

**Department of Food Science and Technology**  
**Chaudhary Devi Lal University, Sirsa**  
**M.Sc. Food Science and Technology (Four Semester Programme)**  
**Scheme and Syllabi w.e.f. Session 2016-17**

**Semester I**

| Type of course      | Course code | Title of course                   | Teaching hours per week | Credits   | Internal Assessment/ Evaluation | End term examination | Total      | Duration of exam (Hrs. Theory/ Practical) |
|---------------------|-------------|-----------------------------------|-------------------------|-----------|---------------------------------|----------------------|------------|---|
| Core                | FST- 101    | Principles of Food Preservation   | 4                       | 4         | 30                              | 70                   | 100        | 3   |
| Core                | FST- 102    | Basic Food Microbiology           | 4                       | 4         | 30                              | 70                   | 100        | 3   |
| Core                | FST-103     | Basic Food Engineering            | 4                       | 4         | 30                              | 70                   | 100        | 3   |
| Core                | FST- 104    | (Laboratory- I) Food Microbiology | 8                       | 4         | -                               | 100                  | 100        | 6   |
| Core                | FST- 105    | (Laboratory-II) Food Analysis     | 6                       | 3         | -                               | 75                   | 75         | 6   |
| Elective Discipline | FST-106     | Food Chemistry                    | 4                       | 4         | 30                              | 70                   | 100        | 3   |
|                     | FST-107     | Food Analysis                     | 4                       | 4         | 30                              | 70                   | 100        | 3   |
| <b>Total</b>        |             |                                   |                         | <b>23</b> |                                 |                      | <b>575</b> |   |

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Semester II

| Type of course      | Course code | Title of course                                   | Teaching hours per week | Credits   | Internal Assessment/ Evaluation | End term examination | Total      | Duration of exam (Hrs. Theory/ Practical) |
|---------------------|-------------|---|-------------------------|-----------|---------------------------------|----------------------|------------|---|
| Core                | FST-201     | Technology of Cereals & Millets                   | 4                       | 4         | 30                              | 70                   | 100        | 3   |
| Core                | FST-202     | Technology of Fruits & Vegetables                 | 4                       | 4         | 30                              | 70                   | 100        | 3   |
| Core                | FST-203     | Unit Operations in Food Engineering               | 4                       | 4         | 30                              | 70                   | 100        | 3   |
| Core                | FST-204     | (Laboratory-III) Technology of Cereals & Millets  | 8                       | 4         | -                               | 100                  | 100        | 6   |
| Core                | FST-205     | (Laboratory-IV) Technology of Fruits & Vegetables | 8                       | 4         | -                               | 100                  | 100        | 6   |
| Elective Discipline | FST-206     | Technology of Beverages                           | 4                       | 4         | 30                              | 70                   | 100        | 3   |
|                     | FST-207     | Food Additives                                    | 4                       | 4         | 30                              | 70                   | 100        | 3   |
| Elective Discipline | FST-208     | Computer Fundamentals & Statistics                | 4                       | 4         | 30                              | 70                   | 100        | 3   |
|                     | FST-209     | Food Biotechnology                                | 4                       | 4         | 30                              | 70                   | 100        | 3   |
| <b>Total</b>        |             |   |                         | <b>28</b> |                                 |                      | <b>700</b> |   |

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### Semester III

| Type of course      | Course code | Title of course                                     | Teaching hours per week | Credits   | Internal Assessment/<br>Evaluation    | End term examination | Total      | Duration of exam (Hrs. Theory/<br>Practical) |
|---------------------|-------------|---|-------------------------|-----------|---------------------------------------|----------------------|------------|--|
| Core                | FST- 301    | Technology of Milk and Milk Products                | 4                       | 4         | 30                                    | 70                   | 100        | 3  |
| Core                | FST- 302    | (Laboratory-V) Technology of Milk and milk Products | 8                       | 4         | -                                     | 100                  | 100        | 6  |
| Core                | FST-303     | Credit Seminar                                      | 2                       | 2         | -                                     | 50                   | 50         | -  |
| Elective Discipline | FST-304     | Food Packaging                                      | 4                       | 4         | 30                                    | 70                   | 100        | 3  |
|                     | FST-305     | Nutrition and Health                                | 4                       | 4         | 30                                    | 70                   | 100        | 3  |
| Elective Discipline | FST-306     | (Laboratory-VI) Food Packaging                      | 8                       | 4         | -                                     | 100                  | 100        | 6  |
|                     | FST-307     | Laboratory-VII Nutrition and Health                 | 8                       | 4         | -                                     | 100                  | 100        | 6  |
| Core                | FST-308     | In Plant training                                   | 3                       | 3         | 37.5                                  | 37.5                 | 75         | -  |
| Core                | FST-309     | Research Project                                    | 2                       | 2         | Continued in 4 <sup>th</sup> semester |                      |            |  |
| <b>Total</b>        |             |   |                         | <b>23</b> |                                       |                      | <b>525</b> |  |

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Semester IV

| Type of course      | Course code          | Title of course   | Teaching hours per week | Credits   | Internal Assessment/ Evaluation | End term examination | Total      | Duration of exam (Hrs. Theory/ Practical) |
|---------------------|----------------------|---|-------------------------|-----------|---------------------------------|----------------------|------------|---|
| Core                | FST- 401             | Technology of Meat, Fish & Poultry Products                   | 4                       | 4         | 30                              | 70                   | 100        | 3   |
| Core                | FST- 309 (Continued) | Research Project (Cont. from III Semester)                    | 2                       | 2         | -                               | 100                  | 100        | 6   |
| Elective Discipline | FST-402              | Industrial Microbiology                                       | 4                       | 4         | 30                              | 70                   | 100        | 3   |
|                     | FST-403              | Nutraceuticals & Functional Foods                             | 4                       | 4         | 30                              | 70                   | 100        | 3   |
| Elective Discipline | FST-404              | Technology of Pulses and oilseeds                             | 4                       | 4         | 30                              | 70                   | 100        | 3   |
|                     | FST-405              | Advances in Food Processing and Preservation                  | 4                       | 4         | 30                              | 70                   | 100        | 3   |
| Elective Discipline | FST-406              | (Laboratory-VIII) Technology of Meat, Fish & Poultry Products | 8                       | 4         | -                               | 100                  | 100        | 6   |
|                     | FST-407              | (Laboratory-IX) Nutraceutical & Functional Foods              | 8                       | 4         | -                               | 100                  | 100        | 6   |
| Elective Discipline | FST-408              | Industrial Food waste management                              | 4                       | 4         | 30                              | 70                   | 100        | 3   |
|                     | FST-409              | Industrial organization and management                        | 4                       | 4         | 30                              | 70                   | 100        | 3   |
| <b>Total</b>        |                      |   |                         | <b>22</b> |                                 |                      | <b>600</b> |   |

## Open Elective Courses: For the student of M.Sc. Food Science and Technology

The student will earn minimum ten credits by choosing some open elective course offered by the different department's in the university other than the Department of Food Science and Technology.

### Open Elective Course: For the Student of other department of the university

The Department of Food science and Technology offer the following open elective course for the students of first, second, third and/or fourth semesters of other departments of the university.

| Type of course | Course Code | Title of Course      | Teaching Hours per week | Credits | Internal Assessment/ Evaluation | End term Examination | Total | Duration of Exam. (Hrs.) |
|----------------|-------------|----------------------|-------------------------|---------|---------------------------------|----------------------|-------|--------------------------|
| Open elective  | OEC-FST-001 | Nutrition and Health | 4                       | 4       | 30                              | 70                   | 100   | 3                        |

### Total Credits & Marks for all the four semesters

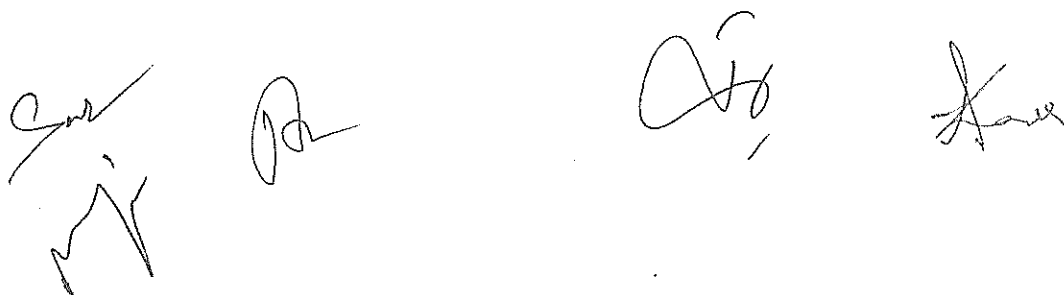
| Semester             | Credits    | Marks       |
|----------------------|------------|-------------|
| Semester-I           | 23         | 575         |
| Semester-II          | 28         | 700         |
| Semester-III         | 23         | 525         |
| Semester-IV          | 22         | 600         |
| Open Elective Course | 10         | 250         |
| <b>Grand Total</b>   | <b>106</b> | <b>2650</b> |

### General instructions:

1. After 2<sup>nd</sup> semester the students will undertake an In-plant summer training of six weeks in industry/organization. The evaluation of training will be done in third semester.
2. The research project will be continued during third and fourth semesters.
3. Each student will submit one assignment and present one presentation to the concerned teacher of the subject.
4. The discipline elective course will be allotted to the students on the basis of their preference and percentage of marks in the first semester examination of M.Sc. Food science and Technology.



5. New experiment in the Laboratory Course may be added from time to time.
6. The ordinance (Choice Based Credit System) of the university shall be followed by the department.

Four handwritten signatures in black ink, arranged horizontally from left to right. The first signature is a stylized 'S' with a horizontal line through it. The second is a cursive 'R'. The third is a cursive 'A'. The fourth is a cursive 'K'.

# Principles of Food Preservation

Paper code: FST 101

Credits: 4

Periods per week: 4 Hrs.

Max. Marks: 70

Duration of Exam.: 3Hrs

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

## Unit I

Introduction and principles of food preservation.

Food spoilage: Microbial, physical, chemical & miscellaneous.

Heat preservation and processing: Heat resistance of microorganisms, thermal death curve, types of heat treatments and effects on foods, canning of foods, cans and container types, spoilage of canned foods, heat penetration, different heating processing methods.

## Unit II

Dehydration: Drying, dehydration and concentration; Drying curves, Drying methods and type of dryers, Freeze drying in food processing, food concentration, methods of concentration, changes in food during dehydration and concentration.

Water activity: Role of water activity in food preservation, Intermediate moisture foods (IMF), Principles, characteristics, advantages and problems of IM foods.

## Unit III

Refrigeration storage: Requirements of refrigeration storage, changes of foods during refrigeration storage.

Freezing and frozen storage: Freezing curves, slow and quick freezing, factors determining freezing rate, freezing methods, changes in food during freezing.

## Unit IV

Food frying: general principles, frying process; shallow frying and deep frying, factors affecting oil uptake during frying.

Emulsification in food processing: principles and applications of emulsification in food.

House hold preservation methods: Salt curing, oiling and smoking.

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

## Text and Reference Books:

1. Norman, N.P and Joseph, H.H.(1997). Food Science, Fifth edition, CBS Publication, New Delhi
2. Frazier, W.C and Westhoff, D.C (1996). Food Microbiology, 4<sup>th</sup> edition, Tata Mc Graw Hill Publication, New Delhi.
3. Kalia M. and Sangita, S. (1996). Food Preservation and Processing, First edition, Kalyani Publishers, New Delhi.
4. Sivasankar, B. (2002): Food Processing and Preservation, Prentice Hall of India Pvt.Ltd., New Delhi.

**Basic Food Microbiology**  
**Paper code: FST 102**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

**Unit I**

Microbiology: Introduction, historical developments in food microbiology, prokaryotes and eukaryotes, classification of microorganisms - a brief account.

Food materials and microorganisms, sources of microorganisms in foods.

**Unit II**

Microbial growth, growth curve, factors affecting growth-intrinsic and extrinsic factors controlling growth of microorganisms.

The microbiology of food preservation, thermal processing, irradiation, low temperature storage, chemical preservatives, high-pressure processing, control of water activity.

**Unit III**

Fermented foods: Fermented milk and milk products, fermented fruits and vegetables, fermented fish, fermented meats, fermented beverages - beer, vinegar and wine. Food spoilage and microbes of milk, meats, fish and various plant products, spoilage of canned foods.

**Unit IV**

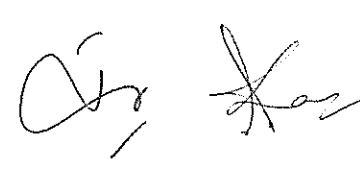
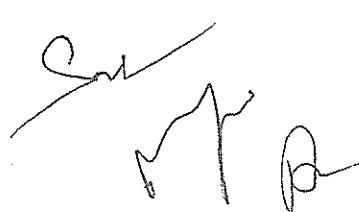
Foods microbiology and public health: Food poisoning, types of food poisonings, important features etc.

Bacterial agents of food borne illness: A brief account of various organisms related with food poisoning, food poisoning by clostridium, salmonella, E. coli, bacillus etc.

Non-bacterial agents of food borne illness: Poisonous algae, fungi and food borne viruses- a brief account.

**Text and Reference Books:**

1. James M. Jay (2000). Modern Food Microbiology, 5<sup>th</sup> Edition, CBS Publishers.
2. Banwart, G.J. (1997). Basic Food Microbiology, CBS Publishers.
3. Adam M.R. & Moss, M.O. (1995). Food Microbiology, New Age International Pvt. Ltd. Publishers.
4. Bibek Ray (1996). Fundamental Food Microbiology, CRC Press.  
Stanier, R.Y. (1996). General Microbiology, Vth Edition, MacMillan.





**Basic Food Engineering**  
Paper code: FST 103

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3 Hrs**

**Note:** There are nine questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt five questions in all, selecting one question from each unit.

**UNIT I**

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

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

**Unit II**

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

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

**Unit III**

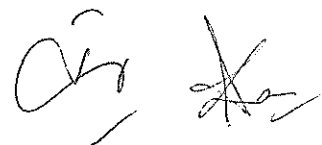
Heat transfer: Modes of heat transfer, conductive, convective and radiative heat transfer, thermal properties of foods, conductive heat transfer in a rectangular slab, tubular pipe and multilayered systems, estimation of convective heat transfer coefficient, forced convection and free convection, estimation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

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

**Unit IV**

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

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



Properties of water vapor: specific volume of water vapor, specific heat of water vapour, Gibbs-Dalton law, Dew point temperature, relative humidity, humidity ratio, wet bulb temperature.

Study of Psychrometric chart.

**Text and Reference Books:**

1. Singh, R.P and Heldman, D.R.(1984). *Introduction to Food Engg.*, Academic Press, INC, London
2. Earle, R.L. (1983) *Unit Operations in Food processing*, 2nd Edition Pergamon Press Oxford, U.K.
3. Toledo, R.T.(1997). *Fundamentals of Food Process Engineering*, CBS Publishers, New Delhi.
4. Batty, J.C. and Folkman, S.L. 1983. *Food Engineering Fundamentals*. John Wiley and Sons, New York.

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**Laboratory I**  
**Food Microbiology**  
**Paper code- FST 104**

**Credits: 4**  
**Periods per week: 8 Hrs.**

**Max. Marks: 100**  
**Duration of Exam.: 6 Hrs**

1. Study of the different parts and use of laboratory microscope.
2. Preparation and sterilization of culture media, glasswares.
3. Estimation of bacterial population in a given sample of food by Direct Microscopic Count (DMC) method.
4. Estimation of bacterial load of food sample by SPC (Standard Plate Count) method.
5. Inoculation of pure culture of bacteria by Pour Plate and Streak Plate methods.
6. To study simple staining of bacteria.
7. To conduct Gram's staining of bacteria and differentiate between Gram +ve and Gram -ve bacteria.
8. Determination of bacteriological quality of potable water and soft drinks by SPC method.
9. Microbial analysis of Cereals and Cereal products such as wheat flour and biscuits.
10. Microbial analysis of spices (red chillies and coriander).
11. Detection of presence of E.coli and other Coliform bacteria by rapid high coliform test.
12. Detection of presence of coliforms in water by MPN method.
13. Studies on the bacterial growth curve.
14. Estimation of Total Microbial Count of:
  - i) Surrounding air
  - ii) Workers
  - iii) Fruit and vegetable products
15. Isolation of bacteria by serial dilution technique.
16. To study various sub-culturing techniques

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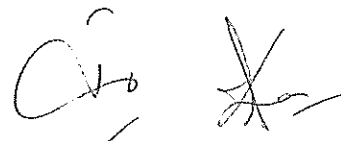
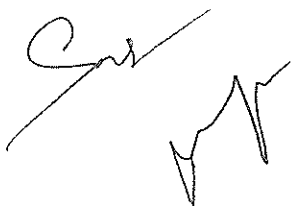
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**Laboratory II**  
**Food Analysis**  
**Paper code - FST 105**

**Credits: 3**  
**Periods per week: 6 Hrs.**

**Max. Marks: 75**  
**Duration of Exam.: 6 Hrs**

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



**Food Chemistry**  
**Paper code: FST 106**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

**Unit I**

Food chemistry: Definition, scope and importance.

Carbohydrates: Classification, chemical and physical properties, functions.

Starches: Functionality of starch in foods, modified starches, resistant starch, gelatinization and retrogradation of starches.

Pectic substances: Structure, properties and uses in food.

Gums: Occurrence, types and uses in food.

Dietary fibers: Types, soluble fibers, insoluble fibers and their important functions.

**Unit II**

Proteins and amino acids: Classifications, types of amino acids and proteins, chemical, physical and functional properties, texturized proteins, denaturation of protein, coagulation of proteins.

Lipids: Classification, functions, physico-chemical properties, oxidation of oils and fats.

**Unit III**

Food enzymes: A brief account, characteristics, enzyme activity, and factors affecting enzyme activity.

Applications of enzymes in food industry; meat industry, baking industry, beverage and fruit industry, starch and sugar industry.

Browning reactions in food: Enzymatic and non-enzymatic browning, their occurrence and applications in food.

**Unit IV**

Chemical properties and functions of minerals and vitamins.

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

**Text and Reference Books:**

1. Meyer, L.H.(1998) Food Chemistry, Van Nostrand, Reinhold Company Publication, New York,
2. Alias C. and Lindeu G (1991) Food Biochemistry, Ellis Horwood, New York
3. Pomeranz, Y and Meloan, R. (1995) Food Analysis : Theory and Practice, Westport, An AVI Publication, New York, Sydney, Toronto.
4. Fennema, R.O (1997) Food Chemistry, Second Edition, Food Science & Technology series, Marcel Dekker, INC., New York

**Food Analysis**  
**Paper code: FST 107**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

### UNIT I

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

Various analytical methods for food samples such as, pH value, turbidity, moisture content etc. Analysis of principal food constituents such as carbohydrates, proteins, fat, vitamins and minerals by various methods.

### UNIT II

Instrumentation in food analysis: Principles of spectroscopy, UV, visible and fluorescence spectroscopy, photometry.

Electrophoresis: Electrophoretic methods for protein: gel electrophoresis, paper electrophoresis, high voltage electrophoresis, starch gel electrophoresis.

### UNIT III

Chromatography: Ion exchange chromatography, affinity chromatography, liquid chromatography, gas chromatography, high performance liquid chromatography (HPLC), gas liquid chromatography (GLC), gas chromatograph mass spectrophotometers (GCMS), Ultra performance liquid chromatography (UPLC), uses, basic instruments and their applications in food analysis.

Methods for measuring textural properties of foods – Instron food tester, penetrometer etc.

### UNIT IV

Methods for measuring rheological and viscoamylographic properties of foods – viscoamylograph, extensograph, arelographic instruments.

Sensory evaluation: Introduction, methods, panel screening, selection methods, Sensory and instrumental analysis in quality control, hedonic scale testing of flavor, aroma, taste, texture, and overall acceptability of food products.

### Text and Reference Books:

1. Ronald S. Kirk, Ronald, Sawyer (1991). *Pearson's Composition & Analysis of foods*, 9th Edition Longman scientific & Technical, U.K.



2. Pomeranz, Y. & Merino (1978). *Food Analysis: Theory and Practice*, Westport, Connecticut: Amerine, M.A., Pangborn, R.M., and Rossler, E.B. 1965. Principles of Sensory Evaluation of Food. Academic Press, New York.
3. Birk, G.G., Herman, J.G. and Parker, K.J. Ed. -1977. Sensory Properties of Foods. Applied Science, London.



## Semester II

### Technology of Cereals & Millets

Paper code: FST 201

Credits: 4

Periods per week: 4 Hrs.

Max. Marks: 70

Duration of Exam.: 3Hrs

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

#### Unit I

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

Dough rheology and its measurement. Functionality of wheat proteins, carbohydrates, lipids and enzymes in bread making. Technology of pasta products and noodles.

#### Unit II

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

#### Unit III

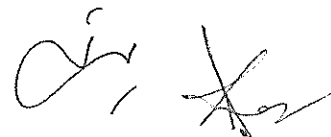
**Rice Chemistry and Technology:** Structure and chemical composition of rice grain, Milling of rice–types of rice mill; huller mill, Sheller-cum-cone polisher mill. Modern rice milling unit operation-dehusking, paddy separation, polishing and grading. Factors affecting rice yield during milling. By-products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

#### UNIT IV

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

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

**Technology of coarse cereal grains:** Chemical, technological and milling aspects of sorghum, oats and millets





### Text and Reference Books:

1. Samuel, A.M.(1996) “ *The Chemistry and Technology of Cereals as Food and Feed* “, CBS Publisher & Distribution, New Delhi.
2. Pomeranz, Y.(1998) “ *Wheat : Chemistry and Technology*”, Vol 1,3” Am. Assoc. Cereal Chemists. St. Paul, MN, USA.
3. Eliasson, A.C. and Larsson, K.(1993) “*Cereals in Bread making*”, Marcel Dekker. Inc. NewYork.
4. Honeney, R.C.(1986) “*Principles of Cereal Science and Technology*”, Am. Assoc. Cereal Chemists, St. Paul, MN, USA.
5. Pomeranz, Y. (1976) “*Advances in Cereal Science and Technology*”, Am. Assoc. Cereal Chemists St.Paul, MN, USA.
6. Juliano, B.O.(1985). “*Rice Chemistry and Technology*”, Am. Assoc. Cereal Chemists, St. Paul, MN, USA.
7. Blanshard J.M.V., Frazier, P.J. and Galliard, T. Ed. 1986. *Chemistry and Physics of Baking*. Royal Society of Chemistry, London.
8. Chakraverty, A. 1988. *Postharvest Technology of Cereals, Pulses and oilseeds*. Oxford and IBH, New Delhi.
9. Durbey, S.C. 1979. *Basic Baking: Science and Craft*. Gujarat Agricultural University, Anand (Gujrat).
10. Kent, N.L. 1983. *Technology of Cereals*. 3<sup>rd</sup> Edn. Pergamon Press, Oxford, UK.
11. Mathews, R.H. Ed. 1989. *Legumes: Chemistry, Technology and Human Nutrition*. Marcel Dekker, New York.
12. Salunkhe, D.K., Kadam, S.S. Ed. 1989. *Handbook of World Food Legumes: Chemistry, Processing and Utilization*, (3 vol. set). CRC Press, Florida.



**Technology of Fruits and Vegetables**  
**Paper code: FST 202**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are nine questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt five questions in all, selecting one question from each unit.

**Unit I**

Classification and composition of fruits and vegetables and their nutritional significance. Preharvest factors influencing post-harvest physiology, post harvest handling, precooling methods, post harvest treatments, edible coatings.

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

**Unit II**

Different storage methods for fruits and vegetables like modified atmospheric storage, cold storage, controlled atmospheric storage etc.

Preprocessing operations; Washing, blanching, peeling, sorting and grading of raw materials. Minimal processing of fruits and vegetables, quality factors for processing, fruit product order (FPO).

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

**Unit III**

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

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

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

Fruit preserves and candied fruits, dehydrated fruits & vegetables, spoilage of processed products.

**Unit IV**

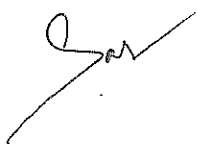
Canning of fruits and vegetables, preparation of syrups and brines, method and spoilage of canned fruits and vegetables

By products from fruit and vegetable wastes

Mushroom technology: Types of edible mushrooms, processing of mushrooms.

**Text and Reference Books:**

1. R.P.Srivastava and Sanjeev Kumar (2001) : Fruit and Vegetable Preservation – Principles and Practices, Third edition, International Book distributing Co. Lucknow(India)



2. A.K.Thompson (2003): Fruit and Vegetables – Harvesting, handling and storage. 2<sup>nd</sup> edition Blackwell Publishing.
3. Er. B. Pantastico: Post harvest Physiology, handling and utilization of tropical and subtropical fruits and vegetables. AVI Publishing Company, Inc.
4. W.V Cruess (1997): Commerical Fruit and Vegetable Products. Allied Scientific Publishers. Bikaner (India)
5. Girdharilal (1996) Preservation of Fruits and Vegetables. ICAR, New Delhi
6. Dauthy, M.E. 1997. Fruit and Vegetable Processing. International Book Distributing Co. Lucknow, India.
7. Hamson, L.P. 1975. Commercial Processing of Vegetables. Noyes Data Corporation, New Jersey.

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**Unit Operations in Food Engineering**  
Paper code: FST 203

Credits: 4  
Periods per week: 4 Hrs.

Max. Marks: 70  
Duration of Exam.: 3Hrs

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

**Unit I**

**Preliminary unit operations:** Material handling: Conveyors and elevators, types of conveyors and elevators. Cleaning: Dry-cleaning; screening, aspiration and magnetic cleaning, wet cleaning; soaking, spray washing, ultrasonic washing, sorting and grading: methods, advantages of sorting and grading.

**Unit II**

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

Mixing: Mixing terminology, mixers for dry solids (tumbler and vertical screw mixers).

Mixers for high viscosity pastes (dough mixer), mixers for low viscosity pastes, effect of mixing on foods.

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

**Unit III**

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

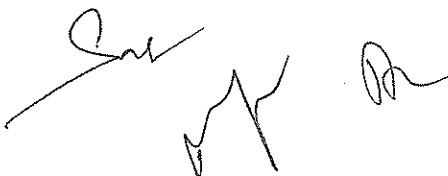
Evaporation: Single effect evaporator, multiple effect evaporators and plate evaporators, batch type pan evaporators, natural circulation, forced circulation, rising film, falling film and agitated thin film evaporators.

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

**Unit IV**

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

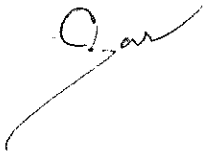
Freezing systems: Direct contact and indirect systems, freezing load calculations.



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

**Text and Reference Books:**

1. Singh, R.P and Heldman, D.R.(1984).*Introduction to Food Engg.*, Academic Press, INC, London.
2. Earle, R.L.(1983) *Unit Operations in Food processing*, 2<sup>nd</sup> Edition Pergamon Press Oxford, U.K.
3. Brennan, J.C., Buffers, J.R., Cowell N.D., Lilly, A.E.V. (1976). *Food Engineering Operations*, 2<sup>nd</sup> Edition, Elsevier, New York.
4. Harper, J.C. 1975. *Elements of Food Engineering*. AVI, Westport.
5. Heldman, D.R. and Lund, D.B. Ed. 1992. *Handbook of Food Engineering*. Marcel Dekker, New York.

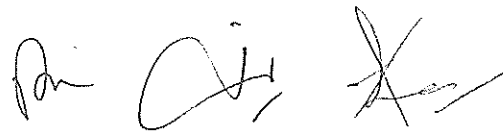
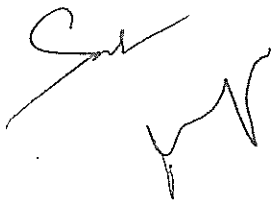


**Lab III**  
**Technology of Cereals & Millets**  
(Paper code - FST 204)

**Credits: 4**  
**Periods per week: 8 Hrs.**

**Max. Marks: 100**  
**Duration of Exam.: 6 Hrs**

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



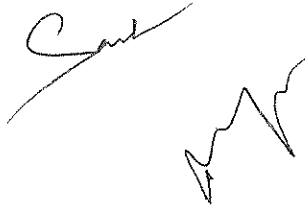
**Lab IV**  
**Technology of Fruits & Vegetables**  
(Paper code - FST 205)

Credits: 4  
Periods per week: 8 Hrs.

Max. Marks: 100  
Duration of Exam.: 6 Hrs

1. Extraction of Juices of different fruit (citrus, pomegranate, apple) and
  - a. Evaluation of Vit C content
  - b. Determination of pH
  - c. Evaluation of Browning Time
  - d. Determination of Acidity
  - e. Cost evaluation of Juice
  - f. Sensory evaluation of the products
  - g. Shelf -life study
2. Preparation of Jams (using different fruits) and
  - i) Determination of Pectin content
  - ii) Evaluation of Total Soluble Solids
  - iii) Evaluation of Sugars using lane eynon method
  - iv) Determination of pH
  - v) Evaluation of Acidity
  - vi) Sensory evaluation of the products
  - vii) Cost evaluation product prepared sensory evaluation & organoleptic test
3. Preparation of Jelly and
  - i) Estimation of Pectin content
  - ii) Determination of TSS
  - iii) Jelmeter test
  - iv) Checking for pH
  - v) Checking of Acidity
  - vi) Cost evaluation of product
  - vii) Microbiological analysis
  - viii) Sensory evaluation of the products
4. Preparation of Marmalade (using different fruits)
  - i) Jam Marmalade
  - ii) Jelly Marmalade
5. Preparation of Preserves and candies
  - i) Evaluation of TSS
  - ii) Determination of End point
  - iii) Microbiological Analysis
  - iv) Evaluation of product cost
  - v) Sensory evaluation of the products
6. Preparation of Potato chips and
  - i) Calculation of product dimension
  - ii) Determination of time-temp combination for product
  - iii) Study of the effect of antibrowning agents

7. Preparation of Tomato products (Sauce, Ketchup, Soup, puree) for
- i) Evaluation of TSS
  - ii) Evaluation of pH
  - iii) Evaluation of acidity
  - iv) Cost evaluation
  - v) Microbiological analysis
8. Pickling & Fermented products
9. Preparation and shelf-life study of ready-to-serve beverages
10. Experimental studies on drying and dehydration of fruits and vegetables

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**Technology of Beverages**  
**Paper code: FST 206**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

**Unit I**

Beverages: Definition, types, importance of beverages in our diets.  
Treatment of water for food industry.  
Technology of alcoholic beverages: Wine, cider, brandy, Perry, toddy, bear and whisky.

**Unit II**

Manufacturing of carbonated beverages and technology of carbonation.  
Technology of soft drinks, ingredients and additives used in production of soft drinks.  
Citrus beverages, whey beverages and utilization of whey in development of fortified drinks, use of low calorie sweeteners in beverages.

**Unit III**

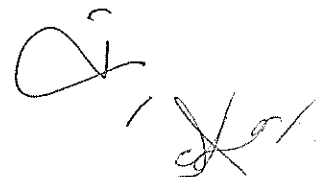
Production, processing and chemistry of tea manufacturing and types of tea.  
Production, processing, roasting and brewing of coffee, soluble coffee, decaffeinated coffee, monsoon coffee, coffee brew concentrate and chicory.

**Unit IV**

Cocoa processing, cocoa beverages and chocolate.  
Packaged drinking water- manufacturing processes, quality evaluation of raw and processed water, methods of water treatment, BIS quality standards of bottled water.

**Text and Reference Books:**

- 1 Tressler, Donald K. and Joslyn, Maynard A. 1971 Fruit and Vegetable Juice processing Technology, Second Edition. The AVI Pub. Com., Inc. USA.
- 2 Manay Shakuntala N and Shadaksharaswamy, M. Foods : Facts and Principles. 2<sup>nd</sup> edition New Age Inter. Publishers, New Delhi.
- 3 Haard, N.F. and Salunkhe, D.K. 1975. Postharvest Biology and Handling of Fruits and Vegetables. AVI, Westport.
- 4 Kader, A. A. 1992. Postharvest Technology of Horticultural Crops, 2nd Ed. University of California, Division of Agriculture and National Resources, California.



**Food Additives**  
**Paper code: FST 207**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

**Unit I**

Introduction to food additives: General classification, types, uses, functions, legal aspects, risks and benefits.

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

Chelating agents and sequestrants: Types, uses and mode of action

**Unit II**

Acidulants and pH control agents: Types, uses and mode of action.

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

Flavoring agents: flavors (natural and synthetic flavors), off flavor in foods, flavor enhancers, flavor stabilization, flavor encapsulation.

**Unit III**

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

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

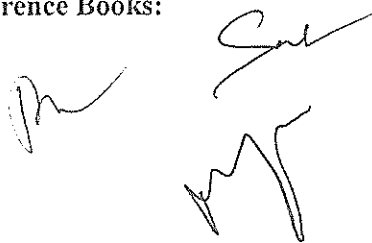
Stabilizers: Types, uses and functions.

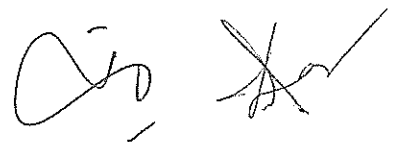
**Unit IV**

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

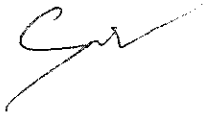
Advances in Food Additives: Classification, functions, safety aspects, recent advances with relevance to color, flavor enhancement, sweeteners and preservatives.

**Text and Reference Books:**





1. Branen, A.L. (2002). Food Additives. Marcel Dekker Inc.
2. Purselove J.W. (1998). 'Spices' Vol. I and II. Longman Publishers
3. Tainter, D.R. and Grenis, A.T. (1993). Spices and Seasonings- A Food Technology Handbook. VCH Publishers, Inc.
4. Merory, J. (1978). Food flavorings, Composition, Manufacture and Use. AVI Publishing, Inc.
5. Farrell, K.T. (1985). Spices, Condiments and Seasonings. AVI Publishing, Inc.



# Computer Fundamentals and Statistics

Paper code: FST 208

Credits: 4

Periods per week: 4 Hrs.

Max. Marks: 70

Duration of Exam.: 3Hrs

Note: There are nine questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt five questions in all, selecting one question from each unit.

## Unit I

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

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

## Unit II

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

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

## Unit III

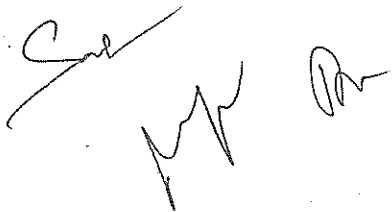
Understanding computer networks: Types; topologies for LANS, transmission media; analog and digital signals; network security.

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

Lab: windows explorer, MS-Word, MS-Excel, MS-Powerpoint, and Internet Surfing.

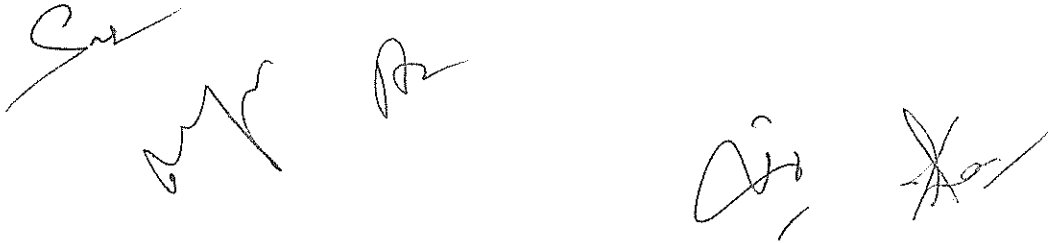
## Unit IV

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



**Text and Reference Books:**

1. Introduction to Information Technology, Pearson Education, New Delhi.
2. Norton, peter, Introduction to Computers, Tata McGraw Hill, New Delhi.
3. Douglas, Comer E., Computer Networks and Internet, Pearsons Education, New Delhi.
4. Rajaraman, V., Fundamentals of Computers, Prentice Hall of India, New Delhi.
5. Office 2000: No Experience Required, BPB Publications, New Delhi.
6. Ray and Acharya, Information Technology: Principles and Applications, Prentice Hall of India, New Delhi.
7. Tanenbaum, A.S., Computer Networks, Eastern Economy ed., PHI, New Delhi.

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**Food Biotechnology**  
**Paper code: FST 209**

Credits: 4  
Periods per week: 4 Hrs.

Max. Marks: 70  
Duration of Exam.: 3Hrs

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

**Unit I**

Introduction to Food biotechnology, basic principles of genetic engineering, improvement of the processing of various crops by genetic engineering, food safety and biotechnology.

**Unit II**

Natural antimicrobials for food preservation: Phytoalexins, essential oils and their components, bacteriocins of LAB, nisin, pediocins etc, applications of bacteriocins in food systems. Aflatoxins - production, control and reduction using molecular strategy.

**Unit III**

Protein engineering in Food technology - methods, applications of protein engineering (e.g. glucose isomerase, Lactobacillus Beta-galactosidase and peptide antibiotic nisin).  
Biotechnology and Food ingredients - Biogums, fats, oils, fatty acids and oilseed crops, fat substitutes, natural and modified starches, citric, fumaric and malic acids.

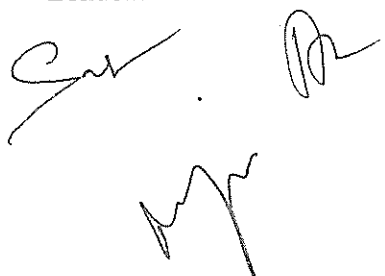
**Unit IV**

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

Transgenic plants and animals: their contribution to food production enhancement.

**Text and Reference Books:**

1. Lee, B.H. (1996). *Fundamentals of Food Biotechnology*, VCH Publishers.
2. Tombs, M.P. (1991). *Biotechnology in Food Industry*, Open University Press, Milton Keynes.
3. Knorr, D. (1987). *Food Biotechnology*, Marcel Dekker, INC, New York.
4. Schwartzberg, A & Rao (1990). *Biotechnology & Food Process Engineering*, Marcel Dekker, INC, New York.
5. Goldberg, I & Williams, R. (1991) *.Biotechnology and food Ingredients*, Van Nostrand Reinhold, New York.
6. King, R. D. and Cheetham , P.S.J. (1986)). *Food Biotechnology*, Elsevier Applied Science, London.



**Semester III**  
**Technology of Milk and Milk products**  
**Paper code: FST 301**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are nine questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt five questions in all, selecting one question from each unit.

**Unit I**

Dairy industry in India & its future prospects.

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

Physicochemical properties and nutritive value of milk.

Liquid milk processing: filtration/clarification, standardization, pasteurization (LTLT, HTST, UHT), homogenization.

Microbiology of milk

**Unit II**

Technology of condensed and evaporated milk: process of manufacture, defects (their causes and prevention).

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

Technology of indigenous milk products: *Dahi*, butter, *ghee*, channa, *paneer* etc.

**Unit III**

Technology of Cheese: Classification, process of manufacture of cheddar and cottage cheese, defects (their causes and prevention).

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

**Unit IV**

Milk and milk product standards and legislations in India: Grading of milk and criterion of grading, reconstituted milk, synthetic milk.

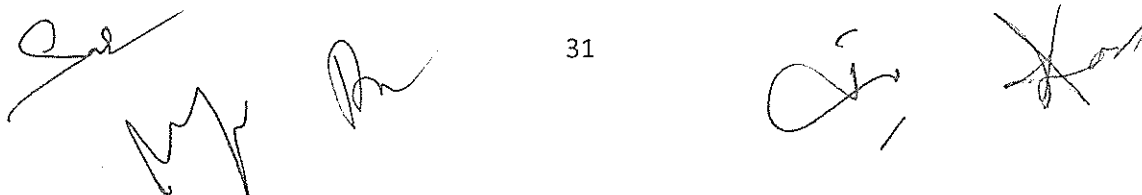
Milk adulteration, synthetic milk and quality control in dairy industry.

By products of dairy industry and their utilization.

Imitation dairy products.

**Text and Reference Books:**

1. Sukumar, De (1994). Outlines of Dairy Technology. Oxford University Press.
2. Smith G. (2003). Dairy processing improving quality. Woodhead Publishers.
3. Andrews, A.T. (1994). Biochemistry of Milk Products. Woodhead Publishers.  
Technology of Dairy Products by Early, R.

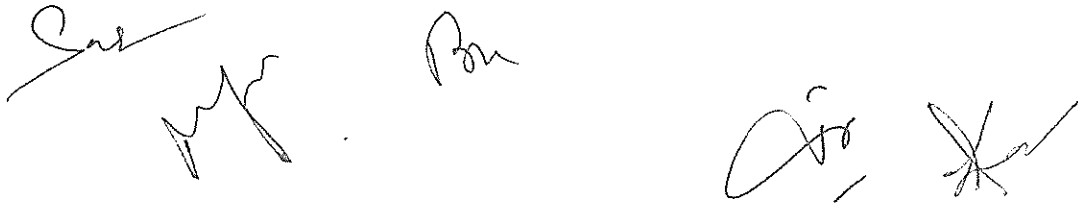


**Lab V**  
**Technology of Milk and milk Products**  
**(Paper code - FST 302)**

**Credits: 4**  
**Periods per week: 8 Hrs.**

**Max. Marks: 100**  
**Duration of Exam.: 6 Hrs**

1. Determination of specific gravity, total solids (T.S) % and SNF (Solid not fat) % in the given milk sample.
2. Determination of percentage fat in the given sample of milk by Gerber centrifuge method.
3. Determination of titrable acidity (T.A.) and pH of milk.
4. Determination of added Urea in the given sample of milk.
5. Determination of added starch in the given sample of milk.
6. To conduct clot on boiling (COB) and Alcohol – Alizarin test for testing milk quality.
7. Determination of added water in a given sample of milk.
8. Preparation qualitative testing of milk products like chhana, Khoa and Paneer, Ice cream.
9. Determination of added preservatives, neutralisers in the given sample of milk.
10. Estimation of bacterial numbers in a given sample of milk by direct microscopic count in a given sample of milk.
11. Determination of microbiological quality of milk of MBR test.
12. To study dismantling, cleaning and assembling of HTST pasteuriser for milk.
13. Separation of cream by cream separator.
14. Visit to a milk collection/chilling and milk processing plant.





**Food Packaging**  
**Paper code: FST 304**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

**Unit I**

Introduction to food packaging, primary food packaging and secondary packaging, factors involved in the evolution and selection of a food package, functions of food packaging  
Packaging requirements of selected foods-cereals and snack food, beverages, milk and dairy products, poultry & eggs, red meat, frozen food, horticultural products.  
Safety considerations in food packaging: Food safety problems associated with package, package labeling and food safety, recycling of packaging materials.

**Unit II**

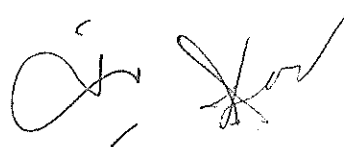
Paper and paper based packaging materials: Types of paper (Kraft, bleached, greaseproof) paper products (paper bags, cartoons, drums and molded paper containers), functional properties of paper, testing of paper packaging materials.  
Plastic packaging materials: Classification of polymers, functional and mechanical.  
Properties of thermoplastic polymers, processing and converting of thermoplastic polymers (extrusion, blow molding, injection molding, compression molding, lamination and heat sealing).

**Unit III**

Metal packaging materials: Functional properties of metal containers, tin plate containers -quality control tests, can manufacturing and protective coatings.  
Glass packaging materials: Composition and manufacturing of glass containers, glass container nomenclature, mechanical and optical properties of glass containers, testing of glass containers.  
Aseptic packaging of foods: Sterilization of packaging material, food contact surfaces & aseptic packaging systems, retort pouches.

**Unit IV**

Active food packaging: Definition, physical and chemical principles involved.



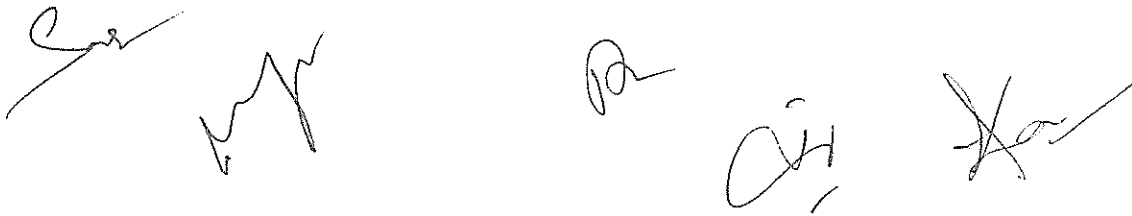
Edible films and coatings as active layer: Concept, different edible films used, use of edible active layers to control water vapor transfer and gas exchange

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

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

**Text and Reference Books:**

1. Sacharow, S. and Griffin, R. C. (1980) *Principles of food packaging*, 2nd Ed., Avi,Publication Co. Westport, Connecticut, USA.
2. Athalye. A.S. (1992) *Plastics in packaging*, Tata McGraw - Hill Publishing Co., New Delhi.
3. Rooney, M.L (1995) *Active Food Packaging*, Blackie Academic & Professional, Glasgow, UK,
4. Bakker, M. (1986) *The Wiley Encyclopaedia of Packaging Technology*, John Wiley Sons.inc: New York.



**Nutrition and Health**  
**Paper code: FST 305**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

**Unit I**

Foods and nutrients: Basic definitions, Functions of food and nutrients, Levels of nutritional status, changing concepts of nutrition.

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

Energy balance: Food energy measure, Energy control in human metabolism, Basal metabolic rate (B.M.R.), Factors affecting B.M.R., Measuring B.M.R., Energy requirements and its estimation

**Unit II**

Nutrition and weight management: Obesity and its causes, Body composition, B.M.I., Weight for height measures, Health implications of obesity, Problems of weight management.

Glycaemic index of foods: Control its importance

Recommended dietary allowances (R.D.A.), ICMR standards, Food guide, Exchange lists, Health promotion guidelines

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

**Unit III**

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

Proteins: Nature and essentiality of amino acids and proteins, Functions of protein, the concept of protein balance, Comparative quality of food proteins, Biological value, Net protein utilization, Protein efficiency ratio, Therapeutic applications of specific amino acids

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

**Unit IV**

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

Functional foods: concept and categories of functional foods and their importance

Food security: Problem and prospects

**Text and Reference Books:**



1. Insel, P., Turner R.E. & Ross, D.(2006). Discovering Nutrition, IInd Edition. ADA, Jones and Bartlett Publishers Inc., USA.
2. Williams, S. R.,(1990).Essentials of Nutrition and Diet Therapy. Times Mirror/Mosby College Publishing.
3. Hegarty, Vincent.(1995). Nutrition Food and the Environment. Eagen Press.
4. Brian, A. F., Allen, G. (1995). Food Science, Nutrition & Health. Edward Arnold, A member of Hodder Headline Group London, Sydney, Auckland.
5. Mudambi Sumati R. & Rajagopal, M.V. (1995). Fundamentals of Food & Nutrition. New Age International (P) Limited, Publishers.
6. ICMR (1995). Nutrient Requirement & RDA, ICMR, New Delhi.
7. Gibney, M.J., Elia, M., Ljungqvist, O. & Dowsett, J. (2005). Clinical Nutrition. The Nutrition society textbook series, Blackwell publishing company.

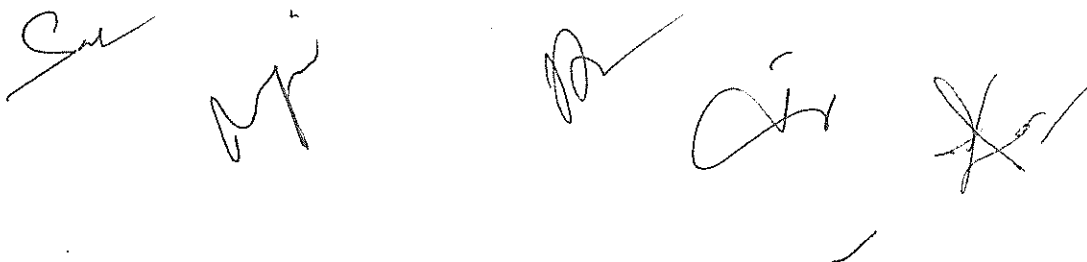
The image shows several handwritten signatures and initials in black ink. On the left, there is a signature that appears to be 'Sud'. To its right are the initials 'MP'. Further right is a signature that looks like 'R'. To the right of 'R' are the initials 'AH' and 'X'. The handwriting is cursive and somewhat stylized.

**Lab VI**  
**Food Packaging**  
**(Paper code - FST 306)**

**Credits: 4**  
**Periods per week: 8 Hrs.**

**Max. Marks: 100**  
**Duration of Exam.: 6 Hrs**

1. Designing of an ideal packaging material for different type of food products.
2. Identification of different packaging materials.
3. Testing of paper based packaging materials.
4. Equilibrium Relative Humidity (ERH) study of foods.
5. To study uniformity and amount of wax in wax paper for packaging of hygroscopic foods.
6. To study chemical resistance of plastic and paper packaging materials.
7. To study Water Vapor Transmission Rates (WVTR) of paper and plastic polymers.
8. Shelf life studies of packaged foods.
9. Study of grease resistance of paper, plastic laminates and aluminium foil for the packaging of fatty foods.
10. To perform various functional tests on corrugated fiberboard boxes.
11. Determination of Cobb value of different types of paper board.
12. Shrink Packaging of poultry products.
13. Aseptic packaging of different food products.
14. Vacuum Packaging of dry powders.
15. Testing of glass containers for thermal shock resistance.
16. Determination of tensile strength and heat seal strength of different plastics.
17. To conduct drop and vibration tests on different types of corrugated fiberboard boxes.
18. Determination of tin coating weight and porosity of tin plate container.
19. Determination of lacquer coating in tin containers.
20. Study of manufacture of 2 piece and 3 piece metal cans.
21. Visit to paper manufacturing industry.



**Laboratory-VII**  
**Nutrition and Health**  
**(Paper code - FST 307)**

Credits: 4  
Periods per week: 8 Hrs.

Max. Marks: 100  
Duration of Exam.: 6 Hrs

- 1) Diet planning for infants
- 2) Diet planning for lactating women
- 3) Diet planning for women above 45 years
- 4) Diet planning for athletic persons
- 5) Diet planning for geriatric persons
- 6) Diet planning for diabetic patients
- 7) Diet planning for heart patients
- 8) Effect of processing methods on nutritive value of different food preparation
- 9) Preparation of food charts
- 10) To estimate the calorific value of different food items
- 11) To estimate PER, NPU, BMR, BV and glycemic index of food stuffs
- 12) Diet planning using food exchange methods



**Semester IV**  
**Technology of Meat, Fish and Poultry products**  
**Paper code: FST 401**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

**Unit I**

Status and scope of meat industry in India.

Structure and physico-chemical properties of muscle.

Meat: Composition and nutritive value, conversion of muscle into meat, environmental and animal production factors that affect meat quality, post mortem changes in meat, rigor mortis, cold shortening, pre-rigor processing.

**Unit III**

Aging of meat, meat tenderization- natural and artificial methods.

Properties of fresh meat-water holding capacity, color, palatability.

Cooking methods for meat.

Storage and preservation of meat: Chilling, Freezing, Curing, Smoking, Dehydration, Canning.

Spoilage of meat.

**Unit III**

Restructured meat products, meat analogs.

Meat industry by products: Importance and applications.

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

Manufacturing of fish oil, fish protein concentrate, fish meal.

By-products of fish industry, their technology of utilization.

**Unit IV**

Egg: Structure, composition, nutritive and functional properties.

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

Egg powder.

Packaging and transportation of eggs.

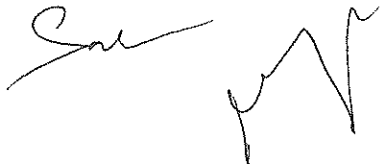
Poultry: Types, chemical and nutritive value of poultry meat, poultry dressing and slaughtering methods, preservation, grading and packaging of poultry meat.

**Text and Reference Books:**

1. Principles of Meat Science by Forest et al.



2. William J. & Owen J., (1977). Egg Science & Technology, AVI Publishing Company, INC. Westport, Connecticut.
3. Egg Science and Technology by Staddelman.
4. Lawrie, R.A. (1998). Lawrie's Meat Science. Woodhead Publishers.
5. Mead, G. (2004). Poultry Meat Processing and Quality. Woodhead Publishers.
6. Panda, P.C. (1992). Text Book on Egg and Poultry Technology, Vikas Publishers.

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**Industrial Microbiology**  
**Paper code: FST 402**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are nine questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt five questions in all, selecting one question from each unit.

**Unit I**

Overview of fermentation: Fermentation as an ancient art, modern era of fermentation technology.  
Biology of industrial microorganisms: Isolation, screening and genetic improvement of industrially important microorganisms.

**Unit II**

Fermentation systems: Batch and continuous systems, fed-batch culture, fermenter design, solid substrate fermentation, instrumentation and control.  
Fermentation raw materials: Criteria used in media formulation, influence of medium, and raw materials for process control.

**Unit III**

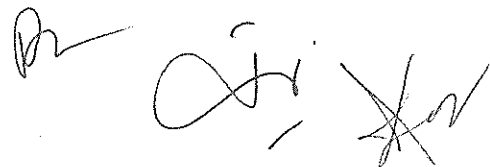
Down stream processing - Objectives, steps, problems, separation processes with examples.  
Microbial production of various primary and secondary metabolites: Alcohol, amino-acids (glutamic acid and lysine), organic acids (citric acid & acetic acid) & enzymes.  
Principles of over-production of metabolites.

**Unit IV**

Biomass production: Microbial production of single cell protein, Baker's yeast.  
Immobilized enzyme technology: Methods of immobilization, reactors and applications.  
Waste treatment: Introduction, waste treatment systems, microbial inoculants and enzymes for waste treatments.

**Text and Reference Books:**

1. Prescott & Dunn (1992). Industrial Microbiology, 4<sup>th</sup> Edition. CBS Publishers, New Delhi.
2. Ward, O.P. (1989). Fermentation Biotechnology- Principles, Process and Products. Prentice Hall Publishers, New Jersey.
3. Stansbury, P.F., Whitakar, A and Hall, S.J. (1995). Principles of Fermentation Technology, Pergamen Press, Oxford.
4. Young, M.Y. (1984). Comprehensive Biotechnology (Vol. 1-4), Pergamon Press, Oxford.
5. Rehm, H.J., Read, G.B., Puhler, A and Stadler (1999). Biotechnology, Vol. 1-8, VCH Publications.
6. Crueger and Crueger (2000) Biotechnology – A Text book of Industrial Microbiology. IInd edition. Panima Publishing company.



# Nutraceuticals and Functional Foods

Paper code: FST 403

Credits: 4

Periods per week: 4 Hrs.

Max. Marks: 70

Duration of Exam.: 3Hrs

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

## Unit I

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

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

## Unit II

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

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

Dietary fibers and complex carbohydrates as functional food ingredients.

## Unit III

Protein as a functional food ingredient.

Probiotic foods and their functional role.

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

## Unit IV

Functional vegetable products, oil seeds and sea foods.

Coffee, tea and other beverages as functional foods/drinks and their protective effects.

Effects of processing, storage and interactions of various factors on the potentials of such foods.

## Recommended readings

Mazza, G (1988). Functional foods–biochemical and processing aspects, Technomic Publ. Lancaster, USA.

Kirk, RS (1999). Pearson's composition and analysis of foods. Wesley Longman Inc. California, USA.

Wildman, REC (2007) Handbook of nutraceuticals and functional foods.

Official Methods of Analysis (2003). Association of official analytical chemists, USA.



**Technology of Pulses and Oil seeds**  
**Paper code: FST 404**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

**Unit I**

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

Importance of oilseeds processing in India.

**Unit II**

Commercial oil resources, basic processing of fats and oils - oil extraction, expeller pressing and solvent extraction, degumming, refining, bleaching, hydrogenation, fractional crystallization, interesterification, glycerolysis, molecular distillation, plasticizing and tempering.

Preparation of protein concentrates and isolates and their use in high protein foods, fermented and traditional products.

**Unit III**

Fat substitutes and mimetics.

Common pulses produced in the country.

Soybean: processing and utilization.

Milling methods for pulses, home scale commercial and recent methods with equipments.

**Unit IV**

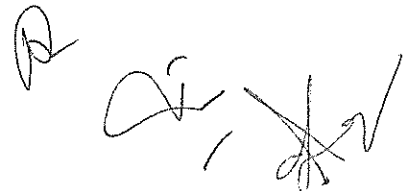
Anti-nutrients in pulses and modes of elimination.

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

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

**Text and Reference Books:**

1. Hamilton, R.J. and Bharti, A. Ed. 1980. Fats and Oils: Chemistry and Technology. Applied Science, London.



2. Salunkhe, O.K. Chavan, J.K, Adsule, R.N. and Kadam, S.S. 1992. World Oilseeds: chemistry, Technology and Utilization. VNR, New York.
3. Wolf, I.A. Ed. 1983. Handbook of Processing and Utilization in Agriculture. (2 vol. set). CRC Press, Florida.

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**Advances in Food Processing and Preservation**  
**Paper code: FST 405**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are **nine** questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt **five** questions in all, selecting one question from each unit.

**Unit I**

**Extrusion technology:** General principles, extrusion process, advantages of extrusion, extrusion equipment, single screw extruders and twin screw extruders, effect of extrusion on food properties, extrusion of starch based foods.

**Hydrostatic Pressure Technology:** General principles, effect of hydrostatic pressure on microorganisms-possible mode of action, application of hydrostatic pressure technology in food industry.

**Unit II**

**Hurdle Technology:** Principles and basic aspects of hurdle technology, different hurdles, hurdle effect, application of hurdle technology in dairy products, intermediate moisture foods, fermented products, heated foods and chilled foods.

**Membrane Technology:** Introduction of membrane, their classification and function, principles of reverse osmosis and ultrafiltration, nanofiltration and microfiltration, applications of membranes in food processing industry, modules for using membrane filters.

**Unit III**

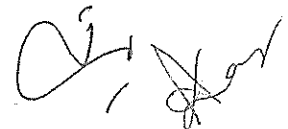
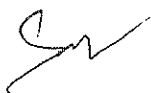
**High intensity electric field pulses (HIEFP):** Principles, generation of electric field pulses, applications in foods, effect on food properties, effect of HIEFP on microorganisms.

**Food Irradiation Technology:** General aspects of irradiation, ionizing radiation, irradiation process, units, mechanism, advantages and disadvantages of irradiation process, recent studies, wholesomeness of irradiated foods, general purposes of irradiation process; inactivation of microorganisms, inhibition of sprouting, delay of ripening and senescence and miscellaneous effects on food properties.

**Unit IV**

**Ultrasound in food processing and preservation:** Introduction, ultrasound instrumentation, ultrasound processing for enhancement of mass transfer, heat transfer and homogenization and emulsification.

**Microwave Processing:** Microwave, properties, heating mechanism, difference between conventional and microwave heating, microwave oven, factors affecting the heating of food in

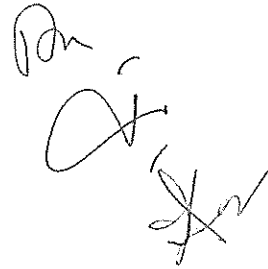
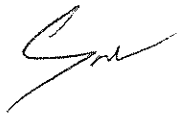


microwave oven, applications of microwave in food processing, effect of microwave on food nutrients, recent studies.

Formulated Foods: Recent advances in formulated and value added foods, seafoods, and infant and weaning foods, emergency foods, soy fortified products, complementary foods.

**Text and Reference Books:**

1. Gloud, G. W. (1995). *New Methods of Food Preservation*, Blackie Academic & Professional, U.K.
2. Holdsworth, S. D. (1993). *Aseptic Processing and Packaging of Food Products*, Elsevier, London.
3. Church, P. N. (1993). *Principles and Applications of Modified Atmosphere Packaging of Food*, Blackie Academic & Professional, U.K.



**Lab VIII**  
**Technology of Meat, Fish & Poultry Products**  
**(Paper code - FST 406)**

**Credits: 4**  
**Periods per week: 8 Hrs.**

**Max. Marks: 100**  
**Duration of Exam.: 6 Hrs**

1. Determination of external quality of poultry egg.
2. Determination of internal quality of poultry egg.
3. To study the effect of time, temperature on co-agulation properties of egg.
4. Determination of time temperature condition on formation of iron sulphide in egg.
5. Preservation and evaluation of different egg products.
6. Preparation of different poultry meat products:
  - i. Chicken nuggets
  - ii. Chicken wings
  - iii. Chicken burgers
  - iv. Fried chicken
  - v. Gravy chicken
  - vi. Chicken tikka
7. Preparation of different mutton products:
  - i. Gravy mutton
  - ii. Sausages
8. Determination of tenderness and water holding capacity of different meats.
9. Visit to meat, fish and poultry processing industries.



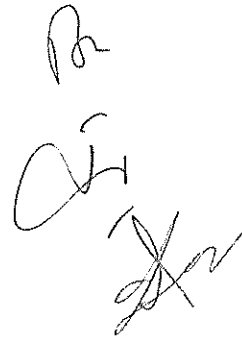
**Lab IX**  
**Nutraceutical and functional foods**

(Paper code - FST 407)

Credits: 4  
Periods per week: 8 Hrs.

Max. Marks: 100  
Duration of Exam.: 6 Hrs

1. Study and demonstration of the antimicrobial effects of plant tannins, alkaloids and sulfur compounds.
2. Preparation and evaluations of probiotic foods and study their health benefits
3. Extraction and estimation of nutraceuticals from various foods: isoflavones. (legumes) capsaicinoids (peppers) organosulfur cereals compounds (onions and garlic) and monosaturated fatty acids (oil seeds) and lecithins (legumes seeds).
4. Extraction and estimation of lycopene from tomato and tomato products.
5. Extraction and estimation of plant phenolic substances by colorimetric and spectrophotometric techniques.
6. Determination of free radical sequencing ability of various foods.
7. Determination and quantifications of some nutraceutical and functional food compounds by GLC and HPLC.
8. New product development by incorporation of bioactive compounds extracted from different sources.





**Industrial food waste management**  
**(Paper code: FST 408)**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are nine questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt five questions in all, selecting one question from each unit.

**Unit I**

Introduction; types of waste generated; non degradable and biodegradable wastes; food industrial wastes from fruit and vegetable processing industry, fish, meat and poultry industry and dairy industry.

Utilization of waste: methods of utilizing wastes to make value added products; pectin, food colorants, antioxidants from fruit peels (citrus, mango, pomegranate), lycopene from tomato peels, enzymes from meat processing, single cell proteins.

**Unit II**

Storage and disposal of waste: solid waste storage and disposal methods, land filling, burial, incineration, recycling; biological treatment of food industry wastes, storage and disposal of liquid and gaseous waste; legal aspects related to storage and disposal

**Unit III**

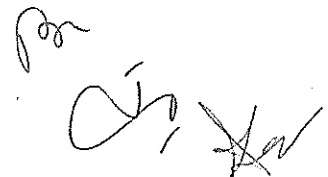
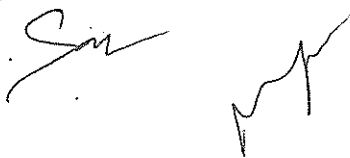
Waste water treatment: characteristics of waste water; different waste water treatment methods-physical, chemical and biological methods.

**Unit IV**

Environment management systems (ISO14000) and its application in food industry; legislation related to waste management.

**Text and Reference Books:**

1. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science Pub Ltd.
2. Water & Wastewater Engineering; Fair GM, Geyer JC & Okun DA; 1986, John Wiley & Sons, Inc.
3. Wastewater Treatment; Bartlett RE; Applied Science Pub Ltd.
4. Symposium: Processing Agricultural & Municipal Wastes; Inglett GE; 1973, AVI.
5. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.
6. Environmental Biotechnology: Principles and Applications; Rittmann BE & McCarty PL; 2001, McGraw-Hill International editions.
7. Environmental Biotechnology; Bhattacharyya B C & Banerjee R; Oxford University Press.



**Industrial Organization and Management**  
**(Paper code: FST 409)**

**Credits: 4**  
**Periods per week: 4 Hrs.**

**Max. Marks: 70**  
**Duration of Exam.: 3Hrs**

**Note:** There are nine questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt five questions in all, selecting one question from each unit.

**UNIT I**

**Management:** Meaning, nature, scope, significance, functions and principles; levels of management, process of management, co-ordination as an essence of management.

**Planning:** Meaning and importance of planning; planning Process; limitations, considerations in planning; methods of planning; types of plans.

**UNIT II**

**Organising:** Meaning and importance, process of organizing, principles of effective organisation; key elements in organizing process; formal v/s informal organization departmentation, decentralisation, delegation of authority Relationship – Line, Staff and Functional.

**Motivation, leadership and communication:** Concept and significance of motivation; determinants of behaviour; Maslow's theory of motivation;

**UNIT III**

**Meaning and importance of leadership;** leadership styles; qualities of leadership.

**Communication:** Meaning, Significance, and principles of Effective Communication.

**Control:** Concept and significance, control process; control techniques.

**Decision making:** Concept and techniques, steps in decision making process.

**UNIT IV**

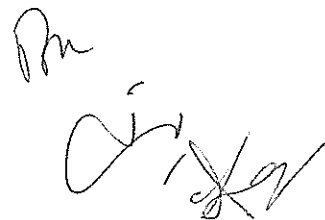
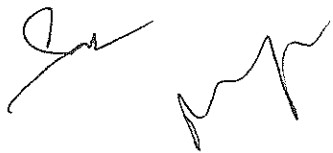
**Introduction to functional areas of management:** Personnel management, production management, financial management and marketing management.

**Concept, objectives and functions of personnel management, marketing management and financial management.**

**Production management:** Plant location and layout, production planning and control.

**Text and Reference Books:**

1. B.P. Singh and A.K. Singh. Modern Management, Excel Book, New Delhi.
2. B.P. Singh. Management Concepts & Practices, Dhanpat Rai & sons, Nai Sarak, Delhi.
3. Fred Luthans, Introduction to Management, Mc Graw Hill, New Delhi.
4. R.S. Dwivedi Management—An Integrated Approach National Publishing Co., Delhi.



(Open Elective)  
Nutrition & Health  
OEC-FST-001

Credits: 4  
Periods per week: 4 Hrs.

Max. Marks: 70  
Duration of Exam.: 3Hrs

Note: There are nine questions in all. Question No. 1 is compulsory, it consists of 5 short questions of 2 marks each. Students have to attempt five questions in all, selecting one question from each unit.

**Unit I**

Food and nutrients: Basic definitions, changing concepts of nutrition.  
Energy requirements of individuals and groups. Control of food intake and weight.

**Unit II**

Obesity and its causes, Body composition, Body Mass Index (B.M.I).  
Basal metabolic rate (B.M.R.), Factors affecting B.M.R.

**Unit III**

Cardio vascular diseases, Diabetics, Hypertension, Inflammatory bowel disorder (IBD): causes, precaution and preventive measures.  
Functional Foods, role in controlling various diseases.

**Unit IV**

Diet planning for specific age groups.  
Diet planning for diabetic patients.  
Preparation of food charts.

**Text and Reference Books:**

1. Insel, P., Turner R.E. & Ross, D. (2006). Discovering Nutrition, II<sup>nd</sup> Edition. ADA, Jones and Bartlett Publishers Inc., USA.
2. Williams, S.R., (1990). Essentials of Nutrition and Diet Therapy. Times Mirror / Mosby College Publishing.
3. Hegarty, Vincent. (1995). Nutrition Food and the Environment. Eagen Press.
4. Brian, A. F., Allen, G. (1995). Food Science, Nutrition & Health. Edward Arnold, A member of Hodder Headline Group London, Sydney, Auckland.
5. Mudambi Sumati R. & Rajagopal, M.V. (1995). Fundamentals of Food & Nutrition. New Age International (P) Limited, Publishers.
6. ICMR (1995). Nutrient Requirement & RDA, ICMR, New Delhi.
7. Gibney, M.J., Elia, M., Ljungqvist, O. & Dowsett, J. (2005). Clinical Nutrition. The Nutrition society textbook series, Blackwell publishing company.

