



JAIN UNIVERSITY

Declared as Deemed-to-be University u/s 3 of the UGC Act, 1956

Master of Technology

*Department of Food
Technology – I to
IV*

Semesters Course Matrix & Syllabus



COURSE MATRIX AND SYLLABUS
Food Technology Division
M.Tech. Program in “Food Technology”
I- Semester

Sr No	Name of the Subject	Subject Code	Credit	L-T-P	Internal Assessment		End Semester Examinations		Minimum Passing Marks	Total Max. Marks
					Max. Marks	Min. Marks	Max. Marks	Min. Marks		
1	Food Chemistry	14FT11	4	4-0-0	50	25	50	25	50	100
2	Food Microbiology	14FT12	4	4-0-0	50	25	50	25	50	100
3	Nutritional Biochemistry	14FT13	4	4-0-0	50	25	50	25	50	100
4	Food Packaging Technology	14FT14	4	4-0-0	50	25	50	25	50	100
5	Elective		4	4-0-0	50	25	50	25	50	100
6	Lab - Food Microbiology	14FTL15	1	0-0-3	25	13	25	12	25	50
7	Lab - Food Chemistry	14FTL16	1	0-0-3	25	13	25	12	25	50
	Total		22		300	151	300	149	300	600



Electives

Sr no	Subject name	Subject code
1	Functional foods and Nutraceuticals	14FTEL11
2	Food storage and Infestation control	14FTEL12
3	Sanitation & Waste management in food industries	14FTEL13
4	Aromatic and Medicinal plants	14FTEL14

Food Technology Division
M.Tech. Program in "Food Technology"
II- Semester

Sr No	Name of the Subject	Subject Code	Credit	L-T-P	Internal Assessment		End Semester Examinations		Minimum Passing Marks	Total Max. Marks
					Max. Marks	Min. Marks	Max. Marks	Min. Marks		
1	Fruit And Vegetable Technology	14FT21	4	4-0-0	50	25	50	25	50	100
2	Grain Processing And Baking Technology	14FT22	4	4-0-0	50	25	50	25	50	100



3	Enzyme And Fermentation Technology	14FT23	4	4-0-0	50	25	50	25	50	100
4	Food Process Engineering - I	14FT24	4	4-0-0	50	25	50	25	50	100
5	Elective		4	4-0-0	50	25	50	25	50	100
6	Food Process Engineering - Lab	14FTL26	1	0-0-3	25	13	25	12	25	50
7	Lab - Basic Food Processing & Biotechnological Methods	14FTL25	1	0-0-3	25	13	25	12	25	50
	Total		22		300	151	300	149	300	600

Electives

Sr no	Subject name	Subject code
1	Plantation Products, Spices and Flavour Technology	14FTEL21
2	Water and Beverage Technology	14FTEL22
3	Meat, Poultry and Marine Food	14FTEL23
4	Lipid, Protein and Sugar technology	14FTEL24



Food Technology Division
M.Tech. Program in “Food Technology”
III- Semester

Sr No	Name of the Subject	Subject Code	Credit	L-T-P	Internal Assessment		End Semester Examinations		Minimum Passing Marks	Total Max. Marks
					Max. Marks	Min. Marks	Max. Marks	Min. Marks		
1	Food Process Engineering-II	14FT31	4	4-0-0	50	25	50	25	50	100
2	Food Analysis, Safety And Quality Control	14FT32	4	4-0-0	50	25	50	25	50	100
3	Dairy Technology	14FT33	4	4-0-0	50	25	50	25	50	100
4	Training - Food Analysis & Quality Control	14FTL34	4		50	25	50	25	50	100
5	VAP									
	Total		16		200	100	200	100	200	400

Value Addition Program (VAP): Entrepreneurship and Management of Food Plant



Food Technology Division
M.Tech. Program in "Food Technology"
IV- Semester

Sr No	Name of the Subject	Subject Code	Credit	L-T-P	Internal Assessment		End Semester Examinations		Minimum Passing Marks
					Max. Marks	Min. Marks	Max. Marks	Min. Marks	
1	Project Work	14FTPW45	20	0-0-0	100	50	400	200	250
Total			20		100	50	400	200	250



FOOD CHEMISTRY

Subject code: **14FT11**

IA Marks: **50**

No of Lecture Hrs / week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Carbohydrates - I)

Nomenclature Classification & structure of carbohydrates, Chemical reactions of carbohydrates. Physical & chemical properties of sugars. Chemistry, properties and preparation of Pectic substances, gums & polysaccharides **(7 h)**

UNIT – II (Carbohydrates - II)

Starch and its hydrolytic products, maltodextrins, Cellulose, Cyclodextrins. Modified Starches, Conversion of starch to sugars; Heteropolysaccharides and Gums **(7 h)**

UNIT – III (Proteins)

Importance of Proteins. Nomenclature, classification, structure and chemistry of amino acids, peptides & Proteins. Sources and distribution of Proteins. Isolation, identification & purity of proteins. Denaturation. Physical & chemical characteristics of Proteins **(10 h)**

UNIT – IV (Lipids - I)

Introduction and classification of lipids. Chemistry of fatty acids & glycerides. Components of Fatty acids, Phospholipids and unsaponifiables. Auto oxidation and hydrolysis, Physical & chemical characteristics of fats & oils, hydrogenated fats, shortening agents, confectionary fats etc **(7 h)**.

Part B

UNIT – V (Lipids - II)

Rancidity of fats & oils and its prevention, antioxidants. Flow chart representation of manufacture of edible oils. Refining of oils and hydrogenation of oils **(7 h)**

UNIT – VI (Vitamins)

Summary of vitamin stability – Toxicity and sources of vitamins – Bioavailability of vitamins – Reasons for the loss of vitamins in foods – Fat-soluble and water soluble vitamins – Choline, carnitine **(10 h)**



UNIT – VII (Chemistry of Pigments, Colors and Flavors I)

Fat & Water Soluble, Meat Pigments. Chlorophyll & chlorophyll derivatives, Haems and bilins, Carotenoids, annatto, saffron, turmeric- Stability to pH, temperature and other processing conditions - Technology for the production of dried colourants - Caramel colour **(9 h)**.

UNIT – VIII (Chemistry of Pigments, Colors and Flavors II)

Ingredients, Taste, Aroma, Undesirable flavors. Classification – Alliaceous flavours – Bittering agents, Coffee and Cocoa, Fruit flavours **(3 h)**

Text Books

1. Food chemistry by Meyer
2. Fundamentals of Biochemistry, J.L. Jain.
3. Textbook of Biochemistry, Lehninger.
4. Biochemistry, L. Stryer, W.H. Freeman and Company.
5. Outline of Biochemistry, Conn & Stumph.
6. Owen R Fennema : Food Chemistry – III edition Marcel Dekkar Inc. New York (1996).
7. Natural Food Colorants: Science and Technology, By Gabriel J. Lauro, , Frederick John Francis, CRC Press Pub., 2000.
8. Flavor Chemistry and Technology, By Gary Reineccius, Henry B. Heath, 2nd Edn., Taylor and Francis group, CRC Press, 2006.



FOOD MICROBIOLOGY

Subject code: **14FT12**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Introduction to Food Microbiology)

Principles that Influence Microbial Growth, Survival, and Death in Foods; microbial growth curve; Spores and Their Significance; Indicator Microorganisms and Microbiological Criteria **(8 h)**

UNIT – II (Microbial Spoilage of Foods)

Meat, Poultry, and Seafood; Milk and Dairy Products; Fruits, Vegetables and Grains **(8 h)**

UNIT- III (Food Borne Pathogens)

Gram positive and negative Bacteria; Toxigenic Molds; Viruses; Helminths; Protozoan parasites **(8 h)**

UNIT – IV (Control of Microorganisms in Food)

Antimicrobial Preservatives, Biologically Based Preservation and Probiotic Bacteria, Physical Methods of Food Preservation, Industrial Strategies for Ensuring Safe Food **(10 h)**

Part B

UNIT - V (Advanced Food Microbiology -I)

Detecting Foodborne Pathogens and Their Toxins- Conventional versus Rapid and Automated Methods; Genetic and Immunologic Techniques for Detecting Foodborne Pathogens and Toxins **(7 h)**.

UNIT - VI (Advanced Food Microbiology -II)

Predictive Modeling; Hazard Analysis and Critical Control Point System- Use in Controlling Microbiological Hazards **(7 h)**

UNIT – VII (Food Fermentations-I)



Lactic Acid Bacteria and fermented foods; Yeast based fermentations; Effect of fermentations on the properties of foods; generation of Biologically Active Compounds **(8 h)**

UNIT – VIII (Food Fermentations - II)

Elimination of Harmful Components; International Regulations Regarding Fermented Foods **(4 h)**

Text Books

1. Food Microbiology: Fundamentals and Frontiers / Edition 3, Michael P. Doyle, Larry R. Beuchat
2. Fermentation-Effects on Food Properties, Bhavbhuti M. Mehta, Afaf Kamal-Eldin, Robert Z. Iwanski
3. Food Microbiology: an Introduction, 2nd Edition, Thomas J. Montville, Karl R. Matthews
4. Principles of Fermentation Technology, P. F. Stanbury, A. Whitaker, and S. J. Hall
5. Fermentation Technology, M L Srivastava.



NUTRITIONAL BIOCHEMISTRY

Subject code: **14FT13**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **3 h**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT - I (Nutrition - Protein)

Energy Requirement, energy value of foods; Proteins- Nutritional aspects, protein deficiency diseases, the requirement of proteins **(8 h)**

UNIT - II (Nutrition - Fats)

Fats- Nutritional aspects, role of the essential fatty acids in our body, omega fatty acids, requirement of fat **(8 h)**

UNIT - III (Nutrition - Carbohydrates)

Carbohydrates- Nutritional aspects, types of sugars and their properties **(8 h)**

UNIT - IV (Nutrition - Vitamins and Minerals)

Vitamins and Minerals- Nutrition significance, deficiency diseases; Dietary fibers- Sources, importance in health; Balanced diets- RDA **(8 h)**

PART - B

UNIT – V (Carbohydrate Metabolism)

Glycolysis, Kreb's cycle, oxidative phosphorylation **(8 h)**

UNIT – VI (Carbohydrate Metabolism)

Hexoses mono phosphate shunt, energetics **(4 h)**

UNIT - VII (Lipid Metabolism)

Transport, storage, mobilization of fat in the body, fatty acid oxidation **(8 h)**

UNIT –VIII (Protein Metabolism)

Deamination, transamination, decarboxylation, amino acid oxidation **(8 h)**



Text Books

1. Principles of Biochemistry. Lehninger
2. Medical Biochemistry. Harpar
3. Biochemistry. Stryer
4. Voet D, Voet G, Principles of Biochemistry, Third Edition, John Wiley and Sons, 2008.
5. Martin Eastwood. Principles of Human nutrition – Second Edition, Ed. Wiley -Blackwell
6. Ronald Ross Watson, Functional foods and Nutraceuticals in Cancer Prevention, Ed.Wiley – Blackwell, 2003. ISBN-13: 978-0813818542
7. Lehninger A.L, Nelson D.L., M.M. Cox, Principles of Biochemistry, W.H. Freeman & Company Publications, 2008. ISBN - 071677108X

Reference Books

1. NIN- Food value

FOOD PACKAGING TECHNOLOGY

Subject code: **14FT14**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT - I (Packaging -I)

Theory- factors affecting the selection of a packaging material, interaction between packaging and foods; types of packaging materials-textiles and wood, metal, glass, flexible films, rigid and semi rigid plastic containers, paper and board (**8 h**)

UNIT - II (Packaging -II)

Combined packaging systems; packaging developments- edible and biodegradable packaging, nanotechnology, active and intelligent packaging; printing-barcodes and other markings;



environmental considerations- packaging costs, recycling **(8 h)**

UNIT – III (Selection of Packages)

Migration characteristics, Package for different individual groups of foods like dehydrated, liquid, frozen & processed foods–vacuum packaging of fruits & vegetables **(6 h)**

UNIT – IV (Selection of Packages)

Equipment & method– packaging equipment for solid, semi–solid & liquid food. Types of filling machines –glass bottle, pouches **(6 h)**

Part B

UNIT - V (Filling and Sealing of Containers)

Rigid and semi rigid containers- filling, sealing; flexible containers- form fill sealing; shrink wrapping and stretch wrapping; tamper evident packaging; labeling; check weighing; metal detection **(8 h)**

UNIT – VI (Thin Films Packaging - I)

Relative merits and demerits. Formation of Films and pouches, Plastics used and their Specific applications, advantages and disadvantages – Polyethylene (LDPE and HDPE), Cellulose, Polypropylene (PP), Polyesters, Polyvinylidene Chloride (PVDC - Diofan, Ixan and Saran), Polyvinyl chloride, Copolymers their applications **(8 h)**.

UNIT – VII (Thin Films Packaging - II)

Co-extruded films and Laminates - Their applications. Filling (Volumetric and Gravimetric) and Sealing of pouches, Pouch form fill seal machines: Rigid and Semi rigid plastic packaging – Fabrication methods in brief – Thermos forming, Blow molding, Injection molding, Extrusion Blow molding **(8 h)**

UNIT - VIII (Interaction of Food Material with Packaging Material)

Active packaging, Moisture control, CO₂ and Oxygen scavenging, modified atmosphere packaging

– Principles, applications. Vacuum and Inert Gas Packaging, Packaging standards and regulations, Packaging specifications and quality control **(8 h)**

Text Books

1. NIIR Board: Food Packaging Technology Handbook, National Institute of Industrial



Research, New Delhi (2004)

2. Shirly V. Vangrade and Morgy Woodburn: Food Preservation and Safety Surabhi Publications, Jaipur India
3. O. G. Pirenger and A. L. Baver: Plastic Packaging Materials for Food Wiely VCH, GmbH, Germany (2000)
4. Food Safety Regulation Concerns And Trade- The Developing Country Perspective, Ed. by Rajesh Mehta And J. George, Published by Macmillan India Ltd., New Delhi. 2005

Lab - FOOD MICROBIOLOGY

Subject code: **14FTL15**

IA Marks: **25**

No of Lecture Hrs/week: **03**

Exam Duration: **03**

Total No. of Lecture Hours: **30**

Exam Marks: **25**

1. To study the factors affecting the microbial growth- pH, temperature and osmotic pressure **(4 h)**
2. Identification of bacteria **(4 h)**
3. Studying the growth kinetics of microbes **(4 h)**
4. Determination of microbial numbers- direct and plate count method **(4 h)**
5. Production of food related metabolites by microbial solid and submerged fermentations **(4 h)**
6. Downstream processing of fermented products **(2 h)**
7. Microbial examination of food products **(4 h)**



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8. Formulation of probiotic cultures **(4 h)**



Lab - FOOD CHEMISTRY

Subject code: **14FTL16**

IA Marks: **25**

No of Lecture Hrs/week: **03**

Exam Duration: **03**

Total No. of Lecture Hours: **30**

Exam Marks: **25**

1. Stoichiometric determination and estimations- volumetry and gravimetry **(4 h)**
2. Determination of carbonate and bicarbonate in a mixture by P^H-metric titration and comparison with visual acid-base titration **(2 h)**
3. Determination of micronutrients in commercial food samples **(4 h)**
4. Preparation of food relevant organic compounds **(4 h)**
5. Estimation of vitamins from natural foods **(4 h)**
6. Determination of protein concentration by different methods **(4 h)**
7. Estimation of crude fibre **(4 h)**
8. Analysis of food relevant molecules – Fats and sugars **(4 h)**



FUNCTIONAL FOODS AND NUTRACEUTICALS

Subject code: **14FTEL11**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Introduction)

Functional foods, the link between nutrition and medicine, Sources and bioavailability of nutraceuticals, Chemistry and structure of nutraceuticals **(8 h)**

UNIT – II (Nutraceuticals)

Micronutrients, Vitamins, Isoflavones: Source and metabolism. Soy protein, soy isoflavones, cardiovascular and bone health. Phytoestrogens: Mechanism of action, menopause, breast and prostate cancer **(8 h)**

UNIT – III (Flavanoids, Carotenoids and Lycopene)

Citrus flavanoids and other natural cholesterol lowering agents. Carotenoids: metabolism and disease. Lycopene: source, properties and nutraceuticals potential **(8 h)**.

UNIT – IV (Nutraceuticals – Garlic, Grape, Wine, Tea)

Garlic: the mystical food in health promotion. Phytochemicals in *Capsicum annum*. Grape, wine and tea polyphenols-disease prevention and green tea catechins **(8 h)**.

Part B

UNIT – V (Omega 3 Fatty Acids, Antioxidant, Chemoprevention and Functional Food)

Olive oil and plant sterols, Omega 3 fatty acids and eicosanoids. Omega 3 fatty acids and lipoprotein metabolism. Omega 3 fatty acids, insulin resistance and rheumatoid arthritis. Free radicals and oxidative stress - Antioxidant mechanisms, the biochemical basis for nutraceuticals for the chemoprevention of disease. Application of herbs to functional foods **(10 h)**

UNIT – VI (Prebiotics and Probiotics)

Probiotic cultures, attributes, Prebiotics, Synbiotics, Formulation **(6 h)**

UNIT – VII (Single Cell Proteins)

Sources, *Spirulina* cultivation and processing **(6 h)**



UNIT – VIII (Regulation of Functional Foods)

Regulations in USA, EU and India (6 h)

Text Books

1. Wildman “Nutraceuticals and Functional Foods” CRC Press, 2001
2. Kramer, Hoppe and Packer, “Nutraceuticals in Health and Disease Prevention” Marcel Dekker. Inc., NY, NY.2001
3. Food Biotechnology, 2nd Edn, Ed. by Shetty, K., Paliyath, G., Pometto, A. and Levin, E.R. CRC press, Taylor & Francis Group

Reference Books

1. Bao and Fenwick, “Phytochemicals in Health and Diseases” Marcel Decker, Inc. NY, NY. 2004
2. Hasler CM, Regulation of functional foods and nutraceuticals, Blackwell publishing, 2005.



FOOD STORAGE AND INFESTATION CONTROL

Subject code: **14FTEL12**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Cold storage, Controlled and Modified atmosphere storage (CAS & MAS))

Cold storage, Controlled and Modified atmosphere storage – effects of nitrogen, oxygen, and carbon–di–oxide on storage of durable and perishable commodities Determination of cooling load **(8 h)**

UNIT – II (Cold Storage Design and Construction -I)

Small and large commercial storages, Cold Room temperatures, Insulation, properties of insulating materials, air diffusion equipment, Doors and other openings. Cold load estimation; prefabricated systems, walk-in-coolers, and Refrigerated container trucks: Freezer Storages, Freezer room Temperatures, insulation of freezer rooms: Pre-cooling and pre freezing **(8 h)**.

UNIT – III (Cold Storage Design and Construction -II)

Cold Storage practice, Stacking and handling of material in and around cold rooms, Optimum temperatures of storage for different food materials-meat and poultry products, marine products, fruits & vegetables, spices & food grains **(6h)**

UNIT – IV (Freezing of Foods)

Freezing equipment, freezing rates, growth rate of ice crystals, crystal size & its effect of texture and quality of foods, Freezer types, Blast freezers, Contact Plate Freezers, conveyORIZED quick freezers, Individual quick freezing **(8h)**.

Part B

UNIT – V (Cryogenic Freezing)

Cryogenic Freezing, Freezing practice as applied to marine foods, meat and poultry, fruits and vegetables **(6 h)**

UNIT – VI (Storage Engineering -I)

Storage of grains–biochemical changes during storage–production, distribution and storage capacity estimate models–storage capacity models–ecology, storage factors affecting losses, storage requirements **(8 h)**



UNIT – VII (Storage Engineering -II)

Bag and bulk storage– pressure distribution– theories–rodent control– method of stacking– preventive method, bio-engineering properties of stored products–function, structural and thermal design of structures **(8 h)**

UNIT – VIII (Food Infestation Control)

Principles of food commodity storage, insect pests and their biology; Moulds in commodity deterioration, rodent and vertebrate pests, pesticides, fumigants. Godown sanitation and hygiene, analysis of pesticide and fumigant residues in foods **(8 h)**

Text books

1. J.S.Pruthi: Quick Freezing Preservation of Foods (2 Volumes) Allied Publishers, Mumbai (1999)
2. Food Packaging: Principles and Practice, By G. L. Robertson, 2nd Edn. CRC Press Pub. (Taylor and Francis group), 2006 ISBN 0849337755, 9780849337758.



SANITATION AND WASTE MANAGEMENT IN FOOD INDUSTRIES

Subject code: **14FTEL13**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Cleaning and Sanitation of Food Process Plants)

Basic principles of hygiene and sanitation; methods of cleaning process- open and closed cleaning methods; cleaning in place (CIP) - single and multi-use CIP systems **(8 h)**

UNIT – II (Sanitation methods)

Sanitation methods- chlorine based sanitizers, quaternary ammonium compounds, iodophores, amphoteric ampholytic bactericides; thermal sterilization; detergents; pest proofing/fumigation methods; water supply- source, water treatment methods **(8 h)**

UNIT – III (Food Industrial Wastes)

Classification and characterization of food industrial wastes from Fruit and Vegetable processing industry, Beverage industry; Fish, Meat & Poultry industry, Sugar industry and Dairy industry **(8h)**

UNIT – IV (Waste Disposal Methods)

Physical, Chemical & Biological; Economical aspects of waste treatment and disposal **(8 h)**

Part B

UNIT – V (Treatment Methods)

Treatment methods for liquid wastes from food process industries; Design of Activated Sludge Process **(5 h)**

UNIT – VI (Treatment Methods)

Rotating Biological Contactors, Trickling Filters, UASB, Biogas Plant **(5 h)**

UNIT – VII (Treatment Methods for Solid Wastes)

Biological composting, drying and incineration; Design of Solid Waste Management System: Landfill Digester, Vermicomposting Pit **(10 h)**

UNIT – VIII (Treatment Methods for Waste Water)



Biofilters and Bioclarifiers, Ion exchange treatment of waste water, Drinking-Water treatment,

Recovery of useful materials from effluents by different methods **(8 h)**

Text Books

1. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science Pub Ltd
2. Water & Wastewater Engineering; Fair GM, Geyer JC & Okun DA; 1986, John Wiley & Sons, Inc.
3. Wastewater Treatment; Bartlett RE; Applied Science Pub Ltd
4. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI
5. Environmental Biotechnology: Principles and Applications; Rittmann BE & McCarty PL; 2001, Mc-Grow-Hill International editions
6. Environmental Biotechnology; Bhattacharyya B C & Banerjee R; Oxford University Press

Reference Books

1. Symposium: Processing Agricultural & Municipal Wastes; Inglett GE; 1973, AVI



AROMATIC AND MEDICINAL PLANTS

Subject code: **14FTEL14**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Introduction)

Review of food and health related aromatic and medicinal plants **(8 h)**

UNIT – II (Production of Aromatic and Medicinal Plants)

Horticultural techniques for the commercial cultivation and tissue culture **(6 h)**

UNIT – III (Extraction Technologies for the Active Ingredients -I)

Collection, processing, extraction- maceration, percolation, infusion techniques, cold fat extraction, decoction and hot continuous extraction, aqueous alcoholic extraction **(9 h)**

UNIT – IV (Extraction Technologies for the Active Ingredients-II)

Distillation technology, solid phase micro extraction, head space trapping extraction, supercritical fluid extraction; packaging and storage **(9 h)**

Part B

UNIT – V (Separation of Active Ingredients)

Centrifugation, Chromatography- TLC, process scale HPLC **(6 h)**

UNIT – VI (Various Chromatographies)

Flash chromatography, low pressure chromatography, counter current chromatography **(6 h)**

UNIT – VII (Quality control)

HPLC, high performance TLC **(8 h)**

UNIT – VIII (Applications)



Food flavouring industry, pharma and cosmetics industry **(8 h)**

Text Books

1. Hand book of herbs, medicinal & aromatic plants cultivation -Engineers India Research Institute, Delhi, 2003
2. Mitra K, A text book of aromatic plants, 2008
3. Syamal MM, Production technology of medicinal and aromatic plants, 2008
4. Handa SS, Khanuja SPS, Longo G and Rakesh DD, Extraction technologies for medicinal and aromatic plants, 2008



FRUIT AND VEGETABLE TECHNOLOGY

Subject code: **14FT21**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Introduction)

Production of Fruits and vegetables in India, Composition of each of the major fruits and vegetables produced in the country; Cause for heavy losses; Spoilage factors; Post harvest field operations (**4 h**)

UNIT – II (Post Harvest Technology for Preserving Fruit Quality)

Fruit Ripening and Related Parameters, Changes in Fruit Quality Attributes during Handling, Processing and Storage; Cold Storage and Fruit Quality, cold chain effect on fruit shelf life, Effect of Heat, Calcium, Polyamine and 1-Methylcyclopropene Treatments (**6 h**)

UNIT – III (Canning of Fruits and Vegetables)

Preparation of fruits and vegetables for canning – Washing, peeling, grating, slicing dicing, deseeding, blanching; Common machinery for operations (**8 h**)

UNIT – IV (Fruit Processing)

Juice and pulp extraction – extractors, Hydraulic Press, Hot and Cold Break process, Clarification, Clarification centrifuges, Decanters and desludgers; Fruit juice concentrates – methods of concentration, types of evaporators; Fruit Powders - Preparation of Fruit material for powder production, Process operations (**10 h**)

Part B

UNIT – V (Dehydration of Fruit and Vegetables)

Preparation of fruits and vegetables for dehydration, Equipments used for drying – Conventional and combination dryers (**8 h**)

UNIT – VI (Aseptic and other Methods of Processing)

Aseptic processing- Aseptic heat exchangers / pasteurizers, Aseptic fillers. Filling systems- Tetra pack for small quantities, Dole system and Scholle system for bulk filling; Hurdle technology with reference to Vegetable and Fruit processing (**8 h**)



UNIT – VII (Advances in Fruit and Vegetable Processing Technologies)

UV applications, High pressure applications, Ultrasound applications, Membrane applications, High intensity pulsed electric field applications, ozone processing, Irradiation applications in fruit processing, Minimal processing, Storage in Modified Atmosphere, Active Packaging, Freeze concentration applications, Vacuum frying applications, Edible coatings **(12 h)**

UNIT – VIII (Enzymes in Fruit and Vegetable Processing)

Enzymatic Peeling, Enzymes in Juice, wine and starch processing **(4 h)**

Text Books

1. Dauthy, M.E.: Fruit and Vegetable Processing. International Book Distributing Co. Lucknow, India. (1997)
2. Srivastava, R.P., and Sanjeev Kumar: Fruit and vegetable preservation; principles and practices.: International Book Distributing Co., Luckno.
3. Y.H.Hui and Others: Hand Book of Vegetable Preservation and Processing Marcel Dekker New York
4. Salunkhe, D.K. and Kadam, S.S.: Handbook of Fruit Science and Technology: Production, Composition and Processing. Marcel Dekker, New York
5. Salunkhe, D.K. and Kadam, S.S.: Handbook of Vegetable Science and Technology. Production, Composition, Storage and processing Marcel Dekker, New York.
6. Chakraverty, A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. Handbook of Post-harvest Technology: Marcel Dekker Press, USA

Reference Books

1. Hamson, L.P: Commercial Processing of Vegetables. Noyes Data Corporation



GRAIN PROCESSING AND BAKING TECHNOLOGY

Subject code: **14FT22**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Introduction)

Importance of Cereals; Nutrient Composition of Cereal Grains; Structure of Cereal Grains; Cereals of the World- Origin, Classification, Types **(6 h)**

UNIT – II (Milling)

Storage and Pre-Processing; Dry Milling Technology (Rice and Wheat) **(6 h)**

UNIT – III (Milling)

Wet Milling (Maize) - Starch and Gluten; Flour Quality; Types and Grades of Flour **(6 h)**

UNIT – IV (Baking -I)

Quality evaluation and functional properties used in baking; specification for raw material used in bakery; characterization and importance of wheat gluten protein in baking **(8 h)**

Part B

UNIT – V (Baking -II)

Role of bakery ingredients; bread making and baked products; bakery norms and setting of bakery unit; prospects and problems in bakery **(8 h)**

UNIT – VI (Technology of Functional Cereal Products)

Novel high fiber and whole grain breads; isolating and concentrating oat beta glucans using different methods; difficulties in the development of high fiber and whole grain white breads-effects of formulation and processing technology **(10 h)**

UNIT – VII (Fortification)

Vitamin and mineral fortification of bread; soy and omega-3 enriched breads; gluten free breads



(6h)

UNIT – VIII (Lowering the GI of Cereal Products)

Glycemic Index (GI) and Glycemic Load; carbohydrate digestibility; dietary fiber and GI;

Ingredients for low GI foods; Effects of processing on the properties of dietary fiber and ingredients **(10 h)**

Text Books

1. Technology of functional cereal products, B R Hamaker
2. Bakery Science & Cereal Technology, Neelam Khetarpaul
3. Technology of cereals (4th edition), Kent NL, Evers AD



Subject code: **14FT23**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **3 h**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Introduction)

Nature, Function, classification & nomenclature of enzymes, Specificity **(6 h)**

UNIT – II (Enzymes)

Amylases, Pectic Enzymes, Proteases; Oxidoreductases- Phenolases, Glucose Oxidases, Catalases, Peroxidases, Lipoxygenases, Xanthine Oxidases, Immobilized enzyme **(6 h)**

UNIT – III (Enzyme Kinetics)

Michaeli's Menton equation, K_m , Lineweaver Berk Plot, Inhibitors, Enzyme kinetics in the presence of different inhibitors **(9 h)**

UNIT – IV (Enzyme Purification)

Ammonium sulphate precipitation, Gel exclusion chromatography, Ion exchange chromatography, Affinity chromatography- GST, His tag, Native PAGE, SDS-PAGE, Zymogram, Coomassie blue and Silver staining **(9 h)**

Part B

UNIT – V (Enzyme Applications)

Application of enzymes in food processing; Application of immobilized enzymes and cells **(6 h)**

UNIT – VI (Fermentation Technology -I)

Fermentation; Types of fermentation; Strain improvement; Inocula; Fermentation media; Sterilization methods **(8 h)**

UNIT – VII (Fermentation Technology -II)

Scale up and scale down; Biomass Production; Enzyme Production; Downstream processing **(6 h)**

UNIT – VIII (Fermentors or Bioreactors)



Fermentor Design and analysis; Aeration and Heat Transfer; Instrumentation and Control; Computers in Fermentation; Batch, Fed batch and continuous bioreactors **(10 h)**

Text Books

1. Principles of Biochemistry, Nelson and Cox
2. Biochemical Engg Fundamentals- Baily, Ollis . MGH
3. Prescott & Dunn's Industrial Microbiology Macmillan
4. Principles of Fermentation Technology- Wittaker and Stanby.

Reference Books

1. Methods in enzymology – Journal

FOOD PROCESS ENGINEERING - I

Subject code: **14FT24**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Properties of Foods)

Composition, Physical, Rheological and biochemical properties, Sensory characteristics, Nutritional quality **(4 h)**

UNIT – II (Food Processing at Ambient - Temperature – I)

Raw Food Processing- Cooling; Cleaning- wet and dry; Sorting and grading- types; Peeling **(2 h).**

Reduction of Size: Theory, equipment, effects on foods and microbes **(4 h).**

UNIT – III (Mixing and Forming)



Mixing and Forming: Mixing - solids and liquids, equipment; Forming - Bread molders, pie, tart and biscuit formers, confectionery molders and depositors **(4 h)**.

UNIT – IV (Separation and Concentration)

Separation and Concentration: Centrifugation, Filtration and Expression; Solvent Extraction, supercritical CO₂, Equipment; Membrane concentration - theory, applications, types, effect on foods and microorganisms **(8 h)**.

Part B

UNIT – V (Food Processing by Heat Removal)

Chilling and modified atmospheres – refrigeration, equipment, cryogenic chilling, cold storage, modified and controlled atmospheric storage; applications- fresh and processed foods **(8 h)**.

UNIT – VI (Freezing)

Freezing: crystal formation, freezing time calculation, thawing; equipment; frozen storage **Freeze drying-** Theory, equipment and effect on foods and microbes, **Freeze concentration-** Theory, equipment and effect on foods and microbes **(10 h)**

UNIT – VII (Food Processing by Heat Application – I)

Heat Processing – Theory- Thermal properties of foods, Heat sources and application - heating methods, energy use and methods to reduce energy consumption, heat exchangers. **Processing by heat using steam or water: Blanching-** Theory, Equipment, **Pasteurization** - packaged & unpackaged foods, effect on foods; **Sterilization** - theory, retorting, equipment; Ultra high temperature; effect on food- canning **(10 h)**

Unit – VIII (Evaporation, Distillation and Extrusion)

Evaporation - economics, equipment, effect on foods; **Distillation- theory**, equipment;

Extrusion- Extrusion cooking, operating characteristics of extruder; single & twin screw extruders; food applications- confectionery, cereal & protein based products; effects on sensory characteristics and nutritional value of foods & microorganisms **(10 h)**

Text Books

1. Unit Operations in Food Processing, Web Edition, 2004. Publisher: The New Zealand Institute of Food Science & Technology (Inc.) Authors: R.L. Earle with M.D. Earle
2. Handbook of Food Engineering Practice, Kenneth J. Valentas, Enrique Rotstein, R. Paul Singh
3. Introduction to Food Process Engineering, Albert Ibarz, Gustavo V. Barbosa-Canovas



4. Fundamentals of food engineering. D. G. Rao, PHI Learning Private Limited, New Delhi, 2010
5. Food processing technology - principles and practice. Fellows PJ, 3rd edition, CRC press, Boca Raton
6. Physical properties of plants and animal materials, N. N. Mohsenin
7. Unit operation of chemical engineering, McCabe, Smith & Harriott, McGrawHill
8. Transport processes and unit operations, Christie J. Geankoplis
9. Food processing operations analysis, H. Das
10. Unit operations of agricultural processing, K. M. Sahay and K. K. Singh
11. Handbook of analysis and quality control for fruits and vegetable products, S. Ranganna
12. Post harvest technology of cereals, pulses and oilseeds, A Chakraverty
13. Food engineering and dairy technology, H. G. Kessler
14. Physical properties of food and food processing system, M J Lewis
15. Introduction to food engineering, R Paul Singh & Dennis R Heldman
16. Transport phenomena in food process engineering, Ashis Kumar Datta, Himalaya Publishing House
17. Rice Postharvest Technology, Epifania Valbuena Araullo, Michael Graham and D. B. de Padua



Lab - BASIC FOOD PROCESSING & BIOTECHNOLOGICAL METHODS

Subject code: **14FTL25**

IA Marks: **25**

No of Lecture Hrs/week: **03**

Exam Duration: **03**

Total No. of Lecture Hours: **30**

Exam Marks: **25**

1. Measurement of water activity in fresh and dehydrated fruits **(2 h)**
2. Storage studies at cold and ambient conditions **(2 h)**
3. High temperature processing- Pasteurizing milk products **(4 h)**
4. Preservation of fruits in syrups- Osmotic dehydration **(4 h)**
5. Studying the effect of chemical preservatives- Benzoates, sorbets **(4 h)**
6. Salting- Preservation of vegetables in brine solution **(2 h)**
7. Canning of fruits and vegetables **(2 h)**

(Note: Microbial safety will be evaluated in all the above experiments)

8. Assaying the food related enzymes **(2 h)**
9. Protein Extraction and analysis by SDS-PAGE **(4 h)**
10. Visualizing enzyme activities on zymogram **(4 h)**



FOOD PROCESS ENGINEERING LAB - I

Subject code: **14FTL26**

IA Marks: **25**

No of Lecture Hrs/week: **03**

Exam Duration: **03**

Total No. of Lecture Hours: **30**

Exam Marks: **25**

1. Physical properties determination of grains, cereal and spice seeds **(4)**
2. Coefficient of static friction for grain against different surfaces and angle of repose **(4 h)**
3. Size reduction of food grains, cereals, spices; sieving of their powder and energy consumption evaluations **(4 h)**
4. Milling of rice - milling yield and performance characteristics of equipments **(4 h)**
5. Solvent extraction of edible oil from oil seeds **(4 h)**
6. Studies using Freeze dryer to find out the freezing time and drying - rehydration characteristics of given food sample **(4 h)**
7. Studies on fruits and vegetable slicing, blanching, pulping, juice making, freezing, pasteurization, concentration, bottle filling and sealing **(4 h)**
8. The performance characterization of fruits and vegetable processing equipments namely: Slicer, Blancher, Pulper, Freeze Dryer, Juicer with Filtration, Kettle, Pasteurizer, Juice Concentrator **(4 h)**



PLANTATION PRODUCTS, SPICES AND FLAVOUR TECHNOLOGY

Subject code: **14FTEL21**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Harvesting the Spices)

Production & importance; stage of harvesting & harvesting methods – threshing, shelling; decortications of spices **(6h)**

UNIT – II (Processing of Spices)

Drying - traditional and mechanical drying; cleaning, grading and grinding – construction and operation of different mills, cryogenic grinding; packaging and storage of spices **(11 h)**

UNIT – III (Processing of Plantation Products)

Production and importance; different plantation products and processing methods- process and equipment; value addition, packaging and storage **(11 h)**

UNIT – IV (Basics of Flavors)

Olfactory perception of flavor, theories of olfaction, Classification of flavors – Natural, Nature identical and synthetic; Flavor potentiates **(8 h)**

Part B

UNIT – V (Chemistry and Technology of Natural Flavors)

Classification; Evolution of flavors during processing; effect of roasting, cooking, frying on flavor developments; Extraction of essential oils and oleoresins – effect of solvents used **(6 h)**

UNIT – VI (Chemistry and Technology of Natural Flavors)

Super critical fluid extraction; Liquid and dry flavor production; Staling of flavors; Microbial and cell suspensions in the production of natural flavors **(6 h)**

UNIT – VII (Analysis of Flavors)

Total component analysis– basics and methods; Solid phase micro extraction of aroma components **(6h)**

UNIT – VIII (Analysis of Flavors)

Head space analysis –static and dynamic methods, basic principles, method and developments; E



nose technology (6h)

Text Books

1. Flavor Chemistry and Technology, By Gary Reineccius, Henry B. Heath, 2nd Edn., Taylor and Francis group, CRC Press
2. Handbook of Flavor Characterization (Food Science and Technology) Ed., Kathryn D. Deibler, Jeannine Delwiche, Marcell Dekker Inc., 2004
3. Flavour Science: Recent Advances and Trends, By W. L. P. Bredie and M.A. Petersen, Elsevier Pub., 2006. ISBN 0444527427, 9780444527424
- 4 Food Flavours – Biology and Chemistry, By Carolyn Fisher, Thomas R. Scott, RSC Publishing, 1997
5. Pruthi, J.S. Minor Spices and Condiments: Crop management and post-harvest technology, ICAR Publications, New Delhi, India pp. 1-781
6. K. V. Peter, Handbook of herbs and spices, Woodhead Publishing Ltd, Cambridge England
7. The complete Book on Coconut & Coconut Products (Cultivation & Processing). By NIIR Board, Asia Pacific Business Press Inc., New Delhi – 110 007
8. Hand Book on Spices. By NIIR Board, Asia Pacific Business Press Inc., New Delhi – 110 007.



WATER AND BEVERAGE TECHNOLOGY

Subject code: **14FTEL22**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Introduction and Importance of Water)

Structure of water & ice. Concept of bound and free water & their implications. Sorption Phenomena and Sorption isotherms, examples – Dispersed systems – some basic considerations water as an ingredient, water properties of reactions, water activity **(6 h)**

UNIT – II (Water Treatment)

The impurities in water; Sedimentation and coagulation; Filtration; The lime and soda ash processing; Ion exchangers; Boiler feed water treatment; Removal of iron and manganese; Treating water for ice manufacture **(8 h)**

UNIT – III (Analysis of Water)

Drinking water standards; the sanitary analysis; the chemical analysis; Chemical reactions in water treatment; Soft and hard water – its implications in Food processing industry **(5 h)**

UNIT – IV (Analysis of Water)

Microbial analysis-coliforms and its importance-MPN count of coliforms -Permissible limits in drinking water **(5 h)**

Part B

UNIT – V (Disinfection of Water)

Use of chlorine; The Ammonia-chlorine process; Break-point chlorination; Excess-lime treatment; Hypochlorites; Ozone; Ionic-silver sterilization process; Ultraviolet rays; Nano particle based Filters **(8 h)**

UNIT – VI (Removal of Tastes and Odors of Water)

Causes of tastes and odors; Removal of tastes and odors-Aeration, Activated carbon, Superchlorination and dechlorination, Ammonia-chlorine process, Chlorine dioxide, Potassium permanganate, Copper sulphate **(8 h)**



UNIT – VII (Beverages)

Ingredients- stabilizers, sweeteners; Formulation- fortification technology and methods to extend shelf-life; Plant based beverages- Alcoholic and Non-Alcoholic beverages; Dairy based beverages **(10 h)**

UNIT – VIII (Brewing Technology)

Raw Material- Barley, Hops, Water, Yeast, Adjuncts; Malt Production; Wort Production; Beer Production- Fermentation, Maturation, Filtration, Stabilization; Filling the beer **(10 h)**

Text Books

1. Functional and Specialty Beverage Technology, P Paquin
2. Technology brewing and malting, Wolfgang Kunze
3. Water treatment and purification technology, William J. Ryan



MEAT, POULTRY AND MARINE FOOD TECHNOLOGY

Subject code: **14FTEL23**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Slaughtering and Carcass Processing)

Ante mortem handling and welfare; slaughtering and processing equipment; abattoir designs and slaughter methods; carcass processing -factors affecting quality; Post mortem changes of meat; Maximising Texture Quality in Meat; Sensory Analysis of Meat **(10 h)**

UNIT – II (Meat Processing)

Curing, smoking, canning, intermediate-moisture meat and dehydrated meat, automated meat processing, chilling and freezing of meat; High pressure processing of meat **(6 h)**

UNIT – III (Meat Processing)

Processing and quality control of restructured meat; Fermented meat products (meat sausages & sauces); Fat content of meat and meat products; By-products from meat industries and their utilization **(6 h)**

UNIT – IV (Sea Food Processing)

Different sea food resources and their postharvest quality changes; bulk handling and chilling; quick freezing; cook-chill processing; modified-atmosphere packaging; retort pouch packaging **(10h)**

Part B

UNIT – V (Fish Products and Technology)

Freshness criteria and quality assessment of fish; Spoilage of Fish; Methods of Preservation of fish- Canning, Freezing, Drying, Salting, Smoking and Curing **(5 h)**

UNIT – VI (Fish Products and Technology)

Fish byproducts - fish meal, fish protein concentrate, fish liver oil etc.; Quality control of processed fish **(5 h)**

UNIT – VII (Poultry Meat Processing)

Classification of poultry meat; Composition and nutritional value of poultry meat & eggs ; Processing of poultry meat and eggs; Pre slaughter factors affecting poultry meat quality; Slaughter through



chilling; Parts, deboning and portion control; Coated poultry products **(8 h)**

UNIT – VIII (Poultry Meat Processing - Spoilage and control)

Spoilage and control; Poultry meat inspection and grading; Functional properties of muscle proteins in processed poultry products; Formed and emulsion products; Marination and curing of poultry products; Co-products and by-products from poultry processing **(10 h)**

Text Books

1. Processed Meats; Pearson AM & Gillett TA; CBS Publishers.
2. Meat; Cole DJA & Lawrie RA; AVI Pub.
3. Egg and poultry meat processing; Stadelman WJ, Olson VM, Shemwell GA & Pasch S; Elliswood Ltd.
4. Fish as Food; Vol 1 & 2; Bremner HA; CRC Press.

Reference Books

1. Developments in Meat Science – I & II, Lawrie R; Applied Science Pub. Ltd.



LIPID, PROTEIN AND SUGAR TECHNOLOGY

Subject code: **14FTEL24**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Introduction)

Structure, properties and functionality of lipid, protein and sugars **(6 h)**

UNIT – II (Sugar Technology)

Sugarcane and sugarbeet as sugar raw materials; Flow charts for manufacture of Granulated and Liquid sugars; Properties of Granulated sucrose and Liquid Sugars; Invert sugar and their characteristics **(8 h)**

UNIT – III (Sugar Production)

Extraction of sugar juice from beet and cane; Juice purification; Decolorisation, Evaporating, Crystallization; Centrifugation; Sugar handling after centrifugals **(10 h)**

UNIT – IV (Sugar Products and Byproducts)

Pressed and dried pulp; Bagasse; Molasses; Liquid sugars; Special crystal sugar products **(8 h)**

Part B

UNIT – V (Protein Products Isolation)

Protein extraction, separation, concentration **(8 h)**

UNIT – VI (Lipid Processing)

Pressing and Extraction of oils; Chemical, Physical and miscellareatory methods **(6 h)**

UNIT – VII (Lipid Processing)

Inter-esterification; hydrogenation; Fat crystallization **(6 h)**



UNIT – VIII (Extended Applications of Lipids)

Food emulsions; Non-aqueous foods; Special food applications- edible coating and film barriers; spray processing of fat containing foodstuffs - spray drying and cooling; low calorie fats; food emulsifiers; lipid emulsions for intravenous nutrition and drug delivery; Fats and oils Formulation; Shortenings; Margarine (**8 h**)

Text Books

- 1 . Lipid Technologies and Applications, Frank D. Gunstone, Fred B. Padley, CRC Press
2. Practical Guide to Vegetable Oil Processing, Monoj K. Gupta, AOCS Publishing
3. Bleaching and Purifying Fats and Oils, Gary List, AOCS Publishing
4. Fats and Oils-Formulating and Processing for Applications, Richard D. O'Brien, CRC Press.
5. Sugar Technology-beet and cane sugar manufacture, P. W. van der Poel, H. Schiweck, T. Schwartz
6. Beet- Sugar Technology , R. A. McGinnis, Publisher: Beet Sugar Development Foundation
7. Principles of sugar technology, P. Honig. Vol.1, Elseviers
8. Encyclopedia of Protein Technology, Josie Mehta



FOOD PROCESS ENGINEERING-II

Subject code: **14FT31**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Food Processing by Heat Application - II)

Drying- theory, intermediate moisture foods; equipment, rehydration; **Smoking** - theory, liquid smoke; processing equipment; **Baking & Roasting** - theory; equipment, control of ovens (**8 h**).

UNIT – II (Frying)

Frying: Theory, time & temperature; equipment, oil filtration, heat recovery; oils used for frying; effect of frying on foods- oil absorption, texture, color and flavor & nutritional changes (**6 h**).

UNIT – III (Food Processing by Heat Application - III)

Heat processing by direct and radiation: Dielectric heating- theory, equipment, applications; Ohmic & Infrared heating - theory, equipment, applications; effect on foods & microbes (**8 h**)

UNIT – IV (Extraction)

Solid - liquid (Leaching), types; principles- counter current extraction, McCabe-Thiele & right angled triangle method; equipment- batch, continuous counter current (CCC), multi stage CCC; applications in food processing- oils & fats, oleoresins, colors, coffee, flavours & pigments (**8 h**)

Part B

UNIT – V (Food Processing at Ambient - Temperature-II)

Irradiation- theory - dose distribution & measurement; applications, disinfection, sprouting inhibition; effect on foods, microbes & packaging; detection of irradiated foods (**6 h**).

UNIT – VI (Food Processing at Ambient - Temperature-II)

High Pressure Processing (HPP) of Foods – theory, equipment, batch & semi continuous operation, effect on yeasts, moulds, bacteria, viruses, enzymes & foods (**8 h**).

UNIT – VII (Minimal Food Processing Methods)

Minimal Food Processing Methods - Pulsed electric field (PEF)- theory, equipment, effects on microbes, enzymes and food; equipment, effects on microbes, enzymes and food; Ultrasound-theory, processing, effects on microorganisms & foods; Microwave (**8 h**)



UNIT – VIII (Hurdle Technology)

Basics, Mechanism; Application to foods - Newer Chemical and Biochemical hurdles- organic acids – Plantderived antimicrobials – Antimicrobial enzymes – bacteriocins – chitin / chitosan (only one representative example for each group of chemical and biochemical hurdle) (8 h)

Text Books

1. Introduction to Food Process Engineering, Albert Ibarz, Gustavo V. Barbosa-Canovas
2. Handbook of Food Engineering Practice, Kenneth J. Valentas, Enrique Rotstein, R. Paul Singh
3. Trends in Food Engineering, Jorge E. Lozano, Cristina Anon, Gustavo V. Barbosa-Canovas, Efren Parada-Arias
4. Fundamentals of food engineering. D.G.Rao, PHI Learning Private Limited, New Delhi, 2010
5. Food processing technology-principles and practice. Fellows PJ, 3rd edition, CRC press, Boca Raton
6. Leistner L. and Gould G. Hurdle Technologies – Combination treatments for food stability safety and quality, Kluwer Academics / Plenum Publishers, New York (2002)
7. Novel Food Processing Technologies (Food Science and Technology Series) by Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Soledad Tapia, M. Pilar Cano, Publisher: CRC Press, November 2004, ISBN-13: 9780824753337
8. Pulsed electric field technology for the food industry: Fundamentals & applications (Food engineering series) RASO J., HEINZ V, 2006
9. Thermal Technologies in Food Processing: Edited by P Richardson, Campden and Chorleywood Food Research Association, UK, Woodhead Publishing Limited, Abington Hall, Abington, Cambridge, CB1 6AH, England, 2001
10. Minimal Processing Technologies in the Food Industry By Thomas Ohlsson, Nils Woodhead Publishing Limited, Abington Hall, Abington, Cambridge, CB1 6AH, England, 2002
11. Pulsed Electric Fields in Food Processing (1999). Gustava C Barbosa-Canovas, Q Howard Zhang (editors). Lancaster Pa: Technomic Publishing Co. (ISBN 1566767830)
12. Food Processing Operations Modelling (2001). Joseph Irudavarai (editor). Marcel Dekker (ISBN 0824704886)



13. Processing of Foods – Quality Optimization and Process Assessment Edited by Fernando A.R.Oliveira and Jorge C. OliveiraCRC Press Boca Raton, London and New York 1999
14. Food Processing Hand Book, Edited by James G.Brennen Wiley – VCH Verlag GmbH 2006
15. Da-wen Sun: Emerging Technologies for Food Processing, Elsevier Academic PressMarcel Dekker Inc. NY (1995)

Reference Books

1. Pulsed electric fields in food processing: Fundamental aspects and applications: a volume in the Food Preservation Technology series, Edited by G V Barbosa-Cánovas, Washington State University and Q H Zhang, Ohio State University, USA, Woodhead Publishing Limited, Abington Hall, Abington, Cambridge, CB1 6AH, England, 2001
 2. Ohmic Heating: A Value-added Food Processing Tool Marybeth Lima, TuoxiuZhong and N. Rao Lakkakula
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FOOD ANALYSIS, SAFETY AND QUALITY CONTROL

Subject code: **14FT32**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Structure, Organization and Practical Operation of International Food Regulatory Bodies)

World Trade order – Functioning and responsibilities of the WTO - Codex Alimentarius –History, operations of Codex alimentarius, Responsibilities – Codex standards and Maximum residue limits

– Current Issues under consideration – SPS (Sanitary and phytosanitary measures) agreement; FDA (6 h)

UNIT – II (World Health Organization)

World Health Organization – History and mandate – Operations and responsibilities – ICGFI– Functions and responsibilities (4 h)

UNIT – III (Regulating Authority of Food Safety in India and its Role)

Food safety and Standards Act – New regulations (8 h)

UNIT – IV (Food Labeling – Regulations)

Need for labeling – Developing labeling standards at the world level – Limitations of labeling-safety issues – Labeling regarding methods of processing – Irradiated products – Products derived from modern biotechnology – organic produce - Genetically modified foods – EU rules on nutritional labeling – US rules on nutritional labeling – Health claims – Approach of US and EU (10 h)

Part B

UNIT – V (General Aspects of Food Safety)

Concept of HACCP (Hazard Analysis and Critical Control Points) – Assembling the team – Product description – Describing the product's intended use – Establishing a process flow diagram

– on site confirmation - Listing potential hazards and control measures - Determination of critical points – decision tree for CCPs- Establishing monitoring procedures- establishing corrective actions



– establishing verification procedures (10 h)

UNIT – VI (General Aspects of Food Safety)

Good Manufacturing Practices (GMP) (4 h)

UNIT – VII (ISO 22000 Regulations)

Basics and differences with HACCP. Implementing HACCP & ISO 22000 for foods of Animal origin – Dairy Foods, Meat & Meat Products and Poultry. Safety aspects of drinking water (microbiological and chemical) - risks and advantages of chlorination of water. Bottled water – origin of water- safety aspects – microbiological and chemical quality – Regulations for bottled water – EU, US and India (10 h)

UNIT – VIII (Food Analysis)

Regular analysis of different foods; microbial, pesticide and other contaminant analysis (8 h)

Text Books

1. Rao ES, Food quality evaluation, 2013. Variety books publishers and distributors
2. J.R.J. Pare and J.M.r. Belanger, 1997. Instrumental Methods of Food Analysis, Elsevier Science B.V., the Netherlands. ISBN: 0-444-81868-5
3. David L. B. Wetzel, George Charalambous, 1998. Instrumental Methods of Food and Beverage Analysis, Elsevier Science BV
4. Instrumental methods of analysis by Willard and Merit(6th Edition)
5. International Food Safety Handbook: Science, International Regulation, and Control, By Kees A. van der Heijden, Sanford Miller, Published by CRC Press, 1999. ISBN 0824793544, 9780824793548
6. Food Safety Regulation Concerns and Trade- The Developing Country Perspective, Ed. By Rajesh Mehta And J. George, Published by Macmillan India Ltd., New Delhi. 2005
7. Kees A. van der Heijden & Sanford Miller- International Food Safety Handbook: Science, International Regulation, and Control 1999, Published by CRC Press. ISBN 0824793544, 9780824793548

Reference Books

1. Guide to The Food Safety and Standards Act 2006, Taxmann Allied Services Pvt. Ltd., ISBN – 10 – 8174968288



DAIRY TECHNOLOGY

Subject code: **14FT33**

IA Marks: **50**

No of Lecture Hrs/week: **04**

Exam Duration: **03**

Total No. of Lecture Hours: **60**

Exam Marks: **50**

Examination Question Paper Pattern

All questions carry equal marks

Answer any FIVE full questions, selecting at least two from each PART A & PART B

PART - A

UNIT – I (Introduction)

Milk - composition, food and nutritive value, physico-chemical properties; milk reception at dairies, quality and quantity tests at reception **(6 h)**

UNIT – II (Milk Processing)

Milk processing flow sheet – Filtration / clarification, Storage of milk; Standardization – simple problems in standardization **(6 h)**

UNIT – III (Homogenization and Pasteurization)

Homogenization; Pasteurization – types of pasteurization process **(8 h)**

UNIT – IV (Homogenization and Pasteurization)

Equipments- Cream separating centrifuges, Pasteurizers, Homogenizers, Bottle and pouch fillers, Milk Chillers **(8 h)**

Part B

UNIT – V (Manufacture of Dairy Products)

Different dairy products and their quality aspects; Manufacture and equipments; Fermented dairy products **(8 h)**

UNIT – VI (Manufacture of Dairy Products)

Extraction of casein from milk; Production of lactose and whey **(8 h)**

UNIT – VII (Advanced Dairy Technologies)

High pressure processing of milk; Pasteurization of milk with pulsed electric fields; ultrasound, irradiation, microwave, radio frequency, ohmic heating, ultraviolet light and bacteriocins **(8 h)**

UNIT – VIII (Applications of Enzymes in Dairy Industry)



Enzymes and their role in the manufacture of dairy products (8h)

Text Books

1. Sukumar D, Outlines of Dairy Technology, Oxford University Press, India.
2. Edger Spreer & Axel Mixa: Milk and Dairy Product technology Mercel dekker Inc.N.Y. (1998)
3. National Institute of Industrial Research, Modern Technology of Milk processing and Dairy products, II Edition, NIIR Publications, India, 2004
4. Arthur W. Farral: Engineering of Dairy and food Products (II Edition 1970) Robert E. Krieger Publishing Co. NY
5. Garret Smit : Dairy Processing (Improved Quality) Woodhead Publishing Ltd. CRC Press (2003)
6. W.M. Clunie Harvey and Harry Hill: Milk Products Bio Tech Books, New Delhi



Training - FOOD ANALYSIS & QUALITY CONTROL

Subject code: **14FTL34**

Total No. of Hours: **30**

IA Marks: **50**

1. Maintenance of quality control lab & regulatory guidelines **(2 h)**
2. Water testing **(4 h)**
3. Analyzing liquid food materials for routine quality control **(4 h)**
4. Analyzing liquid food materials for adulteration, toxins, pesticides and other contaminants **(4 h)**
5. Analyzing solid foods for routine quality control **(4 h)**
6. Analyzing solid foods for adulteration, toxins, pesticides and other Contaminants **(4 h)**
7. Analyzing package materials for safety **(4 h)**
8. Analyzing a nutritional profile of a given food **(4 h)**

FOOD PROCESS ENGINEERING LAB - II

Subject code: **14FTL34**

Total No. of Hours: **30**

IA Marks: **50**

1. Milk analysis for fat, solid non-fat, density and added water **(4 h)**
2. Quantifying Bacteria and Population Growth of raw and pasteurized milk **(4 h)**
3. Evaporation followed by Spray drying of milk for milk powder production **(4 h)**
4. Butter churning and cream separation from milk **(4 h)**
5. Determination of heat and material balances in evaporation using Milk as biological material for evaporation **(4 h)**
6. Determination of flow properties of wheat, rice and maize powders **(4 h)**
7. Determination of thermal process time for sterilization **(4 h)**
8. Sensory evaluation using fuzzy logic **(4 h)**



ENTREPRENEURSHIP AND MANAGEMENT OF FOOD PLANT

Subject code: **Value addition program** No of Lecture Hrs/week: **04** Total No. of Lecture Hours: **60**

UNIT – I (Food Process Economics)

Process economics- various stages in plant design, financial analysis, production cost, break even analysis, business perspective; project economics- fixed, working and growth capital; depreciation; general process economics for clarified fruit juices; clarified fruit juice from banana pulp-production cost estimation, project analysis, breakeven point **(8 h)**

UNIT – II (Basics of Food Plant Layout, location and Design)

General principles; plant design- building design and construction, building functionality, equipment design and fabrication; plant location; social cost benefit analysis; plant layout **(8 h)**

UNIT – III (HACCP)

Application of HACCP concept, ISO, FSSA requirements in food plant layout and design; Preparation of flow sheets for material movement and utility consumption in food plants; food engineer's role **(8 h)**

UNIT – IV (Entrepreneurial Development)

Entrepreneur & entrepreneurial flair; Classification of small, medium and large scale manufacturing industries; Trade license and registration marks; Sources of finance; Selection of land and factory sheds. Agencies for promotion of food processing industries; Source of machine and equipment **(8 h)**

UNIT – V (Reports)

Preparation of project report; Market feasibility reports; Techno-economic feasibility reports **(6 h)**

UNIT – VI (Production Management and Product Development)

Objectives of Production Management, Operation Concept, Production as Conversion Process, Productivity, Qualities and Responsibilities of a Production Manager; Factors Influencing Choice of Manufacturing Systems, Classification of Manufacturing Systems; Factors Governing Plant Location, Basic Procedure of Method Study (Work Study) and Time Study; Concepts, Objectives and functions of Production Planning and Control (PPC) **(8 h)**

UNIT – VII (Product Development)



Product formulation and Product Development (6 h)

UNIT – VIII (Marketing Management)

Marketing Concepts – Need, Want, Demand, 4 P-s, Production Concept, Product Concept, Selling Concept, Marketing Concept, Societal Marketing Concept, Difference between Selling and Marketing; Market Segmentation – STP Concept, Need for Segmentation, Bases of Segmentation, Types of Segmentation. Marketing Research –Need for and Steps of Marketing Research, Questionnaires; Promotion Mix (8 h)

Text Books

1. Entrepreneurial Development by Sarwate (Everest Publication)
2. Industrial Engineering & Production Management - Martand Telsang, S. Chand
3. Industrial & Business Management - Martand T. Telsang, S. Chand
4. Production & Operations Management – Adam, Pearson Education /PHI
5. Industrial Relations, Trade Unions & Labour Legislation - Sinha, Pearson Education Asia
6. Business Organisation & Management - Tulsian, Pearson Education Asia.
7. James M Moore, “Plant Layout and Design”, Mcmillan & Co., (1959)
8. J M Apple, “ Plant layout and Material Handling”, John Willey & Sons, (1977)

References

1. FSSA booklet