

### 3.1 FOOD MICROBIOLOGY

L T P  
3 – 4

#### RATIONALE

This subject is aimed to develop an understanding among the students on various micro flora associated with food products and their beneficial role as well as deleterious effect on processed food products

#### DETAILED CONTENTS

1. Introduction – Definition, historical developments in the food microbiology and its significance (6 hrs)
2. Microbiology of milk and milk products like cheese, butter, Ice-cream, milk powder (6 hrs)
3. Microbiology of meat, fish, poultry and egg products (6 hrs)
4. Microbiology of fruits and vegetable products like jam, jelly, sauce, juice (6 hrs)
5. Microbiology of cereal and cereal products like bread, (6 hrs)
6. Microbial spoilage of foods – food borne pathogens, food poisoning, food infection and intoxication (10 hrs)
7. Concept of TDT, F, Z and D value (02 hrs)
8. Anti-microbial agents – physical and chemical agents – their mechanism of action (6 hrs)

#### LIST OF PRACTICALS

1. Study of the microbiological quality of milk by MBR test
2. Estimation of total microbial bacterial plate count of food sample by direct microscopic and SPC method
3. Estimation of total microbial count of yeast and mould
4. Estimation of total microbial count of (a) milk products (b) fruits and vegetable products (c) meat, fish and poultry products (d) water (e) surface (f) air (g) workers (h) canned foods
5. Study of the growth curve of micro-organisms

6. Demonstration of effect of different anti-microbial agents i.e. (a) high and low temperature (b) UV radiation and (c) chemical preservatives on the growth of microbes

### **INSTRUCTIONAL STRATEGY**

This being one of the most basic subjects for the students of food technology, the teachers should lay a lot of emphasis on explaining the facts, concepts, principles and procedures involved in various topics. The students should be given appropriate tutorial exercises. Teachers should made use of chart and other appropriate media to support classroom instruction. Emphasis during the practical session should be on performance by individual students and teacher should develop instructional manual for various exercises to facilitate the students. Visits to some of the local industries and quality control centers may be arranged to demonstrate various aspects of basic microbiology to the students. Experts may be invited to deliver lecturers on latest developments in the field.

### **RECOMMENDED BOOKS**

1. Essentials of Microbiology by KS Bilgrami; CBS
2. Food Microbiology by WC Frazier; Tata McGraw Hill
3. Modern Food Microbiology by James M Jay; CBS
4. Bacteriology by Sale
5. Standard Methods for Waste Water Analysis by APHA
6. Basic Food Microbiology: Bannett , Chapman and Hall
7. Food Microbiology by M.R. Adams
8. Hand Book of Microbiology by Bisen
9. Text Book of Fungi by Sharma

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	06	12
2	06	12
3	06	12
4	06	12
5	06	12
6	10	22
7	02	06
8	06	12
<b>Total</b>	<b>48</b>	<b>100</b>

### 3.2 FOOD CHEMISTRY AND NUTRITION

L T P  
3 - 2

#### RATIONALE

Diploma holders in food technology are required to test the food products in the laboratories and should have theoretical as well as practical understanding of food chemistry and nutrition, which relates to different aspects of food chemistry and nutrients such as water, carbohydrates, fats, protein, minerals, vitamins, food pigments, enzymes etc. Hence the subject is included for developing these competencies.

#### DETAILED CONTENTS

1. Importance of food. Scope of food chemistry (1 hrs)
2. Introduction to different food groups (cereals & pulses, meat & fish & poultry, milk & milk products, fats & oils, vegetables & fruits, sugar & jaggery, spices and condiments & their classification and importance (3 hrs)
3. Water (5 hrs)  
Structure of water molecule, types and properties of water, water activity and its importance
4. Carbohydrates (5 hrs)  
Basic composition, classification, sources, nutritional and industrial importance
5. Proteins (5 hrs)  
Basic composition, classification, sources, functional, nutritional and industrial importance
6. Fats (5 hrs)  
Basic composition, classification, sources, nutritional and industrial importance
7. Vitamins and Minerals (5 hrs)  
Function and sources of minerals-calcium, iodine, zinc, iron, fluoride, fat soluble and water-soluble vitamins, effect of processing and storage on vitamins
8. Deficiency disorders and requirement of different nutrients (Calcium, Iodine, vitamin-A, iron, protein and calorie or energy. (5 hrs)
9. Concept of Balanced Diet. (2 hrs)

10. Food Pigments (5 hrs)  
Importance and plant sources of pigments (Chlorophyll, Anthocyanin, carotenoids, lycopene)
11. Enzymes (7 hrs)  
Definitions, mode of action, importance sources, nomenclature and classification

### **LIST OF PRACTICALS**

1. Determination of moisture in a given food sample
2. Determination of protein in a given food sample
3. Determination of carbohydrates in a given food sample
4. Determination of ash in a given food sample
5. Determination of crude fat in a given food sample
6. Determination of pH of a given sample
7. Determination of acidity of given food sample/beverage
8. Determination of total non reducing and reducing sugars
9. Determination of vitamin C in given food sample
10. Determination of diastase enzyme activity
11. Identification of pigments in a given food sample
12. Visit to hospital/slide show on various nutritional deficiency disorders

Note: Wherever necessary equipment are not available students may be demonstrated that topic in relevant industry or in any other institute.

### **INSTRUCTIONAL STRATEGY**

This is one of the basic subjects for the diploma holders in food technology. Teacher should design appropriate tutorial exercises for the students. Students may be given sufficient practice on different experiments, individually, under the guidance of teacher. Teachers may also prepare charts and slides. Student may be taken to industry for showing different tests.

## RECOMMENDED BOOKS

1. Essentials of Food and Nutrition by Swaminathan Vol. I and II, Health Kalyani publishers, New Delhi
2. Food Chemistry by LH Meyer, Van Nostrand Reinhold Co. New York ...
3. Hand book of Analysis of Fruits and Vegetables by S. Ranganna, Tata Me Graw-Hill. Publishing Company, New Delhi
4. Biochemistry by Mohinder Singh, Sejwal Publisher. New Delhi
5. Introduction to Biochemistry by Braverman, Elsevier Scientific Publishing
6. Food Chemistry by Linhinger, CBS Publishers, Delhi ...
7. Food Chemistry by FANNEMA,
8. Hand Book of Food & Nutrition by Swaminathan, Narosa Publishing House, New Delhi
9. A Text Book of Biochemistry A.V.S.S. Rama Rao, U B S Publishers, New Delhi
10. A Text Book of Biochemistry A.K.Berry, Narosa Publishing House
11. Nutrition & Dietetics by Joshi, Tata McGraw-Hill Education, New Delhi
12. Clinical Dietetics and Nutrition by Antia & Abraham, Oxford University Press, USA
13. Chemical Changes in Food During Processing by Richardson, John W. Finley ...  
Avi Publishing Co Inc.
14. Fundamentals of Food & Nutrition by Sumati R. Mudambi, Published by New Age International (P) Ltd.,
15. Nutrition & Dietetics by Rose
16. Food science by Sri Laxmi, New Age International Publishers, New Delhi
17. Food chemistry (Narosa publication) by H.K. Chopra and P.S. Panesar (2010),  
Published By Morgan & Claypool

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	01	02
2	03	06
3	05	10
4	05	10
5	05	10
6	05	10
7	05	10
8	05	10
9	02	06
10	05	10
11	07	16
<b>Total</b>	<b>48</b>	<b>100</b>

### 3.3 PRINCIPLES OF FOOD PROCESSING AND PRESERVATION

L T P  
3 – 2

#### RATIONALE

Knowledge and skills related to food processing and preservation are essential for the diploma holder in food technology. In this subject, students are exposed to various techniques of food preservation such as low temperature, high temperature, moisture removal, chemicals and radiation preservation. Relevant skills will also be imparted through this subject

#### DETAILED CONTENTS

1. Scope and trends in food industry (8 hrs)  
 Status of Indian food industry with emphasis on State of Haryana. Definition of food – food technology, food science, food preservation and food engineering – basic considerations. Importance of food processing and preservation. Classification of foods on the basis of shelf life, pH, origin; Different types of food spoilage viz. microbiological, bio-chemical, chemical, physical and their effects on food quality, principles of food preservation
2. Preservation by sugar and salt (5 hrs)  
 Principles of Salt and sugar preservation, Intermediate Moisture Food (IMF)
3. Preservation by Low Temperature (6 hrs)  
 Low temperature required for different foods – refrigeration – refrigeration load, refrigeration systems; slow and fast freezing, freezing process; types of freezer – advantages and disadvantages of freezing; storage and thawing of frozen food
4. Preservation by High Temperature (6 hrs)  
 Pasteurization, Sterilization, Canning: their Definition, Method, advantages and disadvantages,
5. Moisture Removal (10 hrs)  
 Evaporation, concentration, drying and dehydration, types of dryers, advantages and disadvantages, selection of dryers,

6. Food Additives including Chemical Preservatives- (7 hrs)  
Classification, functions and uses in foods
7. Preservation of foods by Radiation – Irradiation of foods, Radiation doses for spices, onions, potatoes and meat. Concept of microwave heating effect on food quality (6 hrs)

### **LIST OF PRACTICALS**

1. Study of changes in fruits/vegetables during storage
2. Peeling of fruits and vegetables
3. Preparation of brine and syrup
4. Blanching of seasonal fruits and vegetables
5. Dehydration of fruits & vegetables
6. Preparation of fruit bars
7. Freezing of seasonal vegetables, meat and fish products
8. Preparation of Jam, Jelly & squash
9. Pickle preparation
10. Storage of frozen products
11. Preparation of sauerkraut
12. Visit to fruits and vegetable industry to see above operations

### **INSTRUCTIONAL STRATEGY**

This being one of the most basic subjects for the students of food technology, the teachers should lay a lot of emphasis on explaining the facts, concepts, principles and procedures involved in various topics. The students should be given appropriate tutorial exercises. Teachers should make use of chart and other appropriate media to support classroom instruction. Emphasis during the practical session should be on performance by individual students and teacher should develop instructional manual for various exercises to facilitate the students. Visits to some of the local industries and quality control centers may be arranged to demonstrate various aspects of food technology and preservation and

principles involved therein to the students. Experts may be invited to deliver lectures on latest developments in the field.

### RECOMMENDED BOOKS

1. Food Science by NN Potter, CBS publishers, New Delhi
2. Technology of Food Preservation by Desrosier, The Avi Publishing Company, Inc., Westport
3. Principles of Food Science Vol. – I by Fennema, Karrel, McGraw-Hill Book Company, New York
4. Preservation of Fruits and Vegetables by Girdhari Lal, Sidhapa and Tandon, CBS Publishers, Delhi
5. Hand book of Analysis of Fruits and Vegetables by S Ranganna, Tata Me Graw-Hill. Publishing Company, New Delhi
6. Fruits and Vegetable Processing by Cruss, Oxford and IBH Publishing Co., New Delhi
7. Food Science by Mudambi, New Age International Pvt Ltd Publishers, New Delhi
8. Basic Food Preparation( Manual)
9. Fruit & Vegetable Processing by Bhatt, Verma, Tata Mc Graw Hill Publishing Company Limited,. New Delhi
10. Commercial Vegetable Processing by Woodroof, vannostrand Reinhold, New York
11. Preservation of Fruits & Vegetables by IRRI, Oxford & IBH Publishing, New Delhi
12. Food Canning Technology by Larcousse & Brown
13. Food Composition & Preservation by Bhawna Sabarwal, Commonwealth *Publishers* 1999, New Delhi.
14. Food Preservation by S.K. Kulshrestha, vikas *publishing* house Pvt. Ltd., New Delhi
15. Processing Foods by Oliverra, CRC Press, New York
16. Principles & Practices for the Safe Processing of Foods by Heinz, H J *Heinz* Company, UK

### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	08	16
2	05	12
3	06	12
4	06	12
5	10	22
6	07	14
7	06	12
<b>Total</b>	<b>48</b>	<b>100</b>



### 3.4 UNIT OPERATIONS IN FOOD PROCESSING

L T P  
3 – 2

#### RATIONALE

This subject is aimed to develop an understanding among the students about various methods of handling, transportation and storage of food grains and perishables. It will also impart knowledge and skills as how to minimize post – harvest loss of food commodities

#### DETAILED CONTENTS

1. Preliminary Unit operation (2 hrs)  
Cleaning, sorting & Grading - aims, methods and applications
2. Conveying and Handling (6 hrs)  
Various unit operations in post-harvest handling, study of different conveying systems like belt conveyors, chain conveyors, screw conveyors, pneumatic conveyors, vibrating and oscillating conveyors, bucket elevators – their selection, operation and maintenance.
3. Size Reduction and Sieve Analysis (8 hrs)  
Theory of comminution; Calculation of energy required during size reduction. Crushing efficiency; Size reduction equipment; Size reduction of fibrous, dry and liquid foods; effects of size reduction on sensory characteristics and nutritive value of food  
Sieving: Separation based on size (mesh size); types of screens; effectiveness of screens
4. Mixing (6 hrs)  
Mixing, Agitating, kneading, blending, homogenization and related equipment
5. Separation Processes (16 hrs)  
Principles of Filtration, Sedimentation, Crystallization and Distillation and equipment used

6. Transportation and Storage (10 hrs)
- Preparation of fresh produce for transportation/or storage
  - Different modes of transportation for fresh and processed foods
  - Storage structures like cold stores, bins, silos and godowns – Operation and maintenance

### **LIST OF PRACTICALS**

1. Sampling techniques of stored foods from different storage structures and conditions
2. Analysis of sampled foods for physical characteristics
3. Determination of critical speed of ball-mill
4. Size reduction and particle size distribution using hammer-mill
5. Steam distillation of herbs
6. Concentration by crystallization
7. Clarification of apple juice using filter press
8. Visit to a public distribution system (PDS) showing storage facilities, warehouse, cold storage, refrigeration system and slaughter house etc
9. Visit to various food industries for demonstration of various unit operations

### **INSTRUCTIONAL STRATEGY**

Teachers should prepare tutorial exercises for the students, involving visits to various food-processing units. These tutorials can be considered a mini projects. Students may be asked to bring specifications and catalogues from industries. Students may also be exposed to relevant National, BIS and international standards. An intensive exercise on actual workbench performance in the industries is recommended. Experts may be invited to deliver lectures on various themes. Use of audio-visual aids will also be useful for better conceptualization of various operations.

### RECOMMENDED BOOKS

1. Handling, Transportation and Storage of Fruits and Vegetables by A Lloyd, Ryall Penizer (AVI Publications)
2. Proceedings of Regional Workshop on Warehouse Management of Stored Food Grains by Girish and Ashok Kumar (UNDP)
3. Modern Potato and Vegetable Storage by Volkind and Roslov (Amerind)
4. Controlled Atmospheric Storage of Fruits by Mettel Skilv
5. Food Grains in Tropical and Sub Tropical Areas by Hall
6. Food Storage Part of a system by Sinha and Muir (AVI)
7. Post Harvest Technology of Fruits and Vegetables – Handling, Processing, Fermentation and Waste Management by LR Verma and VK Joshi; Indus Publishing com., New Delhi
8. Drying and Storage of Grains and Oilseeds by Brooker & Hall, CBS

### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	2	4
2	6	12
3	8	18
4	6	12
5	16	34
6	10	20
<b>Total</b>	<b>48</b>	<b>100</b>

### 3.5 HANDLING, TRANSPORTATION AND STORAGE OF FOODS

L T P  
3 – 2

#### RATIONALE

This subject is aimed to develop an understanding among the students about various methods of handling, transportation and storage of food grains and perishables. It will also impart knowledge and skills as how to minimize post – harvest loss of food commodities

#### DETAILED CONTENTS

1. Introduction (03 hrs)  
Scope and importance of handling, transportation and storage of food and food products, post harvest losses
2. Post Harvest Changes in Foods – Physiological, chemical, microbiological and biochemical (06 hrs)
3. Handling, Transportation and Storage (08 hrs)  
Various unit operations of post-harvest handling, transportation, introduction to different conveying systems like belt conveyors, chain conveyors, screw conveyors, hydraulic conveyors, pneumatic conveyors, vibrating and oscillating conveyors, bucket elevators – their selection, operation and maintenance.
4. Grains (06 hrs)  
Preparation of grains for storage, Storage requirements, infestation control, mycotoxin, handling practices, causes of spoilage and their prevention, factors affecting quality of grain during storage and types of storage structures and facilities
5. Fruits and Vegetables (05 hrs)  
Handling, transportation and storage, spoilage and prevention
6. Animal Foods (07 hrs)  
Pre-slaughter handling and transportation system – their effects on quality of meat products, transportation and storage requirements, ante-mortem examination of animals

7. Milk (03 hrs)  
Collection, pre-cooling, handling and transportation systems – their effects on quality of milk
8. Eggs (03 hrs)  
Candling and grading, packaging, handling, pre-treatment, transportation and storage
9. Cold Storage (07 hrs)  
Introduction to cold storage facilities & requirements for storage of different fruits and vegetables.

### **LIST OF PRACTICALS**

1. Sampling of stored food grains in godown (Silo)
2. Analysis of sampled grain for foreign matter like straw parities, rodent excreta and rodents & insects infected grains
3. Demonstration of changes during storage of fresh fruits and vegetables in (a) traditional storage (b) modified storage system (c) controlled atmosphere
4. Determination of changes in pH and acid values in storage of milk
5. Visit to a public distribution system (PDS) showing storage facilities, warehouse, cold storage, refrigeration system and slaughter house etc
6. Visit to demonstration of material handling systems in various food industries
7. Visits to cold storage

### **INSTRUCTIONAL STRATEGY**

Teachers should prepare tutorial exercises for the students, involving visits to various food-processing units. These tutorials can be considered a mini projects. Students may be asked to bring specifications and catalogues from industries. Students may also be exposed to relevant National, BIS and international standards. An intensive exercise on actual workbench performance in the industries is recommended. Experts may be invited to deliver lectures on various themes. Use of audio-visual aids will also be useful for better conceptualization of various operations.

**RECOMMENDED BOOKS**

1. Handling, Transportation and Storage of Fruits and Vegetables by A Lloyd, Ryall Penizer (AVI Publications)
2. Proceedings of Regional Workshop on Warehouse Management of Stored Food Grains by Girish and Ashok Kumar (UNDP)
3. Modern Potato and Vegetable Storage by Volkind and Roslov (Amerind)
4. Controlled Atmospheric Storage of Fruits by Mettel Skilv
5. Food Grains in Tropical and Sub Tropical Areas by Hall
6. Food Storage Part of a system by Sinha and Muir (AVI)
7. Post Harvest Technology of Fruits and Vegetables – Handling, Processing, Fermentation and Waste Management by LR Verma and VK Joshi; Indus Publishing com., New Delhi
8. Drying and Storage of Grains and Oilseeds by Brooker & Hall, CBS

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	3	6
2	6	12
3	8	16
4	6	12
5	5	12
6	7	16
7	3	6
8	3	6
9	7	14
<b>Total</b>	<b>48</b>	<b>100</b>

### 3.6 TECHNOLOGY OF CEREAL AND PULSES

L T P  
3 – 4

#### RATIONALE

This subject is aimed at imparting knowledge and skills related to the processing techniques, value addition, and handling of processing equipment of cereal, pulses and oil seeds to the students, as the understanding of these aspects is essential for diploma holders in food technology to perform efficiently and effectively in the industry

#### DETAILED CONTENTS

1. Introduction (07 hrs)
 

Status, production and major growing areas of cereals, pulses and oil seeds in India and world

Structure and chemical composition of cereals, pulses and oil seeds, anti-nutritional factors wherever applicable
2. Cereals and millets (27 hrs)
  - 2.1 Wheat: types of wheat, conditioning and tempering, types of wheat milling technology, pasta and extruded products
  - 2.2 Rice: Varieties of rice, classification of rice based on various physical parameters, parboiling, milling of rice, and factors affecting quality of rice products
  - 2.3 Maize: Classification of maize, dry and wet milling of corn, preparation of corn flakes
  - 2.4 Barley and sorghum: Grain characteristics, technology of malt production, milling, malting and popping of sorghum
  - 2.5 Different millets and their chemical composition, processing and utilization
3. Pulses (07 hrs)
 

Pretreatment of pulses for milling, milling of major pulses
4. By-product utilization of different milling industries (07 hrs)

## **LIST OF PRACTICALS**

1. Determination of physical characteristics of (a) rice (b) wheat (c) pulses (d) maize (e) barley and sorghum (f) oil seeds
2. Milling of wheat to study its effect on various physico-chemical properties
3. Estimation of flour quality: Gluten, Ash, Water Absorption Power (WAP) Sedimentation Test, Maltose Value, Pelshenke Value
4. Parboiling and milling of rice
5. Pre-treatment and 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. Visits to flour mill, Rice Mill/Rice Sheller, Dhal Mill, Oil expelling Unit, Refining Units, Milling and Brewing Units

## **INSTRUCTIONAL STRATEGY**

This being one of the most important subjects, teacher should lay emphasis on developing basic understanding of various concepts and principles and procedures involved herein. Suitable tutorial exercises may be designed by the teachers, which require students visit to various industries. Students may also be exposed to various National, BIS and international standards. Visits to the relevant industry for demonstrating various operations involved in the cereal, pulses, and oilseed processing is a must. Experts from the industry may be invited to deliver lectures on the latest technology. Knowledge from pollution control and devices for the same may be provided to the students. Wherever relevant, students may be made aware about safety aspects.

## **RECOMMENDED BOOKS**

1. Cereal Technology by Kent, CBS
2. Wheat Chemistry and Technology by Y Pomeranz, AACC
3. Post Harvest Technology of Cereals pulses and oilseeds by Chakraborty AC, IBH
4. Rice Chemistry and Technology by Julian, AACC



## 5. Chemistry of Technology of Cereals as Food and Feed by Matz

Note: Wherever equipments are not available students may be demonstrated that topic relevant industry or in any other institutions.

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	07	14
2	27	54
3	07	16
4	07	16
<b>Total</b>	<b>48</b>	<b>100</b>

## **ECOLOGY AND ENVIRONMENTAL AWARENESS CAMP**

A diploma holder must have knowledge of different types of pollution caused due to industries and constructional activities so that he may help in balancing the eco system and controlling pollution by pollution control measures. He should also be aware of environmental laws related to the control of pollution.

This is to be organized at a stretch for 3 to 4 days. Lectures will be delivered on following broad topics. There will be no examination for this subject.

1. Basics of ecology, eco system and sustainable development
2. Conservation of land reforms, preservation of species, prevention of advancement of deserts and lowering of water table
3. Sources of pollution - natural and man made, their effects on living and non-living organisms
4. Pollution of water - causes, effects of domestic wastes and industrial effluent on living and non-living organisms
5. Pollution of air-causes and effects of man, animal, vegetation and non-living organisms
6. Sources of noise pollution and its effects
7. Solid waste management; classification of refuse material, types, sources and properties of solid wastes, abatement methods
8. Mining, blasting, deforestation and their effects
9. Legislation to control environment
10. Environmental Impact Assessment (EIA), Elements for preparing EIA statements
11. Current issues in environmental pollution and its control
12. Role of non-conventional sources of energy in environmental protection