

# Maharaja Ranjit Singh Punjab Technical University Bathinda-151001



**FACULTY OF SCIENCES**

**SYLLABUS**

**FOR**

**M.Sc. (FOOD SCIENCE AND TECHNOLOGY)**

**2021 BATCH ONWARDS**

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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
Departmental Elective –I (Select any one)		4	0	0	40	60	100	4
MFOT1-158	Nutraceutical and Functional Foods							
MFOT1-157	Nutrition and Health							
Open Elective –I (Select any one)		3	0	0	40	60	100	3
<b>Total</b>		19	0	8	320	380	700	23

\*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.

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
Departmental Elective –II (Select any one)		4	0	0	40	60	100	4
MFOT1-258	Technology of Beverages							
MFOT1-259	Technology of Malting and Brewing							
Departmental Elective –III (Select any one)		4	0	0	40	60	100	4
MFOT1-260	Food Biotechnology							
MFOT1-261	Food Additives							
<b>Total</b>		20	0	4	260	340	600	22

\*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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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
Departmental Elective –IV (Select any one)*		3	0	0	40	60	100	3
MFOT1-364	Food Standards and Quality Assurance							
MFOT1-363	Technology of Pulses and Oil seeds							
Open Elective –II (Select any one)**		3	0	0	40	60	100	3
MFOT1-420	Dissertation ***	0	0	-	-	-	-	2
<b>Total</b>		17	0	8	320	380	700	23

\*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.

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>		11	0	20	240	260	500	22

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
Total	2500	90

# **SEMESTER FIRST**

**PRINCIPLES OF FOOD PRESERVATION**

**Subject Code: MFOT1-101**

**L T PC  
4 0 0 4**

**Duration: 60Hrs.**

**Course Objectives:**

To imparting knowledge on the causes of food spoilage and principles of food preservation.  
To understanding the applications of basic and advanced equipments used for food preservation.  
To creating the awareness about limits of chemical preservatives safe for human consumption.  
To analyzing the effectiveness of novel preservation techniques over traditional methods with respect to food and environment.

**Course Outcomes:**

Imparting knowledge on the causes of food spoilage and principles of food preservation.  
Understanding the applications of basic and advanced equipments used for food preservation.  
Creating the awareness about limits of chemical preservatives safe for human consumption.  
Analyzing the effectiveness of novel preservation techniques over traditional methods with respect to food and environment.

**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.
3. M. Kalia and S. Sangita, 'Food Preservation and Processing', Kalyani Publishers, New Delhi, India.

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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.

MRSPTU

**BASIC FOOD MICROBIOLOGY**

**Subject Code: MFOT1-102**

**L T PC  
4 0 0 4**

**Duration: 60Hrs.**

**Course Objectives:**

- To applying the knowledge of HACCP and food safety to prevent the growth of microbes in foods.
- To detection of food borne pathogens using novel techniques of analysis.
- To evaluating the factors encouraging and restricting the growth of microbes in foods.
- To analyzing the role of pathogens in food borne illnesses.

**Course Outcomes:**

- Applying the knowledge of HACCP and food safety to prevent the growth of microbes in foods.
- Detection of food borne pathogens using novel techniques of analysis.
- Evaluating the factors encouraging and restricting the growth of microbes in foods.
- Analyzing the role of pathogens in food borne illnesses.

**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.
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 P C  
4 0 0 4**

**Duration: 60Hrs.**

**Course Objectives:**

1. To learn about the knowledge of chemical composition of food.
2. To Understanding the harmful effects of allergens and toxic constituents of foods on human health.
3. To analyzing the factors affecting nutritional composition of food.
4. To evaluating the processes leading to desirable and undesirable changes occurring in food.

**Course Outcomes:**

1. Imparting the knowledge of chemical composition of food.
2. Understanding the harmful effects of allergens and toxic constituents of foods on human health.
3. Analyzing the factors affecting nutritional composition of food.
4. Evaluating the processes leading to desirable and undesirable changes occurring in food.

**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; fat mimetics.

**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 Nostr and, 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 Nostr and, Reinhold Company Publication, New York, U.S.A.



**FOOD ANALYSIS AND INSTRUMENTATION LAB - I**

**Subject Code: MFOT1-104**

**L T PC  
0 0 4 2**

**Duration: 60Hrs.**

**Course Objective:**

1. To understanding the nutritional composition of food.
2. To application of novel techniques in food analysis.
3. To evaluating the quality parameters of food products to ensure food safety and public health.
4. To analysis of proximate composition of food products.

**Course outcome:**

1. Understanding the nutritional composition of food.
2. Application of novel techniques in food analysis.
3. Evaluating the quality parameters of food products to ensure food safety and public health.
4. Analysis of proximate composition of food products.

**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: 60Hrs.**

**Course Objectives:**

1. To imparting the knowledge of media preparation, staining methods and handling practices
2. To understand about of microbial tools and techniques for detection of spoilage microorganisms.
3. To analyzing the microbial load of different food products to determine their safety for human consumption.
4. To evaluating the growth curve of microbes in relation to its effect on food quality.

**Course Outcomes:**

1. Imparting the knowledge of media preparation, staining methods and handling practices.
2. Application of microbial tools and techniques for detection of spoilage microorganisms.
3. Analyzing the microbial load of different food products to determine their safety for human consumption.
4. Evaluating the growth curve of microbes in relation to its effect on food quality.

**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:
  13. Surrounding air
  14. Workers
  15. Fruit and vegetable products
16. Isolation of bacteria by serial dilution technique.
17. To study various sub-culturing techniques.
18. 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 imparting the knowledge of nature, types, and scope of nutraceutical and functional foods .
2. To application of nutraceutical and functional foods for the treatment of various disorders.
3. To creating the ability of effective communication with society regarding therapeutical effects of nutraceutical and functional foods.
4. To evaluating the functionality of nutraceutical compounds with respect to their stability and shelf life.

**Course Outcomes:**

1. Imparting the knowledge of nature, types, and scope of nutraceutical and functional foods.
2. Application of nutraceutical and functional foods for the treatment of various disorders.
3. Creating the ability of effective communication with society regarding therapeutical effects of nutraceutical and functional foods.
4. Evaluating the functionality of nutraceutical compounds with respect to their stability and shelf life.

**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 imparting knowledge about basic terminology of nutrition and different functions of food.
2. To application and role of foods to address various health issues.
3. To creating the awareness regarding social, cultural and physiological aspects of foods.
4. To analyzing the nutritional requirements for different age groups.

**Course Outcomes:**

1. Imparting knowledge about basic terminology of nutrition and different functions of food.
2. Application and role of foods to address various health issues.
3. Creating the awareness regarding social, cultural and physiological aspects of foods.
4. Analyzing the nutritional requirements for different age groups.

**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.

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**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, New York, U.S.A.
3. P.V. Hegarty and 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. Mudambi and M.V. Rajagopal, 'Fundamentals of Food & Nutrition'. New Age International (P) Limited, Publishers, New Delhi, India.
6. ICMR, 'Nutrient Requirement & RDA' ICMR, New Delhi.
7. M.J. Gibney, M. Elia, O. Ljungqvist and J. Dowsett, 'Clinical Nutrition', The Nutrition Society Textbook Series, Blackwell Publishing Company.

# **SEMESTER SECOND**

**BASIC FOOD ENGINEERING**

**Subject Code: MFOT1-206**

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

**Duration: 60Hrs.**

**Course Objectives:**

1. To imparting the knowledge about fundamental concepts of food engineering.
2. To understanding the principles of food engineering for efficient utilization of finance and project management in food industry.
3. To analyze different problems related to commercial sterilization of food products.
4. To aware about interpretation of data using psychrometry and synthesis of information for developing appropriate storage and processing conditions.

**Course Outcomes:**

1. Imparting the knowledge about fundamental concepts of food engineering.
2. Understanding the principles of food engineering for efficient utilization of finance and project management in food industry.
3. Analysis of problems related to commercial sterilization of food products.
4. Interpretation of data using psychrometry and synthesis of information for developing appropriate storage and processing conditions.

**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.

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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.

MRSPTU



**TECHNOLOGY OF CEREALS & MILLETS**

**Subject Code: MFOT1-207**

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

**Duration: 60 Hrs**

**Course Objectives:**

1. To imparting the knowledge of structure and chemical composition of different cereal grains.
2. To application of techniques and machineries for the quality assessment of cereal grains and their products.
3. To analyzing the role of ingredients in development of food products from different cereal grains.
4. To understanding the utilization of by-products of milling and formulation of convenience foods for sustainable development.

**Course Outcomes:**

1. Imparting the knowledge of structure and chemical composition of different cereal grains.
2. Application of techniques and machineries for the quality assessment of cereal grains and their products.
3. Analyzing the role of ingredients in development of food products from different cereal grains.
4. Understanding the utilization of by-products of milling and formulation of convenience foods for sustainable development.

**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 & MAHARAJA RANJIT SINGH PUNJAB TECHNICAL UNIVERSITY, BATHINDA

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Distribution, New Delhi, India.

2. Y. Pomeranz, 'Wheat: Chemistry and Technology', American Association of Cereal Chemists, St. Paul, M N, 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.

**COMPUTER FUNDAMENTALS AND STATISTICS**

**Subject Code: MFOT1-208**

**L T PC  
4 0 0 4**

**Duration: 60Hrs.**

**Course Objectives:**

1. To imparting the basic knowledge of computer, number system and computer networks.
2. To create the awareness about application of software packages for making reports, documents and effective presentations.
3. To analysis and interpretation of data using statistical techniques.
4. To understanding the types and functions of different hardware and software devices for better project management.

**Course Outcomes:**

1. Imparting the basic knowledge of computer, number system and computer networks.
2. Application of software packages for making reports, documents and effective presentations.
3. Analysis and interpretation of data using statistical techniques.
4. Understanding the types and functions of different hardware and software devices for better project management.

**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, 'Introduction to Computers', TataMcGraw Hill Education Pvt. Ltd., New Delhi, India.
3. D.E. Comer, 'Computer Networks and Internet', Pearson Education, New Delhi, India.
4. V. Rajaraman, Fundamentals of Computers, Prentice Hall of India, New Delhi, India.
5. 'Office 2000: No Experience Required', BPB Publications, New Delhi, India.
6. A.K. Ray and T. Acharya, Information Technology: Principles and Applications', 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: 60Hrs.**

**Course Objectives:**

1. To imparting knowledge of proximate composition of flours from different cereal grains.
2. To understanding the mode of working in industrial setup as an individual and as a team.
3. To evaluation of different properties of cereal starches using modern techniques.
4. To analysis of quality attributes of cereal grains so as to meet legal specifications.

**Course Outcomes:**

1. Imparting knowledge of proximate composition of flours from different cereal grains.
2. Understanding the mode of working in industrial setup as an individual and as a team.
3. Evaluation of different properties of cereal starches using modern techniques.
4. Analysis of quality attributes of cereal grains so as to meet legal specifications.

**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  
4 0 0 4**

**Duration: 60Hrs**

**Course Objectives:**

1. To imparting the knowledge of types and importance of beverages.
2. To understanding the technology behind processing of different beverages to meet the legal specifications.
3. To application of low calorie sweeteners for preparation of beverages to address the specified needs of consumers.
4. To creating awareness to communicate regarding safety levels of additives used in beverage preparation along with quality standards of bottled water.

**Objective Outcomes:**

1. Imparting the knowledge of types and importance of beverages.
2. Understanding the technology behind processing of different beverages to meet the legal specifications.
3. Application of low calorie sweeteners for preparation of beverages to address the specified needs of consumers.
4. Creating awareness to communicate regarding safety levels of additives used in beverage preparation along with quality standards 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 PC  
4 0 0 4**

**Duration: 60 Hrs.**

**Course Objectives:**

1. To imparting the basic knowledge of production, trade, structure and composition of barley.
2. To application of malt for development of different food products.
3. To quality evaluation of ingredients involved in production of beer.
4. To understanding the techniques involved in processing and quality assessment of beer.

**Course Outcomes:**

1. Imparting the basic knowledge of production, trade, structure and composition of barley.
2. Application of malt for development of different food products.
3. Quality evaluation of ingredients involved in production of beer.
4. Understanding the techniques involved in processing and quality assessment of beer.

**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  
4 0 0 4**

**Duration: 60 Hrs.**

**Course Objectives:**

1. To imparting the knowledge of basic principles of genetic engineering with respect to food.
2. To understanding the applications of bacteriocins in food systems along with their safety levels.
3. To creating awareness of bioethics in food biotechnology.
4. To application of novel processes and techniques for improvement in various foods.

**Course Outcomes:**

1. Imparting the knowledge of basic principles of genetic engineering with respect to food.
2. Understanding the applications of bacteriocins in food systems along with their safety levels.
3. Creating awareness of bioethics in food biotechnology.
4. Application of novel processes and techniques for improvement in various foods.

**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, pediocin, applications of bacteriocins 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, biocolours, 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  
4 0 0 4**

**Duration: 60Hrs.**

**Course Objectives:**

1. To imparting knowledge of types and functions of different food additives.
2. To understanding the limitations of application of food additives in food products.
3. To creating awareness regarding use of food additives and their permissible limits.
4. To applications of recent advances in additives in context to different food attributes.

**Course Outcomes:**

1. Imparting knowledge of types and functions of different food additives.
2. Understanding the limitations of application of food additives in food products.
3. Creating awareness regarding use of food additives and their permissible limits.
4. Applications of recent advances in additives in context to different food attributes.

**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  
4 0 0 4**

**Duration: 60 Hrs.**

**Course Objectives:**

1. To imparting knowledge about classification and nutritional value of fruits and vegetable.
2. To application of appropriate techniques and modern machineries for the production of quality products from fruits and vegetable.
3. To creating awareness about spoilage in fruits and vegetables to avoid the occurrence of food borne illnesses.
4. To development and utilization of by products from fruits and vegetables waste to address the environmental concerns.

**Course Outcomes:**

1. Imparting knowledge about classification and nutritional value of fruits and vegetable.
2. Application of appropriate techniques and modern machineries for the production of quality products from fruits and vegetable.
3. Creating awareness about spoilage in fruits and vegetables to avoid the occurrence of food borne illnesses.
4. Development and utilization of by products from fruits and vegetables waste to address the environmental concerns.

**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

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3. Publishing, UK.
4. B. Pantastico, 'Post Harvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables', AVI Publishing Company, Inc., Westport, U.S.A.
5. W.V. Cruess, 'Commercial Fruit and Vegetable Products', Allied Scientific Publishers, Bikaner, India.
6. Girdharilal, 'Preservation of Fruits and Vegetables', ICAR, New Delhi.
7. M.E. Dauthy, 'Fruit and Vegetable Processing', International Book Distributing Co. Lucknow, India.
8. L.P. Hamson, 'Commercial Processing of Vegetables', Noyes Data Corporation, New Jersey.

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**UNIT OPERATIONS IN FOOD ENGINEERING**

**Subject Code: MFOT1-311**

**L T PC  
4 0 0 4**

**Duration: 60 Hrs.**

**Course Objectives:**

1. To imparting knowledge of preliminary unit operations.
2. To understanding the principles of food engineering and apply these to manage the projects in industrial set ups.
3. To creating awareness regarding selection and application of tools and techniques used for the production and storage of foods.
4. To formulate and analyze the complex problems of unit operations used in food engineering.

**Course Outcomes:**

1. Imparting knowledge of preliminary unit operations.
2. Understanding the principles of food engineering and apply these to manage the projects in industrial set ups.
3. Creating awareness regarding selection and application of tools and techniques used for the production and storage of foods.
4. Formulate and analyze the complex problems of unit operations used in food engineering.

**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.

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.

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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.

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**Course Objective:**

1. To imparting knowledge regarding packaging and its functions.
2. To understanding of safety considerations in food packaging.
3. To creating awareness regarding novel methods of food packaging.
4. To selection and application of appropriate packaging materials and techniques depending on the requirements of food products.

**Course Outcomes:**

1. Imparting knowledge regarding packaging and its functions.
2. Understanding of safety considerations in food packaging.
3. Creating awareness regarding novel methods of food packaging.
4. Selection and application of appropriate packaging materials and techniques depending on the requirements of food products.

**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 container

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.

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**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: 60Hrs.**

**Course Objectives:**

1. To imparting knowledge regarding extraction of juices and preparation of products from fruits and vegetables.
2. To creating awareness about quality assessment of products for production of quality food.
3. To analyzing the microbiological parameters of the products to meet the safety standards.
4. To evaluating the cost of food products for better management of finance in one's own work and industrial set ups.

**Course Outcomes:**

1. Imparting knowledge regarding extraction of juices and preparation of products from fruits and vegetables.
2. Creating awareness about quality assessment of products for production of quality food.
3. Analyzing the microbiological parameters of the products to meet the safety standards.
4. Evaluating the cost of food products for better management of finance in one's own work and industrial set ups.

**PRACTICALS**

1. Extraction of Juices of different fruit (citrus, pomegranate, apple)
2. Evaluation of vitamin C content and
3. Determination of pH
4. Evaluation of browning time
5. Determination of Acidity
6. Cost evaluation of Juice
7. Sensory evaluation of the products
8. Shelf –life study
9. Preparation of jams (using different fruits)and
10. Determination of pectin content
11. Evaluation of Total Soluble Solids(TSS)
12. Evaluation of sugars using lane eynon method
13. Determination of pH
14. Evaluation of acidity
15. Sensory evaluation of the products
16. Cost evaluation product prepared sensory evaluation & organoleptic test
17. Preparation of jelly and
18. Estimation of Pectin content
19. Determination of total soluble solids(TSS)
20. Jelmeter test
21. Checking for pH
22. Checking of acidity
23. Cost evaluation of product
24. Microbiological analysis
25. Sensory evaluation of the products
26. Preparation of marmalade (using different fruits)
27. Jam Marmalade
28. Jelly Marmalade



29. Preparation of preserves and candies
30. Evaluation of TSS
31. Determination of Endpoint
32. Microbiological Analysis
33. Evaluation of product cost
34. Sensory evaluation of the products
35. Preparation of potato chips and
36. Calculation of product dimension
37. Determination of time-temp combination for product
38. Study of the effect of anti-browning agents
39. Preparation of tomato products (Sauce, Ketchup, Soup, puree)for
40. Evaluation of TSS
41. Evaluation of pH
42. Evaluation of acidity
43. Cost evaluation
44. Microbiological analysis
45. Pickling & fermented products
46. Preparation and shelf-life study of ready-to-serve beverages
47. 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: 60Hrs.**

**Course Objectives:**

1. To identification of different packaging materials as per the requirements of food products using principles of food packaging.
2. To understanding the application of novel food packaging techniques.
3. To evaluating the quality of packaged food products so as to provide safe food for consumption.
4. To analyzing the physical parameters of packaging materials to meet the legal specifications.

**Course Outcomes:**

1. Identification of different packaging materials as per the requirements of food products using principles of food packaging.
2. Understanding the application of novel food packaging techniques.
3. Evaluating the quality of packaged food products so as to provide safe food for consumption.
4. Analyzing the physical parameters of packaging materials to meet the legal specifications.

**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 imparting knowledge of concepts of food quality and assurance.
2. To understanding the laws and regulation in relations to food quality and safety.
3. To applications of good hygiene and good laboratory practices with respect to environmental considerations.
4. To creating awareness about various sampling techniques and analysis of data using statistical quality control.

**Course Outcomes:**

1. Imparting knowledge of concepts of food quality and assurance.
2. Understanding the laws and regulation in relations to food quality and safety.
3. Applications of good hygiene and good laboratory practices with respect to environmental considerations.
4. Creating awareness about various sampling techniques and analysis of data using statistical quality control.

**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 1400

**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. McLoari, '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,

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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.

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**TECHNOLOGY OF PULSES AND OIL SEEDS**

**Subject Code: MFOT1-363**

**L T PC  
3 0 0 3**

**Duration: 60 Hrs.**

**Course Objective:**

1. To imparting knowledge about importance of fats and oils in human nutrition.
2. To understanding the importance of oilseed processing and applying these to one's own work and in industrial setups.
3. To creating awareness about selection and application of techniques and machineries in milling and extraction processes.
4. To demonstrating knowledge about anti-nutritional factors and their modes of elimination so as to ensure public health.

**Course outcomes:**

1. Imparting knowledge about importance of fats and oils in human nutrition.
2. Understanding the importance of oilseed processing and applying these to one's own work and in industrial setups.
3. Creating awareness about selection and application of techniques and machineries in milling and extraction processes.
4. Demonstrating knowledge about anti-nutritional factors and their modes of elimination so as to ensure public health.

**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.

# **SEMESTER FOUR**

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

**Subject Code: MFOT1-415**

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

**Duration: 60 Hrs.**

**Course Objectives:**

1. To imparting knowledge about composition and nutritional value of meat, fish and poultry.
2. To applying ethical principles in various practices involved in slaughtering of animals.
3. To evaluation of internal and external quality parameters of egg to ensure safety for consumption.
4. To creating awareness regarding utilization of by products from meat industry in context to environment.

**Course Outcomes:**

1. Imparting knowledge about composition and nutritional value of meat, fish and poultry.
2. Applying ethical principles in various practices involved in slaughtering of animals.
3. Evaluation of internal and external quality parameters of egg to ensure safety for consumption.
4. Creating awareness regarding utilization of by products from meat industry in context to environment.

**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.
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 P C  
4 0 0 4**

**Duration: 60Hrs.**

**Course Objectives:**

1. To imparting knowledge about composition, nutritive value and processing of milk and milk products.
2. To understanding the microbiological quality of fresh milk to ensure its safety for human consumption and processing.
3. To cost effective utilization of by-products of dairy industry to address the environmental concerns.
4. To creating awareness about scope, strengths and opportunities of dairy industry and its implementation to become entrepreneur.

**Course Outcomes:**

1. Imparting knowledge about composition, nutritive value and processing of milk and milk products.
2. Understanding the microbiological quality of fresh milk to ensure its safety for human consumption and processing.
3. Cost effective utilization of by-products of dairy industry to address the environmental concerns.
4. Creating awareness about scope, strengths and opportunities of dairy industry and its implementation to become entrepreneur.

**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.

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**Subject Code: MFOT1-417**

**L T PC  
3 0 3**

**Duration: 45Hrs.**

**Course Objectives:**

1. To imparting knowledge about proximate analysis of food products.
2. To understanding the selection and application of appropriate modern techniques for quality assessment of foods.
3. To creating awareness regarding sampling techniques, statistical analysis and interpretation of data along with expression of results.
4. To application of novel methodologies for microbial load analysis of food to ensure safety for consumption.

**Course Outcomes:**

1. Imparting knowledge about proximate analysis of food products.
2. Understanding the selection and application of appropriate modern techniques for quality assessment of foods.
3. Creating awareness regarding sampling techniques, statistical analysis and interpretation of data along with expression of results.
4. Application of novel methodologies for microbial load analysis of food to ensure safety for consumption.

**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 LAB -VI**

**Subject Code: MFOT1-418**

**L TPC  
0 0 4 2**

**Duration: 60 Hrs.**

**Course Objectives:**

1. To imparting knowledge development of various processed foods from animal products.
2. To understanding the mode of working in industrial setup as an individual and as a team.
3. To evaluation of microbiological quality of milk and milk products to ensure their safety for consumption.
4. To analysis of quality parameters of animal products so as to meet the legal specifications.

**Course Outcomes:**

1. Imparting knowledge development of various processed foods from animal products.
2. Understanding the mode of working in industrial setup as an individual and as a team.
3. Evaluation of microbiological quality of milk and milk products to ensure their safety for consumption.
4. Analysis of quality parameters of animal products so as to meet the legal specifications.

**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.

