

FACULTY OF SCIENCES

SYLLABUS

FOR

M. Sc. (FOOD TECHNOLOGY) (Credit Based Evaluation & Grading System) (Semester: I - IV)

Examinations: 2019-20



GURU NANAK DEV UNIVERSITY AMRITSAR

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

SCHEME

**Note : All Theory Papers having Mid Semester Marks : 20 & End Semester Marks : 80.
 Total Marks will be 100.**

FIRST SEMESTER

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTL-501	C	Principles of Food Processing and Preservation	3	-	-	3
FTL-502	C	Technology of Cereals, Legumes and Oil Seeds Processing-I	3	-	-	3
FTL-503	C	Technology of Fruits and 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 and Vegetables Processing-I	-	-	2	2
FTP-523	C	Experiments in Cereals, Legumes and Oil Seeds Processing-I	-	-	2	2
FTP-524	C	Experiments in Fluid Milk Processing-I	-	-	2	2
FTP-521 OR FTP-525	E	Experiments in Food Chemistry OR Experiments in Food Microbiology	-	-	2	2
Total Credits			18	-	8	26

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

Option 1: FTL-505 & FTP-525 (Food Microbiology)

OR

Option 2: FTL-506 & FTP-521 (Food Chemistry)

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 Processing-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 Eggs and Poultry Processing	3	-	-	3
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 and 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	Experiments in Confectionery Technology	-	-	2	2
FTP-576	A	In-Plant Training (1 st June-30 th June)	-	-	2	2
Total Credits			18	-	12	30

Note-1 : Submission of In-Plant Training Report within one week after completion of training.

Note-2: PSL-053 ID Course Human Rights & Constitutional Duties (Compulsory Paper). Students can opt. this paper in any semester except the 1st Semester. This ID Paper is one of the total ID Papers of this course.

M.Sc. (Food Technology) (Semester System)
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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 Engineering Lab-I	–	–	2	2
FTP-625	A	Synopsis	–	–	2	2
*ID-1	I	Interdisciplinary (ID) Course	–	–	–	–
Total Credits			15	–	10	25+ID

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
FTL-655	C	Applications of Enzymes in Food Industry	3	-	-	3
FTP-671	C	Experiments in Quality Assurance in Food Industry and Sensory Evaluation	-	-	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	20+ID

Note: Research Project to be submitted by 30thMay

FTL-501: PRINCIPLES OF FOOD PROCESSING AND PRESERVATION

Credits: 3-0-0

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Introduction and historical developments of food preservation.

Principles of Food Preservation. Food Spoilage: Microbial, Physical, Chemical and Miscellaneous.

Refrigeration Storage: Requirements of refrigeration storage; changes in food during refrigeration storage; Refrigeration loads.

Freezing and Frozen Storage: Freezing curves, Factors determining freezing rate, types of freezer, freezing process thawing, changes in Food during freezing.

SECTION-B

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.

SECTION-C

Ionizing Radiation: Source; Equipment; Mechanism of preservation, Dose determination, Effect on food.

Microwaves: Mechanism of heating, Equipment and its Effect on food

Food Additives: Definition, Types, and Functions in food.

SECTION-D

Thermal Processing: Determination of thermal processing schedule, canning process, Equipment, Effect on food, Aseptic processing

Intermediate Moisture (IM) Foods: Principles, Characteristics, Advantages and Problems in developing new IM foods.

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 and Desrosoer.
2. Food Science by N.N. Potter.
3. Introduction to Food Science and Technology by Stewart.

**FTL-502: TECHNOLOGY OF CEREALS, LEGUMES AND OIL SEEDS
PROCESSING-I**

Credits: 3-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

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.

SECTION-B

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, Extensigraph, 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.

SECTION-C

Rice production, rice types. 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.

SECTION-D

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 and 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

**FTL-503: TECHNOLOGY OF FRUITS AND VEGETABLES
PROCESSING-I**

Credits: 3-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

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

SECTION-B

Prepackaging of fresh Fruits & Vegetables.
Storage of fresh Fruits & Vegetables–Ambient, Refrigerated, Modified atmosphere, evaporative cool storage.
General steps of processing of Fruits & Vegetables: Washing, sorting/grading, Peeling, blanching, coring, pitting.

SECTION-C

Canning of Fruits & Vegetables–General process & equipment.
Aseptic canning of Fruits & Vegetables: Process & Equipment, UHT.
Containers for conventional & aseptic canning.

SECTION-D

Spoilage of canned Fruits & Vegetables.
Labeling requirements of Fruits & Vegetables products.
Freezing– Freezing curve, process equipment, storage, thawing.
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

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

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

SECTION-B

Lactose, structure and properties, Minerals and vitamins.
Microbiology of milk, sources of milk contamination.
Methods of milk collection and transportation.
Judging and grading of milk, defects in milk- its causes and prevention.

SECTION-C

Liquid milk processing- filtration/clarification, standardization, pasteurization- (objectives, types, LTLT, HTST, UHT, equipment, advantages), Homogenization (objectives, process, advantages).

SECTION-D

Special milks- Sterilized, flavored, homogenized, reconstituted, recombined, toned, double toned, vitaminized, standardized milk.
Packaging, distribution and storage of liquid milk. HACCP in the milk plant.

Recommended Books:

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

FTL-505: FOOD MICROBIOLOGY

Credits: 3-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

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.

SECTION-B

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.

SECTION-C

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 aw, 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.

SECTION-D

Basic Principles of Food Plant Sanitation.

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

Recommended Books:

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

FTL-506: FOOD CHEMISTRY

Credits: 3-0-0

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Introduction to chemistry of foods.

Carbohydrates:

- Monosaccharides: Occurrence, Classification, hexoses, isomerism, structure determination, diagrammatic representation of optical isomers, absolute configuration, reducing power of sugars, sugar derivative, mutar transformation of sugars and amino sugar
- Oligosaccharides, Disaccharide—sucrose, biosynthesis, trisaccharides classification, commercial sources.
- Polysaccharide: Classification, cellulose, and starches, control hydrolysis of starch, isolation from natural products, enzymes, synthetic polysaccharides, plant gums and hemicellulose.

SECTION-B

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

Proteins: Occurrence, amino acids, physical and chemical properties, determination, peptides, proteins and their properties, sequence of amino acids, structure of protein denaturation, major source of protein. Protein metabolism, Digestion, absorption and functions. End products of protein metabolism Inter-medially metabolism of amino acids and the urea cycle.

SECTION-C

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

Pectic Substances: Occurrence, structure, properties and uses in foods.

SECTION-D

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 and 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

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

Essential Oils: Occurrence, structure, biosynthesis, monoterpene sesquiterpenes, oxygenated terpenes, extraction of essential oils, terpenoid oils, uses in foods. Flavoring compounds in foods.

Recommended Books:

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

FTL-507: BASICS OF FOOD ENGINEERING

Credits: 3-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Dimensions and Units: Basic and derived units, The SI system. Mathematical techniques in process calculations: Linear and Non-linear equations.

SECTION-B

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

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

SECTION-C

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

SECTION-D

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 and D.R. Heldman.
2. Fundamentals of Food Process Engineering by R.T. Toledo.
3. Transport Processes and Unit Operations by C.J. Geankoplis

FTP-521: EXPERIMENTS IN FOOD CHEMISTRY

Credits: 0-0-2

The Students can use Non-Programmable scientific calculators.

1. Preparation and standardization of solution.
2. Moisture content by
 - a. Drying method (using oven and vacuum oven)
 - b. Moisture meters
 - c. Distillation
 - d. Karl Fischer titration.
3. Ash and Mineral Matter: Total ash, acid soluble and insoluble ash, alkalinity of ash, phosphorus, calcium, iron, lead, copper and tin estimations.
Demonstration of polarograph for the estimation of some trace elements.
4. Protein Content by:
 - a. Kjeldhal method
 - b. Formal titration of Folin-ciocalteries method
 - c. Quantitative tests for proteins paper chromatography of amino acids
5. Carbohydrates-qualitative tests, estimation of reducing & non-reducing sugars, total sugars, starch and polarimetry of sugars.
6. Lipid estimation: Soxhlet method, PV, saponification, iodine value, acid value, Free fatty acid.

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 AND 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.

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 (%) and fat (%).
2. Determination of acidity of milk
3. Determination of Specific gravity of milk and 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.

FTP-525: EXPERIMENTS IN FOOD MICROBIOLOGY

Credit: 0-0-2

The Students can use Non-Programmable scientific calculators.

1. Microscopy
2. Micrometry
3. Cleaning and sterilization of glassware
4. Preparation of nutrient media and techniques of inoculation
5. Staining techniques–Monochrome staining negative staining, gram staining, acid fast Staining, spore staining, capsule staining.
6. Isolation of pure cultures.
7. Identification of bacteria, yeasts, molds.
8. Anaerobic Culture methods.
9. Growth characteristics of bacteria
 - a) Determination of microbial numbers– direct and plate count
 - b) Generation time
 - c) Factors influencing growth–pH, temperature thermal death, time, growth curves for bacteria and yeasts, Osmotic pressure, preservatives.
10. Examination of moulds important in foods.
11. Microbiological examination of processed food products:
 - a) Water.
 - b) Milk and milk products.
 - c) Fruits and vegetables.
 - d) Egg, meat and fish products.

Recommended Books:

1. Microbiology–Pelczar, Smith & Chan
2. Food Microbiology by Frazier

**FTL-551: TECHNOLOGY OF CEREALS, LEGUMES AND
OIL SEEDS PROCESSING-II**

Time: 3 Hours

Credits: 3-0-0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

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 and 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 and utilization.

SECTION-B

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.

SECTION-C

Legumes in Human Nutrition: Nutrient composition of raw, cooked, canned and 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.

SECTION-D

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 by 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 and J. Devine.

FTL-552: TECHNOLOGY OF FRUITS AND VEGETABLES PROCESSING-II

Time: 3 Hours

Credits: 3-0-0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Quality of Fruits and Vegetables for processing

Fruit Juice: Method of juice extraction, Equipment, preservation, clarification.

Fruit juice concentration–Technique, equipment, flavor /aroma restoration.

Problems related to concentration & storage.

SECTION-B

Fruit juice based products – Squash, RTS, Syrups.

Vegetable Juice and products – puree, paste, ketchup, soup, sauces.

Jam Jellies & Marmalade– Role of pectin.

SECTION-C

Preserve and candied fruit.

Pickles– fermented, non–fermented

Vinegar– Synthetic & Brewed

Wines – red and white

Soft Drink and Drinking water

SECTION-D

Potato chips

Waste management –utilization and disposal

Plant Sanitation and 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**Time: 3 Hours****Credits: 3-0-0****Max. Marks: 100****Mid Semester Marks : 20****End Semester Marks : 80****Mid Semester Examination: 20% weightage****End Semester Examination: 80% weightage****Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Technology of butter manufacture, ripening and churning, continuous process, butter spread ability, substitutes, spreads, packaging.

Margarine manufacture, emulsions.

SECTION-B

Milk powders, whole and SMP, powder agglomeration, equipment used and properties and advantages.

Technology of Evaporated and Condensed milk.

SECTION-C

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

Ice cream manufacture, ingredients used and their effects, equipment involved, structure of ice cream.

SECTION-D

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

Packaging of dairy products.

Fermented milk and milk products—Kefir, Kumis, Yogurt, dahi, Bulgarian milk, acidophilus milk. Milk plant sanitation and hygiene

Recommended Books:

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

**FTL-554: TECHNOLOGY OF EGG AND POULTRY
PROCESSING**

Time: 3 Hours

Credits: 3-0-0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Eggs – structure, composition, nutritive value and functional properties of eggs.
Internal quality of eggs– quality evaluation, quality troubleshooters in eggs, egg grading.
Preservation and maintenance of internal quality of eggs

SECTION-B

Microbial spoilage of eggs
Packaging and transportation of eggs
Egg products–Egg powders, frozen eggs, egg foams, factors influencing foaming.

SECTION-C

Poultry–types, factors affecting quality, chemical composition and nutritive value of poultry meat.
Poultry dressing–pre and postmortem examination, methods of stunning, slaughter, scalding and dressing.
Grading and packaging of poultry meat.

SECTION-D

Tenderness of poultry, problem factors in poultry meat.
Preservation of poultry meat– chilling, freezing, curing, smoking, dehydration, canning, irradiation.

Utilization of poultry industry by–products.

Mechanical deboning and restructured products.

Recommended Books:

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

FTL-556: CONFECTIONERY TECHNOLOGY

Time: 3 Hours

Credits: 3-0-0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

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.

SECTION-B

Refining and conching of chocolate

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.

SECTION-C

Sugar confectionary: Types of sugar- production , storage , alternative bulk sweeteners, corn syrup and glucose syrup, sorbitol, xylitol, maltitol, isomalt, lactitol, mannitol, polydextrose
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

SECTION-D

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.

Recommended Books:

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

FTL-557: FOOD ENGINEERING OPERATIONS**Time: 3 Hours****Credits: 3-0-0****Max. Marks: 100****Mid Semester Marks : 20****End Semester Marks : 80****Mid Semester Examination: 20% weightage****End Semester Examination: 80% weightage****Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

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

SECTION-B

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.

SECTION-C

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.

SECTION-D

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 and A.E.V. Lilley.
2. Unit Operations of Chemical Engineering by W.L. McCabe, J.C. Smith and 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
Max. Marks : 100

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 and Oil seeds processing plants.

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

Credits: 0-0-2
Max. Marks : 100

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

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

FTP-573: EXPERIMENTS IN MILK PRODUCTS PROCESSING-II

Credits: 0-0-2
Max. Marks : 100

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

1. Preparation of milk products such as

- i) Paneer
- ii) Dahi
- iii) Shreekhand
- iv) Khoa
- v) Ice cream
- vi) Butter
- vii) Kheer
- viii) Flavoured milk

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

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

4. Industrial visit to see Commercial Scale Processing of Milk Products.

FTP-574: EXPERIMENTS IN EGGS AND POULTRY PROCESSING

Credits: 0-0-2
Max. Marks : 100

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

FTP-575: EXPERIMENTS IN CONFECTIONERY TECHNOLOGY

Credits: 0-0-2
Max. Marks : 100

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

1. Preparation of super saturated solutions.
2. Study doctoring of sugar syrups.
3. Microscopic structure of sugar syrups.
4. Study the preparation of Fondant, effect of sugars.
5. Effect of doctoring and inversion on fondant.
6. Preparation of Hard boiled candy, Caramel and Toffee: effect of ingredients
7. Butterscotch and Pulled sugar; Jellies and gums.

FTP-576: IN PLANT 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).

FTL-601: TECHNOLOGY OF MALTING AND BREWING**Credits: 3-0-0****Time: 3 Hours****Max. Marks: 100****Mid Semester Marks : 20****End Semester Marks : 80****Mid Semester Examination: 20% weightage****End Semester Examination: 80% weightage****Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator**Section-A**

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.

Section-B

3. Kilning, changes during kilning, Kilning techniques.
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 adjuncts, properties and complications of using adjuncts of different sources.
Filtration of wort and sparging.

Section-C

7. Spent grain: composition and uses.
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

Section-D

10. Beer: composition, filtration, racking, pasteurization and 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. Beer quality–flavor, taste, alcohol content, chemical constituent etc. Head retention–factors affecting head retention. Haze formation.

Recommended Books:

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

FTL-602: PACKAGING TECHNOLOGY

Credits: 3-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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

Section-B

5. Properties and uses of metals and plastics
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.

Section-C

9. Special packaging methods–vacuum, gas packaging, shrink packaging, free O₂ scavenging packaging.
10. Labelling regulations
11. Edible films and coatings

Section-D

12. Aseptic processing of food products.
13. Nano science in food packaging
14. Specific packaging requirements for different foods–Cereals and 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 and Paine 1992.
5. Foods and Packaging Materials Chemical Interactions by Paul Acherman.

FTL-603: FOOD PLANT LAYOUT AND MANAGEMENT

Time: 3 Hours

Credits: 3-0-0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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.

Section-B

Corrosion in food processing. Types of corrosion (bimetallic corrosion, cavitation 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.

Section-C

Good Manufacturing Practices. Good Laboratories Practices. Quality Circles and Quality Culture Concept, Six Sigma Concept. Government regulatory agencies and their relationship to food industries.

Section-D

Plant maintenance, Objectives and importance, Types of maintenance – corrective or Breakdown maintenance, scheduled maintenance, preventive maintenance and Inspection.

Recommended 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 |

FTL-604: TECHNOLOGY OF FISH AND MEAT PRODUCTS PROCESSING

Credits: 3-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

Scope of meat and meat products industry in India.
Types and microscopic structure of meat tissue.
Chemical composition and nutritive value of meat.
Mechanism of muscle contraction and relaxation.

Section-B

Postmortem biochemical changes-factor affecting post-mortem changes, thaw rigor and cold shortening.
Properties of fresh meat.
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

Section-C

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.

Section-D

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.

Recommended 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).

FTL-605: FOOD PROCESS ENGINEERING-I

Credits: 3-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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.
- (ii) **Convection:** Free convection and forced convection. Estimation of convective heat transfer coefficient and overall heat transfer coefficient. Critical thickness of insulation. 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.

Section-B

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

Section-C

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.

Section-D

- 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.

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 acrospires 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 saccharification 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. Uniformity and amount of wax determination.
4. Chemical resistance of packaging material
5. WVTR of different packaging material
6. Shelf life studies of packaged food.
7. Grease resistance of packaging material
8. Puncture resistance of corrugated boxes
9. Pre-Packaging of Fruits and Vegetables.
10. Determination of thermal shock resistance of glass containers
11. Determination of tin coating weight and porosity
12. Determination of continuity of lacquer coating.
13. Determination of tensile strength and heat seal strength of packaging material
14. Determination of water absorption of paperboard and CFB.
15. To conduct drop test.
16. Visit to Industry/Institute to study packaging equipment/machinery

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 communized meat products.
10. Dressing of fish and calculation of dressing percentage.
11. To determine meat to bone ratio of fish meat.
12. Preparation of fish products such as fish outlets, pickle, curry.
13. Experiments in dehydration of fish.
14. Experiments in pickling of fish.
15. Visit to local slaughterhouse.

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 calorific value of food sample using Bomb Calorimeter.
10. Determination of heat transfer coefficient in free and forced convection.
11. Visit to a food industry.

FTP-625:SYNOPSIS

Credits: 0-0-2

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

Credits: 3-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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

Section-B

4. Taste–Introduction of sensory evaluation of foods and beverages.
5. Sampling and specification of raw materials and finished product.
6. Food Safety and standards authority of India, 2006, FSS Legislation, Food Safety and Standards Regulations, ISO:9000, iso : 22000 Codex Alimentarius;

Section-C

7. HACCP; ISO; Total Quality Management; Process Control Charts.
8. Instrumental analysis in quality control: HPLC, GC, Colorimeter, Spectrophotometer etc.
9. Sensory evaluation introduction, requirement, panel screening selection, methods and factors affecting sensory and. Consumer acceptance.

Section-D

10. Essential Oils: Occurrence, structure, biosynthesis, monoterpene sesquiterpenes, oxygenated terpenes, extraction of essential oils, terpeneless oils, uses in foods.
11. Instrumentation: Techniques of Food Analysis and Principle (Colorimeter, spectrophotometer, fluorometry and polarimetry, chromatography, HPLC and GLC).

Recommended 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.

FTL –653: HUMAN RESOURCES AND MARKETING MANAGEMENT

Time: 3 Hours

Credits: 3–0–0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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,

Section-B

Job satisfaction and its Importance. Motivation, Factors affecting motivation, Introduction to Motivation theory, Quality of Working life.

Section-C

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.

Section-D

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.

Recommended 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

FTL-654: FOOD PROCESS ENGINEERING-II**Time: 3 Hours****Credits: 3-0-0****Max. Marks: 100****Mid Semester Marks : 20****End Semester Marks : 80****Mid Semester Examination: 20% weightage****End Semester Examination: 80% weightage****Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator**Section-A**

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.

Section-B

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

Section-C

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.

Section-D

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.

FTL-655: APPLICATIONS OF ENZYMES IN FOOD INDUSTRY**Credits: 3-0-0****Time: 3 Hours****Max. Marks: 100****Mid Semester Marks : 20****End Semester Marks : 80****Mid Semester Examination: 20% weightage****End Semester Examination: 80% weightage****Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator**Section-A**

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.

Section-B

4. Isolation of enzymes from different sources-microbial, plant and animal.
5. Significance of enzymes in baking industry-amylases, protease, oxidases, lipase and pentosanase.
6. Enzymes in meat industry-Tenderization of meat.

Section-C

7. Enzymes in starch industry – production of different corn syrups and crystalline dextrose.
8. Enzymes in brewing, mashing and beer finishing operation.
9. Enzymes in fats and oils industry

Section-D

10. 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.
11. Enzymes in dairy industry-Natural enzymes in milk, Hydrogen peroxide Catalase Treatment, Rennet-extraction and application in cheese industry, Lactase in milk processing.

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.

**TP-671: EXPERIMENTS IN QUALITY ASSURANCE IN FOOD
INDUSTRY AND SENSORY EVALUATION**

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.

Recommended Books:

1. Chemical and Biological Methods for water pollution studies R.K.Trivedy and 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 and Fescher
4. Analysis of Food Contaminants by J. Gilbert, 1995.

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

FTP-674: PROJECT WORK

Credits: 0-0-2