

**Choice based Credit System (CBCS)  
Scheme and course structure for  
M.Sc. Food Technology 1<sup>st</sup> semester effective from academic session 2015 and onwards**

Course Code	Course Name	Hours			Total Credits
		L	T	P	
FT15101CR	FOOD MICROBIOLOGY	3	0	2	4
FT15102CR	FOOD BIOCHEMISTRY	4	0	0	4
FT15103CR	PRINCIPLES OF FOOD ENGINEERING	4	0	0	4
FT15104DCE	PRINCIPLES OF FOOD PROCESSING	4	0	0	4
FT15105DCE	EXPERIMENTAL BIOCHEMISTRY	0	0	4	2
FT15106GE	ELEMENTARY FOOD PROCESSING	2	1	0	3
FT15107GE	POSTHARVEST PHYSIOLOGY OF FRUITS AND VEGETABLES	2	1	0	3
FT15108OE	FOOD AND NUTRITIONAL SECURITY	1	1	0	2
<b>Credits=26 Hours=29</b>					

**Course Code: FT15101CR**

**Course Name: FOOD MICROBIOLOGY (3+0+1)**

**Unit - I**

- Types of microorganism 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. Yeasts of industrial importance.
- Microbial growth pattern and factors affecting microbial growth.
- Spores and their significance, spore biology, sporulation and germination cycle.

**Unit - II**

- Biochemical changes caused by micro organisms– Degradation of carbohydrates, fermentation, degradation of lipids, degradation of proteins and amino acids, putrefaction.
- **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, appearance of spoiled cans, types of spoilage of canned foods by yeast, moulds and bacteria.
- **Probiotics and their significance**

**Unit - III**

- **Food borne disease** – Staphylococcal gastroenteritis, Botulism, Listeriosis, Salmonellosis, Shigellosis.
- **Toxicants of microbial origins** – Aflatoxins, ochratoxins, patulin, botulinum, 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.

**Unit IV (Practicals)**

1. Microscopy.
2. Cleaning and sterilization of glassware.
3. Preparation of nutrient media and techniques of inoculation.
4. Staining techniques-Monochrome staining, negative staining, gram staining, acid fast staining,
5. spore staining, capsule staining.
6. Examination of bacteria, yeast and moulds.
7. Identification of bacteria on the basis of:
  - 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 mould count, ANPC.

*Annexure to Notification No.F(pres/Rep-PG syllabus CBCS)Acad/KU/15 dated 09-06-2015*  
*Syllabus for M.Sc Food Technology 1<sup>st</sup> to 4<sup>th</sup> semester*

**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.
9. Laboratory Manual in Microbiology by Gunasekaran.

**Course Code: FT15102CR**

**Course Name: FOOD BIOCHEMISTRY (4+0+0)**

**Unit – I**

**Food chemistry** - Definition and importance. Approaches to the study of food chemistry, societal role of food chemists.

**Water in foods**– Water activity and shelf life of foods, moisture sorption isotherms, hysteresis.

**Water solute interactions**- Free water, bound water, 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, pectin, carageenan. 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, denaturation.

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

**Modification of proteins**– Alkylation, acylation, phosphorylation, esterification, enzymatic

Modification.

**Unit IV**

**Pigments in foods** – Heme compounds, chlorophyll, alteration of chlorophyll, preservation of chlorophyll during processing, carotenoids and their properties, anthocyanins, their properties and stability

**Enzymes in foods** – Papain, lipoxxygenase, PPO, use of pectnase, 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

Course Code: FT15103CR

Course Name: PRINCIPLES OF FOOD ENGINEERING (4+0+0)

### 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 super heated 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, Bernoullis Theorme and applications; fluid flow applications.
- **Refrigeration**– Principle, refrigeration cycle, Thermodynamics of 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, Kicks 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. Mixtures for dry and foritilidae foods.
- **Seperation Processes**: Sedimentation, Filtration, Centrifugal Seperation,
- **Cleaning & Sorting operations.**
- **Food plant design** - General consideration in designing the plant, plant location.

*Annexure to Notification No.F(pres/Rep-PG syllabus CBCS)Acad/KU/15 dated 09-06-2015*  
*Syllabus for M.Sc Food Technology 1<sup>st</sup> to 4<sup>th</sup> semester*

- Plant layout-types of layout considerations in 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 Managementn by O. P. Khanna.
6. Unit Operations of Chemical Engineering by Warner L. McCabe.

**Course Code: FT15104DCE**

**Course Name: PRINCIPLES OF FOOD PROCESSING (4+0+0)**

**Unit – I**

**Food production** – Production of important food grains, fruits, vegetables, pulses & animal products in India, consumption trend in India.

**Status of Indian food industry** – Exports scenario of fruits, vegetables, spices, meat and their processed products.

**Scope and importance of food processing**– Driving forces for 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, Extrusion.
- **Dehydration**– Water activity, types of dryers, effect of dehydration on food quality. Freeze drying. Intermediate moisture foods.
- **Fermentation**– Types, nutritional importance of fermented foods.
- **Preservation by chemicals** – Benzoate, sorbate, propionate, sulphur dioxide, anti oxidants,
- **Hurdle Technology**

**Unit – III**

- **Irradiation**– Mechanism, dosimetry, equipment, effect of irradiation on micro-organisms, and food. Safety and wholesomeness of irradiated foods.
- **Aseptic processing**– Equipment, characteristics, HTST and UHT processing,
- **Membrane processing**– Advantages, types of membranes, equipments, applications and effect on foods.
- **Minimally processed foods**– Preservation and packaging of minimally processed foods.
- **Microwave processing**– Electro magnetic spectrum, difference between microwave and infrared energy, dielectric constant, relaxation time, equipment and applications.

**Unit – IV**

- **Refrigeration and frozen storage**- Components of 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.

**Course Code: FT15105DCE**

**Course Name: EXPERIMENTAL BIOCHEMISTRY (PRACTICAL) (0+0+2)**

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



**Course Code: FT15106GE**

**Course Name: ELEMENTARY FOOD PROCESSING (2+1+0)**

**Unit – I**

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

**Unit II**

- Dehydration– Concept of water activity; Types of dryers; Intermediate moisture foods.
- Fermentation– Types, nutritional importance of fermented foods.
- Preservation by chemicals – Benzoate, sorbate, propionate, sulphur dioxide, anti oxidants,
- Irradiation– Mechanism, equipment, effect of irradiation on micro-organisms, and on food. Safety and wholesomeness of irradiated foods.

**Unit – III (Tutorials)**

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

Course Code: FT15107GE

Course Name: POST HARVEST PHYSIOLOGY OF FRUITS & VEGETABLES  
(2+1+0)

Unit I

- Cell and its structure with special reference to plant cell.
- Carbohydrate metabolism; Glycolysis and TCA cycle
- Cell wall associated enzymes: polygalactouranase, Rhamnogalactouranase, pectin methyl esterase, Beta- galactosidase etc. Their role in textural change
- Polyphenol oxidases, lipoxygenase.
- Fruit maturity and ripening; Maturity indices.
- Seed sprouts; concept and effect on anti-nutritional factors ;biochemical changes during sprouting

Unit II

- Introduction to post harvest physiology of fruits and vegetables.
- Classification of fruits based on post harvest considerations.
- Transpiration. Factors affecting transpiration.
- Respiration, RQ, alternate (cyanide resistant respiration) respiration. Factors affecting respiration.
- Ethylene biosynthesis, regulation and mode of action. Factors affecting ethylene production.
- Changes in colour: chlorophyll, carotenoids, anthocyanin and phenolic compounds.
- Water loss during fruit storage, factors affecting water loss, control of water loss.
- Storage atmospheres,; CA Storage, MA Storage, Hypobaric Storage.
- Fruit flavour and volatile metabolism; flavour components; biochemical pathways that produce flavour components. .

Unit III

- Post harvest disorders in fruits and vegetables; mealiness, chilling injury etc.
- Sprouting of bulbs and tubers; causes, mechanism and control (chemical treatment, curing and irradiation).
- 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 its 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 Bewley. *Seed Technology and its Biological Basis*. (CRC press).
3. L.N David, M.C Michael. *Leningers 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)

**Course Code: FT15108OE**

**Course Name: FOOD AND NUTRITIONAL SECURITY (1+1+0)**

**UNIT I**

- Historical milestones in Indian agriculture, contribution of Indian agriculture to the economic development of the country.
- Agricultural productivity trends in India and their sustainability issues.
- National food policy and its impact on food security and rural livelihoods, food availability, nutrients consumption and prices of important food grains in India.
- Status of hunger in India and its regional spread.
- Factors constraining/facilitating Sustainable food security.
- Public distribution system a key to achieve food security in India.
- Global perspectives of food security, WTO and its impact on food security,
- Climate change and food security
- Postharvest losses in agricultural produce, scenario of food processing industries in India- Challenges and Opportunities
- Postharvest management of food as tool for food and nutritional security.
- Food processing and its role in economy.

**UNIT II (Tutorials)**

- Trends in the production of animal based products- milk, meat, egg, poultry, fish
- Shifts in production towards non-food crops and resultant utilization of food crops for non food purpose
- National food security act, 2013.
- Green revolution a cause for shifting consumption pattern and its after effects.

**References:**

Times of India, Review of Indian Agriculture