

**Centre for Food Technology**  
**Jiwaji University, Gwalior MP**  
**M.Sc Food Technology**  
**Syllabus (CBCS)**  
**Session -2022-2024**

*Dhawan*

*Anand*

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*M. P. S.*

**SOS in FOOD TECHNOLOGY**  
**CBCS, M.Sc. I SEMESTER SCHEME**

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
FT 101	Food Chemistry	100	3	60	21	40	14
FT 102	Food Biochemistry & Nutrition	100	3	60	21	40	14
FT 103	Food Microbiology	100	3	60	21	40	14
FT 104	Principles of Food Processing & Preservation	100	3	60	21	40	14
FT 105	Laboratory-I	100	3	60	21	40	14
FT 106	Laboratory-II	100	3	60	21	40	14
FT 107	Seminar*	100	1	100	35	xx	xx
FT 108	Assignment*	100	1	100	35	xx	xx
	<b>Sub Total</b>		20				
FT 109	Comprehensive Viva*	100	4	100	35	xx	xx
	<b>Grand Total</b>		24				

\*AE-Ability Enhancement/SD-Skill Development

*Chakraborty*

*Arora*

*H.P.S.*

**SOS in FOOD TECHNOLOGY**  
**CBCS, M.Sc. II SEMESTER SCHEME**

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
FT 201	Fruits & Vegetable Technology	100	3	60	21	40	14
FT 202	Food Quality control, Laws & Management	100	3	60	21	40	14
FT 203	Food Engineering	100	3	60	21	40	14
FT 204	Food Packaging	100	3	60	21	40	14
FT 205	Laboratory-I	100	3	60	21	40	14
FT 206	Laboratory-II	100	3	60	21	40	14
FT 207	Seminar*	100	1	100	35	xx	xx
FT 208	Assignment*	100	1	100	35	xx	xx
	<b>Sub Total</b>		20				
FT 209	Comprehensive Viva*	100	4	100	35	xx	xx
	<b>Grand Total</b>		24				

\*AE-Ability Enhancement/SD-Skill Development

*Dr. Anil Kumar*

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**SOS in FOOD TECHNOLOGY**  
**CBCS, M.Sc. III SEMESTER SCHEME**

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
FT 301	Processing of Cereals, Legumes, oil seeds, & Sugar crops	100	3	60	21	40	14
FT 302	Dairy Technology	100	3	60	21	40	14
FT 303	Meat, Fish & Poultry products-E1	100	3	60	21	40	14
	Fermentation technology-E2						
	Product development from food industry refuse-E3						
FT 304	Food additives, Spices & Flavor technology E4	100	3	60	21	40	14
	Food Biotechnology-E5						
	Biostatistics, computer applications -E6						
FT 305	Laboratory-I	100	3	60	21	40	14
FT 306	Laboratory-II	100	3	60	21	40	14
FT 307	Seminar*	100	1	100	35	xx	xx
FT 308	Assignment*	100	1	100	35	xx	xx
	<b>Sub Total</b>		20				
FT 309	Comprehensive Viva*	100	4	100	35	xx	xx
	<b>Grand Total</b>		24				

\*AE-Ability Enhancement/SD-Skill Development

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**SOS in FOOD TECHNOLOGY**  
**CBCS, M.Sc. IV SEMESTER SCHEME**

Course Code	Course Name	Total Marks	Credit	End Sem Exam Marks		Sessional Marks	
				MAX	MIN	MAX	MIN
FT 401	Advances in Food technology	100	3	60	21	40	14
FT 402	Nutraceuticals & Functional foods-E7	100	3	60	21	40	14
	Food Toxicology-E8						
	Entrepreneurship & Business management in food technology-E9						
FT 403	Personality/Skill development*	100	2	100	35	xx	xx
FT 404	Project Work	100	12	100	35	xx	xx
	<b>Sub Total</b>		20				
FT 405	Comprehensive Viva*	100	4	100	35	xx	xx
	<b>Grand Total</b>		24				

\*AE-Ability Enhancement/SD-Skill Development

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*Amal*  
*CS*

*Hupel*

# CENTRE FOR FOOD TECHNOLOGY

## SYLLABUS (2022 -2024)

### FT 101: FOOD CHEMISTRY

**Objective-**To acquaint the students about chemistry of various foods.

**Outcome:** The student will have an idea of food constituents, importance and their daily dietary allowances; scope and prospects for food industries. Student will understand the changes in food during cooking, processing, storing and even digestion. Knowledge of the chemical components (nutritional value) of food is essential for developing a food product with essential amino acids and fatty acids. This also informs the health importance of food chemistry

#### UNIT -I

**Carbohydrate:** General introduction, classification, properties and functions of carbohydrates, role of carbohydrate in food industries, Starch, cellulose, hemicelluloses, gums, pectic substances, Modified starch.

**Browning reactions in food:** Enzymatic and non-enzymatic browning in foods of vegetable and animal origin during storage and processing of foods.

#### UNIT -II

**Proteins:** General introduction, classification, structure, properties, functions, physical and chemical properties, purification and denaturation of proteins, protein derived from milk, egg protein, meat protein, fish muscle protein, oil seed protein and cereal protein. Modified proteins and application in food industry. Single Cell Protein. Allergens associated with food.

#### UNIT -III

**Lipids:** General introduction, classification, properties, functions and requirements of food lipids, Vegetable and animal fat, margarine, lard, butter. Refining of crude oil, hydrogenation and winterization, Frying and shortenings. Flavor changes in fats and oils (rancidity, lipolysis), auto-oxidation & factors affecting lipid oxidation.

#### Unit IV

**Vitamins:** General introduction, Fat- and Water-soluble Vitamins, effect of various processing treatments

**Minerals:** General introduction, effect of various processing treatments.

**Fortification:** Methods, Significance and applications.

#### Unit V

**Enzymes:** General introduction, Nature, nomenclature, classification, properties and functions of enzymes Factors affecting rate of enzymatic action. Enzyme activity in different food systems, Introduction of Flavor production by enzymes.

**Plant pigments and their role in Food Industry:** Carotenes, Xanthophylls, Chlorophyll, Bitter Substances and Tannins.

#### Text books and Reference materials

1. Beltz, H.D. 2005. Food Chemistry. Springer Verlag.
2. Fennema, O.R, 2006, Food Chemistry, Academic Press.
3. Meyer, L.H. 1987. Food Chemistry. CBS publishers and Distributors, New Delhi.
4. Potter, N.N. and Hotchikiss, J.H. (2006), Food Sciences, Fifth edition, CBS publishers and Distributors, New Delhi.

## FT 102: FOOD BIOCHEMISTRY AND NUTRITION

**Objective** To acquaint the students about Food biochemistry and Nutrition of various foods.

**Outcome:** To emphasize the need for greater and more efficient utilization of the existing food sources and development of entirely sources of different food groups. Digestion and metabolic pathways of different components knowledge about water, fat soluble vitamin and minerals and recommendatory dietary allowance:

### UNIT -I

**Introduction to different food groups and its importance in nutrition. Carbohydrate:** Introduction, digestion, food sources. Metabolic pathways for breakdown of carbohydrates: glycolytic citric acid cycle, gluconeogenesis, glycoenesis, glycogenolysis electron transport chain, ATP balance pentose phosphate pathway

**Metabolic defects** -Diabetes, disease associated with carbohydrates.

### UNIT -II

**Protein:** Introduction, Essential amino acids. Food sources, metabolic defects, Metabolism Pathways of proteins (digestion and absorption) -transamination, deamination, decarboxylation, Urea Cycle. Nitrogen balance & nitrogen pool, Evaluation of quality of proteins, deficiency symptoms, prevention and cure.

**Fat:** Digestion: Introduction, digestion, metabolism outlines, essential fatty acids, food sources, Metabolism Pathways - fat and fatty acid, Biosynthesis of Fatty Acids nutritive functions, Effects of excess and deficiency:- obesity, cardiovascular diseases. Nutritional significance of lipo-proteins.

### UNIT -III

**Fat soluble vitamins:** bio-Chemical and physiological role physiological role, bio-availability and requirements .food sources, effects of excess and deficiency. **Water soluble vitamins:** Salient features, requirements, food sources, effects of excess and deficiency. **Minerals:** bio-Chemical and physiological role physiological role, bio-availability and requirements, food sources, effects of excess (if any) and deficiency factors affecting utilization.

### Unit IV

**Energy metabolism:** Basal metabolic requirements and activity, SDA- specific dynamic action of food, respiratory quotient of food, caloric requirement of humans.

**Recommendatory dietary allowance:** concept of balance diet, menu planning in different ages and diseases.

### UNIT-V

**Colorimetry:** Introduction, beers & lamberts law, extinction coefficient, general principles of colorimeter, application in food industry.

**Fluorimetry:** Introduction, principle, instrumentation & application., Flame photometry: Instrumentation & application.

**Spectroscopy:** General principle, instrumentation, types-atomic absorption spectrophotometer, UV-Visible, principle, instrumentation & applications

### Text Books / References:

1. Modern Experimental Biochemistry, Boyer, Pearson Education
2. Lubert stryer, Biochemistry, Freeman & Co, N.Y.
3. Voet & Voet, Fundamentals of Biochemistry, Jonh Willey & Sons

## FT 103 FOOD MICROBIOLOGY

**Objective** To understand the role and significance of different microbes and their activity in food safety, food quality and food shelf-life especially during food production to food storage.

**Outcome:** Students will be able to understand the principles behind microbiological techniques used in evaluating the quality of food. They will be able to identify the microorganism responsible for food spoilage and the methods to control the food spoilage. It focuses on the study of microbial ecology related to fermentation, preservation, investigation of food borne illness and national and international Food Legislation.

### UNIT I

Definition, Historical Development, Classification, propagation and importance of Yeast, Mold and Bacteria. Importance of microorganisms in Food science.

Factors affecting the growth of micro-organisms in food – Intrinsic and Extrinsic parameters.

### UNIT II

**Food Hygiene and Sanitation:** Contamination during handling and processing and its control.

Sterilization, Thermal inactivation of microbes- Concept, determination & importance of TDT, F, Z & D values, pasteurization.

### UNIT III

**Protection and preservation of Foods:** Chemical, Modified atmosphere, Radiation in foods from the microbiological angle. Indicator organisms; rapid methods in detection of microorganisms.

Indicators of water and food safety and quality; Microbiological criteria of foods and their Significance. The HACCP and ISO systems for food safety.

### UNIT IV

**Food spoilage:** Characteristic features and significance of spoilage of different groups of foods - Cereal and cereal products, vegetables and fruits, meat, poultry and sea foods, milk and milk products, packed and canned foods.

**Food borne diseases:** Bacterial food borne diseases (Staphylococcal in-toxication, Botulism, Salmonellosis, Shigellosis, Enteropathogenic Escherichia Coli Diarrhea, Clostridium Perfringens gastroenteritis, Bacillus cereus Gastroenteritis), Mycotoxins: Aflatoxicosis, Deoxyvalenol Mycotoxicosis, Ergotism.

### UNIT V

**Food Fermentation:** Microbial culture in food fermentations and their maintenance & evaluation. factors affecting activity of culture, single and mixed cultures of cultures; Therapeutic value of fermented foods.

**Probiotics and Prebiotics:** definition, characteristics, classification, Safety considerations on probiotics, application of probiotics and prebiotics in food industry

#### Text books and Reference materials:

1. Essentials of Microbiology; K. S. Bilgrami; CBS Publishers, Delhi
2. Food Microbiology; WC Frazier; Tata McGraw Hill, Delhi
3. Modern Food Microbiology; James M Jay; CBS Publishers, Delhi
4. Microbiology; Pelczar, Chan and Krieg; Tata McGraw Hill, Delhi
5. Fundamental Food Microbiology. Ray B and Bhunia A. 2013. Fifth Edition. CRC Press
6. Microbiology (7th edition). Prescott LM Harley JP and Klein DA 2006 McGraw Hill, Newyork
7. Text book of Microbiology. Dubey, R.C. and Maheswari, D.K. 2008 S Chand Publishing.



## FT104 PRINCIPLES OF FOOD PROCESSING & PRESERVATION

**Objective:** To identify and select preservation methods appropriate for specific foods and to learn the effects of preservation methods on the quality of food.

**Outcome:** Students shall develop the knowledge of need of food processing and learn various preservation techniques. To impart knowledge on the causes of food spoilage and principles of different techniques used in processing and preservation of foods. Knowledge about baking and milling of process.

### UNIT -I

**Introduction:** Definition and scope of Food science and technology, historical development of food processing and preservation, general principles of food preservation Processing and preservation by heat: Blanching, pasteurization, sterilization and UHT processing, canning, extrusion cooking

**Baking:** Principle of baking and several changes in baked products.

### UNIT -II

**Radiation:** Source of radiations, mode of action effect on microorganisms and different nutrients dose requirements for radiation preservation of food.

**Microwave heating:** Principles and application in Food processing

### UNIT -III

**Refrigeration and Freezing Preservation:** Refrigeration and storage of fresh food major requirement of refrigeration plant atmospheric storage, refrigerated storage of various food freezing point of selected food influence of freezing and quality of the food product. Method of freezing, freeze drying, storage, and thawing of frozen food

### Unit IV

**Chemical Preservation:** Preservation of food by use of sugar, salt, chemicals, antibiotics & by smoking

**Concentration:** Application in food industry processes and equipment for manufacture of various concentrated foods and their keeping quality

**Fermentation:** Application in preservation of food pickling, curing etc

### Unit V

**Drying:** Processing and preservation by drying, various methods employed in production of dehydrated food products, selection of methods based on characteristics of foods to be produced, advantages and disadvantages of different methods, sun-drying, tray or tunnel drying, spray drying, drum drying, fluidized bed drying. Physical and chemical changes during drying control of chemical changes, desirable and undesirable changes. Packaging and storage of dehydrated food products.

### Text books and Reference materials

1. Desrosier NW & James N. (2007). Technology of food preservation. AVI. Publishers
2. Fellows, P.J. (2005). Food processing technology: Principle and Practice. 2nd Ed. CRC Publishers
3. Jelen, P. (2005). Introduction to Food Processing. Prentice Hall
4. N.M.Potter, Food Science and Technology.

## FT 105: LABORATORY COURSE-I

**Objective:** To understand the chemistry of food and to develop skills related to quality evaluation of foods using various qualitative techniques.

**Outcome:** The students shall acquire the practical skills for the sampling of foods and shall be able to carry out quality evaluation foods. They will learn biochemical techniques for estimation of nutritional content in different type of food products. Qualitative analysis of carbohydrates, and Proteins.

1. Qualitative analysis of carbohydrates
2. Qualitative analysis of Proteins
3. Analysis of lipids: acid value, iodine value, saponification value etc
4. Estimation of carbohydrates in food materials
5. Estimation of proteins in food materials
6. Estimation of crude fiber in food materials
7. Estimation of ascorbic acid in food materials
8. Estimation of calcium in food materials
9. Estimation of cholesterol in food materials
10. Estimation of calorific value of foods
11. Balance diet: food exchange list and steps in diet planning.
12. Diet planning for pre-school, school children, lactating women

## FT 106: LABORATORY COURSE -II

**Objective:** To understand the microbial techniques and to develop skills related to microbial quality evaluation of foods using various techniques.

**Outcome:** The students shall acquire the practical skills for the sampling of foods and shall be able to carry out microbial analysis. Introduction to microbiological techniques: Requirements of a microbiology lab, Safety rules to be, analyze food products for possible microbial contamination

### A) Processing Of Food and Food Microbiology

1. Determination of moisture in different food samples.
2. Determination of TSS in different food samples.
3. Quality assessment by Blanching and browning control
4. Quality assessment by different drying methods.
5. Determination of acidity and PH different food samples.
6. Determination of ash in food samples.
7. Instruments used for food processing.
8. Determination of gelatinization
9. Stages of sugar cookery
10. Estimation of gluten content
11. Adulteration test in various samples.

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## B) Food Microbiology Lab

1. Preparation of common laboratory media and study of a compound microscope.
2. Staining: Gram's staining,
3. Sub culturing of a bacterial strain in liquid and solid medium.
4. Study of growth of E. coli by a spectrophotometer.
5. Study of microbiological quality of milk by MBRT test.
6. Preparation of synthetic medium for yeast and mould and inoculation with standard strains of yeasts and moulds.
7. Microbiological analysis of typical processed food and unprocessed food.
8. Dilution and Plating by spread -plate and pour -plate techniques.
9. Isolation of pure culture.
10. Test for adulteration in different food samples.
11. Evaluation of microbiological quality of Water and MPN test of coliforms.

## FT 107: PERSONALITY DEVELOPMENT/ SKILL DEVELOPMENT IN FOOD PRODUCT FORMULATION /SEMINAR\*

Every student shall deliver at least one seminar on topic of the curriculum/ advances in food technology which will individually be assessed by every available teacher on the basis criteria laid down by the Staff council. Students in audience will also be encouraged to assess the seminar on the given criteria and their evaluation will also be given due consideration. The average marking will be taken into consideration.

## FT 108: ASSIGNMENT\*

Every student will be imparted skills in development of new products and will be evaluated by the concerned teacher.

## FT 109: COMPREHENSIVE VIVA\*:

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of semester of the Programme by a board of four examiners.

## FT 201: FRUITS AND VEGETABLE TECHNOLOGY

**Objective:** To develop knowledge regarding biochemistry and physiology of fruits and vegetables and their role in pre- and post-harvest changes in product quality.

**Outcome:** This course aims in providing knowledge about the fruit and vegetable structure, post-harvest physiology and its spoilage. The student shall understand biological, chemical and physical properties of fruits and vegetables and the technologies involved in the processing, preservation and value-addition of fruit and vegetable products.

### UNIT -I

Introduction, definition, role, importance and status of post harvest technology.

**Fruits and vegetables:** Morphology of fruits and vegetables, maturity indices and methods of maturity determinations. Post-harvest physiological and biochemical changes in fruits and vegetables, ripening of climacteric and non climacteric fruits; regulations, methods.

### UNIT -II

**Post harvest disorders-** Factors affecting post harvest changes, handling and packaging of fruits and vegetables, chilling injury & disease, storage practices: CA and MA, hypobaric storage, pre-cooling and cold storage, Zero energy cool chamber, commodity pre-treatments - chemicals, wax coating, VHT and irradiation. Minimal processing of fruits and vegetables- quality factors for processing, export standards.

### UNIT -III

Stages of new product development, by products from fruit and vegetable wastes, utilization and disposal of fruit industry wastes. Production of mushroom and its processed products; Cashew and coconut: chemical composition, processing technology and their processed products.

### UNIT -IV

**Vinegar:** Method of preparation and quality control

**Tea, Coffee and Cocoa:** Production and manufacturing.

**Pectin:** Raw material processes and uses of pectin, products based on pectin, manufacturing and quality control.

### UNIT -V

**Fruits and Vegetables:** Preparation of juice, syrup, squashes, jam, jellies, marmalades, RTS cordials and nectars, fortification and soft drinks.

**Tomato products:** Preparation of various tomato products and quality control.

### References:

1. Bose, T.K. Ed. 1985. Fruits of India: Tropical and Sub-tropical. Naya Prokash, Calcutta. Dauthy, M.E. 1997. Fruit and Vegetable Processing. International Book Distributing Co. Lucknow, India.
2. Hamson, L.P. 1975. Commercial Processing of Vegetables. Noyes Data Corporation, New Jersey.
3. Lai, G., Siddappa, G. and Tondon G.L. 1986. Preservation of Fruits and Vegetables, Indian Council of Agril. Research, New Delhi.
4. Salunkhe, D.K. and Kadam, S.S. Ed. 1995. Handbook of Fruit Science and Technology: Production, Composition and Processing. Marcel Dekker, New York. Salunkhe, D.K. and Kadam, S.S. Ed. 1995. Handbook of Vegetable Science and Technology. Production,

## FT 202: FOOD QUALITY CONTROL, LAWS AND MANAGEMENT

**Objective:** To develop knowledge regarding food quality control and related laws to manage in our food protects.

**Outcome:** This course aims to impart the knowledge of food safety issues, surveillance and monitoring techniques, Food Labeling as well as sanitation and food allergy. To know the principles of Food Safety and Quality. To apply preventive measures and control methods to minimize the hazards in foods. To know the requirements of FSSAI for different food items. To learn the principles of HACCP and to develop procedures and approaches to identify food safety hazards in food processing.

### UNIT -I

**Food safety and hygiene:** General introduction

**Food safety concept- Importance** of food safety in food processing. Food hygiene and its practices (GMP/GHP, GAP, GLP). Hygiene verification in food industry, Clean in Place (CIP) - Different sanitizers and detergents- Sanitation and hygiene in quality assurance in different food industries (Fruits and vegetables, Meat, Milk, Cereal Based) cleaning and sanitation (ETP, WTP, Pest control) prevention and control.

### UNIT -II

**Concept of quality:** Quality attributes- physical, chemical, nutritional, microbial and sensory, evaluation. Quality measurement techniques, process design and control and product design and control, TQM, IPR and Patent.

### UNIT -III

**Food laws and regulations:** Food safety act 2006, 2011 and 2022 basic differences, FSSAI. Various organizations dealing with inspection and traceability and authentication, Certifications (BIS, AGMARK, ISO, FPO, MFPO, PFA, MPO, etc.)

**International food laws and regulations:** US Federal laws, USDA, FDA, FAO, WHO, CODEX, HACCP with new guideline.

### UNIT -IV

Concept of product development -product success and failure, factors for success, process of product development, managing for products success innovation strategy -possibilities for innovation, building up strategy, product design, commercialization, launch, and evaluation product development program for RND in food industry. Cost of Quality, Supplier development, Microbial enumeration, production floor environment monitoring, quality of water (Process/Raw/reuse).

### UNIT- V

Introduction to sensory evaluation, Selection of sensory panellists; Factors influencing sensory measurements; Sensory quality parameters -Size and shape, texture, aroma, taste, colour and gloss; Detection, threshold and dilution tests Different tests for sensory evaluation- discrimination, descriptive, affective; Flavour profile and tests; Ranking tests; Methods of sensory evaluation of different food products. Selection and training of sensory panel; Detection and threshold tests; Ranking tests for taste, aroma colour and texture; Sensory evaluation of various food products using different scales, score cards and tests;

### Text Books / References:

1. Early R. 1995. *Guide to Quality Management Systems for Food Industries*. Blackie Academic.
2. Krammer A & Twigg BA. 1973. *Quality Control in Food Industry*. Vol. I, II. AVI Publ.
3. Chhabra TN & Suria RK. 2001. *Management Process and Perspectives*. Kitab Mahal.
4. Jhingan ML. 2005. *International Economics*. 5th Ed. Virnda Publ.
5. Kotler P. 2000. *Marketing Management*. Prentice Hall.
6. Reddy SS, Ram PR, Sastry TVN & Bhavani ID. 2004. *Agricultural Economics*. Oxford & IBH.

## FT 203: FOOD ENGINEERING

**Objective:** The course provides the knowledge about engineering principles to food materials and food processing operations, food machinery, packaging, ingredient manufacturing, instrumentation and control.  
**Outcome:** The students shall be able to understand the basics of mass and energy conservation, fundamentals of fluid flow dynamics as applied to food processing operations. They will learn planning, designing, improving, as well as maintaining the processing system in food industry,

### UNIT -I

**Mechanical operations in food processing:** Introduction, scope and applications

**Size Reduction process:** Principles, theories & laws, energy consideration, equipments & size reduction of solid and liquid food products

**Mixing & forming:** Theory & applications, mixing indices, equipments for solid and liquid foods products.

### UNIT -II

**Process Heat Transfer** - Thermal properties of foods such as specific heat and thermal conductivity  
Modes of heat transfer and overall heat transfer, Fourier's law. steady state and unsteady state heat transfer, heat exchange equipment. Rheology of foods: Newtonian fluids and non-Newtonian fluids.

### UNIT -III

**Unit operation in Food engineering**

**Food dehydration:** Mechanism of drying, moisture & drying rate curves, constant and falling rate periods, dehydration equipment & freeze drying.

**Evaporation:** Properties of liquid, heat & mass balance, single & multiple effect evaporation, steam economy, heat recovery, efficiency, equipment & systems.

### UNIT - IV

**Filtration** – filtration terminology (feed slurry, filtrate, filter medium, filter cake and filter), filtration methods/equipment's – pressure filtration, vacuum filtration, & centrifugal filtration

**Chilling, refrigeration & freezing:** Introduction, types of freezers, precooling & cold storage,

Shelf-life extension requirements, theories, characteristic curve, cooling rate calculations, chilling & freezing equipment, cryogenics, freeze drying, properties of frozen foods.

### UNIT-V

**Separation processes:**

**Centrifugation:** General principles, instrument & types of centrifuges, preparatory & analytical centrifugation & applications

**Chromatographic Techniques:** General introduction to principles, partition & adsorption chromatography-paper, thin layer, gas & liquid, ion exchange & affinity chromatography gel filtration, HPLC and application in food industry

**Membrane filtration technology:** Principles of other food processing such as-RO, UF, Dialysis, osmosis, micro-filtration, and nano filtration -outlines

### Text Books / References:

1. Heat Transfer: D.Q. Kern, MGH.
2. R.K. Rajput. 2007. Engineering Thermodynamics, 3rd Ed. Laxmi Publications (P) Ltd.,
3. Bangalore. P.K. Nag.2005. Engineering Thermodynamics, 3rd Ed. Tata-McGraw-Hill
4. Basics of Food Engineering, Romeo Toledo
5. Earle RL. 1985. Unit Operations in Food Processing. Pergamon Press.

## FT 204: FOOD PACKAGING

**Objective:** The course aims to develop the student's knowledge in various types of packaging food and packaging materials.

**Outcome:** The students shall gain knowledge on the different types of materials and media used for packaging foods, hazards associated with packaging materials, laws, regulation and the monitoring agencies involved in food safety. They will understand the material Cost reduction strategies and Materials substitution like Bioplastic, recycled, renewable materials, high-performance barrier materials, and holographic foil are some of the few trends influencing the food packaging landscape

### UNIT I

**Introduction to Food Packaging:** Packaging terminology- definition, types of packaging. Functions of food packaging, characteristics of food stuff that influences packaging selection.

### UNIT II

**Packaging material and their properties:** Glass, paper and paper board, corrugated fibre board (CFB), Metal containers -Tin Plate and Aluminium, composite containers, collapsible tubes, plastic films, laminations, metalized films, Co-extruded films.

### UNIT III

**Packaging systems and methods:** vacuum packaging, controlled atmospheric packaging, modified atmospheric packaging, aseptic packaging, Sterilization of packaging materials, retort processing, microwave packaging, active packaging, intelligent packaging, edible packaging, shrink and stretch packaging.

### UNIT IV

**Packaging of fresh and processed foods:** Packaging of fruits and vegetables, fats and Oils, spices, meat, Poultry and sea foods, dairy Products, bakery, beverages, dehydrated and frozen foods.

Liquid and powder filling machines – like aseptic system, form and fill (volumetric and gravimetric), bottling machines. Form & Fill Sealing machines and multilayer aseptic packaging machines.

### UNIT V

**Packaging Laws, Regulations, Evaluation and Quality control-** shelf life testing, corrosion, tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength, tear strength, their methods of testing and evaluation, barrier properties of packaging materials- Theory of permeability, factors affecting permeability, permeability coefficient, gas transmission rate (GTR) and its measurement, water vapour transmission rate (WVTR) and its measurement, prediction of shelf life of foods, selection and design of packaging material for different foods.

#### Text Books and Reference materials

1. NIIR. (2003). Food Packaging Technology Handbook, National Institute of Industrial Research Board, Asia Pacific Business Press Inc.
2. Ahvenainen, R. (Ed.) 2003 Novel Food Packaging Techniques, CRC Press,
3. Han, J.H. (Ed.) 2005 Innovations in Food Packaging, Elsevier Academic Press,
4. Coles, R., McDowell, D. and Kirwan, M.J. (Eds.) 2003 Food Packaging Technology,

## FT - 205: LABORATORY COURSE I

**Objective:** To understand the effect of various preservation techniques on the quality and safety of food products. To evaluate a processing procedure used to preserve a food product.

**Outcome:** The students will be able to understand and utilize different food preservation techniques. Sampling techniques and preparation of test samples, Estimation of Water activity of food sample. Physical and Chemical evaluation of thermally processed food (Canned or Bottled), Pickling and curing of foods. Dehydration of foods and preparation of fruit juice concentrates and powder, Physicochemical analysis of dehydrated food sample.

1. Canning of fruits and vegetables.
2. Dehydration of fruits and vegetables.
3. Preparation of tomato juice.
4. Preparation of tomato puree.
5. Preparation of tomato paste.
6. Preparation of various types of pickles.
7. Preparation of tomato ketchup.
8. Preparation of tomato mock tail.
9. Preparation of tomato soup.
10. Preparation of tomato chutney.
11. Preparation of jackfruit pickles.
12. Preparation of jams
13. Preparation of lime squashes.
14. Preparation of jellys.
15. Preparation of jam marmalades.
16. Pectin determination
17. Determination of chemical preservatives in fruits and vegetables.
18. Blanching of fruits and vegetables for quality estimation.

## FT- 206: LABORATORY COURSE II

**Objective:** To understand the effect of various type of packaging materials, impact of packaging materials in different types of food.

**Outcome:** The students will be able to understand and utilize different type of packaging materials. Moisture content in different type of packaging materials. To perform Test for formal shock resistance in glass bottles etc.

1. Testing of different types of packaging materials.
2. Determine moisture content in given package samples.
3. Test for modified starch in different package materials.
4. Test for water absorbency in corrugated fibre board box.
5. Test for types of adhesive used in CFB.
6. Development of new food products and formulations.
7. To perform flap bend test in CFB.
8. Test for formal shock resistance in glass bottles.
9. Graphical representation of moisture contents in different food products.
10. Determination of shelf lives.



**FT 207: PERSONALITY DEVELOPMENT/ SKILL DEVELOPMENT IN FOOD PRODUCT FORMULATION /SEMINAR\***

Every student shall deliver at least one seminar on topic of the curriculum/ advances in food technology which will individually be assessed by every available teacher on the basis criteria laid down by the Staff council. Students in audience will also be encouraged to assess the seminar on the given criteria and their evaluation will also be

**FT 208: ASSIGNMENT\***

Every student will be imparted skills in development of new products and will be evaluated by the concerned teacher.

**FT 209: COMPREHENSIVE VIVA\***

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of semester of the programme by a board of four examiners.

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## FT 301 PROCESSING OF CEREALS, LEGUMES, OILSEED AND SUGAR CROPS

**Objective:** To create knowledge about the processing and quality evaluation of cereal grains.

**Outcome:** Student will acquire the understanding of the technologies used for processing of cereal grains. Understands structure of wheat, Rice and Corn, Oats, Barley. Baking techniques for cereal's-based products. Processing of legumes, oilseeds and sugar crops. Oil extraction process and its biproducts.

### UNIT -I

Wheat: Types, structure & composition and physicochemical characteristics; wheat milling - products and byproducts; factors affecting quality parameters; physical, chemical and rheological tests on wheat flour; additives used in bakery products; flour improvers and bleaching agents- manufacture of wheat-based products.

### UNIT -II

Rice: Classification, structure & composition, physicochemical characteristics; cooking quality; rice milling technology; by- products of rice milling and their utilization; Rice bran stabilization, oil extraction and refining, parboiling methods of rice criteria of quality of rice: aging of rice - quality changes; processed products based on rice.

### UNIT -III

Corn: Types and nutritive value; dry and wet milling, corn products: corn flakes, corn starch and snacks, tortilla etc., production of glucose syrups, dextrose, high fructose corn syrups, modified Corn starches.

Barley: composition, milling, malting of barley, changes during malting, uses of malt.

Oat: composition, processing of oat, byproducts of oatmeal milling.

### UNIT -IV

Legumes and oilseeds: composition, anti-nutritional factors, processing, hydrogenation and storage; processing for production of edible oil, meal, flour, protein concentrates and isolates; development of low-cost protein foods. Oil extraction process -mechanism, oil refining, utilization of biproducts of oil milling.

### UNIT -V

**Processing of sugar crops and tubers-** (sugar cane, sugar beet crops and their difference). Sugar production and manufacturing, types and grades of sugars, products of sugars (alcohol, beer, wine and sugar syrups).

### Text books and Reference materials

1. Chakrabarthy, M.M. (2003). Chemistry and Technology of Oils and Fats. Prentice Hall.
2. Dendy, D.A.V., & Dobraszczyk, B.J. (2001). Cereal and Cereal Products. Aspen.
3. Hamilton, R.J., & Bhati, A. (1980). Fats and Oils - Chemistry and Technology. App. Sci. Publ.
4. Hosoney, R.S. (1994). Principles of Cereal Science and Technology. 2nd Ed.AACC.
5. Kay, D.E. (1979). Food Legumes. Tropical Products Institute.
6. Kent, N.L. (1983). Technology of Cereals. 4th Ed. Pergamon Press.

## FT 302 DAIRY TECHNOLOGY

**Objective:** To impart knowledge about processing of milk and its products and legislation for the quality control of milk and milk products.

**Outcome:** Students shall acquire knowledge about composition, processing, product development, organization and operations involved in milk processing unit. Impact knowledge about frozen milk products, fermented milk products and evaporated and dried milk products

### Unit - I

Composition and characteristic of milk, Collection, chilling, transportation, cream separation, **Liquid milk processing:** standardization, pasteurization, (LTLT, HTST, UHT), homogenization, packaging, storage and distribution of fluid milk and cleaning and sanitation of dairy equipment's.

**Membrane processing of milk:** Types of membranes, applications of reverse osmosis, ultrafiltration and microfiltration in dairy industry

### Unit - II

**Technology of fermented milk products:** Principles and practices of manufacture, packaging, storage and marketing of Dahi, yoghurt, Shrikhand etc. **Butter:** Manufacture, packaging, storage and marketing of butter; butter defects and their control.

### Unit - III

**Technology of frozen milk products:** Classification, manufacture, packaging, storage and marketing of ice cream, ices, sherbets etc. defects of frozen products and their control.

**Technology of indigenous milk products:** Principles and practices of manufacture, packaging, storage and marketing of ghee, khoa, Paneer, channa and milk based foods.

### Unit - IV

**Technology of evaporated and dried milk:** Manufacture of evaporated milks and milk powders, Sweetened and non-Sweetened condensed milk, SMP, WMP, Packaging storage defects and their control

### Unit - V

**Cheese:** Manufacture of hard, semi hard, soft and processed cheeses, Storage, grading and marketing of cheese, Cheese defects and their control.

**Technology of Dairy by- products:** Utilization of skim milk, buttermilk and whey for the manufacture of casein, lactose etc.

### References:

1. Robinson RK; 1996; Modern Dairy Technology, Vol 1 & 2; Elsevier Applied Science Pub.
2. Milk & Milk Processing; Herrington BL; 1948, McGraw-Hill Book Company.
3. Modern Dairy Products, Lampert LH; 1970, Chemical Publishing Company.
4. Developments in Dairy Chemistry - Vol 1 & 2; Fox PF; Applied Science Pub Ltd.
5. Outlines of Dairy Chemistry, De S; Oxford.

## FT 303 [E1] MEAT, FISH AND POULTRY PRODUCTS

**Objective:** This course shall educate students about the significance and necessity of organized animal products sector, humane slaughtering of animals and poultry and value addition of meat, poultry, egg and fish.

**Outcome:** Students shall be well versed of all aspects of meat, poultry, egg and fish industry, processing, preservation and quality control composition, pre and post slaughtering process for all products. Fish and its preservation methods. Quality parameters of raw materials and finished goods.

### Unit 1

Classification of Edible fish; Commercial handling, storage and transport of raw fish; Average composition of fish; Freshness criteria and quality assessment of fish; Spoilage of Fish; Methods of Preservation of fish: Canning, Freezing, Drying, Salting, Smoking and Curing. Fish products- Fish meal and oil and other important by products

### Unit II

**Meat:** Introduction, slaughtering methods, components of carcass viz., Muscle, postmortem glycolysis, conversion of muscle to meat, pre and post slaughter factors affecting the quality of meat. PSE and DFD condition. Preservation of meat and meat products.

**Meat industry** - Importance, application and growth rate in Indian.

### Unit III

**Poultry:** Pre slaughter care, Ante Mortem examination Slaughter. Dressing and Post mortem Composition of chicken Muscle. Pre and Post Slaughter factors affecting Poultry Meat quality Preservation of poultry Meat; Chilling and Freezing of Poultry Meat. Packaging and Grading. Preparation of products. Cured. Smoked. Canned Barbecue and Curried Poultry.

### Unit IV

**Eggs:** Structure Composition and Nutritive Value of Value of Egg. Egg. Proteins and Functional Properties of egg, Factors affecting Egg quality and its Measurements, Industrial use of Egg, Collection. Grading. Cleaning. Washing Packaging and Spoilage of Egg and products preparation.

### Unit V

**Raw Material:** Quality Parameters and Evaluation Procedures

**Finished Product Quality;** Appearance, Color Texture. Viscosity. Consistency. Flavor Defects. Bacterial Contamination and Foreign Matter.

### References:

1. Processed Meats; Pearson AM & Gillett TA; 1996, CBS Publishers.
2. Meat; Cole DJA & Lawrie RA; 1975, AVI Pub.
3. Egg and poultry meat processing; Stadelman WJ, Olson VM, Shemwell GA & Pasch S; 1988, Elliswood Ltd.
4. Developments in Meat Science – I & II, Lawrie R; Applied Science Pub. Ltd.
5. Egg Science & Technology; Stadelman WJ & Cotterill OJ; 1973, AVI Pub.
6. Fish as Food; Vol 1 & 2; Bremner HA; 2002, CRC Press.

## FT 303[E2] FERMENTATION TECHNOLOGY

**Objective:** Acquaintance with importance of food fermentation and its application in food sector.

**Outcome:** Student shall be capable to understand working principle underlying fermentation and to optimize the parameters for fermentation. Different processing or equipment's for fermentation.

### UNIT I

Fermentation, types of fermentation, Fermentation Kinetics. Bio-chemical pathways of metabolic reactions for utilization of carbon sources and formation of different metabolites by micro-organisms; Strain Development –general techniques of modifying the strains for increased production of industrial products. Use of chemicals, UV rays, genetic engineering to produce newer strains.

### UNIT II

Typical media, Media formulation: - Carbon Source, Nitrogen source, Minerals, Growth Factors, Buffers, Precursors and Inhibitors, O<sub>2</sub> requirement and antifoams. Fermentative production of industrial chemicals: organic acids like (citric acid, lactic acid), amino acids (glutamic acid, lysine), polysaccharides (dextran, xanthan) etc., industrial enzyme production by microorganism

### UNIT III

Fermentor design, Instrumentation and control, Types of fermenters (Shake flask, Batch/stir tank, Continuous, Bubble column, airlift and Tower fermenter), Types of fermentation processes, aeration and agitation (The oxygen requirement for industrial fermentation, Determination of K<sub>La</sub> values).

### UNIT IV

Downstream Processing: Various equipment for product recovery; micro-filters and Ultrafiltration systems for separation of cells and fermentation medium and for concentration of medium containing product; chromatographic systems of separation; extraction of product with solvent; evaporation and crystallization; centrifugation, different types of centrifuges; drying techniques; instrumentation and controls.

### UNIT V

Fermentative Production: a) Foods: Processes for preparing fermented products including Yogurt (curd) and other Traditional Indian Products like idli, dosa, dhokla, shrikhand, etc. Soya based products like soya sauce, natto, etc., Cocoa, Cheese etc.; Alcoholic Beverages based on fruit juices (wines), cereals (whisky, beer, vodka etc.), sugar cane (rum) etc. Process description, quality of raw materials, fermentation process controls etc. b) Industrial chemicals: Fermentative Production of Organic acids like (Citric Acid, Lactic Acid), Amino Acids (Glutamic acid, Lysine), Antibiotics (Erythromycin, Penicillin), Polysaccharides (Dextran, Xanthan) etc.; steroids transformation; process descriptions and key controls for optimal production.

### Text books and Reference material

1. Vogel, H.C. and C.L. Todaro, 2005 Fermentation and Biochemical Engineering Handbook: Principles, Process Design and Equipment, 2nd Edition, Standard Publishers.
2. El-Mansi, E.M.T, 2007, Fermentation Microbiology and Biotechnology 2nd Edition, CRC / Taylor & Francis.

## FT 303[E3] PRODUCT DEVELOPMENT FROM FOOD INDUSTRY REFUSE

**Objective:** To create knowledge about the processing and quality evaluation of cereal grains.

**Outcome:** Student will acquire the understanding of the technologies used for processing of cereal grains. Essential oils extraction and edible films formation. Knowledge about extraction of oil & wax from rice bran

### UNIT -I. Fruits & Vegetables

Production of pectin, ethanol, natural gas, citric acid, activated charcoal, fiber extract from apple pomace, vitamins. Production of citrus oil from peels of citrus fruits; Manufacture of candied peel and pectin from albedo of citrus fruits. Production of single cell protein by the use of potato wastes; Recovery of Protein from potato starch plant waste.

### UNIT -II. Fish, Meat, Poultry.

Production of fish meal; Fish protein concentrate; Animal feed; Shell product; Glue from seafood processing waste. Texturized fish protein concentrate (marine beef); Utilization of organs and glands of animal as human food.

### UNIT -III. Cereals

Feed for livestock from wheat and corn bran and germ. Extraction of oil & wax from rice bran, Puffed cereals from broken rice; Starch, modified starch and industrial alcohol from non usable cereals; Silica from rice husk; Extraction of prolamin (Zein & katirin); Protein from sorghum; Beer spent graining.

### UNIT -IV Dairy industry

Fermentation products from whey. Condensed & dried products from whey; Production of lactose and protein from whey

**UNIT- V Waste Utilization** - Utilization of waste: methods of utilizing wastes to make value added products; pectin, food colorants, antioxidants from fruit peels (citrus, mango, pomegranate), lycopene from tomato peels, vegetable seed oils, biomolecules and enzymes from meat processing, single cell proteins

1. Joshi, V.K. and Ashok Pandey, 1999, Biotechnology: Food Fermentation, Microbiology, Biochemistry and Technology, Vol. I & vol. II Educational Publisher.
2. Peppler, H.J. and D. Perlman, 2004, Microbial Technology: Fermentation Technology, 2nd Edition, Vol. II Academic Press / Elsevier.

## FT 304 [E4] FOOD ADDITIVES, SPICE AND FLAVOR TECHNOLOGY

**Objective:** To impart knowledge about additives in food processing, types of food additives, chemical nature, their analysis and risk and benefits.

**Outcome:** Student shall gain a thorough knowledge of natural and synthetic food additives and their properties in food. They will understand different flavor components arise from the normal biosynthetic processes of animal and plant metabolism. The knowledge of flavorings and other food additives is essential to achieve either flavor intensification or suppression in different food products.

### UNIT I

Food additives – definitions, classification, function, types and safety.  
Need for food additives in food industry, various additives such as preservatives, antioxidants, emulsifiers, sequestrants, humectants, stabilizers with respect to their functioning and role and mechanism.

### UNIT II

Food Flavour basics: Olfactory perception of flavor and taste, relationship of taste-sweet, bitter, salt, sour, chemicals causing pungency, astringency, cooling effects-properties. Flavor technology; types of flavors, classification of flavors-natural, nature identical and synthetic.

### Unit III

Flavor production during processing-enzymatic development, effect of roasting (e.g., coffee), frying on flavor developments, staling of flavors  
Flavour encapsulation-need, methods and application in food industry

### UNIT IV

Major spices and Minor spices–Oleoresins and essential oils; method of manufacture; quality control; fumigation and irradiation of spices.  
Techniques for flavor extraction-supercritical fluid extraction-continuous and semi-continuous methods-effects of types of solvents used, and its role in food industry.

### UNIT V

Food Additives and toxicants added or formed during Food Processing: Safety of food additives; toxicological evaluation of food additives and adulterants, food processing generated toxicants: nitroso compounds, heterocyclic amines. Types of adulteration in food and methods of detection.

### Suggested Readings

1. Morton, I.D. & Macleod, A.J. 1990. Food Flavors. Part A, BC. Elsevier.
2. Branen A.L. and Davidson, P.M. 1983. Antimicrobials in Foods. Marcel Dekker, New York.
3. Gerorge, A.B. 1996. Encyclopedia of Food and Color Additives. Vol. III. CRC Press.
4. Gerorge, A.B. 2004. Fenaroli's Handbook of Flavor Ingredients. 5th Ed. CRC Press
5. Furia, T.E. 1980, Handbook of food additives, Vol I and Vol II.
6. Fennema, O.R. Ed. 1976. Principles of Food Science: Part-I Food Chemistry. Marcel Dekker, New York.
7. Potter, N.N. 1978. Food Science. 3rd Ed. AVI, Westport.

## FT 304 [E5] FOOD BIOTECHNOLOGY

**Objective:** Imparting knowledge about principles of genetic engineering, use of biotechnology in the production of modified foods, enzymes, vitamins and proteins.

**Outcome:** Student will acquire knowledge about genetic improvement of microorganisms for production of metabolites which can be used in field of food technology.

**UNIT –I Fundamental of Biotechnology** - Definition, scope and applications. Application of biotechnology in Food, Recombinant DNA Technology and its application.

### UNIT –II

Traditional applications of food biotechnology - Fermented foods: - dairy products, oriental fermentations, alcoholic beverages, and food ingredients. Health benefits of fermented foods. Types of fermented foods and importance of food fermentation in food preservation and nutritional enhancement.

### UNIT –III

Starter cultures – types, designing and development, micro encapsulation and packaging, scopes and challenge; Development and formulation of novel products such as probiotic foods. Nitrogenomics - concept, working, significance and relevance. Biosensors and novel tools and their application in food science.

### UNIT –IV

Genetically modified foods – concept, types and application. Ethical issues concerning GM foods; testing for GMOs; current guidelines for the production of GMOs; risk assessment and risk management. IPR. GMO Act –2004. Application of biotech in GM Food production.

### UNIT –V

Industrial Biotechnology: Genetically Modified Organisms (GMOs) in Industrial Fermentation Processes (Induction, Manipulation and Recombination); Therapeutic Proteins produced by Biotechnological Processes; Use of Microorganisms in Mineral Beneficiation and Recovery; Biomass Production using Microorganisms.

### Text books and reference materials

1. Lopez, G.F.G. and Canovas, G.V.B. "Food Science and Food Biotechnology" CRC Press, Florida, USA. 2003.
2. Joshi, V.K., and Pandey, A. Biotechnology: Food Fermentation. Vols.I, II. Education Publ. 2002.
3. Bains, W. Biotechnology from A to Z. Oxford Univ. Press. 2009.
4. Lee, B.H. Fundamentals of Food Biotechnology. CH. 2006
5. El-Mansi EMT, Bryce CFA, Demain AL, and Allman AR. 2012. Fermentation Microbiology and Biotechnology. Third Edition. CRC Press.



## FT-304 [E6] BIOSTATISTICS, COMPUTER APPLICATIONS

**Objective:** Imparting knowledge about principles and application of computer in food technology.

**Outcome:** Student will acquire knowledge about application of computer in the area of food technology and different type statically techniques in the field of food technology.

### UNIT I

Computer Applications: Use of computers for preparing and presenting documents, spreadsheets. Internet. Applications of internet in Food Industry; Uses of MS Office Library documentation and scientific literature searching.

### UNIT II

Population and sample – types of statistical data – collection and classification of data – Frequency tables – Diagrammatic Representation of data – Measures of central tendencies – Mean, Median and Mode: Measures of dispersion – Range, Quartile deviation, standard deviation, Skewness and Kurtosis – Sampling techniques – Simple and Stratified Random Sampling techniques.

### UNIT III

Elementary Probability Theory – Addition and Multiplication – Bayes Theorem – Random Variables and Probability distribution- Binomial, Poisson, and Normal. Study of relationship between variables – correlation: Simple, Partial, Multiple Correlation (three variables); Regression – Simple, Multiple (three Variables). Measures of association – Chi square test for goodness of fit & contingency table.

### UNIT IV

Basic concept of hypothesis testing - Type I and type II errors. Tests based on Means & Proportions on Normal, t & F. One-way analysis of variance (CRD), Two-way analysis of variance (RBD), LSD, - Multiple comparison tests (DMRT, Bonferonni, Dunnett's). Carrying out Data Analysis using MS- excel: Descriptive Statistics – Diagrammatic representation – t test for independent samples, paired samples, F test two sample variances: One-way ANOVA, two-way ANOVA, Correlation & Regression (three variables).

### UNIT V

Framing Proposal for acquiring grants: The question to be addressed – Rationale and importance of the question being addressed – Empirical and theoretical framework – Presenting pilot study / data or background information - Research proposal and time frame – Specificity of methodology – Organization of different phases of study – Expected outcome of study and its implications – Budgeting - Available infra-structure and resources - Executive summary.

### Text books and Reference materials

1. Bandarkar, P.L. and Wilkinson T.S. (2000): Methodology and Techniques of Social Research, Himalaya Publishing House, Mumbai.
2. Copper, H.M. (2002). Intergrating research: A guide for literature reviews (2nd Edition). California: Sage
3. Harman, E & Montages, I. (Eds.) (2007). The thesis and the book, New Delhi: Vistar.
4. Mukherjee, R. (1989): The Quality of Life: Valuation in School Research, Sage Publications.

## FT 305 LABORATORY COURSE I

**Objective:** Imparting knowledge about the general methods of quality evaluation, testing and processing cereals and preparation of different type of cereal-based products.

**Outcome:** The students shall be able to assess the quality of wheat, rice and different type cereals. Preparation of different type of cereal-based products.

1. Detection of adulteration in different types of foods.
2. Determination of moisture content in food product by hot air oven drying method.
3. Determination of yeast quality by its dough rising capacity.
4. Determination of thousand kernel weight of different grains sample.
5. Determination of cooking time in different rice sample.
6. Determination of elongation ratio in different rice sample.
7. Determination of Gluten content in different flour sample.
8. Determination of ash content in flour samples.
9. Determination of Acid insoluble Ash
10. Estimation of fat acidity
11. Determination of Alcoholic acidity
12. Preparation of Bread.
13. Preparation of Biscuits.
14. Preparation of Pizza base.
15. Preparation of Dinner roll.
16. Preparation of Cookies.
17. Preparation of Muffins
18. Preparation of Nankhatai.
19. Preparation of Cakes.
20. Preparation of fermented products.
21. Quality evaluation of different biscuit sample—physical and chemical analysis.
22. To determine the foaming capacity of given flour sample.
23. Determination of protein content of flour by Micro Kheldahl Method
24. Estimation of curcumin in turmeric.
25. Determination of cappaicin in content in chilli.

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## FT 306 LABORATORY COURSE II

**Objective:** Imparting knowledge about the general methods of quality evaluation, testing and processing fresh milk and preparation of different type milk products.

**Outcome:** The students shall be able to assess the quality of milk and milk products and to develop various milk products. Preparation of different milk products and fat estimation and analysis of fat for milk and milk products,

1. Platform Test of Milk
2. Adulteration tests.
3. Fat estimation in milk by Garbers Methods.
4. Preparation of flavored milk.
5. Preparation of curd.
6. Preparation of lassi.
7. Preparation of shrikhand.
8. Preparation of ghee.
9. Preparation of khoa.
10. Preparation of chenna and paneer.
11. Determination of total solids in milk, skim milk, butter milk and whey by drying method.
12. Viscosity determination of milk by pipette method.
13. Test for fats: Bromothymol blue test.
14. Alcohol test for determining coagulability of milk.
15. Determination of salt content in butter.
16. Casein estimation in milk sample.

### FT 307: PERSONALITY DEVELOPMENT/ SKILL DEVELOPMENT IN FOOD PRODUCT FORMULATION/SEMINAR\*

Every student will be imparted skills in development of new products and will be evaluated by the concerned teacher.

### FT 308: ASSIGNMENT\*

### FT 309: COMPREHENSIVE VIVA\*

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of semester of the programme by a board of four examiners.

## FT 401 Advances in Food Technology

**Objective:** To understand the importance of various technology used in processing of food.

**Outcome:** Student will acquire knowledge about improvement in food processing and different application for production and improvement in food nutritional content which can be used in field of food technology.

### UNIT I

Historical development and eras of modern food processing, Application of extrusion cooking in food industry; effect of process variables on the physico-chemical and nutritional characteristics of extruded foods. Thermoplastic extrusion cooking-preparation of meat analogues and advantages of meat analogues over natural meat.

### UNIT II

Advances in Non-thermal processing of foods: Bio-preservation, Ultrasound in food processing and preservation: Introduction, ultrasound instrumentation, ultrasound processing for enhancement of mass transfer, Ultra-sonification, high-hydrostatic pressure processing, pulsed electric processing.

### UNIT III

Advances in fortification (complementation & supplementation); Techniques of food fortification: advances in use of radiation and microwaves in processing of foods, GM foods: Safety of Genetically Modified food: potential toxicity and allergenicity of GM foods.

### UNIT IV

Encapsulation; Design and structure of microcapsules, Techniques of microencapsulation, advantages and applications of encapsulation.

### UNIT V

Fractionation of fat

Super-critical carbon dioxide extraction

Introduction to food biotechnology: application and food processing

### Text books and reference materials

1. Lopez, G.F.G. and Canovas, G.V.B. "Food Science and Food Biotechnology" CRC Press, Florida, USA. 2003.
2. Bains, W. Biotechnology from A to Z. Oxford Univ. Press. 2009.
3. Cupp J & Tracy TS. *Dietary Supplements*: Humana Press. 2003.

## FT 402[E7] NUTRACEUTICALS AND FUNCTIONAL FOODS

**Objective:** To understand the importance of various nutrients and effects of imbalance in human health.

**Outcome:** Student shall be able to understand the role of various nutrients, their utilisation, deficiency diseases and metabolic disorders. Study about probiotic products and work on functional foods

### UNIT -I

Nutraceuticals and functional Foods –Definition, concept, history and market; Evolution of nutraceuticals and functional foods market. Classification of nutraceuticals and functional foods. Significance and relevance of nutraceuticals and functional foods in the management of diseases and disorders.

### UNIT -II

Natural occurrence of certain phytochemicals- Antioxidants and flavonoids: omega – 3 fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds. Dosage for effective control of disease or health benefit with adequate safety; studies with animals and humans; acute and chronic studies. Regulatory issues.

### UNIT -III

Probiotics and symbiotics- Probiotics: Definition, types and relevance; Usefulness in gastro intestinal health and other health benefits; development of a probiotic products; recent advances in probiotics; Challenges and regulatory issues related to probiotic products.

### UNIT -IV

Prebiotics: Definition, chemistry, sources, metabolism, effect of processing. Prebiotic in foods; types of prebiotics and their effects on gut microbes; health benefits of prebiotics; recent development in prebiotics.

### UNIT -V

Functional foods - Definition, development of functional foods, use of bioactive compounds in appropriate form with protective substances and activators; Effect of environmental condition and food matrix; Effects of processing conditions and storage. Research frontiers in functional foods, Nutrigenomics- concept of personalized medicine and application in food industry.

### Text Books and Reference materials

1. Wildman, R.E.C. (2007) Handbook of Nutraceuticals and Functional Foods, second edition. CRC Press.
2. Gibson GR & William CM. *Functional Foods - Concept to Product*. 2000.
3. Goldberg I. *Functional Foods: Designer Foods, Pharma Foods*. 2004.
4. Brigelius-Flohé, J & Joost HG. *Nutritional Genomics: Impact on Health and Disease*. Wiley VCH. 2006.

## FT 402 [E8] FOOD TOXICOLOGY

**Objective:** To understand the importance of various nutrients and effects of imbalance in human health.

**Outcome:** Student shall be able to understand the role of various nutrients, their utilization, deficiency diseases and metabolic disorders. Study about food toxicology and work on different types of food products which helps for processing in food products.

### UNIT- I

Definition scope and general principles of food toxicology; manifestation of toxic effects; classification of food toxicants; factors affecting toxicity of compounds; methods used in safety evaluation-risk assessments.

Agricultural and industrial contaminants in foods: pesticides residues in fruits and vegetables, metal contaminants in foods and their toxicity in human body.

### UNIT - II

Natural Toxins in Food: Natural toxins of importance in food- Toxins of plant and animal origin; Microbial toxins (algal toxins, bacterial toxins and fungal toxins). Natural occurrence, toxicity and significance. Food poisoning; Mycotoxicosis of significance. Determination of toxicants in foods and their management.

### UNIT - III

Food allergies and sensitivities: Natural sources and chemistry of food allergens; true/untrue food allergies; handling of food allergies; food sensitivities. Safety of Genetically Modified food: potential toxicity and allergenicity of GM foods.

### UNIT - IV

Environmental Contaminants and Drug Residues in Food: Fungicide and pesticide residues in foods; heavy metal and their health impacts; use of veterinary drugs (e.g. Malachite Green in fish and  $\beta$ - agonists in pork); other contaminants in food. Radioactive contamination of food, Food adulteration and potential toxicity of food adulterants.

### UNIT - V

Food Additives and toxicants added or formed during Food Processing: Safety of food additives; toxicological evaluation of food additives; food processing generated toxicants: nitroso compounds, heterocyclic amines, Dietary Supplements and Toxicity related to Dose: Common dietary supplements; relevance of the dose; possible toxic effects.

### Text Books / References:

1. Helferich, W., and Winter, C.K. Food Toxicology CRC Press 2001 Shibamoto, T. and Bjeldanes, L. 2009. Introduction to Food Toxicology, 2nd Ed. Elsevier Inc., Burlington, MA.
2. Duffus, J.H. and Worth, H.G. J. Fundamental Toxicology The Royal Society of Chemistry 2006.
3. Stine, K.E. and Brown, T.M. Principles of Toxicology (2nd ed.) CRC Press 2006.
4. Tönu, P. 2007. Principles of Food Toxicology. CRC Press, LLC. Boca Raton, FL.

## FT 402 [E9] ENTREPRENEURSHIP AND BUSINESS MANAGEMENT IN FOOD TECHNOLOGY

**Objective:** Imparting knowledge about Entrepreneurship, concepts of Management quality functions.

**Outcome:** Students understands about the different functions Entrepreneurship in food processing, Production, Financial, Marketing Management. Quality and materials managements.

### UNIT-I

**Entrepreneurship in food processing:** Concept of entrepreneur and entrepreneurship, quality, functions of an entrepreneur. Current status of entrepreneurship in Indian food industries.

**Management in food Industries:** History, role, need, benefits of Management Development, Management as Science and Art, Management as a Profession, Functions of Management, Levels of Management

### UNIT-II

**Forms of Business Organisations:**

Types of Organisations – Concepts, merits and demerits of Line, Line and Staff, Classification of small, medium and large-scale manufacturing industries; Opportunities of food processing industries in India and abroad

**Business Organisations,** Advantages and Disadvantages of Private Ownership and Public Ownership; Distinction between Sole Proprietary Firm and Partnership Firm; Distinction between Partnership Firm and Joint Stock Company; Distinction between Private and Public Company

### UNIT-III

**Production Management:** Objectives of Production Management, Qualities and Responsibilities of a Production Manager; Product design and Development, Factors Influencing Choice of Manufacturing Systems, Plant Location, plant layout.

### UNIT -IV

**Financial Management:** Need for Finance, Types of Capital, Methods of Raising

**Marketing Management:** Marketing Concepts – Need, Want, Demand, Difference between Selling and Marketing, Marketing Research –Need for and Steps of Marketing Research, Promotion Mix.

### UNIT-V

**Personnel Management:** Human Resource Planning – Steps in Manpower Planning, Recruitment and Selection –Difference between Recruitment and Selection Steps in the Selection Procedure; Training and Development – Need for Training, Steps in Training, Training Methods; Performance Appraisal.

**Quality and Materials Management:** Concept of Quality needs and its role, Quality Control and its techniques, Total Quality Management-meaning, role, pillars, PDCA cycle, Importance, Objectives and Functions of Materials Management, Inventory control.

### Text Books / References:

1. Production (operations) Management by L.C. Jhamb
2. Entrepreneurship and Management inputs for entrepreneurs in food processing sector by Dinesh Awasthi and Rama Jaggi.
3. Production and Operation Management by R. Panneerselvam (Prentice- Hall of India Pvt.)

**FT 403: PERSONALITY / SKILL DEVELOPMENT IN FOOD PRODUCT FORMULATION\***

Every student will be imparted skills in development of new products and will be evaluated by the concerned teacher.

**FT 404: PROJECT WORK**

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of semester of the programme by a board of four examiners.

**FT 405: COMPREHENSIVE VIVA\***

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of semester of the programme by a board of four examiners.

*Debra*  
*Somali*  
*CS*

*H.I*