

**MRSPTU M.Sc. (FOOD SCIENCE & TECHNOLOGY) SYLLABUS  
2021 BATCH ONWARDS**

**M.Sc. (Food Science and Technology) (1<sup>st</sup> Year)**

**Total Contact Hours=27**

**Total Marks=700**

**Total Credits =23**

Semester 1 <sup>st</sup>		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
MFOT1-101	Principles of Food Preservation	4	0	0	40	60	100	4
MFOT1-102	Basic Food Microbiology	4	0	0	40	60	100	4
MFOT1-103	Food Chemistry	4	0	0	40	60	100	4
MFOT1-104	Food Analysis and Instrumentation Lab.-I	0	0	4	60	40	100	2
MFOT1-106	Food Microbiology Lab.-II	0	0	4	60	40	100	2
<b>Departmental Elective –I (Select any one)</b>		4	0	0	40	60	100	4
MFOT1-158	Nutraceutical and Functional Foods							
MFOT1-157	Nutrition and Health							
<b>Open Elective –I (Select any one)</b>		3	0	0	40	60	100	3
<b>Total</b>		<b>19</b>	<b>0</b>	<b>8</b>	<b>320</b>	<b>380</b>	<b>700</b>	<b>23</b>

\*Departmental Elective: Subject to the availability of teacher and minimum 10 students as per university guidelines.

\*\*Open Elective: Student must choose open elective subject offered by other departments.

**Total Contact Hours=24**

**Total Marks=600**

**Total Credits =22**

Semester 2 <sup>nd</sup>		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
MFOT1-206	Basic Food Engineering	4	0	0	40	60	100	4
MFOT1-207	Technology of Cereals and Millets	4	0	0	40	60	100	4
MFOT1-208	Computer Fundamentals and Statistics	4	0	0	40	60	100	4
MFOT1-209	Technology of Cereals and Millets Lab.-III	0	0	4	60	40	100	2
<b>Departmental Elective –II (Select any one)</b>		4	0	0	40	60	100	4
MFOT1-258	Technology of Beverages							
MFOT1-259	Technology of Malting and Brewing							
<b>Departmental Elective –III (Select any one)</b>		4	0	0	40	60	100	4
MFOT1-260	Food Biotechnology							
MFOT1-261	Food Additives							
<b>Total</b>		<b>20</b>	<b>0</b>	<b>4</b>	<b>260</b>	<b>340</b>	<b>600</b>	<b>22</b>

\*Departmental Elective: Subject to the availability of teacher and minimum 10 students as per university guidelines.

After 2<sup>nd</sup> Semester the students will undertake an In-plant summer training of six weeks in industry/organization. The evaluation of training will be done in the fourth semester.

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**M.Sc. (Food Science and Technology) (2<sup>nd</sup> Year)**

**Total Contact Hours=25**

**Total Marks=700**

**Total Credits =23**

Semester 3 <sup>rd</sup>		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
MFOT1-315	Technology of Fruits and Vegetables	4	0	0	40	60	100	4
MFOT1-311	Unit Operations in Food Engineering	4	0	0	40	60	100	4
MFOT1-312	Food Packaging	3	0	0	40	60	100	3
MFOT1-313	Technology of Fruits and Vegetables Lab.-IV	0	0	4	60	40	100	2
MFOT1-314	Food Packaging Lab.-V	0	0	4	60	40	100	2
<b>Departmental Elective –IV (Select any one)*</b>		3	0	0	40	60	100	3
MFOT1-364	Food Standards and Quality Assurance							
MFOT1-363	Technology of Pulses and Oil seeds							
<b>Open Elective –II (Select any one)**</b>		3	0	0	40	60	100	3
MFOT1-420	<b>Dissertation***</b>	0	0	-	-	-	-	2
<b>Total</b>		<b>17</b>	<b>0</b>	<b>8</b>	<b>320</b>	<b>380</b>	<b>700</b>	<b>23</b>

\*Departmental Elective: Subject to the availability of teacher and minimum 10 students as per university guidelines.

\*\*Open Elective: Student must choose open elective subject offered by other departments.

\*\*\*Thesis will continue in 4<sup>th</sup> Semester. Students will have to finalize the topic of research and its objectives in 3<sup>rd</sup> Semester.

**Total Contact Hours=31**

**Total Marks=500**

**Total Credits =22**

Semester 4 <sup>th</sup>		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
MFOT1-415	Technology of Egg, Meat, Fish and Poultry	4	0	0	40	60	100	4
MFOT1-416	Technology of Milk and Milk Products	4	0	0	40	60	100	4
MFOT1-417	Food Analysis and Instrumentation	3	0	0	40	60	100	3
MFOT1-418	Technology of Animal Products Lab.-VI	0	0	4	60	40	100	2
MFOT1-419	In Plant Summer Training Viva	0	0	0	60	40	100	1
MFOT1-420	Dissertation	0	0	16	Satisfactory/ Unsatisfactory			8
<b>Total</b>		<b>11</b>	<b>0</b>	<b>20</b>	<b>240</b>	<b>260</b>	<b>500</b>	<b>22</b>

**Overall**

Semester	Marks	Credits
1 <sup>st</sup>	700	23
2 <sup>nd</sup>	600	22
3 <sup>rd</sup>	700	23
4 <sup>th</sup>	500	22
<b>Total</b>	<b>2500</b>	<b>90</b>

# **SEMESTER FIRST**

**PRINCIPLES OF FOOD PRESERVATION**

**Subject Code: MFOT1-101**

**L T PC  
4 0 0 4**

**Duration: 60Hrs.**

**Course Objectives:**

1. To impart basic knowledge of food preservation to the students.
2. To introduce them to the concept of food preservation.
3. To make them familiar with different techniques of food preservation.
4. To make them aware about the recent advances in food preservation.

**Course Outcomes:**

1. Students acquire knowledge about basics of food preservation.
2. Students become familiar about concepts of food preservation.
3. Students learn techniques of food preservation.
4. Students become aware about recent advances in food preservation.

**Unit-I (15 Hrs.)**

Introduction and historical developments of food preservation.

**Principles of Food Preservation. Food Spoilage:** Microbial, physical, chemical and miscellaneous.

**Heat Preservation and Processing:** Thermal death curve, canning of foods, canning process, equipment, effect on food, aseptic processing.

**Unit-II (15 Hrs.)**

**Dehydration:** Drying curves, water activity, drying process, types of dryers, dehydration effect in food.

**Concentration:** Technology of concentration, equipment, process, and changes in food during concentration.

**Intermediate Moisture (IM) Foods:** Principles, characteristics, advantages, and problems in developing new IM foods.

**Unit-III (16 Hrs.)**

**Refrigeration Storage:** Requirements of refrigeration storage, changes in foods during refrigeration storage.

**Freezing and Frozen Storage:** Freezing curves, factors determining freezing rate, types of freezers, changes in food during freezing.

**Ionizing Radiation:** Source; equipment; mechanism of preservation, dose determination, effect on food.

**Microwaves:** Mechanism of heating, equipment and its effect on food.

**Household Preservation Methods:** Salt curing, oiling and smoking.

**Chemical Preservation:** types, uses and effects of class I and class II preservatives in foods.

**Unit-IV (14 Hrs.)**

**Recent Methods in Food Preservation:** Pulse electric, ultrasound, infrared, high pressure, Ohmic heating, hurdle technology, nanotechnology in food processing.

**Recommended Books**

1. N.P. Norman and H.H. Joseph, 'Food Science', CBS Publishers & Distributors Pvt. Ltd., New Delhi, India.
2. W.C. Frazier and D.C. Westhoff, 'Food Microbiology', Tata McGraw Hill Publishing Company Ltd., New Delhi, India.

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3. M. Kalia and S. Sangita, 'Food Preservation and Processing', Kalyani Publishers, New Delhi, India.
4. B. Sivasankar, 'Food Processing and Preservation', Prentice Hall of India Pvt. Ltd., New Delhi, India.
5. J.N. Desrosier and N.W. Desrosier, 'Technology of Food Preservation', CBS Publishers & Distributors Pvt. Ltd., New Delhi, India.
6. P. Fellows, 'Food Process Technology: Principles and Technology', CRC Press, Cambridge, England.
7. N. Khetarpaul, 'Food Processing and Preservation', Daya Publishing House, New Delhi, India.

**BASIC FOOD MICROBIOLOGY**

**Subject Code: MFOT1-102**

**L T PC  
4 0 0 4**

**Duration: 60Hrs.**

**Course Objectives:**

1. To impart knowledge about history of microbiology.
2. To study about different types of micro-organisms and the factors affecting their growth.
3. To make students aware about the techniques used for cultivation of micro-organisms.
4. To introduce students about relation of microbiology and public health.

**Course Outcomes:**

1. Students get knowledge about history of microbiology.
2. Students learn about different types of micro-organisms and factors affecting their growth.
3. Students become aware about techniques used for cultivation of micro-organisms.
4. Students acquire knowledge about relation of microbiology and public health.

**Unit-I (15 Hrs.)**

**Microbiology:** Introduction, historical developments in food microbiology; prokaryotes and eukaryotes; classification of microorganisms- a brief account; sources of microorganisms in foods; microbial growth, growth curve; factors affecting growth-intrinsic and extrinsic factors controlling growth of microorganisms, microbiological criteria of foods and their significance.

**Unit-II (15 Hrs.)**

Effect of food preservatives, heating process, irradiation, low temperature storage, chemical preservatives, high-pressure processing; water activity and hurdle technology on microbial growth.

**Unit-III (16 Hrs.)**

**Foods Microbiology and Public Health:** Food poisoning, types of food poisonings, important features etc; bacterial agents of food borne illness, food poisoning by *clostridium*, *salmonella*, *E. coli*, *bacillus*, *staphylococcus* etc.; non-bacterial agents of food borne illness: poisonous algae, and fungi - a brief account, the HACCP system and food safety used in controlling microbiological hazards.

**Unit-IV (14 Hrs.)**

Food spoilage and microbes of milk, meats, fish, fruits, vegetables and cereals, spoilage of canned foods; Indicators microorganisms, methods of isolation and detection of microorganisms; conventional methods; rapid methods (newer techniques) – immunological methods; fluorescent, antibody, radio immunoassay, principles of ELISA, PCR (Polymerized chain reactions).

**Recommended Books**

1. J.M. Jay, 'Modern Food Microbiology', CBS Publishers, New Delhi, India.

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2. G.J. Banwart, 'Basic Food Microbiology', CBS Publishers, New Delhi, India.
3. M.R. Adam and M.O. Moss, 'Food Microbiology', CRC Press, U.S.A.
4. B. Ray, 'Fundamental Food Microbiology', CRC Press, New York, U.S.A.
5. R.Y. Stanier, 'General Microbiology', Palgrave Macmillan, Dunfermline, United Kingdom.

**FOOD CHEMISTRY**

**Subject Code: MFOT1-103**

**L T PC**

**Duration: 60Hrs.**

**4 0 0 4**

**Course Objectives:**

1. To learn about the basics of food chemistry.
2. To make students aware about the chemistry of different food components.
3. To enhance knowledge of students regarding effects of processing on different components of food.
4. To give students an overview of scope and importance of food chemistry.

**Course Outcomes:**

1. Students gain knowledge about basics of food chemistry.
2. Students become familiar to chemistry of food components.
3. Students understand the effect of processing on food components.
4. Students learn about the terminology, scope and importance of food chemistry.

**Unit-I (16 Hrs.)**

**Food Chemistry:** Definition, scope and importance.

**Carbohydrates:** classification, physical and chemical properties of sugars, functional properties, and uses of pectic substances, gums and dietary fiber in food; browning reaction in food: enzymatic and non-enzymatic browning, their occurrence and applications in food; starches: functionality of starch in foods, gelatinization and retro-gradation of starches, modified starches, resistant starches.

**Vitamins:** Water and fat-soluble vitamins, use of vitamins in foods and their properties. Effect of processing on vitamins.

**Minerals of Foods:** Calcium, phosphorus, iron, copper, lead, zinc and arsenic.

**Unit-II (14 Hrs.)**

**Proteins:** structures of protein and amino acids; physical, chemical and functional properties of proteins, functional properties of food proteins, modification of food protein in processing and storage and its implications, texturized, denaturation of protein, gel formation. Enzymes- sources, properties, role of enzymes in dairy, starch and sugar, juice/beverage, and meat industry.

**Unit-III (14 Hrs.)**

**Lipids Classification, Properties-** lipolysis, auto-oxidation, rancidity and flavor reversion, thermal decomposition and effect of ionizing radiations; modification of fats and oils (hydrogenation and inter-esterification); role of food lipids in flavor; nutritional aspects of natural and modified fats; fatmimetics.

**Unit-IV (16 Hrs.)**

**Plant Pigments:** Chlorophyll, anthocyanins and carotenoids, occurrence, structure, chemistry, functions and changes during processing.

**Essential Oils:** Occurrence, structure, biosynthesis, extraction of essential oils, uses in foods. Flavoring compounds in foods.

Allergens, toxic constituents and anti-nutritional factors of foods (enzyme inhibitors, trypsin and chymotrypsin inhibitor, amylase inhibitor, flatulence causing sugars, phytolectins).

**Recommended Books**

1. L.H. Meyer, 'Food Chemistry', Van Nostrand, Reinhold Comp Publications , , USA. New York,
2. C. Alias and G. Linden, 'Food Biochemistry', Ellis Horwood, New York,U.S.A.
3. Y. Pomeranz and R. Meloon, 'Food Analysis: Theory and Practice', Westport, An AVI Publication, New York, Sydney,Toronto.
4. R.O. Fennema, 'Food Chemistry', Marcel Dekker, New York,U.S.A.
5. L.H. Meyer, 'Food Chemistry', Van Nostrand, Reinhold Company Publication, NewYork, U.S.A.

**FOOD ANALYSIS AND INSTRUMENTATION LAB - I**

**Subject Code: MFOT1-104**

**L TPC  
0 0 4 2**

**Duration: 30Hrs.**

**Course Objective:**

1. To develop an understanding of analytical and instrumental techniques used in food analysis.
2. To illustrate the principle and mechanism of analytical instruments.
3. To familiarise students about physical and chemical analysis of processed food.
4. To teach students about different preservation techniques.

**Course outcome:**

1. Students become aware about analytical and instrumental techniques.
2. Students learn about the principle and mechanism of analytical instruments.
3. Students become familiar with physical and chemical evaluation of processed foods.
4. Students understand different food preservation techniques.

**PRACTICAL**

1. Analysis of given food sample for its moisture, fat, protein and ash contents.
2. Determination of vitamin C content in a given sample of citrus juice.
3. Estimation of calcium and phosphorus content in a given sample of food.
4. Calculation of iodine value and saponification value of given sample of fat or oil.
5. Estimation of tannins in a given sample of tea.
6. To study the process of Thin Layer Chromatography (TLC) to separate out various components in a given sample.
7. To estimate the amount of reducing sugars in a given food sample.
8. Calculation of smoke point, flash point and fire point of a given sample of vegetable oil.
9. Estimation of caffeine content in a given sample of coffee.
10. Determination of crude fiber content in given sample of vegetable/fruit.
11. Determination of non-reducing sugars, total sugars and starch in fruit sample.
12. Determination of total ash, acid insoluble and soluble ash in a given flour sample.
13. Estimation of rancidity in rancid oil/fat.
14. Detection of adulterants in oil/fat samples.
15. Estimation of Free Fatty Acids (FFA) in crude and refined oil sample.
16. Sensory analysis of various processed food products like jam, bread, and biscuit.
17. Determination of % age moisture, fat and curd content of Table Butter.

**FOOD MICROBIOLOGY LAB-II**

**Subject Code: MFOT1-106**

**L T P C**  
**0 0 4 2**

**Duration: 30Hrs.**

**Course Objectives:**

1. To make students familiar about different equipment's used for sterilization and disinfection.
2. To provide practical exposure about microbiological examination of different food products.
3. To provide knowledge about manufacturing of food products using desirable micro-organisms.
4. To teach students about isolation techniques of fungi.

**Course Outcomes:**

1. Students become aware about the techniques of sterilization and disinfection.
2. Students learn to examining micro-flora of different food products.
3. Students come out with a strong practical handling in manufacturing of different products using micro-organisms.
4. Students become familiar with different techniques to isolate micro-organisms.

**PRACTICALS**

1. Study of the different parts and use of laboratory microscope.
2. Preparation and sterilization of culture media, glassware.
3. Estimation of bacterial population in a given sample of food by Direct Microscopic Count (DMC) method.
4. Estimation of bacterial load of food sample by SPC (Standard Plate Count) method.
5. Inoculation of pure culture of bacteria by pour plate and streak plate methods.
6. To study simple staining of bacteria.
7. To conduct Gram's staining of bacteria and differentiate between Gram +ve and Gram -ve bacteria.
8. Microbial analysis of cereals and cereal products such as wheat flour and biscuits.
9. Microbial analysis of spices (red chilies and coriander).
10. Detection of presence of *E. coli* and other *Coliform* bacteria in water by MPN and high coliform test.
11. Studies on the bacterial growth curve.
12. Estimation of total microbial count of:
  - i) Surrounding air
  - ii) Workers
  - iii) Fruit and vegetable products
13. Isolation of bacteria by serial dilution technique.
14. To study various sub-culturing techniques.
15. To study about spawn preparation of mushroom.

**NUTRACEUTICAL AND FUNCTIONAL FOODS**

**Subject Code: MFOT1-158**

**L T P C  
4 0 0 4**

**Duration: 60Hrs.**

**Course Objectives:**

1. To make students aware about nutraceutical and functional foods.
2. To teach them the effects of nutraceuticals on different diseases.
3. To make them familiar with the chemistry of nutraceuticals.
4. To enlighten their knowledge about future prospects of nutraceutical foods.

**Course Outcomes:**

1. Students become aware about nutraceutical and functional foods.
2. Students learn about the health benefits of nutraceutical foods
3. Students become familiar with chemistry of nutraceuticals.
4. Students know about various functional components of foods

**Unit-I (15 Hrs.)**

Defining nutraceuticals and functional foods. Nature, type and scope of nutraceutical and functional foods.

Nutraceutical and functional food applications and their health benefits. Nutraceutical compounds and their classification based on chemical and biochemical nature with suitable and relevant descriptions.

**Unit-II (15 Hrs.)**

Nutraceuticals for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension.

Antioxidants and other phytochemicals, (isoflavones, lycopenes), their role as nutraceuticals and functional foods.

Dietary fibers and complex carbohydrates as functional food ingredients.

**Unit-III (15 Hrs.)**

Protein as a functional food ingredient.

Probiotic foods and their functional role.

Cereal products as functional foods – Oats, wheat bran, rice bran etc.

**Unit-IV (15 Hrs.)**

Functional vegetable products, oil seeds and sea foods.

Coffee, tea and other beverages as functional foods/drinks and their protective effects. Stability of Nutraceutical compounds and estimation of their shelf life.

**Recommended Books**

1. G. Mazza, 'Functional Foods: Biochemical and Processing Aspects', Technomic Publication Lancaster, USA.
2. R.S. Kirk and R. Sawyer, 'Pearson's Composition and Analysis of Foods', Wesley Longman Inc. California, USA.
3. R.E.C. Wildman, 'Handbook of Nutraceuticals and Functional Foods', CRC Press, New York, U.S.A.
4. AOAC, 'Official Methods of Analysis', Association of Official Analytical Chemists, USA.

**NUTRITION AND HEALTH**

**Subject Code: MFOT1-157**

**L T P C**  
**4 0 0 4**

**Duration: 60Hrs**

**Course Objectives:**

1. To aware students about relationship between food, nutrition and health.
2. To teach students about the functions of food.
3. To make them familiar about various food groups and balanced diet.
4. To enhance their knowledge regarding digestion, absorption and function of various nutrients and their sources.

**Course Outcomes:**

1. Students understand the relationship between food, nutrition and health.
2. Students gain knowledge about the functions of food.
3. Students learn about various food groups and balanced diet.
4. Students become familiar with the process of digestion and absorption of various nutrients.

**Unit-I (14 Hrs.)**

**Foods and Nutrients:** Basic definitions, functions of food and nutrients, levels of status, changing concepts of nutrition.

**Energy:** Energy content of foods, physiological fuel value - review, measurement expenditure. estimating energy requirements of individuals and groups. regulation metabolism, control of food intake and weight.

**Energy Balance:** Food energy measure, energy control in human metabolism, basal metabolic rate (B.M.R.), factors affecting B.M.R., measuring B.M.R., energy requirements and its estimation.

**Unit-II (16 Hrs.)**

**Nutrition and Weight Management:** Obesity and its causes, body composition, B.M.I., weight for height measures, health implications of obesity, problems of weight management.

**Glycaemia Index of Foods:** Control its importance.

Recommended dietary allowances (R.D.A.), ICMR standards, food guide, exchange lists, health promotion guidelines

**Carbohydrates:** Classification, dietary importance, Special functions of carbohydrates in body tissues, Relationship between dietary fiber and various health problems

**Unit-III (16 Hrs.)**

**Fats:** Functions of EFA, role of  $\omega$ -3,  $\omega$ -6 fatty acids in health and disease. Trans fatty acids and prostaglandins, essential fatty acids, cholesterol, LDL and HDL and their health importance

**Proteins:** Nature and essentiality of amino acids and proteins, functions of protein, the concept of protein balance, comparative quality of food proteins, biological value, net protein utilization, protein efficiency ratio, therapeutic applications of specific amino acids

**Vitamins:** Clinical applications, sources, requirements and functions of vitamin A, D, E, K, C and 'B' complex, vitamins toxicity problems.

**Unit-IV (14 Hrs.)**

**Minerals:** Minerals in human health, macro and micro minerals, trace minerals- functions, clinical applications, food sources and requirements

**Functional Foods:** concept and categories of functional foods and their importance Food security: problem and prospects.

**Recommended Books**

1. P. Insel, R.E. Turner and D. Ross, 'Discovering Nutrition', ADA, Jones and Bartlett Publishers Inc.,USA.
2. S.R. Williams, 'Essentials of Nutrition and Diet Therapy', Mosby Publishing, NewYork,U.S.A.
3. P.V.Hegartyand V. Hegarty, 'Nutrition Food and the Environment', Eagen Press, United States.
4. A.F. Brian and G. Allen, 'Food Science, Nutrition & Health', Edward Arnold, A member of Hodder Headline Group London, Sydney,Auckland.
5. S.R. MudambiandM.V. Rajagopal, 'Fundamentals of Food & Nutrition'. New Age International (P) Limited, Publishers, New Delhi,India.
6. ICMR, 'Nutrient Requirement & RDA' ICMR, NewDelhi.
7. M.J. Gibney, M. Elia, O. Ljungqvist and J. Dowsett, 'Clinical Nutrition', The Nutrition Society Textbook Series, Blackwell PublishingCompany.

MRSPTU

# **SEMESTER SECOND**

**BASIC FOOD ENGINEERING**

**Subject Code: MFOT1-206**

**L T P C**  
**4 0 0 4**

**Duration: 60Hrs.**

**Course Objectives:**

1. To understand the principles of food engineering
2. To acquaint with fundamentals of various processes in food engineering
3. To understand the effects of various thermal and non-thermal processes on food quality.
4. To study the psychrometry and its use in food storage.

**Course Outcomes:**

1. Students understand the principles of food engineering.
2. Students become familiar with fundamental processes of food engineering.
3. Students become aware about the effects of various thermal and non-thermal processes on food quality.
4. Students acquire knowledge about psychrometry.

**Unit-I (15 Hrs.)**

**Fundamental Concepts and Definitions:** Dimensions and units, thermodynamic systems (closed, open and isolated), intensive and extensive properties, equilibrium state, density, specific volume, specific weight, specific heat, enthalpy, entropy, pressure, temperature scales.

**Material Balances:** Basic principles, process flow diagrams, total mass balance, component mass balance, material balance problems involved in dilution, concentration and dehydration.

**Unit-II (15 Hrs.)**

**Energy Balances:** Basic principles, energy terms, specific heat of solids and liquids, properties of saturated and superheated steam, heat balances.

**Fluid Flow Principles:** Fluid statics and dynamics, mass balance and energy balance, Bernoulli's equation, concept of viscosity, Newtonian and non-Newtonian fluids, streamline and turbulent flow, Reynold's number.

**Unit-III (15 Hrs.)**

**Heat Transfer:** Modes of heat transfer, conductive, convective and radiative heat transfer, thermal properties of foods, conductive heat transfer in a rectangular slab, tubular pipe and multilayered systems, estimation of convective heat transfer coefficient, forced convection and free convection, estimation of overall heat transfer coefficient

**Heat exchangers:** plate, tubular, scraped surface and steam infusion.

**Unit-IV (15 Hrs.)**

**Thermal Process Calculations:** Commercially sterile concept, concept of D, F and Z values, reference F value, effect of temperature on thermal inactivation of micro-organisms, lethality function, thermal process calculation for canned foods. Calculation of processing time in continuous flow systems.

**Psychrometrics:** Properties of dry air: composition of air, specific heat of dry air, enthalpy of dry air and dry bulb temperature.

**Properties of Water Vapor:** specific volume of water vapor, specific heat of water vapour, Gibbs-Dalton law, Dew point temperature, relative humidity, humidity ratio, wet bulb temperature. Study of Psychrometric chart.

**Recommended Books**

1. R.P. Singh and D.R. Heldman, 'Introduction to Food Engineering', Academic Press, INC, London.
2. R.L. Earle, 'Unit Operations in Food processing', Pergamon Press Oxford,U.K.
3. R.T. Toledo, 'Fundamentals of Food Process Engineering', CBS Publishers, New Delhi, India.

4. J.C. Batty and S.L. Folkman, 'Food Engineering Fundamentals', John Wiley and Sons, New York, U.S.A.

**TECHNOLOGY OF CEREALS & MILLETS**

**Subject Code: MFOT1-207**

**L T P C**

**Duration: 60 Hrs**

**4 0 0 4**

**Course Objectives:**

1. To familiarize students with the structure and composition of cereal grains.
2. To impart knowledge about manufacturing process of different bakery products.
3. To aware students about rice chemistry and milling.
4. To introduce them with processing of corn and barley.

**Course Outcomes:**

1. Students become familiar with cereal chemistry and technology.
2. Students learn about the manufacturing processes of different bakery products.
3. Students become aware about milling of cereal grains.
4. Students gain knowledge about cereal processing and their usage.

**Unit-I (15 Hrs.)**

**Wheat Chemistry and Technology:** Structure and chemical composition of wheat grain. Criteria of wheat quality – physical and chemical factors. Wheat milling – general principles and operation; cleaning, conditioning and roller milling systems. Flour extraction rates and various flour grades. Criteria of flour quality. Enzymes of wheat and their technological significance.

**Dough rheology and its measurement.** Functionality of wheat proteins, carbohydrates, lipids and enzymes in bread making. Durum wheat- chemistry, quality and technology of pasta products.

**Unit-II (15 Hrs.)**

Bread making processes, importance of critical unit operations, functions of ingredients/additives such as fat, emulsifiers, oxidants, reducing agents and conditioners. Bread faults and remedies. Technology of biscuit, cake, cookie and cracker manufacturing. Baking powders as leavening agents in bakery industry.

**Unit-III (16 Hrs.)**

**Rice Chemistry and Technology:** Structure and chemical composition of rice grain, milling of rice—types of rice mill; huller mill, Sheller-cum-cone polisher mill. Modern rice milling unit operation-dehusking, paddy separation, polishing and grading. Factors affecting rice yield during milling. By-products of rice milling. Rice parboiling technology. CFTRI process of parboiling. Properties of parboiled rice, changes during parboiling. Advantages and disadvantages of parboiling. Cooking characteristics of rice. Rice convenience foods: precooked rice, canned rice, expanded rice, rice-based infant food formulae, rice cakes, rice noodles.

**UNIT-IV (14 Hrs.)**

**Corn Technology:** Wet and dry milling of corn, products of wet and dry milling of corn, corn sweeteners and their uses.

**Malt Technology:** Malting of barley: steeping, germination and drying. Different types of malts and their food applications.

**Technology of Coarse Cereal Grains:** chemical, technological and milling aspects of sorghum, oats and millets.

**Recommended Books**

1. A.M. Samuel, 'The Chemistry and Technology of Cereals as Food and Feed', CBS Publisher & Distribution, New Delhi, India.
2. Y. Pomeranz, 'Wheat: Chemistry and Technology', American Association of Cereal Chemists, St. Paul, MN, U.S.A.
3. A.C. Eliasson and K. Larsson, 'Cereals in Bread Making', Marcel Dekker, Inc. New York, U.S.A.
4. R.C. Honeney, 'Principles of Cereal Science and Technology', American Association of Cereal Chemists, St. Paul, U.S.A.
5. Y. Pomeranz, 'Advances in Cereal Science and Technology', American Association of Cereal Chemists, St. Paul, U.S.A.
6. B.O. Juliano, 'Rice Chemistry and Technology', American Association of Cereal Chemists, St. Paul, U.S.A.
7. J.M.V. Blanshard, P.J. Frazier and T. Galliard, 'Chemistry and Physics of Baking', Royal Society of Chemistry, London.
8. A. Chakraverty, 'Postharvest Technology of Cereals, Pulses and Oilseeds', Oxford and IBH, New Delhi, India.
9. S.C. Durbey, 'Basic Baking: Science and Craft', Gujarat Agricultural University, Anand (Gujrat).
10. N.L. Kent, 'Technology of Cereals', Pergamon Press, Oxford, UK.
11. R.H. Matthews, 'Legumes: Chemistry, Technology and Human Nutrition', CRC Press York, U.S.A.
12. D.K. Salunkhe, S.S. Kadam, 'Handbook of World Food Legumes: Chemistry, processing and Utilization', CRC Press, Florida, U.S.A.

MRSPTU

COMPUTER FUNDAMENTALS AND STATISTICS

Subject Code: MFOT1-208

L T PC  
4 0 0 4

Duration: 60Hrs.

**Course Objectives:**

1. To impart knowledge about the basic parts of computer and their working.
2. To teach students the number system.
3. To provide detailed knowledge of hardware and software used in computers.
4. To familiarize them with computer networks and software packages.

**Course Outcomes:**

1. Students got knowledge about the basics parts of computer.
2. Students learn about number system.
3. Students acquire knowledge of hardware and software used in computers.
4. Students become familiar with computer networks and software packages.

**Unit-I (15 Hrs.)**

**Introduction of Computer:** Characteristics, classification of computer; block diagram of computer and overview of working.

**Number System:** Non-positional vs. positional number, binary, octal, decimal, hexa-decimal conversion of number system.

**Unit-II (13 Hrs.)**

**Hardware:** Input, output, and secondary storage devices, central processing unit.

**Software:** Types of software; meaning, functions and types of operating system.

**Unit-III (17 Hrs.)**

**Understanding Computer Networks:** Types; topologies for LANS, transmission media; analog and digital signals; network security.

**Working with Software Packages:** An introduction to PC-software packages; word processor-working with text, tables, checking spelling and grammar, printing a document; spreadsheet software-working with worksheet, formulas and functions, inserting charts; PowerPoint presentation-working with different views and designing presentation; window XP-working with files and folders, windows explorer.

**Lab.:** Windows explorer, MS-Word, MS-Excel, MS-PowerPoint and Internet Surfing.

**Unit-IV (15 Hrs.)**

Methods of data collection, sampling and sampling methods, measurement of central tendency, mean, median, mode, standard deviation, standard error, variance. Correlation & regression analysis, analysis of variance (ANOVA), tests of significance, t-test, z- test and f- test.

**Recommended Books**

1. 'Introduction to Information Technology', Pearson Education, New Delhi,India.
2. P.Norton,'IntroductiontoComputers',TataMcGrawHillEducationPvt.Ltd.,NewDelhi, India.
3. D.E. Comer, 'Computer Networks and Internet', Pearson Education, New Delhi,India.
4. V.Rajaraman,'FundamentalsofComputers',PrenticeHallofIndia, NewDelhi,India.
5. 'Office 2000: No Experience Required', BPB Publications, New Delhi,India.
6. A.K.RayandT.Acharya,'InformationTechnology:PrinciplesandApplications', Prentice Hall of India, New Delhi,India.
7. A.S. Tanenbaum, 'Computer Networks', Eastern Economy Edn., PHI, New Delhi,India.

**TECHNOLOGY OF CEREALS LAB - III**

**Subject Code: MFOT1-209**

**L T PC  
0 0 4 2**

**Duration: 30Hrs.**

**Course Objectives:**

1. To aware students about the techniques used to assess the quality of cereal grains.
2. To teach students about the proximate analysis of cereal grains.
3. To make them familiar about processes of making bakery products.
4. To provide knowledge about instruments used for measuring quality of cereals.

**Course Outcomes:**

1. Students become aware about techniques used for assessing quality of cereal grains.
2. Students become familiar with various laboratory tests conducted in cereals.
3. Students acquire knowledge to quality control in cereal technology.
4. Students acquire knowledge of manufacturing of bakery products.

**PRACTICAL**

1. Experimental milling of rice and assessment of presence of head rice yield, broken, immature kernels and degree of polishing.
2. Experimental parboiling of rice by different methods and evaluation of parboiled rice.
3. Determination of proximate analysis of wheat flour for moisture, ash, protein and fat contents.
4. Determination of wet gluten and dry gluten content of given sample of wheat Flour.
5. Determination of alpha-amylase activity in wheat flour by falling number apparatus.
6. Determination of amylose content of cereal and legume starches by iodine binding method.
7. Isolation of rice starch and its quantification.
8. Determination of different cooking parameters of various rice cultivars.
9. Determination of the alcoholic acidity of a given sample of wheat flour.
10. Study of pasting properties of corn starch by Rapid Visco Analyzer.
11. Study of thermal properties of different Cereal starches by Differential Scanning Calorimeter.
12. To compare different types of wheat flours by Polenshke test.
13. Determination of turbidity and percentage light transmittance of cereal starches
14. Determination of textural properties of cooked rice using Texture Analyzer.
15. Experimental baking of different baked products like biscuits, breads and cakes and their evaluation for different parameters.
16. Visit to milling and bakery industry.

**TECHNOLOGY OF BEVERAGES**

**Subject Code: MFOT1-258**

**L T PC**

**Duration: 60Hrs**

**4 0 0 4**

**Course Objectives:**

1. To introduce students with different beverages.
2. To familiarize students with manufacturing process of various alcoholic beverages.
3. To aware students about the chemistry, production and processing of beverages.
4. To provide knowledge about processing and packaging of bottled water.

**Objective Outcomes:**

1. Students come to know about different types of beverages.
2. Students become familiar with manufacturing process of alcoholic beverages.
3. Students become aware about chemistry, production and processing of beverages.
4. Students got knowledge about processing and packaging of bottled water.

**Unit-I (15 Hrs.)**

**Beverages:** Definition, types, importance of beverages in our diets. Treatment of water for food industry.

**Technology of Alcoholic Beverages:** Wine, cider, brandy, perry, toddy, bear and whisky.

**Unit-II (16 Hrs.)**

Manufacturing of carbonated beverages and technology of carbonation.

**Technology of soft drinks :** ingredients and additives used in production of soft drinks.

Citrus beverages, whey beverages and utilization of whey in development of fortified drinks, use of low calorie sweeteners in beverages.

**Unit-III (14 Hrs.)**

Production, processing and chemistry of tea manufacturing and types of tea.

Production, processing, roasting and brewing of coffee, soluble coffee, decaffeinated coffee, monsoon coffee, coffee brew concentrate and chicory.

**Unit-IV (15 Hrs.)**

Cocoa processing, cocoa beverages and chocolate.

Packaged drinking water- manufacturing processes, quality evaluation of raw and processed water, methods of water treatment, BIS quality standards of bottled water.

**Recommended Books**

- 1 D.K. Tressler and M.A. Joslyn, 'Fruit and Vegetable Juice Processing Technology', The AVI Publication Com., Inc.U.S.A.
- 2 N. Manay Shakuntala and M. Shadaksharaswamy, 'Foods: Facts and Principles', New Age Inter. Publishers, New Delhi,India.
- 3 N.F. Haard and D.K. Salunkhe, 'Postharvest Biology and Handling of Fruits and Vegetables',AVI Publishing Co. Westport,U.S.A
- 4 A.A. Kader, 'Postharvest Technology of Horticultural Crops', University of California Division of Agriculture and National Resources, California,U.S.A

**TECHNOLOGY OF MALTING AND BREWING**

**Subject Code: MFOT1-259**

**L T P C**

**Duration: 60 Hrs.**

**4 0 0 4**

**Course Objectives:**

1. To familiarize students with composition and structure of barley.
2. To introduce students with steps of malting of barley.
3. To introduce students with steps of brewing of barley.
4. To provide knowledge about beer manufacturing and its quality evaluation.

**Course Outcomes:**

1. Students become familiar with composition and structure of barley.
2. Students learn about malting and brewing.
3. Students become aware about quality aspect of malting and brewing.
4. Students acquire knowledge about beer making.

**Unit-I (15 Hrs.)**

**Barley:** Production and trade, composition and structure of barley. preparation and storage of barley for malting, suitability of different cereals for malting, characteristics of barley for malting and brewing, problem of dormancy and water sensibility. Steeping techniques, germination of barley, morphological, enzymatic and chemical changes during malting, role of gibberellic acid in malting, techniques of malting composition of malt, malting of wheat and other cereals. Kilning, changes during kilning, Kilning techniques.

**Unit-II (16 Hrs.)**

Quality evaluation of malt, special malts, milling techniques. Significance of water quality in brewing process. Mashing: Changes during mashing, methods of mashing, treatment of cereals used as adjuncts, properties and complications of using adjuncts of different sources. Filtration of wort and sparging. Spent grain: Composition and uses.

**Unit-III (15 Hrs.)**

Techniques of wort boiling, changes during boiling, hops, selection of hops, acidification of mash, wort cooling, methods of fermentation, management of primary fermentation. Lagering: objectives and techniques. Beer: Composition, filtration, racking, pasteurization and defects.

**Unit-IV (14 Hrs.)**

**Application of Malt in Food:** baking, infant food etc. Quality control–malt specifications and test procedures. Brewing operations, constituents of hops. brewing adjuncts

**Beer Quality**–flavor, taste, alcohol content, chemical constituent etc. Head retention–factors affecting head retention. Haze formation.

**Recommended Books**

1. M.J. Lewis and T.W. Young ‘Malting and Brewing Science Vol. I’, Springer Science & Business Media, Germany.
2. M.J. Lewis and T.W. Young ‘Malting and Brewing Science Vol. II’, Springer Science & Business Media, Germany.

**FOOD BIOTECHNOLOGY**

**Subject Code: MFOT1-260**

**L T PC**

**Duration: 60 Hrs.**

**4 0 0 4**

**Course Objectives:**

1. To introduce students with basics of biotechnology.
2. To provide them knowledge about the use of biotechnology in food preservation.
3. To aware them about protein engineering and its role in food.
4. To give them detailed information about transgenic plants and animals.

**Course Outcomes:**

1. Students learn about the basics of biotechnology.
2. Students become familiar role of biotechnology in food.
3. Students become aware about protein engineering and its role in food.
4. Students acquire knowledge about transgenic plants and animals and their role in food production.

**Unit-I (15 Hrs.)**

**Introduction to Food Biotechnology:** basic principles of genetic engineering, improvement of the processing of various crops by genetic engineering, food safety.

**Unit-II (15 Hrs.)**

**Natural Antimicrobials for Food Preservation:** Phytoalexins, essential oils and their components, bacteriocins of Lactic acid bacteria, nisin, pediocinsetc, applications of bacetriocins in food systems. Aflatoxins - production, control and reduction using molecular strategy.

**Unit-III (15 Hrs.)**

**Protein Engineering in Food Technology:** Methods, applications of protein engineering (e.g. glucose isomerase, Lactobacillus beta-galactosidase and peptide antibiotic nisin).  
**Biotechnology and Food ingredients:** biogums, fat substitutes, biocolors, organic acids and sweeteners.

**Unit-IV (15 Hrs.)**

Food Biotechnology and Intellectual property rights (IPR), benefits of securing IPRs; bioethics in food biotechnology.

**Transgenic Plants and Animals:** Their contribution to food production enhancement.

**Recommended Books**

1. B.H. Lee, 'Fundamentals of Food Biotechnology', VCH Publishers, New York,U.S.A.
2. M.P. Tombs, 'Biotechnology in Food Industry', Wiley-Blackwell, U.K.
3. D. Knorr, 'Food Biotechnology', Marcel Dekker, INC, New York,U.S.A.
4. A. Schwartzberg and A Rao 'Biotechnology & Food Process Engineering' Marcel Dekker, INC, New York.
5. I. Goldberg and R. Williams, 'Biotechnology and Food Ingredients', Springer Science &Business Media,Germany.
6. R.D. King and P.S.J. Cheetham, 'Food Biotechnology', Elsevier Applied Science,London.

**FOOD ADDITIVES**

**Subject Code: MFOT1-261**

**L T PC**

**Duration: 60Hrs.**

**4 0 0 4**

**Course Objectives:**

1. To introduce students with various food additives.
2. To familiarize students with mode of action of various additives.
3. To teach students about importance of additives in food preservation.
4. To aware students about processing of different spices.

**Course Outcomes:**

1. Students acquire knowledge about food additives.
2. Students become familiar with mode of action of different additives.
3. Students learn about the importance of food additives in food preservatives.
4. Students become aware about processing of spices.

**Unit-I (14 Hrs.)**

**Introduction to Food Additives:** General classification, types, uses, functions, legal aspects, risks and benefits.

**Preservatives:** Antimicrobial agents (types, mode of action and their application), antioxidants (types and mechanism of oxidation inhibition), anti-browning agents (types, functions and mode of action).

**Chelating Agents and Sequestrants:** Types, uses and mode of action.

**Unit-II (15 Hrs.)**

**Acidulants and pH Control Agents:** Types, uses and mode of action.

**Coloring Agents:** Synthetic food colorants, color chemistry, applications and levels of use, natural colorants, sources of natural color (plant, microbial, animal and insects), misbranded colors, color extraction techniques, color stabilization

**Flavoring Agents:** Flavors (natural and synthetic flavors), off flavor in foods, flavor enhancers, flavor stabilization, flavoren capsulation.

**Unit-III (16 Hrs.)**

**Sweeteners:** Natural and artificial sweeteners, nutritive and non-nutritive sweeteners, properties and uses of saccharin, acesulfame-K, aspartame, corn sweeteners, invert sugar sucrose and sugar alcohols (polyols) as sweeteners in food products

**Emulsifiers:** Types, selection of emulsifiers, emulsion stability, functions and mechanism of action.

**Stabilizers:** Types, uses and functions.

**Unit-IV (15 Hrs.)**

**Food Spices and Condiments:** Types and uses spices and condiments, composition extraction, general processing, uses and special attributes of important Indian spices like pepper, cinnamon, clove, ginger, turmeric, cardamom, fenugreek and fennel etc., seasonings and condiments blends

**Advances in Food Additives:** Classification, functions, safety aspects, recent advances with relevance to color, flavor enhancement, sweeteners and preservatives.

**Recommended Books**

1. A.L. Branen, 'Food Additives', Marcel Dekker Inc., New York, U.S.A.
2. J.W. Purseglove 'Spices' Longman Publishers, London, England.
3. D.R. Tainter and A.T. Grenis, 'Spices and Seasonings- A Food Technology Handbook', VCH Publishers, Inc., Hoboken, U.S.A.
4. J. Merory, 'Food Flavorings, Composition, Manufacture and Use', AVI Publishing Inc., Westport, U.S.A.
5. K.T. Farrell 'Spices, Condiments and Seasonings', Springer, U.S.A.

# **SEMESTER THIRD**

**TECHNOLOGY OF FRUITS AND VEGETABLES**

**Subject Code: MFOT1-315**

**L T PC**

**Duration: 60 Hrs.**

**4 0 0 4**

**Course Objectives:**

1. To familiarize students with types of fruits and vegetables along with their nutritive value.
2. To teach them about maturity and changes during ripening of fruits and vegetables.
3. To aware students about different storage methods used for fruits and vegetables.
4. To provide them a detailed knowledge about value addition.

**Course Outcomes:**

1. Students become familiar with classification of fruits and vegetables.
2. Students gain knowledge about maturity and changes during ripening.
3. Students learn about the storage methods of fruits and vegetables.
4. Students get knowledge about value addition of fruits and vegetables.

**Unit-I (15 Hrs.)**

Classification and nutritional value of fruits and vegetables. Pre-harvest factors influencing post-harvest physiology, post-harvest handling, physical and chemical techniques to increase the post-harvest life of fresh fruits and vegetables.

Physical and chemical indices of fruit maturity, ripening, bio-chemical changes during ripening, processing and storage.

**Unit-II (15 Hrs.)**

Different storage methods for fruits and vegetables like modified atmospheric storage, cold storage, controlled atmospheric storage etc., Pre-processing operations; Washing, blanching, peeling, sorting/grading, peeling, blanching, coring, destoning. Minimal processing of fruits and vegetables, quality factors for processing, fruit product order (FPO).

**Unit-III (15 Hrs.)**

Technology of jam, jellies, marmalades, specifications, role of pectin and theories of gel formation.

Technology for juice pressing, juice extraction and clarification, methods of bottling, enzymatic clarification and debittering of juices, fruit juice powders- preparation and packaging.

Fruit juice beverages, squash, cordial, crush, RTS, nectar, syrups, their types and production, blending of juices.

Technology of tomato products: Sauce, puree, ketchup and tomato paste

Fruit preserves, candied fruits, dehydrated fruits & vegetables and fruit leather

**Unit-IV (15 Hrs.)**

Canning of fruits and vegetables, preparation of syrups and brines, spoilage of canned fruits and vegetables. Fermented vegetable products, By products from fruit and vegetable wastes.

**Mushroom Technology:** Types of edible mushrooms, processing of mushrooms.

**Recommended books:**

1. R.P. Srivastava and S. Kumar, 'Fruit and Vegetable Preservation and Practice', Bio-Green Books, New Delhi, India.
2. A.K. Thompson, 'Fruit and Vegetables - Harvesting, Handling and Storage', Blackwell Publishing, UK.
3. B. Pantastico, 'Post Harvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables', AVI Publishing Company, Inc., Westport, U.S.A.
4. W.V. Cruess, 'Commercial Fruit and Vegetable Products', Allied Scientific Publishers, Bikaner, India.

5. Girdharilal, 'Preservation of Fruits and Vegetables', ICAR, NewDelhi.
6. M.E. Dauthy, 'Fruit and Vegetable Processing', International Book Distributing Co. Lucknow,India.
7. L.P. Hamson, 'Commercial Processing of Vegetables', Noyes Data Corporation, New Jersey.

**UNIT OPERATIONS IN FOOD ENGINEERING**

**Subject Code: MFOT1-311**

**L T PC**

**Duration: 60 Hrs.**

**4 0 0 4**

**Course Objectives:**

1. To introduce students with material handling in food industries.
2. To provide them a detailed knowledge of different unit operations carried out in food industries.
3. To familiarize them with different equipment's used in food industry.
4. To aware them about the effects of unit operations on nutrient quality of food.

**Course Outcomes:**

1. Students learn about material handling in food industries.
2. Students acquire knowledge about different unit operations.
3. Students become aware about different equipment's used in food industry.
4. Students become familiar with effects of unit operations on nutrient quality of food.

**Unit-I (15 Hrs.)**

**Preliminary Unit Operations:** Material handling: Conveyors and elevators, types of conveyors and elevators.

**Cleaning:** Dry-cleaning; screening, aspiration and magnetic cleaning, wet cleaning; soaking, spray washing, ultrasonic washing, sorting and grading: methods, advantages of sorting and grading.

**Unit-II (15 Hrs.)**

**Conversion Unit Operations:** Size reduction: Benefits, criteria for size reduction, size reduction of solid, fibrous and liquid foods.

**Mixing:** Mixing terminology, mixers for dry solids (tumbler and vertical screw mixers). mixers for high viscosity pastes (dough mixer), mixers for low viscosity pastes, effect of mixing on foods.

**Filtration:** Filtration terminology (feed slurry, filtrate, filter medium, filter cake), filtration equipments.

**Unit-III (15 Hrs.)**

**Processing/Preservation Unit Operations:** High temperature operations: Pasteurization, pasteurizer and its functioning.

**Evaporation:** Single effect evaporator, multiple effect evaporators and plate evaporators, batch type pan evaporators, natural circulation, forced circulation, rising film, falling film and agitated thin film evaporators.

**Dehydration:** Terminology, dehydration systems; tray drier, tunnel drier, spray drier, fluidized bed drying, vacuum drying and drum driers.

**Unit-IV (15 Hrs.)**

**Low Temperature Operations:** Refrigeration, components of refrigeration system, compressors, condensers and expansion valve, selection of refrigerant, cooling load, coefficient of performance, refrigerant flow rate.

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**Freezing Systems:** Direct contact and indirect systems, freezing load calculations.

**Freeze Drying:** Conventional drying versus freeze drying, Basic principle, freeze dryer and its components

**Recommended Books**

1. R.P. Singh and D.R. Heldman, 'Introduction to Food Engineering', Academic Press, INC, London.
2. R.L. Earle, 'Unit Operations in Food processing', Pergamon Press, Oxford,U.K.
3. J.G. Brennan, J. R. Butters, N. D. Cowell and A. E. V. Lilley, 'Food Engineering Operations', Elsevier, New York, U. S.A.
4. J.C. Harper, 'Elements of Food Engineering', AVI, Westport, U.S.A.

**FOOD PACKAGING**

**Subject Code: MFOT1-312**

**L T PC  
3 0 0 3**

**Duration: 45Hrs.**

**Course Objective:**

1. To demonstrate the functions and types of packaging materials used in food packaging.
2. To understand and compare different types and characteristics of paper and plastic packaging materials.
3. To demonstrate the application of metals in food packaging.
4. To use and understand about different types of packaging.

**Course Outcomes:**

1. Students understand the different types of packaging materials.
2. Students will be able to compare and know about the application of paper and plastics in food packaging.
3. Students will come to know about the use of metals in food packaging.
4. Students acquire the knowledge of different types of packaging techniques.

**Unit-I (10 Hrs.)**

Introduction to food packaging, primary food packaging and secondary packaging, factors involved in the evolution and selection of a food package, functions of food packaging. Packaging requirements of selected foods-cereals and snack food, beverages, milk and dairy products, poultry & eggs, red meat, frozen food, horticultural products.

**Safety Considerations in Food Packaging:** Food safety problems associated with package, package labeling and food safety, recycling of packaging materials.

**Unit-II (12 Hrs.)**

**Paper and Paper Based Packaging Materials:** Types of paper (Kraft, bleached, greaseproof) paper products (paper bags, cartoons, drums and molded paper containers), functional properties of paper, testing of paper packaging materials.

**Plastic Packaging Materials:** Classification of polymers, functional and mechanical.

Properties of thermoplastic polymers, processing and converting of thermoplastic polymers (extrusion, blow molding, injection molding, compression molding, lamination and heat sealing).

**Unit-III (12 Hrs.)**

**Metal Packaging Materials:** Functional properties of metal containers, tin plate containers - quality control tests, can manufacturing and protective coatings.

Glass packaging materials: Composition and manufacturing of glass containers, glass container nomenclature, mechanical and optical properties of glass containers, testing of glass containers.

**Aseptic Packaging of Foods:** Sterilization of packaging material, food contact surfaces & aseptic packaging systems, retort pouches.

**Unit-IV (11 Hrs.)**

**Active Food Packaging:** Definition, physical and chemical principles involved.

**Edible Films and Coatings as Active Layer:** Concept, different edible films used, use of edible active layers to control water vapor transfer and gas exchange

**Oxygen Absorbents:** Classification and main type of oxygen absorbents, factors influencing the choice of oxygen absorbents, application of oxygen absorbents for shelf -life extension of foods, disadvantages of oxygen absorbents.

**Ethanol Vapor:** Ethanol vapor generator, uses of ethanol for shelf - life extension of foods, disadvantages of ethanol/vapor generators.

**Recommended Books**

1. G.L. Robertson, 'Food Packaging: Principles and Practice', Taylor & Francis.
2. S. Sacharow and R.C. Griffin, 'Principles of Foods Packaging', Avi Publication Co. Westport, U.S.A.
3. A.S. Athalye, 'Plastics in Packaging', Tata McGraw Hill Publishing Co., New Delhi, India.
4. M.L. Rooney, 'Active Food Packaging', Blackie Academic & Professional, Glasgow, UK.
5. M. Bakker, 'The Wiley Encyclopedia of Packaging Technology', John Willey & Sons. Inc.; New York, U.S.A.
6. 'Food Packaging Technology Handbook', NIIR Board, National Institute of Industrial Research, New Delhi, India.
7. R. Ahvenainen, 'Novel Food Packaging Techniques', CRC Press, U.S.A.
8. J. Han and J. Han, 'Innovations in Food Packaging', Elsevier Academic Press, U.S.A.
9. R. Coles, D. McDowell and M.J. Kirwan, 'Food Packaging Technology', CRC Press, U.S.A.

**TECHNOLOGY OF FRUITS AND VEGETABLES LAB - IV**

**Subject Code: MFOT1-313**

**L TPC  
0 0 4 2**

**Duration: 30Hrs.**

**Course Objectives:**

1. To familiarize students with different tests used to evaluate fruit juice quality.
2. To provide practical knowledge of manufacturing of fruit and vegetable products.
3. To aware them about sensory evaluation of the different products.
4. To guide them about the microbiological testing of processed products.

**Course Outcomes:**

1. Students become familiar with different tests to evaluate juice quality.
2. Students learn to manufacture different fruit and vegetable products.
3. Students acquire knowledge about sensory evaluation of different products.
4. Students gain knowledge about microbiological testing of processed products.

**PRACTICALS**

1. Extraction of Juices of different fruit (citrus, pomegranate, apple)
  - a. Evaluation of vitamin C content and
  - b. Determination of pH
  - c. Evaluation of browning time
  - d. Determination of Acidity
  - e. Cost evaluation of Juice
  - f. Sensory evaluation of the products
  - g. Shelf –life study
2. Preparation of jams (using different fruits)and
  - a. Determination of pectin content
  - b. Evaluation of Total Soluble Solids(TSS)
  - c. Evaluation of sugars using lane eynon method
  - d. Determination of pH
  - e. Evaluation of acidity
  - f. Sensory evaluation of the products
  - g. Cost evaluation product prepared sensory evaluation & organoleptic test
3. Preparation of jelly and
  - a. Estimation of Pectin content
  - b. Determination of total soluble solids(TSS)
  - c. Jelmeter test
  - d. Checking for pH
  - e. Checking of acidity
  - f. Cost evaluation of product
  - g. Microbiological analysis
  - h. Sensory evaluation of the products
4. Preparation of marmalade (using different fruits)
  - a. Jam Marmalade
  - b. Jelly Marmalade

5. Preparation of preserves and candies
  - a. Evaluation of TSS
  - b. Determination of Endpoint
  - c. Microbiological Analysis
  - d. Evaluation of product cost
  - e. Sensory evaluation of the products
6. Preparation of potato chips and
  - a. Calculation of product dimension
  - b. Determination of time-temp combination for product
  - c. Study of the effect of anti-browning agents
7. Preparation of tomato products (Sauce, Ketchup, Soup, puree)for
  - a. Evaluation of TSS
  - b. Evaluation of pH
  - c. Evaluation of acidity
  - d. Cost evaluation
  - e. Microbiological analysis
8. Pickling & fermented products
9. Preparation and shelf-life study of ready-to-serve beverages
10. Experimental studies on drying and dehydration of fruits and vegetables

**FOOD PACKAGING LAB - V**

**Subject Code: MFOT1-314**

**L TPC  
0 0 4 2**

**Duration: 30Hrs.**

**Course Objectives:**

1. To teach students about identification of different types of packaging materials.
2. To familiarize the students with testing methods of packaging materials.
3. To make them aware about different techniques of packaging.
4. To provide the knowledge of manufacturing and coating of cans.

**Course Outcomes:**

1. Students learn about identification of different types of packaging materials.
2. Students become familiar with testing methods of packaging materials.
3. Students become aware about different types of packaging and their effect on shelf life of foods.
4. Students get knowledge about manufacturing and coating of cans.

**PRACTICAL**

1. Designing of an ideal packaging material for different type of food products.
2. Identification of different packaging materials.
3. Testing of paper based packaging materials.
4. Equilibrium Relative Humidity (ERH) study of foods.
5. To study uniformity and amount of wax in wax paper for packaging of hygroscopic foods.
6. To study chemical resistance of plastic and paper packaging materials.
7. To study Water Vapor Transmission Rates (WVTR) of paper and plastic polymers.
8. Shelf life studies of packaged foods.
9. Study of grease resistance of paper, plastic laminates and aluminum foil for the packaging of fatty foods.
10. To perform various functional tests on corrugated fiberboard boxes.

11. Determination of Cobb value of different types of paperboard.
12. Shrink packaging of poultry products.
13. Aseptic packaging of different food products.
14. Vacuum packaging of dry powders.
15. Testing of glass containers for thermal shock resistance.
16. Determination of tensile strength and heat seal strength of different plastics.
17. To conduct drop and vibration tests on different types of corrugated fiberboard boxes.
18. Determination of tin coating weight and porosity of tin plate container.
19. Determination of lacquer coating in tin containers.
20. Study of manufacture of 2-piece and 3-piece metal cans.
21. Visit to paper manufacturing industry.

**FOOD STANDARDS AND QUALITY ASSURANCE**

**Subject Code: MFOT1-364**

**L T PC  
3 0 0 3**

**Duration: 60Hrs.**

**Course Objectives:**

1. To introduce students with concepts of food quality, safety and management.
2. To aware students about food adulteration and its evaluation.
3. To familiarise students with different laboratory practices.
4. To provide knowledge about the role of National and International agencies in food safety.

**Course Outcomes:**

1. Students acquire knowledge about basic concepts of food quality and safety.
2. Students become aware about food adulteration and its evaluation.
3. Students become familiar with different laboratory practices.
4. Students become acquainted with the role of National and International agencies in food safety.

**Unit-I (15 Hrs.)**

Introduction to concepts of food quality, quality control, quality control cycle, responsibilities of quality control department, food safety, Current challenges to food safety  
Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents.

**Unit-II (15 Hrs.)**

Principles of food quality assurance, total quality management (TQM), good manufacturing /management practices, good hygienic practices, good lab practices, general awareness and role of management practices in quality control, food safety management, applications of HACCP in food safety, concept of food traceability for food safety

**Unit-III (15 Hrs.)**

**Microbial Quality Control:** Determination of microorganisms in foods by cultural, microscopic, physical, chemical methods. Statistical quality control in food industry, Sampling techniques

**Unit-IV (15 Hrs.)**

Role of national and international regulatory agencies, Bureau of Indian Standards (BIS), AGMARK, Food Safety and Standards Authority of India (FSSAI), Codex alimentarius commission, USFDA, International organization for standards (ISO) and its standards for food quality and safety (ISO 9000 series, ISO 22000, ISO 15161, ISO 14000).

**Recommended Books**

1. R. Early, 'Guide to Quality Management Systems for the Food Industry', Blackie, Academic and Professional, London.
2. W.A. Gould and R.W. Gould, 'Total Quality Assurance for the Food Industries', CTI Publications Inc. Baltimore.
3. Y. Pomeraz and C.E. MeLoari, 'Food Analysis: Theory and Practice', CBS Publishers and Distributor, New Delhi, India.
4. F.L. Bryan, 'Hazard Analysis Critical Control Point Evaluations- A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage', World Health Organization, Geneva.
5. R. Kirk and R. Sawyer, 'Pearson's Composition and Analysis of Food', Longman Scientific and Technical, England.
6. 'Manuals of Food Quality Control, Additives Contaminants Techniques', Food and Agricultural Organization, Rome.
7. T.E. Furia, 'Regulatory Status of Direct Food Additives', CRC Press, Florida, U.S.A.

**TECHNOLOGY OF PULSES AND OIL SEEDS**

**Subject Code: MFOT1-363**

**L T PC  
3 0 0 3**

**Duration: 60 Hrs.**

**Course Objective:**

1. To explain the importance of fats and oils in human nutrition.
2. To study the different physical, chemical and functional properties of oils and fats.
3. To familiarize the students with different extraction techniques of oil from oilseeds by various methods.
4. To provide knowledge about the processing and quality evaluation of pulses and oilseeds.

**Course outcomes:**

1. Students gain knowledge about importance fats and oils.
2. Students acquire the knowledge about physical, chemical and functional properties of oils and fats.
3. Students gain knowledge about extraction techniques of oil from oil seeds.
4. Students become familiar with processing techniques of pulses and oilseeds and estimation of their quality parameters.

**Unit-I (15 Hrs.)**

Importance of fats and oils in human nutrition, Chemical, physical and functional properties of fats and oils.

Importance of oilseeds processing in India.

**Unit-II (15 Hrs.)**

Commercial oil resources, basic processing of fats and oils - oil extraction, expeller pressing and solvent extraction, degumming, refining, bleaching, hydrogenation, fractional crystallization, inter-esterification, glycerolizes, molecular distillation, plasticizing and tempering. Preparation of protein concentrates and isolates and their use in high protein foods, fermented and traditional products.

**Unit-III (15 Hrs.)**

Fat substitutes and mimetics.

Common pulses produced in the country. Soybean: processing and utilization.

Milling methods for pulses, home scale commercial and recent methods with equipment's.

**Unit-IV (15 Hrs.)**

Anti-nutrients in pulses and modes of elimination.

Main processing methods: Cooking, germination, sprouting, fermentation, roasting, puffing, frying and extrusion cooking etc.

Products from legumes and uses: Starch, flour, protein concentrates and isolates.

**Recommended Books**

1. R.J. Hamilton and A. Bharti, 'Fats and Oils: Chemistry and Technology', Applied Science, London.
2. D.K. Salunkhe, J.K, Chavan, R.N. Adsule and S.S. Kadam, 'World Oilseeds: Chemistry, Technology and Utilization', VNR, New York,U.S.A.
3. I.A. Wolf, 'Handbook of Processing and Utilization in Agriculture', CRC Press, Florida, U.S.A.

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# SEMESTER FOUR

**TECHNOLOGY OF EGG, MEAT, FISH AND POULTRY**

Subject Code: MFOT1-415

L T PC  
4 0 0 4

Duration: 60 Hrs.

**Course Objectives:**

1. To aware students about the scope of meat industry in India.
2. To teach them about the composition and nutritive value of meat.
3. To enlighten their knowledge regarding post mortem changes in meat and its effect on meat quality.
4. To make them familiar with various egg, meat and fish products.

**Course Outcomes:**

1. Students come to know about the scope of meat industry in India.
2. Students get knowledge about composition and nutritive value of meat.
3. Students acquire detailed knowledge about the post mortem changes and its effect on meat quality.
4. Students become familiar with various egg, meat and fish products.

**Unit-I (15 Hrs.)**

Status and scope of meat industry in India. Structure and physico-chemical properties of muscle. Meat: Composition and nutritive value, conversion of muscle into meat, environmental and animal production factors that affect meat quality, post mortem changes in meat, rigor mortis, cold shortening, pre-rigor processing.

**Unit-II (15 Hrs.)**

Aging of meat, meat tenderization- natural and artificial methods. Properties of fresh meat-water holding capacity, color, palatability.

Cooking methods for meat.

Storage and preservation of meat: Chilling, freezing, curing, smoking, dehydration, canning. Spoilage of meat.

**Unit-III (15 Hrs.)**

Restructured meat products, meat analogues.

Meat industry by products: Importance and applications.

**Fish:** Factors affecting quality of fresh fish, fish dressing, chilling, freezing, salting and canning of fish.

Manufacturing of fish oil, fish protein concentrate, fish meal. By-products of fish industry, their technology of utilization.

**Unit-IV (15 Hrs.)**

**Egg:** Structure, composition, nutritive and functional properties.

**Quality of Egg:** Internal quality evaluation, egg candling, egg grading, microbial spoilage of eggs, preservation and storage methods for eggs.

Egg powder.

Packaging and transportation of eggs.

**Poultry:** Types, chemical and nutritive value of poultry meat, poultry dressing and slaughtering methods, preservation, grading and packaging of poultry meat.

**Recommended Books**

1. W.J. Stadelman and J. Owen, 'Egg Science & Technology', AVI Publishing Company, INC. Westport, U.S.A.
2. R.A. Lawrie and D. Ledward, 'Lawrie's Meat Science', Woodhead Publishers, UK.

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3. G. Mead, 'Poultry Meat Processing and Quality', Woodhead Publishers, UK.
4. P.C. Panda, 'Text Book on Egg and Poultry Technology', Vikas Publishers, Chennai, India.

**TECHNOLOGY OF MILK AND MILK PRODUCTS**

**Subject Code: MFOT1-416**

**L T PC  
4 0 0 4**

**Duration: 60Hrs.**

**Course Objectives:**

1. To aware students about scope of dairy industry in India.
2. To give them an overview about composition of milk and its nutritive value.
3. To make them familiar about the various milk processing techniques.
4. To enrich their knowledge regarding manufacturing of various food products.

**Course Outcomes:**

1. Students become aware about the scope of dairy industry in India.
2. Students get enlightened about composition of milk and its nutritive value.
3. Students become familiar about various milk processing techniques.
4. Students learn about the manufacturing procedures of various milk products.

**Unit-I (15 Hrs.)**

**Dairy Industry in India:** Scope, strengths and opportunities for dairy industry.

**Milk:** Definition, composition and nutritive value, factors affecting composition of milk.

Physicochemical properties and nutritive value of milk.

**Liquid Milk Processing:** filtration/clarification, standardization, pasteurization (LTLT, HTST, UHT), homogenization.

Microbiology of milk

**Unit-II (15 Hrs.)**

**Technology of Recombined and Reconstituted Milk:** Composition, process of manufacture, defects

**Technology of Condensed and Evaporated Milk:** process of manufacture, defects (their causes and prevention).

**Technology of Milk Powders (WMP, SMP):** process of manufacture, defects (their causes and prevention), instantization of milk powder.

**Technology of Indigenous Milk Products:** Dahi, butter, ghee, channa, paneer etc.

**Unit-III (15 Hrs.)**

**Technology of Cheese:** Classification, composition, nutritive value, process of manufacture of cheddar, mozzarella, cottage and processed cheese, defects (their causes and prevention).

Technology of frozen milk products: process of manufacture, defects (their causes and prevention).

**Unit-IV (15 Hrs.)**

**Milk and Milk Product Standards and Legislations in India:** Grading of milk and criterion of grading, reconstituted milk, synthetic milk.

**Membrane Processing of Milk:** types of membranes, applications of reverse osmosis, ultra filtration and microfiltration in dairy industry.

Milk adulteration, synthetic milk. By products of dairy industry and their utilization. Imitation dairy products.

**Recommended Books:**

1. Sukumar, De 'Outlines of Dairy Technology', Oxford University Press, UK.
2. G. Smith, 'Dairy processing improving quality', Woodhead Publishers, New Delhi, India.

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3. A.T. Andrews and J. R. Varley, 'Biochemistry of Milk Products' Woodhead Publishers, New Delhi, India.
4. R. Early, 'Technology of Dairy Products', Springer Science & Business Media, Germany.
5. R.P. Aneja, B.N. Mathur, R.C. Chandan and A.K. Banerjee, 'Technology of Indian Milk Products', Dairy India Publishers, New Delhi, India.

**FOOD ANALYSIS AND INSTRUMENTATION**

**Subject Code: MFOT1-417**

**L T PC  
3 0 0 3**

**Duration: 45Hrs.**

**Course Objectives:**

1. To study about various instruments used in food analysis.
2. To acquire knowledge about the procedures of proximate analysis of food.
3. To make them familiar with sensory analysis of food.
4. To make them aware about various sampling techniques of food.

**Course Outcomes:**

1. Students gain knowledge about various instruments used in food analysis.
2. Students learn about the proximate analysis of foods.
3. Students become familiar with sensory analysis of food.
4. Students become aware of the sampling techniques used for food analysis.

**Unit-I (10 Hrs.)**

Introduction to food analysis, types of samples and sampling techniques, storage and preservation of samples, expression of results.

**Proximate Analysis of Foods:** Principles of moisture, fat, protein, carbohydrates, crude fiber and vitamins in foods.

**Unit-II (10 Hrs.)**

**Sensory Analysis of Foods:** Overview of the sensory principles and practices, selection and screening of the sensory panel, types of panel (trained, semi trained), methodology of sensory evaluation: discriminative tests: difference tests, paired comparison, duo trio, triangle; descriptive tests.

**Unit-III (12 Hrs.)**

**Instrumentation in Food Analysis:** Principles, types and applications of spectroscopy, photometry, electrophoresis; chromatography and atomic absorption spectro photometry.

**Unit-IV (13 Hrs.)**

**Instrumentation in Food Analysis:** Color measurement in foods; X-ray analysis of foods and its applications; mass spectroscopy; nuclear magnetic resonance (NMR); differential scanning calorimetry (DSC).

Refractometry and ultrasonic in food analysis; texture analysis in foods, sensory versus instrumental analysis of texture, rapid methods of microbial analysis; immunoassays methods.

**Recommended Books**

1. R.S. Kirk and R. Sawyer, 'Pearson's Composition & Analysis of foods', Longman Scientific and Technical, UK.
2. G.G. Birk, J.G. Herman and K.J. Parker, 'Sensory Properties of Foods', Applied Science, London.

**TECHNOLOGY OF ANIMAL PRODUCTS**

**Subject Code: MFOT1-418**

**L TPC  
0 0 4 2**

**Duration: 30 Hrs.**

**Course Objectives:**

1. To make students familiar with the basic tests of milk and milk products.
2. To aware them about the adulteration and microbiological testing of milk.
3. To aware students about egg and meat quality.
4. To teach students about manufacturing of different animal based food products.

**Course Outcomes:**

1. Students gain knowledge about testing of milk.
2. Students become able to perform microbiological tests of milk and milk products.
3. Students get knowledge about egg and meat quality.
4. Students acquire knowledge about making different animal based food products.

**PRACTICALS**

1. Determination of specific gravity, total solids (T.S) % and SNF (Solid not fat) % in the given milk sample.
2. Determination of percentage fat in the given sample of milk by Gerber centrifuge method.
3. Determination of titrable acidity (T.A.) and pH of milk.
4. Determination of added Urea in the given sample of milk.
5. Determination of added starch in the given sample of milk.
6. To conduct clot on boiling (COB) and Alcohol – Alizarin test for testing milk quality.
7. Determination of added water in a given sample of milk.
8. Preparation qualitative testing of milk products like Chhana, Khoa and Paneer, Icecream.
9. Determination of added preservatives, neutralizers in the given sample of milk.
10. Estimation of bacterial numbers in a given sample of milk by direct microscopic count in a given sample of milk.
11. Determination of microbiological quality of milk of MBR test.
12. To study dismantling, cleaning and assembling of HTST pasteurizer for milk.
13. Separation of cream by cream separator.
14. Visit to a milk collection/chilling and milk processing plant.
15. Determination of external and internal quality of poultry egg.
16. To study the effect of time, temperature on coagulation properties of egg.
17. Determination of time temperature condition on formation of iron sulphide in egg.
18. Preservation and evaluation of different egg products.
19. Preparation and evaluation of different egg products
20. Preparation of different types of meat products using different methods of preservation.
21. Visit to meat, fish and poultry processing industries.
22. Determination of tenderness and water holding capacity of different meat.

