

UNIVERSITY DEPARTMENTS
ANNA UNIVERSITY : : CHENNAI 600 025
REGULATIONS - 2013

I TO IV SEMESTERS CURRICULUM AND SYLLABUS (FULL TIME)

M. TECH. FOOD TECHNOLOGY

SEMESTER – I

CODE	COURSE TITLE	L	T	P	C
THEORY					
FD8101	Advanced Food Chemistry and Microbiology	3	1	0	4
FD8102	Food Additives	3	0	0	3
FD8103	Mechanical Engineering, Refrigeration and Cold Chain	4	0	0	4
	Elective I	3	0	0	3
	Elective II	3	0	0	3
	Elective III	3	0	0	3
PRACTICAL					
FD8111	Chemical and Microbial Analysis of Food Lab	0	0	6	3
TOTAL		19	1	6	23

SEMESTER – II

CODE	COURSE TITLE	L	T	P	C
THEORY					
FD8201	Advanced Bioprocess	3	1	0	4
FD8202	Food Packaging Technology	3	0	0	3
FD8203	Food Process Engineering	3	1	0	4
	Elective IV	3	0	0	3
	Elective V	3	0	0	3
	Elective VI	3	0	0	3
PRACTICAL					
FD8211	Advanced Bioprocess Lab	0	0	6	3
TOTAL		16	2	6	23

SEMESTER – III

CODE	COURSE TITLE	L	T	P	C
FD8311	Advanced Food Analysis Techniques Lab	0	0	6	3
FD8312	Food Processing and Quality Control Lab	0	0	6	3
FD8313	Project work – Phase I	0	0	12	6
TOTAL		0	0	24	12

SEMESTER – IV

CODE	COURSE TITLE	L	T	P	C
FD8411	Project work – Phase II	0	0	24	12
TOTAL		0	0	24	12

LIST OF ELECTIVES

M. TECH. FOOD TECHNOLOGY

CODE	COURSE TITLE	L	T	P	C
FD8001	Applied Statistics for Food Technology	3	0	0	3
FD8002	Cereal, Pulse and Oilseed Technology	3	0	0	3
FD8003	Chemical Engineering in Food Industry	3	0	0	3
FD8004	Control of Food Infestations	3	0	0	3
FD8005	Dairy Processing	3	0	0	3
FD8006	Economics and Trade in Food	3	0	0	3
FD8007	Environmental Issues in Food Industry	3	0	0	3
FD8008	Flavor, Spices and Plantation Products	3	0	0	3
FD8009	Food Plant Equipments	3	0	0	3
FD8010	Food Processing and Preservation	3	0	0	3
FD8011	Food Product Design and Development	3	0	0	3
FD8012	Food Supply Chain Management	3	0	0	3
FD8013	Fruit and Vegetable Technology	3	0	0	3
FD8014	Functional Foods and Ingredients	3	0	0	3
FD8015	Meat, Fish and Poultry Technology	3	0	0	3
FD8016	New Process and Production Systems for Food	3	0	0	3
FD8017	Numerical Methods	3	0	0	3
FD8018	Quality Assurance and Safety in Food Processing	3	0	0	3
FD8019	Sensory Attributes and Evaluation of Foods	3	0	0	3



Attested

Sobhan
DIRECTOR

Centre For Academic Courses
Anna University, Chennai-600 025.

OBJECTIVE

The course is targeted to develop the knowledge of students in Food Chemistry at advanced level. This is necessary for effective understanding of food processing and technology subjects. This course will enable students to appreciate the similarities and complexities of the chemical components in foods.

OUTCOME

On completion of the course the students are expected to

- Be able to understand the significant role of food biomolecules
- Grasp the functional role of food components and their interaction in food products in terms of color, flavor, texture and nutrient composition
- Understand the significance and role of microbe in fermentation, spoilage and food borne infectious diseases

UNIT I WATER RELATIONS IN FOOD 5 +1

Water relationships in foods: water activity and its relevance to deteriorative processes in foods (chemical, enzymatic, physical and microbial changes); Glass transitions and molecular mobility in foods, their relevance to quality and shelf life of food systems.

FOOD LIPIDS, ANTIOXIDANTS 6

Chemistry of oils and fats (Review), free radical chemistry, reactive oxygen, photosensitized oxidation, metal catalyzed reactions, Antioxidants: chemistry and mechanisms of action, techniques of evaluation of antioxidant activity, uses.

UNIT II FOOD PROTEINS AND ENZYMES; STARCH, HYDROCOLLOIDS AND GUMS 12

Chemistry, structure and functions of amino acids and proteins (Review). Chemistry and structure of food proteins, enzymic reactions, kinetics, Maillard reactions, enzymic browning, Role of enzyme in food processing. Functional properties of proteins: modified proteins, application in product formulation. Starch, hydrocolloids and gums: occurrence, functions in food systems, properties, gelatinization, retro gradation and modified starches; Food carbohydrates: structural, analytical, physicochemical, nutritional and functional aspects of small molecular weight carbohydrates and polysaccharides of plant and microbial origin.

UNIT III ANALYTICAL CHEMISTRY 12

Introduction to Chemical instrumentation; basic components of analytical instruments, optical detectors (photomultipliers, monochromators, etc.), electrical detectors (pH – electrodes, etc), miscellaneous detectors; Atomic and molecular emission, absorption and fluorescence spectroscopy, Basic principles of analytical instrumentation used in Food quality, Quality control of food and containers, migration of metals and compounds from container into food; Case studies.

UNIT IV FOOD SPOILAGE AND FOOD FERMENTATION 12

History of microbiology of food; Microbial growth pattern, physical and chemical factors influencing destruction of micro-organisms (Review); Types of micro-organism normally associated with food-mold, yeast and bacteria; Micro-organism in natural food products and their control; Contaminants of food-stuffs, vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing; Biochemical changes caused by micro-organisms, deterioration of various types of food products.

MICROBIAL FOOD FERMENTATION

Microbes of importance in food fermentations: homo & hetero-fermentative bacteria, yeasts & fungi; lactic acid bacteria fermentation and starter cultures. Alcoholic fermentations- yeast fermentations, fungal fermentations. Microbes associated with typical food fermentations- yoghurt, cheese, fermented milks, breads, idli, soy products, fermented vegetables and meats

UNIT V FOOD PATHOGENS

12

Microbial growth in food: intrinsic, extrinsic and implicit factors (Review); Food poisoning and microbial toxins, Food borne intoxicants and mycotoxins; Microbial interactions; Use of antimicrobial chemicals - organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, benzoates, sorbates / propionates naturally occurring antimicrobials – Their mode of action; Tolerance of microbes to chemical and physical methods in various foods; Effects on enzymes and other proteins; death kinetics of microbes; Combination systems. Adaptation phenomena and stress phenomena; Effect of injury on growth or survival; Microbial standards for different foods

TOTAL : 60 PERIODS

REFERENCES

1. Chopra, H.K and Panesar, P.S. "Food Chemistry", Narosa, 2010
2. Damodaran, S., Parkin, K.L. and Fennema, O.R. "Food Chemistry", 4th Edition, CRC / Taylor & Francis, 2008
3. Belitz, H.D., Grosch, W and Schieberle, P. "Food Chemistry", 3rd Edition, Springer, 2004
4. Walstra, P. "Physical Chemistry of Foods", Marcel Dekker, 2003
5. Adams, M.R. "Food Microbiology", New Age International, 1995
6. Frazier, William M.C and Dennis, C.W. "Food Microbiology", 4th Edition, Tata Mc-Graw-Hill, 1988
7. Vijaya, R.K. "Food Microbiology", MJP, 2007

FD8102

FOOD ADDITIVES

**L T P C
3 0 0 3**

OBJECTIVE

To expose the students to the use of different chemical additives in foods during food processing and preservation

OUTCOME

- To understand the principles of chemical preservation of foods
- To understand the role of different food additives in the processing of different foods and their specific functions in improving the shelf life, quality, texture and other physical and sensory characteristics of foods
- To know the regulations and the monitoring agencies involved in controlling the safer use of additives in foods

UNIT I INTRODUCTION

9

Definition, role of food additives, classification of food additives based on their role, dual role of certain additives, INS numbering system of food additives, safety requirements of food additives, Acceptable daily intake of food additives, JECFA and Food Chemical Codex standards for food additives, status of food additives with respect to Indian laws, GMP and permissible upper levels of food additives under Indian food laws.

UNIT II ACIDITY REGULATORS AND PRESERVATIVES

9

Acidity Regulators – definition, chemical structure, role and importance, pH modulation and taste, acidity profile, permitted acidity regulators, levels of usage and food applications. Preservatives of chemical and microbial origin; mode of action on spoilage organisms and pathogens, factors affecting the performance of preservatives, active forms of preservatives, necessity in a food and levels of usage; permitted preservatives and food applications. Case studies / illustrations

UNIT III EMULSIFIERS, STABILIZERS AND THICKENERS 9

Emulsion, surface tension, oil in water and water in oil emulsion, Hydrophilic and Lipophilic balance (HLB), role of emulsifiers, different classes of emulsifiers and their chemical structure, their HLB values and role in emulsion stabilization; role of different stabilizers and other substances in emulsion stability; emulsion formation process and equipment; measurement of emulsion stability; permitted emulsifiers and stabilizers and food applications.

Thickeners – definition, chemical structure, role in food processing and product end characteristics, list of permitted thickeners and food applications.

UNIT IV ANTIOXIDANTS AND ANTI-CAKING AGENTS 9

Antioxidants - Chemistry of oxidative deterioration of food and its constituents and its effect on the quality; defining antioxidant; water soluble and oil soluble antioxidants and their chemical structure, permitted antioxidants; mechanism of action, permitted levels and food application. Anticaking agents – definition, role in preventing spoilage, mode of action, permitted list of anticaking agents and food application.

UNIT V COLOR AND ARTIFICIAL SWEETENERS 9

Color – Natural and synthetic food colors, their chemical structure, shades imparted, stability, permitted list of colors, usage levels and food application.

Artificial Sweeteners – list, structure, taste profile, permitted list, usage levels and food applications.

TOTAL : 45 PERIODS

REFERENCES

1. Mahindru, S. N. "Food Additives- Characteristics Detection and Estimation", TATA McGraw Hill, 2000
2. Wilson, R. "Ingredient Handbook Sweeteners", Blackwell, 2007
3. Emerton, V. "Food Colors", Blackwell, 2008
4. Peter A Williams and Glyn O Philips, " Gums and stabilizers for the Food Industry", RSC, 2006.
5. Branen, A. L. "Food Additives" 2nd Edition, CRC press, 2002

**FD8103 MECHANICAL ENGINEERING, REFRIGERATION & COLD CHAIN L T P C
4 0 0 4**

OBJECTIVE

The course is aimed to impart basic knowledge about engineering materials and cold chain value addition.

OUTCOME

On completion of the course the students are expected to have a

- Basic understanding about engineering materials, pumps, heat exchangers
- Knowledge about principles of thermodynamics, refrigeration
- Problem solving ability on types of loads and capability to design cold storage systems for food products

UNIT I ENGINEERING MATERIALS

Ferrous and Non Ferrous CI, Steel, S.S. Lead, Tin, Al, Cu – Types – Properties – Mechanical, Thermal & Chemical Corrosion and Prevention

12

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UNIT II	JOINING	12
Vc and gas welding – Threaded joints – Shafts and Couplings – Belt drives, Chain drives, gear trains – Types of gears – Flywheel – Springs – Pressure Vessels.		
UNIT III	PUMPS	12
Types – Centrifugal – Reciprocating and other types – Components of – Prevention of Leaks – Seals. Heat exchangers – Principle – Types – applications – Compressors and blowers		
UNIT IV	BASIC PRINCIPLES OF THERMODYNAMICS	12
Laws of Thermodynamics – application – simple applied problems		
UNIT V	PRINCIPLE OF REFRIGERATION	12
Vapor compression and absorption systems – complete cycle – Definition of terms – Design of cold storage and air conditioning systems - types of loads in cold storage and their calculations, design of cold storage for food products, construction of cold storage, equipment selection, insulating materials, vapor barriers, care and maintenance of cold storage; concept of freezing – refrigeration requirements – Packing of frozen foods.		

TOTAL : 60 PERIODS

REFERENCES

1. Anand, M.L. "Refrigeration and Air-conditioning", Asian Books, 2002
2. Nag, P.K. "Engineering Thermodynamics", Tata McGraw-Hill, 2008
3. Khanna, O.P. "Material Science and Metallurgy", Dhanpat Rai Publication, 1995
4. Rajput, R.K. "Thermal Engineering", S. Chand Publication, 2000

FD8111 **CHEMICAL AND MICROBIAL ANALYSIS OF FOOD LAB** **L T P C**
0 0 6 3

OBJECTIVE

To develop skills related to chemical and microbial analysis of food using various techniques

OUTCOME

The students will have the practical skills for: the sampling of foods and be able to apply physical, chemical and microbial techniques of analysis

EXPERIMENTS

1. Moisture estimation by Karl Fischer Titration
2. Soluble and insoluble Dietary Fibre
3. Determination of Fatty Acids in fats
4. Detection of allergens in Foods: soya, peanut
5. Estimation of Vitamin B by HPLC
6. Estimation of Fat soluble vitamins by HPLC
7. Determination of Antioxidant activity of foods
8. Detection of Salmonella by ELISA
9. Rapid methods for hygiene monitoring in equipments and plants
10. Membrane filtration in detection of pathogens, enrichment and detection

TOTAL : 90 PERIODS

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OBJECTIVE

To expose the students in bioreactor and upstream processing, fermentation process and scale up, metabolic engineering and enzymes in food technology

OUTCOME

- To understand the concept of bioreactor configuration advanced fermentation processes and its control systems.
- To understand the modes of operation of a fermenter and its scale – up
- To acquire knowledge about case studies on microbial production of functional food ingredients and significance role of enzymes in food industry

UNIT I BIOREACTOR AND UPSTREAM PROCESSING 12

Bioreactor Configuration, design and physic chemical variables to be monitored. Medium optimization : Design of experiments, Plackett Burman design, Response surface methodology – Principle, evaluation coefficients using statistical software, contour diagram and arriving at optimum numerically and graphically – Case studies in medium optimization. Sterilization concepts – Batch and continuous sterilization.

UNIT II FERMENTATION PROCESS AND SCALEUP 12

Modes of fermentation process – batch, continuous, fed batch and cell recycle process. Aeration and agitation in fermentation process. Scaleup and scale down concepts. Validation concepts in Industries.

UNIT III METABOLIC ENGINEERING 12

Introduction to metabolic engineering, flux balance analysis, Changing central metabolic pathways, Biosynthetic pathways to produce food ingredients – Case studies amino acids, carotenoids, plant products in microbes.

UNIT IV ENZYMES IN FOOD TECHNOLOGY 12

Enzymes used in starch industries. Pectinases and its food applications. Enzymes in food processing industries. Enzymes in dairy industry. Lipoxygenases and food quality. Enzymatic synthesis of oligosaccharides.

UNIT V CASE STUDIES ON PRODUCTION OF FOOD INGREDIENTS 12

Microbial production of oils and fats. Microbial production of food flavours. Microbial production of carotenoids. Alcoholic beverages. Biotechnological production of alternate sugars.

TOTAL : 60 PERIODS**REFERENCES**

1. Joshi, V.K. and Ashok Pandey, "Biotechnology: Food Fermentation, Microbiology, Biochemistry and Technology", (Vol. I & Vol. II) Educational Publisher, 1999
2. Pepler, H.J. and Perlman, D. "Microbial Technology: Fermentation Technology", 2nd Edition, Vol. II Academic Press / Elsevier, 2004
3. Stanbury, P.F, Whitaker, A, Hall, S.J. "Principles of Fermentation Technology", 2nd Edition, Aditya Books, 1997
4. Vogel, H.C. and Todaro, C.L. "Fermentation and Biochemical Engineering Handbook: Principles, Process Design and Equipment", 2nd Edition, Standard Publishers, 2005
5. El-Mansi, T. *et al.*, "Fermentation Microbiology and Biotechnology", 2nd Edition, CRC / Taylor & Francis, 2007

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OBJECTIVE

The course aims to develop the knowledge of students in the area of packaging of foods and the related technology used. This course will enable students to appreciate the application of scientific principles in the packaging of foods.

OUTCOME

The students will gain knowledge on

- The different types of materials and media used for packaging foods.
- Hazards and toxicity associated with packaging materials and laws, regulations and the monitoring agencies involved in food safety, labeling of foods
- Methods of packaging, shelf life and food factors affecting packaging

UNIT I INTRODUCTION TO FOOD PACKAGING 9

An over view of packaging; Historical back ground of packaging; Packaging – Dimensions, Concepts, Functions, Definition, Significance, Classification; Hazards to the Packaging – Climatic Hazards, Mechanism of spoilage, Mechanical Hazards; Packaging Components – Unit/Retail Packaging, Intermediate/Secondary Packaging, Bulk/Transport Packaging; Traditional Packaging Materials; Importance of Packaging in Food industry; Status of current packaging.

UNIT II PACKAGING MEDIA AND MATERIALS 10

Primary packaging media; Flexible packaging materials – Manufacturing, Properties and applications of Papers, Specialty Papers and Paper boards, Cellulose films, Polymer films, Aluminium Foils, Flexible Laminates, Co-extruded Films; Aluminium Collapsible Tubes, Flexible plastic tubes, Flexible Lamitubes; Rigid Packaging Materials – Manufacturing, Properties and Applications of Glass Bottles / Jars, Tin containers, Aluminium Containers, Composite Containers, Rigid Plastic Containers; Bulk Packaging Media; Manufacturing, Properties and Applications of Corrugated Fibre Board Boxes, Plastic Corrugated Boxes, Metal Drums, Fibre Board Drums, Plastic Drums, Ply-wood & Wooden Boxes; Ancillary Packaging Materials – Caps & Closures, Labels, Tapes, Reinforcement Materials, Angle Boards/Edge Guards, Cushioning Materials, adhesives, inks and lacquers.

UNIT III PACKAGING SYSTEMS AND METHODS 10

Vacuum packaging, Gas flush packaging, Tamper-evident packaging; Modified Atmosphere Packaging (MAP), Controlled Atmosphere Packaging (CAP) & Aseptic Packaging, Retort pouch technology, Bag-in-box; Microwave packaging; Active packaging; Bio-degradable packages, Edible packages; Use of smart packaging by the food industry; Use of sensor technology within the food packaging industry; Industrial packaging: unitizing – Shrink and Stretch Wrapping, palletizing, containerizing, stacking and materials handling; distribution systems for packaged foods including prevention of shock damage to articles during transportation; Rigid and semi-rigid containers; Thermoformed packages – skin packaging and Blister Packaging; Flexible containers; form-fill-seal systems; Shelf-Life Studies; Testing & evaluation of packaging materials & packages – retail packs, transport packages and ancillary packaging materials.

UNIT IV PACKAGING FRESH AND PROCESSED FOODS 10

Packaging requirements for different foods and processing methods- General classification and packaging types, varieties and trends; packaging of convenience foods; Packaging of Food products – Fresh Fruits and vegetables, Packaging of Fruit juices, Packaging of Jams and Jellies, Packaging of Pickles and Chutnies, Packaging of Fats and Edible oils, Packaging of Break-fast cereals, Packaging of Tea, Coffee & other Beverage products; Packaging of Soft Drinks; Packaging of Bakery products- Bread, Biscuits & Cakes; Packaging of Snack foods; Packaging of Ready-cook products; Packaging of Spices, Condiments, Oleoresins ; Packaging of Meat and Poultry Products; Packaging of Fish and other Sea-foods; Packaging of Dairy Products; Packaging requirements for Thermal-processed, Dehydrated, Frozen, Irradiated and other specially processed foods.

'UNIT III RADIATION PROCESSING 9

Principles of radiation processing, applications like disinfection, pasteurization and sterilization, extending shelf life of plant products, advantages and limitations; ionizing radiations, mechanisms of action, dosage for different applications in terms of products; equipment for generating ionizing radiation and exposure

Safety and Regulations governing irradiation of foods – India and abroad; product permitted to be irradiated and the levels; special labeling requirements of irradiated foods; Irradiation facilities in India

UNIT IV EMERGING PROCESSING TECHNOLOGIES 9

High Pressure Processing – principles, mechanism of action, advantages and disadvantages over conventional processing; Equipment and applications in food industry, Pulsed electric field processing - principles, mechanism of action, advantages and disadvantages over conventional processing; Equipment and applications in food industry.

Ohmic heating of foods - principles, mechanism of action, advantages and disadvantages over conventional processing; Equipment and applications in food industry, Infra – red heating – principles, mechanism of action food application

UNIT V CONTROLLED/MODIFIED ATMOSPHERE STORAGE AND PACKAGING (CAS/MAP), ACTIVE PACKAGING 5

Principles of CAS and MAP, its advantages in preserving fresh fruits and vegetables and grains, Co₂ tolerance, controlled storage rooms; respiration rate of fruits and vegetables role of barrier properties of packaging in MAP, designing of MAP for fruits and vegetables; application of MAP in extending the shelf life of processed foods

Principles of active packaging; preservation role of active packaging and its application in foods

HURDLE TECHNOLOGY 4

Minimal processing of foods, principles of hurdle technology, advantages of hurdle technology, different types and classes of hurdles, homeostasis and application of hurdle technology in food preservation.

TOTAL : 60 PERIODS

REFERENCES

1. Toledo, R.M. "Fundamentals of Food Process Engineering", 3rd Edition, Springer, 2007
2. Chandra, G.R. "Essential of Food Process Engineering", BS Publications, 2006.
3. Das, H. "Food Processing Operations Analysis", Asian Books, 2005.
4. Smith, P.G. "Introduction to Food Process Engineering", Springer, 2005.
5. Fellows, P.J. "Food Processing Technology: Principles and Practice", Wood head Publishing, 1997
6. Barbosa-Canovas, Gustavo *et al.*, "Novel Food Processing Technologies", Marcel Dekker/CRC, 2005

FD8211

ADVANCED BIOPROCESS LAB

**L T P C
0 0 6 3**

OBJECTIVE

To enable the students to understand the design, scale up and operation of equipment in handling of food based enzymes and cultivation of microbes relevant to food industry on industrial scale.

OUTCOME

The students will learn the following skills:

- To sterilize
- To operate the bioreactor
- To design experiments for evaluating the performance of the bioreactor
- To develop enzyme immobilized processes

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EQUIPMENT NEEDED

Bioreactor
Centrifuge
Microfiltration unit
Homogenizer

EXPERIMENTS

1. Enzyme Kinetics and Evaluation of Coefficients by Computational Methods
2. Enzyme Immobilization – Cross Linking Method and Application
3. Enzyme Application – Use of Enzyme to Liquefy Starch and produce Glucose
4. Sterilization Kinetics – Batch Sterilizer Design.
Scale down experiment to simulate large bioreactor condition and evaluate nutrient depletion quality.
5. Batch Cultivation – Evaluation of Yield Coefficients, Exhaust Gas Analysis, Carbon Distribution
6. Plackett Burman Design and Response Surface Methodology for getting an optimum condition

TOTAL : 90 PERIODS

REFERENCES

1. Bailey, J.E. and Ollis, D.F. "Biochemical Engineering Fundamentals", 2nd Edition, McGraw – Hill, 1988.
2. Lee, J.M. "Biochemical Engineering", PHI, 1992
3. Stanbury, P.F. *et al.*, "Principles of Fermentation Technology", 2nd Edition, Butterworth – Heinemann / Elsevier, 1995.
4. El-Mansi, E.M.T. *et al.*, "Fermentation Microbiology and Biotechnology", 2nd Edition, CRC / Taylor & Francis, 2007.
5. Peppler, H.J. and Perlman, D. "Microbial Technology" (vol. I Microbial Processes and Vol. II Fermentation Technology), 2nd Edition, Academic Press / Elsevier, 2004.

FD8311

ADVANCED FOOD ANALYSIS TECHNIQUES LAB

**L T P C
0 0 6 3**

OBJECTIVE

To enable the students to understand the principles and methods of advanced techniques in the analysis of foods

OUTCOME

The students will learn the following skills:

- To apply different methods of extracting food components
- To use different types of spectrophotometers
- To use instruments that analyze the physical properties of foods

EXPERIMENTS

1. Determination of beta-carotene/lycopene in fruits using spectrophotometer
2. Estimation of nickel content in Hydrogenated vegetable oil by AAS.
3. Determination of added vitamin A in vanaspathy
4. Determination of sugars in soft drinks by HPLC.
5. Screening of corn/groundnuts for Aflatoxins by TLC method.
6. Determination of Refractive Index of oils
7. Detection of adulteration of honey using Polarimetry

8. Determination of antioxidant activity of foods by DPPH method
9. Measurement of colour of whole, liquid and semi-solid foods.
10. Texture Measurement of foods using Texture Analyser

TOTAL : 90 PERIODS

FD8312

FOOD PROCESSING AND QUALITY CONTROL LAB

**L T P C
0 0 6 3**

OBJECTIVE

To enable the students to understand the principles and methods of processing foods

OUTCOME

The students will learn the following skills

- To apply different methods of extracting food components to analyze the quality of foods
 - To understand and use different techniques of food processing to preserve foods
 - To use instruments that analyze the physical properties
1. Determination of absorbed oil content in fried foods.
 2. Monitoring the primary and secondary oxidative rancidity in oils.
 3. Determination of thermal load during retort processing of food products.
 4. Determination of browning and colour measurement in foods.
 5. Preparation of pickled vegetables, fruit jams, and bakery products; and their chemical analysis
 6. Canning of vegetables & fruits - fruit juices, squashes, syrups and ready-to-serve beverages.
 7. Drying of fruits and vegetables, quality control of processed products.
 8. Spray drying of liquid foods
 9. Freezing of foods.
 10. Shelf life calculation for moisture sensitive and oxygen sensitive foods.
 11. Estimation of shelf life of seasonal fresh vegetables & fruits.
 12. Packaging of food products using retort pouch technology.

TOTAL : 90 PERIODS

FD8313

PROJECT WORK – PHASE I

**L T P C
0 0 12 6**

Students should identify one project that can be carried out in two phases either in-house or in industry or research institutes. When working outside, an internal guide from the department will monitor and review progress of work.

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OBJECTIVE

The course aims to develop the knowledge of students in the area of Cereal, pulse and oilseed processing and technology. This is necessary for effective understanding specific aspects of food processing related to these foods.

OUTCOME

On completion of the course the students are expected to

- Be able to understand and identify the know-how technologies used for cereals, pulses, oilseeds
- Understand the application of scientific principles, processing and utilization of value added products
- Enable students to appreciate the application of scientific principles and technology in the processing of materials

UNIT I MAJOR CEREALS 15

Cereal Grains- new varieties, production trends of wheat, rice, barley, oat, corn, sorghum, pearl millet and minor millets in India; Structure and nutrient distribution in cereals, wheat types, Processing: Wheat- milling, (Atta and maida), quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products – Bread, Biscuit, Cakes, Eextruded products, Pizza, Chapattis, malting and malt products; Rice- Milling, milling machine, effect of different factors on milling yield and rice quality, parboiling of rice, effect of aging of rice, rice products-enrichment with vitamin and minerals, byproduct utilization; Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Traditional and Fermented cereal products

UNIT II OTHER CEREALS 8

Corn- Wet and dry milling, Corn Products – Corn flakes, Corn starch, its derivatives syrup, germ oil, preparation of extruded products; canned corn products, puffed product, Barley-pearling and malting of barley. Oats- Milling, Oat Products – Steel cut, rolled oats, quick cooking.

UNIT III MILLETS 8

Sorghum, Pearl Millet, Finger millet, Foxtail millet, Kodo Millet - Basic agricultural aspects, structure and composition; storage, insect control; processing - pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

UNIT IV PULSES AND LEGUMES 9

Basic agricultural aspects, structure, composition, storage, insect control, processing- Milling/splitting, dhal milling; processing of pulses- fermented and traditional products – puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soya protein Isolate, soya paneer

UNIT V OIL SEEDS 5

Oil seeds processing: Groundnut, mustard, soybean, sunflower, safflower, sesame and other oil bearing materials. Processing and utilization of soybean for value added products. Innovative products from oilseeds

TOTAL : 45 PERIODS

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REFERENCES

1. Matz, S.A. "The Chemistry and Technology of Cereals as Food and Feed", 2nd Edition, CBS, 1996
2. Agro-Food Processing: Technology Vision 2020- Cereals Current Status and Vision', TIFAC (DST) Report, 1996
3. Potter, N. "Food Science", 5th Edition, CBS, 1996
4. Vaclavik, V.A. and Christian, E. W. "Essentials of Food Science", 2nd Edition, Springer, 2003
5. Hamm, W and Hamilton, R.J. "Edible Oil Processing", Blackwell / Ane Books, 2004.

FD8003

CHEMICAL ENGINEERING IN FOOD INDUSTRY (For Science stream graduates)

**L T P C
3 0 0 3**

OBJECTIVE

To understand the principles of process calculations and principles of fluid mechanics and its application

OUTCOME

- To perform calculations pertaining to processes and operations
- To apply fluid mechanics principles to applied problems

UNIT I MATERIAL AND ENERGY BALANCE 9

Units – dimensions – composition Material Balances – Steady state, unsteady state – energy balance – steady state and unsteady state.

UNIT II FLUID MECHANICS 9

Fluids – concepts of fluid statics – flow through pipes – energy balance – flow measurement – pumps – fittings – valves.

UNIT III HEAT TRANSFER 9

Phenomena of heat transfer – concepts and application of conduction – convection and radiation – Heat transfer equipments.

UNIT IV MASS TRANSFER 9

Concepts of diffusion and mass transfer coefficients – application in mass transfer operations – Absorption, Distillation, Extraction, Leaching, Adsorption, Ion exchange, operations – Drying – Crystallisation.

UNIT V MECHANICAL OPERATIONS 9

Size Reduction – Principles – Equipments – Separation Techniques – Screening – Settling – Sedimentation – Filtration – Centrifugal separation – Ultrafiltration – Membrane Separation – Agitation – Mixing.

TOTAL : 45 PERIODS

REFERENCES

1. McCabe, W.L. and Smith, J.C. "Unit Operations in Chemical Engineering", 5th, 6th, & 7th, Editions, McGraw - Hill, 1993, 2001, 2005
2. Geankoplis, C.J. "Transport Processes and Separation Processes", 4th Edition, Prentice Hall India, 2003
3. Treybal, R.E. "Mass Transfer Operations", 3rd Edition, McGraw – Hill, 1981.
4. Perry, R.H and Green, D. W. "Perry's Chemical Engineer's Handbook", 7th Edition, McGraw – Hill, 1998

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OBJECTIVE

This course is aimed to develop the knowledge about pest infestation, risk associated and its prevention

OUTCOME

- To get awareness about post harvest issues in stored grains and processed foods caused by pests
- To improve the analyzing and problem-solving capabilities on risk assessments, prevention and control

UNIT I FOOD INFESTATION 9

Post harvest problems of infestation in stored food grains, spices and processed foods and food processing units; Economic losses and safety issues.

UNIT II COMMON PESTS 9

Common pests involved in food storage and handling: pests and their habits: rodents, cockroaches, flies, ants, stored product insects – beetles, weevils, moths; birds and other vertebrates

UNIT III RISK FROM PESTS 9

Risk posed by pests to foods, food handlers and public; contamination, toxicology and microbiology, transmission of pathogens, food infection and food poisoning. Food hygiene: regulations, GHP and GMP relevant to pest control

UNIT IV PEST PREVENTION 9

Pest prevention- E-R-D Exclusion, restriction, destruction in food operations; building design and pest proofing, warehousing and storage areas, water and drains. Waste collection and disposal

UNIT V PEST CONTROL 9

Inspection and auditing, physical methods: use of monitoring traps/detectors – electric fly control units, pheromone traps; Chemical control methods – use of insecticides, pesticides and rodenticides, safety and environmental consideration of chemicals used for control, biopesticides; fumigation and disinfection; Pest awareness training and education. Integrated Pest Management in the food industry

TOTAL : 45 PERIODS**REFERENCES**

1. Dennis, S. H. "Pests of Stored Foodstuffs and their Control", Springer, 2002
2. Hall, F.R and Menn, J.J. "Biopesticides: Use and Delivery", Humana Press, 1999
3. Rami, H., *et al.* "Integrated Pest Management: Potential, Constraints and Challenges Insect Pest Management: Field and Protected Crops", 2004
4. David Pimentel, Encyclopedia of Pest Management, Volume 2, CRC Press, 2007

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OBJECTIVE

To provide in-depth knowledge in various unit operations and basic concepts in dairy processing

OUTCOME

To understand the principle and significance of

- Various Processing Methods (both thermal and emerging non-thermal) of market milk and milk product in dairy plant
- Dairy engineering inputs to dairy plant
- Dairy products analysis, Sanitation and Hygiene requirements

UNIT I INTRODUCTION TO MILK 6

Milk: Definition, composition, Physical and chemical properties; National and international standards; Present milk industry scenario and its future practices related to procurement and transportation

UNIT II MILK PROCESSING 10

Fundamentals of mechanical separation: Principle and application of centrifugal separation in Dairy industry (Cream Separator, Self-de-sludging, centrifuge, bactofuge, clarifier, tri-processor) their maintenance; Homogenizer: Classification and maintenance; UHT processed milk products, their properties and prospects, types of UHT plants, aseptic fillers, effect on milk quality; Methods of determining lethality of thermal processing; Non-thermal processing (working Principle, merits and demerits): Pulsed Electric field, Infra red, Ohmic heating, High hydrostatic pressure processing; Soy milk manufacturing and application of High Pressure Processing; Use of carbonation in extending the shelf life of dairy product; techno- economic considerations;

UNIT III UNIT OPERATIONS 10

Dehydration - Advances in drying of milk and milk products, freeze concentration, freeze dehydration: physicochemical changes during freeze drying and industrial developments; evaporation systems - evaporator; milk dryers; spray dryer and roller dryer; Water activity; energy of binding water, control of water activity of different milk products in relation to their chemical; microbiological and textural properties; Design of pressure vessel, storage tank, milk coolers, pasteurizing plants, flavor treating equipment.

UNIT IV SAFETY AND SANITATION 9

Current trends in cleaning and sanitization of dairy equipment: advanced CIP systems; pumps: classification, reciprocating, centrifugal pumps, pressure variation; Ultrasonic techniques in cleaning; bio-detergents, development of sanitizers- heat; chemical; radiation, mechanism of fouling and soil removal; Bio-films, assessing the effectiveness of cleaning and sanitization of dairy products; Application of HACCP system in dairy industry.

UNIT V DAIRY PRODUCTS PROCESSING AND ANALYSIS 10

Recent Developments in Yoghurt Manufacture, Modern Cheese processing: Hard and Soft Cheeses, Equipment for butter, ghee, ice-cream, cheese making and their maintenance; Developments in Cream Separation and Processing; Byproduct technology- Whey and Casein processing and utilization; Membrane processing: ultra filtration, nanofiltration and reverse osmosis, Effect of milk constituents on operation; Rapid, automated microbiological and analytical techniques in Dairy industry - Detecting pathogens, antibiotic and elementary xenobiotic residues in raw & processed dairy products; hurdle technology and its application in development of shelf-stable and intermediate-moisture foods.

TOTAL : 45 PERIODS*Attested**Sahana*
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REFERENCES

1. Kapoor, A. "Diary Science and Technology", Vishvabharti Publications, 2005
2. Spreer, E. "Milk and Dairy Product Technology". Marcel Dekker, 2005.
3. Walstra, P., *et al.* "Dairy Technology - Principles of Milk Properties and Processes", Marcel Dekker, 1999
4. Eckles, C.H and Combs, W.B. "Milk and Milk Products", 4th Edition, Tata McGraw-Hill, 1973
5. Marth, E.H and Steele, J.L. "Applied Dairy Microbiology", 2nd Edition, Marcel Dekker, 2001

FD8006

ECONOMICS AND TRADE IN FOOD

**L T P C
3 0 0 3**

OBJECTIVE

This course aims to emphasis the significant role of economics and trade in food sector

OUTCOME

- To understand the rudimentary concepts of Indian Economy under various sector and methods of measurement
- To update the economic reforms and Modern Technology
- To be aware of the importance of management in Quality domain

UNIT I ECONOMICS FUNDAMENTALS 9

Nature of Indian Economy – Role of Agricultures Sector, Industrial Sector and Services Sector in the development of Indian Economy. National Income of India, Methods of its measurement – Growth of National Income, per capita income

UNIT II INFRASTRUCTURE 9

Energy, Transportation, Storage, Communication, Health, Education, Importance of Co-operation, Role of Small and Medium Enterprises (SMEs), CLUSTER and Industrial Park concept, Self Help Groups (SHG).

UNIT III ECONOMICS REFORMS 9

Liberalization, Privatizations, Disinvestment, Globalization, Importance of Export, Export Documentation, Inflation, Foreign exchange reserves.

UNIT IV IMPORTANCE OF MODERN TECHNOLOGY 9

Modern technology and its evaluation, Importance of Marketability and Feasibility, Definition of Trade and Business, Importance of Scale of Production, Capacity, Concept of productivity.

UNIT V QUALITY MANAGEMENT 9

Total Quality Management, conventional methods, Agmark - certification of Food (Agro) Products Role and Function of Reserve Bank of India in Food Processing Sector, pricing policy fundamentals

TOTAL : 45 PERIODS

REFERENCES

1. Francis, C. "International Trade and Export Management", Himalaya Publishing, 2007
2. Gupta, K.R. "International Economics", Atlantic Publishers, 2009
3. Dhingra, I.C. "Indian Economy," Sultan Chand, 2003
4. Mote, V.L., Paul, S. and Gupta, G. S. "Managerial Economics", Tata McGraw Hill, 2000
5. Narang, G.B.S. and Kumar, V. "Production and Costing", Khanna Publishers, 1998.

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OBJECTIVE

To create awareness about environmental issues in food industry

OUTCOME

To acquire knowledge about Environmental pollutions, its measurements and management

To initiate projects on methods of utilizing wastes to make value added products

To understand and design Air duct and room air distribution for the basic control of Air Quality, Waste Water Treatment

UNIT I ENVIRONMENT AND POLLUTION 9

Components of environment; Environmental pollutions, its measurements and management; Air pollution and its control; Water pollution and its control; Xenobiotic compounds; Pesticides and pest management; processes; Solid wastes and management; Microorganisms as components of the environment; microorganisms as indicators of environmental pollution; bioorganic pollution; microbial toxicants and pollutants, and their bio-degradation; biodegradation of plastics, biofouling and biofilms; bioremediation.

UNIT II CONTROL OF AIR QUALITY 9

Air duct design and room air distribution; air conditioning systems; clean-room air conditioning; important pollutants of air; properties of particulate matter and air pollution control methods; air quality in the processing plants, legal requirements.

UNIT III WASTE WATER TREATMENT 9

Waste water sources characteristics - standards for disposal of water, physical, chemical and biological characteristics of waste water; measurement of organic content in waste water; Physical unit operations in waste water treatment - screening; racks, mixing, flocculation, sedimentation, floatation, elutriation, vacuum filtration, incineration; chemical unit operations in waste water treatment - reaction kinetics; chemical precipitation, aeration and gas transfer process, rate of gas transfer, adsorption, disinfection; biological unit operations - aerobic and anaerobic

UNIT IV STORAGE & DISPOSAL OF WASTE 9

Types of waste generated; Non- degradable & biodegradable wastes, Solid waste storage and disposal methods- land-filling, burial, incineration, recycling; Biological treatment of food industry wastes, storage and disposal of liquid and gaseous waste; legal aspects related to storage and disposal; environmental laws; pests & their control.

UNIT V UTILIZATION OF WASTE 9

Methods of utilizing wastes to make value added products- generation of biogas, extraction of specific components, use in animal feeds, zero emission plants; recovery & recycling of materials.

TOTAL : 45 PERIODS

REFERENCES

1. Moorthy, C.K. "Principles and Practices of Contamination Control and Clean rooms", Pharma Book Syndicate, 2003
2. Roday, S. "Hygiene and Sanitation in Food Industry", Tata McGraw – Hill Publishing, 1999
3. Wilson, C.L. "Microbial Food Contamination", 2nd Edition, CRC, 2008
4. Hester, R.E. and Harrison, R.M. "Food Safety and Food Quality", (Issues in Environmental Science and Technology), RSC, 2001
5. Potter, N. and Hotchkiss, J.H. "Food Science", 5th Edition, CBS, 1996

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OBJECTIVE

This course aims to explain the flavor, Spice and Plantation crops application in food industry

OUTCOME

- To understand the flavor profiling, analytical and processing techniques, quality aspects of flavor, spices and plantation products
- To acquire knowledge about stability studies on storage, processing, transportation

UNIT I FLAVOR – INTRODUCTION 9

Definition and Description of flavor, flavor profile. Measurement of flavor, particularly for wine, tea, coffee, spices and condiments. Natural and synthetic flavoring substances and their chemical characteristics. Flavor components/constituents of fruit and vegetables, coffee, tea and cocoa bean, spices and condiments

UNIT II FLAVOR PROCESSING AND STABILITY STUDIES 9

Effect of storage, cooking condition of various foods, processing, transportation and environmental condition on flavor components. Processing (industrial/commercial) technologies / methods of flavoring compounds of plant foods and their utilization and application

Recent developments in flavor research, processing and technology

UNIT III PLANTATION CROPS 10

Tea: Processing of tea, various types of tea, chemistry of constituents, fermentation, tea concentrates decaffeination process, Evaluation and grading of tea. Coffee: Processing of coffee, type of coffee, drying, fermentation, roasting and browning processes and their importance, chicory chemistry and technology. Analysis of tea and coffee, quality components - standards and specification of tea and coffee products. Processing and analysis of cocoa bean, beverages and study of factors that affect quality and uses for the consumers

UNIT IV SPICES- CLASSIFICATION, QUALITY AND FUNCTIONAL VALUE 9

Scope of spice processing in India, Types, spice qualities and specification, uses and physiological effects, components, antimicrobial and antioxidant properties, Medicinal value of condiments and spice products

UNIT V SPICE PROCESSING 8

Important spices added in food products, Processing and manufacturing of major Indian Spices: Pepper, cinnamon, cardamom, Nutmeg, saffron, turmeric and Ginger, minor spices- cloves, leafy spices, bay oregano, and seed spices. Spice processing machineries, packaging and handling of spices. Spice blends and extractives, essential and encapsulated oils, oleoresins – uses in processed foods

TOTAL : 45 PERIODS

REFERENCES

1. Heath, H.B. "Flavor Chemistry and Technology", CBS Publications, 2005
2. Spanier, A.M *et al.*, "Food Flavor and Chemistry: Explorations into the 21st Century", RSC, 2005
3. Reineccius, G. "Flavor Chemistry and Technology", 2nd Edition, Taylor & Francis, 2006
4. Hirasu, K and Takemasa, M. "Spice Science and Technology", Marcel Dekker, 1998
5. Pruthi, S. "Quality Assurance in Spices and Spice Products (Modern methods of analysis)", Allied Publishers, 1999

OBJECTIVE

To provide knowledge in the various type of equipment used for unit operations in food processing

OUTCOME

To get through the principles, design and significance of

- Milling and extrusion equipments
- Downstream processing equipments
- Mixing, Blending and Filling Equipments
- Waste water treatment installations, Clean-in-Place (CIP) system

UNIT I MILLING AND EXTRUSION EQUIPMENTS 9

Milling equipments used for rice and wheat, pearling and flaking equipment; dhal mills; Extrusion processing: principles; different types and design of extruders

UNIT II WASHING, FILTRATION & CENTRIFUGATION EQUIPMENTS 9

Different Fruits and Vegetable washing systems; Conveyor belts - types, material of construction, product specific conveyors; Design of screw, bucket, belt, oscillating and vibratory conveyors; filtration of liquid foods (dairy, fruit & vegetables); centrifugation systems: Solid bowl and disc bowl centrifuges; cyclone separator and self cleaning centrifuge.

UNIT III MIXING, BLENDED & FILLING EQUIPMENTS 9

Agitation and mixing of liquid foods, powders and pastes; Mixers -ribbon blenders, augur, nauta, cone.

Liquid and powder filling machines - like aseptic system, form and fill (volumetric and gravimetric), bottling machines.

UNIT IV HEAT PROCESSING & COOLING EQUIPMENTS 9

Autoclaves - types, operation; Different drying systems - Spray, Fluidized bed, tunnel; evaporators; pasteurizers, steamer, roaster ovens, kettles, baking & confectionery equipments

Freezing equipments - Plate, Tunnel, blast, IQF, Liquid nitrogen, Heat exchangers - Tubular and Plate; Refrigerated transport and transportation in insulated containers.

UNIT V HYGIENIC DESIGN ASPECTS 9

Basic principles: as applied to various equipment- sanitary pipes and fittings, pumps, machines, tanks, stirrers and mixers, pasteurizers; evaporators; thermo-compressors and; dryers; sterilizers and treatment by irradiation; waste water treatment installations, Clean-in-Place (CIP) system; corrosion process and their control.

TOTAL : 45 PERIODS**REFERENCES**

1. Lopez, G.A. and Barbosa, C.G.V. "Food Plant Design", Taylor & Francis, 2005
2. Smith, P.G. "Introduction to Food Process Engineering", Springer, 2005.
3. Rao, M.A., Rizvi, S.S.H and Datta, A.K. "Engineering Properties of Food", 3rd Edition, Taylor & Francis, 2005
4. Proceedings of International Conference on Emerging Technology in Agricultural & Food Engg. IIT Kharagpur, "Food and Bio Process Engineering" Anamaya Publishers, 2005

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OBJECTIVE

To expose the students to the principles and different methods of food processing and preservation

OUTCOME

- To understand the principles of food processing and preservation.
- To understand the role of different methods of preservation on different foods and their impact on the shelf life, quality, and other physical and sensory characteristics of foods.
- To familiarize with the recent methods of minimal processing of foods
- To understand the materials and types of packaging for foods

UNIT I PRINCIPLES OF FRESH FOOD STORAGE 9

Nature of harvested crop, plant and animal; Product storage; Effect of cold storage and quality- storage of grains; Principles of refrigerated gas storage of food- Gas packed refrigerated foods; Sub atmospheric storage; gas atmospheric storage of foods.

Principles of food freezing: development of frozen food Industry, the freezing point of foods, freezing of bakery products. Psychrometric chart, Freezing and cold storage. Freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT II PRINCIPLES OF CANNING AND DRYING 12

The art of appertizing; categories of foods for canning; spoilage of canned foods, storage of canned foods; Influence of canning on the quality of food; improvement in canning technology. Transport phenomena with respect to foods; Factors affecting heat and mass transfer; Study of heat transfer and its application in the design of thermal processes; calculation of process time temperature-schedules.

Drying – A natural process: artificial drying, adiabatic driers, influence of drying on pigments and enzymes; Dehydration of fruits, vegetables, milk, animal products etc.

Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures.

Newer methods of thermal processing- batch and continuous; application of infra-red microwaves; ohmic heating.

UNIT III PRINCIPLES OF FOOD CONCENTRATES 6

Control of water activity; preservation by concentration and dehydration; osmotic methods; High solid- high acid foods; Pectin and gel formation; Use of sugar and Invert sugar, jelly making, other food products,

UNIT IV NON-THERMAL METHODS 9

Chemical preservatives - Food additives, functional chemical additives applications. Chemical preservatives and antibiotics; Preservation by ionizing radiations- technology aspects of the radiations, pasteurization of foods; public health aspects, microbiology of irradiated foods; Ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology.

UNIT V FOOD PACKAGING 9

Packaging– Concepts, definition, Significance, classification; Packaging– Development, Retail/Unit ; Packaging of foods –fresh and processed; Basic packaging materials, types of packaging, packaging design, packaging for different types of foods, retort pouch packing, vacuum packaging; MAP, costs of packaging and recycling of materials.

TOTAL : 45 PERIODS

REFERENCES

1. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002
2. Desrosier, N.W and Desrosier, J.N. "The Technology of Food Preservation", 4th Edition, CBS, 1987
3. Khetarpaul, N. "Food Processing and Preservation", Daya Publications, 2005
4. Gopala Rao, "Essentials of Food Processing Engineering", BS Publications, 2006
5. Fellows, P. J. "Food Processing Technology: Principles and Practices", Wood Head Publishing, 1997
6. Ranganna, S. "Handbook of Canning and Aseptic Packaging" Vol. I, II & III, Tata McGraw – Hill, 2000

FD8011

FOOD PRODUCT DESIGN AND DEVELOPMENT

**L T P C
3 0 0 3**

OBJECTIVE

To study the steps and strategies related to Innovation in Food Products and New Food Product Development.

OUTCOME

- To impart the knowledge of various aspects of Creativity, Innovation and New Product Development
- To enable the students to understand the process of development of food products
- To develop ideas for new food products which are nutritious, cost effective, functional and marketable

UNIT I FOOD NEEDS & CONSUMER PREFERENCE 9

Market survey and its importance in; designing a questionnaire to find consumer needs for a product or a concept; advantages of processed foods in urbanised Modern Society; why people buy processed foods. Developing a Product to Meet the Requirements

UNIT II DESIGNING NEW PRODUCTS 9

New Food Product Development (NPD) process and activities, NPD success factors, new product design, food innovation case studies, market-oriented NPD methodologies, organization for successful NPD; Recipe Development; use of traditional recipe and modification; recent developments in food ingredients/additives flavorings, colorings, emulsifiers, stabilizer and sweeteners; involvement of consumers, chefs and recipe experts; selection of materials/ingredients for specific purposes; modifications for production on large scale, cost effectiveness, nutritional needs or uniqueness; use of novel food ingredients and novel processing technologies.

UNIT III STANDARDIZATION & LARGE SCALE PRODUCTION 9

Process design, equipment needed and Design; establishing process parameters for optimum quality; Sensory Evaluation; Lab requirements; different techniques and tests; statistical analysis; application in product development and comparison of market samples; stages of the integration of market and sensory analysis.

UNIT IV QUALITY, SAFETY & REGULATORY ASPECTS 9

Product Stability; evaluation of shelf life; changes in sensory attributes and effects of environmental conditions; accelerated shelf life determination; developing packaging systems for maximum stability and cost effectiveness; interaction of package with food; Regulatory Aspects; whether standard product and conformation to standards; Approval for Proprietary Product.

UNIT III ORDER PROCESSING 8

Multi-level supply control, Inventory control systems of stock replenishment, Cost elements, EOQ and derivative models; Order processing and information systems- Defining order processing, order status reporting- industrial order processing, retail order processing, customer order processing; web – based channel order planning.

UNIT IV MODELS AND E- COMMERCE INPUTS 9

Porter's industry analysis and value chain models; concept of total cost ownership; Use of stochastic models and combinatorial optimization in SC planning, layout, capacity planning, inventory optimization; Operation research models for operational and strategic issues in supply chain management, the Bullwhip effect and supply chain management game; Internet technologies and electronic commerce in SCM related to ERP, Q procurement, e-logistics, internet auctions

UNIT V APPLICATION OF SUPPLY CHAIN MANAGEMENT IN MULTI-SECTOR 8

Specific supply chain practices (buy local vs. commodity supply chain)- Pre and Post Harvest Management of Fresh Produce; Food Manufacturing Restaurant and Hospitality Industry, Controlling Food Safety and Insuring Quality, Sustainable and Organic Food Supply Chains and Certification Programs. Benefits and risks associated with FDI in retail sector of India.

TOTAL : 45 PERIODS

REFERENCES

1. Pullman, M. and Wu, Z. "Food Supply Chain Management: Economic, Social and Environmental Perspectives", 2011
2. Chopra, S and Meindl, P. "Supply Chain Management Strategy, Planning and Operation", Pearson Education, 2004
3. Janat, S. "Supply Chain Management: Text and Cases", Pearson, 2009
4. Raghuram, G and Rangaraj, N. " Logistics and Supply Chain Management: Cases and Concepts" , Macmillan, 2000
5. Simchi, L.D., Kaminski. P., Simchi, L.E. "Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies" , 2nd edition, Irwin/McGraw- Hill, 2003

FD8013

FRUIT AND VEGETABLE TECHNOLOGY

**L T P C
3 0 0 3**

OBJECTIVE

The course aims to develop the knowledge of students in the area of vegetable and fruit processing and technology. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

OUTCOME

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for vegetables and fruits and the various products derived from these materials.
- Understand the application of scientific principles in the processing technologies, product specification and regulations.
- Grasp the changes in the composition of foods with respect to the type of processing technology used

UNIT I	PRE-PROCESSING	9
Fresh fruits and vegetables – Handling, grading, cleaning, pretreatments, transportation, pre cooling, chilling, modified atmosphere packaging, Controlled atmosphere storage, packaging, transportation, quality assurance.		
UNIT II	FREEZING OF FRUITS AND VEGETABLES	6
Different freezing methods and equipments, problems associated with specific fruits and vegetables.		
UNIT III	DEHYDRATION OF FRUITS AND VEGETABLES	9
Dehydration – different methods of drying including sun, tray, cabinet, drum, spray, vacuum, tunnel, spray, low temperature drying process, process calculations osmotic dehydration and other modern methods, choice of suitable methods, preserving the color, flavor and nutrient content of the products		
UNIT IV	CANNING, JUICES & CONCENTRATES	9
Different unit operations involved in fruit and vegetable Pulp/juice extraction, concentration, Bulk aseptic packaging of fruit and vegetable pulps, juices and concentrates; aseptic packaging of fruit drinks, juices and other products Bottling, canning - essential principles, different types of cans, unit operations in canning blanching, exhausting, processing conditions. Fruit Juice / pulp/ Nectar/Drinks, concentrates – General and specific processing, different packing including aseptic; Vegetable Purees/pastes - processing of Tomato and tomato products		
UNIT V	FRUIT AND VEGETABLE PRODUCTS & STANDARDS	9
Ready to eat vegetable products, Jams/Marmalades, Squashes/cordials, Ketchup/sauces, Chutneys, Fruit Bar, Soup powders, Candied Fruits, Natural colors, Fruit and Vegetable Fibres - specific processing, different packing including aseptic, Product specifications and standards; food regulations with respect to fruit and vegetable products.		

TOTAL : 45 PERIODS

REFERENCES

1. Indira, G and Mohanram, M. "Fruits" NIN, 1996
2. Arthey, D and Ashwat P.R. "Fruit Processing: Nutrition, Products, and Quality Management", 2nd Edition, Springer, 2005
3. Alzamora, S.M., Tapia, M.S. and Lopez – Malo, A. "Minimally Processed Fruits and Vegetables: Fundamental Aspects and Applications", Springer, 2005
4. Salunkhe, D.K. and Kadam, S.S. "Handbook of Fruit Science and Technology: Production, Composition, Storage, and Processing", Marcel Dekker, 2005
5. Valpuesta, V. "Fruit and Vegetable Biotechnology" CRC / Wood Head Publication, 2002.

FD8014	FUNCTIONAL FOODS AND INGREDIENTS (for Graduates with Food background)	L T P C 3 0 0 3
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OBJECTIVE

To impart the concept of nutraceuticals, functional ingredients and foods and their role in health and disease

OUTCOME

- To understand the different nutrient and non-nutrient functional ingredients and their sources
- To understand the role of phytochemicals and nutraceuticals in health and their therapeutic applications

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UNIT I NEED FOR FUNCTIONAL FOODS 6

Lifestyle changes & diet, lifestyle diseases like cardiovascular diseases, diabetes, cancer and effects of diet in their control

UNIT II NUTRACEUTICALS & PHYTOCHEMICALS 15

Definition of Nutraceuticals and difference from nutrients. Traditional Health Sciences including Ayurveda, Unani, Chinese etc. Benefits of Nutraceuticals in controlling certain diseases; Natural Occurrence of certain phytochemicals and their usefulness in functional foods with following examples: Antioxidants and Flavonoids; Omega-3 Fatty Acids; Carotenoids; Dietary Fibre; Phytoestrogens; Glucosinolates; Organosulphur Compounds etc. their effectiveness in specific disease conditions; other functional ingredients in foods such as peptides, fatty acids, antimicrobial compounds; Clinical Studies including Structure-Activity relationship of active compound. Dosage for effective control of disease or health benefit with adequate safety; Studies with animals and humans; acute and chronic studies. Sea weeds as functional foods and as source of functional ingredients.

UNIT III PRE- & PROBIOTICS 9

Usefulness of Probiotics & Prebiotics in gastrointestinal health and other benefits. Examples of useful microbes and their benefits; Prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes.

UNIT IV PREPARATION OF PHYTOCHEMICALS FROM PLANT MATERIALS 6

Care in handling and storage of raw material with minimal damage to sensitive bioactive compounds; Extractive methods for maximum recovery and minimal destruction of active material; Stability studies.

UNIT V DEVELOPMENT OF FUNCTIONAL FOODS 9

Developing Functional Foods; Use of bioactive compound in appropriate form with protective substances and activators; Effect of environmental conditions in food matrix on activity of bioactive compound; Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods; delivery of immunomodulators / vaccines in functional foods.

TOTAL : 45 PERIODS

REFERENCES

1. Wildman, Robert E.C. "Handbook of Nutraceuticals and Functional Foods", 2nd Edition, CRC/Taylor & Francis, 2007
2. Schmidl, M.K. and Labuza, T.P. "Essentials of Functional Foods", Aspen Publications, 2000
3. Vaclavik, V.A. and Christian, E.W. "Essential of Food Science", 2nd Edition, Springer, 2005

**FD8015 MEAT, FISH AND POULTRY TECHNOLOGY L T P C
3 0 0 3**

OBJECTIVE

This course developed to denote the significance and necessity of organized animal product sector, controlled-advanced processing for efficient slaughtering of animals and poultry, value added egg and marine products.

OUTCOME

- Able to be aware of Feed, Breed Management on production and quality
- Get through Pre and Post slaughter handling techniques
- Capable of detailed understanding the detailed process flow of value added products from herbivores, poultry and marine species

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UNIT I INTRODUCTION**6**

Sources of meat and meat products in India, its importance in national economy; Effect of feed, breed and management on meat production and quality

UNIT II SLAUGHTERING OF ANIMALS AND POULTRY**9**

Common and commercially important meats; pre and post slaughter handling, meat inspection and grading; animal welfare and safety in slaughter plant; Factors affecting post-mortem changes, properties and shelf-life of meat; Meat quality evaluation; Mechanical deboning, meat tenderization.

UNIT III MEAT PROCESSING**12**

Structure and composition of meat, carcass chilling, ageing; storage of fresh meat-Modified atmosphere packaging, packaging of retail cuts; Processing and preservation-artificial tenderizing, chilling, freezing, curing, smoking, sausage manufacture, ready-to-eat meats and meat products; Aging, pickling and smoking of meat; Meat plant sanitation and safety, Byproduct utilization; Recent trends in meat processing; MMPO, MFPO, radiation processing; meat safety. Kosher and Halal certification, safety issues, regulation and quality assurance.

UNIT IV EGG AND EGG PRODUCTS**9**

Structure, composition, nutritive value and functional properties of eggs and its preservation by different methods. Factor affecting egg quality and measures of egg quality; egg products- egg powder and frozen liquid eggs

UNIT V FISH AND MARINE PRODUCTS**9**

Types of fish, composition, post harvest quality changes, post harvest losses, methods for assessing and preventing losses; structure, post-mortem changes in fish; handling of fresh water fish and marine fish; processing of fish, crab, prawns, seaweeds, canning, smoking, freezing and dehydration of fish; Fish sausage and home making; Freezing techniques and irradiation process, value addition, preparation of fish products (fermented fish, fish products, fish soups, fish powder, prawn powder and cutlets), seaweed products like pickles, hydrocolloids and fish oil.

TOTAL : 45 PERIODS**REFERENCES**

1. Sofos, J.N. "Improving the Safety of Fresh Meat" Wood Head Publishing / CRC, 2005.
2. Toldra, F. "Handbook of Meat Processing", Wiley Blackwell, 2010
3. Kerry, J.P. "Improving the Sensory and Nutritional Quality of Fresh Meat", CRC/Wood Head, 2009
4. Venugopal, V. "Seafood Processing: Adding Value through Quick Freezing, Retort able Packaging and Cook-Chilling & other methods" (Food Science and Technology Vol. 13) , CRC press, 2006

FD8016 NEW PROCESS AND PRODUCTION SYSTEMS FOR FOOD**L T P C
3 0 0 3****OBJECTIVE**

This course is developed to explore the physico-chemical properties of functional food ingredients and optimization at molecular and macroscopic levels

OUTCOME

- Be Capable of characterizing molecules/groups of food compounds
- Greater Exposure with advanced techniques such as Super Critical fluid extraction, head space sampling, NMR, IR, Pulse Nuclear Magnetic Resonance spectroscopy
- Ability to get deep insight knowledge about the Bio-process technology for the production and improvement of functional food ingredients

UNIT I INTRODUCTION 6

Importance and need for processes to explore the physical-chemical properties of functional food ingredients and nutraceuticals and optimization of both the nutritional/physiological functionality of ingredients at the molecular, mesoscopic and macroscopic levels

UNIT II EXTRACTION 9

Different types of methods of extraction for molecules of interest and their optimization; Industrial processes for extraction of desirable and undesirable components from fresh and/or stored products by supercritical fluid (SCF) extraction and other techniques; application of ultrafiltration, reverse osmosis; nanofiltration and microfiltration in food industry.

UNIT III FRACTIONATION 12

Methods used for fractionation and characterization of molecules/groups of compounds such as polyphenols, phytates, saponins, phytoestrogens, fatty acids, volatile and aroma / flavour components - by head-space sampling, extraction, concentration, separation and identification techniques - chromatography with mass spectroscopic techniques, GC-MS, random MS and ESR, NMR, IR and Raman Spectroscopy; Pulse Nuclear Magnetic Resonance (PNMR) spectroscopy, X-ray crystallography and polarising light microscopy, scanning electron microscopy, spectro-polarimetry, circular dichroism and differential scanning calorimetry.

UNIT IV SYNTHESIS OF INGREDIENTS 9

Production of functional ingredients by microbes – oligosaccharides, polysaccharides, biosweeteners, biopreservatives, flavour and colour components; Modification of phytonutrients using enzymes or microbial fermentations to improve bioavailability, enhance water-solubility, slow-release applications, solubility in oil, and effecting hydroxylation/methylation patterns to modulate bioactivity.

UNIT V BIOPROCESSING TECHNOLOGY FOR NUTRACEUTICALS 9

Pasteurisation & Sterilization with high pressure – ultrahydrostatic pressure treatment, dense carbon-di-oxide treatment, encapsulation of nutraceuticals – materials, mechanical processes and chemical based processes, nanoencapsulation; packaging requirements and practices for functional foods; distillation and dehydration technologies to retain bioactive compounds.

TOTAL : 45 PERIODS

REFERENCES

1. Gilbert, J and Seuyava, H.Z (Eds). "Bioreactive Compounds in Foods", Blackwell Publishing, 2008
2. Hurst, W.F. (Ed.) "Methods of Analysis for Functional Foods and Nutraceuticals", 2nd Edition, CRC Press, 2008
3. Shi, J (Ed) "Functional Food Ingredients and Nutraceuticals Processing Technologies", CRC Press, 2008

OBJECTIVE

The course is aimed to impart basic knowledge about numerical solutions of partial differential equations.

OUTCOME

On completion of the course the students are expected to

- Have a basic understanding about interpolation and approximation
- Have learnt about various numerical solutions for ordinary and partial differential equations
- Have basic knowledge about perturbation theories

UNIT I INTERPOLATION AND APPROXIMATION 9

Piecewise spline approximation, uniform approximation, rational approximation

UNIT II NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATION 9

Euler Method, Improved Euler Method, Modified Euler method, Runge Kutta Method of Second and Fourth orders, Predictors – Corrector Methods of Miline and Adams – Bashforths

UNIT III NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9

Second order equations, elliptic, parabolic, hyperbolic types using finite difference methods.

UNIT IV FINITE ELEMENT METHODS 9

One dimensional stress deformation, global and local co-ordinates, one dimensional problems, interpolation functions, relations between global local coordinates, requirements for approximation functions, stress and strain relations, principle of minimum potential energy, potential energy approach for assembly, boundary conditions.

UNIT V PERTURBATION METHOD 9

Perturbation theory, Regular and singular Perturbation Theory. Perturbation methods for linear Eigen Value problems, asymptotic matching

TOTAL : 45 PERIODS

REFERENCES

1. Jain, M.K, Iyengar, S.R.K. and Jain, R.K. "Numerical Methods for Simple and Engineering Computation". Eastern Ltd., 1995
2. Desai, C.S. "Elementary Finite Methods", Prentice Hall, 1922 Ch. 2&3
3. Bender, C.M and Orzag, S.A. "Advanced Mathematical Methods for Scientists and Engineers", McGraw Hill, 1998

FD8018 QUALITY ASSURANCE AND SAFETY IN FOOD PROCESSING L T P C

3 0 0 3

OBJECTIVE

To create awareness and understanding of quality control and assurance, risk assessments and GMPs, regulations in the food sector

OUTCOME

- To understand the process control, sampling methods, and quality control applied /used in food industry
- To appreciate the mandatory concept of HACCP and pre-requisite programmes
- To be aware of food safety management systems and updated Food regulations

UNIT I QUALITY CONTROL AND ASSURANCE IN THE FOOD INDUSTRY 10

Defining quality, Objectives, importance and functions of quality control and quality assurance, quality cost; statistical quality control; material specifications, different types of defects, incoming and finished product inspection, acceptable quality levels, attributes and variables, role of distribution, acceptance by variable and attribute sampling, different sampling methods, process control and role of control charts; application examples in food industry.

UNIT II ASSESSMENT OF FOOD SAFETY 9

Definition of food safety, importance of food safety; Causes of unsafe food; food hazards – biological, chemical and physical, allergens; sources and effects of food hazards; Risk assessment covering risk analysis, risk management and risk communication; GMO food and ingredient and its safety; concept of Acceptable Daily Intake of additives and its role in setting of standards.

UNIT III GOOD MANUFACTURING PRACTICES (GMP) AND HACCP IN FOOD INDUSTRY 10

Food chain, Food safety hazards, probability of occurrence, severity of food safety hazard and its risk, different control measures against the food safety hazards; Objectives and role of GMP; essentials, implementation and maintenance of GMP in a food factory. CODEX guidelines, FSSA and ISO standards on GMP
Role of HACCP, seven principles of HACCP, categorization and monitoring of control measures, HACCP implementation and maintenance

UNIT IV FOOD REGULATION 10

Need for food laws and regulations, consumer protection; Indian Food Laws governing food industry- Food Safety and Standards Act 2006 and Regulations made there under, structure and functions of Food Safety and Standard Authority of India, detailed understanding of Labeling and claim Regulations and regulations related to product standards, novel foods and novel ingredients and product approval.
Legal Metrology Act and Packaged commodity rules; mandatory BIS certification of food products, and Infant Milk Substitute Act
International standards and regulations – An overview of CODEX, EFSA, USFDA

UNIT V FOOD SAFETY MANAGEMENT SYSTEMS 6

International organization of standardization (ISO), Food safety and quality management system, essentials of ISO 9001 and ISO 22000, accreditation and certification

TOTAL : 45 PERIODS

REFERENCES

1. Entis, P, "Food Safety: Old Habits, New Perspectives", ASM/Blackwell Publishing, 2007
2. Mortimone, S and Wallace, C. "HACCP" (Food Industry Briefing Series), Blackwell Science, 2007
3. Schmidt, R. H and Rodrick, G.E. "Food Safety Handbook", Wiley Interscience, 2005
4. Mehta, R and George, J. "Food Safety Regulations Concerns and Trade" : The Developing Country Perspective", Macmillan, 2005
5. Paster, T. "The HACCP: Food Safety Training Manual", John Wiley, 2006

