FACULTY OF SCIENCES

SYLLABUS

FOR

M.Sc. (FOOD TECHNOLOGY)

(Under Credit Based Continuous Evaluation Grading System)

(Semester: I - IV)

Examinations: 2015–16

GURU NANAK DEV UNIVERSITY, AMRITSAR.

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M.Sc. (Food Technology) Semester System
(Under Credit Based Continuous Evaluation Grading System)

FIRST SEMESTER

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTL-501	**C**	Principles of Food Processing & Preservation	3	-	-	3
FTL-502	**C**	Technology of Cereals, Legumes &Oil Seeds Processing–I	3	-	-	3
FTL-503	**C**	Technology of Fruits & Vegetables Processing –I	3	-	-	3
FTL-504	**C**	Technology of Fluid Milk Processing–I	3	-	-	3
FTL-505 **OR** FTL-506	**E**	Food Microbiology **OR** Food Chemistry	3	-	-	3
FTL-507	**C**	Basics of Food Engineering	3	-	-	3
FTP-522	**C**	Experiments in Fruits & Vegetables Processing–I	-	-	2	2
FTP-523	**C**	Experiments in Cereal, Legumes & Oil Seeds Processing–I	-	-	2	2
FTP-524	**C**	Experiments in Fluid Milk Processing–I	-	-	2	2
Total Credits			**18**	**-**	**6**	**24**

For elective courses: The students can opt for **any one** option from the following:

Option 1: FTL-505 (1st Sem) (Food Microbiology)
Option 2: FTL-506 (1st Sem) (Food Chemistry)

M.Sc. (Food Technology) Semester System
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SECOND SEMESTER

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTL-551	**C**	Technology of Cereals, Legumes and Oil Seeds-II	3	-	-	3
FTL-552	**C**	Technology of Fruits and Vegetables Processing-II	3	-	-	3
FTL-553	**C**	Technology of Milk Products Processing-II	3	-	-	3
FTL-554	**C**	Technology of Egg and Poultry Processing	3	-	-	3
FTL-555	**C**	Application of Enzymes in Food Industry	2	-	-	2
FTL-556	**C**	Confectionery Technology	3	-	-	3
FTL-557	**C**	Food Engineering Operations	3	-	-	3
FTP-571	**C**	Experiments in Cereals, Legumes and Oil Seeds Processing-II	-	-	2	2
FTP-572	**C**	Experiments in Fruits & Vegetables Processing-II	-	-	2	2
FTP-573	**C**	Experiments in Milk Products Processing-II	-	-	2	2
FTP-574	**C**	Experiments in Egg and Poultry Processing	-	-	2	2
FTP-575	**C**	Confectionery Technology	-	-	2	2
FTP-576	**A**	In-plant Training (1^{st} June-30^{th} June)	-	-	2	2
Total Credits			**20**	**-**	**12**	**32**

Last date for submission of:

i) Training report within one week after coming from training.

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THIRD SEMESTER

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTL–601	**C**	Technology of Malting and Brewing	3	–	–	3
FTL–602	**C**	Packaging Technology	3	–	–	3
FTL–603	**C**	Food Plant Layout and Management	3	–	–	3
FTL–604	**C**	Technology of Fish and Meat Products Processing	3	–	–	3
FTL–605	**C**	Food Process Engineering–I	3	–	–	3
FTP–621	**C**	Experiments in Malting Technology	–	–	2	2
FTP–622	**C**	Experiments in Food Packaging	–	–	2	2
FTP–623	**C**	Experiments in Fish and Meat Products Processing	–	–	2	2
FTP–624	**C**	Food Engg Lab–I	–	–	2	2
FTP–625	**A**	Synopsis	–	–	2	2
ID-1	**I**	Interdisciplinary (ID) Course	–	–	–	–
Total Credits			**15**	**–**	**10**	**25+ID**

M.Sc. (Food Technology) Semester System
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FOURTH SEMESTER

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTL–651	**C**	Quality Assurance in Food Industry and Sensory Evaluation	3	–	–	3
FTL-653	**C**	Human Resources and Marketing Management	3	–	–	3
FTL–654	**C**	Food Process Engineering– II	3	–	–	3
FTP–671	**C**	Quality assurance in Food Industry and Sensory Evaluation (Practical)	–	–	2	2
FTP–672	**C**	Food Engineering Lab–II	–	–	2	2
FTP–673	**C**	Seminar	–	–	2	2
FTP–674	**A**	Project Work	–	–	2	2
ID-2	**I**	Interdisciplinary (ID) course	–	–	–	–
Total Credits			**9**	**–**	**8**	**17+ID**

Last date for submission of:

i) Research Project to be submitted by 15th June

M.Sc. (Food Technology) Semester–I
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FTL–501: PRINCIPLES OF FOOD PROCESSING & PRESERVATION

Credits: 3–0–0

Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

1. Introduction and historical developments of food preservation.
   Principles of Food preservation.
   Food Spoilage: Microbial, Physical, Chemical & Miscellaneous.
2. **Refrigeration Storage:** Requirements of refrigeration storage; changes in food during refrigeration storage; Refrigeration loads.
3. **Freezing and Frozen Storage:** Freezing curves, Factors determining freezing rate, types of freezer, freezing process thawing, changes in Food during freezing.
4. **Dehydration:** Drying curves, Water activity, Drying process, Types of dryers, Dehydration effect in food.

UNIT-II

5. **Concentration:** Technology of Concentration, Equipment, Process, and Changes in Food during concentration.
6. **Ionizing Radiation:** Source; Equipment; Mechanism of preservation, Dose determination, Effect on food.
7. **Microwaves:** Mechanism of heating, Equipment & its Effect on food
8. **Food Additives:** Definition, Types, and Functions in food.

UNIT-III

9. **Thermal Processing:** Determination of thermal processing schedule, canning process, Equipment, Effect on food, Aseptic processing
10. **Intermediate Moisture (IM) Foods:** Principles, Characteristics, Advantages, and Problems in developing new IM foods.
11. **Recent Methods in Food Preservation**: Pulse electric, Ultrasound, microwave, Infrared, High Pressure, Ohmic heating, Hurdle technology, Nanotechnology in food processing.

Recommended Books:

1. The Technology of Food Preservation by Desrosier & Desrosoer.
2. Food Science by N.N. Potter.
3. Introduction to Food Science and Technology by Stewart.

FTL–502: TECHNOLOGY OF CEREALS, LEGUMES & OIL SEEDS PROCESSING–I

Credits: 3–0–0

Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

Wheat production, varieties and their quality. Types of wheat grading system. Structure and composition, environmental effect in relation to processing quality, Enzyme in wheat and their implications in wheat technology. Cleaning, conditioning and milling of wheat. Principles and machine operations, Air fractionation of flours, composition and application of air classified flours. Flour, its treatment. Technology of bakery product such as bread, biscuits, cake, crackers, pretzel, etc. Production, equipment and ingredients. Role of ingredients in bakery products.

UNIT-II

Criteria of quality evaluation of flour. Introduction to dough rheology and dough chemistry, Testing properties of flour slurry and dough using instruments–Farinograph, Falling Number, Extensiograph, Amylograph, Mixograph, Rapid Visco–analyser, Alveograph etc. Industrial processes for the production starch and gluten from wheat. Functional properties and uses of wheat starch, chemistry and technology of durum wheat and pasta products.

UNIT-III

Rice production, rice type. Rice structure and proximate composition, distribution of various chemical constituents in rice grain. Production of rice starch, uses and evaluation of functional properties of rice starch. Methods of studying quality of rice with special reference to cooking quality. Changes during aging of rice. Methods of accelerated aging of rice. Methods of enrichment with vitamins and mineral. Rice milling, operation, milling machine, degree of Milling, milling yields of paddy. Factors affecting milling yield and Milling effect on nutrition and quality of rice. Rice bran stabilization, methods of stabilization, Methods of parboiling, controlling the degree of parboiling, nutrition, advantages and disadvantages. Technologies of quick cooking rice, infant foods, rice flakes and breakfast cereals. Rice in brewing and manufacture of beer.

Manufacturing of ready to eat cereals: flakes, gun puffed, extruded and shredded grains.

Recommended Books:

1. Wheat Chemistry and Technology by Yashajahu Pomeranz & F.H. Websten
2. Oats Chemistry and Technology by F.H. Websten
3. Corn Chemistry and Technology by S.A. Watsan and P.E. Ramsat
4. Rice Chemistry and Technology by B.O. Juliano
5. Durum Wheat Chemistry and Technology by G.Fabriani and C. Lintas.
6. The Amylography Handbook by W. C. Shuey and K. H. Topples.
7. The Farinograph Handbook by B.L.D. Appolonia and W.H. Kunerth
8. Fundamentals of Dough Rheology by H. Faridi and J.M. Faubion

M.Sc. (Food Technology) Semester–I
(Under Credit Based Continuous Evaluation Grading System)

FTL–503: TECHNOLOGY OF FRUITS & VEGETABLES PROCESSING–I

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

1. Classification and Nutritive value of Fruits & Vegetables.
   Harvesting & Post Harvest physiology of Fruits & Vegetables
2. Physical and chemical techniques to increase the post harvest life of fresh Fruits & Vegetables.

UNIT-II

3. Prepackaging of fresh Fruits & Vegetables.
4. Storage of fresh Fruits & Vegetables–Ambient, Refrigerated, Modified atmosphere, evaporative cool storage.
5. General steps of processing of Fruits & Vegetables: Washing, sorting/grading, peeling blanching, coring, destoning.

UNIT-III

6. Canning of Fruits & Vegetables–General process & equipment.
7. Aseptic canning of Fruits & Vegetables: Process & Equipment, UHT.
8. Containers for conventional & aseptic canning.
9. Spoilage of canned Fruits & Vegetables.
10. Labeling requirements of Fruits & Vegetables products.
11. Freezing– Freezing curve, process equipment, storage, thawing.
12. Dehydration–Drying curve process, equipment, storage, and reconstitution.

References Books:

1. Preservation of Fruits and Vegetables–Girdhari Lal, Siddhapa and Tondon, ICAR, New Delhi.
2. Hand Book of Analysis and Quality Control of Fruits & Vegetable Products–S. Ranganna Tata McGraw Hill, New Delhi.
3. Commercial Vegetable Processing–Wood Roof & Lue.
4. Commercial Fruit & Veg. Processing–W.V. Cruses.

FTL–504: TECHNOLOGY OF FLUID MILK PROCESSING–I

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

Composition of milk and its synthesis, various factors affecting the composition of milk, physico chemical properties.
Dairy industry in India.
Structure and composition of fat and its properties.
Milk proteins, casein and whey proteins, stability, structure, aggregation.
Lacrosse, structure and properties, Minerals and vitamins.

UNIT-II

Microbiology of milk , sources of milk contamination.
Methods of milk collection and transportation.
Liquid milk processing– filtration/clarification, standardization, pasteurization– (objectives, types, LTLT, HTST, UHT, equipment, advantages), Homogenization (objectives, process, advantages).

UNIT-III

Packaging, distribution & storage of liquid milk.

Judging and grading of milk, defects in milk– its causes and prevention.

Special milks–Sterilized, flavored, homogenized, reconstituted, recombined, toned, double toned, vitaminized, standardized milk.

HACCP in the milk plant.

Recommended Books:

1. Technology of Dairy Products by Early, R.
2. Outlines of Dairy Technology by De. S.

M.Sc. (Food Technology) Semester–I
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FTL–505: FOOD MICROBIOLOGY

Credits: 3–0–0

Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

1. Fundamental of Microbiology

i) Historical development.
ii) Morphology, general cytology and reproduction of bacteria, yeast, fungi, actinomycetes and algae.
iii) Physiology of microorganisms
iv) General principles of serology and immunology.
vi) Viruses–structure and replication with particular reference to food borne viruses.

UNIT-II

2. Growth and Destruction of Microorganisms:

i) Growth curves.
ii) Physical and chemical factors influencing the destruction of microorganisms including thermal death time, Z, F and D values.

3. Microorganism in Natural Products and Their Control:

i) Sources and prevention of contamination.
ii) General principles of food preservation.
iii) Microbiology of atmosphere, water, influence of a_w, milk and milk products, cereals and cereal products; meat and meat products, fish or fish products: poultry and eggs; sugars; spices and salt, canned foods.

UNIT-III

4. Basic Principles of Food Plant Sanitation.

5. i) Food poisoning
ii) Food borne infections.
iii) Food borne intoxications
iv) Mycotoxins.

Recommended Books:

1. Microbiology by Pelczar, Smith & Chan.
2. Food Microbiology by Frazier
3. Introduction to Microbiology by Stainier.

M.Sc. (Food Technology) Semester–I
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FTL–506: FOOD CHEMISTRY

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

1. **Introduction – to chemistry of foods.**
2. **Carbohydrates:**
   a) Monosaccharides: Occurrence, Classification, hexos, isomerism, structure determination, diagrammatic representation of optical isomers, absolute configuration, reducing power of sugars, sugar derivative, pintos transformation of sugars & amino sugar
   b) Oligosaccharides, Disaccharide–sucrose, biosynthesis, trisaccharides classification, commercial sources.
   c) Polysaccharide: Classification, cellulose, and starches, control hydrolysis of starch, isolation from natural products, enzymes, synthetic polysaccharides, plant gums and hemicellulose.
3. **Minerals of Foods:** Calcium, phosphorus, iron, copper, lead, zinc & arsenic.

UNIT-II

4. **Proteins:** Occurrence, amino acids, physical & chemical properties, determination, peptides, proteins & their properties, sequence of amino acids, structure of protein denaturation, major source of protein. Protein metabolism, Digestion, absorption & functions. End products of protein metabolism Inter–medially metabolism of amino acids & the urea cycle.
5. **Plant Pigments:** Chlorophyll, anthocyanins and carotenoids, occurrence, structure, Chemistry, functions and changes during processing.
6. **Pectic Substances:** Occurrence, structure, properties and uses in foods.

UNIT-III

7. **Oils and Fats:** Introduction, occurrence, composition, classification of glycosides, structure, physical and chemical properties, rancidity and flavor, reversion processing of oil bearing materials, refining of oils and fats, splitting & esterification hydrogenation, shortenings and low fat spreads. Lipid metabolism: digestion, absorption and functions. Oxidation of fatty acids. Biosynthesis of fatty acids and fats. Food emulsions
8. **Vitamins:** Water and fat–soluble vitamins, use of vitamins in foods and their properties.

   Effect of processing on vitamins.
9. **Essential Oils:** Occurrence, structure, biosynthesis, monoterpene sesquiterpenes, oxygenated terpeans, extraction of essential oils, terpeanless oils, uses in foods.
10. Flavoring compounds in foods.

Recommended Books:

1. Food Chemistry by O.R. Fennema.
2. Food Chemistry by H. Meyer.
3. Fundamentals of Food Chemistry Laboratory – J. Kaur, Houghton Mifflin Company, New York (2006).

M.Sc. (Food Technology) Semester–I
(Under Credit Based Continuous Evaluation Grading System)

FTL–507: BASICS OF FOOD ENGINEERING

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

1. **Dimensions and Units:** Basic and derived units, The SI system. Mathematical technique in process calculations: Linear and Non–linear equations.

2. **Material Balance:** Basic principles. Process flow diagram. Material balance calculations in food processing industries pertaining to steady state operations only, bypass and purge.

UNIT-II

3. **Energy Balance:** General principles and application in food processing operations.

4. **Rheology:** Basic concept and definitions, elasticity, plasticity, visco–elasticity. Rheological models: Kelvin, Maxwell, Burgers models, stress relaxation and creep behaviour.

UNIT-III

5. **Fluid Flow:** Nature and classification of fluids, concept of viscosity and its measurement– capillary tube viscometer, rotational viscometer. Mechanical energy balance, Bernoulli's equation and its application, friction in pipes, pipe line fittings, flow measurement devices– Pitot tube, Orifice meter, Venturimeter. Pressure and its measurement– Simple and Differential manometers.

Recommended Books:

1. Introduction to Food Engineering by R.P. Singh & D.R. Heldman.
2. Fundamentals of Food Process Engineering by R.T. Toledo.
3. Transport Processes and Unit Operations by C.J. Geankoplis

FTP–522: EXPERIMENTS IN FRUITS AND VEGETABLES PROCESSING–I

Credits: 0–0–2
Note: Students can use the Non-Programmable scientific calculator.

1. Examination of fresh fruits and vegetables for processing.
2. Pre– Packaging of Fresh fruits and vegetables, modified atmosphere packaging, controlled atmosphere packaging.
3. Can seaming operations.
4. Canning of fruits.
5. Canning of vegetables.
6. Testing of can, cut out test.
7. Preparation and analysis of syrups and Brines.
8. Experimental dehydration of fruits and vegetables.
9. Thermal process evaluation for low and high acid canned foods.
10. Freezing of fruits and vegetables.
11. Visit to a fruits and vegetables processing industry.

FTP–523: EXPERIMENTS IN CEREALS, LEGUMES & OIL SEEDS PROCESSING–I

Credits: 0–0–2
Note: Students can use the Non-Programmable scientific calculator.

1. Physico–chemical testing of wheat and rice.
2. Milling of rice and assessment of per cent of head, broken, immature kernels degree of polish etc.
3. Parboiling and evaluation of quality of parboiled rice.
4. Evaluation of cooking quality of rice.
5. Conditioning and milling of wheat.
6. Determination of quality characteristics of flours.
7. Rheological properties of dough using Farinograph/ Extensograph/Mixograph.
8. Pasting properties of starches using Visco–amylograph/RVA.
9. Baking of bread, cookies and cakes and evaluation of their quality.
10. Processing of paste goods and evaluation of their quality.
11. Extrusion cooking and quality evaluation of extrudates.
12. Visit to wheat and rice, processing plants.

M.Sc. (Food Technology) Semester–I
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FTP–524: EXPERIMENTS IN FLUID MILK PROCESSING–I

Credits: 0–0–2
Note: Students can use the Non-Programmable scientific calculator.

1. Estimation of milk constituents such as moisture, % TS & fat.
2. Determination of acidity of milk
3. Determination of Specific gravity of milk & observe effect of water addition on it.
4. Performance of platform tests on given sample of milk
5. Preparation of flavored milks.
6. Detection of adulterants in milk.
7. Detection of preservatives in milk.
8. Determine bacteriological quality of milk by MBRT.
9. Determination of mastitis in milk.
10. Visit to local milk processing plant.

M.Sc. (Food Technology) Semester–II
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FTL–551: TECHNOLOGY OF CEREALS, LEGUMES AND OIL SEEDS PROCESSING–II

Credits: 3–0–0

Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

Corn Technology: structure of grain and proximate composition, corn types, Quality evaluation, Dry and Wet milling of corn. Functional properties of corn starch. Products of wet milling, corn starch–evaluation method, properties modification, Syrups, germ oil & gluten. By–products of corn milling and their utilization. Alkaline cooked products: processing of Tortillas, Modern method of Alkaline cooked products, preparation of Nixtamalized cornflours, processing of cornflakes, tortillas chips, extruded snacks, corn germ oil– composition, processing & utilization.

UNIT-II

Oats Technology: Production and trade in the world, Structure of oat grains, proximate composition, chemistry and technology.

Legumes: Production, trade, varieties and structure, chemical composition, processing and cooking methods, utilization of legumes. Criteria of quality evaluation of pulses.

Legumes in Human Nutrition: Nutrient composition of raw, cooked, canned & sprouted legumes. Anti nutritional factors in legumes and their elimination. Technology of legume protein flour, isolates and concentrates: Preparation uses nutritional value, their physico chemical and functional properties. Functional properties of starch and protein from pulses.

UNIT-III

Processed soybean products. Technology of product of soyamilk, tofu, soyprotein concentrate and isolates.

Oilseeds – Production, trade, composition, oil extraction with expellers, solvent extraction processes, purification of crude oil and hydrogenation, interesterification and refining processes for oil.

Recommended Books:

1. Pulses Chemistry and Technology, B. Tiwari and N. Singh RSC.
2. Fats and Oil by Bailey.
3. Chemistry and Technology of Edible Fats and Oils by P.N. Williams & J. Devine.

M.Sc. (Food Technology) Semester–II
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FTL–552: TECHNOLOGY OF FRUITS & VEGETABLES PROCESSING–II

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

1. Quality of Fruits & Vegetables for processing
2. **Fruit Juice:** Method of juice extraction, Equipment, preservation, clarification.
3. Fruit juice concentration–Technique, equipment, flavor /aroma restoration. Problems related to concentration & storage.

UNIT-II

4. Fruit juice based products – Squash, RTS, Syrup
5. Vegetable Juice & products – Tomato puree, paste, ketchup, soup, veg sauces.
6. Jam Jellies & Marmalade– role of pectin.

UNIT-III

7. Preserve & candied fruit.
8. Pickles– fermented, non–fermented
9. Vinegar– Synthetic & Brewed
10. Wines – red and white
11. Soft Drink & Drinking water
12. Potato chips
13. Waste management –utilization disposal
14. Plant Sanitation & Hygiene Management.

Recommended Books:

1. Preservation of Fruits and Vegetables–Girdhari Lal, Siddhapa and Tondon, ICAR, New Delhi.
2. Hand Book of Analysis and Quality Control of Fruits & Vegetable Products– S. Ranganna Tata McGraw Hill, New Delhi.
3. Commercial Vegetable Processing–Wood Roof & Lue.
4. Commercial Fruit Processing–W.V.Cruses.

FTL–553: TECHNOLOGY OF MILK PRODUCTS PROCESSING–II

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

Technology of butter manufacture, ripening and churning, continuous process, butter spreadability, substitutes, spreads, packaging.
Margarine manufacture, emulsions.
Milk powders, whole and SMP, powder agglomeration, equipment used and properties and advantages.
Technology of Evaporated and Condensed milk.

UNIT-II

Cheese manufacture. Types of cheese, changes during ripening, starters and their manufacture.

Ice cream manufacture, ingredients used and their effects, equipment involved, structure of ice cream.
Milk plant sanitation & hygiene

Indigenous milk products: khoa, paneeer, lassi, ghee.

UNIT-III

Packaging of dairy products.

Whey processing.

Fermented milk and milk products–Kefir, Kumis, Yogurt, Bulgarian milk, acidophilus milk.

Recommended Books:

1. Technology of Dairy Products by Early, R.
2. Outlines of Dairy Technology by De. S.
3. Chemistry & Testing of Dairy Products by Atherten.

M.Sc. (Food Technology) Semester–II
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FTL–554: TECHNOLOGY OF EGG & POULTRY PROCESSING

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

1. Eggs – structure, composition, nutritive value and functional properties of eggs.
2. Internal quality of eggs– quality evaluation, quality troubleshooters in eggs, egg grading.
3. Preservation and maintenance of internal quality of eggs.
4. Microbial spoilage of eggs.
5. Packaging and transportation of eggs.

UNIT-II

6. Egg products–Egg powders, frozen eggs, egg foams, factors influencing foaming.
7. Poultry–types, factors affecting quality, chemical composition and nutritive value of poultry meat
8. Poultry dressing–pre and postmortem examination, methods of stunning, slaughter, scalding & dressing.
9. Grading and packaging of poultry meat.

UNIT-III

10. Tenderness of poultry, problem factors in poultry meat.
11. Preservation of poultry meat– chilling, freezing, curing, smoking, dehydration, canning, irradiation.
12. Utilization of poultry industry by–products.
13. Mechanical deboning and restructured products.

Recommended Books:

1. Egg Science & Technology by Staddelman
2. Poultry Products Technology by G.J. Mountney

FTL–555: APPLICATION OF ENZYMES IN FOOD INDUSTRY

Credits: 2–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

1. Fundamentals of enzymes- enzyme general properties, classification, co–enzymes and inhibitors.
2. Enzyme kinetics. Factors affecting enzymatic action.
3. Immobilization of enzymes-methods of immobilization and food applications.
4. Isolation of enzymes from different sources-microbial, plant and animal.

UNIT-II

5. Significance of enzymes in baking industry-amylases, protease, oxidases, lipase and pentosanase.
6. Enzymes in starch industry – production of different corn syrups and crystalline dextrose.
7. Enzymes in brewing, mashing and beer finishing operation.
8. Enzymes in meat industry–Tenderization of meat.

UNIT-III

9. Enzymes in fruits and vegetables products.
    i) Distribution of pectic substances and pectic enzymes in fruits.
    ii) Specific applications of enzymes in juice technology like clarification, debittering, etc.
10. Enzymes in dairy industry-Natural enzymes in milk, Hydrogen peroxide Catalase treatment, Rennet-extraction and application in cheese industry, Lactase in milk processing.
11. Enzymes in fats and oils industry

Recommended Books:

1. Enzymes in Food Processing by Tilak Nagodainthana and Gerald Reed.
2. Enzymes in Food Processing by G.A.Tucker and LFJ Woods.

M.Sc. (Food Technology) Semester–II
(Under Credit Based Continuous Evaluation Grading System)

FTL–556: CONFECTIONERY TECHNOLOGY

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

History of chocolate; cocoa beans and production; microbial and chemical changes occurring during fermentation; drying, storage and transportation of cocoa beans.
Ingredients in chocolate; crystalline and amorphous sugar; lactose, glucose and fructose; milk and other dairy ingredients.
Processing of cocoa beans: cleaning, roasting and winnowing ; grinding of nib, production of cocoa butter and cocoa powder
Refining and conching of chocolate

UNIT- II

Liquid chocolate: viscosity, effects of particle size, fat addition, emulsifier, moisture
Cocoa Butter Properties: Structure, crystalline forms, tempering, fat substitutes and equivalents
Chocolate Tempering, Molding, Enrobing and Panning. Packaging Requirements and material used in packaging of chocolate.
Sugar confectionary: Types of sugar- production , storage , alternative bulk sweeteners, corn syrup and glucose syrup, sorbitol, xylitol, maltitol, isomalt, lactitol, mannitol, polydextrose

UNIT-III

Fondant-structure, manufacture, machinery involved, remelting of fondant, casting of fondant, frappe, caramel, toffee, butterscotch and fudge, formulation and manufacture
Hard Boiled candy- Formulation, ingredients, syrup cooking, forming, pulled sugar, aerated boiling, marsh mallows, naugat
Jellies and gums- Formulations and ingredients, manufacture process. High and low methoxyl pectins used in pectin jellies. Jellies made from other gelling agents: starch, agar, gum Arabic, gelatin.
Hard and Soft Panning.
Spoilage problems, fat and sugar bloom- Causes and Preventions. Packaging Requirements of sugar confectionary and material used. Chewing gum and Bubble gum- Ingredients, functions manufacture and machinery.

References

1. The Science of Sugar Confectionary by W.P. Edwards, RSC Publishers.
2. The Science of Chocolate by Stephent Becett, RSC Publisher.
3. Chocolate, Cocoa and confectionary Science and Technology by Bernard W. Minifie.

M.Sc. (Food Technology) Semester–II
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FTL–557: FOOD ENGINEERING OPERATIONS

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

Pumping in Food Industry: Introduction, general considerations for pipeline selection, factors influencing the choice of a pump, types of pumps.

Mixing and Emulsification: Mixing theory, measurement of mixing, rates of mixing, types of mixers–Mixers for liquids of low or moderate viscosity, Mixers for high viscosity pastes and plastic solids, Mixers for dry solids. Emulsification theory, equipments and applications.

UNIT-II

Filtration and Membrane Separation: Filtration theory, constant rate and constant pressure filtration. Classification of filtration equipments–bed filters, plate–and–frame filter press, leaf filters, continuous rotary filters. Filter media and Filter aids. Membrane separation – ultrafiltration and reverse osmosis.

Centrifugation: Theory, rates of settling in centrifuges. Centrifuge equipment– Liquid–liquid centrifuges, Centrifugal clarifiers, Desludging and dewatering centrifuges.

UNIT-III

Extrusion: Introduction, functions, advantages and terminology of extrusion, types of extruders – single screw extruder, twin screw extruder, their classification and applications in food industry.

Recommended Books:

1. Food Engineering Operations by J.G. Brennan, J.R. Butters, N.D. Cowell & A.E.V. Lilley.
2. Unit Operations of Chemical Engineering by W.L. McCabe, J.C. Smith & P. Harriott.
3. Transport Processes and Unit Operations by C.J. Geankoplis.
4. The Technology of Extrusion Cooking by N.D. Frame.
5. Extruders in Food Applications by M.N. Riaz.

FTP–571: EXPERIMENTS IN CEREALS, LEGUMES AND OIL SEEDS PROCESSING–II

Credits: 0–0–2
Note: Students can use the Non-Programmable scientific calculator.

1. Evaluation of corn: physico–chemical properties, dry and wet milling of corn, corn based product, evaluation of corn starch,
2. Evaluation of oat and oat products,
3. Preparation of soya milk/tofu.
4. Experimental expeller processing and solvent extraction of oil seeds
5. Quality evaluation of oil extracted from corn germ
6. Experimental Milling of Legumes
7. Separation and evaluation of starch and protein from different legumes
8. Cooking quality, textural evaluation and physico–chemical testing of legumes.
9. Preparation of edible flours, protein concentrates and isolates

10 Evaluation starch characteristics of pulses

11. Determination of antioxidant activity in pulses

12. Determination of total phenolics content in pulses

13. Visit to Cereal/ Legume & Oil seeds processing plants.

FTP–572: EXPERIMENTS IN FRUITS AND VEGETABLES PROCESSING –II

Credits: 0–0–2
Note: Students can use the Non-Programmable scientific calculator.

1. Preparation of fruit juice
2. Preparation of vegetable juice
3. Concentration of fruit & vegetable juice
4. Manufacture of squash, RTS
5. Jam Jellies & Marmalade
6. Preserve & Candied Fruit
7. Pickle & Vinegar
8. Water analysis
9. Preparation of wine
10. Potato chips

FTP–573: EXPERIMENTS IN MILK PRODUCTS PROCESSING–II

Credits: 0–0–2
Note: Students can use the Non-Programmable scientific calculator.

Preparation of milk products such as

- Paneer
- Dahi
- Shreekhand
- Khoa
- Ice cream
- Butter
- Kheer
- Flavoured milk

Determination of moisture content, reconstitution and bulk density of milk powders.

Determination of composition of butter such as moisture, fat and salt content.

Industrial visit to see commercial scale processing of milk products.

M.Sc. (Food Technology) Semester–II
(Under Credit Based Continuous Evaluation Grading System)

FTP–574: EXPERIMENTS IN EGGS & POULTRY PROCESSING

Credits: 0–0–2
Note: Students can use the Non-Programmable scientific calculator.

1. Determination of different components of egg.
2. Determination of egg constituents such as ash, Total solid, moisture
4. Determination of Specific gravity of eggs.
5. Preservation of internal quality of egg by different methods.
6. Effect of high temperature on coagulation time of egg contents.
7. To determine effect of different time and temperature combination conditions on formation of iron sulfide in egg.
8. Preparation of Egg pickle.
9. To study slaughtering & dressing of poultry bird
10. To make retail cuts of dressed chicken and calculating percentage yields.
11. To determine meat to bone ratio of chicken
12. Preparation of comminuted meat products.

FTP–575: CONFECTIONERY TECHNOLOGY

Credits: 0–0–2

Note: Students can use the Non-Programmable scientific calculator.

Preparation of super saturated solutions.

Study doctoring of sugar syrups.

Microscopic structure of sugar syrups.

Study the preparation of Fondant, effect of sugars.

Effect of doctoring and inversion on fondant.

Preparation of Hard boiled candy, Caramel and Toffee. Effect of ingredients, Butterscotch and Pulled sugar;

Jellies and gums.

M.Sc. (Food Technology) Semester–II
(Under Credit Based Continuous Evaluation Grading System)

FTP–576: INPLANT TRAINING

(1st June to 30th June)

Credits: 0–0–2

The students would undergo four weeks training in a food processing factory. On the basis of written report, viva–voce and factory manager report, the students will be evaluated (satisfactory/unsatisfactory).

M.Sc. (Food Technology) Semester–III
(Under Credit Based Continuous Evaluation Grading System)

FTL–601: TECHNOLOGY OF MALTING AND BREWING

Credits: 3–0–0

Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

1. 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.
2. 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.
3. Kilning, changes during kilning, Kilning techniques.

UNIT-II

4. Quality evaluation of malt, special malts, milling techniques.
5. Significance of water quality in brewing process
6. Mashing: changes during mashing, methods of mashing, treatment of cereals used as adjucts, properties and complications of using adjuncts of different sources.

   Filtration of wort and sparging.
7. Spent grain: composition and uses.

UNIT-III

8. Techniques of wort boiling, changes during boiling, hops, selection of hops, acidification of mash, wort cooling, methods of fermentation, management of primary fermentation.
9. Lagering: objectives and techniques
10. Beer: composition, filtration, racking, pasteurization & defects.
11. Application of malt in food: Baking, infant food etc.
12. Quality control–malt specifications and test procedures.
13. Brewing operations, constituents of hops. Brewing adjuncts
14. Bear quality–flavor, taste, alcohol content, chemical constituent etc. Head retention–factors affecting head retention. Haze formation.

Books:

1. Malting and Brewing Science Vol. I: Lewis and Young (1981)
2. Malting and Brewing Science Vol. II: Lewis and Young (1982)

M.Sc. (Food Technology) Semester–III
(Under Credit Based Continuous Evaluation Grading System)

FTL–602: PACKAGING TECHNOLOGY

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

1. Introduction to packaging, functions of package. Designing of a package.
2. Physical and chemical properties of packaging materials.
3. Packaging materials: Classification and uses of wood based packaging-Paper, paperboard
4. Glass-composition, properties, advantages and disadvantages
5. Properties and uses of metal and plastics.

UNIT-II

6. Laminates-techniques for fabrication of laminates, uses and advantages of laminates
7. Determination of shelf life of packaged products.
8. Principles of developing a protective package for hygroscopic and light sensitive products.
9. Special packaging methods–vacuum, gas exchange packaging, shrink packaging, free O2 scavenging packaging.
10. Labeling regulations

UNIT-III

11. Edible films and coatings.
12. Aseptic processing of food products.
13. Nano science in food packaging.
14. Specific packaging requirements for different foods–Cereals & cereal products, meat, poultry, fish, fruits and vegetables, fats and oils, beverages and dairy products.

Recommended Books:

1. Principles of Food Packaging by Saccharow and Griffin, 1980.
2. Food Packaging Principles by Gordon Robertson, 2005.
3. Food Packaging by Takashi Kadoya, 1990.
4. Handbook of Food Packaging by Paine & Paine 1992.
5. Foods & Packaging Materials Chemical Interactions by Paul Acherman

M.Sc. (Food Technology) Semester–III
(Under Credit Based Continuous Evaluation Grading System)

FTL–603: FOOD PLANT LAYOUT AND MANAGEMENT

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT–I

Food Plant Organization and management. Organization Chart, Factors in plant location, selection of site, design, layout, Food plant layout and facilities, equipments, machinery and building.

UNIT- II

Corrosion in food processing. Types of corrosion (bimetallic corrosion, caviation corrosion, crevice corrosion, corrosion fatigue, erosion corrosion, fretting corrosion, galvanic corrosion, pitting corrosion, intergranular corrosion, stress corrosion, selective corrosion). Corrosion by non, mildly and highly corrosive food. Corrosion by service fluids– steam, water, alkaline and acidic detergents, sanitizing agents, cooling brines, insulating materials.

UNIT – III

Good Manufacturing Practices. Quality Circles and Quality Culture Concept,
Six Sigma Concept. Government regulatory agencies and their relationship to food industries. Plant maintenance, Objectives and importance, Types of maintenance – corrective or Breakdown maintenance, scheduled maintenance, preventive maintenance and Inspection.

Books:

1. Plant Layout and Design : James M Moore
2. Industrial Engineering and Management : O P Khanna
3. Food Processing Operations and Scale Up : Leon Leuine and Peter Clerk
4. Production Operations and Mangement : B S Goel

M.Sc. (Food Technology) Semester–III
(Under Credit Based Continuous Evaluation Grading System)

FTL–604: TECHNOLOGY OF FISH & MEAT PRODUCTS PROCESSING

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

Scope of meat & meat products industry in India.
Types & microscopic structure of meat tissue.
Chemical composition and nutritive value of meat.
Mechanism of muscle contraction and relaxation.
Postmortem biochemical changes–factor affecting post–mortem changes, thaw rigor and cold shortening.
Properties of fresh meat.

UNIT-II

Packaging of meat– fresh and cured
Preservation of meat–chilling, freezing, curing, smoking, canning, dehydration, irradiation, freeze drying, microwave, chemicals
Meat carcass grading and cuts.
Restructured meat products
Prerigor processing of meat. Mechanical deboning of meat. Meat tenderization–and its techniques.
Sausage–types and other comminuted meat products and their processing steps
Cooking, palatability and eating quality of meat, microbial spoilage of meat
Meat plant sanitation and safety.
Utilization of meat industry by–products. Recent trends in meat processing.

UNIT-III

Fish processing– introduction, fisheries resources of the world, types of fish.
Preservation methods of fish and other sea foods–cold storage, freezing preservation, Canning of fish and fish products. Drying and dehydration. Smoking, curing and pickling.
Fish pastes and sauces. Fish oils, fish protein concentrates fishmeal. Surimi type products.
By products of fish processing industry.

Books:

1. Principles of Meat Science by Forrest et al. 1975.
2. Developments in Meat Science by Lawrie–Vol.1, 2, 3, 4, 1998.
3. Processed Meats by Pearson (1996).
4. Fish Processing Technology by George M. Hall (1997).

M.Sc. (Food Technology) Semester–III
(Under Credit Based Continuous Evaluation Grading System)

FTL–605: FOOD PROCESS ENGINEERING–I

Credits: 3–0–0

Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

1. **Heat Transfer:** Modes of heat transfer–conduction, convection and radiation.

(i) Conduction: Fourier's law, applications of steady–state heat transfer i.e. conductive heat transfer in a rectangular slab, tubular pipe, composite rectangular wall (in series), composite cylindrical tube (in series) and sphere. Critical thickness of insulation.

(ii) Convection: Free convection and forced convection. Estimation of convective heat transfer coefficient and overall heat transfer coefficient. Heat exchangers– Steam injection, Steam infusion, Plate heat exchanger, Scraped surface and Tubular heat exchanger. Design of a tubular heat exchanger by LMTD and NTU–Effectiveness method.

(iii) Radiation: Stefan–Boltzmann law. Black body. Emissivity. Grey body. Application of radiation in food drying.

UNIT-II

2. **Refrigeration:** Refrigeration system and its components. Selection of a refrigerant. Cold–storage plants.

3. **Freezing:** Food Freezing systems: Indirect contact systems– Plate freezers, Air–blast freezers and Freezers for liquid foods; and Direct contact systems–Air– blast and immersion freezing systems. Calculation of freezing time by Plank's equation and other modified methods.

UNIT-III

4. Evaporation: Heat transfer in evaporation, operation methods and types of evaporators– Batch type pan evaporator, Natural circulation evaporator, Rising–film evaporator, Falling–film evaporator, Rising/Falling–film evaporator, Forced–circulation type evaporator, Agitated thin–film evaporator. Vapour recompression systems– Thermal recompression and Mechanical vapour recompression systems.

Recommended Books:

1. Introduction to Food Engineering (3rd Edition) by R. Paul Singh and Dennis R. Heldmann; Academic Press, London, UK, 1993.
2. Heat Transfer by J.P. Holman, 2008.
3. Fundamentals of Food Process Engineering by R.T. Toledo, 1993.
4. Frozen Food Technology by C.P. Mallett, 1992.

M.Sc. (Food Technology) Semester–III
(Under Credit Based Continuous Evaluation Grading System)

FTP– 621: EXPERIMENTS IN MALTING TECHNOLOGY

Credits: 0–0–2

Note: Students can use the Non-Programmable scientific calculator.

1. Evaluation of physic-chemical characteristics of barley.
2. Determination of germination capacity of barley.
3. Estimation of mealiness in barley malt.
4. Determination of husk content of barley.
5. Preparation of malt.
6. Measurement of length of acrospire of barley malt.
7. Determination of "Exact" in barley malt.
8. Determination of diastatic activity in barley malt.
9. Determination of Cold Water Extract of barley malt.
10. Determination of proteolytic activity in barley malt.
11. Estimation of alcohol content in beer.
12. Determination of viscosity of wort.
13. Estimation of saccharificaiton time.
14. Quality testing of beer.
15. Visits to beer manufacturing industries.
16. Determination of alpha amylase activity in barley.

FTP–622 EXPERIMENTS IN FOOD PACKAGING

Credits: 0–0–2
Note: Students can use the Non-Programmable scientific calculator.

1. Identification of different types of packaging material.
2. Physical properties of packaging films.
3. Designing of packaging material for foods.
4. Uniformity and amount of wax determination.
5. Chemical resistance of packaging material
6. WVTR of different packaging material
7. Shelf life studies of packaged food.
8. Grease resistance of packaging material
9. Puncture resistance of corrugated boxes
10. Packaging of fresh foods I) Fruits & Vegetables II) Meat
11. Shrink packaging of poultry
12. Determination of tin coating weight & porosity
13. Determination of continuity of lacquer coating.
14. Determination of tensile strength and heat seal strength of packaging material
15. Determination of water absorption of paperboard and CFB.
16. To conduct drop test.
17. Visits to paper manufacturing industry

FTP–623: EXPERIMENTS IN FISH AND MEAT PRODUCTS PROCESSING

Credits: 0–0–2

Note: Students can use the Non-Programmable scientific calculator.

1. Survey of meat and fish products available in market.
2. To study slaughtering and dressing of meat animals.
3. Meat cutting and handling.
4. Evaluation of meat quality.
5. Preparation of meat spread.
6. Preparation of meat block.
7. Preparation of meat pickle.
8. Preparation of sausage.
9. Preparation of communited meat products.
9. Dressing of fish and calculation of dressing percentage.
10. To determine meat to bone ratio of fish meat.
11. Preparation of fish products such as fish cutlets, pickle, curry.
12. Experiments in dehydration of fish.
13. Experiments in pickling of fish.
14. Visit to local slaughterhouse.

M.Sc. (Food Technology) Semester–III
(Under Credit Based Continuous Evaluation Grading System)

FTP–624 FOOD ENGINEERING LAB–I

Credits: 0–0–2
Note: Students can use the Non-Programmable scientific calculator.

1. Study the working principle and operation of various types of grinders.
2. Study the working principle and operation of various types of crushers.
3. Study of particle size distribution and determination of average particle size.
4. Study of a belt conveyor – its working and design calculations.
5. Study of a screw conveyor – its working and design calculations.
6. Study of a bucket elevator – its working and design calculations.
7. Determination of freezing time of selected food materials.
8. Study of an evaporator.
9. Determination of thermal conductivity of food materials.
10. Determination of heat transfer coefficient in free and forced convection.
11. Visit to a food industry.

M.Sc. (Food Technology) Semester–III
(Under Credit Based Continuous Evaluation Grading System)

FTP-625:SYNOPSIS

Credits: 0–0–2

M.Sc. (Food Technology) Semester–IV
(Under Credit Based Continuous Evaluation Grading System)

FTL–651: QUALITY ASSURANCE IN FOOD INDUSTRY AND SENSORY EVALUATION

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

1. Introduction, objectives, importance and functions of quality control.
2. Methods of quality assessment of materials like fruits & vegetables, cereals and cereal products, dairy product, meat and meat products, poultry, eggs products, oils & fats and processed foods.
3. **Quality Attributes of Foods:** size and shape, color and gloss, Texture–Visual and objectively measurable attributes, Aroma of Foods.
4. Taste–Introduction of sensory evaluation of foods and beverages.

UNIT-II

5. Sampling and specification of raw materials and finished product.
6. Statistical quality control.
7. **Food Laws and Regulation:** Agricultural product Act 1937 (AG–Marks); FSSA (2006); Technical standardization, committee (TSC) 1944 (Army), Fruit product order (FPO), 1955; Prevention of food adulteration Act (PFA), 1954; and rules there of, 1955, sugar (control order 1966, export (quality control & inspection) Act 1963 and rules, 1964, Meat food products order, 1974 ; Bureau of Indian Standards (certification marks) Act, 1952. The consumers' protection act, 1986. Solvent extracted oil, de–oiled meal and edible flours (control) order, 1967, vanaspati (control) order, 1978, Codex Alementarius, HACCP, ISO, Total quality management, Process control charts.
8. Instrumental analysis in quality control: HPLC, GC, calorimeter, spectrophotometer etc.

UNIT-III

9. Sensory evaluation introduction, requirement, panel screening selection, methods and factors affecting sensory and. Consumer acceptance.
10. **Essential Oils:** Occurrence, structure, biosynthesis, monoterpene sesquiterpenes, oxygenated terpeans, extraction of essential oils, terpeanless oils, uses in foods.
11. **Instrumentation:** Techniques of food analysis and principle (Colorimeter, spectrophotometer, fluormetry & polarimetry, chromatography, HPLC and GLC).

Books:

1. Sensory Evaluation Practices by Stone, 2004.
2. Principles of Sensory Evaluation of Foods by M.A. Amerine, R.M. Rangborn and E.B. Roessler.
3. Quality Control in Food Industry by Hershoerfer, 1972.
4. Quality Control in Food Industry by Kramer and Tuig.

M.Sc. (Food Technology) Semester–IV
(Under Credit Based Continuous Evaluation Grading System)

FTL –653: HUMAN RESOURCES AND MARKETING MANAGEMENT

Credits: 3–0–0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

Introduction to Human Resource Management and its definition, Functions of Human Resource Management and its relation to other Managerial functions, Importance of human resource management in Industry. Need for Human Resource Planning, Process of Human Resource Planning, Methods of Recruitment and Interviews. Meaning and Importance of Placement and Induction, Job satisfaction and its Importance.

UNIT-II

Motivation, Factors affecting motivation, Introduction to Motivation theory, Quality of Working life. Grievances and Grievance Handling Procedure, Discipline and Disciplinary action. Human Relations and Industrial Relations, Differences between Human Relations and Industrial Relations, Factors required for Good Human Relations policy in Industry.

UNIT-III

Market– meaning, scope, types of markets, marketing functions, marketing of food produce in India. Storage and Warehousing. Four P's of market– Market Price, Product, Packaging and Promotion. Co–ordination of research personnel and facilities with the production and sales department. Test marketing of food products.

Books:

1. Personnel Management : CB Mamoria
2. Principles of Personnel Managements : Dawin B Filppo
3. New Food Product Development : Gordon W Fuller
4. Principle and Practice of Marketing in India : CB Mamoria and RC Joshi

M.Sc. (Food Technology) Semester–IV
(Under Credit Based Continuous Evaluation Grading System)

FTL–654: FOOD PROCESS ENGINEERING–II

Credits: 3-0-0
Note: Students can use the Non-Programmable scientific calculator.

UNIT-I

1. **Energy in Food Processing:** Steam generation, thermodynamics of phase change. Steam tables. Steam utilization. Fuel utilization. Electric power utilization, Electric motors, Electrical controls, Electric lighting.

2. **Crystallisation:** Solubility, types of crystallizers– tank crystallizer, scraped surface crystallizer, circulating–liquid evaporator–crystallizer, circulating–magma vacuum crystallizer, Nucleation theories.

UNIT-II

3. **Distillation:** Vapour–liquid equilibrium relations, Raoult's law, boiling point diagram, classification of distillation– Equilibrium or Flash distillation, Simple batch or Differential distillation, Simple steam distillation and Distillation with reflux.
4. **Leaching:** Rates of leaching, types of leaching equipment– Fixed bed leaching, Moving–bed leaching, Agitated solid leaching.

UNIT-III

5. **Drying:** Theory of drying, free moisture content, bound moisture content, critical moisture content, equilibrium moisture content, constant rate drying period, falling rate drying period; heat transfer in drying; types of driers– tray drier, tunnel drier, roller or drum drier, fluidized bed drier, spray drier, pneumatic drier, rotary drier, trough drier, bin drier, vacuum drier and freeze drier.

Recommended Books:

1. Fundamentals of Food Process Engineering by R.T. Toledo, 1993.
2. Transport Processes and Unit Operations (3rd Edition) by Christie J. Geankoplis, Prentice– Hall of India Pvt Ltd, New Delhi, 1999.
3. Unit Operations of Chemical Engineering (5th Edition) by Warren L. McCabe, Julian C. Smith, Peter Harriott; McGraw–Hill, Inc., New Delhi, 1998.
4. Fundamentals of Food Engineering by Radha Charan Verma and Sanjay Kr Jain; Himanshu Publications, Udaipur, 2002.

FTP–671: QUALITY ASSURANCE IN FOOD INDUSTRY AND SENSORY EVALUATION (PRACTICAL)

Credits: 0–0–2
Note: Students can use the Non-Programmable scientific calculator.

1. To examine the quality of fruits and vegetables, meat, poultry, milk, cereal and their products.
2. Application of statistical techniques in quality control and sensory evaluation.
3. Identification and ranking of food product attributes
4. Sensory methods for measuring food quality: Hedonic Scale, TRIO, Paired Comparison, DVO.
5. Instrumental techniques for evaluation of color, texture, viscosity and consistency etc.
6. Texture evaluation of fruits, vegetable, dough, baked, paste, dairy and meat products.
7. Analysis of products for FPO specifications
8. Qualitative and quantitative Determination of adulterants in milk Ghee, Khoa, edible oil, Legumes, saffron, sugar, black pepper, sela rice, silver leaves, Turmeric, Chillies, Coffee, Jaggery powder, wheat, rice flour, common salt, honey, mustard seeds.
9. Determination of food additives and food constituents.
10. Visit to Food Processing industry/ quality control lab implementing GMP/ISO/HACCP.

Books:

1. Chemical and Biological Methods for water pollution studies R.K.Trivedy & P.K.Goel, 1984.
2. Pearons composition and analysis of foods by R. Kirk/R. Sawyer, 1991.
3. Physical properties of food by R. Jowitt & Fescher
4. Analysis of food contaminants by J. Gilbert, 1995.

M.Sc. (Food Technology) Semester–IV
(Under Credit Based Continuous Evaluation Grading System)

FTP–672: FOOD ENGINEERING LAB–II

Credits: 0–0–2
Note: Students can use the Non-Programmable scientific calculator.

1. Determination of viscosity of liquid foods.
2. Determination of Reynolds number and nature of fluid flow in a pipe.
3. Determination of pressure drop using manometer.
4. Study of dehydration characteristics of food materials using Cabinet drier.
5. Study of dehydration characteristics of food materials using Fluidized bed drier.
6. Study the working principle and operation of a spray drier.
7. Study the working principle and operation of a freeze drier.
8. Study of a distillation operation.
9. Study of a filtration operation.
10. Study of a mixer.
11. Study of psychrometrics–use and applications.

FTP–673: SEMINAR

Credits: 0–0–2

M.Sc. (Food Technology) Semester–IV
(Under Credit Based Continuous Evaluation Grading System)

FTP–674: PROJECT WORK

Credits: 0–0–2