# PROPOSED SYLLABUS

# B.Sc. (H) FOOD TECHNOLOGY
# Choice Based Credit System

# Submitted to UGC
# 2015

**PROPOSED SCHEME FOR CHOICE BASED CREDIT SYSTEM FOR B. SC. HONOURS IN FOOD TECHNOLOGY**

| Semester | CORE COURSE (14) | Ability Enhancement Compulsory Course (AECC) (2) | Skill Enhancement Course (SEC) (2) | Elective: Discipline Specific DSE (4) | Elective: Generic (GE) (4) |
|---|---|---|---|---|---|
| I | C1 –Fundamentals of Food Technology | (English Communication/ MI L)/ Environmental Science | | | GE * |
| | C2-Principles of Food Science | | | | |
| II | C3- Technology of Food Preservation | Environmental Science/(English/ MI L Communication) | | | GE * |
| | C4- Food Processing Technology | | | | |
| III | C5-Food and Nutrition | | SEC * | | GE * |
| | C6- Technology of Fruits, Vegetables and Plantation Crops | | | | |
| | C7-Technology of Dairy and Sea Food | | | | |
| IV | C8- Technology of Cereals, Pulses and Oilseeds | | SEC * | | GE * |
| | C9- Food Microbiology | | | | |
| | C10- Technology of Meat, Poultry and Egg | | | | |
| V | C11-Food Engineering | | | DSE * | |
| | C12- Food Chemistry-I | | | DSE * | |
| VI | C13-Food Chemistry-II | | | DSE * | |
| | C14-Food Quality and Sensory Evaluation | | | DSE * | |

***Any 4 DSE, 2 SEC AND 4 GE to be picked up by the student.**

## STRUCTURE OF B.SC HONOURS FOOD TECHNOLOGY UNDER CBCS

**CORE COURSE (14 Courses) Total Credits 84**

**CREDITS – 6 Each (4 Credits Theory + 2 Credits Practical = 6)**

C1 –Fundamentals of Food Technology: 4 Credits Theory + 2 Credits Practical

C2-Principles of Food Science: 4 Credits Theory + 2 Credits Practical

C3- Technology of Food Preservation: 4 Credits Theory + 2 Credits Practical

C4- Food Processing Technology: 4 Credits Theory + 2 Credits Practical

C5-Food and Nutrition: 4 Credits Theory + 2 Credits Practical

C6- Technology of Fruits, Vegetables and Plantation Crops: 4 Credits Theory + 2 Credits Practical

C7-Technology of Dairy and Sea Food: 4 Credits Theory + 2 Credits Practical

C8- Technology of Cereals, Pulses and Oilseeds: 4 Credits Theory + 2 Credits Practical

C9- Food Microbiology: 4 Credits Theory + 2 Credits Practical

C10- Technology of Meat, Poultry and Egg: 4 Credits Theory + 2 Credits Practical

C11-Food Engineering: 4 Credits Theory + 2 Credits Practical

C12-Food Chemistry-I: 4 Credits Theory + 2 Credits Practical

C13-Food Chemistry-II: 4 Credits Theory + 2 Credits Practical

C14-Food Quality and Sensory Evaluation: 4 Credits Theory + 2 Credits Practical

**DISCIPLINE SPECIFIC ELECTIVE (ANY FOUR) (4 x 6 = 24 Credits)**

**CREDITS – 6 Each (4 Credits Theory + 2 Credits Practical = 6)**

DSE-1 Food Safety: 4 Credits Theory + 2 Credits Practical

DSE-2 Food Quality Management: 4 Credits Theory + 2 Credits Practical

DSE-3 Bakery Technology: 4 Credits Theory + 2 Credits Practical

DSE-4 Food Packaging: 4 Credits Theory + 2 Credits Practical

DSE-5 Nutraceutical and Functional Foods: 4 Credits Theory + 2 Credits Practical

DSE-6 Food Plant Sanitation: 4 Credits Theory + 2 Credits Practical

**SKILL ENHANCEMENT ELECTIVE COURSE (ANY TWO) (2 x 2 = 4)**

**CREDITS – 2 Each (2 Credits Theory or Practical = 2)**

SEC-1 Entrepreneurship Development: 2 Credits Theory

SEC-2 Food Product Development: 2 Credits Practical

SEC-3 Food Fermentation Technology: 2 Credits Practical

SEC-4 Confectionary Technology: 2 Credits Practical

SEC 5 Project and Technical Report: 2 Credits Practical

**GENERIC ELECTIVE (ANY FOUR) (4 x 6 = 24)**

**CREDITS – 6 Each (4 Credits Theory + 2 Credits Practical = 6)**

GE 1. Food Processing and Preservation: 4 Credits Theory + 2 Credits Practical

GE 2. Chemistry of Food: 4 Credits Theory + 2 Credits Practical

GE 3. Sensory Evaluation of Food: 4 Credits Theory + 2 Credits Practical

GE 4. Food Microbiology and Food Safety: 4 Credits Theory + 2 Credits Practical

GE 5. Food Engineering and Packaging: 4 Credits Theory + 2 Credits Practical

GE 6. Technology of Plant and Animal Foods: 4 Credits Theory + 2 Credits Practical

B. Sc. (H) FOOD TECHNOLOGY – SCHEME OF EXAMINATION

| Semester | Course Opted | Course Name | Credits |
|---|---|---|---|
| I | Ability Enhancement Compulsory Course - I | English Communications/ Environmental Science | 2 |
| | C-1 Theory | Fundamentals of Food Technology | 4 |
| | C-1 Practical | Fundamentals of Food Technology Practical | 2 |
| | C-2 Theory | Principles of Food Science | 4 |
| | C-2 Practical | Principles of Food Science Practical | 2 |
| | GE -1 Theory | GE -1 | 4 |
| | GE -1 Practical | GE -1 Practical | 2 |
| II | Ability Enhancement Compulsory Course - II | English Communications/ Environmental Science | 2 |
| | C-3 Theory | Technology of Food Preservation | 4 |
| | C-3 Practical | Technology of Food Preservation Practical | 2 |
| | C-4 Theory | Food Processing Technology | 4 |
| | C-4 Practical | Food Processing Technology Practical | 2 |
| | GE -2 Theory | GE -2 Theory | 4 |
| | GE – 2 Practical | GE – 2 Practical | 2 |
| III | C-5 Theory | Food and Nutrition | 4 |
| | C-5 Practical | Food and Nutrition Practical | 2 |
| | C-6 Theory | Technology of Fruits, Vegetables and Plantation Crops | 4 |
| | C-6 Practical | Technology of Fruits, Vegetables and Plantation Crops Practical | 2 |
| | C-7 Theory | Technology of Dairy and Sea Food | 4 |
| | C-7 Practical | Technology of Dairy and Sea Food Practical | 2 |
| | SEC-1 | SEC-1 | 2 |
| | GE -3 Theory | GE -3 Theory | 4 |
| | GE – 3 Practical | GE – 3 Practical | 2 |
| IV | C-8 Theory | Technology of Cereals, Pulses and Oilseeds | 4 |
| | C-8 Practical | Technology of Cereals, Pulses and Oilseeds Practical | 2 |
| | C-9 Theory | Food Microbiology | 4 |
| | C-9 Practical | Food Microbiology Practical | 2 |

| | | | |
|---|---|---|---|
| | C-10 Theory | Technology of Meat, Poultry and Egg | 4 |
| | C-10 Practical | Technology of Meat, Poultry and Egg Practical | 2 |
| | SEC-2 | SEC-2 | 2 |
| | GE -4 Theory | GE -4 Theory | 4 |
| | GE – 4 Practical | GE – 4 Practical | 2 |
| V | C-11 Theory | Food Engineering | 4 |
| | C-11 Practical | Food Engineering Practical | 2 |
| | C-12 Theory | Food Chemistry-I | 4 |
| | C-12 Practical | Food Chemistry-I Practical | 2 |
| | DSE -1 Theory | DSE -1 Theory | 4 |
| | DSE -1 Practical | DSE -1 Practical | 2 |
| | DSE -2 Theory | DSE -2 Theory | 4 |
| | DSE -2 Practical | DSE -2 Practical | 2 |
| VI | C-13 Theory | Food Chemistry-II | 4 |
| | C-13 Practical | Food Chemistry-II Practical | 2 |
| | C-14 Theory | Food Quality and Sensory Evaluation | 4 |
| | C-14 Practical | Food Quality and Sensory Evaluation Practical | 2 |
| | DSE -3 Theory | DSE -3 Theory | 4 |
| | DSE -3 Practical | DSE -3 Practical | 2 |
| | DSE -4 Theory | DSE -4 Theory | 4 |
| | DSE -4 Practical | DSE -4 Practical | 2 |
| | | **Total** | **140** |

Total Credits: 84 Core + 24 DSE + 4 SEC + 4 AECC + 24 GE = 140

# PREAMBLE

The course in Choice Based Credit System would be of 3 year duration having 6 semesters, divided into 14 Core papers, 4 Discipline Specific Elective courses, 2 Skill Enhancement Elective Courses and 4 Generic Elective Courses. Each Year would consist of 2 semesters. The new course has been prepared keeping in view, the unique requirements of B.Sc. (H) Food Technology students. The objectives of the course are-

- To impart knowledge of various areas related to Food Science and Technology,
- To enable the students to understand food composition and its physico-chemical, 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.

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. For the Generic elective(GE) to be chosen by Food Technology students, It is recommended that subjects like Biochemistry, Biology, Chemistry, Maths & statistics, Biostatistics, Physics be chosen as they are synergistic to the curriculum. However, students are free to pick up any of the Generic Elective Courses offered by other departments.

- For each paper, the objectives have been listed and the contents divided into units.
- The detailed syllabus for each paper is appended with the list of suggested readings.
- Teaching time allotted for each paper shall be 4 periods for each theory paper and 4 periods for each practical class per week for each paper per week .Each practical batch should ideally be between 15-20 students so that each student receives individual attention.

# CORE COURSES

## Core Course 1: FUNDAMENTALS OF FOOD TECHNOLOGY (CREDITS: THEORY – 4 PRACTICAL - 2)

### THEORY

**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** **(4 lectures)**

- Historical evolution of food processing technology.

**UNIT 2 Compositional, Nutritional and Technological aspects of Plant foods**

**I. Cereals and Millets**

**(10 lectures)**

- Structure and composition of cereals
- Wheat- structure and composition, types (hard, soft/ strong, weak) Diagrammatic representation of longitudinal structure of wheat grain.
- Malting, gelatinization of starch, types of browning- Maillard & caramelization.
- Rice- structure and composition, parboiling of rice- advantages and disadvantages.

**I. Pulses**

**(6 lectures)**

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

**II. Fats and Oils**

**(6 lectures)**

- Classification of lipids, types of fatty acids - saturated fatty acids, unsaturated fatty acids, essential fatty acids, trans fatty acids**.**
- Refining of oils, types- steam refining, alkali refining, bleaching, steam deodorization, hydrogenation**.**
- Rancidity –Types- hydrolytic and oxidative rancidity and its prevention.

**IV. Fruits and Vegetables (8 lectures)**

- Classification of fruits and vegetables, general composition, enzymatic browning, names and sources of pigments, Dietary fibre.

  Post harvest changes in fruits and vegetables – Climacteric rise, horticultural maturity, physiological maturity, physiological changes, physical changes, chemical changes, pathological changes during the storage of fruits and vegetables.

**UNIT 3 Compositional, Nutritional and Technological aspects of Animal foods**

**I. Flesh Foods - Meat, Fish, Poultry**

**(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), aquaculture , composition of fish, characteristics of fresh fish, spoilage of fish- microbiological, physiological, biochemical.
- Poultry - Structure of hen's egg, composition and nutritive value, egg proteins, characteristics of fresh egg, deterioration of egg quality, difference between broiler and layers.

**II. Milk and Milk Products (6 lectures)**

- Definition of milk, chemical composition of milk, its constituents, processing of milk, pasteurization, homogenization. An overview of types of market milk and milk products.

**FUNDAMENTALS OF FOOD TECHNOLOGY**

**PRACTICAL**

1. Study different types of browning reactions: enzymatic and non enzymatic.
2. To study gelatinization behavior of various starches
3. To study the concept of gluten formation of various flours.
4. To study malting and germination.
5. To study dextrinization in foods.
6. Identification of pigments in fruits and vegetables and influence of pH on them.
7. Quality inspection of animal foods.

**Recommended Readings**

1. Bawa. A.S, O.P Chauhan etal. Food Science. New India Publishing agency, 2013
2. Roday,S. Food Science, Oxford publication, 2011.
3. B. Srilakshmi, Food science, New Age Publishers,2002
4. Meyer, Food Chemistry, New Age,2004
5. De Sukumar., Outlines of Dairy Technology, Oxford University Press, 2007

## Core Course 2 : PRINCIPLES OF FOOD SCIENCE
## (CREDITS: THEORY – 4 PRACTICAL - 2)

### THEORY

**Objectives:**

To impart basic knowledge of:

- Food Dispersions
- Sensory science
- Food Science
- Food Sanitation
- Packaging Materials

### CONTENTS

**UNIT 1 Food dispersions**

**(10 lectures)**

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

**(Ch 11 Manay, Ch 3 Meyer and Ch 2 Deman)**

**UNIT 2 Sensory evaluation of food (5 lectures)**

- Objectives, type of food panels, characteristics of panel member, layout of sensory evaluation laboratory, sensitivity tests, threshold value, paired comparison test, duo-trio test, triangle test, hedonic scale, chemical dimension of basic tastes, Amoore's classification of odorous compounds. Sherman and Sczezniak classification of food texture.

**(Ch 19 Ranganna and Ch 7, 8 Deman)**

**UNIT 3 Growth of microorganisms in foods (4 lectures)**

- Food as a substrate for microorganism, factors affecting growth of microbes : pH, water activity, O-R potential, nutrient contents, inhibitory substance and biological structure**.**

**(Ch 1, Frazier)**

**UNIT 4 Hurdle technology (5 lectures)**

- Principles and applications, Hurdle effect in fermented foods, shelf stable products, intermediate moisture foods, application of hurdle technology.

**UNIT 5 Minimal processing (5 lectures)**

- Minimal processing of foods with thermal methods and non thermal methods-safety criteria in minimally processed foods-Minimal processing in practice-fruits and vegetables-seafood-effect on quality-Future developments

**(Ch 3, Ramaswamy)**

**UNIT 6 Ohmic heating and High Pressure processing (5 lectures)**

- Principles, equipment and processing, effect on food.

**(Ch 11 Potter and Ch 3 Ramaswamy)**

**UNIT 7 Water disposal and sanitation (5 lectures)**

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

**(Ch 22 Potter, Ch 1 De)**

**UNIT 8 Packaging (9 lectures)**

- Objectives of packaging, flexible packaging, properties of the following packaging materials-low density polyethylene, high density polyethylene, polypropylene ,polyvinyl chloride, polyvinylidene chloride, ethylene vinyl alcohol, polystyrene, polyethylene terepthalate, nylon, ethylene vinyl acetate, ethylene acrylic acid, ethylene methacrylic acid, ionomers.

**(Ch 21 Potter, Ch 4 Jenkins and Ch 7 Coles)**

## PRINCIPLES OF FOOD SCIENCE

**PRACTICAL**

1. Estimation of reducing sugar by Fehlings procedure
2. Estimation of salt content in brine
3. Estimation of salt content in butter
4. Preparation of brix solution and checking by hand refractometer
5. Application of collioidal chemistry to food preparation
6. Demonstration of the Soxhlet method for determination of fat content
7. Determination of acidity of water
8. Determination of alkalinity/ hardness of water
9. Demonstration of the Kjeldahl's method for estimation of protein content

**Recommended Readings**


1. Coles R, McDowell D and Kirwan MJ, Food Packaging Technology, CRC Press, 2003
2. De S, Outlines of Dairy Technology, Oxford Publishers, 1980
3. Deman JM, Principles of Food Chemistry, 2nd ed. Van Nostrand Reinhold, NY 1990
4. Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi, 2004
5. Jenkins WA and Harrington JP, Packaging Foods with Plastics, Technomic Publishing Company Inc., USA, 1991
6. Manay NS and Shadaksharaswamy M, Food-Facts and Principles, New Age International (P) Ltd. Publishers, New Delhi, 1987
7. Meyer LH, Food Chemistry, CBS Publication, New Delhi, 1987
8. Potter NH, Food Science, CBS Publication, New Delhi, 1998
9. Ramaswamy H and Marcott M,Food Processing Principles and Applications CRC Press, 2006
10. Ranganna S, Handbook of Analysis and Quality Control for Fruits and Vegetable Products, 2nd ed. TMH Education Pvt. Ltd, 1986


## Core Course 3 : TECHNOLOGY OF FOOD PRESERVATION
## (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**Objectives:**

- To study the importance microorganisms in food preservation
- To introduce the basics of various food processing and preservation technologies.

**CONTENTS**

**Unit 1 Food Microbiology (10 lectures)**

Principles of Food Preservation, microorganisms associated with foods- bacteria, yeast and mold, Importance of bacteria, yeast and molds in foods. Classification of microorganisms based on temperature, pH, water activity, nutrient and oxygen requirements, typical growth curve of micro-organisms. Classification of food based on pH, Food infection, food intoxication, definition of shelf life, perishable foods, semi perishable foods, shelf stable foods.

**Unit II Food Preservation by Low temperature (10 lectures)**

**Freezing and Refrigeration :**Introduction to refrigeration, cool storage and freezing, definition, principle of freezing, freezing curve, changes occurring during freezing, types of freezing i.e. slow freezing, quick freezing, introduction to thawing, changes during thawing and its effect on food.

**Unit III Food Preservation by high temperature (8 lectures)**

**Thermal Processing-** Commercial heat preservation methods: Sterilization, commercial sterilization, Pasteurization, and blanching.

**Unit IV Food Preservation by Moisture control**

**Drying and Dehydration -** Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), heat and mass transfer, factors affecting rate of drying, normal drying curve, names of types of driers used in the food industry.

**(9 lectures)**

**Evaporation –** Definition, factors affecting evaporation, names of evaporators used in food industry. **(4 lectures)**

**Unit V Food Preservation by Irradiation**

Introduction, units of radiation, kinds of ionizing radiations used in food irradiation, mechanism of action, uses of radiation processing in food industry, concept of cold sterilization. **(7 lectures)**

## TECHNOLOGY OF FOOD PRESERVATION

**PRACTICAL**

1. Methods of Sampling.
2. Concept of shelf life of different foods
3. To study the concept of Asepsis and sterilization
4. Determination of pH of different foods using pH meter.
5. Study quality characteristics of foods preserved by drying/dehydration/ freezing.
6. To perform pasteurization of fluids using different methods.
7. To perform blanching of different plant foods.

**Recommended Readings**


1. B. Srilakshmi, Food science, New Age Publishers,2002
2. Meyer, Food Chemistry, New Age,2004
3. Bawa. A.S, O.P Chauhan etal. Food Science. New India Publishing agency, 2013
4. Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi, 2004


## Core Course 4: FOOD PROCESSING TECHNOLOGY
## (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**Objectives:**

To impart basic knowledge of:

1. Cold Preservation and freezers
2. Dehydration
3. Irradiation
4. Food Packaging
5. Thermal Processing

**FOOD PROCESSING OPERATIONS**:

**UNIT 1 Cold preservation (4 lectures)**

- Freezing: 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 influences

**(Ch 9, Potter)**

**UNIT 2 Freezing- Mechanism and freezers (6 lectures)**

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

**(Ch 9, Potter)**

**UNIT 3 Dehydration (10 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, spray dryer, drum dryer, vacuum dryer ,freeze drying ,foam mat drying**.**

**(Ch 10, Potter)**

**UNIT 4 Food Irradiation and Microwave Heating (7 lectures)**

- Ionizing radiation and sources, unit of radiations, direct and indirect radiation effects, safety and wholesomeness of irradiated food. Microwave heating and application**.**

**(Ch 11, Potter)**

**UNIT 5 Packaging of foods (8 lectures)**

- Packaging: Properties of packaging material, factors determining the packaging requirements of various foods and brief description of packaging of frozen products, dried products, fats and oils and thermally processed foods

**(Ch 1, 9-12, Paine and Paine)**

**UNIT 6 Material handling (3 lectures)**

- Elementary concept of material handling in food industry, equipment and functioning of belt conveyor, screw conveyor, bucket elevator and pneumatic conveyor.

**(Ch 26, Rao)**

**UNIT 7 Thermal processing (5 lectures)**

- Introduction, classification of Thermal Processes, Principles of thermal processing, Thermal resistance of microorganisms, Thermal Death Time, Lethality concept, characterization of heat penetration data, Thermal process Calculations

**(Ch 3, Ramaswamy)**

**UNIT 8 Separation processes (5 lectures)**

- Principles and methods of: distillation, extraction, washing, filtration, sedimentation, sieving and centrifugation

**(Ch 13, 14 Toledo)**

**FOOD PROCESSING TECHNOLOGY**

**PRACTICAL**

1. Comparison of conventional and microwave processing of food
2. Preservation of food by the process of freezing
3. Drying of food using Tray dryer/other dryers
4. Preservation of food by canning(Fruit/Vegetable/meat)

5. Cut-out analysis of canned food
6. Osmotic dehydration
7. Minimal Processing
8. Testing of Packaging material

**Recommended Readings**


1. Desrosier NW and Desrosier JN, The Technology of Food Preservation, CBS Publication, New Delhi, 1998
2. Paine FA and Paine HY, Handbook of Food Packaging, Thomson Press India Pvt Ltd, New Delhi- 1992
3. Potter NH, Food Science, CBS Publication, New Delhi, 1998
4. Ramaswamy H and Marcott M, Food Processing Principles and Applications CRC Press, 2006
5. Rao PG, Fundamentals of Food Engineering, PHI Learning Pvt Ltd, New Delhi, 2010
6. Toledo Romeo T, Fundamentals of Food Process Engineering, Aspen Publishers, 1999


## Core Course 5 : FOOD AND NUTRITION
## (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**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.

**CONTENTS**

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

Basic terms used in study of food and nutrition, BMI and Nutritional Status, Understanding relationship between food, nutrition and health.

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

Functions of food-physiological, psychological and social, Concept of Balanced Diet, Food Groups, Food Pyramid.

**UNIT III: NUTRIENTS** (**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 B12 and vitamin C
- Minerals – calcium, iron, iodine, fluorine, copper and zinc

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

Factors affecting meal planning, understanding specific considerations for planning meal for different groups of people.

**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.

**UNIT VI: NUTRITIONAL LABELING (2 lectures)**

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

**Recommended Readings**


1. Bamji MS, Krishnaswamy K, Brahmam GNV (2009). Textbook of Human Nutrition, 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.
2. Srilakshmi (2007). Food Science, 4th Edition. New Age International Ltd.
3. Srilakshmi,(2005), Dietetics, Revised 5th 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.


**FOOD AND NUTRITION**

**PRACTICAL**

**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 meals for adults of different activity levels for various income groups.
5. Planning of nutritious snacks for different age and income groups.
6. Preperation of nutritious snacks using various methods of cooking.
7. Nutritional labeling of food products.
8. Estimation of BMI and other nutritional status parameters.

**RECOMMENDED READINGS**


1. Bamji MS, Krishnaswamy K, Brahmam GNV (2009). Textbook of Human Nutrition, 3rd 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.


## Core Course 6 : TECHNOLOGY OF FRUITS, VEGETABLES AND PLANTATION CROPS
## (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**Objectives**

1. To impart knowledge of different methods of fruits and vegetable processing.
2. 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:** 13

**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) .**

**TECHNOLOGY OF FRUITS, VEGETABLES AND PLANTATION CROPS**

**PRACTICAL**

**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. 3rd Ed. International Book Distributing Co.

## Core Course 7 : TECHNOLOGY OF DAIRY AND SEA FOOD (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**Objectives**

- To know the need and importance of dairy and fishery industry
- To know the compositional and technological aspects of milk and fish.
- To study processed milk and fish products.

**CONTENTS**

**UNIT I Introduction** **(2 Lectures)**

Status of fishery industry in India.

**UNIT 2 Chilling and Freezing of fish** **(3 Lectures)**

Relationship between chilling and storage life, MAP, general aspects of freezing, freezing systems (air blast freezing, plate or contact freezing spray or immersion freezing, freezing on board, onshore processing, changes in quality in chilled and frozen storage, thawing.

**UNIT 3 Fish Curing and Smoking (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, examples of smoked and dried products.

**UNIT 4 Canning of fish (4 lectures)**

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).

**UNIT 5 Fishery by-products (6 lectures)**

Surimi- Introduction, fish muscle proteins, the surimi process, traditional and modern surimi production lines, quality of surimi products, comparision of surimi and fish mince products**.(Ch- 3 Hall)**

Fish protein concentrates (FPC), fish protein extracts (FPE), fish protein hydrolysis (FPH)

**UNIT 6 Fermented fish (2 Lectures)**

Flowchart of Indigenous products- Fish sauce and Paste

**UNIT 7 Concept of other Sea foods (2 lectures)**

Crabs, lobsters, prawns, shrimps, shell- fish.

**TECHNOLOGY OF MILK AND MILK PRODUCTS**

**UNIT 8 Physical properties of milk (2 Lectures)**

Color, taste, pH and buffering capacity, refractive index, viscosity, surface tension, freezing, boiling point, specific heat, OR, electrical conductivity.

**(Chapter 1 of Outlines of dairy technology by Sukumar De**)

**UNIT 9 Lactose (1 Lecture)**

Lactose (alpha and beta forms and their differences)

Significances of lactose in dairy industry.

(Chapter 6 of Fundamentals of dairy chemistry by Webb & Johnson)

**UNIT 10 Milk fat** **(5 Lectures)**

Composition and structure, factors affecting melting point, boiling point, solubility and Refractive Index, fat constants (saponification value, iodine value, RM value, Polenske value, peroxide value).

Chemical reactions of fat (hydrolysis, auto-oxidation), condition favouring auto-oxidation, prevention, measurement of auto-oxidation.

(Chapter 4 of Fundamentals of dairy chemistry by Webb & Johnson)

**UNIT 11 Protein and Enzymes** **(5 Lectures)**

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 of Fundamentals of dairy chemistry by Webb & Johnson)

**UNIT 12 Market milk industry and milk products** **(5 Lectures)**

Systems of collection of milk

Reception, Platform testing

Various stages of processing

- Filtration, Clarification
- Homogenization
- Pasteurization

Description and working of clarifier, cream separator, homogenizer and plate heat exchanger.

Flow diagram of following milk products – **( 6 Lectures)**

Butter, ghee, flavored milk, yoghurt, dahi, shrikhand, ice-cream, condensed milk, milk powder, channa, paneer, cheese (cheddar).

**(Chapter 1-11** of Outlines of dairy technology by Sukumar De)

## TECHNOLOGY OF DAIRY AND SEAFOOD

**PRACTICAL**

**CONTENT**

1 To perform platform tests in milk.(Acidity,COB,MBRT,specific gravity,SNF)
2 To estimate milk protein by Folin method.
3 To estimate milk fat by Gerber method.
4 Preparation of flavoured milk/. Pasteurization of milk
5 To prepare casein and calculate its yield.
6 Quality evaluation of fish/prawn.

7 Subjective evaluation of Fresh Fish.
8 Cut out examination of canned fish.(Sardine,Mackerel,Tuna)
9 Fish product formulation/canning.

**Recommended Readings**


1. De Sukumar, Outlines of Dairy Technology, Oxford University Press, Oxford. 2007.
2. Hall GM, Fish Processing Technology, VCH Publishers Inc., NY, 1992
3. Sen DP, Advances in Fish Processing Technology, Allied Publishers Pvt.Limited 2005
4. Shahidi F and Botta JR, Seafoods: Chemistry, Processing, Technology and Quality, Blackie Academic & Professional,London,1994
5. Webb and Johnson, Fundamentals of Dairy Chemistry, 3rd ed., CBS Publishers, New Delhi 1988


## Core Course 8 : TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**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

## TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS PRACTICAL

**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. 2003. Technology of Cereal, 5th 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 Priniciples.Wiley Eastern Limited.


## Core Course 9: FOOD MICROBIOLOGY
## (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**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** (3 Lectures)( Chapter 1 , Garbutt, Chapter 1 , Pelczar et.al)

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

**UNIT 2. Characteristics of Microorganisms in Food** (5 Lectures) (Chapter 1, Jay )

- Types of microorganisms associated with food,their morphology and structure
- Significance of spores in food microbiology

**UNIT3. Microbial Growth in Food** (4 Lectures) ( Chapter 4and 6,Garbutt)

- Bacterial growth curve and microbial growth in food
- Factors affecting the growth of micro organisms in food

**UNIT4. Microbial Food Spoilage** (8 Lectures) ( Part 3, Frazier and Westhoff, Chapter 8, Garbutt)

- Sources of Microorganisms in foods
- Some important food spoilage microorganisms
- Spoilage of specific food groups- Milk and dairy products, Meat,poultry and seafoods,Cereal and cereal products, Fruits and vegetables and Canned products

**UNIT5. Food Fermentations (8 Lectures)** ( Part 4, Frazier and Westhoff, Chapter 10, Garbutt)

- Fermentation –definition and types
- Microorganisms used in food fermentations
- Dairy Fermentations-starter cultures and their types , concept of probiotics, Fermentated Foods-types,methods of manufacture for vinegar, sauerkraut, tempeh, miso , soya sauce ,beer,wine and traditional indian foods

**UNIT6. Foodborne Diseases (3 Lectures)** (Chapter 9 , Garbutt)

- Types – foodborne infections, foodborne intoxications and toxiinfections
- Common and Recent Examples

**UNIT7. Cultivation of Micro-organisms** (6 Lectures)(Chapter 5, Garbutt)

- Pure culture technique
- Methods of isolation and cultivation
- Enumeration of Microorganisms- qualitative and quantitative

**UNIT8. Control of Microorganisms in Foods** ( 8 Lectures) (Part 2, Frazier)

- Principles and methods of preservation
- Physical Methods of Food Preservation- Dehydration, Freezing, Cool Storage, Heat Treatment (esp.thermobacteriology), Irradiation,
- Biopreservatives esp. Bacteriocins
- Introduction to Hurdle concept and Non Thermal methods

**UNIT9. Trends in Food Microbiology (3 Lectures) (Chapter 11, Garbutt)**

- Rapid Methods of Detection
- Recent Advances

## FOOD MICROBIOLOGY

**PRACTICAL**

**CONTENTS**

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

**Recommended Readings**

1) Frazier William C and Westhoff, Dennis C. Food Microbiology, TMH, New Delhi, 2004

2) Jay, James M. Modern Food Microbiology, CBS Publication, New Delhi, 2000

3) Garbutt, John. Essentials of Food Microbiology, Arnold, London, 1997

4) Pelczar MJ, Chan E.C.S and Krieg, Noel R. Microbiology, 5th Ed., TMH, New Delhi, 1993

## Core Course 10 : TECHNOLOGY OF MEAT, POULTRY AND EGG

**(CREDITS: THEORY – 4 PRACTICAL - 2)**

**THEORY**

Objectives:

- To understand need and importance of livestock, egg and poultry industry
- To study structure, composition and nutritional quality of animal products.
- To study processing and preservation of animal foods.
- To understand technology behind preparation of various animal food products and by-product utilization.

**CONTENTS**

**UNIT 1 Introduction** (2 lectures)

Livestock and poultry population in India, Development of meat and poultry industry in India and its need in nation's economy, Glossary of live market terms for animals and birds. (Misc. Internet)

**UNIT 2 Meat quality** (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 Chapter 13,14 Shai Barbut

**UNIT 3 Slaughter process** (8 lectures)

Slaughter, inspection and grading, Antemortem examination of meat animals, slaughter of buffalo, sheep/ goat, poultry,pig A GenericHACCP model, dressing of carcasses, post-mortem examination of meat Chapter 4,12 Shai Barbut

**UNIT 4 Preservation of meat** (10 lectures)

Refrigeration and freezing, thermal processing- canning of meat, retort pouch, dehydration, irradiation, and RTE meat products, meat curing. Sausages-processing, types and defects

**UNIT 5 By-products** (3 lectures)

Importance, classification and uses, Manufacture of Natural casings

**UNIT 6 Egg Industry and Egg Production Practices** (12 lectures)

The egg industry, its techniques of working, General management, structure, composition and nutritive value of egg and its products.

**UNIT 7 Preservation of eggs** (6 lectures)
Refrigeration and freezing, thermal processing, dehydration, coating. Chapter 11 and 14, Stadelman

**UNIT 8 Quality identification of shell eggs** (3 lectures)
Factors affecting egg quality and measures of egg quality.

## TECHNOLOGY OF MEAT, POULTRY AND EGG

**PRACTICAL**

**CONTENTS**

1) Estimation of moisture content of meat
2) Cutout analysis of canned meats/retort pouches
3) Estimation of protein content of meat
4) Analysis of frozen meat/meat emulsion products
5) To study shelf-life of eggs by different methods of preservation
6) Evaluation of eggs for quality parameters(market eggs,branded eggs)
7) To perform freezing of yolk/albumen
8) Meat/Egg product formulation

**Recommended Readings**


1) Lawrie R A, Lawrie's Meat Science, 5th Ed, Woodhead Publisher, England, 1998
2) Parkhurst & Mountney, Poultry Meat and Egg Production, CBS Publication, New Delhi, 1997
3) Pearson & Gillet Processed Meats,3 Ed, CBS Publication, New Delhi, 1997
4) Shai Barbut,Poultry Products Processing,CRC Press 2005
5) Stadelman WJ, Owen J Cotterill Egg Science and Technology, 4th Ed. CBS Publication New Delhi, 2002


## Core Course 11 : FOOD ENGINEERING
## (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**Objectives:**

1) To understand the principle of Unit operation
2) To acquaint with fundamentals of food engineering and its process
3) To understand the basics of designing of food plant and systems

**CONTENTS**

**UNIT 1- Introduction** (Singh and Heldman 2003) (2 Lectures)

- Concept of Unit operation,
- Units and dimensions, Unit conversions, dimensional analysis
- Mass and Energy Balance.
- Related numericals

**UNIT 2- Design of food plant** (Rao 2010) (2 Lectures)

- Important considerations for designing of food plants
- Types of layout

**UNIT 3 – Grinding and mixing** (Fellow 1988) (2 Lectures)

- Principle and equipments used in food industry

**UNIT 4 - Fluid Flow in food Processing** (Singh and Heldman 1993) (8 Lectures)

- 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
- Concept of Flow Measurement devices
- Related basic numericals

**UNIT 5 – Refrigeration and Freezing** (Singh and Heldman 2003) (8 Lectures)

- 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 and R-717, superheating and sub cooling
- Freezing time calculation using Plank's Equation
- Frozen food storage

- Related basic numericals

**UNIT 6 – Heat and Mass Transfer** (Singh and Heldman 2003) (12 Lectures)

- Systems for heating and cooling food products
- Thermal Properties of Food
- Modes of heat transfer
- Application of steady state heat transfer- estimation of conductive heat transfer
- cofficient, convective heat transfer coefficient, overall heat transfer coefficient
- and,design of tubular heat exchanger. Related basic numericals
- 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.

**UNIT 7 - Psychrometrics** (Singh and Heldman 2003) (4 Lectures)

- Properties of Dry Air
- Properties of Water Vapour
- Properties of air Vapour mixture
- Psychrometric Chart
- Related basic numericals

**UNIT 8- Steam, Evaporation and Dehydration** (Singh and Heldman 1993, Rao 2006) (10 Lectures)

- 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 systems
- Dehydration system Design.
- Related basic numericals

## FOOD ENGINEERING

**PRACTICAL**

**CONTENTS**

1. Plant layout design
2. Determination of drying characteristics
3. Determination of viscosity of Newtonian and non Newtonian fluids
4. Study of effect of temperature on viscosity
5. Screen analysis of food sample
6. Study of evaporation process
7. Freezing time calculation
8. Psychrometrics- use and application.

**Recommended Readings**

1) Rao DG. 2010. Fundamentals of food engineering. PHI learning private ltd.

2) Singh RP and Heldman DR.1993, 2003, 2009. Introduction to food engineering. Academic press 2nd, 3rd and 4th edition.

3) Rao C G 2006 Essentials of food process engineering. B S publications

4) Fellow P. 1988 Food processing technology

## Core Course 12 : FOOD CHEMISTRY – I
## (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**Objectives:**

- To understand the chemistry of foods - composition of food, role of each component and their interaction.
- To understand the functional aspects of food components and to study their role in food processing.

**CONTENTS**

**UNIT 1. Introduction to Food Chemistry** (1 Lecture)Chapter-1-3,Potter

- Definition
- Composition of food

**UNIT 2. Water** (8 Lectures) Chapter-1, DeMan

- Definition of water in food
- Structure of water and ice
- Types of water
- Sorption phenomenon

- Water activity and packaging
- Water activity and shelf-life

**UNIT 3. Lipids** (9 Lectures) Chapter-2, DeMan

- 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.
- 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, Fat Mimetics

**UNIT 4. Proteins** (10 Lectures)

Chapter-3,DeMan

- Protein classification and structure
- Nature of food proteins(plant and animal proteins)
- Properties of proteins (electrophoresis, sedimentation, amphoterism and
- denaturation,)
- Functional properties of proteins eg. organoleptic, solubility, viscosity ,binding gelation / texturization , emulsification , foaming.

**UNIT5. Carbohydrates** (9 Lectures)

Chapter-4, DeMan

- Classification(mono, oligo and poly saccharides)
- Structure of important polysaccharides( starch, glycogen, cellulose, pectin,
- hemicellulose, gums)
- Chemical reactions of carbohydrates –oxidation, reduction , with acid & alkaki
- Modified celluloses and starches

**UNIT 6. Vitamins** (7 Lectures)

Chapter-9, DeMan

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

**UNIT 7.Flavour** (6 Lectures)

Chapter-7, DeMan

- Definition and basic tastes
- Chemical structure and taste

- Description of food flavours
- Flavour enhancers

## FOOD CHEMISTRY – I

**PRACTICAL**

**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 smoke point and percent fat absorption for different fat and oils.
6. Determination of percent free fatty acids
7. Estimation of saponification value
8. Estimation of reducing and non-reducing sugars using potassium ferricyanide method.

**Recommended Readings:**


1. Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York, 1996
2. Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002
3. Wong, Dominic WS, Food Enzymes, Chapman and Hall, New York, 1995
4. Potter,N.N.and Hotchkiss,J.H, Food Science, 5th Ed., Chapman & Hall,1995
5. DeMan, J.M., Principles of Food Chemistry, AVI, NewYork, 1980


## Core Course 13 : FOOD CHEMISTRY – II
## (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**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.
- To understand the concept of new product development.

**CONTENTS**

**UNIT 1 Minerals** (4 Lectures) (Chap. 5, deMan)

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

**UNIT 2 Natural Food Pigments** (8 Lectures)
- Introduction and classification
- Food pigments(chlorophyll, carotenoids, anthocyanins and flavonoids, beet pigments, caramel)

**UNIT 3 Browning Reactions In Food (8 Lectures) (Chap.9,Fennema)**
- Enzymatic browning
- Non – Enzymatic browning
- Maillard reaction
- Caramelization reaction
- Ascorbic acid oxidation

**UNIT 4 Enzyme**s (10 Lectures) (Chap.13, Fennema)
- Introduction, classification
- General characteristics
- Enzymes in food processing
- Industrial Uses of Enzymes
- Immobilized enzymes

**UNIT 5 Physico-chemical and nutritional changes occurring during food processing treatments** ( 10 Lectures) (Chap. 10 deMan and Chap.1 ,Whitehurst and Law)
- Drying and dehydration
- Irradiation
- Freezing
- Canning

**UNIT 6 New product development** (8 Lectures) ( Chap. 1 Desrosier and Desrosier) (Chap. 1, Fuller)
- Definition
- Importance
- Need of product development
- Steps of product development-
- Product development tools
- Reasons for failure

**FOOD CHEMISTRY – II**

**PRACTICAL**

**CONTENTS**

1. Estimation of total ash
2. Estimation of minerals -demo
3. Determination of thermal inactivation time of enzymes in fruits andvegetables.
4. Estimation of iodine value
5. Estimation of peroxide value
6. Determination of carotenoids w.r.t flour pigments.
7. Extend of non-enzymatic browning by extraction methods.
8. Introduction of the concept of new product development

**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 , 4th Ed.,Westport, Conn. : AVI Pub. Co., 1977.
3. Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York, 1996
4. Fuller, Gordon W, New Product Development From Concept to Marketplace, CRC Press,2004.
5. Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002

## Core Course 14 : FOOD QUALITY AND SENSORY EVALUATION (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**UNIT 1 Introduction to quality attributes of food (4 Lectures)**

- Appearance, flavour, textural factors and additional quality factors.

**UNIT 2 Gustation (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 measurement- Electronic Tongue
- Taste abnormalities

**UNIT 3 Olfaction (10 Lectures)**

- Introduction, definition and importance of odour and flavor
- Anatomy of nose, physiology of odour perception
- Mechanism of odour perception
- Theories of odour classification, chemical specificity of odour.
- Odour measurement techniques – historical perspective and emphasis on recent techniques- e- nose etc.
- Olfactory abnormalities

**UNIT 4 Colour (10 Lectures)**

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

**UNIT 5 Texture (14 Lectures)**

- Introduction, definition and importance of texture
- Phases of oral processing
- Texture perception, receptors involved in texture perception
- Rheology of foods
- Texture classification
- Texture measurement – basic rheological models, forces involved in texture measurement and recent advances in texture evaluation.
- Application of texture measurement in cereals, fruits and vegetables, dairy, meat and meat products

## FOOD QUALITY AND SENSORY EVALUATION

**PRACTICAL**

**CONTENT**

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

**Recommended Readings**


1. Rao E. S. (2013). Food Quality Evaluation. Variety Books.
2. Pomeranz Y and Meloan CE (2002). Food Analysis – Theory and Practice, CBS Publishers and Distributors, New Delhi.
3. deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer.
4. Meilgard (1999). Sensory Evaluation Techniques, 3rd ed. CRC Press LLC, 1999.
5. Amerine, Pangborn & Roessler (1965). Principles of Sensory Evaluation of food, Academic Press, London.


# DISCIPLINE SPECIFIC ELECTIVES

## DSE 1: FOOD SAFETY
## (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**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) ( Chap.1, Forsythe)

- Definition
- Types of hazards, biological, chemical, physical hazards
- Factors affecting Food Safety
- Importance of Safe Foods

**UNIT2 Food Hazards of Physical and Chemical Origin** (5 Lectures) ( Chap.2, Lawley et.al)

- Introduction
- Physical Hazards with common examples
- Chemical Hazards(naturally occurring ,environmental and intentionally

- added ), Packaging material as a threat
- Impact on health
- Control measures

**UNIT 3 Food Hazards of Biological Origin** (7 Lectures)(Chap. 5 , Forsythe and Chap.2, Lawley et.al)

- Introduction
- Indicator Organisms
- Food borne pathogens: bacteria, viruses and eukaryotes
- Seafood and Shell fish poisoning
- Mycotoxins

**UNIT 4 Management of hazards** (5 Lectures)(Chap., 7 Forsythe)

- Need
- Control of parameters
- Temperature control
- Food storage

**UNIT 5 Hygiene and Sanitation in Food Service Establishments** (8 Lectures) ( Chap. 1 Marriott)

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

**UNIT 6 Food Safety Management Tools** (8 Lectures)(Chap.7, Forsythe)

- Basic concept
- Prerequisites- GHPs ,GMPs,
- HACCP
- ISO series
- TQM - concept and need for quality, components of TQM, Kaizen.
- Risk Analysis
- Accreditation and Auditing

**UNIT 7 Microbiological criteria** (5 Lectures) (Chap. 8, Forsythe)

- Microbiological standards and limits ( for processed food, water)

- Sampling
- Basic steps in detection of food borne pathogens
- Water Analysis

**UNIT 8 Food laws and Standards** (4 Lectures)( Chap.10, Forsythe and FSSA act)

- Indian Food Regulatory Regime
- Global Scenario
- Other laws and standards related to food

**UNIT 9 Recent concerns** (3 Lectures) ( Chap 1, Rawley et. Al and Chap. 1, De Vries)

- New and Emerging Pathogens
- Genetically modified foods \ Transgenics
- Organic foods
- Newer approaches to food safety

## FOOD SAFETY

**PRACTICAL**

**CONTENTS**

1. Preparation of different types of media (complex, differential and selective)
2. Enumeration of aerial microflora using PDA
3. Identification of Molds by lactophenol blue staining
4. Negative Staining
5. Microbiological Examination of food
6. Bacteriological Analysis of Water by MPN method
7. Assessment of surface sanitation by swab and rinse method
8. Assessment of personal hygiene

**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
5. Forsythe,S.J.The Microbiology of Safe Food , second edition, Willey-Blackwell,U.K.,2010
6. Mortimore S.and Wallace C.HACCP,A practical approach,Chapman and Hill,London,1995
7. Blackburn CDW and Mc Clure P.J.Food borne pathogens. Hazards,risk analysis &

control.CRC Press,Washington,U.S.A, 2005

## DSE 2: FOOD QUALITY MANAGEMENT
## (CREDITS: THEORY – 4 PRACTICAL - 2)

### THEORY

### 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 Management (Ch-1, Pieternel) (10 Lectures)**

- Introduction to food quality management – Definition of quality, quality concepts, quality perception, quality attributes.
- Concepts of quality management: Objectives, importance and functions of quality control and quality assurance; Quality management systems in India
- 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 Contamination in Food Chain (Ch-11, DeMan) (10 lectures)**

- Contamination in Food: Physical, chemical contaminants (heavy metals, pesticide residues, antibiotics, agrochemicals, veterinary drug residues, environmental pollutants, radionucleides, solvent residues, chemicals) and Natural toxins.
- Contaminants formed during processing & packaging – nitrosamines, acrylamide, alloys, benzene, dioxins and furans, persistent organic pollutants, polymers, etc.
- Chemicals from processing such as fumigants, autoxidation products, carcinogens in smoked foods,; intentional and unintentional additives.

**UNIT3 Food Additives (Ch-11,DeMan, Barren-**
**Ch 1,2, 3,4,5,6,8,9,15,17)**
**(14 Lectures)**

- Chemical, technological and toxicological aspects

- Risk assessment studies- Safety and quality evaluation of additives and contaminants, Acute and chronic studies, NOEL, ADI, $LD_{50}$
- 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 (14 Lectures)**

- High fructose corn syrup, cryogenic freezing, supercritical fluid extraction, fat mimetics, flavour encapsulation, use of nano technology in foods etc.

## FOOD QUALITY MANAGEMENT

**PRACTICAL**

**CONTENT**

1. Qualitative tests for hydrogenated fats, butter, and ghee.
2. Quality inspection of various food stuffs- cereals, pulses, spices and condiments etc.
3. Estimation of sulphur dioxide in foods
4. Chromatographic estimation of colour.
5. Analysis of edible common salt for moisture content, MIW and total chlorides.
6. Estimation of ammonia nitrogen in water.
7. Estimation of benzoic acid/ sorbic acid in foods.

**Recommended Readings**


1. Pieternel 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. Jones JM, Food Safety, Eagan Press, 1992
4. Shapton DA and Shapton NF, Principles and Practices for the safe processing of Foods. CRC Press, 1998
5. DeMan, 3rd edition, Principles of Food Chemistry, Springer, 2007.
6. Carol E. Steinhart, M. Ellin Doyle, Food Safety, Food Research Institute, Marcel Dekker, Inc., New York : 1995


## DSE 3: BAKERY TECHNOLOGY

**(CREDITS: THEORY – 4 PRACTICAL - 2)**

**THEORY**

**Objectives**

- To understand the fundamentals of baking
- To learn the technologies behind bakery products.
- To understand industry trends

**CONTENTS**

**UNIT-I BAKERY INDUSTRY** (8 lectures)

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

**UNIT II BREAD, BUNS AND PIZZA BASE** (10 lectures)
Ingredients & processes for breads, buns, pizza base, Equipments used, product quality characteristics, faults and corrective measures

**UNIT III CAKES** (10 lectures)
Ingredients & processes for cakes, Equipments used, product quality characteristics, faults and corrective measures. Different types of icings.

**UNIT IV BISCUITS, COOKIES & CRACKERS** (10 lectures)
Ingredients & processes, Equipments used, product quality characteristics, faults and corrective measures.

**UNIT VI MODIFIED BAKERY PRODUCTS** (4 lectures)

Modification of bakery products for people with special nutritional requirements e.g. high fibre, low sugar, low fat, gluten free bakery products.

**UNIT-VII BREAKFAST CEREALS, MACARONI PRODUCTS AND MALT** (6 lectures)
Production and quality of breakfast cereals, macaroni products and malt.

**Recommended Readings:**

1. Dubey, S.C. (2007). Basic Baking 5th Ed. Chanakya Mudrak Pvt. Ltd.
2. Raina et.al. (2003). Basic Food Preparation-A complete Manual. 3rd 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. Faridi Faubion (1997). Dough Rheology and Baked Product Texture, CBS Publications.
8. Samuel A. Matz (1992). Cookies & Cracker Technology, Van Nostrand Reinhold

## BAKERY TECHNOLOGY

**PRACTICAL**

**CONTENTS**

1. Preparation of pizza base and assessment of its quality
2. Preparation of bread and assessment of its quality
3. Preparation of buns and assessment of quality
4. Preparation of butter cake and assessment of its quality.
5. Preparation of sponge cake with icing and assessment of its quality.
6. Preparation of cookies and assessment of quality.
7. Preparation of biscuits and assessment of quality.

**Recommended Readings:**

1. Dubey, S.C. (2007). Basic Baking 5th Ed. Chanakya Mudrak Pvt. Ltd.
2. Raina et.al. (2003). Basic Food Preparation-A complete Manual. 3rd 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. Faridi Faubion (1997). Dough Rheology and Baked Product Texture, CBS Publications.
8. Samuel A. Matz (1992). Cookies & Cracker Technology, Van Nostrand Reinhold

## DSE 4: FOOD PACKAGING
## (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**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** ( Chapter 1,2 Paine & Paine, 1992) (5 Lectures)

Packaging Functions and Requirements,, Printing of packages .Barcodes & other marking,

Labeling Laws

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

Paper and paper-based materials, corrugated fiber board (CFB).

Plastics, formation- Injection molding, Blow molding, Types of plastics, Lamination, Biodegradable plastics, Edible packaging and Bio-composites. Environmental Concerns-recycling and disposal of plastic waste

Metal 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** (Chapter 7,8,9,10,11,13 Paine and Paine, 1992) (15 Lectures)

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**( Chapter 22 Robertson, 2012) (5 Lectures)

Testing Procedures for Packaging Materials- thickness, tensile strength, puncture resistance, bursting strength, seal strength, water vapor permeability, CO2 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**(Chapter 4 ,Paine & Paine, 1992,Coles et al, 2003) (8 Lectures)

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

## FOOD PACKAGING

**PRACTICAL**

**CONTENTS**

1. Testing of physical/mechanical properties of food packaging material .
2. Testing of thermal shock resistance of glass .
3. Gas/Vacuum packaging of foods and shelf life studies.
4. Determination of Water Vapor Transmission rate of Packaging Material.
5. Edible packaging of Food Samples.
6. Study of Sorption Isotherm for Food Package Design.
7. Packaged food cut-out analysis.
8. To study the operation of FFS machine.

**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

## DSE 5: NUTRACEUTICALS AND FUNCTIONAL FOODS
## (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**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 readings:**
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.

## NUTRACEUTICALS AND FUNCTIONAL FOODS

## PRACTICAL

## CONTENTS

1. Identification of various nutraceuticals and functional foods available in the market
2. Estimation of chlorophyll content of green vegetable
3. Determination of lycopene in fruit/vegetable
4. Determination of total pectin in plant material
5. Estimation of crude fibre/dietary fibre content in cereals and their products
6. Estimation of anthocyanins in food sample
7. Preparation and evaluation of probiotic/prebiotic foods

**Recommended Readings**

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

## DSE 6: FOOD PLANT SANITATION
## (CREDITS: THEORY – 4 PRACTICAL - 2)

### THEORY

**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 Desig**n (Chapter -10,24,25 Rao, D. G. (2010)) (15 Lectures)

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

Scope 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, 2nd 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

### FOOD PLANT SANITATION

**PRACTICAL**

**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, 5th 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

# SKILL ENHANCEMENT ELECTIVE COURSES

### SEC 1: ENTREPRENEURSHIP DEVELOPMENT
### (CREDITS: THEORY – 2)

**CONTENTS**

**UNIT I: ENTREPRENEURIAL DEVELOPMENT** (10 lectures)

- 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** (14 lectures)

- 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 Kottler (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.


## SEC 2: FOOD PRODUCT DEVELOPMENT
## (CREDITS: PRACTICAL - 2)

**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 13,14Moskowitz 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 productsbased 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 food 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.


## SEC 3: FOOD FERMENTATION TECHNOLOGY
## (CREDITS: PRACTICAL - 2)

**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 food

1. Food Fermentation Technologies.
2. Study of a Bio fermentor – its design and operation, Down Stream Processing and Product recovery.
3. Starter cultures.
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

**Recommended Readings:**


1. Food Microbiology. 2nd Edition By Adams M & Moss, M. 2008. RSC Publishing.

2. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2 by Joshi V. K. & Pandey, A., Sanjanya Books 1999.
3. Essentials of Food Microbiology. Edited by John Garbutt. Arnold International Students Edition. 1997
4. Microbiology of Fermented Foods. Volume II and I. By Brian J. Wood.Elsiever Applied Science Publication.1997
5. Principles of Fermentation Technology by Stanbury, P.F., Whitekar A. and Hall. 1995., Pergaman. McNeul and Harvey. (AC) NEW

## SEC 4: CONFECTIONARY TECHNOLOGY
## (CREDITS: PRACTICAL - 2)

**Objectives**

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

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, equipment's & processes, product quality parameters, faults and corrective measures. ( Chapter 5, 7 & 8 – Minifie .)

**Practicals**

1. Determine the effect of heat on sugar solution and perform the thread and cold water test.
2. To study the process of inversion, melting and caramelization in sucrose.
3. Preparation of fondant, fudge and brittles.
4. Preparation of *Shakarpara* and *Chhana murki*.
5. Preparation of candy and toffee and to perform quality assessment tests.
6. Preparation of cake decorations.

**Recommended Readings:**

1. Raina et.al. (2003). Basic Food Preparation-A complete Manual. 3rd Ed. Orient Longman Pvt. Ltd.
2. Manay, S. & Shadaksharaswami, M. (2004). Foods: Facts and Principles, New Age Publishers.
3.Beckette S.T. (2009). Industrial Chocolate Manufacture, Blackwell Publishing Ltd.
4.Minifie B.W. (1999). Chocolate, Cocoa and Confectionary, Aspen Publication.

5. Mohini Sethi, Eram Rao (2011) Food science- Experiments and applications, 2nd ed., CBS publishers &Distributors pvt ltd.

### SEC 5: PROJECT AND TECHNICAL REPORT
### (CREDITS: PRACTICAL - 2)

# GENERIC ELECTIVE (GE)

## GE 1: FOOD PROCESSING AND PRESERVATION
### (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**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. 56

**UNIT 4.MINIMAL PROCESSING AND HURDLE TECHNOLOGY (Journal) ( 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

## PRACTICAL

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

## GE 2: CHEMISTRY OF FOOD
### (CREDITS: THEORY – 4 PRACTICAL - 2)

## THEORY

**Objectives:**

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

**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

## PRACTICAL

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

# GE 3: SENSORY EVALUATION OF FOOD
**(CREDITS: THEORY – 4 PRACTICAL - 2)**

## THEORY

**CONTENTS**

**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 flavor
- 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

## PRACTICAL

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, 3rd ed. CRC Press LLC, 1999
4. deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer. 62
5. Brannen and et al.,(1990)Food Additives, Marcel Dekker,New York,1990

# GE 4: FOOD MICROBIOLOGY AND FOOD SAFETY

**(CREDITS: THEORY – 4 PRACTICAL - 2)**

## THEORY

**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.

**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

**PRACTICAL**

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 65 &Sons; USA,

## GE 5: FOOD ENGINEERING AND PACKAGING
## (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**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

**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

**PRACTICAL**

**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, 2nd, 3rd and 4th Ed., Introduction to food engineering. Academic press.


## GE 6: TECHNOLOGY OF PLANT AND ANIMAL FOODS (CREDITS: THEORY – 4 PRACTICAL - 2)

**THEORY**

**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 – FSSA 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, icecream, 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 Preservationchilling, 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)

**PRACTICAL**

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, 5th 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 70 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, 5th 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, 4th Ed. CBS Publication New Delhi
13. Hall GM, 1992,Fish Processing Technology, VCH Publishers Inc., NY, 1992