

## Bachelor of Technology in Food Technology

### 5<sup>th</sup> SEMESTER

S.N	Subject Code	Subject	Teaching			Sessional award	Theory	Pract.	Total Marks	Duration of exam in Hrs	Formatted
			L	T	P						Formatted
1	FTT-301 E	Dairy Product Technology	3	2	0	50	100	0	150	3	Formatted ... [1]
2	FTT – 303 E	Fruit & vegetable Technology	3	2	0	50	100	0	150	3	Formatted ... [2]
3	FTT-05 E	Food analysis & Quality control	3	1	0	50	100	0	150	3	Formatted ... [3]
4	FTT-307 E	Food Engineering	3	2	0	50	100	0	150	3	Formatted ... [4]
5	FTT-309E	Industrial Pollution Control	3	1	0	50	100	0	150	3	Formatted ... [5]
6	FTT- 311E	Dairy Product lab	0	0	2	25	0	50	75	3	Formatted ... [6]
7	FTT- 313 E	Fruit & vegetable Technology Lab	0	0	3	25	0	50	75	3	Formatted ... [7]
8	FTT- 315 E	Food analysis & Quality control Lab	0	0	3	25	0	50	75	3	Formatted ... [8]
9	FTT- 317 E	Food Engineering lab	0	0	2	25	0	50	75	3	Formatted ... [9]
10	FTT- 319 E	Training Seminar	0	2	0	25	0	25	50	2	Formatted ... [10]
<b>Grand Total</b>			<b>15</b>	<b>10</b>	<b>10</b>	<b>375</b>	<b>500</b>	<b>225</b>	<b>1100</b>		Formatted
			<b>35</b>								

## FTT-301E DAIRY PRODUCT TECHNOLOGY

L	T	P	Sessional	50 Marks
3	1	0	Theory	100 Marks
			Total	150 Marks
			Exam	Duration
			3hrs	

**Note: -The examiner will set eight questions, taking two from each unit. The students will be required to attempt at least one from each unit. All questions will carry equal marks.**

### UNIT – I

**Special Milks**:- Sterilized Milk, homogenized milk, soft- curd milk, flavored milk, vitaminized/ irradiated milk, frozen concentrated milk, fermented milk, standardized milk, reconstituted/ rehydrated milk, recombined milk, toned milk, double toned milk, humanized milk, miscellaneous milk.

**Cream**:- Introduction, definition, classification, composition, food and nutritive value, physico- chemical properties, production, collection of cream, neutralization of cream, standardization of cream, pasteurization of cream, manufacture of different types of cream, packaging, storage and distribution of table cream, judging and grading of cream, defect in cream, their causes and prevention, uses of cream.

### UNIT – II

**Butter**:- Introduction, definition, history, classification, composition, food and nutritive value, method of manufacture, packaging & storage, distribution; Overrun; yield; theories of churning; history of development of the butter churn, fat losses in butter making, continuous butter making, judging and grading of table butter, defect in butter, , their causes and prevention, uses of butter.

**Butter oil**:- Introduction, definition, history, classification, composition, food and nutritive value, method of manufacture, cooking, packaging, storage & distribution, market quality, keeping quality, anti- oxidants as preservatives, judging and grading of butteroil, defects in butteroil, , their causes and prevention, uses.

### UNIT – III

**Dried Milk Products** :- Introduction, buttermilk powder, whey powder, cream powder, butter powder, ice cream mix powder, cheese powder, malted milk powder, (Dried) infant milk Food, dry sodium casein ate, srikhand powder, channa powder, khoa powder.

**Indian Dairy Products** :- Introduction, statistics of production and consumption, comparison with western dairy products, flow diagram of manufacture from whole milk, kheer, khoa/mawa, Khurchan, rabri, kulfi/malai–ka-baraf, dahi, srikhand, panir, channa, makkhan, ghee, lassi, ghee residue.

## UNIT – IV

**Cheese** :- Introduction, definition, classification, composition, nutritive value & manufacturing of cheese, curing, freezing, yield, processing and packaging, storage, judging and grading, defects and their remedies, uses of cheese.

**By Products**:- Introduction, definition, classification, composition, principle and methods of utilization.

### **TEXT BOOKS**

<u>Title</u>	<u>Author</u>
Outline of dairy Tech.	Sukumar de

### **REFERENCE BOOKS**

Milk and milk products	Lampert Lincoln M
Arbuckle's	Ice Cream

## FTT-303E FRUIT & VEGETABLE TECHNOLOGY

L	T	P	Sessional	50 Marks
3	1	0	Theory	100 Marks
			Total	150 Marks
			Exam	Duration
			3hrs	

**Note: -The examiner will set eight questions, taking two from each unit. The students will be required to attempt at least one from each unit. All questions will carry equal marks.**

### UNIT – I

**Spoilage in Canned Foods**:- Discoloration of fruit products, metallic contamination, coloring matter in fruit & vegetables, canned food products, Discoloration corrosion and perforation in plate, spoilage by micro organisms, spoilage by fungi, storage life of canned products, hydrogen swell & perforation preserves, candied and crystallized fruits, preliminary processing, candied, glazed and crystallized fruits, improved equipment for manufacture of preserves, some common preserves, candied fruits.

### UNIT – II

**By Products**:- Utilization waste material, citrus by products, citrus oils. Manufacture and uses of pectin:- Pectin from apples, citrus fruits, and other materials.

### UNIT – III

**Water for Cannery** :- Qualities of water, analysis, purification, major mineral constituents, bacteriological examination, analysis and chlorination.

**Food Colours**:- Certified and Banned colours.

### UNIT – IV

**Processing and Preservation for a small scale industry**:- Products for small scale manufacture, equipments, medium and large sized multi commodity processing.

**Process time for canned vegetables and non acid foods** :- Graphical and general method, equal time interval procedure, general consideration, determining 'F' value from death rate data.

### TEXT BOOK

<u>Title</u>	<u>Author</u>
Handbook of Analysis for fruit and Vegetables	Ranganna

### REFERENCE BOOK

Quality control in food industry (vol I& II)	Kramer & Twig
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## FTT-305E FOOD ANALYSIS AND QUALITY CONTROL

L    T    P  
3    1    0

Sessional    50 Marks  
Theory        100 Marks  
Total         150 Marks  
Exam Duration 3hrs

**Note:** -The examiner will set eight questions, taking two from each unit. The students will be required to attempt at least one from each unit. All questions will carry equal marks.

### UNIT – I

**Introduction** :- Quality control department and its requirements. Function of quality control department, Quality control lab, sample preparation techniques.

**Quality Attributes and Measurement:- Colour & Gloss:-** Its importance need of colour determination, method of colour determination (spectrophotometer, colorimeter, Hunter colour lab, CIE system, flavors, theory of taste and smell.

### UNIT – II

**Consistency and viscosity:-** Factor affecting Consistency and viscosity, method of measurement (capillary viscometer, adman's consistometer, Brook field viscometer, orificemeter etc.) Determination of colour and its importance.

**Kinesthetics and Texture:-** Food texture, physical characteristics of food, texture profile analysis texture measurement instruments (maturometer, Magness – Tylor pressure tester, Fibro meter, texturmeter, tendero meter, succrometer, karmarshear press, instron)

### UNIT – III

**Modern Techniques of Food Analysis:-** Chromatography (adsorption and partition chromatographic techniques). Spectrophotometry and colorimetry .

**Measurements of various properties** :- Optical rotation, optical density, pH, specific gravity, refractive index. Importance of measurement and properties.

### UNIT – IV

**Sensory Quality and Analysis** :- Aims, objective, sensory scales, sensory requirements, panel selection, requirements of sensory lab, sensory measurement techniques.

**Food Law and Regulations** :- Development of food standards, objectives and requirements of consumers protection Act. (1986), Vanaspati control Order (1978), Export quality control and inspection Act. (1963), Meat products order (1974) Codex

alimentary Act, ISO 9000 series. TQM, GMP, use of HACCP in food processing, food adulteration & food safety.

**TEXT BOOK**

Title

Quality control in food industry(vol I& II)

Author

Kramer & Twig

**REFERENCE BOOK**

Handbook of Analysis for fruit 7 Vegetables

Ranganna

## FTT-307E FOOD ENGINEERING

L     T     P  
3     2     0

Sessional     50 Marks  
Theory         100 Marks  
Total            150 Marks  
Exam Duration 3hrs

**Note: - The examiner will set eight questions, taking two from each unit. The students will be required to attempt at least one from each unit. All questions will carry equal marks.**

### UNIT – I

**Material & Energy Balance** :- Properties of wet, dry saturated & superheated steam, use of steam tables & Mollier diagram, Numerical problems on material and energy balance related of food processing.

**Thermal Processing** :- Microbial inactivation, concept of F, Z & D value, evaluation of thermal process time for batch sterilization by graphical & formula method, calculation of process time, continuous flow system, factor affecting rate of heat penetration, effect of can size on sterility requirement, different types of sterilizers ( batch and continuous type ).

### UNIT-II

**Evaporation:-** Boiling point elevation. Basic principles of evaporators. Construction and operation. Different types of evaporators used in food industry. Basic concept of multiple effect evaporator. Operation and various feeding systems. Economy of evaporators. TVR, MVR system and refrigerent use to improve evaporator economy.

### UNIT – III

**Drying** :- Introduction to principles of drying, Equilibrium moisture content, bound and in-bound moisture, rate of drying, constt, & falling rate periods, Introduction of freeze-drying, calculation of freeze-drying and spray drying times, Engg. aspects of different types of driers used in food processing including tray drier, drum drier, fluidized bed drier, spray and freeze drier etc.

**Freezing** :- Depression of Freezing point, Planks equation and other modified equations for prediction of Freezing time, Freezing time calculation for a product having uniform temperature ( negligible internal resistance), Different types of Freezers like air blast freezer, plate freezer and cryogenic freezer.

### UNIT – IV

**Extraction, Leaching and Gas Absorption** :- Theory, equilibrium concentration relationship, operating line and Equilibrium line, liquid- liquid extraction, solid-

liquid extraction. Rate of extraction, calculation of optimum number of contact stages by graphical methods, Theory of Gas Absorption, Gas absorption in dilute and concentrated solutions. Calculation of HTU & NTU, equipments of leaching, Extraction & Gas Absorption.

**TEXT BOOK**

Title

Elements of Food Engineering

Author

D. R & R.P. Singh

**REFERENCE BOOK**

Fundamentals of Food Process Engineering

R. T. Toledo

## FTT-309E INDUSTRIAL POLLUTION CONTROL

L    T    P  
3    1    0

Sessional    50 Marks  
Theory        100 Marks  
Total         150 marks  
Exam Duration 3hrs

**Note: -The examiner will set eight questions, taking two from each unit. The students will be required to attempt at least one from each unit. All questions will carry equal marks.**

### UNIT – I

**Introduction:-** Concept of neat & clean environment, types of industrial effluents and their detrimental effects on natural environment pollution indicating parameters.

**Liquid Waste Treatment :-** Physical, chemical and biological characteristics of waste water, Biochemical Oxygen Demand and Chemical Oxygen Demand, their measurements and significance, Kinetics of BOD exertion. Removal of suspended solids, clarifiers, biological treatment of liquid wastes, activated sludge process and trickling filters, Govt. regulation regarding discharge of effluents.

### UNIT – II

**Air Pollution and control:** - Common air pollution, effect on air quality, natural and anthropogenic sources, stack gas monitoring, analyzing fuel gases for sulfur dioxide, SPM, NO, Carbon Dioxide. Govt. regulations regarding stack emission, stack height determinations, meteorological factors, wind rose diagram, lapse rates and its effect on air pollution, plume behavior, air pollution control devices, ESP's bag filters, scrubbers absorbers and adsorbers.

### UNIT – III

**Solid Waste Management:-** Sanitary landfills, composting, incineration

### UNIT – IV

**Environmental Impact Assessment:-** Assessing a project for its possible effect on physical, chemical, biological, socio- economical and politico – cultural environment, suggesting alternatives and mitigative measures, preparing an EIA report.

### TEXT BOOK

Title

Environmental Protection

Author

Chanlett

### REFERENCE BOOK

Waste Water; Treatment Disposal and reuse

Metcalf & Eddy

**FTT-311E DAIRY PRODUCT TECHNOLOGY**  
**PRACTICAL**

Sessional      25 Marks  
Practical      50 Marks  
Exam Duration 3hrs

**List of Experiments**

❖ Preparation of following Dairy Products

- 1      Cream.
- 2      Butter & Ghee.
- 3      Khoa.
- 4      Srikhand.
- 5      Kulfi & Ice Cream.
- 6      Different types pf cheese.

All experiments are compulsory.

**FTT-313E FRUIT & VEGETABLE TECHNOLOGY**  
**PRACTICAL**

Sessional      25 Marks  
Practical      50 Marks  
Exam Duration 3hrs

**List of Experiments**

- 1      Analysis of water.
- 2      Determination of corrosion of tin plate.
- 3      Preparation of pectin.
- 4      Determination of colour by extent of non enzymatic browning.
- 5      Peroxidase and Rehydration test of dried food products.
- 6      Determine the Oxidation and iodine value of vinegar.
- 7      Determination of benzoic acid and saccharine from food products.

All experiments are compulsory.

**FTT-315E FOOD ANALYSIS & QUALITY CONTROL**  
**PRACTICAL**

Sessional     25 Marks  
Practical     50 Marks  
Exam Duration 3hrs

**List of Experiments**

- 1 Proximate analysis of marketed food products.
- 2 Detection of common adulterants in food products.
- 3 Detection of non- permitted food additives in market food samples, sweets and savory products.
- 4 Cut – out analysis of canned food.
- 5 Test of sensory evaluation.
  - a. Hedonic scale
  - b. Duo – trio test
  - c. Ranking difference
  - d. Triangle Test
- 6 Consumer acceptability trial.
- 7 Statistical analysis of sensory data.
- 8 Visit to the quality control labs of the food industry and educational institutions.

All experiments are compulsory.

**FTT-317E FOOD ENGINEERING**  
**PRACTICAL**

Sessional      25 Marks  
Practical      50 Marks  
Exam Duration 3hrs

**List of Experiments**

Study of the following:-

- 1      Batch sterilizer.
- 2      Continuous sterilizer.
- 3      Standard & basket type evaporators.
- 4      Batch dries.
- 5      Continuous dries.
- 6      Basket type oilseed extractor.
- 7      Rotocel oilseed extractor.
- 8      Dough thicker.

All experiments are compulsory.



## FTT-302E TECHNOLOGY OF CEREALS, PULSES & OILSEEDS.

L	T	P
3	2	0

Sessional	50 Marks
Theory	100 Marks
Total	150 Marks
Exam Duration	3hrs

**Note:** - The examiner will set eight questions, taking two from each unit. The students will be required to attempt at least one from each unit. All questions will carry equal marks.

### UNIT – I

**Introduction** :- Status, production and utilization of food grains such as wheat, paddy, corn, millets, pulses & oilseeds in Punjab, India, and the world. Scope of relevant agro-based industries in India. Cereal varieties and their suitability for processing.

**Structure and composition**:- Structures of prominent cereals (wheat, paddy, corn, barley, sorghum, oats), pulses (moong, mash, arhar, lentil, blackgram), oilseeds (sunflower, mustard, cotton seed, ground nut), Their chemical compositions and nutritional values. Distribution of vitamins, proteins, minerals, carbohydrates, and fats in different grain and their relevance of milling.

### UNIT – II

**Wheat and Rice Technology** :- A brief review of wheat and rice milling & technology.

### UNIT – III

**Corn Milling**:- Dry milling of corn into grits, coarse meal and flours, wet milling of corn into starch. gluten and germ.

**Milling of Pulses**:- Composition of pulses and their importance in Indian diet  
Precondition:dry milling and wet milling of pulses, splitting and cleaning of pulses, scope of dal milling industry in India.

### UNIT-IV

**Oilseed Technology**:- Importance of oilseeds processing industry in India. Preconditioning of oilseeds for improving extraction efficiency. Expeller and solvent extraction process and equipment. Principles and methods of filtration of oil. Oil refining and refining equipments. Hydrogenation process, storage and utilization oilseeds oils.  
Extruded Products:- Macarroni, noodles, sphagetti, vermicelli.

### **TEXT BOOK**

Title

Cereal Technology

Author

R.L.Kent

## FTT-304 E MEAT FISH AND POULTRY TECHNOLOGY

L    T    P  
3    2    0

Sessional    50 Marks  
Theory        100 Marks  
Total         150 Marks  
Exam Duration 3hrs

**Note:** - The examiner will set eight questions, taking two from each unit. The students will be required to attempt at least one from each unit. All questions will carry equal marks.

### UNIT – I

**Introduction:** - Scope of meat and fish industry in Punjab & India. Effect of food , breed and environment on fish & meat and their quality. Structure composition, nutritive value and post mortem biochemical changes in relation to quality of fish and meat tissues.

**Meat Processing & Preservation** :- Antemortem inspection & grading, stunning & slaughtering of cattle, buffalo, sheep, goat, and pigs and their dressing, post- mortem inspection. Post mortem changes. Quality factor in meats. Factor affecting quality of fresh & cured meats. Meat tenderizations, principles of meat Preservation, Preservation by curing, smoking, canning, freezing, dehydration, chemicals & antibiotics.

### UNIT – II

**Sausage:**- Types, composition, production.

### UNIT – III

**Fish processing & Preservation:**- Quality control of fresh fish and fish products. Preservation of fish by salting, smoking, dehydration, canning, and freezing.

**Fish Products** :- Selection of raw material for processing of streaking and filleting of fish. Production of fish paste, fish oil, saus, pickle, and other products such as fish protein concentrates, fish meat.

### UNIT – IV

**Handling & Dressing of poultry** :- Inspection of poultry birds, dressing and preparation of ready to cook poultry, factors affecting quality.

**Egg & Egg Products** :- Structure, chemical composition, nutritive value, spoilage, preservation of whole egg and egg products preparation of egg powder.

### TEXT BOOKS:-

Title  
Meat poultry & Sea Food Tech.  
Fish Technology

Author  
Henricksons  
R. J. Robert

### REFERENCE BOOK

Poultry products Tech.

G. L. Mountney

## FTT-306 E PACKAGING TECHNOLOGY

L    T    P  
3    1    0

Sessional    50 Marks  
Theory        75 Marks  
Total         125 Marks  
Exam Duration 3hrs

**Note:** - The examiner will set eight questions, taking two from each unit. The students will be required to attempt at least one from each unit. All questions will carry equal marks.

### UNIT – I

**Introduction:** - Historical background. Basic concept, definitions, objectives and functions of packaging materials.

**Properties of Packaging Material:**- Product characteristics, packaging requirements and selection of packaging form and material such as WVTR, OTR, GTR, Tensile strength, bursting strength, training resistance etc. Method of testing and evaluating the packaging materials.

### UNIT – II

**Packaging Materials:**- Types of packaging materials such as wood paper, polymeric, cellulosic, plastics, glass, metal & biodegradable plastics.

**Packaging Equipments & Machinery:**- Manual and automatic packaging machines, Special methods such as vacuum, gas, shrink, controlled atmosphere and other systems.

### UNIT – III

**Food Packaging Systems:**- Different from of packaging. Composite rigid, semi- rigid and flexible forms with adhesive bands, classes, coatings, for (a) fresh fruits and vegetables (b) frozen food, (c) dehydrated foods, (d) milk and milk products (e) fish, egg, meat & meat products. Storage, transportation and distribution.

### UNIT – IV

**Packaging Standards & Environmental Pollution** :- Evaluation of packaging performance to satisfy regulations & quality control standards complete with labeling & printing.

### TEXT BOOKS

Title  
Handbook of Packaging

Author  
Paine & Paine.

## FTT-308 E FOOD BIOTECHNOLOGY

L    T    P  
3    2    0

Sessional    50 Marks  
Theory        75 Marks  
Total         150 Marks  
Exam Duration 3hrs

**Note:** - The examiner will set eight questions, taking two from each unit. The students will be required to attempt at least one from each unit. All questions will carry equal marks.

### UNIT – I

**Introduction to Food biotechnology** Importance and scope. Isolation, cultivation and preservation of microorganisms of food biotechnological importance. G.M. Food and their scope.

### UNIT – II

**Fermentation technology:-** Fermentation definition, type- aerobic and anaerobic Fermentation. Design of typical bioreactors and their parts, function and operations.

**Fermented Food Products** :- Microbial starter culture, their uses in dairy, meat, fruits, and vegetables products. Production of pickle and olives, alcoholic beverages and pre- and probiotic foods, acetone, butanol, glutamic acid, lactic acid, citric acid, vitamin B<sub>12</sub> and baker's yeast.

### UNIT – II

**Biotechnological Techniques:-** Genetic Engg. Technique and their application in food technology. Biotechnology applied to fats and oils, Nutritional value and flavor novel food. Meaning production of single cell protein, low calorie sweeteners, food coloring and nutraceuticals. Enzyme Immobilization, definition and different method. application of immobilized enzymes in food processing technology.

### UNIT – IV

**Socio- Economic Aspects of Food Biotechnology:-** Process Waste:- Whey, molasses, starch substrates and other food waste for bioconversion to useful products. Use of genetically modification food and various legal and ethical aspects involved.

#### **REFERENCE BOOKS:-**

	<u>Author</u>
1    Biotechnology in food industry	M.P. Tombs
2    Modern Food Microbiology	James M. Jay
3    Food Microbiology	W.C. Frazier
4    Biotechnology	P. K. Gupta
5    Biotechnology - food Fermentation	V.K. Joshi & Pandey
6    Biotechnological strategies in agro processing	J.K. Arora
7    Testing of Genetically Modification Organisms in Food	Farid E Ahmed

## FTT-310 E BIOCHEMICAL ENGG.

L    T    P  
4    2    0

Sessional    50 Marks  
Theory        100 Marks  
Total         150 Marks  
Exam Duration    3hrs

**Note:** -The examiner will set eight questions, taking two from each unit. The students will be required to attempt at least one from each unit. All questions will carry equal marks

### UNIT – I

**Biochemical Engineering:-** Introduction, Definition, medium formulation, carbon sources, nitrogen sources, precursors, inhibitors, inducers, antifoam agents.

**Design of Bioreactor :-** Introduction , function, body construction, different parts- agitator aerator, baffles. Achievement of aseptic inoculation of plant fermenter.

### UNIT – II

**Enzyme kinetics :-** Simple Enzyme kinetics, complex Enzyme kinetics, Enzyme inhibition – competitive and non- competitive, Lineweaver – burk plot, Enzyme immobilization general account.

### UNIT – III

**Media Sterilization:-** Thermal Sterilization, Sterilization by filtration. Design criteria & design equations for Sterilization process. Temp. – time profile and design calculation. Thermal death of micro – organisms. Effect of temperature on specific death rate.

**Air Sterilization:-** Methods, interception, diffusion, combined mechanism, effect of multiple layers and packing.

### UNIT – IV

**Aeration and Agitation:-** Oxygen supply and demand in microbial process. Mass transfer resistance. Critical value of oxygen concentration and oxygen uptake rate, aeration, types and design of sparger.

### TEXT BOOK:-

<u>Title</u>	<u>Author</u>
Process Computation in Biochemical Engg.	Gosh

### REFERENCE BOOK

Biochemical Engg. Fundamentals	Bailley & Ollis
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**FTT-312E TECHNOLOGY OF CEREALS, PULSES AND OIL SEED**  
**PRACTICAL**

Sessional     50 Marks  
Practical     50 Marks  
Exam Duration 3hrs

**List of Experiments**

- 1     Determination of physical characteristics of (a) rice (b) wheat (c) pulses (d) maize (e) barley and sorghum (f) oil seed.
- 2     Milling of wheat and study their effect on various physicochemical properties.
- 3     Estimation of flour quality : gluten, ash, water absorption power (WAP) sedimentation test, maltose value, pelshenke value.
- 4     Parboiling & Milling of pulses.
- 5     Pre treatment in Milling of pulses.
- 6     Demonstration of oil extraction and refining of oil, and visit to relevant industry.
- 7     Preparation of pasta products – noodles, macroni, Vermicelli (Sevian)
- 8     Preparation of ready– to– eat (RTE) food products by extrusion cooking technology.
- 9     Visit of flour –mill, rice mill/ rice Sheller, dal mill, oil expenditure unit, refining units, milling and brewing units.

All Experiments are compulsory.

**FTT-314E MEAT, FISH & POULTRY TECH. LAB.**  
**PRACTICAL**

Sessional      50 Marks  
Practical      50 Marks  
Exam Duration 3hrs

**List of Experiments**

- 1      Preparation of different types of meat products and their quality evaluation.
- 2      Cutting of meat.
- 3      Preparation of sausages.
- 4      Retail cuts of dressed chicken.
- 5      Preparation of meat patties, kabab, seenkh, meat balls.
- 6      Determination of the moisture and solid content of different egg constituents.
- 7      Determination of specific gravity of egg.
- 8      Preparation of fish , meat & egg pickle.
- 9      Visit to slaughterhouses and abattoir.

All Experiments are compulsory.

**FTT-318E FOOD BIOTECHNOLOGY**  
**PRACTICAL**

Sessional      50 Marks  
Practical      50 Marks  
Exam Duration 3 hrs

**List of Experiments**

1      Demonstration and study of fermenter and its functioning.

**Preparation of the following :-**

- 2      Wine.
- 3      Beer.
- 4      Vinegar.
- 5      Fruit beer.
- 6      To determine alcohol content in alcoholic beverages.
- 7      Visit to beverages and distillery (Whiskey, brandy, rum)

All Experiments are compulsory.

**FTT-320E BIOCHEMICAL ENGINEERING**  
**PRACTICAL**

Sessional      50 Marks  
Practical      50 Marks  
Exam Duration 3hrs

**List of Experiments**

**❖ To study the following:-**

- 1      Designing of air – lift fermenters.
- 2      Horizontal & Rotating fermenters.
- 3      Plant cell and tissue culture.
- 4      Mixed culture characteristics of microorganisms.
- 5      Process of sterilization by filtration.
- 6      Effect of multiple layers and packing in air sterilization.

All Experiments are compulsory.



**FTT-401 E UTILIZATION OF INDUSTRIAL  
WASTE & BY PRODUCTS**

L    T    P  
4    2    0

Sessional      50 Marks  
Theory          100 Marks  
Exam Duration 3hrs

**Note:- The examiner will set eight questions taking two from each unit. The students will be required to attempt at least one from each unit. all question will carry equal marks.**

**UNIT – I**

**Introduction**:-Type of waste and magnitude of waste generation in different food processing industries, concept, scope and importance of waste management and effluent treatment.

**Waste Characterization**:- Temperation, pH, oxygen Demand (BOD, COD, TOD), fat, oil and grease content, metal content, forms of phosphorus and sulphur in waste waters, microbiology of waste, otjer ingredients like insecticide, pesticides and fungicides, residues.

**UNIT – II**

Environmental Protection Act and specification for effluent of different food industries.  
Waste Utilization

**UNIT – III**

**Effluent Treatment**:- Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation. Secondary treatments: biological oxidation-trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons

**UNIT – IV**

**Tertiary treatment**:- Advanced waste water treatment process-sand, coal and activated carbon filters, phosphorus, sulphur, nitrogen and heavy metals removal Assessment, treatments and disposal of soil waste; concept of vermin composting and bio-gas generation

**REFERENCE BOOK**

Food Processing work Management by Green and Krammer; CBS publication

**TEXT BOOK**

Principles of food sanitation by Mariett, N.G. CBS publication

## **FTT-403 E FOOD PROCESSING PLANT LAYOUT & DESIGN**

L    T    P  
3    1    0

Sessional    50 Marks  
Theory        100 Marks  
Exam Duration 3hrs

**Note:- The examiner will set eight questions taking two from each unit. The students will be required to attempt at least one from each unit. all question will carry equal marks.**

### **UNIT – I**

**Introduction:-** Introduction to plant design, Basic decisions to be taken by management for effective plant design.

### **UNIT-II**

**Plant Location:-** Influence of location on plant layout, location factors, location theory and models, Economic plant size, types of manufacturing processes like continuous, repetitive and intermittent processes.

**Plant Layout:-** Meaning & definition of plant layout, reasons for development of layout problems classes of plant layout problems, objective and principles of layout, classical types of layout viz product layout, process layout and stationary layout, Data collection of materials and processes, plant layout tools and techniques like process charts, process flow diagram, machine data cards, material movements patterns, visualization of layout by templates, machines, work model and sketches, calculation of space requirement for machines, workstations and storage, selection of material and process equipments, development of plot and block plan, checking, consultation and installation of layout, plant layout procedures.

### **UNIT-III**

**Network Analysis of Processes:-** Basic terms, introduction, objective and advantages of network analysis, various Network techniques, explanation of PERT and CPM techniques, smoothing.

**Evaluation of Layout:-** Measurement of effectiveness of layout, layout evaluation by systematic, optimization and mathematical model.

## UNIT-IV

**Plant Building:-** Consideration in building design, type of factory buildings, choice of building construction material for floors, foundation, walls, doors, windows, drains etc, ventilation, fly control, mold prevention and illumination in food processing industries.

**Cost Analysis:-** Fixed cost, variable cost, depreciation, method of economic analysis, profitability analysis of a plant.

**Plant Layout of Different Industries:-** Layout of different types of food and fermentation industries including, bread, biscuits, soft drinks, tomato processing plant, beer, alcohol, fruit juice, canning, dairy, integrated rice mill and wheat mill.

### **BOOKS RECOMMENDED:-**

Author	Title	Pub.
O.P. Khanna	Production Engg. & Industrial mgmt.	Dhanpat rai & sons
Moore	Plant layout and Design	McGraw Hill
Peterse & Timmerhaus	Plant Design for Chemical Engg.	McGraw Hill
Rase & Brrow	Project Engg. of process plant	John Willey & Sons
Farrall	Engg. for Dairy & Food Products	McGraw Hill

## **FTT-405 E TECNOLOGY OF SPICES, HERBS & FOOD ADDITIVES**

L    T    P  
4    2    0

Sessional    50 Marks  
Theory        100 Marks  
Exam Duration 3hrs

**Note:- The examiner will set eight questions taking two from each unit. The students will be required to attempt at least one from each unit. all question will carry equal marks.**

### **UNIT – I**

Importance and role of spices in food processing  
Classification and properties of spices and herbs – their products, including medicinal properties.

### **UNIT – II**

Uses of spices and medicinal herbs  
Processing of major spices, ginger, pepper, turmeric  
Minor spices: Clove, nutmeg cardamom  
Leafy spices: bay oregano, tulsi, mint, thyme and curry leaves  
Seed spices: Fenugreek, mustard seasm, garlic  
Common medicinal plant and their uses : Brahmi, tulsi, mint, turmeric, curry leaves, lemon grass, herbal tea, saffron  
Preparation of pastes, extraction of oleoresins  
Packaging of spices, herbs and their products.

### **UNIT – III**

Food additives – Definition and importance  
classification of food additives, function and uses:

- Preservatives
- Antioxidants
- Mould Inhibitors
- Emulsifiers
- Acids, bases, salts and buttering agents
- Anti – caking agents
- Flour maturing and bleaching agents
- Colorants
- Flavoring agents

- Texture modifiers, stabilizers, thickeners
- Humitants
- Leavening agents
- Low and non – calorie sweetening agents
- Fat replacers

#### **UNIT – IV**

Stability of food additives during processing  
Legal standards and permissible limits of food additives

#### **TEXT BOOKS**

Medicinal plants By NS Chauhan  
Spices and Condiments by Pruthy

#### **REFERENCE BOOKS**

Manual of Analysis for Fruits and Vegetables by Rangaanna

## **FTT-407 E BAKERY AND CONFECTIONERY TECHNOLOGY**

L    T    P  
4    2    0

Sessional    50 Marks  
Theory 100 Marks  
Exam Duration 3hrs

**Note:- The examiner will set eight questions taking two from each unit. The students will be required to attempt at least one from each unit. all question will carry equal marks.**

### **UNIT – I**

**Introduction:-** Status of bakery industry in India and Government licensing policy. Raw materials for Bakery products Flour sugar, shortening, yeast, salt etc as raw material for bakery products, their role and PFA specifications of these raw materials.

### **UNIT – II**

**Manufacturing of Bakery Products:-** Different types of bread and preparation of bread using different methods, quality evaluation of bread, staling of bread Different types of biscuits and preparation of biscuits using different methods, quality evaluation of biscuits.

### **UNIT – III**

Different types of cakes, preparation of cakes using different methods quality evaluation of cakes, Different types of toppings Preparation of others Bakery Products:- rusks, crackers, buns, muffins and pizza

### **UNIT – IV**

**Ingredients, types, candy, and chocolates:-** manufacturing process, quality, consideration and parameters.

Layout, setting up units and hygienic conditions required in bakery plant, Operation and maintenance of bakery equipment.

### **TEXT BOOKS**

- 1 Bakery Engg. and Tech. vol. I and II by Matz; CBS
- 2 Bakery Products published by SIRI
- 3 Cereal Tech. by Kent; CBS

### **REFERENCE BOOKS :-**

- 1 Wheat Chemistry and Tech. by Pomeranz
- 2 Practical baking by William Sultan vol I and II

**FTT-411 E UTILIZATION OF INDUSTRIAL WASTE & BY PRODUCTS**

**LAB.**

L    T    P  
0    0    2

Sessional    50 Marks  
Practical    50 Marks  
Exam Duration 3hrs

- 1    Waste characterization : (a) Temperature (b) pH (c) Solid content  
      (d) Turbidity, (e) BOD, (f) COD
- 2    Visit to effluent treatment plant.
- 3    To estimate residual chlorine
- 4    Evaluation effect of lime treatment on waste water in respect of BOD,  
      COD, solids, contents, phosphate contents
- 5    Demonstration of various industries using waste and food by products.
- 6    Visit of Biogas plant and vermi – culture center.

**FTT-413 E TECHNOLOGY OF SPICES HERBS & FOOD ADDITIVES**

**LAB.**

L    T    P  
0    0    3

Sessional    50 Marks  
Practical    50 Marks  
Exam Duration 3hrs

- 1    Demonstration of process of oil extraction and oleoresin of different spices.
- 2    Study of detection of adulteration in spices.
- 3    Study of sensory characteristics of oleoresin.
- 4    Demonstration of :- Dehydration of ginger, process of turmeric, processing of kesar
- 5    Visit to oleoresin extraction unit.
- 6    Demonstration of processing of locally available spices and herbs.

**FTT-415 E BAKERY AND CONFECTIONARY TECHNOLOGY**  
**LAB**

L    T    P  
0    0    3

Sessional    50 Marks  
Practical    50 Marks  
Exam Duration 3hrs

- 1    Quality analysis of raw material used in bakery and confectionary industry according to PFA.
- 2    Preparation and evaluation of bakery and confectionary products.
  - Bread: White sandwich: High volume milk bread, using different methods
  - Cakes: With eggs: Without eggs, using different methods
  - Biscuits, using different methods
  - Buns
  - Pizza
  - Candy
- 3    Study and analysis of the production charts used for different products by bakery industries.
- 4    Visit of bakery and confectionary industry.
- 5    Local market survey for bakery and confectionary products.

## Bachelor of Technology in food Technology

### 8<sup>th</sup> SEMESTER

S.N	Subject Code	Subject	Teaching			Sessional award	Theory	Pract.	Total Marks	Duration exam hrs	Formatted
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1	FTT-402E	Food Storage Engg.	4	2	0	50	100	0	150	3	Formatted ... [31]
2	FTT-404E	Entrepreneurship development & Management	4	2	0	50	100	0	150	3	Formatted ... [32]
3	FTT-406E	Instrumentation & process Control	4	2	0	50	100	0	150	3	Formatted ... [33]
4	FTT-408E	Industrial Statistics	3	2	0	50	100	0	150	3	Formatted ... [34]
5	FTT-410E	Comp. Application in food Tech.	0	0	4	50	0	50	100	3	Formatted ... [35]
6	FTT-412E	Food Storage Engg. Lab	0	0	2	25	0	25	50	3	Formatted
7	FTT-414E	Industrial Statistics Lab.	0	0	2	25	0	25	50	3	Formatted ... [36]
8	FTT-416E	Project	0	0	4	100	0	100	200	3	Formatted
<b>Grand Total</b>			<b>15</b>	<b>08</b>	<b>12</b>	<b>400</b>	<b>400</b>	<b>200</b>	<b>1000</b>		Formatted
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## FTT – 402E FOOD STORAGE ENGINEERING

L    T    P  
4    2    0

Sessional: 50 Marks  
Theory.: 100 Marks  
Total      150 Marks  
Exam Duration: 3 Hrs

**Note:- The examiner will set eight question taking two from each unit. The students will be attempt at least one from each unit. All questions will carry equal marks.**

### UNIT – I

**Introduction:-** Scope and importance of handling, transportation and storage of food and food products, post – harvest losses. Post – Harvest Changes in Food Physiological, Chemical, Microbiological and Biochemical

### UNIT – II

**Fruit and Vegetables:-** Various unit operation of post- harvest handling, transportation, study of different conveying system like belt conveyors, chain conveyors, screw conveyors, pneumatic conveyors, vibrating and oscillating conveyors, bucket elevators – their selection, operation and maintenance, storage, transportation and storage system, their requirement. Handling and spoilage during transportation and storage- its prevention.

**Grains:-** Preparation of grains for storage. Storage requirements, infestation control, mycotoxin, handling practices, causes of spoilage and their prevention. Factor affecting quality of grain during storage and types of storage structures and facilities.

### UNIT – III

**Animal Foods:-** Pre- Slaughter handling and transportation system- their effects on quality of meat products, Transportation and storage requirements, ante- mortem examination of animals.

**Milk:-** Collection, pre- cooling handling and transportation system – their effects on quality of milk.

### UNIT – IV

**Eggs:-** Candling and grading, packaging, handling, pre- treatment, transportation and storage.

**Cold Storage :-** Design parameters, selection of parameter for designing cold storage for food products. Different types of referents, refrigerator system such as vapour compression refrigerator, vapour absorption refrigerator, air cycle refrigerator etc. Specific purpose, criteria for collection, operation and maintenance of refrigerator systems. Cooling load calculations.

**TEXT BOOKS:-**

- 1 Handling transportation and Storage of fruits and vegetables by A.Lloys, Ryall Penizer(AVI Publications)
- 2 Proceedings of regional workshop on Warehouse Management of stored food Grain by Girish and Ashok Kumar (UNDP)

**REFERENCE BOOKS:-**

- 1 Food Storage part of a system by Sinha and Muir (AVI)
- 2 Post Harvest Technology of fruit and vegetables- Handling, Processing, Fermentation and waste Management by LR Verma and VK Joshi; Indus Publishing Co. , New Delhi.

## **FTT – 404E ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT**

L    T    P  
4    2    0

Sessional: 50 Marks  
Theory: 100 Marks  
Total: 150 Marks  
Exam Duration: 3 Hrs

**Note:- The examiner will set eight question taking two from each unit. The students will be attempt at least one from each unit. All questions will carry equal marks.**

### **UNIT – I**

**Entrepreneurship**:- Concept/ Meaning, Need, Competencies/ Qualities of an entrepreneur.

**Entrepreneurship support system** :- District Industry Center (DICs). Commercial Banks.State Financial Corporations. Small industries Service institute (SISIs), small industries development Bank of India (SIDBI), National Bank for agriculture and rural Development (NABARD), National Small industries corporation (NSIC) and other relevant institutions/ Organization at state level.

### **UNIT – II**

**Market Survey and Opportunity Identification (Business planning)** : Assessment of demand and supply in potential areas of growth. Understanding business opportunity. Considerations in product selection. Data collection for setting up small Ventures.

**Project Report preparation** :- Preliminary Project Report.Techno- Economic feasibilities report. Project Viability.

**Managerial aspects of small Business** :- Principles of Management (Definition, Function of management viz planning, Organisms, coordination, and control Operational Aspects of Production. Basic principal of financial management. Marketing techniques. Personnel and Inventory Management. Importance of communication in business

### **UNIT-III**

**Legal Aspects of small Business :-** Elementary Knowledge income tax, sales tax, excise rules, factory act and paymemt of wages act.

**Environmental Considerations**:- Concept of ecology and environment Factors contributing to Air, Water, Noise pollution. Air, Water and noise pollution standards and control. Personal Projection Equipment (PPEs) for safety at work places

## UNIT – IV

**Miscellaneous**:- Human and industrial Relations. Human Relations and performance in organization. Industrial Relations and disputes. Relations with Subordinates, peers and superiors. Labour Welfare. Worker participation in management

**Motivation**:- Factors determining motivation. Characteristics of motivation. Methods of improving motivation. Incentives- pay, promotion, rewards

**Leadership**:- Need for Leadership. Functions of a leader. Factors to be considered for accomplishing effective leader.

### **TEXT BOOKS**:-

- 1 A handbook of entrepreneurship, Edited by BS Rathore and Dr. J.S.Saini; Aapga Publications, Panchkula (Haryana)
- 2 Entrepreneurship Development by CB Gupta and P Srinivasan, Sultan Chand and Sons, New Delhi.
- 3 Environmental Engg. and Management by Suresh K Dhamija, SK Kataria and sons, New Delhi

### **REFERENCE BOOKS**:-

- 1 Environmental and pollution Awareness by Sharma BR, Satya Prakashan, New Delhi
- 2 Environmental Protection Law and Policy in India by Thakur Kailash, Deep and Deep Publication, New Delhi

## FTT – 406 E INSTRUMENTATION AND PROCESS CONTROL

L    T    P  
4    2    0

Sessional: 50 Marks  
Theory.: 100 Marks  
Total : 150 MARKS  
Exam Duration: 3 Hrs

**Note:- The examiner will set eight question taking two from each unit. The students will be attempt at least one from each unit. All questions will carry equal marks.**

### UNIT – I

**Basic Building Blocks of any Instrumentation System** :- Scope and necessity of instrumentation. Names of important process variable, their units. Building blocks of instrumentation system. Various testing signal

**Basic Concepts** :- Definition of the terms accuracy, precision sensitivity, Linearity, hysteresis gauge factor etc.

**Definitional and Classification of transducers** :- Selection criteria of transducers. Variable Resistance transducers. Construction, working, principle and application of potentiometers, strain gauge, load cell. Hot wire anemometer, photo resistor, humidity sensor. Resistor temperature transducers

**Thermistors** :- Carbon microphones. Variable inductance Transducers. Basic Principles. Electromagnetic pick up. Induction potentiometer. Linear variable differential transformer (LVDT). Variable Reluctance Transducers. Variable Capacitance Transducers

- a. Basic principles
- b. Capacitance Pick up
- c. Condenser microphones
- d. Differential Capacitor Pick up

### UNIT-II

**Piezoelectric Transducers** :- Basic Principles of Piezoelectric Transducers. Piezoelectric crystals and their properties. General forms of Piezoelectric Transducers. Seismic pick up

**Magneto – strictive Transducers** :- Magneto elastic property of nickel and perm alloy, construction of magnetostrictive transducers. Other types of Transducers. Transducers based on hall effect, eddy current, ionization Optical Transducers – photo diode, Photo transistor, Photo voltaic cell, LDR Digital transducers-single shaft encoders. Tacho generator

### UNIT-III

**Basic Control Loops and Characteristics :-** Introduction, R, L, C elements in pneumatic, hydraulic and electrical system. Simple process like:

- a) Single capacity pressure system
- b) Single capacity temperature system
- c) Single capacity level system
- d) Single flow loop system

**Control system :-** Basic elements of a feedback control system, open loop, feedback and lead forward linear and non-linear, continuous and sampled data control systems digital control, practical examples of the above.

**Control System Components :-** DC and AC servomotors, tacho-generator, potentiometer, synchros, stepper motor, gyroscope, AC position control system. Trends in process control, safety aspects in instrumentation and control system, economics of process instrumentation, selection of key variables for process controls pneumatic and electronic instrumentation.

**Flow Measurement :-** Flow measurement with orifices, magnetic, ultrasonic, vortex flow meters. Level Measurements. Level detectors, float level devices, level gauges, optical level devices, radiation level sensors, thermal level sensors.

### UNIT-IV

**Temperature Measurement :-** Temperature sensors-thermocouples, RTD, thermistors, radiation thermometry, IR detectors, fiber-optic temperature sensor; acoustic pyrometer. Pressure measurement. Pressure sensors, bellows, diaphragm, bourdon and helical types, electronic pressure sensor, manometers, pressure gauges, vacuum sensor, high pressure sensors, pressure repeaters. Measurement systems for density, pH, humidity, moisture and weight. Instrumentation and safety. Alarm and shutdown devices, safety interlock systems. Computer control system – introduction to SDC and DDC and their application in process industries.

#### **TEXT BOOKS:**

- 1 Mechanical and Industrial Measurement by RK . Jain, Khanna Publishers, New Delhi
- 2 Industrial Instrumentation by Donald P Eickman
- 3 Electrical and Electronic Measurement and Instrumentation by AK Sawhney, Dhanpat Rai and company

#### **REFERENCE BOOKS:-**

- 1 Automatic Control System by Kuo, BC, Prentice Hall of India, New Delhi
- 2 Modern Control Engg. by Ogata K, Prentice Hall of India, New Delhi
- 3 Theory and Problems of Feedback control system by Schaum series, Schajit Publishing Co, New York.

## FTT - 408 E INDUSTRIAL STATISTICS

L    T    P  
3    2    0

Sessional: 50 Marks  
Theory    100 Marks  
Total:     150 Marks  
Exam Duration: 3 Hrs

**Note:- The examiner will set eight question taking two from each unit. The students will be attempt at least one from each unit. All questions will carry equal marks.**

### UNIT – I

#### Classification of Data:

- 1     Introduction purpose and scope
- 2     Statistics terms & notations
- 3     Presentation of frequency distribution table
- 4     Some basic rules in preparation frequency
- 5     Distribution table
- 6     Exercise

#### Graphical Representation of Biometric Data:

- 1     Introduction and unit of representation
- 2     Quantitative and continuous data
- 3     Histogram
- 4     Frequency polygon
- 5     Frequency curve
- 6     Cumulative Frequency curve or ogive
- 7     Scatter or dot diagram
- 8     Quantitative and discontinuous data
- 9     Bar diagram
- 10    Pie chart and sector diagram
- 11    Exercise

### UNIT-II

#### Measures of Central Tendency:

- 1     Introduction
- 2     Mathematical average
- 3     Arithmetic mean
- 4     Geometric mean
- 5     Harmonic mean
- 6     Averages of position
- 7     Median
- 8     Mode
- 9     Exercise

### **Measures of Dispersion:**

- 1 Introduction
- 2 Range
- 3 Quartile Deviation
- 4 Mean Deviation
- 5 Standard Deviation
- 6 Variance
- 7 Exercise

### **UNIT-III**

#### **Test of Significance:**

- 1 Introduction definition and uses of standard error of mean
- 2 Standard error of mean ( $SE_M$ ) in ungrouped data.
- 3 Standard error of mean ( $SE_M$ ) in grouped data.
- 4 Standard error of Standard deviation in ungrouped data.
- 5 Standard error of Standard deviation in grouped data.

#### **Student's Test:**

- 1 Introduction
- 2 Unpaired or uncorrected T- Test.
- 3 Paired or corrected T- Test.
- 6 T- Test from Paired grouped data.

#### **The CHI- SQUARE Test:**

- 1 Introduction, definition and common application of Chi- Square.
- 2 Pre – requisites of Chi- Square test and method to draw inference.
- 3 Calculation of Chi Square Test
- 4 Exercise.

### **UNIT – IV**

#### **Probability:**

- 1 Introduction
- 2 Terminology related to probability.
- 3 Definition of probability.
- 4 Calculation of probability of simple events.
- 5 Rules probability of simple events.
- 6 Rules of probability
- 7 Conditional probability distribution.
- 8 Theoretical probability distribution.
- 9 Types of probability distribution.

- 10 The Binomial distribution.
- 11 The Poisson distribution.
- 12 The normal distribution.
- 13 Deviation from the normal Distribution - Skewness.
- 14 Kurtosis
- 15 Exercise.

**Correlation:**

- 1 Introduction
- 2 Positive, negative and linear correlation
- 3 Correlation coefficient
- 4 Method of studying correlation
- 5 Types of correlation
- 6 Pearson's products moment method
- 7 Spearman's rank difference method
- 8 Standard error of correlation coefficient and verification.
- 9 Significance of correlation coefficient.

**Regression :**

- 1 Introduction and difference between correlation and Regression
- 2 Objective of Regression analysis
- 3 Linear Regression
- 4 Regression Equation
- 5 Regression coefficient
- 6 Calculation of Regression equation from values of deviation mean of two variables
- 7 Standard deviation for the Regression line.

## **FTT –410 E COMPUTER APPLICATION IN FOOD TECHNOLOGY**

L    T    P  
0    0    4

Sessional: 50 Marks  
Practical: 50 Marks  
Exam Duration: 3 Hrs

Major areas to be covered during laboratory classes for instruction are:-

**Introduction** Introduction to various software for their application technology.

**Application** Spread sheet fundamental, solving problems in spread sheet environment. Graphical application and statistics analysis using various software, familiarization wise MS office package- familiarization with software related to food technology and statistical package

**C++**

Application of computers in instrumentation and control of food machinery, inventory control, process control etc.

### **List Of Practicals:-**

- 1 Introduction to computer.
- 2 Operation system using spread sheet.
- 3 Problem solving using spread sheet.
- 4 Use graphics package for analysis of data.
- 5 Use statistical package for analysis of data.
- 6 Use of word processing software for creating report.
- 7 Familiarization with software related to food industry.
- 8 C++ : Introduction and practice.

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