

## **FOOD TECHNOLOGY (B. Tech)**

### **PREAMBLE**

The B.Sc. (H) Food Technology course was introduced in the annual mode by the faculty of science in the academic year 1989-1990 and was revised in 2008. The course is being offered by two colleges of University of Delhi in semester mode from 2011 onwards. Now, it is proposed as a B.Tech. Food Technology (Four Year Programme) from 2013. The new course has been prepared keeping in view, the unique requirement of B.Tech. Food Technology students. The objectives of the course are-

- To empower the students with the professional competence and expertise of Food Technology.
- To enable the students to understand food composition and its physicochemical, nutritional, microbiological and sensory aspects,
- To familiarize the students about the processing and preservation techniques of pulses, oilseeds, spices, fruits and vegetables, meat, fish, poultry, milk & milk products,
- To emphasize the importance of food safety, food quality, food plant sanitation, food laws and regulations, food engineering and packaging in food industry.

This course also offers professional edge to the students by providing hands on training during the research project of six month in the 8th semester in various Food Industries and related organizations. The contents have been drawn-up to accommodate the widening horizons of the discipline of Food Technology. They reflect the current changing needs of the students; esp. the subjects like Project Management, Entrepreneurship and Food Regulation and Product Development.

- There will be 11+1 Foundation courses, 20 Discipline Course (DC-I) papers of core Food Technology having one Research Methodology and one Research Project along with 6 DC-II papers ( to be offered for other departments) and 4 Applied Course papers . Thus, a total of 50 papers are being offered in this full time programme, which will commence from the academic session 2013-2014.
- For each paper, the objectives have been listed and the contents divided into units. Each unit is supported with number of classes.
- The detailed syllabus for each paper is appended with the list of suggested readings.

## **FOOD TECHNOLOGY (B. Tech)**

### **PREAMBLE**

The B.Sc. (H) Food Technology course was introduced in the annual mode by the faculty of science in the academic year 1989-1990 and was revised in 2008. The course is being offered by two colleges of University of Delhi in semester mode from 2011 onwards. Now, it is proposed as a B.Tech. Food Technology (Four Year Programme) from 2013. The new course has been prepared keeping in view, the unique requirement of B.Tech. Food Technology students. The objectives of the course are-

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- To enable the students to understand food composition and its physicochemical, nutritional, microbiological and sensory aspects,
- To familiarize the students about the processing and preservation techniques of pulses, oilseeds, spices, fruits and vegetables, meat, fish, poultry, milk & milk products,
- To emphasize the importance of food safety, food quality, food plant sanitation, food laws and regulations, food engineering and packaging in food industry.

This course also offers professional edge to the students by providing hands on training during the research project of six month in the 8th semester in various Food Industries and related organizations. The contents have been drawn-up to accommodate the widening horizons of the discipline of Food Technology. They reflect the current changing needs of the students; esp. the subjects like Project Management, Entrepreneurship and Food Regulation and Product Development.

- There will be 11+1 Foundation courses, 20 Discipline Course (DC-I) papers of core Food Technology having one Research Methodology and one Research Project along with 6 DC-II papers ( to be offered for other departments) and 4 Applied Course papers . Thus, a total of 50 papers are being offered in this full time programme, which will commence from the academic session 2013-2014.
- For each paper, the objectives have been listed and the contents divided into units. Each unit is supported with number of classes.
- The detailed syllabus for each paper is appended with the list of suggested readings.

- Teaching time allotted for each theory paper shall be 4 periods with one period for student's presentation and 4 periods for each practical class per week. AC papers would be running with 3 credits per week (theory cum practical) .Each practical batch should ideally be between 15-20 students so that each student receives individual attention.

**Every semester, teaching will be spread over 16 weeks, including 2 weeks of review.**



**DISCIPLINE COURSE (DC) – I**

**B. Tech. in FOOD TECHNOLOGY (FOUR YEAR PROGRAMME) COURSE STRUCTURE**

**COURSE STRUCTURE OF APPLIED COURSE (AC)**

<b>Semester I</b>		
<b>Paper No</b>	<b>Title of Paper</b>	<b>Marks</b>
1.1	Principles of Food Science	150
1.2	Food and nutrition	150
<b>Semester II</b>		
2.1	Food processing technology	150
2.2	Technology of Fruits, Vegetables and Plantation Crops	150
<b>Semester III</b>		
3.1	Food Microbiology	150
3.2	Technology of Meat, Milk, Fish and Egg	150
<b>Semester IV</b>		
4.1	Food Chemistry	150
4.2	Food Quality and Sensory Evaluation	150
<b>EXIT I: Diploma in Food Technology</b>		
<b>Semester V</b>		
5.1	Food Engineering	150
5.2	Technology of Cereals, Pulses and Oilseeds	150
5.3	Processing of Animal Foods	150
<b>Semester VI</b>		
6.1	Bakery and Confectionary Technology	150
6.2	Food Safety and Regulations	150
6.3	Nutraceuticals and Functional Foods	150
<b>EXIT II: Bachelor in Food Technology</b>		
<b>Semester VII</b>		
7.1	Advance Food Chemistry	150
7.2	Food Quality Management	150
7.3	Research Methodology	100
<b>Semester VIII</b>		
8.1	Food Packaging Technology	150
8.2	Food Plant Sanitation and Waste Management	150
8.3	Research(Industrial Project)	100
<b>EXIT III: B.Tech. in Food Technology</b>		
<b>Paper No.</b>	<b>Title of Paper</b>	<b>Marks</b>



SEMESTER III 3.3 (AC)	Techniques for Food Analysis	75
SEMESTER IV 4.3(AC)	Entrepreneurial Development and Food Business Management	75
SEMESTER V 5.4 (AC)	Food Fermentation Technology	75
SEMESTER VI 6.4 (AC)	New Food Product Development	75

## **Discipline Course II: FOOD TECHNOLOGY**

- 1. Food Processing and Preservation**
- 2. Chemistry of Food**
- 3. Sensory Evaluation of Food**
- 4. Food Microbiology and Food safety**
- 5. Food Engineering and Packaging**
- 6. Technology of Plant and Animal Foods**

## (DC I) PRINCIPLES OF FOOD SCIENCE

### THEORY

<b>Paper No.</b>	:	<b>1.1</b>
<b>Maximum Marks</b>	:	<b>150</b>
<b>Teaching Period</b>	:	<b>4 Theory + 1 Students' Presentation/ Week</b>
<b>Teaching Load</b>	:	<b>48 Theory Periods + 12 Presentation/ Semester</b>

### Objectives:

- To understand the history and evolution of food processing.
- To study the structure, composition, nutritional quality and post harvest changes of various plant foods.
- To study the structure and composition of various animal foods.

### CONTENTS

#### UNIT 1 INTRODUCTION (Kenneth) (3 lectures)

Historical evolution of food processing technology.

#### UNIT 2 COMPOSITIONAL, NUTRITIONAL AND TECHNOLOGICAL ASPECTS OF FOODS (Ch-15 S.Manay,Ch-17)

**I. Cereals and Millets ((Ch-15 S.Manay) (8 lectures)**  
Structure and composition of cereals and coarse cereals, Wheat- structure and composition, types (hard, soft/ strong, weak), Malting, gelatinization of starch, types of browning- Maillard & caramelization, Rice- structure and composition, parboiling of rice- advantages and disadvantages.

**II. Pulses (Ch-17,S.Manay) (5 lectures)**

Structure and composition of pulses, toxic constituents in pulses, processing of pulses- soaking, germination, decortications and fermentation.

**III. Fats and Oils (Ch-2 Meyer) (6 lectures)**

Classification of lipids, types of fats - saturated, unsaturated, essential fatty acids, trans fatty acids.

Refining of oils, types- steam refining, alkali refining, bleaching, steam deodorization, hydrogenation.

Rancidity –Types- hydrolytic, oxidative and its prevention.

**IV. Fruits and Vegetables (Ch-8,Srilakshmi) (8 lectures)**

Classification of fruits and vegetables, structure and composition, enzymatic browning, pigments, Post harvest changes in fruits and vegetables.

### UNIT 3 COMPOSITIONAL, NUTRITIONAL AND TECHNOLOGICAL ASPECTS OF ANIMAL FOODS

#### I. Flesh Foods - Meat, Fish, Poultry (Ch-22,23,24 S.Manay) (12 lectures)

**Meat** - Definition of carcass, concept of red meat and white meat, composition of meat, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat.

**Fish** - Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish, spoilage of fish- microbiological, physiological, biochemical.

**Poultry** - Structure and composition of hen's egg, egg proteins, characteristics of fresh egg, deterioration of egg quality.

#### II. Milk and Milk Products(Ch-1,2,4,5,7,11 De,S.) (6 lectures)

Definition and composition of milk, Homogenization and thermal processing of milk; types of pasteurization, an overview of types of market milk and milk products.

#### Recommended Readings

1. Kenneth F. et al. (2000), edited-Vol-1, 2, The Cambridge World History of Food, Cambridge Univ. Press.
2. Kent, N.L. (2003) Technology of Cereal, 5<sup>th</sup> Ed. Pergamon Press.
3. Srilakshmi (2007). *Food Science*, 4th Edition. New Age International Ltd.
4. Meyer, L.H. (2004) Food Chemistry, New Age.
5. Potter, N. M. (1999), Food Science, 5<sup>th</sup> Ed. CBS Publication.
6. De, S. (1980). Outlines of Dairy Technology, Oxford University Press.
7. Manay.etal, 2004, Food :Facts and Principles. New Age publisher

### (DC I) FOOD AND NUTRITION

#### THEORY

Paper No.	:	1.2
Maximum Marks	:	150
Credits	:	4
Teaching Periods	:	4 Theory + 1 Students' Presentation/ Week
Teaching Load	:	48 Theory Periods + 12 Presentation/ Semester

#### Objectives



This course will enable the student to:

- Understand the relationship between food, nutrition and health.
- Understand the functions of food. Learn about various food groups and balanced diet.
- Understand digestion, absorption and function of various nutrients and their sources.
- Learn about the various methods of preparing food.

## CONTENTS

### UNIT I: INTRODUCTION TO FOOD AND NUTRITION (2 lectures)

Basic terms used in study of food and nutrition, Understanding relationship between food, nutrition and health. (Ch 1, Food Science, Srilakshmi)

### UNIT II: BALANCED DIET (3 lectures)

Functions of food-physiological, psychological and social, Concept of Balanced Diet, Food Groups, Food Pyramid. (Chapter 2, Wardlaw et al)

### UNIT III: NUTRIENTS (Ch 1,2,3,4,5,7,13 Bamji et al) (37 lectures)

Classification, digestion, functions, dietary sources, RDA, clinical manifestations of deficiency and excess and factors affecting absorption of the following in brief:

- Energy
- Carbohydrates, lipids and proteins
- Fat soluble vitamins-A, D, E and K
- Water soluble vitamins – thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B<sub>12</sub> and vitamin C
- Minerals – calcium, iron, iodine, fluorine, copper and zinc
- Spectrum of macro and micronutrient disorders in the community-Understanding the problem of micro and macronutrient disorders like Protein Energy Malnutrition and low birth weight, Iron Deficiency Anemia, Vitamin A Deficiency Disorder, Iodine Deficiency Disorders, Obesity, diabetes, Cardiovascular Diseases in India.

### UNIT IV: CONCEPTS OF MEAL PLANNING (2 lectures)

Factors affecting meal planning, understanding specific considerations for planning meal for different groups of people. (Chapter 1, Dietetics, Srilakshmi)

### UNIT V: METHODS OF COOKING (2 lectures)

Dry, moist, frying and microwave cooking, Advantages, disadvantages and the effect of various methods of cooking on foods. (Chapter 1, Food Science, Srilakshmi)

**UNIT VI: NUTRITIONAL LABELING (Codex, FSSAI portals) (2 lectures)**

Importance, global trends, codex guidelines, nutritional labeling in India, FSSAI guidelines.

**Recommended Readings**

1. Bamji MS, Krishnaswamy K, Brahmam GNV (2009). *Textbook of Human Nutrition*, 3<sup>rd</sup> Edition. Oxford and IBH Publishing Co. Pvt. Ltd.
2. Srilakshmi (2007). *Food Science*, 4th Edition. New Age International Ltd.
3. Srilakshmi,(2005), Dietetics, Revised 5<sup>th</sup> edition. New Age International Ltd.
4. Wardlaw MG, Paul M Insel Mosby 1996). *Perspectives in Nutrition*, Third Edition.
5. Codex Guidelines on Nutrition Labelling (CAC/GL 2\_1985) (Rev.1\_1993). Rome, Food and Agriculture Organisation of the United Nations / World Health Organisation, 1993.
6. Food Safety and Standards Authority of India portal, Government of India
7. Gopalan, C., (1990). NIN, ICMR. *Nutritive Value of Indian Foods*.
8. Seth V, Singh K (2005). Diet planning through the Life Cycle: Part 1. Normal Nutrition. A Practical Manual, Fourth edition, Elite Publishing House Pvt Ltd.

**(DC I) PRACTICALS IN FOOD SCIENCE**

<b>Maximum Marks</b>	:	<b>50</b>
<b>Credits</b>	:	<b>2</b>
<b>Teaching Period</b>	:	<b>4 / Week</b>
<b>Teaching Load</b>	:	<b>48/Semester</b>

1. Study different types of browning reactions; enzymatic and non enzymatic.
2. Study germination, fermentation and dextrinization in foods.
3. Quality inspection of spices and condiments according to BIS.
4. Study different types of blanching of fruits and vegetables.
5. To study gelatinization behaviour of various starches and factors affecting it.
6. To study the concept of glutenization of various flours.
7. Identification of pigments in fruits and vegetables and influence of pH on them.
8. To study the melting point and specific gravity of fats and oils.

**Recommended readings:**

1. Sethi, M. and Rao, E.S. (2011). Food Science Experiments and Applications. CBS
2. FSSA, AGMARK and BIS Standards.

## (DC I) PRACTICALS IN FOOD AND NUTRITION

Maximum Marks	:	50
Credits	:	2
Teaching Period	:	4 / Week
Teaching Load	:	48/Semester

### CONTENTS

1. Identification of food sources for various nutrients using food composition tables
2. Record diet of self using 24 hour dietary recall and its nutritional analysis.
3. Introduction to meal planning, concept of food exchange system.
4. Planning of meal for adults of different activity levels
5. Planning and preparation of nutritious snacks
6. Nutritional labeling of prepared snacks.
7. Modification of diet for people with special needs.

### RECOMMENDED READINGS

1. Bamji MS, Krishnaswamy K, Brahmam GNV (2009). Textbook of Human Nutrition, 3<sup>rd</sup> edition. Oxford and IBH Publishing Co. Pvt. Ltd.
2. Srilakshmi (2007). Food Science, 4th Edition. New Age International Ltd.
3. Wardlaw MG, Paul M Insel Mosby 1996). Perspectives in Nutrition, Third Edition.
4. Introduction to Human Nutrition ed. Gibney et al, Blackwell Publishers, 2005
5. Khanna K, Gupta S, Seth R, Mahna R, Rekhi T (2004). The Art and Science of Cooking: A Practical Manual, Revised Edition. Elite Publishing House Pvt Ltd.
6. NIN, ICMR (1990). Nutritive Value of Indian Foods..
7. Seth V, Singh K (2005). Diet planning through the Life Cycle: Part 1. Normal Nutrition. A Practical Manual, Fourth edition, Elite Publishing House Pvt Ltd.
8. ICMR (2010). Nutrient Requirements and Recommended Dietary Allowances for Indians.

## (DC I) FOOD PROCESSING TECHNOLOGY

### THEORY

Paper No. : 2.1



<b>Maximum Marks</b>	:	<b>150</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 Theory + 1 Students' Presentation</b>
<b>Teaching Load</b>	:	<b>48 Theory Periods + 12 Presentations / Semester</b>

## Objectives

To impart basic knowledge of:

- Freezing ,Dehydration Processes and Equipment
- Principles of Thermal Processing
- Technology of colloids
- Food Sanitation and waste disposal
- Packaging Materials

## CONTENTS

### UNIT 1 FOOD PROCESSING OPERATIONS

#### Refrigeration and Freezing (Ch.9,Potter N.) (10Lectures)

Requirements of refrigerated storage - controlled low temperature, air circulation and humidity, changes in food during refrigerated storage, progressive freezing, changes during freezing –concentration effect and ice crystal damage, freezer burn. Refrigeration load, factors determining freezing rate-food composition and non compositional influence.

Freezing methods -direct and indirect, still air sharp freezer, blast freezer, fluidized freezer, plate freezer, spiral freezer and cryogenic freezing.

#### Dehydration (Ch10,Potter N.) (10Lectures)

Normal drying curve, effect of food properties on dehydration, change in food during drying ,drying methods and equipments air convection dryer, tray dryer, tunnel dryer ,continuous belt dryer, fluidized bed dryer, dryer, drum dryer, vacuum dryer, freeze drying, foam mat drying.

#### Thermal Processing of Foods (Ch.3,Ramaswamy H and Marcotte M) (8Lectures)

Classification of thermal processes, Principles of thermal processing, commercial canning operations, Commercial retort types, Aseptic Processing, UHT.

### UNIT 2 TECHNOLOGY OF COLLOIDS IN FOODS (Ch.11Manay NS and Shadaksharaswamy M.) (6 Lectures)

Characteristics, sols, gels, pectin gels, colloidal sols, stabilization of colloidal system, syneresis, emulsions, properties of emulsions, formation of emulsion, emulsifying

agents, food foams, formation stability and destruction of foam, application of colloidal chemistry to food preparation. Equipments – Colloid mill and homogenizer.

**UNIT 3 WATER DISPOSAL AND SANITATION (Ch.22,Potter N) (5Lectures)**

Waste water ,hardness of water, break point chlorination, physical and chemical nature of impurities, BOD, COD, waste water treatment, milk plant sanitation, CIP system, sanitizers used in food industry.

**UNIT 4 PACKAGING(Ch.1 Coles R, McDowell D and Kirwan MJ.) (9Lectures)**

Objectives of packaging, Types of Packaging Materials-Glass, Paper and paper board, Metal, Plastics, properties of plastics.

**Recommended Readings**

1. Potter NH.1998. Food Science, CBS Publication, New Delhi
2. Ramaswamy H and Marcotte M,Food Processing Principles and Applications CRC Press
3. Coles R, McDowell D and Kirwan MJ.2003. Food Packaging Technology, CRC Press
4. Deman JM.1982. Principles of Food Chemistry, 2<sup>nd</sup> ed. Van Nostrand Reinhold, NY
5. Jenkins WA and Harrington JP.1991. Packaging Foods with Plastics, Technomic Publishing Company Inc., USA
6. Manay NS and Shadaksharaswamy M.1987. Food-Facts and Principles, New Age International (P) Ltd. Publishers, New Delhi

**(DC I) TECHNOLOGY OF FRUITS, VEGETABLES AND PLANTATION CROPS**

**THEORY**

**Paper No. : 2.2**  
**Maximum Marks : 150**  
**Credits : 4**  
**Teaching Period : 4 Theory + 1 Students' Presentation**  
**Teaching Load : 48 Theory Periods + 12 Presentation/Semester**

**Objectives**

- To impart knowledge of different methods of fruits and vegetable processing.
- To learn about processing of various spices, tea, coffee and cocoa.

## **CONTENTS**

### **TECHNOLOGY OF FRUITS AND VEGETABLES:**

#### **UNIT 1 INTRODUCTION**

**(3 Lectures)**

Importance of fruits and vegetable, history and need of preservation, reasons of spoilage, method of preservation (short & long term). (Chapter 1–Girdharilal) .

#### **UNIT 2 CANNING AND BOTTLING OF FRUITS AND VEGETABLES**

**(8 Lectures)**

Selection of fruits and vegetables, process of canning, factors affecting the process- time and temperature, containers of packing, lacquering, syrups and brines for canning, spoilage in canned foods. (Chapter 2 – 7–Girdharilal) .

#### **UNIT 3 FRUITS BEVERAGES**

**(7 Lectures)**

Introduction, Processing of fruit juices (selection, juice extraction, deaeration, straining, filtration and clarification), preservation of fruit juices (pasteurization, chemically preserved with sugars, freezing, drying, tetra-packing, carbonation), processing of squashes, cordials, nectars, concentrates and powder. (Chapter 9–Girdharilal) .

#### **UNIT 4 JAMS, JELLIES AND MARMALADES**

**(6 Lectures)**

Introduction, Jam: Constituents, selection of fruits, processing & technology, Jelly: Essential constituents( Role of pectin, ratio), Theory of jelly formation, Processing & technology, defects in jelly, Marmalade : Types, processing & technology, defects. (Chapter 11–Girdharilal) .

#### **UNIT 5 PICKLES, CHUTNEYS AND SAUCES**

**(5 Lectures)**

Processing , Types, Causes of spoilage in pickling.( Chapter 14–Girdharilal) .

#### **UNIT 6 TOMATO PRODUCTS**

**(4 Lectures)**

Selection of tomatoes, pulping& processing of tomato juice, tomato puree, paste, ketchup, sauce and soup.( Chapter 13–Girdharilal) .

#### **UNIT 7 DEHYDRATION OF FOODS AND VEGETABLES**

**(4 Lectures)**

Sun drying & mechanical dehydration, process variation for fruits and vegetables, packing and storage.( Chapter 16–Girdharilal) .

### **TECHNOLOGY OF PLANTATION PRODUCTS:**



## UNIT 8 SPICES

(6 Lectures)

Processing and properties of major and minor spices, essential oils & oleoresins, adulteration.( Chapter 20–Manay) .

## UNIT 9 TEA, COFFEE AND COCOA

(5 Lectures)

Processing, Variety and Products.( Chapter 12–Manay) .

### Recommended Readings

1. Girdharilal, Siddappaa, G.S and Tandon, G.L.1998. Preservation of fruits & Vegetables, ICAR, New Delhi
2. W B Crusess. Commercial Unit and Vegetable Products, W.V.2003. Special Indian Edition, Pub: Agrobios India
3. Manay, S. & Shadaksharaswami, M.2004. Foods: Facts and Principles, New Age Publishers
4. Ranganna S.1996. Handbook of analysis and quality control for fruits and vegetable products, Tata Mc Graw-Hill publishing company limited, Second edition.
5. Srivastava, R.P. and Kumar, S. 2006 . Fruits and Vegetables Preservation- Principles and Practices. 3<sup>rd</sup> Ed. International Book Distributing Co.

### (DC I) PRACTICALS IN FOOD PROCESSING TECHNOLOGY

Maximum Marks	:	50
Credits	:	4
Teaching Period	:	4 / Week
Teaching Load	:	48/ Semester

### CONTENTS

- 1 Canning of foods
- 2 Preservation of food by the process of freezing
- 3 Drying of food using Tray dryer/other dryers
- 4 Estimation of Chemical Oxygen Demand(Demonstration)
- 5 Preparation of brix solution and checking by hand refractometer
- 6 Analysis of water
- 7 Testing of Packaging Material
- 8 Application of colloidal chemistry in food preparation

### Recommended Readings

1. Potter NH, Food Science.1998. CBS Publication, New Delhi
2. Ramaswamy H and Marcotte M.2003.Food Processing Principles and Applications CRC Press
3. Coles R, McDowell D and Kirwan MJ.2003. Food Packaging Technology, CRC Press
4. Deman JM.1990. Principles of Food Chemistry, 2<sup>nd</sup> ed. Van Nostrand Reinhold, NY
5. Jenkins WA and Harrington JP.1991. Packaging Foods with Plastics, Technomic Publishing Company Inc., USA
6. Manay NS and Shadaksharaswamy M.1987. Food-Facts and Principles, New Age International (P) Ltd. Publishers, New Delhi

## **(DC I) PRACTICALS IN TECHNOLOGY OF FRUITS, VEGETABLES AND PLANTATION CROPS**

<b>Maximum Marks</b>	<b>: 50</b>
<b>Credits</b>	<b>: 4</b>
<b>Teaching Period</b>	<b>: 4 / Week</b>
<b>Teaching Load</b>	<b>: 48 / Semester</b>

### **CONTENTS**

1. Estimation of total soluble solids(TSS).
2. Estimation of pH and acidity of products.
3. Estimation of brix: acidity ratio
4. Estimation of ascorbic acid and effect of heat treatment on it.
5. To study the steps of can making process.
6. Preparation and evaluation of pectin products.
7. Adulteration of spices.
8. Dehydration of fruits and vegetables.
9. Rehydration of fruits and vegetables.

### **Recommended Readings**

1. Girdharilal, Siddappaa, G.S and Tandon, G.L.1998. Preservation of fruits & Vegetables, ICAR, New Delhi
2. W B Crusess.2004. Commercial Unit and Vegetable Products, W.V. Special Indian Edition, Pub: Agrobios India
3. Manay, S. & Shadaksharaswami, M.2004. Foods: Facts and Principles, New Age Publishers
4. Ranganna S.1986. Handbook of analysis and quality control for fruits and vegetable products, Tata Mc Graw-Hill publishing company limited, Second edition.
5. Srivastava, R.P. and Kumar, S. 2006 . Fruits and Vegetables Preservation- Principles and Practices. 3<sup>rd</sup> Ed. International Book Distributing Co.

## (DC I) FOOD MICROBIOLOGY

### THEORY

Paper No.	:	3.1
Maximum Marks	:	150
Credits	:	4
Teaching Period	:	4 Theory + 1 Students' Presentation/ Week
Teaching Load	:	48 Theory Periods + 12 Presentation/ Semester

### Objectives

- To know the important genera of microorganisms associated with food and their characteristics.
- To understand the role of microbes in fermentation, spoilage and food borne diseases.

### CONTENTS

#### UNIT 1. INTRODUCTION TO FOOD MICROBIOLOGY (2 Lectures)

History and Development of Food Microbiology, Definition and Scope of food microbiology, Inter-relationship of microbiology with other sciences.

(Chapter 1, Garbutt)

#### UNIT 2. CHARACTERISTICS OF MICROORGANISMS IN FOOD (6 Lectures)

Types of microorganisms, Classification and Nomenclature , Morphology and Structure and their importance in food ( bacteria, fungi, viruses and prions, protozoans and others), Significance of spores.

(Chapter 3,5,17,18,19,20, Pelczar et.al)

#### UNIT 3. MICROBIAL GROWTH IN FOOD (6 Lectures)

Microbial Growth Characteristics- Bacterial growth curve, microbial reproduction and microbial growth in food, Factors affecting the growth of microorganisms in food.

(Chapter 4, Banwart )

#### UNIT 4. MICROBIAL FOOD SPOILAGE (7 Lectures)

Sources of Microorganisms in foods, Some important food spoilage bacteria, Changes caused by micro-organisms during spoilage (breakdown of proteins, carbohydrates, fats and other constituents)



Spoilage of specific food groups- milk and dairy products, meat, poultry and seafoods, cereal and cereal products, fruits and vegetables and canned products.  
(Chapter 4 to 9 Jay ; Chapter 12,13,14,17,18, Frazier and Westhoff)

**UNIT 5 FOODBORNE DISEASES (5 Lectures)**

Types – food borne infections, food borne intoxications and toxin infections, Origin, symptoms and prevention of some commonly occurring food borne diseases, Emerging pathogens of concern  
(Chapter 23,24,25 - Frazier and Westhoff)

**UNIT 6. FOOD PRESERVATION (7 Lectures)**

Principles and methods of preservation, Physical Methods of Food Preservation- Dehydration, Freezing, Irradiation, Thermal Methods and Non Thermal methods, Thermobacteriology, Biopreservatives esp. Bacteriocins  
(Chapter 10,11,12- Banwart; Chapter 4 Adams and Moss)

**UNIT 7 CULTIVATION OF MICRO-ORGANISMS (6 Lectures)**

Pure culture technique, Methods of isolation and cultivation, Enumeration of Microorganisms- qualitative and quantitative methods  
(Chapter 8 Pelczar et. al ; Chapter 2 Banwart )

**UNIT 8 FOOD FERMENTATIONS (4 Lectures)**

Definition, Type of Starter microorganisms, Common Food Fermentations  
(Chapter 9-Banwart ; Chapter 9-Adams and Moss)

**UNIT 9. TRENDS IN FOOD MICROBIOLOGY (5 Lectures)**

Introduction to Hurdle concept and Predictive Microbiology, Minimal Processing, Genetically Modified Foods, Probiotics, Rapid Methods of Detection of food borne pathogens.  
(Chapter 1 -Tortorello and Gendel)

**Recommended Readings**

1. Frazier William C and Westhoff, Dennis C.2004. Food Microbiology, TMH, New Delhi
2. Jay, James M.2000. Modern Food Microbiology, CBS Publication, New Delhi

3. Garbutt, John. 1997. Essentials of Food Microbiology, Arnold, London
4. Pelczar MJ, Chan E.C.S and Krieg, Noel R. 2007. Microbiology, 5th Ed., TMH, New Delhi.
5. Banwart G.J. 1979 . Basic Food Microbiology ,AVI Publishing.
6. Adams M.R. and Moss M.O. 2000. Food Microbiology IInd Edition ,The Royal Society.
7. Tortorello M.L. and Gendel S.M. 1999. Food Microbiology and Analytical Methods, CRC Press.

## **(DC I) TECHNOLOGY OF MEAT, MILK, FISH AND EGG THEORY**

<b>Paper No.</b>	<b>:</b>	<b>3.2</b>
<b>Maximum Marks</b>	<b>:</b>	<b>150</b>
<b>Credits</b>	<b>:</b>	<b>4</b>
<b>Teaching Period</b>	<b>:</b>	<b>4 Theory + 1 Student's Presentation</b>
<b>Teaching Load</b>	<b>:</b>	<b>48 Theory Periods + 12 Student's Presentation</b>

### **Objectives**

- To know the need and importance of meat, egg, dairy and fishery industry
- To know abattoir operations, the compositional and technological aspects of meat, poultry, egg, milk and fish.

## **CONTENT**

### **UNIT I - MEAT AND POULTRY TECHNOLOGY**

**(1 Lecture)**

Livestock and poultry population in India, Status of meat industry in India.

**(4 Lectures)**

Effects of feed, breed and environment on production of meat animals and their quality, Meat Quality - color, flavor, texture, Water-Holding Capacity(WHC), Emulsification capacity of meat, Grading and Inspection of Meat. **(Chapter 13,14 Shai Barbut)**

**(8 lectures)**

Slaughter, Abattoir, Antemortem examination of meat animals, slaughter of buffalo, sheep/goat, poultry, pig, dressing of carcasses, post-mortem examination of meat, Generic HACCP model of Poultry slaughter **(Chapter 4,12 Shai Barbut)**

### **UNIT 2 - FISH TECHNOLOGY**

(1 lecture)

Status of fishery industry in India.

(2 lectures)

Relationship between chilling and storage life, MAP, general aspects of freezing, changes in quality during chilled and frozen storage (Chapter 4, Hall)

(8 lectures)

Drying and salting of fish, water activity and shelf-life, salting process, salting methods (brining, pickling, kench curing, gaspe curing), types of salts, dried and salted fish products- pindang, fishwood, dried shrimp. Preservation by smoking, smoke production, smoke components, quality, safety and nutritive value of smoked fish, processing and equipment, pre-smoking processes, smoking process control. Traditional chimney kiln, modern mechanical fish smoking kiln. (Chapter 2, Hall)

### UNIT 3 – EGG SCIENCE AND TECHNOLOGY

(1 lecture)

Status of egg industry in India.

(2 lectures)

Structure and composition of egg, Nutritive value of Egg, Egg formation (Chapter 3,6,7 Stadelman)

(5 lectures)

Factors affecting egg quality and measures of egg quality. (Chapter 3, Stadelman)

(4 lectures)

Functional properties of eggs in foods-Coagulation, Foaming, Emulsification, Crystallization control, Color, Flavor. (Chapter 16, Stadelman)

### UNIT 4 – TECHNOLOGY OF MILK

Status of Milk Industry in India

(1 lecture)

Color, taste, pH and buffering capacity, refractive index, viscosity, surface tension, freezing, boiling point, specific heat, OR, electrical conductivity. (Chapter 1, Sukumar De) (2 lectures)

Lactose, alpha and beta forms and their differences, Significances of lactose in dairy industry. (Chapter 6, Webb & Johnson) (1 lecture)

Composition and structure of Milk Fat, Factors affecting melting point, boiling point, solubility and Refractive Index. (Chapter 4, Webb & Johnson) (2 lectures)

Milk protein-General structure, amphoteric nature, difference between casein and serum protein, different types of casein (acid and rennet), uses of casein, fractionation of protein, Enzymes-



catalase, alkaline phosphatase, lipases and proteases (Chapter 3 , Webb & Johnson)  
(4 lectures)

Systems of collection of milk, Reception, Platform testing, Various stages of processing.  
(Chapter 1, Sukumar De) (2 Lectures)

### Recommended Readings

1. De Sukumar, Outlines of Dairy Technology, Oxford University Press, Oxford. 2007
2. Shahidi F and Botta JR, Seafoods: Chemistry, Processing, Technology and Quality, Blackie Academic & Professional, London, 1994
3. Webb and Johnson, Fundamentals of Dairy Chemistry, Jain publications, second edition, 2005
4. Lawrie R A, Lawrie's Meat Science, 5<sup>th</sup> Ed, Woodhead Publisher, England, 1998
5. Parkhurst & Mountney, Poultry Meat and Egg Production, CBS Publication, New Delhi, 1997
6. Shai Barbut, Poultry Products Processing, CRC Press 2005.
7. Stadelman WJ, Owen J Cotterill Egg Science and Technology, 4<sup>th</sup> Ed. CBS Publication New Delhi, 2002
8. Hall GM, Fish Processing Technology, VCH Publishers Inc., NY, 1992

### (DC I) PRACTICALS IN FOOD MICROBIOLOGY

Maximum Marks	:	50
Credits	:	4
Teaching Period	:	4 / Week
Teaching Load	:	48/Semester

### CONTENTS

1. Introduction to the Basic Microbiology Laboratory Practices and Equipment
2. Components and use of a compound microscope
3. Cleaning and sterilization of glassware
4. Preparation and sterilization of nutrient broth
5. Cultivation and sub-culturing of microbes using slant, stab and agar plates
7. Morphological study of bacteria and fungi using permanent slides
8. Simple staining
9. Gram's staining
10. Negative staining
11. Endospore staining
12. Standard Plate Count Method

## Recommended Readings

- 1) Frazier William C and Westhoff, Dennis C.2004. Food Microbiology, TMH, New Delhi
- 2) Jay, James M.2000. Modern Food Microbiology, CBS Publication, New Delhi
- 3) Garbutt, John.1997. Essentials of Food Microbiology, Arnold, London
- 4) Pelczar MJ, Chan E.C.S and Krieg, Noel R.2007. Microbiology, 5th Ed., TMH, New Delhi.

## (DC I) PRACTICALS IN MEAT, MILK, FISH AND EGG

Maximum Marks	:	50
Credits	:	4
Teaching Period	:	4 / Week
Teaching Load	:	48/Semester

## CONTENTS

1. Subjective evaluation of Fresh Fish.
2. To perform platform tests in milk.(Acidity, COB, MBRT, specific gravity, SNF)
3. To estimate milk fat by Gerber method.
4. To estimate milk protein by Folin method.
5. Estimation of moisture content of meat.
6. Estimation of moisture content of Milk.
7. Estimation of protein content of meat by kjeldahl method.
8. Evaluation of eggs for quality parameters(market eggs, branded eggs)

## Recommended Readings

1. De S. (2007). Outlines of Dairy Technology, Oxford University Press, Oxford.
2. Shahidi F and Botta JR (1994). Seafoods: Chemistry, Processing, Technology and Quality, Blackie Academic & Professional, London.
3. Webb and Johnson, (1988). Fundamentals of Dairy Chemistry, 3<sup>rd</sup> Ed. CBS publisher and distributors, New Delhi
4. Lawrie R A, (1998). Lawrie's Meat Science, 5<sup>th</sup> Ed, Woodhead Publisher, England.
5. Parkhurst & Mountney, (1997). Poultry Meat and Egg Production, CBS Publication, New Delhi.
6. Shai Barbut, (2005). Poultry Products Processing, CRC Press.
7. Stadelman WJ, Owen J Cotterill (2002). Egg Science and Technology, 4<sup>th</sup> Ed. CBS Publication New Delhi.
8. Hall GM, (1992). Fish Processing Technology, VCH Publishers Inc., NY.

## (DC I) FOOD CHEMISTRY

### THEORY

<b>Paper No.</b>	:	<b>4.1</b>
<b>Maximum Marks</b>	:	<b>150</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Periods</b>	:	<b>4 Theory + 1 Students' Presentation/ Week</b>
<b>Teaching Load</b>	:	<b>48 Theory Periods + 12 Presentation/ Semester</b>

### Objectives

- To understand the chemistry of foods - composition of food, role of each component and their interactions.
- To study the properties of various food components which affect the quality of food.

### CONTENTS

#### UNIT 1 INTRODUCTION TO FOOD CHEMISTRY ( Fennema and Chapter 1 DeMan) (1 Lecture)

Definition and Composition of food

#### UNIT 2 WATER ( Chapter -1 DeMan) (4 Lectures)

Definition of water in food, Structure of water and ice, Types of water, Interaction of water with solutes

#### UNIT 3 LIPIDS ( Chapter-2, DeMan) (5 Lectures)

Classification of lipids, Physical properties-melting point, softening point, specific gravity, refractive index, smoke, flash and fire point, turbidity point. Chemical properties-reichert meissel value, polenske value, iodine value, peroxide value, saponification value.

#### UNIT 4 PROTEINS (Chapter-3, DeMan) (5 Lectures)

Protein classification and structure, Nature of food proteins(plant and animal proteins), Properties of proteins (electrophoresis, sedimentation, amphotericism and denaturation)

#### UNIT 5 CARBOHYDRATES (Chapter-3, Fennema) (6 Lectures)

Classification (mono, oligo and poly saccharides), Structure of important polysaccharides (starch, glycogen, cellulose, pectin, hemicellulose, gums)  
Chemical reactions of carbohydrates, Modified celluloses and starches

#### UNIT 6 VITAMINS (Chapter-9, DeMan) (7 Lectures)



Structure, Importance and Stability, Water soluble vitamins, Fat soluble vitamins

**UNIT 7 FLAVOUR (Chapter-7, DeMan)**

**(7 lectures)**

Definition, Description of food flavours, Flavour enhancers

**UNIT 8 MINERALS (Chapter-5, DeMan)**

**(5 Lectures)**

Major and minor minerals, Metal uptake in canned foods, Toxic metals

**UNIT 9 NATURAL FOOD PIGMENTS (Chap.9, Fennema)**

**(6 Lectures)**

Introduction and classification, Food pigments (chlorophyll, carotenoids, anthocyanins and flavonoids, beet pigments, caramel)

**Recommended Readings**

1. Fennema, Owen R. 1996. Food Chemistry, 3rd Ed., Marcell Dekker, New York
2. Potter, N.N. and Hotchkiss, J.H. 1995. Food Science, 5th Ed., Chapman & Hall
3. DeMan, J.M. 1982. Principles of Food Chemistry, AVI, New York

**(DC I) FOOD QUALITY AND SENSORY EVALUATION**

**THEORY**

<b>Paper No.</b>	:	<b>4.2</b>
<b>Maximum Marks</b>	:	<b>150</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 Theory + 1 Students' Presentation/ Week</b>
<b>Teaching Load</b>	:	<b>48 Theory Periods + 12 Presentation/ Semester</b>

**Objectives**

- To understand basic quality attributes of food in raw as well as processed form.
- To learn various systems of objective and subjective evaluation and their application in industry.

**CONTENTS**

**UNIT 1 INTRODUCTION TO QUALITY ATTRIBUTES OF FOOD (Potter) (4 lectures)**

Appearance, flavor, textural, sanitary, nutritional and other quality attributes of food in food quality evaluation.

**UNIT 2 GUSTATION (Amerine, Rao) (10 Lectures)**

Introduction and importance of gustation; Structure and physiology of taste organs- tongue, papillae, taste buds, salivary glands; Mechanism of taste perception, Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami; Factors affecting taste quality, reaction time, taste modification, absolute and recognition threshold; Taste abnormalities; Taste measurement

**UNIT 3 OLFACTION (Amerine, Rao) (10 Lectures)**

Introduction, definition and importance of odor and flavor; Anatomy of nose, physiology of odor perception; Olfactory abnormalities; Mechanism of odor perception; Odor classification, chemical specificity of odor; Odor measurement using different techniques – primitive to recent techniques; Merits and demerits of each method.

**UNIT 4 COLOR ( DeMan, Rao) (10 Lectures)**

Introduction and importance of color, Dimensions of color and attributes of color; gloss, appearance etc., Physiology of color perception, Color abnormalities, Measurement of color; Munsell color system, CIE color system, Hunter color system, spectrophotometry and Colorimetry etc.

**UNIT 5 TEXTURE (DeMan, Rao) (14 Lectures)**

Introduction, definition and importance of texture, Physiology of touch in texture perception, receptors involved in texture perception, Phases of oral processing; Rheology of foods, viscosity, plasticity; Texture classification; Texture Measurement – basic rheological models, forces involved in texture measurement, Application of texture measurement in cereals, fruits and vegetables, dairy, meat and meat products.

**Recommended Readings**

1. Rao E. S. (2013). Food Quality Evaluation, Variety Books.
2. DeMan J. (2007). Principles of Food Chemistry, 3<sup>rd</sup> ed., Springer.
3. Meilgard (1999). Sensory Evaluation Techniques, 3<sup>rd</sup> ed. CRC Press LLC,
4. Potter, N. and Hotchkiss, J.H. 1995. Food Science, 5<sup>th</sup> Ed., Chapman & Hall.
5. Amerine, Pangborn & Roeissler (1965). Principles of Sensory Evaluation of food, Academic Press, London.

## (DC I) PRACTICALS IN FOOD CHEMISTRY

<b>Maximum Marks</b>	:	<b>50</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 / Week</b>
<b>Teaching Load</b>	:	<b>48/Semester</b>

### CONTENTS

1. Preparation of primary and secondary solutions
2. Estimation of moisture content
3. Determination of gelatinization temperature range (GTR) of different starches and effect of additives on GTR.
4. Determination of refractive index and specific gravity of fats and oils.
5. Determination of carotenoids w.r.t flour pigments.
6. Estimation of saponification value
7. Estimation of reducing and non-reducing sugars using potassium ferricyanide method.
8. Estimation of total ash.

### Recommended Readings

1. Fennema, Owen R.1996. Food Chemistry, 3<sup>rd</sup> Ed., Marcell Dekker, New York
2. Whitehurst and Law.2002. Enzymes in Food Technology, CRC Press, Canada
3. Wong, Dominic WS.1995. Food Enzymes, Chapman and Hall, New York
4. Potter,N.N.and Hotchkiss,J.H.1995. Food Science, 5<sup>th</sup> Ed., Chapman & Hall
5. DeMan, J.M.1982. Principles of Food Chemistry, AVI, NewYork

## (DC I) PRACTICALS IN FOOD QUALITY AND SENSORY EVALUATION

<b>Maximum Marks</b>	:	<b>50</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 / Week</b>
<b>Teaching Load</b>	:	<b>48/Semester</b>

### CONTENTS

1. Training of sensory panel.
2. To perform sensitivity tests for four basic tastes
3. To perform analytical and affective tests of sensory evaluation.
4. Recognition tests for various food flavours, flavor defects in milk.
5. Sensory evaluation of milk and milk products.



6. Extraction of pigments from various fruits and vegetables and study the effect of temperature and pH
7. Texture evaluation of various food samples- crispies/ cookies/ biscuits/ snack foods
8. Textural measurement of various food products using Texture Analyzer
9. Measurement of colour by using Tintometer/ Hunter Colour Lab etc.

### Recommended Readings

1. Amerine, Pangborn & Roessler (1965). Principles of Sensory Evaluation of food, Academic Press, London.
2. Meilgard (1999). Sensory Evaluation Techniques, 3<sup>rd</sup> ed. CRC Press LLC, DeMan J. (2007). Principles of Food Chemistry, 3<sup>rd</sup> ed., Springer.
3. Rao E. S. (2013). Food Quality Evaluation. Variety Books.

## (DC-I)FOOD ENGINEERING

### THEORY

<b>Paper No.</b>	:	<b>5.1</b>
<b>Maximum Marks</b>	:	<b>150</b>
<b>Credits</b>	:	<b>5</b>
<b>Teaching Period</b>	:	<b>4 Theory + 1 Presentation</b>
<b>Teaching Load</b>	:	<b>48 Theory Periods + 12 Presentations / Semester</b>

### Objectives:

- 1) To understand the principles of Unit operations
- 2) To acquaint with fundamentals of food engineering and its process
- 3) To understand the basics of designing of food systems

## CONTENT

### UNIT 1 – Heat and Mass Transfer ( Chapter.1, 4, Singh and Heldman 2003) (Lectures-15)

- Concept of Unit operation,
- Units and dimensions, Unit conversions, dimensional analysis
- Mass and Energy Balance.
- Thermal Properties of Food
- Systems for heating and cooling food products
- Modes of heat transfer
- Application of steady state heat transfer- estimation of conductive heat transfer coefficient, convective heat transfer coefficient, overall heat transfer coefficient

- and, design of tubular heat exchanger.
- Fick's Law of Diffusion
- Membrane separation systems-Electrodialysis system , Reverse Osmosis Membrane System, and Ultrafiltration Membrane System
- Membrane devices used for RO and UF: Plate and Frame, Tubular, Spiral wound and hollow fiber devices

## **UNIT2 - Fluid Flow in food Processing ( Chapter 2, Singh and Heldman 1993) (Lectures-8)**

- Liquid Transport systems
- Properties of Liquids
- Newton's Law of Viscosity
- Principle of capillary tube and rotational viscometer
- Properties of Non-Newtonian fluids,
- Flow characteristics, Reynolds Number, Bernoulli's Equation
- Principles of Flow Measurement devices

## **UNIT 3, Refrigeration ,Freezing and Psychrometrics (Chapter 7,8,10, Singh and Heldman 2003) (Lectures- 15)**

- Concept and selection of a refrigerant
- Description of a Refrigeration cycle
- Pressure Enthalpy charts and Tables
- Mathematical expressions useful in analysis of vapour compression refrigeration cycle
- Numericals based on VCR system, Freon 12 ,R134a and R-717, superheating and sub cooling
- Freezing time calculation using Plank's Equation
- Frozen food storage
- Properties of Dry Air
- Properties of Water Vapour
- Properties of air Vapour mixture
- Psychrometric Chart

## **UNIT 4- Steam, Evaporation and Dehydration ( Chapter 3,9,12, Singh and Heldman 1993, Rao2006) (Lectures-10)**

- Generation of steam
- Construction and functions of fire tube and water tube boilers
- Thermodynamics of Phase change
- Steam tables

- Boiling point elevation
- Types of evaporations
- Design of single effect evaporators
- Basic Drying Process
- Moisture content on wet basis and dry basis
- Dehydration system Design.

### Recommended Readings:

1. Rao DG. Fundamentals of Food Engineering. PHI learning private ltd.2010
2. Singh RP and Heldman DR. Introduction to Food Engineering. Academic press 1993, 2003, 2009 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> edition.
3. Toledo. Fundamentals of Food Process Engineering, Amazon publishers 3<sup>rd</sup> Edition 2000

## (DC I) TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS THEORY

<b>Paper No.</b>	:	<b>5.2</b>
<b>Maximum Marks</b>	:	<b>150</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 Theory + 1 Students' Presentation</b>
<b>Teaching Load</b>	:	<b>48 Theory Periods + 12 Presentations / Semester</b>

### Objectives

- To teach technology of milling of various cereals
- To impart technical knowhow of pulses and oilseeds refining

## CONTENTS

### UNIT 1 TECHNOLOGY OF CEREALS

Introduction ( chap 1,2&3, Kent)	(2 lectures)
Wheat --Types , milling, flour grade, flour treatments (bleaching, maturing), flour for various purposes, Products and By-products. ( Chap 4,6,7,8&9, Kent)	(7 lectures)
Rice – Physicochemical properties , milling (mechanical & solvent extraction), parboiling, ageing of rice, utilization of by products. ( Chap 15, Kent)	(6 lectures)
Corn – Milling (wet & dry) , cornflakes, corn flour (Chap 16,Kent)	(4 lectures)
Barley- Milling(pearl barley, barley flakes & flour) (Chap 12, Kent)	(3 lectures)
Oats – Milling ( oatmeal,oatflour & oatflakes ) (chap 13, Kent)	(3 lectures)



Sorghum and millets – Traditional & commercial milling ( dry &wet ) (4 lectures)  
( Chap 17, Kent )

Rye and triticale—milling (flour),uses (Chap 14, Kent ) (2 lectures)

**UNIT 2 TECHNOLOGY OF PULSES (Chap 13, Chakraverty) (4 lectures)**

Milling of pulses, Dry milling, Wet milling, Improved milling method

**UNIT 3 TECHNOLOGY OF OILSEEDS (Chap 14, 15, 16, Chakraverty) (9 lectures)**

Introduction, Extraction of oil and refining, Sources of protein (defatted flour, protein concentrates and isolates), properties and uses, protein texturization, fibre spinning

**UNIT 4 ALCOHOLIC BEVERAGES (Chap 12.6, Manay) (4 lectures)**

Beer

Wine

Distilled Spirits

### **Recommended Readings:**

1. Kent, N.L. 2003. Technology of Cereal, 5<sup>th</sup> Ed. Pergamon Press.
2. Chakraverty. 1988. Post Harvest Technology of Cereals, Pulses and Oilseeds, revised Ed., Oxford & IBH Publishing Co. Pvt Ltd.
3. Marshall, Rice Science and Technology. 1994. Wadsworth Ed., Marcel Dekker, New York.
4. Manay, S. and Sharaswamy, M. 1987. Food Facts and Principles. Wiley Eastern Limited.

## **(DC I) PROCESSING OF ANIMAL FOODS**

### **THEORY**

<b>Paper No.</b>	:	<b>5.3</b>
<b>Maximum Marks</b>	:	<b>150</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 Theory + 1 Student's Presentation</b>
<b>Teaching Load</b>	:	<b>48 Theory Periods + 12 Student's Presentation</b>

## **Objectives:**

- To study processing and preservation of animal foods.
- To understand technology behind preparation of various animal food products and by-product utilization.

## **UNIT 1 – PROCESSING OF MEAT AND MEAT PRODUCTS**

Refrigeration and freezing of meat, thermal processing- canning of meat, retort pouch, dehydration, irradiation, and RTE meat products, meat curing. Sausages- processing, types and defects. (Chapter 3,9,15 Pearson and Gillet, Chapter 7,8 Lawrie) (8 lectures)

Importance, classification and uses of meat by-products, Manufacture of Natural casings (Chapter 11, Pearson & Gillet) (3 lectures)

Trends in meat packaging.

(1 lecture)

## **UNIT 2 – PROCESSING OF FISH**

Principles of canning, classification based on pH groupings, effect of heat processing on fish, storage of canned fish, pre-process operations, post process operations, cannery operations for specific canned products. (Tuna, Mackerel, Sardine) (Chapter 5, Hall) (4 lectures)

Introduction, fish muscle proteins, the surimi process, traditional and modern surimi production lines, quality of surimi products, comparison of surimi and fish mince products. (Chapter 3, Hall) (4 lectures)

Fish protein concentrates (FPC), fish protein extracts (FPE), fish protein hydrolysis (FPH) (Chapter 6, Hall) (2 lectures)

Flowchart of Indigenous products- Fish sauce and Paste. (Chapter 7, Hall) (2 lectures)

## **UNIT 3 – PROCESSING OF MILK AND MILK PRODUCTS**

Flow diagram of milk processing, Filtration, Clarification, Homogenization, Pasteurization, Description and working of clarifier, cream separator, homogenizer and plate heat exchanger. (6 lectures)

Flow diagram of following milk products – Butter, ghee, flavored milk, yoghurt, dahi, shrikhand, ice-cream, condensed milk, milk powder, channa, paneer, cheese (cheddar).  
(Chapter 1-11, Sukumar De) (6 lectures)

#### **UNIT 4 – EGG PRODUCTION PRACTICES AND PROCESSING OF EGG**

Egg Industry and Egg Production Practices, General management of a layer house.  
(Chapter 2, Stadelman) (6 lectures)

Preservation of eggs, Refrigeration and freezing, thermal processing, dehydration, coating.  
(Chapter 11 and 14, Stadelman) (6 lectures)

#### **Recommended Readings**

1. Hall GM, Fish Processing Technology, VCH Publishers Inc., NY, 1992
2. Sen DP, Advances in Fish Processing Technology, Allied Publishers Pvt. Limited 2005
3. Webb and Johnson, Fundamentals of Dairy Chemistry, Jain publications, second edition, 2005
4. Lawrie R A, Lawrie's Meat Science, 5<sup>th</sup> Ed, Woodhead Publisher, England, 1998
5. Pearson & Gillet Processed Meats, 3 Ed, CBS Publication, New Delhi, 1997
6. Shai Barbut, Poultry Products Processing, CRC Press 2005.
7. Stadelman WJ, Owen J Cotterill Egg Science and Technology, 4<sup>th</sup> Ed. CBS Publication New Delhi, 2002
8. De Sukumar, Outlines of Dairy Technology, Oxford University Press, Oxford. 2007

#### **(DC I) PRACTICALS IN FOOD ENGINEERING**

**Maximum Marks** : 50  
**Teaching Period** : 4  
**Teaching Load** : 48 / Semester

#### **CONTENTS**

1. To study colligative properties of food
2. Determination of drying characteristics
3. Determination of viscosity of Newtonian and Non Newtonian fluids



4. Study of effect of temperature on viscosity
5. Study of evaporation process
6. Freezing time calculations
7. Psychrometrics- use and application
8. Plant layout and design

### Recommended Readings:

1. Rao DG. Fundamentals of Food Engineering. PHI learning private ltd.2010
2. Singh RP and Heldman DR. Introduction to Food Engineering. Academic press 1993, 2003, 2009 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> edition.
3. Toledo. Fundamentals of Food Process Engineering, Amazon publishers 3<sup>rd</sup> Edition 2000

## (DC I) PRACTICALS IN TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS

Maximum Marks	:	50
Credits	:	2
Teaching Period	:	4 / Week
Teaching Load	:	48/Semester

### CONTENTS

1. Physical characteristics of Wheat.
2. Estimation of Gluten Content of flour.
3. Estimation of Pelenske Value of flour.
4. Estimation of Potassium Bromate in flour.
5. Fermenting power of yeast.
6. Physical Characteristics of Rice and paddy
7. Cooking characteristics of rice.
8. Determination of sedimentation power of flour

### Recommended Readings:

1. Kent, N.L, Technology of Cereal, 5<sup>th</sup> Ed. Pergamon Press, 2003
2. Chakraborty, Post Harvest Technology of Cereals, Pulses and Oilseeds, revised Ed., Oxford & IBH Publishing Co. Pvt Ltd, 1988
3. Marshall, Rice Science and Technology, Wadsworth Ed., Marcel Dekker, New York, 1994.

## (DC I) PRACTICALS IN ANIMAL FOODS

Maximum Marks	:	50
Credits	:	2
Teaching Period	:	4 / Week
Teaching Load	:	48/Semester

### CONTENTS

1. To prepare casein and calculate its yield.
2. Cut out examination of canned fish.(Sardine, Mackerel, Tuna)
3. Cutout analysis of canned meats/retort pouches/Analysis of frozen meat.
4. To study shelf-life of eggs by different methods of preservation.
5. To study the functional properties of egg.
6. Preparation of flavored milk/milk product.
7. Meat/Fish/Poultry/Egg product formulation.
8. Quality analysis of the formulated product.

### Recommended Readings:

1. Hall GM, Fish Processing Technology, VCH Publishers Inc., NY, 1992
2. Pearson & Gillet Processed Meats, 3 Ed, CBS Publication, New Delhi, 1997
3. Shai Barbut, Poultry Products Processing, CRC Press 2005.
4. Stadelman WJ, Owen J Cotterill Egg Science and Technology, 4<sup>th</sup> Ed. CBS Publication New Delhi, 2002
5. De Sukumar, Outlines of Dairy Technology, Oxford University Press, Oxford. 2007

## (DC I) BAKERY AND CONFECTIONARY TECHNOLOGY

### THEORY

Paper No.	:	6.1
Maximum Marks	:	150
Credits	:	4
Teaching Periods	:	4 Theory + 1 Students Presentation/ Week
Teaching Load	:	48 Theory Periods + 12 Students Presentation/ Semester

### Objectives

- Understanding status of bakery and confectionary industry in India
- To learn the technologies behind bakery and confectionary products.
- To know about innovations in this sector.

# CONTENTS

## UNIT-I BAKERY

(26 lectures)

Current status, growth rate, and economic importance of Bakery and Confectionary Industry in India. Product types, nutritional quality and safety of products, pertinent standards & regulations.

Bakery Products: Ingredients & processes for breads, buns, pizza base, biscuits, cookies & crackers, cakes & pastries, doughnuts and rusks.

Equipments used, product quality characteristics, faults and corrective measures for above bakery products. Defining and assessing quality of ingredients & products.

Part I, (Chapter 1, 2, 3 & 4. Part II, Chapter 1 – 7, Dubey.)

## UNIT II CONFECTIONARY

(12 lectures)

Sugars- Types and sources, methods of preparation of sugars, jaggery, khandsari, raw and refined sugar. Principles of sugar cookery, crystalline and non-crystalline candies. Chapter 26–Manay .

Confectionary Products: Cake icings, hard-boiled candies, toffees, fruit drops, chocolates and other confections- ingredients, equipments & processes, product quality parameters, faults and corrective measures. ( Chapter 5, 7 & 8 – Minifie .)

## UNIT-III

(6 lectures)

Production & quality of breakfast cereals, macaroni products and malt. (Chapter 15–Manay .)

## UNIT IV

(4 lectures)

Modification of bakery products for people with special nutritional requirements e.g. high fibre, low sugar, low fat, gluten free bakery products. (Chapter 10–Barndt)

### Recommended Readings:

1. Dubey, S.C. (2007). Basic Baking 5<sup>th</sup> Ed. Chanakya Mudrak Pvt. Ltd.
2. Raina et.al. (2003). Basic Food Preparation-A complete Manual. 3<sup>rd</sup> Ed. Orient Longman Pvt. Ltd.
3. Manay, S. & Shadaksharaswami, M. (2004). Foods: Facts and Principles, New Age Publishers.
4. Barndt R. L. (1993). Fat & Calorie – Modified Bakery Products, Springer US.
5. Samuel A. Matz (1999). Bakery Technology and Engineering, PAN-TECH International Incorporated.



6. Beckett S.T. (2009). Industrial Chocolate Manufacture, Blackwell Publishing Ltd.
7. Faridi Faubion (1997). Dough Rheology and Baked Product Texture, CBS Publications.
8. Minifie B.W. (1999). Chocolate, Cocoa and Confectionary, Aspen Publication.
9. Samuel A. Matz (1992). Cookies & Cracker Technology, Van Nostrand Reinhold

## (DC I) FOOD SAFETY AND REGULATIONS

### THEORY

<b>Paper No.</b>	<b>:</b>	<b>6.2</b>	
<b>Maximum Marks</b>	<b>:</b>	<b>150</b>	
<b>Credits</b>	<b>:</b>	<b>4</b>	
<b>Teaching Period</b>	<b>:</b>	<b>4 Theory + 1 Students Presentation/ Week</b>	
<b>Teaching Load</b>	<b>:</b>	<b>48 Theory Periods + 12 Students Presentation/ Semester</b>	

### Objectives

To understand the following:

- Food safety and hygiene
- Types of hazards associated with food
- Food regulations (national as well as international )
- Design and implementation of food safety management systems such as ISO series, HACCP and its prerequisites such as GMP, GHP etc.
- Emerging concerns

### CONTENTS

#### UNIT 1 INTRODUCTION TO FOOD SAFETY (3 Lectures)

Definition, Types of hazards, biological, chemical, physical hazards, Factors affecting Food Safety, Importance of Safe Foods.  
( Chapter 1, Forsythe)

#### UNIT 2 FOOD HAZARDS OF PHYSICAL AND CHEMICAL ORIGIN (5 Lectures)

Introduction, Physical Hazards with common examples, Chemical Hazards(naturally occurring ,environmental and intentionally added ), Impact on health, Control measures  
( Chapter 2, Lawley et.al)

#### UNIT 3 FOOD HAZARDS OF BIOLOGICAL ORIGIN (7 Lectures)

Introduction, Indicator Organisms, Food borne pathogens: bacteria, Food borne pathogens: viruses, Food borne pathogens: eukaryotes, Seafood and Shell fish poisoning, Mycotoxins.  
(Chapter 5 , Forsythe; Chapter 2, Lawley et.al)

**UNIT 4 MANAGEMENT OF HAZARDS** (5 Lectures)

Need, Control of parameters, Temperature control, Food storage, Product design  
(Chapter 7 Forsythe)

**UNIT 5 HYGIENE AND SANITATION IN FOOD SERVICE ESTABLISHMENTS** (5 Lectures)

Introduction, Sources of contamination, General Principles of Food Hygiene(GHP)  
( Chapter 1 Marriott)

**UNIT 6 FOOD SAFETY MANAGEMENT TOOLS** (10 Lectures)

Basic concept, Prerequisites- GHPs ,GMPs, SSOPs etc, HACCP, ISO series, TQM -  
concept and need for quality, components of TQM, Kaizen, Risk Analysis, Accreditation  
and Auditing  
(Chapter 7 Forsythe)

**UNIT 7 MICROBIOLOGICAL CRITERIA** (5 Lectures)

Microbiological standards and limits, Sampling, Basic steps in detection of food borne  
pathogens, Water Analysis, Assessment of Surface Sanitation and Personal Hygiene  
(Chapter 8, Forsythe)

**UNIT 8 FOOD LAWS AND STANDARDS** (4 Lectures)

Indian Food Regulatory Regime, Global Scenario, Other laws and standards related to  
food  
( Chapter 10, Forsythe and FSSA act)

**UNIT 9 RECENT CONCERNS** (3 Lectures)

Packaging , Product labeling and Nutritional labeling, Organic foods, Newer approaches  
to food safety  
( Chapter 1, Lawley et. al ; Chapter 1, De Vries)

**Recommended Readings:**

1. Lawley, R., Curtis L. and Davis,J. The Food Safety Hazard Guidebook , RSC  
publishing, 2004

2. De Vries. Food Safety and Toxicity, CRC, New York, 1997
3. Marriott, Norman G. Principles of Food Sanitation, AVI, New York, 1985
4. Forsythe, S J. Microbiology of Safe Food, Blackwell Science, Oxford, 2000

## **(DC I) NUTRACEUTICALS AND FUNCTIONAL FOODS THEORY**

<b>Paper No.</b>	:	<b>6.3</b>
<b>Maximum Marks</b>	:	<b>150</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 Theory + 1 seminar / Week</b>
<b>Teaching Load</b>	:	<b>48 Theory Periods + 12 seminar / Semester</b>

### **Objectives:**

- To develop comprehensive understanding of different nutraceuticals and functional foods
- To understand the potential of various functional foods in promoting human health

### **CONTENTS**

#### **Unit 1: Introduction (8 lectures)**

Background, status of nutraceuticals and functional food market, definitions, difference between nutraceuticals and functional foods, types of nutraceutical compounds and their health benefits, current scenario. (Ch 1 Wildman, 2001 and Journals)

#### **Unit 2: Nutraceuticals (17 lectures)**

Types of nutraceutical compounds – Phytochemicals, phytosterols and other bioactive compounds, peptides and proteins, carbohydrates (dietary fibers, oligosaccharides and resistant starch), prebiotics, probiotics and synbiotics, lipids (Conjugated Linoleic Acid, omega-3 fatty acids, fat replacers), vitamins and minerals; their sources and role in promoting human health. (Ch 2-10, 17-19, 25-27 Wildman, 2001 and Journals)

#### **Unit 3: Functional Foods (17 lectures)**

Cereal and cereal products, Milk and milk products, egg, oils, meat and products, sea foods, nuts and oilseeds, functional fruits and vegetables, herbs and spices, beverages (tea, wine etc), Fermented foods – their health benefits and role in conditions like cardiovascular diseases, hypertension, diabetes etc. Future prospects of functional foods and nutraceuticals and their potential for use in improving health. Development in processing of functional foods. Formulation and fabrication of functional foods. (Ch 11-15, 18, 21, 24-25 and 28 Wildman, 2001 and Journals)



## Unit 4: Legal Aspects

(6 lectures)

Stability of nutraceuticals. Safety, Consumer acceptance and assessment of health claims, labeling, marketing and regulatory issues related to nutraceuticals and functional foods. (Ch 30-31 Wildman, 2001 and Journals)

### Recommended reading:

1. Wildman REC, *Handbook of Nutraceutical and Functional Foods*, CRC Press 2001
2. Ghosh D *et al*, *Innovations in Healthy and Functional Foods*, CRC Press 2012
3. Pathak YV, *Handbook of nutraceuticals* Volume 2, CRC Press 2011
4. Various journals of food technology, food science and allied subjects.

## (DC I) PRACTICALS IN BAKERY AND CONFECTIONARY TECHNOLOGY

Maximum Marks	:	50
Credits	:	4
Teaching Periods	:	4 / week
Teaching Load	:	48/Semester

### CONTENTS

1. Preparation of pizza base and assessment of its quality
2. Preparation of bread by straight dough method with and without dough improvers and to study the difference.
3. Preparation of butter cake and assessment of its quality.
4. Preparation of sponge cake with icing and assessment of its quality.
5. Preparation of cookies/biscuits and assessment of quality.
6. Preparation of fondant, fudge and brittles.
7. Preparation of candy and toffee and to perform quality assessment tests.

### Recommended Readings:

1. Dubey, S.C. (2007). *Basic Baking* 5<sup>th</sup> Ed. Chanakya Mudrak Pvt. Ltd.
2. Raina et.al. (2003). *Basic Food Preparation-A complete Manual*. 3<sup>rd</sup> Ed. Orient Longman Pvt. Ltd

## **(DC I) PRACTICALS IN FOOD SAFETY**

<b>Maximum Marks</b>	:	<b>50</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 / Week</b>
<b>Teaching Load</b>	:	<b>48/Semester</b>

### **CONTENTS**

1. Preparation of different types of media (complex, differential and selective)
2. Enumeration of aerial microflora using PDA
3. Microbiological examination of different food samples
4. Bacteriological analysis of Water
5. Assessment of surface sanitation by swab/rinse method
6. Assessment of personal hygiene
7. Biochemical tests for identification of bacteria
8. Scheme for the detection of food borne pathogens
9. Implementation of FSMS – HACCP, ISO : 22000

### **Recommended Readings:**

1. Lawley, R., Curtis L. and Davis, J. The Food Safety Hazard Guidebook , RSC publishing, 2004
2. De Vries. Food Safety and Toxicity, CRC, New York, 1997
3. Marriott, Norman G. Principles of Food Sanitation, AVI, New York, 1985
4. Forsythe, S J. Microbiology of Safe Food, Blackwell Science, Oxford, 2000 & Sons; USA, 1987

## **(DC I) PRACTICALS IN NUTRACEUTICALS AND FUNCTIONAL FOODS**

<b>Maximum Marks</b>	:	<b>50</b>
<b>Credits</b>	:	<b>2</b>
<b>Teaching Period</b>	:	<b>4 / Week</b>
<b>Teaching Load</b>	:	<b>48/ Semester</b>

### **CONTENTS**

1. Identification of various nutraceuticals and functional foods available in the market

2. Estimation of polyphenol content of various foods
3. Estimation of lycopene in tomato and tomato products
4. Extraction and quantification of flavonoids in functional foods
5. Estimation of crude fibre content in cereals and their products
6. Estimation of vitamin A, vitamin C and vitamin E in some functional foods
7. Preparation and evaluation of probiotic foods

### Recommended Readings

1. Ranganna S.1986. Handbook of analysis and quality control for fruits and vegetable products, Tata McGraw-Hill publishing company limited, Second edition

## (DC I) ADVANCED FOOD CHEMISTRY

### THEORY

<b>Paper No.</b>	:	<b>7.1</b>
<b>Maximum Marks</b>	:	<b>150</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 Theory + 1 Students Presentation/ Week</b>
<b>Teaching Load</b>	:	<b>48 Theory Periods + 12 Students Presentation/ Semester</b>

### Objectives

- To understand the chemistry of food components and their interactions.
- To know about the role of enzymes and various processing treatments in food industry.

### CONTENTS

#### UNIT 1 WATER ACTIVITY IN FOOD (4 Lectures) (Chapter 2, Fennema)

Sorption phenomenon, Water activity and packaging, Water activity and spoilage.

#### UNIT 2 CHANGES IN FATS DURING PROCESSING AND SPOILAGE (8 Lectures) (Chapter 2, DeMan and Chapter 4 Fennema)

Effect of frying on fats, Changes in fats and oils- rancidity, lipolysis, flavor reversion, Auto-oxidation and its prevention, Technology of edible fats and oils- Refining, Hydrogenation and Interesterification.



**UNIT 3 FUNCTIONAL PROPERTIES OF PROTEINS**  
(Chapter 5, Fennema)

(8 Lectures)

Functional properties of proteins eg. organoleptic, solubility, viscosity, binding, gelation / texturization, emulsification, foaming.

**UNIT 4 BROWNING REACTIONS IN FOOD**  
(Chapter 3, Fennema)

(8 Lectures)

Enzymatic browning  
Non – Enzymatic browning  
1. Maillard reaction  
2. Caramelization reaction  
3. Ascorbic acid oxidation

**UNIT 5 ENZYMES**  
(Chapter 6, Fennema, Chapter 10 DeMan, Chapter 1 Whitehurst and Law)

(10 Lectures)

Introduction, classification, General characteristics, Enzymes in food processing, Industrial Uses of Enzyme, Immobilized enzymes

**UNIT 6 PHYSICO-CHEMICAL AND NUTRITIONAL CHANGES OCCURRING DURING FOOD PROCESSING TREATMENTS**  
(Chap. 1 Desrosier and Desrosier)

(10 Lectures)

Drying and dehydration, Irradiation, Freezing, Canning

**Recommended Readings:**

1. DeMan, John M., Principles of Food Chemistry, 3rd Ed., Springer 1999
2. Desrosier, Norman W. and Desrosier, James N., The technology of food preservation, 4<sup>th</sup> Ed., Westport, Conn. : AVI Pub. Co., 1977.
3. Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York, 1996

**(DC I) FOOD QUALITY MANAGEMENT**

**THEORY**

<b>Paper No.</b>	:	<b>7.2</b>
<b>Maximum Marks</b>	:	<b>150</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 Theory + 1 Students Presentation/ Week</b>
<b>Teaching Load</b>	:	<b>48 Theory Periods + 12 Students Presentation/ Semester</b>

## Objectives

- To learn about quality management in food production chain.
- To learn about physical, chemical contaminants in foods
- To learn about latest trends and techniques in food science
- To understand the significance of safe processing of foods.

## CONTENTS

### UNIT 1 FOOD QUALITY (Ch-1, Pieterl) (10 Lectures)

Introduction to food quality management – Definition, quality concepts, quality, quality perception, quality attributes, safety, health, sensory, shelf life, convenience, extrinsic attributes, factors affecting food behavior.

Quality in the Agri- food production chain, Techno- managerial approach, food quality relationship and food quality management functions. Dynamics on the agri- food production chain, core developments in food quality management.

### UNIT 2 FOOD CONTAMINATION AND ADULTERANTS (Ch-11 DeMan, Shalton & FSSAI regulations) (10 lectures)

Contamination in Foods - Physical (stones, glass, dust, dirt), chemical (heavy metals, pesticide residues, antibiotics, veterinary drug residues, dioxins, environmental pollutants, radionuclides, solvent residues, chemicals), Natural toxins.

Contaminants formed during processing – nitrosamines, acrylamide etc. natural food contaminants and contaminants from packaging materials. Contamination with intention-adulterants

### UNIT 3 Food Additives (Ch-11 DeMan, Ch-1,2,3,4,5,6,8,9,15,17Barren) (14 Lectures)

Chemical, technological and toxicological aspects

Risk assessment studies- Safety and quality evaluation of additives and contaminants, Acute and chronic studies, NOEL, ADI, LD50

Introduction, need of food additives in food processing and preservation. Characteristics and classification of food additives.

Antimicrobial agents. -Nitrites, sulphides, sulphur di oxide, sodium chloride, hydrogen peroxide.

Antioxidants - Introduction, mechanism of action, natural and synthetic anti-oxidants, technological aspect of antioxidants.

Sweeteners- Introduction, importance, classification- natural and artificial, chemistry, technology and toxicology, consideration for choosing sweetening agents.

Colors- Introduction, importance, classification- natural, artificial, and natural identical, FD&C Dyes and Lakes. Use of plant tissue culture, polymeric colors etc for color

#### **UNIT 4 BASIC PRINCIPLES AND APPLICATION OF PROCESSING TECHNIQUES (Journals) (14 Lectures)**

Microwave processing, high fructose corn syrup, extrusion cooking, vacuum evaporation, cryogenic freezing, supercritical fluid extraction, fat mimetics, flavour encapsulation, use of nano technology in foods etc.

#### **Recommended Readings:**

1. Pieterel A, Luning, Willem J. Marcelis, Food Quality Management Technological and Managerial principles and practices, Wageningen,2009.
2. Brannen and et al., Food Additives, Marcel Dekker, New York,1990
3. Shalton, Principles and Practices for the Safe processing of Foods.
4. DeMan, 3<sup>rd</sup> edition, Principles of Food Chemistry, Springer, 2007.

#### **(DC I) RESEARCH METHODOLOGY**

#### **THEORY**

<b>Paper No.</b>	:	<b>7.3</b>
<b>Maximum Marks</b>	:	<b>100</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 Theory + 1 Students' Presentation</b>
<b>Teaching Load</b>	:	<b>48 Theory Periods + 12 Presentations / Semester</b>

#### **Objectives**

- To gain insights into how scientific research is conducted.
- To learn and understand the basic statistics involved in data presentation

#### **CONTENTS**

#### **UNIT I INITIATION OF RESEARCH**

**(10 Lectures)**

Historical account of research in food technology, Identification of areas of research, literature databases-mode of their use and retrieval of literature, Search of journal websites for specific topics, inculcation of habit of scientific reading



## UNIT II SAMPLING

(12 Lectures)

Sampling, Need for sampling, unit, population, sample, sampling error, sampling methods; Simple Random Sampling, Probability Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling and Multistage Sampling. Sample size, Standard Error. Experimental designs, retrieval and understanding of protocols, Statistics- analysis Measures of Central Tendency (Mean, Mode Median); Measures of Central Dispersion(Range, Standard Deviation, Standard Error, Coefficient of Variation); Normal Distribution, Tests of Significance – 't' Test ( One Sample and Two Sample Tests), Testing of Hypothesis; Analysis of Variation (ANOVA), Correlation Analysis, significance of data

## UNIT III DEVELOPING PRESENTATION SKILLS

Tutorials on the art of scientific writing and presentation. Interpretation and presentation of data.

## UNIT IV PREPARING THE BASE FOR PROJECT WORK

Designs of experiments specific to project work, Optimization of tools and protocols

## UNIT V PRACTICALS AND HANDS- ON

Seminar presentations, submission of research proposal, optimization of some methods to be used in the project/dissertation and visiting research institutions and labs, interactive sessions with PIs.

### Recommended Readings:

- 1) Kothari, C.R., Research Methodology (Methods and Techniques), New Age Publisher
- 2) Fundamentals of modern statistical methods By Rand R. Wilcox
- 3) Power Analysis for Experimental Research A Practical Guide for the Biological, Medical and Social Sciences by R. Barker Bausell, Yu-Fang Li Cambridge University Press
- 4) Design of Experiments: Statistical Principles of Research Design and Analysis, by Robert O. Kuehl Brooke/Cole
- 5) Research Methodology: A step by step guide for beginners by Kumar, 2<sup>nd</sup> Ed, Pearson Education, 2005

## (DC I) PRACTICALS IN ADVANCED FOOD CHEMISTRY

Maximum Marks	:	50
Credits	:	4
Teaching Period	:	4 / Week
Teaching Load	:	48/Semester

## CONTENTS

1. Determination of water activity in foods
2. Determination of thermal inactivation time of enzymes in fruits and vegetables
3. Estimation of iodine value
4. Estimation of peroxide value
5. Determination of percent free fatty acids and acid value
6. Determination of Nitrogen solubility index
7. Determination of smoke point and percent fat absorption for different fat and oils
8. Extend of non-enzymatic browning by extraction method

### Recommended Readings:

1. DeMan, John M., Principles of Food Chemistry ,3rd Ed., Springer 1999
2. Desrosier, Norman W. and Desrosier.,James N.,The technology of food preservation , 4<sup>th</sup> Ed.,Westport, Conn. : AVI Pub. Co., 1977.
3. Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York, 1996
4. Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002

## (DC I) PRACTICALS IN FOOD QUALITY MANAGEMENT

Maximum Marks	:	50
Credits	:	4
Teaching Period	:	4 / Week
Teaching Load	:	48/ Semester

## CONTENTS

1. Qualitative tests for hydrogenated fats, butter, ghee
2. Platform tests for milk
3. Quality evaluation of various food stuffs- cereals, pulses, honey, jaggery, sugar, tea, coffee etc.
4. Estimation of residual sulphur dioxide in beverages.
5. Chromatographic estimation of colour.
6. Analysis of edible common salt for moisture content, MIW and total chlorides.
7. Estimation of ammonia in water.
8. Estimation of benzoic acid in foods.

### Recommended Readings:

1. Pieterel A, Luning, Willem J. Marcelis, Food Quality Management Technological and Managerial principles and practices, Wageningen,2009.
2. Brannen and et al.,Food Additives, Marcel Dekker,New York,1990
3. Shalton , Principles and Practices for the safe processing of Foods.
4. DeMan, 3<sup>rd</sup> edition, Principles of Food Chemistry, Springer, 2007.



## (DC I) FOOD PACKAGING TECHNOLOGY

### THEORY

<b>Paper No.</b>	:	<b>8.1</b>
<b>Maximum Marks</b>	:	<b>150</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 Theory + 1 Students' Presentation</b>
<b>Teaching Load</b>	:	<b>48 Theory Periods + 12 Presentations / Semester</b>

#### Objectives:

- To impart comprehensive overview of the scientific and technical aspects of food packaging.
- To instill knowledge on packaging machinery, systems, testing and regulations of packaging.

#### **Unit 1: Introduction to Food Packaging (5 lectures) ( Chapter 1,2 Paine & Paine, 1992)**

History, Packaging Functions and Requirements- Historical background, importance and scope of food packaging, functions of food packaging and requirements for effective food packaging

Graphics, Package Design, Printing and Labeling- Function of packaging graphics, main printing processes, printing inks, varnishes, adhesives and labels

#### **Unit 2: Food Packaging Materials (15 lectures) ( Chapter 6,7,8 Robertson, 2012 and Chapter7 Coles *et al*, 2003)**

Paper and paper-based materials, corrugated fiber board (CFB); injection molding, blow molding types of plastics and their properties, co-extrusion, lamination, Biodegradable plastics, edible packaging and bio-composites. Environmental Concerns- recycling and disposal of packaging waste

Metal and Glass packaging- Metals: Tinplate, tinning process, components of tinplate, tin free can (TFC) types of can, metallic films, lacquers, Glass: composition, properties, methods of bottle making, types of closures.

#### **Unit 3: Package Designing for Foods (15 lectures) (Chapter 7,8,9,10,11,13 Paine and Paine, 1992)**



Package design for fresh horticultural produce and animal foods, dry and moisture sensitive foods, frozen foods, fats and oils, thermally processed foods and beverages

#### **Unit 4: Testing and Regulatory Aspects of Food Packaging (5 lectures) (Chapter 22 Robertson, 2012)**

Testing Procedures for Packaging Materials- thickness, tensile strength, puncture resistance, bursting strength, seal strength, water vapor permeability, CO<sub>2</sub> permeability, oxygen permeability, grease resistance,

Testing Procedures for Packaged Foods - Compatibility and shelf life studies, evaluation of transport worthiness of filled packages. Food Packaging Laws and Regulations

#### **Unit 5 Packaging Machinery and Systems (8 lectures) (Chapter 4, Paine & Paine, 1992, Coles *et al*, 2003 )**

Bottling machines, cartoning systems, seal and shrink packaging machine; form, fill and sealing machine (FFS); vacuum, controlled and modified atmosphere packaging systems; Aseptic packaging systems; Retort packaging, Active and Intelligent packaging systems

#### **Recommended Readings:**

1. Robertson GL, Food Packaging – Principles and Practice, CRC Press Taylor and Francis Group, 2012
2. Paine FA and Paine HY, A Handbook of Food Packaging, Blackie Academic and Professional, 1992
3. Coles R, McDowell D, Kirwan MJ Food Packaging Technology. Blackwell, 2003

### **(DC I) FOOD PLANT SANITATION AND WASTE MANAGEMENT**

#### **THEORY**

<b>Paper No.</b>	:	<b>8.2</b>
<b>Maximum Marks</b>	:	<b>150</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 Theory + 1 Students' Presentation</b>
<b>Teaching Load</b>	:	<b>48 Theory Periods + 12 Presentations / Semester</b>

#### **Objectives**

1. To study design of plant and processing equipment.
2. To develop comprehensive understanding of waste product handling and management.

## CONTENTS

### **UNIT 1 Food Plant Layout and Equipment Design (Chapter -10,24,25 Rao, D. G. (2010).) (15lectures)**

General principles of food plant Design and layout ,Design of food processing equipments :Size Reduction, mixing, separation, extraction, filtration, centrifugation, distillation and, gas absorption equipments.

### **UNIT 2 Warehousing and Cold Chain Management (Chapter1,13,23. James 2013) (15 lectures)**

Food hygiene and safety in transportation, with a focus on warehouse storage and refrigerated ships- Safe food storage at shopping outlets: use of coolers/chillers/freezers, length of time in storage ,Design of warehouses Scopes of Cold Chain for enhancing marketing potentials of perishables in domestic and international markets Principles of Cold Chain Creation and Management. Physicochemical changes in stored products during storage, air tight, non-air tight, under ground conventional & modern storage structures for fruits, vegetables, meat and marine products ; Aerated, refrigerated and controlled atmospheric storage; Layout and Design of storage structures, economics of storage structures

### **UNIT 3 Food Plant Hygiene and Sanitation ( Chapter 5,6,7,8. Norman G. et al 2006) (18 lectures)**

Waste disposal, Control methods using Physical and Chemical Agents, Pest and Rodent Control, ETP Design and Layout food storage sanitation, transport sanitation and water sanitation. By-products utilisation obtained from dairy plant, egg& poultry processing industry and meat industry. Wastewater and solid waste treatment: - Waste-types-solid and liquid waste characterization, physical, chemical, biological, aerobic, anaerobic, primary, secondary and tertiary (advanced) treatments.

### **Recommended Readings:**

1. Norman G. Marriott and Robert B. Gravani. (2006). Principles of Food Sanitation,5th edition
2. Rao, D. G. (2010). Fundamentals of Food Engineering, PHI learning Private Ltd.
3. Fellows P. (2000). Food Processing Technology, 2<sup>nd</sup> Edition. Woodhead Publishing Limited and CRC Press LLC
4. James A (2013) The supply chain handbook, distribution group.
5. FAO, US (1984) Design and operations of cold store in developing countries.

## **(DC I) RESEARCH (INDUSTRIAL PROJECT)**

<b>Paper No.</b>	:	<b>8.3</b>
<b>Maximum Marks</b>	:	<b>100</b>
<b>Credits</b>	:	<b>4</b>
<b>Teaching Period</b>	:	<b>4 + 1</b>
<b>Teaching Load</b>	:	<b>48 + 12 / Semester</b>

**Industrial Project/Dissertation**

## **(DC I) PRACTICALS IN FOOD PACKAGING**

<b>Maximum Marks</b>	:	<b>50</b>
<b>Credit</b>	:	<b>2</b>
<b>Teaching Period</b>	:	<b>4 / Week</b>
<b>Teaching Load</b>	:	<b>48 / Semester</b>

### **CONTENTS**

1. Identification of packaging materials
2. Testing physical/mechanical properties of food packaging material
3. Testing thermal shock resistance of glass
4. Gas/Vacuum packaging of foods
5. Determination of water vapor transmission rate of packaging material
6. Testing sealing strength integrity of packaging materials
7. Determination of porosity of tin plate.
8. Testing of packaged foods-cut out analysis

### **Recommended Readings:**

1. Robertson GL, Food Packaging – Principles and Practice, CRC Press Taylor and Francis Group, 2012
2. Paine FA and Paine HY, A Handbook of Food Packaging, Blackie Academic and Professional, 1992
3. Coles R, McDowell D, Kirwan MJ Food Packaging Technology. Blackwell, 2003

## **(DC I) PRACTICALS IN FOOD PLANT SANITATION AND WASTE MANAGEMENT**

<b>Maximum Marks</b>	:	<b>50</b>
<b>Credits</b>	:	<b>2</b>



**Teaching Period** : 4 / Week  
**Teaching Load** : 48/Semester

## **CONTENTS:**

1. Design and layout of various food processing systems and food service areas.
2. Design and layout of cold storage and warehouse.
3. Determination of physico-chemical properties of wastewater.
4. Preparation of a sanitation schedule for food preparation area.
5. Testing of sanitizers and disinfectants.
6. Study of Phenol coefficient of sanitizers.
7. Determination of BOD (biological oxygen demand)/ COD in waste water.
8. Study of waste water treatment system/ETP.

## **Recommended Readings:**

1. Norman G. Marriot and Robert B. Gravani. 2006, 5<sup>th</sup> Ed. ,Principles of Food Sanitation
2. Forsythe, S.J. and Hayes, P.R. (1998). Food Hygiene, Microbiology and HACCP. Gaitersburg, Maryland: Aspen.
3. Hui, Y.H., Bruinsma, B., Gorham, R., Nip, W.-K. (2003). Food Plant Sanitation. New York: Marcel Dekker.
4. Rees, N. and D. Watson. (2000). International Standards for Food Safety. Gaitersburg, Maryland: Aspen

# SYLLABUS FOR APPLIED COURSE

## (AC) TECHNIQUES FOR FOOD ANALYSIS

<b>Paper No.</b>	:	<b>3.3</b>
<b>Maximum Marks</b>	:	<b>75</b>
<b>Credits</b>	:	<b>3</b>
<b>Teaching Periods</b>	:	<b>3 Theory cum Practical</b>
<b>Teaching Load</b>	:	<b>36</b>

### Objectives

- To understand basic principles underlying analytical techniques related to food analysis.
- To understand the operation of analytical instruments, data analysis and interpretation of data generated by instruments.

### PROJECTS (any 5)

1. To learn the working of common lab instruments: pH meter, weighing balances, Centrifuges and Laminar-air flow.
2. To analyze food samples of different origin using Texture Analyzer.
3. Determination of moisture content using KF titrator.
4. Spectrometric determination of protein or sugar content in a food sample using double beam spectrophotometer.
5. Thin Layer Chromatographic (TLC) separation of amino acids/chlorophyll samples.
6. Analysis of various food samples using atomic absorption system.
7. Molecular weight determination of protein sample using SDS-PAGE.
8. Estimation of fatty acid content in oil seed sample using Gas chromatography.
9. Estimation of capsaicin content in capsicum using high performance liquid chromatography (HPLC).

### Recommended Readings

1. H.H. Willard, L.L. and Merritt Jr. 1986. Instrumental Methods of Analysis. 6th, CBS Publishers and Distributors.
2. Chatwal G Anand, S. 1989. Instrumental Methods of Chemical Analysis. Himalaya Publishing House, Mumbai.
3. Williams, B.L. and Wilson, K. 1975. A Biologists Guide to Principles and Techniques of Practical Biochemistry.
4. B.B. Straughan and S. Walker. Chapman and Hall. 2009. Spectroscopy. Vol.I.

5. R. J. Hamilton and P. A. Sewell..2007.Introduction to High Performance Liquid Chromatography.

## **(AC) ENTREPRENEURIAL DEVELOPMENT AND FOOD BUSINESS MANAGEMENT**

**PRACTICAL**

<b>Paper No.</b>	<b>:</b>	<b>4.3</b>
<b>Maximum Marks</b>	<b>:</b>	<b>75</b>
<b>Credits</b>	<b>:</b>	<b>3</b>
<b>Teaching Period</b>	<b>:</b>	<b>3 Periods</b>
<b>Teaching Load</b>	<b>:</b>	<b>36 Periods</b>

### **OBJECTIVE:**

The course aims to:

- Help a person in strengthening and fulfilling his entrepreneurial motive and in acquiring skills and capabilities necessary for playing his entrepreneurial role effectively.
- Promote the chances of entrepreneurial success by developing and strengthening entrepreneurial quality and motivation.
- To familiarize the students with the principles of Food Business Management

## **PROJECTS**

### **UNIT I: ENTREPRENEURIAL DEVELOPMENT**

Case studies of successful entrepreneurs

Exercises on ways of sensing opportunities – sources of idea, creating efforts, SWOT Analysis

Entrepreneurial skill assessment test

Techniques of development of entrepreneurial skills, positive self image and locus of control

### **UNIT II: FOOD BUSINESS MANAGEMENT**

Case studies of Food Processing Business and its aspects

Business opportunity Identification and Assessment techniques

Business Idea Generation and evaluation exercise

Market Assessment study

Analysis of competitive situation

SWOT Analysis for business and for competitors

Preparation of business plan



Preparation of project report  
Methods of Arrangement of inputs – finance and material

## Recommended Readings

1. Vasant Desai (2012) Fundamentals of Entrepreneurship and Small Business Management, Himalya Publishing House Pvt. Ltd., Mumbai
2. Vasant Desai (2011) The Dynamics of Entrepreneurial Development and Management, Himalya Publishing House Pvt. Ltd., Mumbai
3. D. David and S Erickson (1987) Principles of Agri Business Management , Mc Graw Hill Book Co., New Delhi.
4. Acharya S S and Agarwal N L (1987) Agricultural Marketing in India, Oxford & ISH Publishing Co., New Delhi.
5. David H. Holt (2002) Entrepreneurship – Anew Venture Creation, Prentice Hall of India, New Delhi.
6. Phill Kotler (1994) Marketing Management, Prentice Hall of India Private Limited, New Delhi.
7. Chandra, Prasanna (1996) Projects, Planning, Analysis, Selection, Implementation and Review, Tata McGraw-Hill Publishing Company Limited, New Delhi.

## (AC) FOOD FERMENTATION TECHNOLOGY

<b>Paper No.</b>	:	<b>5.4</b>
<b>Maximum Marks</b>	:	<b>75</b>
<b>Credits</b>	:	<b>3</b>
<b>Teaching Period</b>	:	<b>3 Theory cum Practical</b>
<b>Teaching Load</b>	:	<b>36/Semester</b>

## Objectives

- To understand the principles of food fermentation technology
- To study the types of starters used in Food Industry
- To study the production of various fermented foods

## PROJECTS

(36 Lectures)

1. Food Fermentation Technologies.
2. Study of a Bio fermentor – its design and operation, Down Stream Processing and Product recovery.
3. Starter cultures- Types, Propagation and maintenance at lab scale and their purity/activity tests
4. Production of Baker's Yeast
5. Production of yoghurt using DIV cultures

6. Development of a fermented food/drink utilizing plant products /animal products or byproducts as substrate and submission of a project report.

### **Recommended Readings:**

1. Food Microbiology. 2nd Edition By Adams
2. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2 by Joshi.
3. Essentials of Food Microbiology. Edited by John Garbutt. Arnold International Students Edition.
4. Microbiology of Fermented Foods. Volume II and I. By Brian J. Wood. Elsevier Applied Science Publication.
5. Principles of Fermentation Technology by Stanbury, P.F., Whitekar A. and Hall. 1995., Pergamon. McNeul and Harvey.

### **(AC) NEW FOOD PRODUCT DEVELOPMENT**

<b>Paper No.</b>	:	<b>6.4</b>
<b>Maximum Marks</b>	:	<b>75</b>
<b>Credits</b>	:	<b>3</b>
<b>Teaching Periods</b>	:	<b>3 Theory cum Practical</b>
<b>Teaching Load</b>	:	<b>36</b>

### **Objectives**

- To understand the concept of development of a new product and prepare new products based on special dietary requirements, functionality, convenience and improvisation of existing traditional Indian foods.

### **PROJECTS**

#### **Development of New Product (Chapter-3,4,5,6,14,15,19, Anil Kumar et al. and Chapter 13,14 Moskowitz and Saguy)**

Definition, Importance , objectives & Need of product development , Reasons of failure, Types and Steps of product development ,Product development Tools and their use

#### **Projects on:**

1. Market and literature survey to identify the concepts of new products based on special dietary requirements, functionality, convenience and improvisation of existing traditional Indian foods.
2. Screening of product concept on the basis of techno-economic feasibility.

3. Development of prototype product and Standardization of formulation process.
4. Proximate Analysis of New Product
5. Packaging, labeling and shelf-life studies
6. Cost analysis and Final Project Report

Each team/group of students would develop a new product on the basis of above mentioned lines /steps and would submit a project report

#### **Recommended Readings**

1. Fuller, Gordon W. 2004. New Product Development- From Concept to Marketplace, CRC Press.
2. Anil kumar, S., Poornima, S.C., Abraham, M.K.& Jayashree, K.2004. Entrepreneurship Development. New Age International Publishers.
3. Moskowitz, Howard and Saguy ,R. I. Sam 2009. An Integrated Approach to New Food Product , CRC Press.

## **SYLLABUS FOR DC-II**

### **Paper No. 1: (DC II) FOOD PROCESSING AND PRESERVATION THEORY**

**Maximum Marks : 150**

**Credits : 4**

**Teaching Period : 4 Theory + 1 Students' Presentation/ Week**

**Teaching Load : 48 Theory Periods +12 Students' Presentation/Semester**

#### **Objectives:**

To impart basic knowledge of:

- Freezing ,Dehydration processes and equipment
- Principles of thermal processing
- Technology of colloids
- Water disposal and sanitation



- Minimal Processing and hurdle technology

## CONTENTS:

### UNIT 1. FOOD PROCESSING OPERATIONS:

#### Refrigeration and Freezing (Ch.9,Potter N) (9 lectures)

Requirements of refrigerated storage - controlled low temperature, air circulation and humidity, changes in food during refrigerated storage, progressive freezing, changes during freezing  
Freezing methods -direct and indirect, still air sharp freezer, blast freezer, fluidized freezer, plate freezer, spiral freezer and cryogenic freezing.

#### Dehydration (Ch.10,Potter N) (9 Lectures)

Normal drying curve , effect of food properties on dehydration ,change in food during drying, drying methods and equipments air convection dryer, tray dryer, tunnel dryer ,continuous belt dryer , fluidized bed dryer, dryer, drum dryer, vacuum dryer ,freeze drying ,foam mat drying.

#### Thermal Processing of Foods (Ch.3,Ramaswamy H and Marcotte M) (7 Lectures)

Classification of thermal processes, Principles of thermal processing, commercial canning operations, Aseptic Processing, UHT.

#### Irradiation and microwave heating (Ch.11,Potter N) (5 Lectures)

Principles, Dosage, Applications of Irradiation, Mechanism of microwave heating and applications.

### UNIT2.TECHNOLOGY OF COLLOIDS IN FOOD (Ch.11,ManayNS and Shadaksharaswamy M)

(6 Lectures)

Characteristics, sols, gels, pectin gels, colloidal sols, stabilization of colloidal system, syneresis, emulsions, properties of emulsions, formation of emulsion, emulsifying agents, food foams, formation stability and destruction of foam, application of colloidal chemistry to food preparation.

### UNIT 3. WATER DISPOSAL AND SANITATION (Ch.22,Potter N) (6 Lectures)

Waste water ,hardness of water, break point chlorination, physical and chemical nature of impurities, BOD, COD, waste water treatment, milk plant sanitation, CIP system, sanitizers used in food industry.

**UNIT 4. MINIMAL PROCESSING AND HURDLE TECHNOLOGY**  
**(Journals) ( 6 Lectures)**

**UNIT-5 Food Additives, contaminants and regulations (Ch-11, DeMan)**  
**(10 lectures)**

Food Additives - Introduction, need of food additives in food processing and preservation, Characteristics and classification of food additives, Chemical, technological and toxicological aspects. Contamination in Food- : Physical, chemical (heavy metals, pesticide residues, antibiotics, veterinary drug residues, dioxins, environmental pollutants, radionucleides, solvent residues, chemicals) Natural toxins. Food Laws and Regulations- Codex, HACCP, ISO; FSSA etc

**Recommended Readings:**

1. Potter NH, 1998, Food Science, CBS Publication, New Delhi
2. Ramaswamy H and Marcotte M, 2009, Food Processing Principles and Applications CRC Press
3. Deman JM, 2007, Principles of Food Chemistry, 3rd ed. Springer
4. Manay NS and Shadaksharaswamy M, 1987, Food-Facts and Principles, New Age International (P) Ltd. Publishers, New Delhi

**Paper No. 1: (DC-II) PRACTICALS IN FOOD PROCESSING AND PRESERVATION**

<b>Maximum Marks :</b>	<b>50</b>
<b>Credits :</b>	<b>4</b>
<b>Teaching Period :</b>	<b>4/week</b>
<b>Teaching Load :</b>	<b>48 Periods/ Semester</b>

**CONTENTS:**

- 1 Canning of foods
- 2 Preservation of food by the process of freezing
- 3 Drying of food using Tray dryer/other dryers

- 4 Estimation of Chemical Oxygen Demand (Demonstration)
- 5 Preparation of brix solution and checking by hand refractometer
- 6 Analysis of water
- 7 Minimal Processing of food
- 8 Application of colloidal chemistry in food preparation

**Recommended Readings:**

1. Potter NH,1998, Food Science, CBS Publication, New Delhi
2. Ramaswamy H and Marcotte M,2009, Food Processing Principles and Applications CRC Press
3. Deman JM,2007, Principles of Food Chemistry, 3rd Ed.Springer
4. Manay NS and Shadaksharaswamy M,1987, Food-Facts and Principles, New Age International (P) Ltd. Publishers, New Delhi

**Paper No. 2: (DC II) CHEMISTRY OF FOOD**

**THEORY**

**Maximum Marks : 150**

**Credits : 4**

**Teaching Period : 4 Theory + 1 Students' Presentation/ Week**

**Teaching Load : 48 Theory Periods +12 Students' Presentation/Semester**

**Objectives:**

- To understand the chemistry of foods - composition of food, role of each component.
- To understand the effect of processing on various food components

**CONTENTS:**

**UNIT 1. Introduction (Ch-1,Deman,Ch-1,Fennemma)**

**(1 Lecture)**



Introduction to Food Chemistry, Composition of food

**UNIT 2. Water (Ch-1,Deman) (3 Lectures)**

Definition of water in food, Structure of water and ice, Types of water, Role of water activity

**UNIT 3. Lipids (Ch-2,Deman) (5 Lectures)**

Classification of lipids, Physical and chemical characteristics, Chemical deterioration of fats and oils (auto oxidation, rancidity, lipolysis, flavor reversion)

**UNIT 4. Proteins (Ch-3,Deman) (5 lectures)**

Protein classification and structure, types of food proteins (plant and animal proteins), Physicochemical and functional properties of proteins

**UNIT5. Carbohydrates (ch-3,Fennema) (4 Lectures)**

Classification, Structure and Chemical reactions of carbohydrates

**UNIT 6. Vitamins (Ch-9,Deman) (4 Lectures)**

Types (Water soluble vitamins and Fat soluble vitamins)

**UNIT 7. Flavour (Ch-7,Deman) (4 Lectures)**

Definition and basic tastes, Description of some common food flavors.

**UNIT 8. Minerals(Ch-5,Deman) (2 Lectures)**

Major and minor minerals, Toxic minerals in food

**UNIT 9. Natural Food Pigments(Ch-9,Fennema) (4 Lectures)**

Introduction and classification, Types of food pigments (chlorophyll, carotenoids, anthocyanins and flavonoids, beet pigments, caramel)

**UNIT 10. Browning Reactions in Food (Ch-3,Fennema) (4 Lectures)**

Types, Enzymatic and Non enzymatic Browning and their control measures

**UNIT 11 . Enzymes (3 Lectures)**

Introduction, classification, General characteristics, Important enzymes in food processing

**UNIT 12. Physico-chemical and nutritional changes occurring during food Processing (Desrosire and Desrosier) (4 Lectures)**

**UNIT 13. New Food Product Development (2 Lectures)**

Introduction, need, objectives and types

**Recommended Readings:**

1. DeMan, John M.1982. Principles of Food Chemistry ,3rd Ed., Springer
2. Desrosier, Norman W. and Desrosier.,James N.1977.The technology of food preservation , 4th Ed.,Westport, Conn. : AVI Pub. Co.
3. Fennema, Owen R1996. Food Chemistry, 3rd Ed., Marcell Dekker, New York,
4. Whitehurst and Law.2002. Enzymes in Food Technology, CRC Press, Canada
5. Wong, Dominic WS.1885. Food Enzymes, Chapman and Hall, New York
6. Potter,N.N.and Hotchkiss,J.H.1995. Food Science5th Ed., Chapman & Hall

**Paper No. 2: (DC-II) PRACTICALS IN CHEMISTRY OF FOOD**

<b>Maximum Marks :</b>	<b>50</b>
<b>Credits :</b>	<b>4</b>
<b>Teaching Period :</b>	<b>4/week</b>
<b>Teaching Load :</b>	<b>48 Periods/ Semester</b>

**CONTENTS:**

1. Preparation of primary and secondary solutions
2. Estimation of moisture content
3. Determination of gelatinization temperature range (GTR) of different starches and effect of additives on GTR
4. Determination of percent free fatty acids
5. Estimation of Peroxide Value
6. Estimation of Total Ash
7. Estimation of Protein Content

## Recommended Readings:

1. DeMan, John M.1982. Principles of Food Chemistry ,3rd Ed., Springer
2. Desrosier, Norman W. and Desrosier.,James N.1977.The technology of food preservation , 4th Ed.,Westport, Conn. : AVI Pub. Co.
3. Fennema, Owen R1996. Food Chemistry, 3rd Ed., Marcell Dekker, New York,
4. Whitehurst and Law.2002. Enzymes in Food Technology, CRC Press, Canada
5. Wong, Dominic WS.1885. Food Enzymes, Chapman and Hall, New York
6. Potter,N.N.and Hotchkiss,J.H.1995. Food Science5th Ed., Chapman & Hall

## PAPER NO-3 (DC-II) SENSORY EVALUATION OF FOOD

### THEORY

Maximum Marks	:	150
Credits	:	4
Teaching Period	:	4 Theory + 1 Students Presentation/ Week
Teaching Load	:	48 Theory Periods + 12 Students Presentation/ Semester

#### UNIT 1 Taste (Amerine, Rao)

(12 Lectures)

- Introduction and importance of taste
- Structure and physiology of taste organs- tongue, papillae, taste buds, salivary glands.
- Mechanism of taste perception
- Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami
- Factors affecting taste quality, reaction time, taste modification, absolute and recognition threshold
- Taste abnormalities
- Taste measurement

#### UNIT 2 Odour (Amerine, Rao)

(12 Lectures)

- Introduction, definition and importance of odour and flavour
- Anatomy of nose, physiology of odour perception
- Mechanism of odour perception
- Odour classification, chemical specificity of odour.
- Odour measurement using different techniques – primitive to recent techniques. Merits and demerits of each method.
- Olfactory abnormalities



**UNIT 3 Colour (DeMan, Rao) (12 Lectures)**

- Introduction and importance of colour.
- Dimensions of colour and attributes of colour, appearance factors, gloss etc.
- Perception of colour.
- Colour abnormalities
- Measurement of colour; Munsell colour system, CIE colour system, Hunter colour system, spectrophotometry and colorimetry etc.

**UNIT 4 Texture (DeMan, Rao) (12 Lectures)**

- Introduction, definition and importance of texture
- Phases of oral processing
- Texture perception, receptors involved in texture perception
- Texture classification
- Texture measurement – basic rheological models, forces involved in texture measurement

**PAPER No. 3: (DCII) PRACTICALS IN SENSORY EVALUATION OF FOOD**

<b>Maximum Marks :</b>	<b>50</b>
<b>Credits :</b>	<b>2</b>
<b>Teaching Period :</b>	<b>4 / Week</b>
<b>Teaching Load :</b>	<b>8 Practical / Semester (4 Periods each)</b>

**CONTENT**

1. Training of sensory panel.
2. To perform recognition and sensitivity tests for four basic tastes.
3. To perform analytical tests of sensory evaluation.
4. Recognition tests for various food flavours, flavor defects in milk.
5. Sensory evaluation of milk and milk products.
6. Texture evaluation of various food samples- crispies/ cookies/ biscuits/ snack foods
7. Measurement of colour by using Tintometer/ Hunter Colour Lab etc.
8. Qualitative tests for hydrogenated fats, butter, ghee
9. Platform tests for milk
10. Quality evaluation of various food stuffs- cereals, pulses, honey, jaggery, sugar, tea, coffee etc.

**Recommended Readings**

1. Rao E. S. (2013). Food Quality Evaluation, Variety Books.
2. Amerine, Pangborn & Roessler (1965). Principles of Sensory Evaluation of food, Academic Press, London.
3. Meilgard (1999). Sensory Evaluation Techniques, 3<sup>rd</sup> ed. CRC Press LLC, 1999
4. deMan J. (2007). Principles of Food Chemistry, 3<sup>rd</sup> ed., Springer.

5. Brannen and et al.,(1990)Food Additives, Marcel Dekker,New York,1990

**Paper No. 4: (DC-II) FOOD MICROBIOLOGY AND FOOD SAFETY  
THEORY**

**Maximum Marks : 150**

**Credits : 4**

**Teaching Period : 4 Theory + 1 Students' Presentation/ Week**

**Teaching Load : 48 Theory Periods +12 Students' Presentation/ Semester**

**Objectives:**

- To know the important genera of microorganisms associated with food and their characteristics.
- To understand the role of microbes in fermentation, spoilage and food borne diseases.
- To understand Food safety and hygiene, types of hazards associated with food.
- To understand current Food regulations and Food Safety Management Systems.

**CONTENTS:**

**UNIT 1. Introduction to Food Microbiology (Ch-1,Garbutt) (2 Lectures)**

History and Development of Food Microbiology, Definition and Scope of food microbiology

**UNIT 2. Types of Microorganisms in Food(Ch-3,5,17,18,19,20 Pelczar etal)  
(6 Lectures)**

Classification and Nomenclature, Morphology and Structure Importance in food (bacteria, fungi and viruses ) Significance of spores

**UNIT 3. Microbial Growth in Food(Ch-4,Banwart) (4 Lectures)**

Bacterial growth curve, Factors affecting the growth of micro organisms in food

**UNIT 4. Microbial Food Spoilage(Ch 4-9,Jay,Ch-12,13,14,17,18, Frazier and  
westhoff) (6 Lectures)**

Sources of Microorganisms in foods, Some important food spoilage bacteria, Spoilage of some specific food groups

### **UNIT 5. Food Fermentations (6 Lectures)**

Fermentation –definition and types, Microorganisms used in food fermentations, Fermented Foods-types, methods of manufacture for vinegar, sauerkraut, yoghurt , soya sauce, wine and traditional Indian foods

### **UNIT6. Food borne Diseases (Ch-23,24,25,Frazier and Westhoff) (4 Lectures)**

Types – food borne infections, food borne intoxications and toxin infections, Origin, symptoms and prevention of some commonly occurring food borne diseases

### **UNIT7. Enumeration techniques & control of microorganisms in foods (6 lectures)**

Qualitative and quantitative methods-conventional as well as rapid, Principles and methods of preservation (thermal and non thermal),Introduction to Hurdle Technology

### **UNIT 8 .Introduction to Food Safety (Ch-1,forsythe) (4 Lectures)**

Definition, Types of hazards, biological, chemical, physical hazards, Factors affecting Food Safety

### **UNIT 9.Hygiene and Sanitation in Food Service Establishments (Ch-1,Marriot) (6Lectures)**

Introduction, Sources of contamination, Control methods using physical and chemical agents, Waste Disposal, Pest and Rodent Control, Personnel Hygiene

### **UNIT 10. Food Safety Management Tools (Ch-7,Forsythe) (4 Lectures)**

Basic concept, Prerequisites, HACCP, ISO series, TQM and Risk Analysis

### **Recommended Readings:**

1. Frazier William C and Westhoff, Dennis C. 2004 Food Microbiology, TMH, New Delhi,
2. Jay, James M. 2000 Modern Food Microbiology, CBS Publication, New Delhi,
3. Garbutt, John.1997 Essentials of Food Microbiology, Arnold, London,
4. Pelczar MJ, Chan E.C.S and Krieg, Noel R 1993 Microbiology, 5th Ed., TMH, New Delhi
5. Lawley, R., Curtis L. and Davis,J. , 2004 The Food Safety Hazard Guidebook , RSC publishing.



6. De Vries, 1997, Food Safety and Toxicity, CRC, New York,
7. Marriott, Norman G. , 1985, Principles of Food Sanitation, AVI, New York,
8. Forsythe, S J , 1987, Microbiology of Safe Food, Blackwell Science, Oxford, 2000 & Sons; USA,

### **Paper No. 4: (DC II) PRACTICALS IN FOOD MICROBIOLOGY AND FOOD SAFETY**

<b>Maximum Marks :</b>	<b>:</b>	<b>50</b>
<b>Credits</b>	<b>:</b>	<b>4</b>
<b>Teaching Period</b>	<b>:</b>	<b>4/week</b>
<b>Teaching Load</b>	<b>:</b>	<b>48 Periods/ Semester</b>

### **CONTENTS:**

1. Introduction to the Basic Microbiology Laboratory Practices and Equipments
2. Preparation and sterilization of nutrient broth and media
3. Morphological study of bacteria and fungi using permanent slides
4. Simple staining and Gram's staining
5. Standard Plate Count Method
6. Bacteriological Analysis of Water
7. Assessment of surface sanitation by swab/rinse method
8. Assessment of personal hygiene
9. Scheme for the detection of food borne pathogens
10. Implementation of FSMS – HACCP, ISO : 22000

### **Recommended Readings:**

1. Frazier William C and Westhoff, Dennis C. 2004 Food Microbiology, TMH, New Delhi,
2. Jay, James M. 2000 Modern Food Microbiology, CBS Publication, New Delhi,
3. Garbutt, John. 1997 Essentials of Food Microbiology, Arnold, London,
4. Pelczar MJ, Chan E.C.S and Krieg, Noel R 1993 Microbiology, 5th Ed., TMH, New Delhi
5. Lawley, R., Curtis L. and Davis, J. , 2004 The Food Safety Hazard Guidebook , RSC publishing.
6. De Vries, 1997, Food Safety and Toxicity, CRC, New York,
7. Marriott, Norman G. , 1985, Principles of Food Sanitation, AVI, New York,
8. Forsythe, S J , 1987, Microbiology of Safe Food, Blackwell Science, Oxford, 2000

& Sons; USA,

**Paper No. 5: (DC-II) FOOD ENGINEERING AND PACKAGING**

**THEORY**

**Maximum Marks : 150**

**Credits : 4**

**Teaching Period : 4 Theory + 1 Students' Presentation/ Week**

**Teaching Load : 48 Theory Periods +12 Students' Presentation/Semester**

**Objectives:**

- To understand the principles of Unit operation
- To acquaint with fundamentals of food engineering and its process
- To develop an understanding of different food packaging materials and packaging design and techniques used for various foods

**CONTENTS:**

**Unit 1. Unit Operations and Processes (Singh and Heldman) (20 lectures)**

Introduction, Units and Dimensions, Heat Transfer-Conduction, Convection and Radiation, Mass transfer-Diffusion, membrane separation processes, Steam generation and Boilers, Evaporation, Drying and dehydration, Refrigeration, Freezing, Psychometrics and Fluid flow.

**Unit 2. Separation and Size Reduction Processes (9 lectures)**

Principles and equipments used in separation Extraction, sedimentation, filtration, centrifugation, Size reduction – Milling, grinding and mixing of foods

**Unit 3. Introduction to Food Packaging (Paine and Paine,Robertson) (10 lectures)**

Objectives and functions of food packaging, Requirements for effective food packaging, Types of packaging Materials, General properties of packaging materials

**Unit 4. Packaging of Foods (Paine and Paine) (9 lectures)**

Packaging of fresh produce and processed foods, Aseptic packaging, Advances in food packaging

**Recommended Readings:**

1. Paine FA and Paine HY, 1992 *A Handbook of Food Packaging*, Blackie Academic and Professional,
2. Rao CG. 2006, *Essentials of food process engineering*. B S publications
3. Rao DG, 2010, *Fundamentals of food engineering*. PHI learning private Ltd.
4. Robertson GL, 2012, *Food Packaging – Principles and Practice*, CRC Press Taylor and Francis Group
5. Singh RP and Heldman DR, 1993, 2003, 2009, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> Ed., *Introduction to food engineering*. Academic press.

### **Paper No. 5: (DCII) PRACTICALS IN FOOD ENGINEERING AND PACKAGING**

<b>Maximum Marks :</b>	<b>50</b>
<b>Credits :</b>	<b>4</b>
<b>Teaching Period :</b>	<b>4/week</b>
<b>Teaching Load :</b>	<b>48 Periods/ Semester</b>

#### **CONTENTS:**

1. Study the dehydration process
2. Study the freezing characteristics of foods
3. Study the process of evaporation
4. To design layout of a food plant
5. Determination of viscosity of foods
6. Identification of packaging materials
7. Testing of packaging materials
8. Demonstration of vacuum/gas packaging of foods

#### **Recommended Readings:**

1. Paine FA and Paine HY, 1992 *A Handbook of Food Packaging*, Blackie Academic Professional,
2. Rao CG. 2006, *Essentials of food process engineering*. B S publications
3. Rao DG, 2010, *Fundamentals of food engineering*. PHI learning private Ltd.
4. Robertson GL, 2012, *Food Packaging – Principles and Practice*, CRC Press Taylor and Francis Group



5. Singh RP and Heldman DR, 1993, 2003, 2009, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> Ed., Introduction to food engineering. Academic press.

## (DC II) TECHNOLOGY OF PLANT AND ANIMAL FOODS THEORY

<b>Paper No.</b>	<b>: 6</b>
<b>Maximum Marks</b>	<b>: 150</b>
<b>Credits</b>	<b>: 4</b>
<b>Teaching Period</b>	<b>: 4 Theory + 1 Students' Presentation/ Week</b>
<b>Teaching Load</b>	<b>: 48 Theory Periods +12 Students' Presentation/Semester</b>

### Objectives:

- To know the need and importance of meat, egg, dairy and fishery industry
- To know the compositional and technological aspects of meat, egg, milk and fish.
- To impart knowledge of different methods of fruits and vegetable processing
- To impart technical knowhow of Cereals, pulses and oilseeds processing
- To learn about processing of various spices, tea, coffee and cocoa

### UNIT 1. Technology of Fruits and Vegetables (14 lectures)

**Introduction** and importance of fruit and vegetable preservation, history and need of preservation. **Canning and bottling of fruits and vegetables:** Selection of fruits and vegetables, process of canning, containers of packing, spoilage in canned foods. **Fruits beverages:** Introduction, process and preservation of fruit juices. **Jams, jellies and marmalades:** Processing and technology, defects in jelly. **Pickles, chutneys and sauces:** Processing, types, causes of spoilage in pickling. **Tomato products:** Selection of tomatoes, processing of tomato juice, tomato puree, paste, ketchup, sauce and soup, Dehydration of Fruits and Vegetables. (Chapter 1, 2, 7, 9, 11, 13, 14, 16 – Girdharilal).

### UNIT 2. Technology of cereals, legumes and oilseeds: (7 lectures)

Wheat - Types, milling, flour grade. Rice – Variety, milling, parboiling. Corn – Variety, milling, Millets - milling. Pulses- Dry and wet milling, Oilseeds- Extraction of oil and refining. (Chapter 4–7, 15, 16 – Kent, Chapter 13 & 14 – Chakraborty.)

### UNIT 3. Spices & Plantation Products (3 lectures)

**Spices** - Processing and properties of important spices.  
**Tea and Coffee:** Processing (Chapter 12 & 20 – Manay)

**UNIT 4. Dairy and Fish Technology** (12 lectures)

**Dairy –**

FSSAI Definition of Milk, Types of Market Milk, Physico-chemical properties of milk, processing of Milk, Concept of Filtration, Clarification, Homogenization, Pasteurization, Introduction to various Milk Products: Butter, ghee, flavored milk, yoghurt, dahi, shrikhand, ice-cream, condensed milk, milk powder, channa, paneer, cheese (cheddar). (Chapter 1-11, Sukumar De)

**Fish –**

Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish, spoilage of fish- microbiological, physiological, biochemical, Methods of Fish Preservation- chilling, freezing, Drying, salting, smoking. (Chapter 25, Manay, Chapter 2, Hall)

**UNIT 5. Meat, Poultry and Egg Technology** (12 lectures)

**Meat and Poultry –**

Definition of carcass, composition of meat, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat, Concept of an abattoir, Process of slaughtering in an abattoir. (Chapter 23, Manay, Chapter 4,12 Shai Barbut)

**Egg –**

Structure and composition of hen's egg, egg proteins, characteristics of fresh egg, deterioration of egg quality. Preservation of eggs, Refrigeration and freezing, thermal processing, egg powder. (Chapter 3,4,11 and 14, Stadelman)

**Recommended Readings:**

1. Girdharilal, Siddappaa, G.S and Tandon, G.L., 1998, Preservation of fruits & Vegetables, ICAR, New Delhi
2. Kent.N.L, 2003 , Technology of Cereal, 5<sup>th</sup> Ed. Pergamon Press
3. Chakraborty., 1988, Post Harvest Technology of Cereals, Pulses and Oilseeds, revised ed., Oxford & IBH Publishing Co. Pvt Ltd
4. Marshall, 1994, Rice Science and Technology, Wadsworth Ed., Marcel Dekker, New York
5. H. Faride, 1997, The Science of Cookie and Cracker Production, CBS Publication, New Delhi
6. W B Crusess.2007,Commercial Unit and Vegetable Products, W.V. Special Indian Edition, Pub: Agrobios India
7. Manay, S. 2004, & Shadaksharaswami, M., Foods: Facts and Principles, New Age Publishers



8. Srilakshmi (2007). Food Science, 4th Edition. New Age International Ltd.
9. De Sukumar, . 2007, Outlines of Dairy Technology, Oxford University Press, Oxford.
10. Lawrie R A, 1998, Lawrie's Meat Science, 5<sup>th</sup> Ed, Woodhead Publisher, England
11. Shai Barbut, 2005., Poultry Products Processing, CRC Press
12. Stadelman WJ, Owen J Cotterill, 2002, Egg Science and Technology, 4<sup>th</sup> Ed. CBS Publication New Delhi
13. Hall GM, 1992, Fish Processing Technology, VCH Publishers Inc., NY

## **Paper No. 6: (DCII) PRACTICALS IN TECHNOLOGY OF PLANT AND ANIMAL FOODS**

<b>Maximum Marks :</b>	<b>50</b>
<b>Credits :</b>	<b>4</b>
<b>Teaching Period :</b>	<b>4/week</b>
<b>Teaching Load :</b>	<b>48 Periods/ Semester</b>

### **CONTENTS:**

- 1 Physical Characteristics of Wheat
- 2 Estimation of gluten content of flour
- 3 Estimation of degree Brix : Acid ratio
4. Estimation of percent Ascorbic acid
5. Platform tests in milk.(Acidity, COB, specific gravity)
6. Evaluation of eggs for quality parameters(market eggs, branded eggs)
7. Cut out examination of canned fish(Sardine, Mackerel, Tuna)/Meat.
- 8 To prepare casein and calculate its yield.

### **Recommended Readings:**

1. Girdharilal, Siddappaa, G.S and Tandon, G.L., 1998, Preservation of fruits & Vegetables, ICAR, New Delhi
2. Kent.N.L, 2003 , Technology of Cereal, 5<sup>th</sup> Ed. Pergamon Press
3. Chakraborty, 1988, Post Harvest Technology of Cereals, Pulses and Oilseeds, revised ed., Oxford & IBH Publishing Co. Pvt Ltd,
4. Marshall, 1994, Rice Science and Technology, Wadsworth Ed., Marcel Dekker, New York, 1994
5. H. Faride, 1997, The Science of Cookie and Cracker Production, CBS Publication, New Delhi, 1997



6. W B Crusess.2007,Commercial Unit and Vegetable Products, W.V. Special Indian Edition, Pub: Agrobios India
7. Manay, S. 2004, & Shadaksharaswami, M., Foods: Facts and Principles, New Age Publishers,
8. Srilakshmi (2007). *Food Science*, 4th Edition. New Age International Ltd.
9. De Sukumar, . 2007, Outlines of Dairy Technology, Oxford University Press, Oxford.
- 10.Lawrie R A, 1998,Lawrie's Meat Science, 5<sup>th</sup> Ed, Woodhead Publisher, England,
- 11.Shai Barbut, 2005.,Poultry Products Processing,CRC Press 2005.
- 12.Stadelman WJ, Owen J Cotterill, 2002, Egg Science and Technology, 4<sup>th</sup> Ed. CBS Publication New Delhi
- 13.Hall GM, 1992,Fish Processing Technology, VCH Publishers Inc., NY, 1992

## Foundation Courses

### Introduction:

The 11 Foundation Courses, being multi-disciplinary were entrusted to separate Empowered Committees, one for each course. Interdisciplinary and trans-disciplinary approaches were discussed by teachers from the departments and from colleges who were members in each committee. Several meetings were held for every course. It was agreed that Foundation Courses would be designed to strengthen the educational base of the students in relation to the grand challenges facing India. The curriculum would encourage appreciation and learning of academic tools that explore some of these problems and point towards some solutions. Through lectures, group projects and class presentations, it is expected that students will acquire both knowledge and ability in the areas being addressed. The Foundation Course curriculum takes up these issues implicitly:

- Economic Development, Rural, Urban & Linkages
- Energy, water
- Urbanization, Infrastructure, Transport, Sanitation
- Environment & Public Health
- Food security, Agriculture
- Education, Literacy
- Ethics, Society & Justice

The teaching methodology in the Foundation courses is participative and project based. Reading material is pertinent, engaging and of manageable length for students. Presentations in class are mandatory. Evaluation procedures are recommended to ensure continuous learning. In addition to the 11 Foundation Courses, 1 Applied course in Language (Arabic/Bengali/English/Hindi/Persian/Punjabi/Sanskrit/Urdu) will also be taught in the first year.

### Foundation Courses:

#### (a) Courses (First Year):

01. Language, Literature, and Creativity - I
02. Language, Literature, and Creativity - II (English)
03. Information Technology
04. Business, Entrepreneurship, and Management
05. Science and Life
05. History of Science (for Visually Impaired students)
06. Indian History and Culture
07. Building Mathematical Ability
07. Mathematical Awareness (for Visually Impaired students)

#### (b) Applied Language Course - (one course).

- Arabic
- Bengali
- English
- Hindi
- Persian
- Punjabi
- Sanskrit



- Urdu

(a) Courses (Second Year):

08. Governance and Citizenship

09. Philosophy, Psychology, Communication and Life Skills

10. Geographic and Socio-Economic Diversity

11. Environment and Public Health

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## Remodeling FYUP B.Tech. Food Technology into B.Tech. Food Technology

### Discipline- I

Paper No	Title of Paper	Marks
1.1	Principles of Food Science	150
1.2	Food and nutrition	150
<b>Semester II</b>		
2.1	Food processing technology	150
2.2	Technology of Fruits, Vegetables and Plantation Crops	150
<b>Semester III</b>		
3.1	Bakery and Confectionary Technology	150
3.2	Technology of Meat, Milk, Fish and Egg	150
3.3	Technology of Cereals, Pulses and Oilseeds	150
<b>Semester IV</b>		
4.1	Food Chemistry	150
4.2	Food Quality and Sensory Evaluation	150
4.3	Processing of Animal foods	150
<b>Semester V</b>		
5.1	Differential Equations	150
5.2	Advanced Food Chemistry	150
5.3	Food Microbiology	150
<b>Semester VI</b>		
6.1	Food Engineering	150
6.2	Food Safety and Regulations	150
6.3	Analytical Instrumentation	150
<b>Semester VII</b>		

## **Food Processing Equipment and Plant Design**

**Theory**

<b>Paper</b>	<b>:</b>	<b>7.4</b>
<b>Maximum Marks</b>	<b>:</b>	<b>100</b>
<b>Credits</b>	<b>:</b>	
<b>Teaching Period</b>	<b>:</b>	<b>4 theory + 1 student's presentation</b>

### **Objectives:**

- **To acquaint and equip the students with the design features of different food processing equipments used in the food industries**
- **To introduce the basic concept of process selection and food plant design management.**

**UNIT I:** Design operation in food equipments- definition and scope in industry. Design of machinery for sorting and grading, drying, freezing, size reduction, dry and wet separation, mixing, evaporation, condensation, membrane separation.

**UNIT II:** Plant design concepts and general design considerations: plant location, selection of materials of construction and standard components, design standards and testing standards. Human factors in design- Ergonomics, safety- OSHAS

**UNIT III:** Product and process design, process selection, process flow charts (bakery and dairy industry).

**UNIT IV:** Setting up a plant, estimation of capital investment, analysis of plant cost and profitability, General management techniques in plant operation, preparation of project report.

### **Practical in Food Processing Equipment and Plant Design**

<b>Maximum Marks</b>	<b>:</b>	<b>50</b>
<b>Credits</b>	<b>:</b>	
<b>Teaching Period</b>	<b>:</b>	<b>4/week</b>

### **Contents**

- 1) Design and drawing of mechanical dryers/ milling equipment/evaporators/ mixers/Fermenter/Freezer etc.
- 2) Each individual student will be asked to visit a food processing plant system and develop a plant design report which shall include product identification and selection, site

07.1	Food Quality Management	150
7.2	Food Packaging Technology	150
7.3	Industrial/research project	150
<b>Semester VIII</b>		
8.1	Food Plant Sanitation and Waste Management	150
8.2	Nutraceuticals and Functional Foods	150
8.3	Industrial/research project	150

The allied courses for third to eighth semester (one paper each) are as follows:

Paper No	Title of Paper	Marks
<b>Semester III</b>		
3.4	Conceptual Organic Chemistry	150
<b>Semester IV</b>		
4.4	Molecules of Life	150
<b>Semester V</b>		
5.4	Thermal Physics	150
<b>Semester VI</b>		
6.4	Probability and Statistical Methods	150
<b>Semester VII</b>		
7.4	Allied Engineering (to be decided)	150
<b>Semester VIII</b>		
8.4	Allied Engineering (to be decided)	150