

Annexure to Notification No.F(Pres-Syllabi.PG-CBCS)Acad/KU/14 dated 15-05-2014
Syllabus for M.Sc Food Technology 1st to 4th semester

Choice based Credit System (CBCS)
Scheme and course structure for
M.Sc Food Technology 1st semester effective from academic session 2014 and onwards

Course Code	Course Name	Hours			Credits
		L	T	P	
FT14101CR	FOOD MICROBIOLOGY	4	0	0	4+0+0=4
FT14102CR	FOOD BIOCHEMISTRY	4	0	0	4+0+0=4
FT14103CR	PRINCIPLES OF FOOD ENGINEERING	4	0	0	4+0+0=4
FT14104EA	PRINCIPLES OF FOOD PROCESSING	4	0	0	0+0+4=4
FT14105EA	EXPERIEMENTS IN FOOD MICROBIOLOGY	0	0	8	0+0+4=4
FT14106EA	EXPERIEMENTS IN FOOD CHEMISTRY	0	0	8	0+0+4=4
FT14107EA	POSTHARVEST PHYSIOLOGY	3	2	0	3+1+0=4
FT14108EO	FOOD & NUTRITIONAL SECURITY	3	2	0	3+1+0=4

FT14101CR

FOOD MICROBIOLOGY

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 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.
- Viruses- Structure and replication with particular reference to food born viruses.
- Biochemical changes caused by micro organisms– 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, appearance of spoiled cans, types of spoilage of canned foods by yeast, moulds and bacteria.
- **Probiotics and their significance**

Unit IV

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

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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.

FT14102CR

FOOD BIOCHEMISTRY

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– Lipid oxidation, rancidity, factors affecting rate of oxidization, methods to measure lipid oxidization, control of rancidity.

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.

Effect of processing on protein quality

Enzymes in foods – Papain, lipoxxygenase, PPO, use of pectnaise, cellulase and amylase in food industry.

Loss of vitamins and minerals due to processing.

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, betalains and their properties, use of pigments and biocolours.

Food Additives- Flavor Enhancers, Monosodium Glutamate (MSG), Sugar Substitutes, Sweeteners, Fat Mimetics, Thickening Agents, Gel Builders, Stabilizers; Humectants; Anticaking Agents, Bleaching Agents, Clarifying Agents

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

FT14103CR

PRINCIPLES OF FOOD ENGINEERING

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

Syllabus for M.Sc Food Technology 1st to 4th semester

- **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.
- 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.

FT14104EA

PRINCIPLES OF FOOD PROCESSING

Unit – I

- **Food production**– Production of important food grains and pulses in India, consumption trend in India.
- **Status of Indian food industry**– Exports scenario of fruits, vegetables, spices, 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.**

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 on 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**– Electromagnetic 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.

FT14105EA

EXPERIMENTS IN FOOD MICROBIOLOGY (PRACTICAL)

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, spore staining, capsule staining.
5. Examination of bacteria, yeast and moulds.
6. Identification of bacteria
 - i) Cultural characteristics
 - ii) Morphological characteristics
 - iii) Biochemical characteristics
 - a) Indole Test.
 - b) Starch-hydrolysis
 - c) Oxidase Test
 - d) TSI test
 - e) Coagulase test
 - f) Catalase test
 - iv) Serological slide and tube agglutination test for Salmonella
7. Enumeration of micro-organisms– TPC, Yeast and mould count.
8. Anaerobic Culture methods.
9. Growth characteristics of bacteria,
 - a) Generation time
 - b) Factors influencing growth-pH, temperature, thermal death, time, growth curves for bacteria and yeasts, Osmotic pressure, preservatives.
10. Examination of moulds important in foods.
11. Examination of yeast and algae.
12. Microbiological examination of natural product.
 - a) Water
 - b) Milk and milk products.
 - c) Fruits and vegetables.

References:-

1. Microbiology-Pelczar, Smith & Chan.
2. Food Microbiology by Frazier.
3. Textbook of Practical Microbiology by Subhash Chandra Parija.

4. Laboratory Manual in Microbiology by Gunasekaran.

FT14106EA

EXPERIMENTS IN FOOD CHEMISTRY (PRACTICAL)

1. Preparation and standardization of solution.
2. Moisture content by
 - a) Drying method (using hot-air oven and vacuum oven)
 - b) Moisture meters
3. Ash Estimation in different foods:
 - Fruits
 - Cereals
 - Vegetables
 - Meat
4. Protein content by
 - a) Kjeldhal method
 - b) Lowrey's Method
 - c) Quantitative tests for proteins paper chromatography of amino acids
5. Carbohydrates-qualitative tests, estimation of reducing & non-reducing sugars, total sugars, starch, amylose and polarimetry of sugars.
6. Determination of trypsin inhibitor.
7. Crude fibre estimation in foods.
8. Estimation of crude fat in food samples.
9. Determination of acidity of various food samples.
10. Determination of Vit. C in foods.
11. Determination of diastase activity in cereals.
12. Estimation of chlorophyll in leafy vegetables.
13. Estimation of anthocynins in fruits.
14. Determination of carotenoids in foods.

References:-

1. Handbook of Analysis and Quality Control for Fruit and Vegetable products by Ranganna.
2. General Analytical Techniques in Nutritional Biochemistry by Krishna and Ranjah.
3. Experiments in General, Organic and Biological Chemistry by Arne Langsjoen et al.
4. Experimental Biochemistry by Beedu Sashidhar

FT14107EA

POST HARVEST PHYSIOLOGY

Unit I

- Cell and its structure with special reference to plant cell.
- Cell membrane; transport of metabolites- active and passive transport. Role of carrier proteins.
- Enzymes; classification of enzymes; mechanism of action; factors affecting enzyme activity. Kinetics of enzyme action- Michaelis-Menten equation; Enzyme inhibition.
- Plant hormones: types, structure and their role in physiology.
- Cell wall associated enzymes: polygalactouranase, Rhamnogalactouranase, pectin ethyl esterase, Beta- galactosidase etc. Their role in textural change
- Polyphenol oxidases, lipoxygenase.
- Carbohydrate metabolism: glycolysis, TCA cycle.

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 (cynide 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.
- Post harvest changes in polysaccharides in fruits and vegetables (pectin, cellulose, and xyloglucans).
- Fruit flavour and volatile metabolism; flavour components; biochemical pathways that produce flavour components.
- Non enzymatic mechanism of change in fruits and vegetables; expansions, hydroxyl radicals and cell wall lysis, calcium and apoplast.
- Impact of mechanical injury on fruit physiology; PPO activity and its significance.

Unit III

- Physiology of seed development and maturation; chemical composition, synthesis and accumulation of seed reserve with special reference to cereals.
- Seed respiration; breakdown of stored reserves, mobilization & interconversion pathways.

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- Seed dormancy; types, significance & mechanism. Factors regulating seed dormancy. Role of phytochromes and anti sense technology.
- Seed sprouts; concept and effect on anti-nutritional factors ;biochemical changes during sprouting
- Physiology of seed ageing and deterioration; lipid peroxidation.

Unit IV

- 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.

Suggested books

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. *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)

FT14108EO

FOOD AND NUTRITIONAL SECURITY

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, 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.

UNIT II

National food policy and its impact on food security and rural livelihoods, food availability, nutrients consumption and prices of important food grains in India, agricultural development and food security in India, food processing and its role in pushing up economic status of the farmers, status of hunger in India and its regional spread, factors constraining/facilitating Sustainable food security, appraisal of the policies and programmes of the government to ensure food security, food prices, inflation and food consumption patterns in different regions of India, public distribution system a key to achieve food security in India,

UNIT III

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.

UNIT IV (Tutorials)

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