M. Sc. Food Technology

Choice Based Credit System

1st SEMESTER

Course Code	**Course Name**	**Credits**			**Total**
		L	**T**	**P**	
FT18101CR	Food Microbiology	**4**	**0**	**0**	**4**
FT18102CR	Food Chemistry	**4**	**0**	**0**	**4**
FT18103CR	Principles of Food Engineering	**4**	**0**	**0**	**4**
FT18104DCE	Principles of Food Processing	**4**	**0**	**0**	**4**
FT18105DCE	Experimental Food Chemistry	**0**	**0**	**2**	**2**
FT18106DCE	Experiments in Food Microbiology	**0**	**0**	**2**	**2**
FT18001GE	Elementary Food Processing	**2**	**0**	**0**	**2**
FT18002GE	Postharvest Physiology of Fruits and Vegetables	**2**	**0**	**0**	**2**
FT18001OE	Food and Nutritional Security	**1**	**1**	**0**	**2**

2nd SEMESTER

Course Code	Course Name	Credits			Total
		L	T	P	
FT18201CR	Food Quality Assurance	**3**	**0**	**1**	**4**
FT18202CR	Food Packaging	**3**	**0**	**1**	**4**
FT18203CR	Advanced Techniques of Food Analysis	**2**	**0**	**2**	**4**
FT18204CR	Food Additives and Flavor Technology	**4**	**0**	**0**	**4**
FT18205DCE	Food Biotechnology	**4**	**0**	**0**	**4**
FT18206DCE	Bakery and Confectionery Technology	**2**	**0**	**0**	**2**
FT18207DCE	Human Nutrition	**2**	**0**	**0**	**2**
FT18208DCE	Plantation Crops And Spices	**2**	**0**	**0**	**2**
FT18003GE	Postharvest Diseases of Fruits And Vegetables	**2**	**0**	**0**	**2**
FT18004GE	Lipid Technology	**2**	**0**	**0**	**2**
FT18002OE	Food Safety	**1**	**1**	**0**	**2**

3rd SEMESTER

Course Code	Course Name	Credits			Total
		L	T	P	
FT18301CR	Cereal, Legume and Oil Seed Technology	**4**	**0**	**0**	**4**
FT18302CR	Fruit and Vegetable Technology	**4**	**0**	**0**	**4**
FT18303CR	Processing of Foods of Plant Origin (Practical)	**0**	**0**	**4**	**4**
FT18304CR	Industrial Microbiology	**2**	**0**	**0**	**2**
FT18305CR	Industrial Training	**0**	**0**	**2**	**2**
FT18306DCE	Neutraceuticals and Functional Foods	**3**	**1**	**0**	**4**
FT18307DCE	Novel Techniques of Food Processing	**3**	**0**	**0**	**3**
FT18308DCE	Postharvest Management of Tree Nuts	**2**	**0**	**1**	**3**
FT18309DCE	Credit Seminar	**0**	**1**	**0**	**1**
FT18005GE	Meat Science	**2**	**0**	**0**	**2**
FT18003OE	Elementary Milk Products Technology	**0**	**1**	**1**	**2**

4th SEMESTER

Course Code	Course Name	Credits			Total
		L	T	P	
FT18401CR	Technology of Milk and Milk Products	**4**	**0**	**0**	**4**
FT18402CR	Technology of Meat, Fish And Poultry Products	**4**	**0**	**0**	**4**
FT18403CR	Processing of Animal Based Foods (Practical)	**0**	**0**	**4**	**4**
FT18404DCE	Project Work	**0**	**0**	**4**	**4**
FT18405DCE	Food Plant Design: Fruits and Vegetables Based	**1**	**1**	**0**	**2**
FT18406DCE	Food Plant Design: Cereal Based	**1**	**1**	**0**	**2**
FT18407DCE	Food Plant Design: Dairy Based	**1**	**1**	**0**	**2**
FT18408DCE	Food Plant Design: Meat Based	**1**	**1**	**0**	**2**
FT18409DCE	Food Toxicology	**2**	**0**	**0**	**2**
FT18006GE	Baked Products Technology	**1**	**0**	**1**	**2**
FT18004OE	Small Scale Processing of Fruits, Vegetables & Cereals	**0**	**1**	**1**	**2**

FT18101CR

FOOD MICROBIOLOGY (4+0+0)

Objectives

To provide a basic understanding of different types of microbes associated with foods and their spoilage

Unit - I

- **History and scope of food microbiology**– Historical development in food preservation, food spoilage and food poisoning.
- **Microbial growth pattern**– Growth curve of microbial cultures, its application to food preservation.
- **Factors affecting microbial growth**– pH, moisture content, Eh, nutrient content, antimicrobial constituents, biological structures, extrinsic factors.
- **Control of microbial growth in foods**–High temperature, freezing, refrigeration, chemical preservatives, irradiation.

Unit – II

- Types of microorganisms associated with food – Mold-general characteristics, morphological features, reproduction, physiological requirements, common molds associated with foods.
- Bacteria–Morphological & structural features of Gram +ve & Gram –ve bacteria, physiological characteristics, important food spoilage and pathogenic bacteria associated with foods.
- Yeast- General Characteristics, reproduction, cultural characteristics, physiological characteristics.
- Viruses- Structure and replication with particular reference to food-borne viruses.
- Biochemical changes caused by microorganisms– Degradation of carbohydrates, fermentation, degradation of lipids, degradation of proteins and amino acids, putrefaction.

Unit – III

- Spores and their significance, spore biology, sporulation and germination cycle.
- **Microbial contamination and spoilage of foods**– Vegetables, cereals, pulses, oilseeds, milk and meat during handling, processing and storage.

- **Microbiology of water and Atmosphere.**
- **Spoilage of processed foods** – Canned products, causes of spoilage, the appearance of spoiled cans, types of spoilage of canned foods by yeast, molds and bacteria.
- **Probiotics and their significance**

Unit IV

- **Foodborne disease** – Staphylococcal gastroenteritis, Botulism, Listeriosis, Salmonellosis, Shigellosis.
- **Toxicants of microbial origins** – Aflatoxins, ochratoxins, patulin, botulism, enterotoxins.
- **Detection & Enumeration of Microbes in foods:** Sampling plan, establishing limits, indicators of microbiological quality, indicators of pathogens & toxins. Physical, Chemical & immunological methods of detecting microbes in foods.

References:

1. Food Microbiology by Frazier.
2. Modern Food Microbiology by James Jay.
3. Basic Food Microbiology by Banwart.
4. Alcoms Fundamentals of microbiology by Jeffery C. Pommerville.
5. Introduction to Microbiology by Stainier.
6. Fundamentals of Food microbiology by Bibek Ray & Arun Bhunia
7. Microbiology-Pelczar, Smith & Chan
8. Textbook of Practical Microbiology by Subhash Chandra Parija.

FT18102CR

FOOD CHEMISTRY (4+0+0)

Objectives

The course aims to provide an advanced understanding of the core chemistry of major components of foods.

To provide the composition and properties of food and the chemical changes it undergoes during processing.

Unit – I

- **Food chemistry** - Definition and importance. Approaches to the study of food chemistry, the societal role of food chemists.
- **Water solute interactions-** Free water, bound water, the interaction of water with ionic and non-ionic groups.
- **Carbohydrates**–Classification, Structure and properties**.** Monosaccharides, Oligosaccharides and Polysaccharides, Polysaccharide Solubility, Polysaccharide Solution Viscosity and Stability, Gels, Polysaccharide Hydrolysis, starch gelatinization and retrogradation. Modified starches, alginate, carrageenan.
- Non- enzymatic browning. Factors affecting the rate of non-enzymatic browning.

Unit – II

- **Lipids -** Classification, Structure and use of lipids in food, saturated and unsaturated fats, hydrogenation of fats.
- **Physical and chemical properties of lipids**– Rheological properties and density. Physicochemical mechanism of lipid phase transitions.
- Lipid oxidation, rancidity, factors affecting rate of oxidization, methods to measure lipid oxidization, control of rancidity. Role of antioxidants

Unit – III

- **Protein and amino acids** – Physical and chemical properties, protein structure.
- Forces governing stability of proteins structure, Conformational stability and adaptability of proteins
- Protein denaturation- Thermodynamics, Physical and chemical denaturing agents.

- **Functional properties of proteins** – Protein hydration, solubility, emulsifying properties, foaming properties.

Unit IV

- **Pigments in foods** – Chlorophyll, alteration of chlorophyll, preservation of chlorophyll during processing, carotenoids and their properties, anthocyanins, their properties and stability.
- **Enzymes in foods** – Kinetics of enzyme reactions.
- Papain, lipoxygenase, PPO, pectnaise, cellulase and amylase in food industry.

References:

1. Food Chemistry by Owen R. Fennema.
2. Food Chemistry by Meyer.
3. Mechanism & Theory in Food Chemistry by Wong.
4. Food Chemistry by H. D. Belitz
5. Principles of Food Chemistry by John M. deMan

FT18103CR

PRINCIPLES OF FOOD ENGINEERING (4+0+0)

Objectives

To enhance the understanding of students about the physical properties of foods, process optimization and machine/ plant design.

Unit –I

- **Unit and dimensions** – Definition of dimension, unit, base unit, derived unit, precision, accuracy, systems of measurement, SI system, conversion of units, dimensional constant.
- **Material balance –** Basic principles, total mass balance, component mass balance, numerical problems based on dilution, concentration and dehydration.
- **Heat transfer** - Modes of heat transfer, conduction, convection and radiation.
- Introduction to laws of thermodynamics, specific heat of solids and liquids, properties of saturated and superheated steam, steam tables.
- **Energy balance -** heat balance, numerical problems based on heat balanced.
- **Heat exchanger–** scraped surface, double pipe, shell and tube and plate heat exchangers. Concept of OHTC; Designing of heat exchangers
- **Thermal process calculations**- D Value, Z value, F value calculation of process time for canned foods.

Unit – II

- **Fluid flow** – Viscosity and its measurement; Newtonian and non-newtonian fluids.
- Fluid dynamics- Equation of continuity, Bernoulli's Theorem and applications; fluid flow applications.
- **Refrigeration–** Principle, refrigeration cycle, Thermodynamics of a refrigeration system.
- **Food freezing**– **theory of freezing,** Prediction of freezing time,
- **Types of freezers**- chest freezers, blast freezers, belt freezers, fluidized bed freezers, immersion freezers.
- **Evaporation–** Single effect evaporators, multiple effect evaporators; types of evaporators; steam economy. Essence recovery during evaporation.
- **Designing of evaporators**

Unit – III

- **Dehydration** – Drying curves and calculation of drying time; designing of dehydrators; ERH, EMC.
- **Psychrometry**- psychrometric charts and their application
- **Mechanical handling**- Conveying and elevation.
- **Size reduction** – Elastic stress limit, yield point, Kick's law, Rittengers law, Bonds law.
- Equipment for fibrous foods – slicing, dicing, flaking, shredding, pulping and chopping.
- Equipment of dry foods – ball mills, disc mills, hammer mills, roller mills. Size reduction of liquid foods – homogenization,

Unit – IV

- **Mixing –** Theory of solids mixing, theory of liquids mixing, equipment for low, medium and high viscosity foods.
- Food plant design - General consideration in designing the plant, plant location.
- Plant layout-types of layout considerations in an efficient layout.
- Food plant hygiene – Cleaning, sterilizing, waste disposal methods.

References:

1. Introduction to Food Engineering by R.P. Singh and D.R. Heldman.
2. Fundamentals of Food Process Engineering by R.T. Toledo.
3. Transport Processes and Unit Operation by C.J. Geankoplis.
4. Food Processing Technology by P.Fellows.
5. Industrial Engineering and Management by O. P. Khanna.
6. Unit Operations of Chemical Engineering by Warner L. McCabe.

FT18104DCE

PRINCIPLES OF FOOD PROCESSING (4+0+0)

Objectives

To familiarize students with the basic concepts and techniques of processing and preservation of foods.

Unit – I

- **Food production –** Production of important food grains, fruits, vegetables, pulses & animal products in India, consumption trend in India.
- **Status of the Indian food industry** – Exports scenario of fruits, vegetables, spices, meat and their processed products.
- **Scope and importance of food processing**– Driving forces for the food industry and constraints, challenges to food security, impact of WTO on food scenario, national and international perspective. Approaches to combat world hunger
- **Causes of food spoilage -** Principles and methods of preservation.

Unit–**II**

- **Thermal Processing** – Canning, Sterilization, Pasteurization.
- **Dehydration**– Water activity, types of dryers, the effect of dehydration on food quality. Freeze drying. Intermediate moisture foods.
- **Fermentation**– Types, nutritional importance of fermented foods.
- **Preservation by chemicals –** Benzoate, sorbate, propionate, sulfur dioxide, antioxidants,
- **Hurdle Technology**

Unit – III

- **Irradiation**– Mechanism, dosimetry, equipment, the effect of irradiation on micro-organisms, and food. Safety and wholesomeness of irradiated foods.
- **Aseptic processing–** Equipment, characteristics, HTST and UHT processing, Extrusion.
- **Membrane processing–** Advantages, types of membranes, equipments, applications and effect on foods.

- **Minimally processed foods–** Preservation and packaging of minimally processed foods.
- **Microwave processing–** Electromagnetic spectrum, the difference between microwave and infrared energy, dielectric constant, relaxation time, equipment and applications.

Unit – IV

- **Refrigeration and frozen storage**- Components of a refrigerator, freezing curves, equipment, freezing and chilling injuries.
- **Controlled atmospheric storage** – Principle, design considerations, effects of CA storage on food quality.
- **Modified atmospheric storage -** Gas storage, hypobaric storage.

References:

1. Food Processing Technology by P. Fellows.
2. The Technology of Food Preservation by Desrosier.
3. Food Science by N.N. Potter.
4. Introduction to Food Science and Technology by Stewart.
5. Handbook of Food Preservation by M. Shafiur Rahman.

FT18105DCE

EXPERIMENTAL FOOD CHEMISTRY (PRACTICAL) (0+0+2)

Objectives

To understand the basics of compositional analysis of foods.

To demonstrate influence on the loss of quality and/or wholesomeness of foods.

Practical to be performed

1. Preparation and standardization of solution.
2. Proximate analysis of foods:
    - Estimation of moisture by oven drying and IR-Moisture Analyser
    - Estimation of Crude protein by Micro-Kjddhal and Lawry's method
    - Crude fat, Crude fiber and Ash
3. Qualitative tests for Carbohydrates
4. Estimation of sugars by phenol sulphuric acid method.
5. Determination of Browning Index
6. Protein separation and characterization using SDS-PAGE electrophoresis
7. Smoke, Flash and Fire points of oils and fats
8. Determination of free fatty acids
9. Peroxide value and TBA for measuring lipid oxidation
10. Assessment of protein functional properties
11. Determination of amylose and amylopectin in foods.
12. Estimation of Total phenolic content
13. Estimation of myoglobin
14. Estimation of Total carotenoids

References:-

1. Handbook of Analysis and Quality Control for Fruit and Vegetable products by Ranganna.
2. Food Analysis by S. Suzanne Nielsen
3. Chemical Analysis of Foods and Food Products by Jacobs, Morris B

FT18106DCE

EXPERIMENTS IN FOOD MICROBIOLOGY (PRACTICAL) (0+0+2)

Objectives

To demonstrate culturing of microorganisms

To characterize the micro-organisms by morphological properties and biochemical tests.

Practicals to be performed

1. Microscopy.
2. Cleaning and sterilization of glassware.
3. Preparation of nutrient media.
4. Techniques of inoculation.
5. Staining techniques-Monochrome staining, negative staining, gram staining
6. Examination of bacteria, yeast and molds.
7. Identification of bacteria based on:
   - Cultural characteristics
   - Morphological characteristics
   - Biochemical characteristics:
     Indole Test/ MVIC test, Starch-hydrolysis, Oxidase Test, TSI test, Coagulase test, Catalase test
8. Enumeration of micro-organisms– TPC, Yeast and mold count, ANPC.
9. Microbiological examination of:

a) Water

b) Milk and milk products.

c) Fruits and vegetables.

References:

1. Textbook of Practical Microbiology by Subhash Chandra Parija.
2. Laboratory Manual in Microbiology by Gunasekaran.
3. Practical Food Microbiology by Diane Roberts and Melody Greenwood

FT18001GE

ELEMENTARY FOOD PROCESSING (2+0+0)

Objectives

To give a brief introduction to various causes of food spoilage and methods of food processing and storage.

Unit – I

- Status of the Indian food industry– Exports scenario of fruits, vegetables, spices, and their processed products
- Causes of food spoilage.
- Thermal Processing – Canning, Sterilization, Pasteurization, Aseptic processing.
- Preservation by low temperature- Refrigeration and Freezing

Unit–II

- Concept of water activity; Intermediate moisture foods.
- Fermentation– Types, nutritional importance of fermented foods.
- Hurdle Technology
- Controlled atmospheric storage – Principle, design considerations, effects of CA storage on food quality.

References:

1. Food Processing Technology by P. Fellows.
2. The Technology of Food Preservation by Desrosier.
3. Food Science by N.N. Potter.
4. Introduction to Food Science and Technology by Stewart.

FT18002GE

POST-HARVEST PHYSIOLOGY OF FRUITS & VEGETABLES (2+0+0)

Objectives

To understand various changes that occur in fruits and vegetables after harvesting and factors influencing their quality.

Unit I

- Cell and its structure with special reference to plant cell.
- Introduction to postharvest physiology of fruits and vegetables.
- Classification of fruits based on post-harvest considerations.
- Fruit maturity and ripening; Maturity indices.
- Ethylene biosynthesis, regulation and mode of action. Factors affecting ethylene production.
- Water loss during fruit storage, factors affecting water loss, control of water loss.
- Storage atmospheres; CA Storage, MA Storage, Hypobaric Storage.

Unit II

- Cell wall-associated enzymes: polygalacturonase, Rhamnogalactouranase, pectin methylesterase, Beta-galactosidase, etc. Their role in textural change
- Polyphenol oxidases, lipoxygenase.
- Post-harvest disorders in fruits and vegetables; mealiness, chilling injury etc.
- Role of minerals in post-harvest storage life of fruits and vegetables with special reference to Ca, Mg, Zn, Mo & Co.
- Management of post-harvest processes and their importance to reduce post-harvest losses: temperature management, atmospheric control and genetic control.

References:

1. Michael knee. *Fruit Quality and its Biological Basis*; (CRC press).
2. M. Black & J.D Bewely. *Seed Technology and its Biological Basis*. (CRC press).
3. L.N David, M.C Michael. *Lehningers Principle of Biochemistry*. (FreeMan and company, New York).
4. P. Trevor, L.R.B Phillips. *Enzymes in Biochemistry and Biotechnology. (*Harwood 2007).
5. Bench ALR & Sanchez RA. 2004. *Handbook of Seed Physiology*. (Food Product Press).
6. Black M & Bewley JD. (Eds.). 2000. *Seed Technology and its Biological Basis*. (Sheffield Academic Press).

7. Wills R.B.H, W.B. McGlasson, Graham.D, Lee T.H and Hall E.G; *An Introduction to the Physiology and Handling of Fruits and Vegetables* (CBS publishers)

FT18001OE

FOOD AND NUTRITIONAL SECURITY (1+1+0)

Objectives

To acquaint the students with the production and consumption trends of different foods.

To understand the challenge to global food security.

UNIT I

- Historical milestones in Indian agriculture, the contribution of Indian agriculture to the economic development of the country.
- Agricultural productivity trends in India and their sustainability issues.
- Global perspectives of food security, WTO and its impact on food security,
- Postharvest losses in agricultural produce, the scenario of food processing industries in India- Challenges and Opportunities
- Postharvest management of food as a tool for food and nutritional security.
- Food processing and its role in the economy.

UNIT II (Tutorials)

- Trends in the production of animal-based products- milk, meat, egg, poultry, fish
- Climate change and food security
- Shifts in production towards non-food crops and resultant utilization of food crops for nonfood purpose
- Public distribution system: A key to achieve food security in India.
- National Food Security Act, 2013.

References:

Food Security in the Developing World by John Ashley

Times of India, Review of Indian Agriculture

FT18201CR

FOOD QUALITY ASSURANCE (3+0+1)

Objectives

To provides an in-depth understanding of food quality, its evaluation and importance in consumer acceptability of food.

Unit – I

- **Objectives, importance and functions of quality control.**
- **Methods of quality assessment**-Subjective & objective methods.
- **Sampling**-Types of samples, preparations & preservation of sample, sampling errors. Factors affecting sampling size.
- **Statistical quality Control**-X & R charts, steps for developing control charts.
- **Properties of foods**– Color, gloss, flavor, consistency, viscosity, texture & their relationship with the quality.

Unit – II

- **National & international Food laws** – Codex Alimentarius Commission; Food Safety and Standards Act 2006- establishment and composition of FSSAI.
- Licensing and registration of food businesses.
- Offenses and penalties under FSSA.
- **General hygiene and sanitation in the food industry**– GMP, HACCP.
- **Food adulteration and food safety**– Physical, chemical & biological hazards in foods. Methods of evaluation of different food adulterants.
- **Establishment of food testing laboratory**– Infrastructure requirement, design and accreditation considerations.

Unit III

- **Sensory evaluation** - Definition, objectives.
- **Panel screening** - Selection methods, interaction and threshold.
- **Sensory evaluation methods/training**– Difference tests (Paired comparison, Duo Trio, Triangle), Rating (ranking, single sample, two-sample, multiple samples, hedonic), sensitivity threshold test.

- **Quality evaluation of foods** – Fruits, vegetables, cereals, dairy products, meat, poultry, egg and processed food products.

Unit IV (Practical)

1.To examine the quality of fruits and vegetables- firmness, TSS and visual examinations.

2.To examine the quality of meat color, texture, flavor, WHC, drip loss.

3.To examine the quality of milk-acidity, foaming, specific gravity, TS, SNF

4.To examine the quality of cereal products-color and texture of bread, cake and cookies.

5.Sensory methods for measuring food attributes- Difference tests and Rating tests.

6.Determination of adulterants in milk, ghee, edible oil, chilies, honey.

7.Determination of total solids, total dissolved solids, total suspended solids in the waste water.

8. Determination of temporary and permanent hardness of water.

References:

1. Sensory Evaluation Practices by Stone.
2. Principles of Sensory Evaluation of Foods by M.A. Amerine, R. M. Rangborn and E.B. Roessler.
3. Quality Control in Food Industry by Hershoerfer.
4. Quality Control in Food Industry by Kramer and Tuig.
5. Chemical and Biological Methods for Water Pollution Studies R.K.Trivedy & P. K. Goel.
6. Pearson Composition and Analysis of Foods by R .Kirk / R . Sawyer.
7. Physical Properties of Food by R.Jowitt & Fescher.
8. Analysis of Food Contanminents by J. Gilbert.
9. Food Quality Evaluation by Eram S Rao.

FT18202CR

FOOD PACKAGING (3+0+1)

Objectives

To impart knowledge and skill related to designing packaging systems in food products. Acquaint the students with novel technologies in food packaging.

Unit I

- Definition and functions of packaging.
- Deteriorative reaction in foodstuffs and factors affecting their kinetics.
- Shelf-life studies of packaged foodstuff. Shelf life testing of packaged foods.
- Migration of contaminants and its testing.
- Metals: Tinplate containers, tinning process, Low tin steels, tin-free steel (TFS).
- Can manufacturing, types of cans, seaming.
- Aluminum containers
- Metal corrosion and lacquering.

Unit II

- Paper: pulping, fibrillation and beating, types of papers and their testing methods;
- Glass: composition, properties, types of closures, methods of bottle making;
- Plastics: chemistry and properties, polymerization. Polymer processing.
- Barrier properties of packaging materials: Theory of permeability, factors affecting permeability, permeability coefficient, gas transmission rate (GTR) and its measurement, water vapor transmission rate (WVTR) and its measurement.
- Laminated plastic materials. Tetra packs
- Biodegradable packaging, types advantages and disadvantages. Concept of green plastics.
- Edible films and coatings and their application.

Unit III

- New technologies in food packaging: active packaging, intelligent packaging; application and technologies.
- MAP- basic concepts and role of various gases.
- Packaging requirements of fruits and vegetables

- Packaging of fresh and processed meat. Deterioration and color chemistry of meat and meat products.
- Packaging of dairy products- milk powder, butter, cheese etc.
- Packaging of spices, cereals and cereal-based products.
- Packaging of fats and oils and their products.
- Food packaging regulations and labeling. Temper evident packages.

Unit IV (Practical)

- Identification of films
- Determination of WVTR of packages
- Determination of shelflife of packaged foods
- Determination of chemical resistance of packages
- Porosity of tinplate
- Shrink and vacuum packaging of different foods
- Industrial visits to demonstrate aseptic packaging, ffs machinery, filling operations, tests for determination of mechanical properties etc.

References:

1. Food Packaging Principles by Gorden Robertson. .
2. Handbook of Food Packaging by Paine and Paine.
3. Food Packaging- Science & Technology by Lee
4. Innovations in Food Packaging by Jung M. Han.
5. Principles of Food Packaging by Saccharow and Griffin.
6. Food Packaging by Takashi Kadoya
7. Food and Packaging Materials Interactions by Paul Acherman
8. Environmentally Compatible Food Packaging by Emo Chiellini
9. Innovations in Food Packaging by Jung H. Han.

FT18203CR

ADVANCED TECHNIQUES OF FOOD ANALYSIS (2+0+2)

Objectives

To provide knowledge of various techniques and instrumentation used for the analysis of foods.

Unit – I

- **Role of analyst**
- **Tristimulus color system & hunter lab CDM.**
- **Flame photometry**– Concept of the ground state, excited state, ionization energy. resonance line, inferences, components of flame emission spectrophotometer.
- **X-ray analysis of foods**– Properties, production & detection, x-ray tubes, detectors, sources, application in the food industry.

Unit - II

- **Mass spectroscopy**– Instrumentation and interpretation
- **Chromatography**– Principles of different chromatographic separations.
- **Rheology measurement**– Farinograph, Amylograph, Rheometer.
- **Nuclear magnetic resonance (NMR)** – Principle, Components, Interpretation of NMR spectra, application of NMR.
- **Immunoassays and Nucleic acid-based techniques:** ELISA & PCR

Unit – III (Practical)

1. Mineral estimation by Atomic absorption spectroscopy (AAS)
2. Mineral estimation by ICP
3. Working of HPLC
4. Working of GC
5. Studying morphology of food samples using SEM
6. Analysis of XRD- Data for estimation of % crystallinity in starch samples

Unit-IV (Practical)

1. Farinography of wheat samples
2. RVA of starch and wheat samples
3. Texture analysis of foods products using Texture Analyser
4. Phase transitions, enthalpy changes and oxidative stability of foods using DSC
5. Structural analysis of food samples using ATR-FTIR

References:

1. Food Analysis by Pomeranz.
2. Food Analysis by S. Suzanne Nielsen
3. Advances in Food Diagnostics by Leo M. L. Nollet and Y.H Hui
4. Methods of Analysis for Functional Foods and Nutraceuticals by W.Jaffrey
5. Instrumental Methods in Food Analysis by J.R. J Pare and J.M.R Belanger

FT18204CR

FOOD ADDITIVES AND FLAVOR TECHNOLOGY (4+0+0)

Objectives

To know about legislation, classification and action mechanism of food additives.

UNIT -1

- Definition and classification of additives.
- Antioxidants: General function, classification and toxicological aspects.
- Antimicrobial, chemical & toxicological properties of common preservatives- Benzoic acid, Sulfur dioxide, Propionic acid, Sorbic acid
- Acidulants- General functions, Classification, General application in foods.

UNIT -11

- Artificial flavors
- Natural and synthetic colorants used in foods
- Artificial sweeteners used in foods

Unit-1II

- **Flavor characteristic**- Primary and Secondary
- Molecular mechanisms of flavor perception
- **Taste substances & Nonspecific saporous sensations**: Sweet, bitter, sour, salty, astringency, pungency and cooling.
- **Flavor forms:** Water-soluble liquid flavor, Clear water-soluble liquid flavor, oil-soluble liquid flavor, emulsion-based flavors, dispersed flavors, spray-dried flavors.
- Analysis of odor-active compounds of foods/beverages

Unit-1V

- **Flavors in foods:** Dairy flavors, cereal products, fruits and vegetable flavors.
- **Flavors in Fermented products**
- Spice flavors: Essential oils and oleoresins.
- **Flavor encapsulation & stabilization:** Principles, types & techniques of flavor encapsulation & their applications in the food industry.

References:

- Food Biotechnology principles and practices by V.K. Joshi and R.S. Singh
- Food Additive Toxicology by Joseph A. Maga and Anthony T. Tu
- Food chemical safety; Volume 2: Additives by David H Watson
- Food Additives by A. Larry Branen, P. Michael Davidson and Seppo Salminen
- Food Flavor Technology, Second edition. Andrew J. Taylor and Robert S.T.Linforth.
- Food Flavors: Formation, Analysis, & packaging influences. E. T. Contis, C. T. Ho, C. J. Mussinan, T. H. Parliament, F. Shahidi&Spanier.
- Encapsulation Technology for active food ingredients & food Products. Nicolass Jan Zuidam, Viktor A. Nedovic.
- Food flavors. I. D. Morton & A. J. Macleod.
- Food Chemistry. Owen R. Fennema.
- Bitterness in foods and beverages. Russel L. Rouseff.
- Chemistry of Foods & Beverages: Recent Developments. George Charalambous& Ira Katz. Phenolic, George Charalambous& George Inglet.
- Food Additives. S. N. Mahindru.

FT18205DCE

FOOD BIOTECHNOLOGY (4+0+0)

Objectives

To provide insight to the students about the role of biotechnology in the production, quality and nutritional enhancement of foods.

Unit I:

- Introduction to Food Biotechnology.
- Food Biotechnology & World Feeding problems
- Nucleic Acids: Structure & function, the concept of gene.
- Introduction to Genetic Engineering, Recombinant DNA technology, Vectors, Ti Plasmid.
- SCP: Sources, substrate requirement, Production.

Unit II

- G.M Foods: Advantages, safety Evaluation, Allergenicity, Public attitudes, G.M. Crops: Bt Corn, Bt Brinjal & Golden Rice.
- Antisense RNA & Gene Silencing: An approach To Food manipulation.
- Genetic Manipulation of fruit Ripening & fruit softening.
- Ethylene Biosynthesis.
- Use of Enzymes in Food Industry (Lipases, Amylase, Proteases, transglutaminase, pectinase, oxidases).

Unit III

- Bioclours: Technology of Production, sources (Microbial & plant) and applications.
- Flavors: Current approaches for bioproduction of flavors.
- Production & Harvesting of Baker's Yeast.
- Production and application of pullulans and alginates.
- Oil seed engineering: New approaches to increase oil yields.

Unit IV

- Bio preservatives: Classification and mode of action.
- Biosensors and their application in food industry.
- Waste utilization: production of fats, essential oils, pectin, starch, animal feed.

- Strategies for biotechnology of waste utilization.

References:

1. Joshi, V. K. and Sing., R.K. Food Biotechnology principles & Practises.
2. Buchanan, Jones, G. Biochemistry and molecular biology of plants. I.K. International Pvt. Ltd.
3. Adrian, S., Nigel W. S., Mark, R.F. Plant Biotechnology: The genetic manupilation of plants. Second Edition, Oxford University Press.

FT18206DCE

BAKERY AND CONFECTIONERY TECHNOLOGY (2+0+0)

Objectives

To acquaint the students about the Technology of production of bakery and confectionery products.

Unit-I

- Bakery flours, Major baking ingredients, Principles of baking
- Bakery plant layout- Design and Equipments
- Manufacturing technology of bakery products: Bread, cakes, cookies, biscuits, crackers, pretzels, wafers.
- Legislation and regulatory aspects of producing bakery
- Packaging and storage of bakery products
- Detection of non halal ingredients for halal verification in bakery and confectionary.

Unit-II

- Fats for confectionary coatings and filling with special mention to the use of zero trans fats and low saturated fats
- Manufacturing technology of confectionery: boiled sweets, aerated confections, gelled candies, coatings and chocolate confectionery
- Product design and shelf life issues
- Pest control, Packaging and storage
- Legislation and regulatory aspects of producing confectionery

Recommended Reading:

1. G. Talbot, (2009). Science and Technology of Enrobed and filled chocolate, confectionery and bakery products. CRC Press, Wood head Publishing Limited.
2. S. A. Matz, (1992). Bakery technology and engineering. Springer US.
3. Y. H. Hui, (2006). Bakery Products Science and Technology. Blackwell Publishing Ltd.

FT18207DCE

HUMAN NUTRITION (2+0+0)

Objectives

To make students understand about the nutritional requirement of humans of different categories.

To make use of different dietary requirements for formulating foods of the different categories.

Unit I
(Normal Nutrition)

- Introduction to Human Nutrition: Food, Nutrition & Health
- Nutrient requirements & recommendation
- Digestion & Absorption of Nutrients
- Methods of cooking.
- Enhancing nutritional quality of the Diet.
- Lifecycle nutrition
- Principles of meal planning
- Food-based dietary guidelines
- Nutrition for Adults, pregnancy, lactation, infancy, preschools, adolescents & elderly.

Unit II
(Therapeutic& Special Nutrition)

- Clinical & therapeutic diets
- Diet in lifestyle disorders:- diabetes, CVD, Cancer
- Diet in fever, burns & surgery
- Nutritional care in weighs manager.
- Special Nutrition
- Food borne diseases (Introduction)
- Exercise & Sports Nutrition.
- Nutrition & infection

Recommended Reading

1. Davidson, Sirstanley, Passmore, R. J. F. Brock, A. S. Trustwell, (1975). Human Nutrition and Dietitics 6th Edition, The English language book society and Churchill Living stone.

2. Swaminathan, (1985). Advanced Text Book on Foods & Nutrition 2nd Edition, Banglore Printing & Publishing Co. Ltd.
3. MudambiSumati R. &Rajagopal, M. V. (1995). Fundamentals of Food & Nutrition, 3rd Edition, New Age International (P) Limited, Publishers.
4. J. Mann, A. S. Trustwell, (2017). Essentials of Human Nutrition 5th Edition Oxford University Press.

FT18208DCE

PLANTATION CROPS & SPICES (2+0+0)

Objectives

The core objective of the course is to pool available information on production, chemical composition and processing of plantation crops and spices grown in India. These crops are dealt elaborately covering all aspects of processing and packaging.

UNIT –I

- **Plantation Crops:** Definition and role of plantation crops in national economy and export potential.
- **Spices:** Definition, classification and functions. Quality specifications for spices.
- **Major & minor spices of India:** Chemical composition, processing, uses and special attributes of different spices like saffron, chillies, cumin, coriander, turmeric, fennel, fenugreek, pepper, cinnamon, cloves, ginger, mint and cardamom.
- **Extractives of spices:** oleoresins and essential oils. Simple seasoning blends.

UNIT II

- **Tea:** Composition and processing of tea. Tea products such as tea concentrate, decaffeinated tea and flavored tea. *Kashmiri kehwa.*
- **Coffee:** Chemical composition, processing, roasting and brewing of coffee. Coffee products such as decaffeinated coffee and instant coffee.
- **Cocoa:** Chemical composition, processing of cocoa and cocoa beverages.

References

1. Chakraverty et al. Handbook of Postharvest Technology. Marcel Cekker
2. Purseglove, J. W. *et al* (1998). Spices 'Vol. I and II. Logman publishers.
3. Peter, K. V. (2004). Handbook of Herbs and Spices Vol. I and II. Woodhead Publishing Limited, Cambridge, England.
4. Raghavan, S. (2007). Handbook of Spices, Seasonings and Flavorings. CRC Press (Taylor and Francis Group).
5. Voilley, A. & Etivant, P. (2003). Flavor in Food. Woodhead Publishing Limited, Cambridge, England.
6. Ho, C-T., Lin, J-K., & Shahidi, F. (2009). Tea and Tea products. CRC Press (Taylor and Francis Group).
7. S.K Chadha & P. Rethinam. Advances in Horticulture- Plantation and spice crops. Malhotra Publishing House, New Delhi (9^{th} & 10^{th} Ed.)

FT18003GE

POSTHARVEST DISEASES OF FRUITS AND VEGETABLES (2+0+0)

Objectives

To acquaint the students with commonly occurring diseases in fruits and vegetables after harvest.

To learn about various factors affecting development and diseases.

UNIT-I

- Postharvest disease initiation: The pathogens, origin of pathogens. Spore germination and Pathogen penetration into the host
- Main pathogens of harvested fruits & vegetables
- Mycotoxins: occurance, types of mycotoxins, Methods of prevention of mycotoxins.
- Factors affecting disease development: preharvest factors, harvesting and handling, inoculum level.

UNIT-II

- Attack mechanisms of the pathogen: Enzymatic activity, toxin production, detoxification of host defense compounds by pathogens.
- Physiological & Biochemical changes following infection
  a) Changes in fruit respiration & ethylene evolution
  b) Pectolytic activity & its source in infected tissue
  c) Fruit softening & changes in pectic compounds
  d) Changes in Biochemical constituents of infected tissue

Reference:

1. Pathak V.N. 1970. Diseases of fruit crops & their control IBH publication New Delhi.
2. Barkai Golan; Postharvest diseases of fruits and vegetables: development and control. Elsevier science: first Indian reprint 2005.

FT18004GE

LIPID TECHNOLOGY (2+0+0)

Objectives

The course provides a comprehensive review of the nature of lipids, their major sources and quality assessment of edible fats and oils. The course will help in better understanding of extraction technology and other important operations in oil processing.

UNIT 1

- Nomenclature of saturated and unsaturated fatty acids
- Common sources of vegetable oils and their oil content
- Chemical characterization of fats and oils.
- Properties of common oils-Soybean, peanut, Corn, Sunflower, safflower, Canola, Olive, Coconnut, palm oil.
- Common tests for quality control of oils

UNIT I1

- Extraction and rendering- Physical and chemical refining
- Bleaching, Hydrogenation
- Interesterfication, Winterization
- Dewaxing, Fractionation
- Exterfication, Blending, Deodorization
- Storage and protection of oils

Books Recommended

1. Food Lipids: Chemistry nutrition and biotechnology by Casimer C. Akoh and David B. Min
2. Fats and oils by Richard D-O' Brien
3. Food Chemistry by Fenimma
4. Bailey's industrial oil and fat products by Fereidoon Shahidi

FT18002OE

FOOD SAFETY (1+1+0)

Objectives

The objective of this course is to provide an understanding of current issues in food safety and measures that are used in the food industry to assure a safe food supply.

Unit – I

- Definition of food safety and importance of safe food
- Hazards and types of hazards
- Physical and Chemical hazards- Sources harmful effects and management
- Naturally occurring toxicants in foods, Process induced food toxicants, Safety aspects of food additives
- Biological hazards, food borne illnesses
- Toxicants of fungal and bacterial origin
- Food adulteration, common food adulterants; Methods to detect food adulteration

Unit – II (Tutorial)

- Food safety and Quality management system; HACCP
- Food Safety and Standards Act 2006 and regulation 2011.
- Registration and Licensing
- Packaging and labeling
- Nutrition and Health Claims
- Zoonotic diseases. e,g. Bird flu, Swine flu
- Genetically modified food- safety aspects

References:

1. Food Safety & standards Act 2006, Commercial law Publishers (India) Pvt. Ltd
2. Food Science by Norman N.Potter
3. Food Safety Handbook by Rouland H. Schmidt

FT18301CR

CEREAL, LEGUME AND OIL SEED TECHNOLOGY (4+0+0)

Objectives

To focus on the comprehensive details on the cereal, oil seed and legume crops which are potentially staple food crops, more widely exploited especially in developing countries where protein and malnutrition continue to escalate.

Unit – I (Wheat Chemistry and Technology)

- Current status and future scenario of world wheat production and uses.
- Structure and chemical composition of wheat grain and its relation to processing qualities.
- Criteria of wheat quality – physical and chemical. Molecular basis of wheat grain hardness/softness.
- Wheat milling – principle, conditioning and milling systems. Flour streams, extraction rates and their composition.
- Structure and functionality of wheat proteins, carbohydrates and lipids in bread making.
- Enzymes of wheat and their technological significance.
- Vital wheat gluten – manufacturing techniques, uses and functionality.
- Dough rheology and dough testing apparatus such as recording dough mixers, load extension meter.

Unit – II (Minor Cereal Grains and Bakery products)

- Composition and structure of corn.
- Wet and dry milling of corn. Corn products and their uses.
- Composition and structure of barley and oat. Milling of oat and barley. Classification of malt products, nutritive value and food applications of malt.
- Chemical, technological and nutritional aspects of sorghum and millets.
- Bread making processes, development in bread making methods, functions of ingredients/ additives such as fat, emulsifiers, oxidants, reducing agents, conditioners. Bread faults and remedies.
- Durum wheat – chemistry, quality and technology of pasta products.

Unit – III (Rice Chemistry and Technology)

- Rice grain structure and chemical composition.
- Milling of rice – types of rice mill: huller mill, sheller-cum-huller mill, sheller-cum-cone polisher mill, small capacity rice mill. Modern rice milling. Factors affecting rice yield during milling. By-products of rice milling and their utilization.
- Cooking quality of rice.
- Parboiling of rice – traditional method and their drawbacks. CFTRI process of parboiling. Properties of parboiled rice. Changes during parboiling. Advantages and disadvantages of parboiling.
- Rice convenience foods – precooked rice, canned rice, expanded rice, rice based infant food formulas, rice puddings and breads, rice cakes, rice noodles and fermented foods.

Unit IV (Oil seed and Legume processing)

- Types of oil seeds and their chemical composition.
- Oil extraction – Mechanical and solvent extraction.
- Refining of crude oils.
- Processing of oil seeds for protein concentrates and isolates.
- Margarine manufacturing processing and its uses.
- Structure and composition of pulses, their importance in Indian diet.
- Dhal milling and processing of pulses.
- Fermented and traditional products.

References:

1. Pomeranz, Y. (1998). *Wheat: Chemistry and Technology*, Vol. I 3rd Ed., American Association of Cereal Chemists, St. Paul, MN, USA.
2. Juliano, B. O. (1985). *Rice Chemistry and Technology*, American Association of Cereal Chemists, St. Paul, MN, USA.
3. Samuel, A.M. (1996). *The Chemistry and Technology of Cereal as Food and Feed*. CBS Publishers & Distribution, New Delhi.
4. Dandy, D. A. V & Dobraszczyk, B. J. (2001) Cereal and Cereal Products: Chemistry abd Technology, Aspen Publishers.
5. Kent, N. L. & Evers, A. D. (1994) Kent's Technology of cereals 4th Ed. Elsevier science Ltd. Oxford, U. K.

FT18302CR

FRUIT AND VEGETABLE TECHNOLOGY (4+0+0)

Objectives

To facilitate understanding of students about the commercial processing of fruits and advances storage techniques of fruits/ vegetables.

UNIT-I

- Fruit maturity and ripening indices.
- Postharvest changes in fruits and vegetables.
- Ethylene biosynthesis, mode of action, inhibition of ethylene synthesis.
- Handling of horticultural produce.
- Precooling and transport of horticultural commodities.

UNIT-II

- Cold chain management.
- Storage: Definition & functions
- Types of storage: low cost and high cost storage systems
- Controlled atmospheric storage: Its construction and control of gases.
- Hypobaric storage
- Zero energy cool chamber: Its construction and advantages.

UNIT-III

- Principles of preservation,
- Preservation by heat, chemicals, sugar, salt, fermentation, drying, freezing
- Chemistry of pectin, theories of gel formation
- Role of enzymes in processing
- Quality standards of fruits & vegetable products.
- Canning: spoilage of canned products

UNIT-IV

- Fruit & vegetable Juices: Preparation & preservation of juices syrups, cordials,
- Squash, concentrate pickles, tomato products

- Dehydration of fruits & vegetables
- Freezing of fruits & vegetables
- Jams, Jellies, Marmalades and preserves
- Waste utilization

Reference:

1. Postharvest Technology of Fruit & Vegetables by A.K. Thompson.
2. Postharvest Technology of Fruits & Vegetables by verma & joshi 2000. Indus publications, New Delhi
3. An introduction to Postharvest Technology by RBH Wills. 2003
4. Preservation of fruits & Vegetables by Siddappa etal 1999. ICAR, New Delhi
5. Preservation of Fruits & Vegetables by Srivastava & Kumar, 1996. Intl. Book publishing Co. Lucknow
6. Handbook of Vegetables and Vegetable Processing by Y. H. Hui 2011. Wiley Blackwell
7. Handbook of Fruits and Fruit Processing by Y. H. Hui 2006. Wiley Blackwell

FT18303CR

PROCESSING OF FOODS OF PLANT ORIGIN (PRACTICAL) (0+0+4)

Objectives

To experience the technology of production of plant based foods like fruit & vegetable and cereal based.

To experience the quality control of plant based foods.

Part I (Cereals)

1. Physico-chemical testing of wheat and rice.
2. Experimental milling of wheat and rice. Assessment of per cent of head rice, broken, immature kernels and degree of polish in rice.
3. Determination of quality characteristics of flours.
4. Experimental parboiling and evaluation of quality of parboiled rice.
5. Evaluation of cooking quality of rice.
6. Rheological properties of dough using Farinograph/ Extensograph/Mixograph.
7. Pasting properties of starches using Visco-amylograph/RVA.
8. Experimental baking of bread, cake and biscuit and their evaluation,
9. Experimental extrusion cooking and quality evaluation of extrudates.
10. Solvent extraction of oil seeds.
11. Quality evaluation of oils.
12. Visit to wheat and rice processing plants.
13. Determination of yeast activity
14. Preperaion of protein isolates from legumes and evaluation of cooking quality of legumes.

Part 11 (Fruits and Vegetables)

1. Quality Evaluation of Fruits & Vegetables (TSS, Color, Acidity, Texture etc.)
2. Canning of fruits & vegetables.
3. Testing of can, cut out analysis
4. Preparation and analysis of syrups and Brines.
5. Experimental dehydration of fruits and vegetables (Dehydration and rehydration ratio)
6. Preparation of juices.
7. Preparation of squashes and RTS.

8. Preparation of Jam, Jellies and marmalades.
9. Preparation of pickle and vinegar.
10. Preparation of tomato ketchup and sauce.
11. Visit to a fruit and vegetable processing industry.

Refrences:

1. Handbook of Analysis and Quality Control of Fruit and Vegetable Products S. Ranganna
2. Preservation of fruits & Vegetables by Siddappa etal 1999. ICAR, New Delhi
3. Pomeranz, Y. (1998). *Wheat: Chemistry and Technology*, Vol. I 3rd Ed., American Association of Cereal Chemists, St. Paul, MN, USA.
4. Juliano, B. O. (1985). *Rice Chemistry and Technology*, American Association of Cereal Chemists, St. Paul, MN, USA.
5. Stanley P.Cauvain & Lindas S. Young. Baked Products. Blackwill Publishing.
6. Stanley P.Cauvain & Lindas S. Young. The Chorleywood Bread Process. CRC Publications.
7. Bakery Technology & Engineering by Samueal A. Matz.
8. Manual of American Assocation of Cereal Chemists
9. Manual of AOAC, 1990

FT18304CR

INDUSTRIAL MICROBIOLOGY (2+0+0)

Objectives

To know about the use of different types of fermentation for production of novel foods, beverages and components of industrial importance

Unit I

- Introduction to fermentation processes-Biomass, enzymes & metabolite production.
- Process components: Batch, Continuous & Fed batch cultures.
- Fermentation Media: Formulation, Carbon & Nitrogen sources, Oxygen requirements, antifoams & sterilization.

Unit II

- Bioreactors: Basic function, Design, Operation, Aeration, Agitation and sterilization.
- Types of Fermentation: Solid substrate & submerged Fermentation, Continuous & batch Fermentation, homo & hetero Fermentation.
- Enzyme immobilization: Methods & Advantages.
- Down Stream Processing.

References:

1. Fermented Foods of the world. (A Dictionary & Guide) –by Geoffrey Champbell, Platt, Butterworths, London.
2. Industrial Microbiology by Brinton M miller & Warren Litsky. MGH.
3. Biotechnology by U. Satyanarayan. Books and Allied (P) Ltd.
4. Industrial Microbiology by Prescott & Dunn

FT18305CR

INDUSTRIAL TRAINING (0+0+2)

Objectives

To get students exposed to industrial environment and to get hands on training in various industrial operations

FT18306DCE

NEUTRACEUTICALS AND FUNCTIONAL FOODS (3+1+0)

Objectives

To get the students acquainted with health promoting effects of some food components, their sources and mode of action.

Unit – I

- Introduction - Definition, Classification of nutraceutical factors. Food and non food sources. Mechanism of action.
- Nutraceutical factors in specific foods.
- Introduction to diseases of developed world- diabetes, obesity, hypertension
- Dietary fibre – Types, Effects of fibre deficient diets
- Physical and physiological properties of dietary fiber
- Hypocholesterolemic, hypolilpidemic and hypoglycemic effects. Role in prevention of CHD and cancer.
- Beta- glucan- Chemical features and health benefits

Unit – II

- Probiotics- definition, criteria for selection of probiotic microorganisms.
- Common probiotic products, yoghurt, kefir and ice-cream.
- Health benefits of probiotics-immune modulation and cancer prevention
- Prebiotics – Importantant prebiotic molecules and their beneficial effects.
- Concept of synbiotics.
- Fatty acid as functional food- Mono and poly-unsaturated fatty acids
- Omega 3 fatty acids- introduction, nomenclature & sources.
- Eicosanoid metabolism of fatty acids and its implications in human health
- Biological and functional effects. Omega 3 fatty acids and insulin resistance.
- Olive oil and its health benefits.

Unit – III

- Phytochemicals and Antioxidants – Introduction, therapeutic properties of some common plants.
- Free radicals and oxidative stress
- Biosynthesis of common phytochemicals-Shikmic acid and mavalonic acid pathway
- Role of ascorbic acid, flavonoids, Tocopherols, Carotenoids, capsaicinoids, lycopeneb as disease prevention agents.
- Garlic-composition and its therapeutic effects
- Tea and its health benefits
- Soybean as a functional food.

Unit – IV (Tutorials)

- Proteins as functional foods
- Vitamins and minerals as functional ingredients
- Extraction of neutraceuticals
- Stability of nutraceuticals factors during processing and digestion
- Testing efficacy of functional foods
- Marketing of functional foods.
- Legislative aspects of functional foods.

References:

1. Functional Foods by Goldberg.
2. Handbook of Neutraceuticals and Functional Foods by Wildman.
3. Functional Foods: principles and technology by Mingruo Guo.
4. Chemical and Functional Properties of Food Components by Zdzislaw E. Sikorski.
5. Technology of Functional Cereal Products by Bruce R. Hamaker.
6. Functional Foods: Biochemical and Processing Aspects byJohn Shi, G. Mazza, Marc Le Maguer, CRC Press

FT18307DCE

NOVEL TECHNIQUES IN FOOD PROCESSING (3+0+0)

Objectives

To acquaint the students with novel food processing techniques and instrumentation for improving the food safety and food quality.

Unit – I

- High Pressure Processing of Foods**:** Concept of high pressure processing, quality changes, effects of pressure on microorganisms and its application in food processing.
- Ultrasonic in Food Processing: Properties and generation of ultrasonic, Cavitation, application of ultrasonics as an analytical tool and processing techniques.
- Cold plasma for Food Processing – Principle, classification and generation of cold plasma. Application of cold plasma Technology.

Unit – II

- Pulse electric field - Principle, PEF system, Mechanism of microbial inactivation, Factors effecting pulse electric field efficiency. Applications of PEF.
- Ohmic heating and moderate Electric field- Advances, Microbial death Kinetics. Applications.
- Micronization in Food Processing: Techniques and benefits of micronization process.
- Supercritical fluid micronization techniques

Unit – III

- Supercritical Fluid Extraction in Food Processing: Properties of super critical fluids, Principle, Extraction, Separation and Application of super critical fluid extraction technology.
- Encapsulation, Stabilization, and Controlled Release of Food Ingredients and Bioactives.
- Nanotechnology**:** Principles, mechanism and applications in foods.

References:

1. New Methods of Food Preservation by G. W Gould, 2012*; Springer*

2. Novel Food Processing Technologies by G.V.Barbosa-Canovas, M.S.Tapia, M.P.Cano 2005 CRC Press
3. Novel Food Processing Technologies by V.Nanda, S.Sharma, 2017, NIPA.
4. Introduction to Food Engineering by R. P Singh and Dennis R Heldman, 1983*; Academic press Elsevier*
5. Food processing technology: *Principles and practice* by P.J Fellows, 2009; *CRC Press*
6. Handbook of Food Preservation by M. Shafiur Rahman, 1999 *; CRC Press*
7. Engineering Properties of Foods, Third Edition (Food Science and Technology) by M. A. Rao, Syed S.H. Rizvi, Ashim K. Datta ,2010 ; *CRC Press*.
8. Food Physics: Physical properties- Measurement and applications by L.O.Figura and A.A.Teixeira 2007; *Springer*

FT18308DCE

POST HARVEST MANAGEMENT OF TREE NUTS (2+0+1)

Objectives

To acquaint the students about the nutritional significance of nuts.

To provide basic understanding of postharvest handling of tree nuts.

Unit I

- Horticulture maturity indices of tree nuts (Almonds, Pistachios, Pecans, Hazelnuts, Walnuts, Chestnuts)
- Harvesting & Post harvest handling operations of the tree nuts (Almonds, Pistachios, Pecans, Hazelnuts, Walnuts, Chestnuts)
- Packaging and Storage of tree nuts
- Chemical composition of tree nuts

Unit II

- Quality standards of in shell and shelled tree nuts
- Nutritional and Neutraceutical factors in tree nuts and their importance in human health.
- Aflatoxins in tree nuts and their health hazards and control
- Flavors and volatile components of tree nut

Unit III (Practical)

- Product development from tree nut.
- Physical characteristics of tree nuts.
- Proximate Composition of tree nuts.
- Iodine value of tree nuts oil.
- Peroxide value of tree nut oils.
- Saponification number of tree nut oils.

References:

1. Tree nuts; Production, Processing, Products Vol.1 & 2 by J.G. Woodroof.

2. The book of edible nuts by Frederic Rosengarten, Jr.

3. Tree nuts; Composition, phytochemicals and health effects edited by Cesarettin Alasalvar & Fereidoon Shahidi

FT18309DCE

CREDIT SEMINAR (0+1+0)

Objectives

To learn about preparation and delivery of seminars

FT18005GE

MEAT SCIENCE (2 +0)

Objectives

To understand the science underlying spoilage and preservation of meat

To know the techniques of commercial processing and preservation of meat.

UNIT-I

- Sources of meat, Ante-mortem handling and inspection of meat animals.
- Meat and human nutrition
- Slaughtering and processing equipment: Plant location and facilities; stunning methods; sticking/bleeding; dressing methods; offal inspection and processing.
- Structure and functions of living muscle: Microstructure, contraction mechanism, muscle metabolism.
- Postmortem changes in muscle: Biochemical alterations, physical alterations-rigor mortis; shortening; unusual patterns of postmortem metabolism. Factors affecting post mortem changes in meat.

UNIT-II

- Meat quality parameters: Color, WHC, flavor, tenderness and texture.
- Microbial deterioration of meat: sources of microbial contamination, deteriorative changes, identification of meat spoilage.
- Principles of various preservation techniques: Refrigeration, freezing, curing, canning and dehydration of meat.
- Traditional meat products of J&K.

References:

1. Lawre. R. A. & Ledward, D. A. (2006). Lawres Meat Science 7th Ed. Woodhead Publishing Company, Cambridge, England (U.K.)
2. Pearson, A. M., & Gillet, T. A., (1996). Processed Meats. Springer Publishing (3rd Ed.).
3. J. F. Gracey, David S. Collins & Robert J. Huey (2009). Meat Hygiene. Elsevier Publishing (10th Ed.).
4. Hui, Y. H., & Nip, W-Q. (2001). Meat Science and Applications. CRC Press (Taylor and Francis Group).
5. Forest, J. C., Abesle, E.D., Hedrele, H.B., Judge, M.D., Merkle, R.A. (2006). Principles of Meat Science. Academic Press, New York.
6. Thornton, H. ( ). Textbook of Meat Hygiene. Harcourt Publishers 6th Ed.

FT18003OE

ELEMENTARY MILK PRODUCTS TECHNOLOGY (0+1+1)

Objectives

To impart knowledge to students about dairy and meat products and their processing.

Unit-I (Tutorial)

- Scope of dairy industry in India.
- Processing of market milk- standardization, toning of milk, homogenization.
- Storage, transportation and distribution of milk. Pasteurization and sterilization.
- Milk products- Processing of cream, butter, cheese, ice cream.
- Traditional milk products of J&K.

Unit-II (Practical)

- Quantative estimation of milk constituents such as moisture, %TS, fat.
- Determination of acidity and specific gravity of milk.
- Platform tests on given sample of milk.
- Standardization of milk.
- Detection of adulterants in milk- water, starch, urea.
- Preparation of common milk products like flavored milk, yoghurt, paneer.
- Pasteurization of milk.
- Visit to local milk processing plant.

References:

1. Outlines of Dairy Technology by S. K. De
2. Chemistry and Testing of Dairy products by H.V. Atherton & J.A. Newlander
3. Milk and dairy Product Technology by Edger Spreer.
4. Dairy Chemistry by H.H. Sommer

FT18401CR

TECHNOLOGY OF MILK AND MILK PRODUCTS (4+0+0)

Objectives

To develop the skills of testing, standardization and processing of milk and milk products.

Unit – I

- Dairy industry in India and its scope.
- Sources and composition of milk, nutritive value.
- Chemistry of Milk-Milk fat, proteins, lactose, vitamins, minerals & salts
- Factors affecting composition of milk.
- Processing of market milk- standardization, toning of milk, homogenization.

Unit – II

- Storage, transportation and distribution of milk. Pasteurization and sterilization.
- Milk products - Processing of cream, butter oil, condensed milk, evaporated milk, whole and skimmed milk.
- Cheese and its types,

Unit – III

- Production of Ice creams & its quality controle.
- Stater culture production & propogation for fermented milk products.
- Production of fermented milk products.
- Instantization of milk and milk products.

Unit – IV

- Judging and grading of milk and its products.
- In plant cleaning system.
- Quality standards of milk and milk products.
- Packaging of dairy products.
- By product utilization.

References:

1. Technology of Dairy Products by Early. R.
2. Outlines of Dairy Technology by S. K. De.
3. Chemistry and Testing of Dairy Products by Athestem.

FT18402CR

TECHNOLOGY OF MEAT, FISH AND POULTRY PRODUCTS (4+0+0)

Objectives

To provide complete guide on the composition, nutritional properties, quality evaluation and preservation of meat, fish and poultry products**.**

Unit – I

- Scope of meat industry in India with special reference to J&K.
- Sources of meat, composition and nutritive value of meat.
- Structure of muscle. Microscopic structure of meat.
- Contraction and relaxation of muscle.
- Factors affecting meat production and quality.

Unit – II

- Slaughtering of animals and poultry.
- Inspection and grading of meat.
- Conversion of muscle to meat. Factors affecting post mortem changes in meat.
- Properties and shelf life of meat.
- Eating quality of meat – color, flavor, tenderness, juiceness and water holding capacity.
- Meat quality evaluation.
- Mechanical deboning.
- Meat tenderization and aging.
- Restructuring of meat products.
- Preservation of meat by freezing, curing, pickling and smoking of meat.

Unit - III

- Meat plant sanitation and safety.
- By product utilization of meat industry.
- Recent trends in meat processing.
- Traditional meat products of J&K.
- Structure, composition, nutritive value and functional properties of eggs.
- Factor affecting egg quality and measures of egg quality.
- Preservation of eggs by different methods. Preparation of egg powders.

Unit – IV

- Types of fish, composition, structure. Post mortem changes in fish.
- Handling of fresh water fish.
- Preservation of fish by freezing, glazing of fish, canning, smoking, freezing, irradiation and dehydration.
- Technology of production of fish sauce, fish sausage, fish meal and fish oil.

References:

1. Lawre. R. A. & Ledward, D. A. (2006). Lawres Meat Science 7th Ed. Woodhead Publishing Company, Cambridge, England.
2. Throntons Meat Hygiene.
3. Principles of Meat Science by Forest.
4. Developments in Meat Science by Lawrie.
5. Processed Meats by Pearsons.
6. Fish Processing Technology by George M. Hall.
7. Fish Processing Technology by Gopalkumar K. (ICAR – publications).

FT18403CR

PROCESSING OF ANIMAL BASED FOODS (PRACTICAL) (0+0+4)

Objectives

To impart practical training of production of meat and dairy based foods

To impart training for quality control of animal based foods.

Practical's to be performed

1. Survey of meat and fish products available in market.
2. To study slaughtering and dressing of meat animals.
3. Study of post-mortem changes.
4. Meat cutting and handling.
5. Evaluation of meat quality.
6. Preparation of various meat products such as: Meat pickle & cured meat
7. Meat emulsion and sausage manufacture.
8. Preparation and evaluation of traditional meat products.
9. Shelf-life studies on processed meat products.
10. Slaughtering of poultry.
11. Determination of meat to bone ratio in Chicken.
12. To evaluate freshness of fish.
13. To determine meat to bone ratio of fish.
14. Dressing of fish and calculation of dressing percentage.
15. Preparation of fish products such as fish cutlets, pickle, curry.
16. Experiments in dehydration, freezing, canning, smoking and pickling of fish and meat.
17. Visit to local slaughterhouse.
18. Quality evaluation of eggs.
19. Preservation of eggs.
20. Functional properties of eggs.

Dairy Science

- Quantative estimation of milk constituents such as moisture, total solids, fat.
- Determination of acidity of milk.
- Determination of specific gravity of milk.
- Platform tests on given samples of milk.
- Determination of adulterants in milk-water, urea, starch, sucrose etc.

- Detection of preservatives in milk.
- COB test.
- Visit to local milk processing plant.
- Preparation of common milk products
- Flavored milks.
- Yoghurt.
- Butter.
- Ice-cream.

References:

5. Outlines of Dairy Technology by S. K. De
6. Chemistry and Testing of Dairy products by H.V. Atherton & J.A. Newlander
7. Milk and dairy Product Technology by Edger Spreer.
8. Dairy Chemistry by H.H. Sommer
9. Lawre. R. A. & Ledward, D. A. (2006). Lawres Meat Science 7th Ed. Woodhead Publishing Company, Cambridge, England.
10. Throntons Meat Hygiene.
11. Principles of Meat Science by Forest.
12. Developments in Meat Science by Lawrie.
13. Processed Meats by Pearsons.

FT18404DCE

PROJECT WORK (0+0+4)

Objectives

To undertake detailed industrial or research projects and come up with specific findings

FT18405DCE

FOOD PLANT DESIGN: FRUITS AND VEGETABLES BASED (1+1+0)

Objectives

To acquaint the students with requirements for establishing of food plant and preparation of detailed project report

Unit I

- Scope of fruit/vegetable processing in J&K.
- Problems of fruit processing in J&K.
- Selection of site for fruit processing plant.
- Layout for a fruit processing plant.
- Building requirements for a fruit processing plant.
- Plant and machinery requirements for fruit processing.
- Water quality requirements for fruit processing.
- Environmental considerations, waste disposal and byproduct utilization.
- Financial requirements for setting up a fruit processing plant
- Techniques of financial analysis-Break-even analysis, Payback period.

Unit II

Project formulation for a fruit/Vegetable processing plant.

Students will be required to formulate a detailed project report for setting up a fruit/ vegetable based processing plant. It may involve manufacture of products like juices, concentrates, jams, jellies, dehydrated products, canned products etc.

Project report should cover all the important areas like feasibility of location, land requirements, design of building, plant machinery, environmental issues, licensing, financial requirements, sources of finance and financial feasibility analysis.

References:

7. Industrial Engineering and Managementn by O. P. Khanna.
8. Institutional Food Management by Mohini Sethi.
9. Food Plant Sanitation by Michael M. Cramer

FT18406DCE

FOOD PLANT DESIGN: CEREAL BASED (1+1+0)

Objectives

To acquaint the students with requirements for establishing of food plant and preparation of detailed project report

Unit I

- Scope of cereal processing in J&K.
- Problems of cereal based processing plants in J&K.
- Selection of site for cereal based processing plant.
- Layout for a cereal processing plant.
- Building requirements for a cereal based processing plant.
- Plant and machinery requirements for cereal processing.
- Environmental considerations, waste disposal and byproduct utilization.
- Financial requirements for setting up a cereal processing plant
- Techniques of financial analysis-Break-even analysis, Payback period.

Unit II

Project formulation for a cereal based processing plant.

Students will be required to formulate a detailed project report for setting up a cereal based processing plant. It may involve manufacture of products likebread, cookies, cakes, muffins etc.
Project report should cover all the important areas like feasibility of location, land requirements, design of building, plant machinery, environmental issues, licensing, financial requirements, sources of finance and financial feasibility analysis.

References:

1. Industrial Engineering and Managementn by O. P. Khanna.
2. Institutional Food Management by Mohini Sethi
3. Food Plant Sanitation by Michael M. Cramer

FT18407DCE FOOD PLANT DESIGN: DAIRY BASED (1+1+0)

Objectives

To acquaint the students with requirements for establishing of food plant and preparation of detailed project report

Unit I

- Scope of milk processing in J&K.
- Problems of milk processing in J&K.
- Selection of site for milk processing plant.
- Layout for a milk processing plant.
- Building requirements for a milk processing plant.
- Plant and machinery requirements for milk processing.
- Water quality requirements for milk processing.
- Environmental considerations, waste disposal and byproduct utilization.
- Financial requirements for setting up a milk processing plant
- Techniques of financial analysis-Break-even analysis, Payback period.

Unit II

Project formulation for a milk processing plant.

Students will be required to formulate a detailed project report for setting up milk based processing plant. It may involve manufacture of products like dhahi, cheese, butter; processing and packaging of fluid milk, etc.

Project report should cover all the important areas like feasibility of location, land requirements, design of building, plant machinery, environmental issues, licensing, financial requirements, sources of finance and financial feasibility analysis.

References:

1. Industrial Engineering and Managementn by O. P. Khanna.
2. Institutional Food Management by Mohini Sethi
3. Food Plant Sanitation by Michael M. Cramer

FT18408DCE FOOD PLANT DESIGN: MEAT BASED (1+1+0)

Objectives

To acquaint the students with requirements for establishing of food plant and preparation of detailed project report

Unit I

- Scope of meat processing in J&K.
- Problems of meat processing in J&K.
- Selection of site for meat processing plant.
- Layout for a meat processing plant.
- Building requirements for a meat processing plant.
- Plant and machinery requirements for meat processing.
- Water quality requirements for meat processing.
- Environmental considerations, waste disposal and by-product utilization.
- Financial requirements for setting up a meat processing plant
- Techniques of financial analysis-Break-even analysis, Payback period.

Unit II

Project formulation for a meat processing plant.

Students will be required to formulate a detailed project report for setting up meat based processing plant. It may involve manufacture of traditional meat products like Rista, Goshtaba and their canning etc.

Project report should cover all the important areas like feasibility of location, land requirements, design of building, plant machinery, environmental issues, licensing, financial requirements, sources of finance and financial feasibility analysis.

References:

1. Industrial Engineering and Managementn by O. P. Khanna.
2. Institutional Food Management by Mohini Sethi
3. Food Plant Sanitation by Michael M. Cramer

FT18409DCE

FOOD TOXICOLOGY (2+0+0)

Objectives

To develop basic understanding of chemical toxins, mode of action, their origin and mitigation strategies.

Unit – I

- Introduction, history and scope of toxicology
- Basic concepts of toxicology- Dose effect and response, dose response relationship, statistical concept of toxicity
- Toxicity testing; Toxicological testing methods
- Manifestation of organ toxicity.
- Carcinogenesis, mutagenesis and teratogenesis.
- Biotransformation reactions- Phase I and Phase II reactions

Unit – II

- Naturally occurring toxins in foods – occurrence and denaturation.
- Food additives, general principles for use, safety assessment; Types of food additives and their toxics effect. Food colors, Sweeteners, Antioxidants, Acidulants, Flavoring agents, Antimicrobial agents
- Heavy metals, radio nucleotides and industrial containments; Food packaging containments.
- Toxins produced during processing.
- Residues in animal and plant products
- Poisonous forms of mushrooms

References:

1. Handbook of Food Toxicology by S.S. Deshpande
2. Food Additives Toxicology by Joseph A. Maga.
3. Food Toxicology by Carl K.Winter
4. Food and Nutritional Toxicology by Stanly T. Omaye

FT18006GE

BAKED PRODUCT TECHNOLOGY (1+1+0)

Objectives

To acquaint the students about the technology of production of bakery products.

Unit I:

- Structure and morphology of grain; Classification of wheat
- Milling, aims and principle of milling, steps of milling, milling machinery
- Raw materials used in bakery and their role in the product: Flour, yeast, fat, sugar, baking powder, egg, salt etc.
- Dough rheology and its measurement
- Basics of bread making: Basic bread recipe, flour characteristics and improvement, steps in bread making process, Charley-wood bread making process.
- Manufacturing cookies, biscuits and cakes, icings and toppings
- Enzymes used in the baking industry
- Bread faults and their remedies

Unit II (Practicals):

1. Determination of physical properties of kernals: Length, breadth, thickness, volume, aspect ratio, 1000-kernal weight.
2. Physico-chemical tests: Estimation of moisture, protein, fat and minerals.
3. Determination of SDS- sedimentation volume.
4. Determination of gluten content.
5. Preparation of bread.
6. Preparation of cake.
7. Preparation of cookies.
8. Evaluation of cookies

Refrences:

1. Wheat chemistry and technology, Volume-I by Y. Pomeranz.
2. Advances in cereal science and Technology by Y. Pomeranz.
3. Cereals and cereal products by D. A. V. Dendy and B. J. Dobraszczyk.

4. Cereal processing technology by G. Owens.
5. Baking science and technology: fundamentals and ingredients by E. J. Pyler and L. A. Gorton.
6. Bread Science: The Chemistry and Craft of Making Bread by Emily Buehler.

FT18004OE

SMALL SCALE PROCESSING OF FRUITS, VEGETABLES & CEREALS (0+1+1)

Objectives

To familiarize the students with small-scale processing of fruits and vegetables.

Unit-I (Tutorial)

- Production Facilities

1. Site
2. Building
3. Processing equipments
4. Services
5. Sanitation

Unit-II (Practical)

1. Preparation of squashes, Crush, Juices
2. Preparation of Jam, Candy
3. Preparation of Pickle
4. Preparation of Tomato Ketchup
5. Preparation of Bread
6. Preparation of Cakes
7. Preparation of Cookies

References:

Preservation of Fruits & Vegetables by Siddappa et al 1999. ICAR, New Delhi

Preservation of Fruits & Vegetables by Srivastava & Kumar, 1996. Intl. Book Publishing Co. Lucknow

10. Small Scale Fruit & Vegetable Processing & Products (Production methods, Equipment Assurance Practices) UNIDO Technology Manual.
11. Stanley P.Cauvain & Lindas S. Young. Baked Products. Blackwell Publishing.
12. Stanley P.Cauvain & Lindas S. Young. The Chorleywood Bread Process. CRC Publications.
13. Bakery Technology & Engineering by Samuel A. Matz.