing –II	4(2+2)	100	30+30	35	5
		FTNM23	T&P	Advances in Food Packaging	3 (2+1)	100	40+20	35	5
		FTNM24	T&P	Food Quality Management Systems	3 (2+1)	100	40+20	35	5
		FTNM25	T&P	Mechanical Operation and Chemical Engineering Fundamentals	4(2+2)	100	30+30	35	5
		FTNM26	T&P	Food Plant Layout and Management	3(1+2)	100	20+40	35	5
		FTNM27	T&P	Research Methodology and Statistics	4(1+3)	100	20+40	35	5
		FTNM28	P	Technical Writing	2(0+2)	100	0+60	35	5
		FTNM29	P	Industrial Training/Excursion	3(0+3)	100	0+100	0	0
			<b>Total</b>	<b>30(12+18)</b>		<b>580(210+370)</b>			
III		FTNM31	T&P	Sensory Evaluation	3(2+1)	100	40+20	35	5
		FTNM32	T&P	Food Emulsions, Foams, Gels and Food Rheology and Microstructure	5(4+1)	100	40+20	35	5
		FTNM33	T&P	Instrumentation in Nutrition	4(3+1)	100	40+20	35	5
		FTNM34	P	Software Packages for Statistical Computing	3(0+3)	100	0+60	35	5
		FTNM35	P	Seminar	3(0+3)	100	0+100	0	0
		FTNM36	P	Comprehensive Viva-voce	1(0+1)	100	0+100	0	0
		FTNM37	P	Industrial Training and its Report /Research	8(0+8)	200	0+200	0	0
		FTNM38	P	Industrial Excursion	3(0+3)	100	0+100	0	0
			<b>Total</b>	<b>30(9+21)</b>		<b>740(120+620)</b>			
IV	Plant Manager; Level- 9	FTNM41	P	Research Project/Thesis/Dissertation	15(0+15)	400	0+400	0	0
		FTNM42	T	Intellectual Property and Its Management	4(4+0)	100	60+0	35	5
		FTNM43	T	Entrepreneurship Development Program	5(5+0)	100	60+0	35	5
		FTNM44	P	Seminar	3(0+3)	100	0+100	0	0
		FTNM45	P	Industrial Excursion	3(0+3)	100	0+100	0	0
			<b>Total</b>	<b>30(9+21)</b>		<b>720(120+600)</b>			

**Internal:** Class test, assignment, project, presentation, industry visit etc.

# DETAIL SYLLABUS

## FTNM11: Fundamentals of Food Technology –I

Tot. Cr.(T+P): 5(3+2)

### THEORY

**Unit-1:** Basic principles of food processing & preservation: Food spoilage: microbial, physical, chemical & miscellaneous. Thermal processing methods and preservation: heat resistance of microorganisms, thermal death curve. Blanching, pasteurization, sterilization, Canning of foods, heat penetration. Moisture removal: Evaporation, drying, dehydration and concentration, Principle, Methods, equipment and effect on quality: Drying curve, drying methods and type of dryers; physical and chemical changes in food during drying. Need and principle of concentration, methods of concentration, changes in food quality by concentration Preservation by salt and sugar: Pickling, fermentation, intermediate moisture foods

**Unit-2:** Principles of food engineering: Sterilizers and accessories used in canning industries; Seaming machine. Construction of cold storage; Different types of freezers including plate contact freezer, air blast freezer, cryogenic freezing and refrigerated vans. Various types of driers– Tray drier, roller drier, spray drier, fluidized bed drier, freeze drier and solar drier.

**Unit-3:** Food additives and ingredients: Food additives, Preservatives, antioxidants, colours and flavours (synthetic and natural), emulsifiers, sequesterants, humectants, hydrocolloids, sweeteners, acidulants, buffering salts, anticaking agents, Spices- pepper, cinnamon, turmeric, fennel, chilli, cardmom (small and big), cumin, mint, ginger cloves and fenugreek. Condiments- definition. Spice oleoresins, spice essential oils, encapsulated spices (Brief) Food flavours, Flavour enhancers, their properties and toxicity, analysis of flavours, extraction techniques of flavours, Proteins, starches and lipids as functional ingredient

**Unit – 4:** Cereal and pulse processing technology: Rice: paddy processing and rice milling, quality characteristics influencing final milled products. Parboiling: rice bran stabilization and its methods; Aging of rice; Enrichment – need, methods; processed foods from wheat: break system, purification system and reduction system; extraction rate and its effect on flour composition; Quality characteristics of flour and their suitability for baking. Corn: corn milling – dry and wet milling, starch and gluten separation, milling fractions and modified starches. Barley: malting and milling; Sorghum: milling, malting, pearling and industrial utilization; Millets: importance of millet, composition, processing of millets for food uses, major and minor millets; Classification and types of legumes, anti-nutritional compounds in legumes; methods of removal of anti-nutritional compounds, milling of legumes: home scale, cottage scale and modern milling methods, milling quality, efficiency and factors affecting milling; problems in dhal milling industry, Soaking and germination of pulses, Cooking quality of legumes – factors affecting cooking quality, Byproduct of pulses and their value addition.

**Unit – 5:** Milk and milk product technology: Clean milk production, annual milk production, production growth rate and per capita availability, Anand pattern, NDDB, operation flood, contribution of Kurien. Processing of market milk, UHT milk, flavoured milk, dahi, yoghurt, cream, butter, butter oil and ghee, ice cream, condensed and dried milk, malted milk powder, infant milk food,

cheese (Cheddar, Swiss, mozzarella, cottage, processed cheese, cheese spread) khoa, gulabjamun, channa, rasogolla, paneer, dairy by-products, CIP.

**Unit-6 :** Meat, poultry & fish processing technology: Structure of meat, muscle protein, composition of meat, Rigor mortis, post mortem changes in meat, meat slaughtering process, meat products, meat preservation, meat plant sanitization & waste disposal, meat byproducts. Processing of poultry meat, classification & composition of poultry meat, egg Processing & egg products, fish processing & fish product.

## **PRACTICAL**

1. Preservation of food by high concentration of sugar i.e. jam.
2. Preservation of food by addition of chemicals i.e. tomato ketchup.
3. Preservation of food by using acidulants i.e. pickling by acid, vinegar or acetic acid
4. Calculation of freezing time for some typical foods
5. Determination of moisture in whole and ground spices.
6. Determination of total ash in spices.
7. Adulteration tests for different spices
8. Determination of starch content of cereal
9. Study on gelatinization of starch
10. Determination of amylase content of rice
11. Analysis of milk testing –MBRT, Platform tests, Detection of Fat, SNF, adulterants in milk
12. Physico-chemical and microbiological quality of different types of meat.
13. Estimation of nitrites/nitrates in processed meat products.

## **SUGGESTED READINGS**

1. Norman, N.P and Joseph, H.H.(1997). Food Science, Fifth edition, CBS Publication, New Delhi
2. Principles of Cereal Science and Technology A. Chakravarthy Y. Pomeranz Keral Kulp Hosney RS
3. Sukumar De. 2005. Outlines of Dairy Technology. Oxford University Press, New Delhi. H.G.
4. Kessler. 1981. Food Engineering and Dairy Technology.
5. Fundamentals of Food Process Engineering; Toledo RT; 2nd ed, 2000, CBS Publishers.
6. Stadelman W.J. and Cotterill O.J., Egg science and technology; CBS Publishers.
7. Pearson A.M. and Gillett T.A., Processed Meats; CBS Publishers.
8. Stadelman W.J., Olson V.M., Shemwell G.A. and Pasch S., Egg and poultry meat Processing; Elliswood Ltd.
9. Balachandran K.K., Post-harvest Technology of Fish and Fish Products; Daya Publ. House.
10. MirceaEnachescaDanthy. 1997. Fruit and Vegetable Processing. International Book Publ.
11. Bailey's industrial oils and fat products, D. Swern, Wiley - Inter Science, Publications, New York

## FTNM12: Fundamentals of Food Technology –II

Tot. Cr.(T+P): 5(3+2)

### THEORY

**Unit-1:** Bakery, confectionery and sugar processing technology: Roles & pfa specification of raw materials used in bakery industry, processing of bread, biscuit, cake, pastry, cookie, crackers, pizza, pie, rusk. cane sugar processing, beet sugar, liquid sweetener, reaction of sugar, confectionary ingredients, sugar boiled confectionary, chocolate confectionary, Indian confectionary, bakery plant layout & maintenance & hygiene, bakery equipment.

**Unit-2:** Food beverage technology: Roles of ingredients used in beverage industry, synthetic and natural beverages, dry mix beverages, sports drinks, dairy based beverages, fruit juice beverages & processing, carbonated beverages & processing, packaged drinking water processing, types of tea & tea processing, coffee processing, cocoa processing & cocoa beverages, alcoholic beverages-wine, beer, distilled spirit.

**Unit-3:** Food plant utilities and services: Introduction to food plant utilities; industrial water; steam boiler; air moving and vacuum equipment; electrical equipment; waste treatment; plant size and capacity.

**Unit -4:** Instrumentation and process control: Introduction to instrumentation and process control; hydrostatic balance measurement, temperature measurement and control, pressure measuring transducers and control, viscosity and flow rate measuring transducers, chromatographic measurement; spectrophotometric analysis.

**Unit – 5:** Documentation in food processing: Documentation and inspection of raw material in food industry. Methods of documentation for raw material to finished product. Labeling of finished products in packaging materials. Calibration and validation of different instruments, glass wares and machines and equipment Introduction and implementation of ERP, application of ERP in food industry. Statistical analysis in food industry

**Unit-6:** Industrial safety and hazards: Origin of process hazards, Laws Codes, Standards, Health hazards of industrial substances. Toxicology: Toxic materials, properties, effect of dose and exposure time, relationship. Threshold value, material safety data sheets, industrial hygiene evaluation. Fire & explosion: Fire and explosion hazards, causes and preventive methods. Flammability characteristics. Other Energy Hazards: Electrical hazards, noise hazard, radiation hazard etc.

### PRACTICAL

1. Quality assessment: Flour (Maltose Number, Water Absorption, Sedimentation value, Alcohol Acidity), yeast, water, leavening agents.
2. Dough characteristics - determination of gluten.
3. Determination of reducing and non-reducing sugars in sugar product.
4. Chemical and microbiological analysis of raw water quality
5. Preparation fruit juice, dairy based beverages, alcoholic beverages
6. Study of various transducers for measuring temperature, pressure, specific gravity, viscosity and flow rate.

## SUGGESTED READINGS

1. Chilton's Food Engineering. Published by Chilton Co., 1979
2. Hui YH. et al 2004. Handbook of Food and Beverage Fermentation Technology. Marcel Dekker.
3. Samuel A. Matz , Bakery Technology and Engineering ,Chapman and Hall
4. Bela G. Liptak. 2003. Instrument Engineer's Handbook, Vol. I and II, 4 th Ed. CRC Press, Boca Raton,FL, USA.
5. Sanjoy Banerjee. 2002. Industrial Hazards and Plant Safety by Amazon Publisher.
6. K.T.Patel and N.P Chotai, Apr-jun, 2011, Documentation and record: Harmonized GMP requirement, v(3).
7. Energy Efficiency and Management in Food Processing Facilities, by Lijun Wang. Published by CRC Press, 2008

## FTNM13: Advances in Food Bio-Chemistry and Nutrition

Tot. Cr.(T+P): 3(2+1)

### THEORY

**Unit 1:** Physical and chemical properties of water: structure and chemical properties, hydrogen bonding, effect of hydrogen bonding on the properties of water, solute effects on water, state of water in foods, kinetic principles; water activity: principles, measurement, control, effects, related concepts; acid-base chemistry of foods and common additives

**Unit 2:** Proteins: physical properties of proteins in relation to protein structure, analytical methods; basic properties: hydration, ionization, colloidal behaviour; functional properties -denaturation, hydrolysis, changes in proteins during processing; effects of food processing: changes occurring in chemical, functional & nutritional properties of proteins; nitrite function, chemistry and nitrosamine formation. Protein as nutrient, protein quality, role in human body. Protein metabolism.

Enzymes - criteria for purity of enzyme, Specificity, mechanism of enzyme action, factors influencing enzymatic activity, controlling enzyme action, enzymes added to food during processing, **Browning reaction**- Enzymatic and non enzymatic browning, advantages and disadvantages, factors affecting their reaction and control.

**Unit 3:** Lipids: Content and role in foods, analytical methods, processing of fats and oils, degradation reactions Physical and chemical properties - hydrolysis, hydrogenation, rancidity and flavour reversion, emulsion and emulsifiers, saponification value, acid value and iodine value, Reichert-Meissl number, Polenske value, smoke point. Lipids of biological importance like cholesterol and phospholipids, fat metabolism.

**Unit 4: Carbohydrates:** simple sugars, sugar derivatives and oligosaccharides, basic chemistry, conformation, anomeric forms, equilibrium, reactivity, sweetness; sugar derivatives: sugar alcohols, glycosides, etc.; browning and related reactions; case studies – acrylamide and furan formation in foods; polysaccharides: basic structures and properties, starches, celluloses, gums, modification techniques; dietary fiber: components, properties, analysis. Nutritional importance. Metabolic processes like glycolysis, pentose phosphate pathway, TCA cycle. Oxidative phosphorylation

**Unit 5:** Vitamins: structure and properties of vitamins, distribution and morphology of vitamins in foods, changes of vitamins in food processing and storage, Regulation and control of vitamins in foods, relationship of vitamins and food quality. Deficiency of vitamins and metabolic disorders.

**Unit 6:** Minerals: structure and properties of minerals, distribution and morphology of minerals in foods and processed goods, changes of minerals in food processing and storage, regulation and control of minerals in foods, relationship of minerals and food quality

**Unit 7:** Role of protein, carbohydrate and lipid in nutrition, water, minerals and vitamins in nutrition: Functions, food sources, storage in body, deficiency, bioavailability etc.

**Unit 8:** Effect of cooking and heat processing on nutritive value of food. Processed supplementary foods. Use of food in body: digestion, absorption transportation and utilization. Nutrition and its relation to obesity. Energy calculations form foods and formulation of balanced diet.

## **PRACTICAL**

1. Estimation of moisture content in food sample
2. Estimation of reducing sugars
3. Estimation of crude fibre content
4. Estimation of protein by Kjeldahl's method
5. Estimation of total ash, water soluble and acid soluble ash
6. Extraction of fat by Gravimetric Method (Mojonnier Method)
7. Estimation of free fatty acids
8. Estimation of peroxide value
9. Estimation of iodine value
10. Estimation of saponification value
11. Refractive index of fats and oils
12. Specific gravity of fats and oils
13. Water activity
14. Calculation of normal diet
15. Calculation of liquid diet
16. Calculation of high and low calorie diet

## **SUGGESTED READINGS**

1. Fennema's Food Chemistry, Fourth Edition (Food Science and Technology) Srinivasan Damodaran, Kirk L. Parkin, Owen R. Fennema
2. Belitz, H. D. and Grosch, W. Food Chemistry. Second Edition. New York: Springer verlag, Berlin Heidelberg, 1999
3. Medeiros, D., & Wildman, R. (2011). Advanced Human Nutrition: Jones & Bartlett Learning.
4. Handbook of Food Analysis Part XI Dairy Products (BIS)
5. Lehninger. Principles of Biochemistry by Nelson, David.L. , Michael M. Cox, 7<sup>th</sup> edition, published by W.H. Freeman, New York, 2009.
6. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto, Lubert Stryer. Biochemistry Eighth edition by, Published By W.H. Freeman, New York, 2015.

## **FTNM14: Advances in Food Microbiology and Food Biotechnology**

**Tot. Cr.(T+P): 4(2+2)**

### **THEORY**

#### **A. *Advances in Food Microbiology***

**Unit 1:** History, scope and importance of food microbiology

**Unit 2:** Microorganisms and food: Their primary sources of microorganisms in foods: Airborne bacteria and fungi, Microorganisms found in soil, Microorganisms in water, Normal flora of skin, nose, throat, GI tract

**Unit 3:** Factors affecting the survival and growth of microorganisms in food: Intrinsic factors for growth, Moisture, pH & acidity, Nutrient content, Biological structure, Redox Potential, Naturally occurring and added antimicrobials, Competitive micro flora, Extrinsic factors for growth, Types of packaging/atmospheres, Effect of time/temperature conditions on microbial growth, Storage/holding conditions, Processing steps

**Unit 4:** Microbiological examination-Methods of Isolation and detection of microorganisms or their products in food. -

Conventional methods - Rapid methods (Newer techniques) –Immunological methods: Fluorescent, antibody, Radio immunoassay, ELISA etc. – Chemical methods PCR (Polymers chain reactions), RT PCR, Microchip based techniques

**Unit 5:** Microflora of Fresh Food: Meat, Poultry, Eggs, Fruits and vegetable, Shellfish and Fish, Milk, Microbial Spoilage of Food, Fresh Foods, Fresh Milk, Canned Foods

**Unit 6:** Food Preservation and application to different types of foods: Physical methods –, Drying, freeze-drying, cold storage, heat treatments (pasteurization, UHT), TDT, TDP, D-value, Z-value, F-value, 12-D concept Irradiation (UV, microwave, ionization), high pressure processing, Aseptic packaging, modified atmosphere, Chemical preservatives and Natural antimicrobial compounds. Biologically based preservation systems

**Unit 7:** Food borne infections and diseases: Significance to public health food hazards and risk factors, Bacterial, and viral food-borne disorders, Food-borne important animal parasites, Mycotoxins. - Bacillus, Campylobacter, Brucella, Staphylococcus, Clostridium, *E.coli*, Aeromonas, *Vibrio cholerae*, Listeria, Mycobacterium, Salmonella, Shigella

**Unit 8:** Cheese fermentation technology, Traditional fermented food products- pickle, sauerkrauts, kishk, raabadi, temph, meso, idli, sausages, misti dahi etc. prebiotics with probiotics, water activity, intermediate moisture food. Factors affecting microbiological quality of food, food preservation by heating cooling and drying, microbiological food safety in food industry, Use of DVS culture for preparation of fermented milk product, importance of UHT milk

### ***B. Advances in Food Biotechnology***

**Unit 1:** Advances in preservation of food by various biotechnological process.

**Unit 2:** technology on fermented food for fruits, vegetables, cereals, legumes, milk, meat, fish etc. Role of LAB on preservation of food items.

**Unit 3:** Extraction and clarification of fruit vegetable juice by enzymes.

**Unit 4:** Fermentative production of enzymes like amylase, protease, pectinase, glucose isomerase, glucose oxidase, cellulase, xylanase, lipases etc.

**Unit 5:** purification of enzymes by downstream processing. Production of alcohol, lactic acid and acetic acid from various food materials. production of alcohol and brewing process in alcoholic beverages.

**Unit 6:** Treatment for waste from food industries by biotechnological application, improvement of quality of food by biotechnological process.

**Unit 7:** bacteriocin production and uses in food preservation, biotechnological process for food fortification, prebiotics and oligosaccharides.



**Unit 8:** Central dogma of molecular genetics, mutation, common recombination processes like conjugation, transduction, transformation, plasmid and phage vector in advances in biotechnology.

### **PRACTICAL**

1. Preparation of common laboratory media and special media for cultivation of bacteria, yeast & molds.
2. Staining of Bacteria: Simple staining, Gram's staining, Negative staining, acid -fast, spore, capsule, Motility of bacteria, Staining of yeast and molds.
3. Isolation of microorganisms: Different methods and maintenance of cultures of microorganisms.
4. Bacteriological analysis of Foods using conventional methods
5. Coli forms analysis of milk and water samples by Most Probable Number (MPN) method
6. To perform various biochemical tests used in identification of commonly found bacteria in foods: IMVIC, urease, H<sub>2</sub>S, Catalase, coagulase, gelatin and fermentation (Acid/gas)
7. Determination of thermal death characteristics of bacteria
8. Demonstration of available rapid methods and diagnostic kits used in identification of microorganisms or their products.
9. Starter Culture Activity and Purity Test
10. Detection of some pathogenic bacteria like *Staphylococcus aureus*, *Salmonella typhi*, *Bacillus cereus* etc.
11. Enumeration of microorganisms in air
12. Visits (at least two) to food processing unit or any other organization dealing with advanced methods in food microbiology.

### **SUGGESTED READINGS**

1. Prescott, S.C. Dunn C.G. Industrial microbiology 4th edition, edited by Gerald Reed, published by AVI Publishing Company, 1982
2. Pelzer, M.I. and Reid, R.D. (1993) Microbiology McGraw Hill Book Company, New York, 5 th Edition.
3. Atlas, M. Ronald (1995) Principles of Microbiology, 1st Edition, Mosby-Year Book, Inc, Missouri, U.S.A.
4. Topley and Wilson's (1983) Principles of Bacteriology, Virology and Immunity, Edited by S.G. Wilson, A. Miles and M.T. Parkar, Vol. I: General Microbiology and Immunity, II: Systematic Bacteriology. 7 th Edition. Edward Arnold Publisher.
5. Frazier, W.C. (1988) Food Microbiology, McGraw Hill Inc. 4 th Edition,
6. Jay, James, M. (2000) Modern Food Microbiology, 6 th Edition. Aspen publishers, Inc., Maryland.
7. Banwart, G. (1989) Basic Food Microbiology, 2 nd Edition. CBS Publisher.
8. Doyle, P. Benehat, L.R. and Mantville, T.J. (1997): Food Microbiology, Fundamentals and Frontiers, ASM Press, Washington DC.
9. Adams, M.R and M.G. Moss (1995): Food Microbiology, 1st Edition, New Age International (P) Ltd.
10. Handbook of Fermented Functional Foods edited by Edward R. Farmworth, CRC Press Taylor and Francis Group.
11. Dairy Microbiology Handbook – The Microbiology of Milk and Milk Products, Richard K Robinson

## FTNM15: Functional Foods and Nutraceuticals

Tot. Cr.(T+P): 4(2+2)

### THEORY

- Unit -1:** Definition, classes of functional foods, status of functional foods in world and India. Concept of new product development, classes of nutraceuticals and functional foods. Safety; marketing strategy and consumer response; economic analysis and costing of novel foods, recent advances in different categories and type of dairy product. Regulatory issues for nutraceuticals including CODEX
- Unit -2:** Nutritional status and dietary requirement of different target group and deficiency diseases, in special reference to micronutrients. Dietary and therapeutic significance of dairy nutrients, bioactive components in dairy products like lactose, whey proteins, milk minerals, CLA, fermented milks etc.
- Unit – 3:** Food fortification, techniques for fortifying dairy foods with minerals and vitamins, High protein foods prospective nutraceuticals for fortification of dairy foods. Nutritional significance of dietary fibers, classes of dietary fibers, fortification techniques for fibers in dairy foods.
- Unit – 4:** Infant nutrition and dietary formulations for meeting normal and special needs of infants, current status of infant foods, additives for infant foods. Foods for aged persons, design consideration, ingredients for geriatric foods.
- Unit – 5:** Technological aspects of reduced calorie foods, alternatives for calorie reduction, low calorie sweeteners, bulking agents and their application, fat replacers and their utilization in low calorie dairy foods.
- Unit – 6:** Nutritional and health significance of sodium in foods, Alternatives for sodium in foods, techniques for reducing sodium in processed dairy foods. Bio-flavours and flavour enhancers.
- Unit – 7:** Sports foods, ingredients for sports foods, dairy components in sports foods, sports drinks, design consideration, ergogenic aids in sports nutrition.
- Unit – 8:** Herbs, various classes of herbs, their therapeutic potential and application in foods with special reference to dairy products like functional drinks, herbal ghee etc.
- Unit – 9:** Prebiotic substances and their utilization in functional foods, symbiotic foods, technological aspects and recent development in probiotics, prebiotics and synbiotics.
- Unit – 10:** Definition and various classes of phytochemicals, their role in CVD, Cancer and immune system enhancer, utilization in functional foods, ~~phytosterol~~, phytoestrogens, glucosinolates, lycopene, isoflavonoids, glucosamine, organosulphur compounds, flavonoids, chatchins, tannins carotenoids, Phytoestrogens, phytosterols, pigments (lycopene, carcumine) etc. Phytatics ,Protease inhibitors, amylase inhibitors, Hemagglutinins, Saponins. Non nutrient effect of PUFA and MUFA, Vitamins and Mineral as proteins, Peptides and Neucleotides
- Unit – 11:** Functional foods and nutraceuticals for management of cholesterol, CVD, cancer, IBD, diabetics, obesity, joint pain, age-related macular degeneration, endurance performance, persons suffering with milk allergy and lactose intolerance with special emphasis on dairy nutrients and foods, mechanisms of action, dosage levels
- Unit – 12:** Nutrients as gene modulators: Its effect on puberty, reproduction, Polycystic Ovary and nutritional management. Mechanism of action of Xenoestrogen, Food sources of xenoestrogen, Nutrigenomics, Epigenetics
- Unit – 13:** Foodomics, Nutrigenomics, nutri-metabolomics, and nutri-proteomics

**Unit – 14:** Food Nanotechnology: Functionality and applicability of food nanotechnology, Nanocarrier systems for delivery of nutrients and supplements, Nanocoatings on food contact surfaces, Safety concerns

### **PRACTICAL**

1. Determination of total fiber, neutral detergent fiber in foods
2. Manufacture of fiber enriched milk beverage
3. Manufacture of low calorie burfi/ice cream
4. Preparation of flavoured milk using artificial sweetener and its estimation
5. Determination of antioxidant activity of food/food components
6. Determination of bioavailability of nutrients
7. Development of malted milk food and weaning food
8. Determination of  $\beta$ -galactosidase activity and application of lactases for lactose free dairy products
9. Determination of prebiotic potential of certain plant/milk components and their application in synbiotics dairy foods
10. Preparation of sports beverage, herbal dairy drinks
11. Preparation of high protein products
12. Identification and estimation of lycopene
13. Identification and estimation of carotene
14. Determination of total antioxidant capacity of selected nutraceuticals
15. Determination of gamma oryzanol content in rice bran oil
16. Determination of tocopherol content in rice bran oil
17. Determination of tannin content, ascorbic acid content in aonla juice
18. Development of protein enriched biscuits as a functional food
19. Production of functional food for diabetic patient
20. Determination of dietary fibre content in selected functional food
21. Preparation of symbiotic yoghurt/ dahi and its sensory and microbiological evaluation
22. Production of flavonoid rich food product and evaluation of flavonoid content in it
23. Development of labels for health foods
24. Production of carotenoids from pumpkin powder
25. Production of ginger and turmeric oleoresins and their used in food products
26. Visit to Functional food/ Nutraceuticals manufacturing industry

### **SUGGESTED READINGS**

1. Chadwick R. 2003. *Functional Foods*. Springer.
2. Desai BB. 2000. *Handbook of Nutrition and Diet*. Marcel Dekker.
3. Gibson G & William C. 2000. *Functional Foods*. CRC Press.
4. Goldberg I. (Ed.). 1994. *Functional Foods*. Chapman & Hall.
5. Haberstroh CE. 1991. *Fat and Cholesterol Reduced Foods*. Gulf Publ. Co.
6. Mazza G. 1998. *Functional Foods. Biochemical and Processing Aspects*. Technomic Publ. Co.
7. Mitchell H. 2006. *Sweeteners and Sugar Alternatives in Food Technology*. Oxford's Blackwell Publ.
8. Mitchell JR & Ledward DA. 1986. *Functional Properties of Food Macromolecules*. Elsevier.
9. Mudambi SR & Rajagopla MV. 1981. *Fundamentals of Foods and Nutrition*. Wiley Eastern.
10. Nabors Lyn O'Brien 2001. *Alternative Sweeteners*. Marcel Dekker.
11. Pomeranz Y. 1991. *Functional Properties of Food Components*. Academic Press.
12. Sadler MJ & Saltmarch M. 1998. *Functional Foods: The Consumer, The Products and the Evidence*. Royal Society of London.

13. Saltmarch M & Buttriss J. (Ed.). 2000. *Functional Foods II: Claims and Evidence*. Royal Society of Chemistry, London.
14. Schmidl MK & Labuza TP. 2000. *Essentials of Functional Foods*. Aspen Publ.
15. Shi J, Mazza G & Maguer M Le. 2002. *Functional Foods: Biochemical and Processing Aspects*. CRC Press.
16. Smith J. 1993. *Technology of Reduced Additives*. Blackie.
17. Watson RR. 2003. *Functional Foods and Nutraceuticals in Cancer Prevention*. Iowa State Press, Iowa
18. Mingruo Guo. 2009. *Functional food: principle and technology*. CRC Press .Woodhead publishing limited. New Delhi.
19. Robert EC. 2006. *Handbook of Nutraceuticals and Functional Foods*. 2nd Ed. Wildman.
20. Shi J. (Ed.). 2006. *Functional Food Ingredients and Nutraceuticals: Processing Technologies*. CRC Press.
21. Webb GP. 2006. *Dietary Supplements and Functional Foods*. Blackwell Publ.
22. Tomar S.K. 2011. *Functional Dairy Foods Concepts and Applications*. Satish Serial Publishing House, Delhi.
23. Gibson GR & William CM. 2000. *Functional Foods - Concept to Product*.
24. Mahan, L.K. and Escott Stump, S.2000. *Krause's Food Nutrition and Diet Therapy 10th Ed.*, WB Saunders & Co. London
25. Wildman, R.E.C. (2007) *Handbook of Nutraceuticals and Functional Foods*, second edition. CRC Press.
26. Gibson GR & William CM. *Functional Foods - Concept to Product*. 2000.
27. Goldberg I. *Functional Foods: Designer Foods, Pharma Foods*. 2004.
28. Brigelius-Flohé, J & Joost HG. *Nutritional Genomics: Impact on Health and Disease*. Wiley VCH. 2006.

## FTNM16: Communications Skill Development

**Tot. Cr.(T+P): 3(0+3)**

### PRACTICAL

**Communication Skills** - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

### Suggested Readings

1. Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
2. Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*. Abhishek.
3. Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2<sup>nd</sup> Ed. Prentice Hall of India.
4. Wren PC & Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.
5. MS Office 2007 in a Nutshell by S. Saxena, Publisher: S. Chand (G/L) & Company Ltd

## FTNM17: Computer Skill Development

Tot. Cr.(T+P): 3(0+3)

### PRACTICAL

**Computer skills** – Components of computer, MS-Word, MS-Excel, MS-PowerPoint, Internet, typing

### Suggested Readings

1. Fundamentals of Computers by E. Balagurusamy (Author) Publisher: McGraw Hill Education (India) Private Limited
2. Ms Office 2007 in a Nutshell by S. Saxena (Author) Publisher: S.Chand (G/L) & Company Ltd
3. Computer Fundamentals Paperback – by P. K. Sinha (Author) Publisher: BPP

## FTNM21: Advances in Food Processing - I

Tot. Cr.(T+P): 4(2+2)

### THEORY

**Unit – 1:** Status of food processing industry in India and abroad; prospects and constraints in development of Indian food industry.

**Unit – 2:** Post-harvest management of fruits and vegetables, Harvesting indices, Biochemical and physical changes during ripening of fruits & vegetables, respiration and factors affecting it, role of ethylene in accelerated ripening, storage of agricultural produce, Factors affecting shelf life of agriculture produce as well as products post-harvest treatments for extension of shelf-life of fresh produce, Strategic interventions to minimize postharvest losses including vapour heat treatment, wax coating, chemicals, etc. Advances in fruits and vegetable selection, grading, sorting, blanching and other pre-processing steps in automation of processing line

Storage of grains, biochemical changes during storage, production, distribution and storage capacity estimate models, storage capacity models, ecology, storage factors affecting losses, storage requirements.

Bag and bulk storage, godowns, bins and silos, rat proof godowns and rodent control, method of stacking, preventive method, bio-engineering properties of stored products, function, structural and thermal design of structures, aeration system. Physical factors influencing flow characteristics, mechanics of bulk solids, flow through hoppers, openings and ducts; recent advances in handling of food materials, Grain markets, storage pests and control, BIS/FSSAI standards.

**Unit – 3:** Principles of chilling & refrigeration storage of foods, quality changes in cold stored products, controlled and modified atmospheric storage. Freezing of foods, defects in frozen foods, re-crystallization, freezing of fruits and vegetables, freeze concentration of fruit juices.

**Unit – 4:** Application of heat energy to foods for preservation and processing

**Unit – 5:** Basic principles involved in fermentation, Technological aspects of pickled vegetables like sauerkraut, cucumbers, Technology of wine, beer and distilled alcoholic beverages, defects in alcoholic beverages.

**Unit – 6:** Advances in milling of rice (solvent extractive milling) and Turbo milling of wheat. Bakery products; role of ingredients, changes during processing of bakery products. Utilization and importance of dairy ingredients in bakery products.

**Unit – 7:** Definition, classification and technologies of fabricated and formulated foods and their nutritional aspects. Imitation dairy products and dairy analogues. Principle of extrusion processing, design and working of extruder, classification, application in food and dairy processing. Food additives, including stabilizers, emulsifiers, antioxidants, preservatives, etc. for formulated foods.

**Unit – 8:** Important group of enzymes involved in food processing; Application of enzymes in food processes like enzymes juice extraction, juice clarification, in bread manufacture, meat tenderization, ice cream manufacture, de- sugaring of egg, etc.

**Unit – 9:** Membrane Technology in Food Processing: Membrane techniques: Introduction, principle and classification. Physical and chemical characteristics of membrane, components of a membrane processing system. Construction materials of membrane- cellulosic and non-cellulosic membrane, configuration of membranes Techniques for membrane preparation. Functionality and selection of membrane, Applications of membranes for concentration and separation of food products. Factors affecting membrane fouling, flux enhancement and fouling control. Membrane maintenance-Physical and chemical cleaning

Ultrafiltration and Nano filtration: concept and working principle Vs conventional filtration, Application in the food industry- fruit juices, soy sauce, vegetable oil. Reverse osmosis, and microfiltration: concept and working principle, Application in the food industry- fruit juices, milk. Whey processing soy sauce, vegetable oil. Developments in the manufacture and utilization of food grade lactose from UF permeate. Use of membrane in preparation of-organic acids, biopolymers, vitamins, amino acids, low lactose powder, casein etc. Membrane technology for food processing waste treatment, membrane bioreactor and its application Emerging application of membrane processing (osmo-distillation): Introduction, concept and working Various commercial application and future trends

**Unit – 10:** Newer concepts in food processing including organic foods, processing of organic raw material, genetically modified foods.

## **PRACTICAL**

1. Determination of quality and maturity indices of selected foods
2. Measurement of respiration of fruits/grains in the laboratory and determination of shelf life
3. Determination of effects after different postharvest treatments
4. Study of evaporative cooling and cold storage systems for selected fruits and vegetables
5. Determination of WVTR & GTR in different packaging materials
6. Visits to traditional storage structures, CA storage , cold storage
7. Shelf life evaluation of packaged food products
8. MAP and its effect on shelf-life of fresh fruits and vegetables
9. Preparation of squash, cordial, nectar and whey beverages, whey based soups
10. Manufacture of bread, pizza base, biscuits and cake
11. Application of milk ingredients in caramel, egg-less cake, mayonnaise
12. Canning of fruits & vegetables
13. Manufacture of chicken soup, comminuted meat products
14. Enzymatic extraction and clarification of fruit juices
15. Preparation of soymilk and tofu
16. Drying of fruits & vegetables, efficacy of blanching treatment
17. Manufacture of sauerkraut/fermented vegetables

## **SUGGESTED READINGS**

1. Ramaswamy H.S. 2015. *Post harvest technologies for fruits and vegetables*. DESTech Publications, Inc
2. Chakraverty A. & Singh R.P. 2014. *Postharvest technology and food process engineering*. CRC Press
3. Chakraverty A., Mujumdar A.S. & Ramaswamy H.S. 2002. *Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices*. CRC Press
4. Wills R. & Golding J. 2016. *Postharvest: An Introduction to the Physiology and Handling of Fruit and Vegetables*. CABI
5. FAO. 1984. *Design and Operation of Cold Stores in Developing Countries*. FAO.
6. Hall CW 1970. *Handling and Storage of Food Grains in Tropical and Sub-tropical Areas*. FAO Publ. Oxford & IBH.
7. Henderson S & Perry SM. 1976. *Agricultural Process Engineering*. 5 th Ed. AVI Publ.
8. McFarlane Ian. 1983. *Automatic Control of Food Manufacturing Processes*. Applied Science Publ.
9. Multon JL (Ed). 1989. *Preservation and Storage of Grains, Seeds and their By-products*. CBS.
10. Ripp BE 1984. *Controlled Atmosphere and Fumigation in Grain Storage*. Elsevier.
11. Shefelt RL & Prussi SE. 1992. *Post Harvest Handling – A System Approach*. Academic Press.
12. Shejbal J (Ed). 1980. *Controlled Atmosphere Storage of Grains*. Elsevier.
13. Vijayaraghavan S. 1993. *Grain Storage Engineering and Technology*. Batra Book Service
14. Fellows PJ. 2000. *Food Processing Technology: Principles and Practices*. 2nd Ed. CRC-Woodhead Publ.
15. Fennema CR. 1975. *Principles of Food Science*. Part II. *Physical Principles of Food Preservation*. Marcel Dekker.
16. Guy R. 2001. *Extrusion Cooking: Technologies and Applications*. CRC- Woodhead Publ.
17. Honseney RC. 1986. *Cereal Science and Technology*. American Association of Cereal Chemists, St. Paul, Minnesota.
18. Hui YH, Meunier-Goddick L, Hansen AS, Josephsen J, Nip WK, Stanfield PS & Toldra F. 2004. *Handbook of Food and Beverage Fermentation*. Marcel Decker.
19. Hui YH, Nip WK, Rogers RW & Young DA. 2001. *Meat Science and Application*. Marcel Decker.
20. Cui Z.F. and Muralidhara H.S. 2010. *Membrane Technology A Practical Guide to Membrane Technology and Applications in Food and Bioprocessing*. Butterworth-Heinemann (imprint of Elsevier), Oxford, UK
21. Cheryan M.1998. *Ultrafiltration and Microfiltration Handbook*. Technomic Publ. House.
22. Zadow JG. 1994. *Whey and Lactose Processing*. Elsevier

## **FTNM22: Advances in Food Processing - II**

**Tot. Cr.(T+P): 4(2+2)**

### **THEORY**

**Unit -1:** Emerging technology in food processing- HPP, PEF, Ultra sound. Supercritical fluid extraction: Concept, property of near critical fluids NCF and extraction methods. Application of SCFE in food processing

**Unit -2:** Microwave and radio frequency, IR drying: Definition, Advantages, mechanism of heat generation, inductive heating in food processing and preservation. Application in food processing: microwave blanching, sterilization and finish drying. Hurdle technology: Types of preservation techniques and their principles, concept of hurdle technology and its application.

**Unit -3:** High Pressure processing: Types of equipment, mechanism of microbial inactivation Effect of HPP on -fruit juices, meat products, jam Ultrasonic processing: Properties of ultrasonic, types of equipment, effect of ultrasonic treatment on microbial inactivation, oil yield etc.

**Unit -4:** High intensity light generation system, Application of high intensity light in food processing, Pulse electric field-mechanism of inactivation, PEF generation system, PEF treatment chambers, Mechanism of ohmic heating and its application in liquid food processing, Principle of cold plasma technology and its generation systems and its application Nanotechnology: Principles and its applications in foods.

**Unit -5:** Cryogenic grinding- Properties of cryogenes, systems, and their different applications

**Unit -6:** RTE Food products; Overview of grain-based snacks: whole grains – roasted, toasted, puffed, popped and flakes. Coated & enrobing grains-salted, spiced and sweetened. Flour based snack– batter and dough based products; *savoury* and *farsans*; formulated chips and wafers, papads.

Technology for coated nuts – salted, spiced and sweetened products- *chikkis*, *Sing bhujia*. Technology of ready to eat fruits and vegetable based food products like, sauces, fruit bars, glazed candy etc. Technology of ready to eat canned value added fruits/vegetables and mixes and ready to serve beverages etc. Technology for ready-to-cook food products- different puddings and curried vegetables etc. Technology for ready-to-cook and ready to eat meat and meat food products

Technology of ready- to- eat baked food products, drying, toasting roasting and flaking, coating, chipping.

Extruded snack foods: Formulation and processing technology, colouring, flavouring and packaging Products and Byproduct of cereal and millets: infant foods from cereals and millets, breakfast cereal foods – flaked, puffed, expanded, and shredded products, etc.

Technology for preparation of instant cooked rice, carrot and other cereals based food products. Technology of ready to eat instant premixes based on cereals, pulses etc.

Technology for RTE puffed snack- sand puffing, hot air puffing, explosion puffing, gun puffing etc. Technology for preparation of traditional Indian dairy products

**Unit -7:** Applications of nanotechnology in food technology and nutrition

## **PRACTICAL**

1. To evaluate the characteristics of treated water using RO system
2. To carry out ultrafiltration study on fruit juices
3. To carry out nanofiltration study on liquid foods
4. To study super critical fluid extraction system and to carry out extraction of eugenol from Basil leaves
5. To carry out extraction of lycopene from tomato using SCFE system
6. To study microwave system and to evaluate the effect of different power on drying characteristics of selected vegetable product
7. To study microwave blanching of fruits and vegetable and determination of blanching efficacy
8. To study the ultrasonicator and evaluate the effect of ultrasonication on micro-organism present in idli batter
9. To study the ultrasonicator and to evaluate the effect of ultrasonication on extracted juice yield from fruit pomace
10. To evaluate the different pre-treatment on oil yield from oil seed cake
11. To study cryogenic grinding of selected spices



12. To compare the yield and quality of bioactive compounds obtained from cryogenically ground spice
13. To prepare nano emulsion and study of their characteristics
14. To study ohmic heating system and to study the processing of fruit pup using ohmic heating system
15. Determination of Hardness in water.
16. Determination of Chloride content in water.
17. To visit food industries utilizing advance food processing techniques

### **SUGGESTED READINGS**

1. Barbosa-Canovas 2002. *Novel Food Processing Technologies*. CRC.
2. Dutta AK & Anantheswaran RC.1999. *Hand Book of Microwave Technology for Food Applications*.
3. Frame ND. (Ed.). 1994. *The Technology of Extrusion Cooking*. Blackie.
4. Gould GW. 2000. *New Methods of Food Preservation*. CRC.

## **FTNM23: Advances in Food Packaging**

**Tot. Cr.(T+P): 3(2+1)**

### **THEORY**

- Unit – 1:** Status of current packaging; types of packaging materials; criteria for selection of proper packaging; testing of packaging materials.
- Unit – 2:** Adhesives; graphics; coding, and labeling used in food packaging.
- Unit – 3:** Protective packaging of foods; packaging of food products sensitive to oxygen, light, moisture; active packaging; special problems in canned foods.
- Unit – 4:** Packaging of dairy products; packaging of convenience foods, packaging of fruits, vegetables, and fruit juices.
- Unit – 5:** Packaging of fats and oils; packaging of spices; packaging of meat and poultry; packaging of fish and other seafoods.
- Unit – 6:** Modified atmosphere packaging, controlled atmosphere packaging, shrink and stretch packaging.
- Unit – 7:** Retort pouch technology, microwavable, biodegradable, and edible packages.
- Unit – 8:** Industrial packaging: unitizing, palletizing, containerising, distribution systems for packaged foods including prevention of shock damage to articles during transportation
- Unit – 9:** Safety aspects of packaging materials; sources of toxic materials and migration of toxins into food materials.
- Unit –10:** Active and intelligent packaging systems, Advances in Active packaging techniques and Intelligent packaging techniques. Current use of novel packaging techniques in different food products, consumers acceptance of novel food packaging
- Unit –11:** Oxygen and ethylene, scavenging technology, concept and its food applications. Carbon dioxide, odor and flavour absorber and other scavengers, ethanol emitters and preservative releaser, and their food packaging uses. Antimicrobial food packaging: concept and mechanism, Factors affecting the effectiveness of antimicrobial packaging.

- Unit –12:** Non-migratory bioactive polymers (NMBP) in food packaging, Advantages and limitations. Inherently bioactive synthetic polymers: types and applications, Polymers with immobilized bioactive compounds.
- Unit –13:** Time-temperature indicators (TTIs), Definition and classification of TTIs, Requirement, development and current TTI systems, effectiveness of TTIs, Application of TTIs- to monitor shelf-life, and optimization of distribution and stock rotation
- Unit –14:** Packaging-flavour interactions, Factors affecting flavour absorption, Role of the food matrix and different packaging materials. Case studies: Packaging and lipid oxidation, Modelling lipid oxidation and absorption. Shelf life evaluation of packaged food
- Unit –15:** Permeability properties of polymer packaging, measurement of permeability – water and gases. Selection criteria of packaging films. Novel MAP gases, Testing novel MAP applications, Novel MAP applications for fresh and prepared food products,
- Unit –16:** Aseptic packaging technology-advances, systems and its food applications, packaging for high pressure processing
- Unit –17:** Process of packaging: bottling, canning, labelling form fill sealed and cartooning machinaries, vacuum and gas packaging, CAP, lined cartooning, system. PET, pre form, tetra pack, flash 18 process, biocomposite and alternative packaging.
- Unit –18:** Packaging standards and regulation: laws, specifications and quality control, collection, separation, disposal and recycling of packaging materials. Effect of packaging materials on environment.

## **PRACTICAL**

1. Testing of packaging materials for quality assurance like determination of thickness, GSM, bursting strength, tearing resistance, puncture resistance, Dart impact test, Scotch test
2. Estimation of shelf life of vegetables and seasonal fresh fruits;
3. Packaging of turmeric powder and ground red chilli powder,
4. Vacuum packaging of dairy products.
5. Determination of WVTR in different packaging materials
6. Determination of GTR in different packaging materials.
7. Development of ethylene scavengers for fresh fruits and vegetables
8. Development of oxygen scavengers systems for food products
9. Application of anti-microbial packaging for moisture sensitive foods
10. Evaluation of chemical residue migration from package to food
11. Application of MAP packaging in selected foods
12. Study of time temperature indicators
13. Determination of oxidative changes in packaged foods
14. Comparative evaluation of flexible and rigid packages for fragile foods
15. Packaging of foods under inert atmosphere.
16. To study textural characteristics of selected fruit/ vegetable under MAP storage
17. Shelf life evaluation of packaged food product.
18. Study of aseptic packaging system
19. Determination of oil and grease resistant test for packaging films
20. Determination of respiration rate in fresh fruits and vegetables
21. Visit to food packaging material manufacturing industry

## SUGGESTED READINGS

1. F.A. Paine Fundamentals of packaging , 2<sup>nd</sup> edition by, published by Institute of Packaging, 1981.
2. Heiss, Principles of Food Packaging- an introductioal guide revised published by Heusenstamm:FAO/ Keppler,1970.
3. Sacharow S & Griffin RC.1980. *Principles of Food Packaging*. AVI Publ.
4. Ahvenainen R. 2001. *Novel Food Packaging Techniques*. CRC.
5. Crosby NT. 1981. *Food Packaging Materials*. App. Sci. Publ.
6. Mahadeviah M & Gowramma RV. 1996. *Food Packaging Materials*. Tata McGraw Hill.
7. Painy FA. 1992. *A Handbook of Food Packaging*. Blackie.
8. Palling SJ. 1980. *Developments in Food Packaging*. App. Sci. Publ.
9. Rooney ML. 1988. *Active Food Packaging*. Chapman & Hall.
10. Coles R, McDowell D & Kirwan M.J. 2003. *Food Packaging Technology*. Oxford Blackwell.
11. Frank A, Paine H & Paine Y. 1983. *A Handbook of Food Packaging*. Leonard Hill.
12. Gordon L Robertson. 2006. *Food Packaging: Principles and Practice*. 2nd Ed. CRC Press.
13. Malhlouthi M. 1994. *Food Packaging and Preservation*, Blackie. Raija A. 2006. *Novel Food Packaging*.
14. Woodland Publ. Co.

## FTNM24: Food Quality Management Systems

**Tot. Cr.(T+P): 3(2+1)**

### THEORY

- Unit – 1:** Introduction to food - its nutritional, technological and safety aspects. Introduction to Indian legal system, an overview of food regulations in India. Food safety and standards act and role of FSSAI. Various food plant inspection bodies and legislations.
- Unit – 2:** International Standards: Codex Alimentarius: Structure of organization, standards related to Indian foods.
- Unit – 3:** Introduction to food safety: definition, food safety issues, factors affecting food safety, importance of safe foods. Shelf life of food products: factors affecting shelf life and methods to check the shelf life.
- Unit – 4:** Food contaminants of natural origin- seafood toxins, toxic amino acids and others. Indirect additives: pesticides, pesticide residues, metallic contamination, radionuclides, other adulterants.
- Unit – 5:** Good Hygienic Practices (GHP), Good Manufacturing Practices (GMP), Food Safety Plan, Food Safety Management Risk Analysis. Traceability, food product recall.
- Unit – 6:** Food safety Management Systems: ISO 22000: Importance of implementing a HACCP system and how it can be applied to various products, develop a HACCP plan including a HACCP team, produce product workflow diagrams for a range of products and their verification processes etc. Audits: Introduction, objectives, documentation, responsibilities, management review, audit certification and its importance etc.
- Unit – 7:** ISO 14000: Introduction, various standards among 14000 series, certification and its importance, various clauses of 14001. ISO 17025 - General requirements for the competence of testing and calibration laboratories. ISO 9000 – Quality Management System
- Unit – 8:** Good agricultural practices for crops, land animals, human beings, finished goods etc. Good manufacturing practices: Concept, current problems in food industry and solutions using good manufacturing practices.

**Unit – 9:** World Trade Organization (WTO), Sanitary and Phytosanitary Measures and Technical Barriers to Trade, Food and Agriculture Organization (FAO), World Health Organization (WHO), World Animal Health Organization, International Plant Protection Convention (IPPC) Export – Import of Food.

**Unit – 10:** Six sigma, 5-S, Kizen

### **PRACTICAL**

1. Preparation of quality manual of a food company
2. Shelf life study of any food product.
3. Study of food regulations in various countries
4. Study of nutritional labeling of packaged food items by visiting food market,
5. Visit the websites of FSSAI, BIS, AGMARK, ISO, Codex Alimentarius Commission , USFDA
6. HACCP plan for any food industry
7. Licensing and registration process
8. Adulteration test of food sample [Physical test, chemical test, DART (Detect adulteration with rapid test)]
9. Methods to eliminate anti-nutritional factors from foods

### **SUGGESTED READINGS**

1. FSSAI (2011). Food safety and standards (Food product standards and Food Additives) regulation.
2. Neal D. Fortin. 2009. Food regulation, Wiley Publishers.
3. Naomi Rees. David Watson. 2000. International standards for food safety, Aspen Publications.
4. Assuring food safety and quality. 2012. FAO Food and Nutrition Manual., FAO publications, Rome.

## **FTNM25: Mechanical operation and chemical engineering fundamentals**

**Tot. Cr.(T+P): 4(2+2)**

### **THEORY**

**Unit 1:** Engineering properties of biological materials and their significance in equipment design; processing and handling of products.

**Unit 2:** Fluid flow operations: food rheology, mechanical energy balance, piping system, flow measurement and pumping equipment

**Unit 3:** Mechanical processing: Size reduction, size enlargement, mixing and forming, conveying of solids and separations.

**Unit 4 :** Heat transfer: coefficients, heat exchangers, electrical/radiation heating and applications

**Unit 5:** Mass transfer: vapour/liquid equilibria, distillations, solvent extraction, gas/liquid absorption, adsorption and ion exchange, crystallization and osmo concentration of food

**Unit 6:** Thermal processing: kinetics of thermal inactivation, heat transfer considerations, equipment, in-container sterilization, continuous-flow sterilization, pasteurization, baking, roasting and frying.

**Unit 7:** Drying: Psychrometrics, drying kinetics, dryer design, drying equipment, energy efficiency in drying

**Unit 8:** Process analysis: spreadsheet applications, heat exchanger problem formulation & solution, psychrometric calculation, fitting curves and statistical quality control

**Unit 9:** Electrical conductivity of the fluid, Theory of electrolytic activity, dielectric properties of basic food principle, Assessment of Food quality using dielectric properties.

**Unit 10:** Hydraulic separation and expansion-mechanics of settling, Hydraulic pressing, heavy media separation, elutriation and tabling.

**Unit 11:** Sedimentation and flocculation- free and hindered settling, thickening, counter current decantation, flow through packed bed and pressure drop calculations, flocculation and flocculating agents.

**Unit 12:** Basic concepts of Filtration and centrifugation.

**Unit 13:** Mixing of solids, liquids and slurries- agitating, kneading, blending and homogenizing.

## **PRACTICAL**

1. Determination of particle density / true density, bulk density and specific gravity of solid grains / fruits and vegetable
2. Determination of coefficient of friction, angle of internal friction and aerodynamic property(Terminal Velocity) of grain sample
3. Determination of viscosity of food materials
4. Study of various types of heat exchangers
5. Mixing – determining \mixing parameters
6. Chemical kinetics in food processing a) Determining rate constants of zero, first order reactions and half-life of reactions
7. Microbial destruction in thermal processing of foods a) Determining decimal reduction time from microbial survival data b) Thermal resistance factor, z-value, in thermal processing of foods c) Determining process lethality for conduction heating food with a microorganism with a z-value d) Determining center and mass-averaging sterilizing value for a thermal process
8. Mechanical transport of liquid foods a) Measuring viscosity of liquid foods using a capillary tube viscometer b) Rheological properties of power law fluids
9. Steady state heat transfer in food processing a) Reducing heat transfer through a wall using insulation b) Selecting insulation to reduce heat loss from cylindrical pipes c) Convective heat transfer coefficient in laminar flow conditions d) Convective heat transfer coefficient in turbulent flow conditions
10. Transient heat transfer in food processing a) Predicting temperature in a liquid food heated in a steam jacketed kettle b) Transient heat transfer in spherical shaped foods c) Transient heat transfer in a cube
11. Solving simultaneous equations in designing multiple-effect evaporators

## **SUGGESTED READING**

1. Chemical reactor theory- an Introduction by K.G. Denbeigh, J.C.R. Turner, published by CUP Archive, 1984.
2. Fundamentals of Food Process Engineering 3 rd edition by Romeo T. Toledo published by Kluwer Academic/ Plenum Publishers, New York, London, 1999
3. McCabe, W.L. Smith, & Peter Harriot, Unit operations of chemical engineering. 5<sup>th</sup> ed. New York; London: McGraw-Hill, 1993.
4. Blackadder, D.A. and Nedderman, R.M. (1971), A Handook of Unit operations, academic, London

5. TREYBAL, R.E., Mass transfer, 3<sup>rd</sup> edition, McGraw Hill, New York, 1987.
6. Romeo T. Toledo ,Fundamentals of food process engineering, 2<sup>nd</sup> ed. , New York: Chapman & Hall, 1991.
7. Saravacos G.D. & Maroulis Z.B. 2011. *Food Process Engineering Operations*. CRC Press.
8. Chandra P.K. & Singh R.P. *Applied Numerical Methods for Food and Agricultural Engineers*. CRC Press.
9. Singh R.P. *Computer Applications in Food Technology*. Elsevier Science & Technology

## **FTNM26: Food Plant Layout and Management**

**Tot. Cr.(T+P): 3(2+1)**

### **THEORY**

**Unit- 1:** Introduction: definition, basic concepts of plant layout and design with special reference to food process industries. Application of haccp concept, iso, fpo & mpo requirements in food plant layout and design.

**Unit -2:** Plant location: influence of location on plant layout, location factors, location theory and models, economic plant size, types of manufacturing processes like continuous, repetitive and intermittent processes.

**Unit -3:** Plant layout: preparation of a plant layout, plant layout problem, importance, objectives, classical types of layouts. Evaluation of layout. Advantages of good layout

**Unit – 4:** Plant building: considerations in building design, type of factory buildings, choice of building construction, material for floors, foundation, walls, doors, windows, drains etc, ventilation, fly control, mold prevention and illumination in food processing industries.

**Unit -5:** Plant layout & Equipment Layout: Plant layout and design of bakery and biscuit industries; fruits and vegetables processing industries including beverages; milk and milk products; meat, poultry and fish processing industries.

### **PRACTICAL**

1. Preparation of project report
2. Preparation of feasibility report Layout of food storage wares and godowns
3. Visit to food storage wares and godowns
4. Layout and design of cold storage
5. Visit to cold storage plant
6. Layout of preprocessing house
7. Layout of milk and milk product plant
8. Visit of milk processing plant Layout and design of bakery and related product plant
9. Visit to bakery unit
10. Layout and design of fruit processing plant
11. Layout and design of vegetable processing plant
12. Visit to fruit and vegetable processing plant Design and layout of multiproduct and composite food plant
13. Waste treatment and management of food plant

## SUGGESTING READING

1. John Holah, H. L. M. Lelieveld, (2011), “Hygienic Design of Food Factories”, Elsevier Publication.
2. J. Peter Clark, (2008), “Practical Design, Construction and Operation of Food Facilities”, Academic Press Publishers.
3. Zacharias B. Maroulis, George D. Saravacos, (2007), “Food Plant Economics”, CRC Press Publishers.
4. Antonio Lopez-Gomez, Gustavo V. Barbosa-Canovas, (2005), “Food Plant Design”, CRC Press Publishers.

## FTNM27: Research Methodology and Statistics

**Tot. Cr.(T+P): 4(1+3)**

### THEORY

#### *A. Research Methodology*

**Unit -1:** Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.

**Unit -2:** Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.

**Unit -3:** Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.

**Unit -4:** Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design - concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

**Unit -5:** Bioassays- direct and indirect, indirect assays based on quantal dose response, parallel line and slope ratio assays potency estimation.

**Unit -6:** Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

#### *B. Statistics*

**Unit 1:** Applications of statistical procedures in food processing, Descriptive statistics, Analysis of differences, Types of significance test, Association, correlation and regression and Experimental design

**Unit 2:** Sensory and consumer data: Introduction, The quality and nature of sensory and consumer data, Experimental design issues, Consumer data (sensory and survey), Trained panel sensory data, Analysis of relationships

**Unit 3:** Instrumental data: Introduction, Quality and nature of instrumental data, Sampling and replication, Experimental design issues, Statistical analysis of instrumental data, Chemical analysis applications, Analysis of relationships

**Unit 4:** Food product formulation: Introduction, Design application in food product development, Single ingredient effects, Two or more ingredients, Screening of many ingredients, Formulation by constraints

**Unit 5:** Statistical quality control: Introduction, Types of statistical quality control, Sampling procedures, Control charts, Acceptance sampling

**Unit 6:** Multivariate applications: Introduction, Multivariate methods and their characteristics, Multivariate modes, Relationship of consumer preference with sensory measures

**Unit 7:** Correlation analysis, regression analysis, test of hypothesis, Chi-Square test, F-test, Non-parametric test, t-test, one way ANOVA, Two way ANOVA, quantification of experimental data by statistical method like Response Surface methodology, use of Design expert, use of ORIGIN, use of ms Excel in statistical aspects.

**Unit 8:** Principal component analysis, Chemometrics, Partial least square, Response surface methodology, Mixture design, Fractal analysis, Cluster analysis, ANN and Fuzzy logic

### SUGGESTED READINGS

1. Bhalla GS & Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
2. Punia MS. *Manual on International Research and Research Ethics*. CCS, Haryana Agricultural University, Hisar.
3. Montgomery D.C. 1997. *Design and Analysis of Experiments 4ed*. Wiley
4. Geisser S. 1993. *Predictive Inference: An Introduction*. Chapman & Hall.
5. John A. Bower 2013. *Statistical Methods for Food Science: Introductory Procedures for the Food Practitioner 2ed* Wiley Blackwell.
7. Everitt BS & Dunn G. 1991. *Advanced Multivariate Data Analysis*. 2nd Ed. Arnold.
8. Gupta SP, *Statistical Methods*, Sultan Chand & Books, Educational Publishers, New Delhi

## FTNM28: Technical Writing

**Tot. Cr.(T+P): 2(0+2)**

### PRACTICAL

Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review and research article.

### Suggested Readings

1. *Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
2. *Collins' Cobuild English Dictionary*. 1995. Harper Collins.
3. Gordon HM & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston.
4. Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
5. James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.



6. Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
7. Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
8. Richard WS. 1969. *Technical Writing*. Barnes & Noble.

## **FTNM31: Sensory Evaluation**

**Tot. Cr.(T+P): 3(2+1)**

### **THEORY**

**Unit -1:** General testing conditions, Requirements of sensory laboratory; Organizing sensory evaluation program, Development of sensory testing, human subjects as instruments (test design, instrumentation, interpretation of results)

**Unit -2:** Sensory attributes, appearance (colour, size and shape, surface texture, clarity, carbonation), odour/ aroma/ fragrance, consistency and texture, noise Human senses (sense of vision, sense of touch, olfactory sense, sense of taste, sense of hearing)

**Unit -3:** Test controls, test room design, location, the booth, descriptive analysis and training area, preparation area, storage. General design factor, colour and lightning, air circulation, temperature and humidity, construction material. Sample preparation, supplies and equipment, materials, preparation procedure, sample preparation, order, coding, number of samples, product sampling

**Unit -4:** Panelist control, Panel training orientation, Factors affecting sensory verdicts, physiological factors, psychological factors, poor physical condition,

**Unit -5:** Different tests for sensory evaluation, Difference (Qualitative test: Paired comparison, duo-Trio, Triangle test). Rating (Quantitative: Ranking, single, two and multiple sample, hedonic, Numerical scoring, composite), Sensitivity (Threshold, dilution)

**Unit -6:** Applications and Advances in Electronic-Nose Technologies, Aroma Types and Characteristics, Conceptual Development of the Electronic Nose and instrumentation, Data Analysis for Electronic Noses, E nose applications. Electronic tongue

**Unit -7:** Computer-aided sensory evaluation of food & beverage, statistical analysis of sensory data.

### **PRACTICAL**

1. Selection and training of sensory panel
2. Detection and threshold tests
3. To study the masking effect of different taste
4. To study Paired comparison test
5. To study Duo-Trio test
6. Ranking tests for taste, aroma colour and texture
7. To study hedonic rating test
8. Sensory evaluation of various food products using hedonic scales
9. Sensory evaluation of various food products using different scales, score cards and tests
10. Sensory evaluation of various food products using fuzzy logic
11. Objective estimation of color and texture
12. Subjective estimation of color and texture
13. To study single sample test
14. Statistical analysis of single sample test
15. To study two sample difference test

## 16. Statistical analysis of single sample test

### SUGGESTED READINGS

1. Amerine MA, Pangborn RM & Rossles EB. 1965. *Principles of Sensory Evaluation of Food*. Academic Press.
2. Early R. 1995. *Guide to Quality Management Systems for Food Industries*. Blackie Academic.
3. Jellinek G. 1985. *Sensory Evaluation of Food - Theory and Practice*. Ellis Horwood.
3. Lawless HT & Klein BP. 1991. *Sensory Science Theory and Applications in Foods*. Marcel Dekker.
4. Maslowitz H. 2000. *Applied Sensory Analysis of Foods*. Vols. I, II. CRC Press.
5. Morten C. Meilgaard, B. 2007. *Sensory Evaluation Techniques*, Fourth Edition. Thomas Carr, Gail Vance Civille
6. Piggot JR. 1984. *Sensory Evaluation of Foods*. Elbview Applied Science Publ.
9. Rai SC & Bhatia VK. 1988. *Sensory Evaluation of Agricultural Products*. Indian Agricultural Statistics Research Institute (ICAR).
10. Stone H & Sidel JL. 1985. *Sensory Evaluation Practices*. Academic Press.
11. Watts CM, Ylimaki CL, Jaffery LE & Elias LG. 1989. *Basic Sensory Methods for Food Evaluation*. Int. Dev. Res. Centre, Canada.

## **FTNM32: Food Emulsions, Foams, Gels and Food Rheology and Microstructure**

**Tot. Cr.(T+P): 5(4+1)**

### THEORY

#### ***A. Technology of Food Emulsions, Foams and Gels***

**Unit -1:** Food dispersions, their characteristics and factors affecting food dispersions.

**Unit -2:** Food emulsions- conventional and nano emulsions; emulsifiers and their functions in foods; HLB concept in food emulsifiers; Emulsion formation and stability; Examples of emulsions in food- mayonnaise, sauce, beverages Polymers and surfactants.

**Unit -3:** Foam morphology- dry and wet, Structure of foams- ordered and disordered, foam formation and stability, Foam ripening and coalesce, Advantage and disadvantages of foam in food processing, Foam generation, Foaming agents, antifoaming agents Egg foams and uses, milk foams and their applications,

**Unit -4:** Theory of gel formation; pectic substances and jellies; fruit pectin gels; fruit jellies.

**Unit -5:** Structure of foods representing emulsions, foams and gels; Physical structure of fat rich, concentrated, fermented, coagulated and dried products.

**Unit -6:** Techniques for evaluation of structure for food emulsions, foams and gels.

**Unit -7:** Application of foams in other food processing application Case study foam mat drying

#### ***B. Food Rheology and Microstructure***

**Unit -1:** Introduction to rheology of foods: Definition of “texture”, “rheology” and “psychophysics” – their structural basis; salient definitions –Stress tensor and different kinds of stresses.

**Unit -2:** Rheological classification of fluid foods : Shear-rate dependence and time dependence of the flow-curve; Non-Newtonian fluids; thixotropy; Mechanisms and relevant models for non-Newtonian flow; Effect of temperature; Compositional factors affecting flow behaviour; Viscosity of food dispersions – dilute and semidilute systems, concentration effects.

**Unit -3:** Rheology of semi-solid and solid food; Rheological characterization of foods in terms of stress-strain relationship; rheology and flow characteristics of food powders, Viscoelasticity; Transient tests - Creep Compliance and Stress Relaxation Mechanical models for viscoelastic foods: Maxwell, Kelvin, Burgers and generalized models and their application; Dynamic measurement of viscoelasticity.

**Unit -4:** Large Deformations and failure in foods: Definitions of fracture, rupture and other related phenomena; Texture Profile Analysis; Instrumental measurements – Empirical and Fundamental methods; Rheometers and Texture Analyzers; Measurement of Extensional viscosity; Acoustic measurements on crunchy foods.

**Unit -5:** Rheological and textural properties of selected food products: Measurement modes and techniques; Effect of processing and additives (stabilizers and emulsifiers) on food product rheology; Relationship between instrumental and sensory data.

**Unit -6:** Examining food microstructures: history of food microstructure studies, light microscopy, transmission electron microscopy, scanning electron microscopy, other instrumentation and techniques, image analysis: image acquisition, image processing, measurement analysis.

**Unit -7:** Food structure: traditional food structure and texture improvement, approaches to food structure, extrusion and spinning, structured fat products, structure and stability, gels, gelation mechanisms, mixed gels, the microstructure of gels, structure-property relations in gels.

## **PRACTICAL**

### ***A. Technology of Food Emulsions, Foams and Gels***

1. Determination of the rate of formation and stability of emulsions
2. Determination of creaming index for an emulsion
3. Determination of emulsion stability index of emulsifier
4. Determination of emulsion capacity of an emulsifier
5. Determination of HLB value for an emulsifier
6. Preparation of mayonnaise (o/w emulsion)
7. To study role of emulsifier food emulsions
8. To carry out ringing test for beverage emulsions
9. Particle size characterization in beverage emulsion
10. To examine foam formation and determination of foam stability
11. To study foaming in food systems (Foam mat drying to product instant tomato powder)
12. To study gel formation and gel properties
13. Preparation of gelatine based food gels
14. Preparation of pectin based food gels
15. To study properties of various gelling agents for foods.

### ***B. Food Rheology and Microstructure***

1. Viscosity measurements of fruit juices using ostwald visometer
2. Viscosity measurements of liquid food products using Brookefield viscometer
3. To study the effect of temperature on viscosity of liquid foods
4. Development of stress and strain curve for Newtonian fluids

5. Development of stress and strain curve for Non Newtonian fluids
6. Determination of thermal conductivity of selected food products
7. Determination of specific heat of selected food products using differential scanning calorimetry
8. Texture analysis of fruits, vegetables and their products
9. Texture analysis of baked products (bread/ biscuit)
10. Starch characterization using starch master
11. Dough rheology using doughlab
12. Preparation of food emulsions and their stability study
13. Preparation of food gels and their characteristics
14. Determination of microstructures in selected foods using light microscopy
15. TEM and SEM, image analysis and image processing techniques
16. Evaluation of phase transition in colloidal systems, evaluation of structure texture function relations
17. To correlate subjective sensory evaluation with textural analyzer
18. Visit to food microstructure laboratory

### SUGGESTED READINGS

1. Blanshard JMV & Lillford P. 1987. *Food Structure and Behaviour*. Academic Press.
2. Hasehueti GL.1977. *Food Emulsifiers and their Application*. Chapman & Hall.
3. McClement DJ.1999. *Food Emulsions - Principles, Practice and Techniques*. CRC Press.
4. Srinivas D & Alain P.1977. *Food Proteins and their Applications*. Marcel Dekker.
5. Barbosa-Canovas GV, Kokini JL, Ma L & Ibarz A. 1997. *Rheology of Semi-liquid foods*. *Adv. Food & Nutr. Res.*, 39:1-69.
6. DeMann JM, Voisey PW, Rasper VF & Stanley DW. 1976. *Rheology and Texture in Food Quality*. AVI Publ.
7. Aguilera JM. 2001. *Micro Structure: Principles of Food Processing Engineering*.
8. Bechtel DB. 1983. *New Frontiers in Food Microstructure*. American Association of Cereal Chemists.
9. Moskowitz 1999. *Food Texture*. AVI Publ.
10. Stefee J.F. Rheological methods in food process engineering. Freeman Press.

## FTNM33: Instrumentation in Nutrition

**Tot. Cr.(T+P): 4(3+1)**

### THEORY

**Unit 1:** Introduction to Food Analysis: Introduction to food and its components, Sampling, Sample preservation, Extraction, Proximate analysis

**Unit 2:** Spectroscopic Techniques: Introduction & theory of spectroscopic techniques, - Principle, Instrumentation, application of each technique. UV-Visible, IR, Raman, & Mass spectroscopy, flame photometry, CD spectroscopy, NMR – Principle, Instrumentation, application of each technique. Potentiometry: principle, various electrodes; electrometric measurements of pH, buffers. Fluorescence, Turbidoimetric techniques – Principle, Instrumentation, application of each technique. AAS – Principle, Instrumentation, applications. NMR/ESR spectroscopy – Principle, Instrumentation, application.

**Unit 3:** Chromatographic Techniques: Introduction, column, gel-permeation, HPLC, GC, Paper chromatography, TLC/HPTLC, Ion chromatography, Flash chromatography – Principle, Instrumentation, applications of each technique.

**Unit 4:** Biological Techniques: Electrophoresis, PCR/RT-PCR, Immunoassays - Principle, Instrumentation, applications of each technique

**Unit 5:** Recent Techniques: Rheology, DSC/DTA/TGA/TMA, XRD/XRF, Electron microscopy, Refractivity, Polarimetry - Principle, Instrumentation, applications of each technique, Radio immuno assay (RIA), Enzyme linked immunosorbent assay (ELISA). Circular dichroism (CD), Protein sequencing, X-ray crystallography.

### **PRACTICAL**

1. Determination of moisture by Karl Fischer method
2. Determination of carotenes (spectrophotometric)
3. Determination of Vitamin C (spectrophotometric)
4. Determination of gingerol by HPLC
5. Determination of minerals by AAS
6. Fatty acid profile in lipids by GC
7. Determination of Chloride content by Ion Chromatography
8. Determination of thermal properties using DSC
9. Determination of rancidity using Rancimat
10. Determination of sugar concentration and solids using Refractometer
11. Separation of amino acids using TLC/HPTLC
12. Separation of food colors using TLC/HPTLC
13. Demonstration of PCR for Gene amplification
14. Agarose Gel Electrophoresis
15. Demonstration of ELISA test
16. Preparation of a buffer and measurement of its pH electro-metrically and using indicators
17. SDS gel electrophoresis and molecular weight determination
18. Determination of sodium and potassium by flame photometry
19. Separation of milk proteins using ion-exchange chromatography

### **SUGGESTED READINGS**

1. Food Analysis: Theory and Practice, 1994. Y. Pomeranz and C.E. Meloan. 3rd edn., Conn. (USA): AVI Publ. Co.
2. Stewart, K.K. and Whitaker, J.R. (1984). Modern Methods of Food Analysis. Conn: AVI Publ. Co.
3. James, CS. (1995). Analytical Chemistry of Foods. Blackie Academic and Professional, UK
4. Methods of analysis of food components and additives by Semih Otle, Published in 2005 by CRC Press

### **FTNM34: Software packages for statistical computing**

**Tot. Cr.(T+P): 3(0+3)**

### **PRACTICAL**

**Unit 1:** Research Design: Qualitative and quantitative research, measurement scale, concept of theory, construct and variables

**Unit 2:** Descriptive statistics, introduction to SPSS, data entry, data managing, creating graphs, assumptions of parametric tests (SPSS)

**Unit 3:** Parametric tests-dependent & independent sample t-test, ANOVA, Repeated measures ANOVA (SPSS)

Nonparametric tests-Mann Whitney, Kruskal-Wallis, Wilcoxon signed-rant test, Friedman ANOVA and Chi Square test (SPSS)

**Unit 4:** Multiple Regression Analysis (SPSS)

**Unit 5:** Discriminant Analysis, Logistic Regression Analysis (SPSS)

**Unit 6:** Introduction to mediation analysis, Testing simple mediation models. Introduction to moderation analysis, testing moderation models (Process Macro)

**Unit 7:** Exploratory Factor Analysis, Cluster Analysis (SPSS)

**Unit 8:** Introduction to CB-SEM: Concept of Confirmatory Factor Analysis (Measurement Model) and Structural Equation Model.

CFA & SEM with case study, interpreting and writing (AMOS)

**Unit 9:** Smart PLS: Introduction to PLS-SEM, Formative and Reflective measurement, Measurement Model Evaluation: (a) Convergent validity-three approaches, factor loading, variance extracted, reliability, (b) Discriminant validity (c) Cross-loadings

## **FTNM41: Intellectual Property and Its Management**

**Tot. Cr.(T+P): 4(4+0)**

### **THEORY**

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

### **SUGGESTED READINGS**

1. Erbisch FH & Maredia K.1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
2. Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
3. *Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC & Aesthetic Technologies.
4. Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. *Technology Generation and IPR Issues*. Academic Foundation.
5. Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
6. Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.
7. *The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000;*
8. *Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout*

9. *Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.*

## **FTNM42: Entrepreneurship Development Program**

**Tot. Cr.(T+P): 5(5+0)**

### **THEORY**

- Unit-1:** Business Management: introduction, theories and functions, food industry management, marketing management and human resource development, personal management. Sectors in food industry and scale of operations in India. International trade & global food consumption. Chance of Entrepreneurship Development in Economic Development. Characteristics, qualities and pre-requisite of entrepreneur: new generation entrepreneurship vs. social entrepreneurship. Women entrepreneurship. Tour entrepreneurship, contemporary issues in family business.
- Unit – 2:** Methods and procedures to start and expand one's own business; environmental factors affecting success of a new business: reasons for the failure and problems for new business
- Unit – 3:** Preparation of Feasibility Reports: Project Reports: Market Potential Measurement, Economic. Technical. Financial Marketing and Managerial Feasibility of Project, Preparation of Detailed Project Report.
- Unit – 4:** Pitching, Elevator pitching, Angel investors, venture capital funds, Incubators and its roles. Student start up, technopreneurs, social entrepreneurs and its distinct advantage. Working capital estimation, policy & programmes and agencies promoting entrepreneurship KVIC. NABARD, NSIC, SIDBI, EDII, NIESBUD, DIC etc.
- Unit -5:** Legal issues, environmental clearance, quality standards, and government stores purchase schemes (e-tender process), exemption from income tax, industrial parks & Food Park.

### **SUGGESTED READINGS**

1. Chhabra TN & Suria RK. 2001. Management Process and Perspectives. Kitab Mahal.
2. Jhingan ML. 2005. International Economics. 5th Ed. Virnda Publ.
3. Kotler P. 2000. Marketing Management. Prentice Hall.
4. Reddy SS, Ram PR, Sastry TVN & Bhavani ID. 2004. Agricultural Economics. Oxford & IBH.

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