MAHATMA GANDHI UNIVERSITY
KOTTAYAM

B Sc FOOD TECHNOLOGY & QUALITY ASSURANCE

SYLLABUS MODEL III
2017

INTRODUCTION

The course enables graduates to acquire the technical and professional skills for a career in either the food industry or a government food control authority through an understanding of the sciences underlying food technology together with a comprehension of food quality assurance.

The expected outcomes for graduates are:

• A knowledge and competence in the principles of quality assurance and quality management systems as they are applied in the food manufacture and distribution to produce safe food meeting quality and legal requirements;
• An understanding of the chemical, biological and physical principles which underlie food processing and storage;
• An ability to apply the principles of chemical analysis, microbiology and statistical control techniques to assure the quality and safety of food;
• A capacity to undertake research into the science of foods;
• Critical, presentational and interpersonal skills.

NEED AND SCOPE OF THE COURSE

` In the world, India is the second largest producer of food after China; the country has achieved the potential of being the biggest, with the food and agricultural sector. Indian food industry is considered to supply about two third of total Indian retail market needs. In addition to that, modern skills and equipment have been introduced in food industries such as canning, dairy, cereal processing, speciality processing, packaging, frozen food, refrigeration and thermal processing. India's food processing industry has been growing at the rate of 13% despite the global slowdown. And now the government is aiming to double the turnover in the next five year by setting up mega food parks to attract even global capital.

At present the export from agro-sector represents about 16% of total Indian exports. The primary export commodities are cereals, fruits, vegetables and their processed products, and marine products but fast growing specialty products have also penetrated into the foreign markets. Considering the contribution of these products in Indian export, it is necessary to have appropriate technology for handling and processing of agricultural produce.

Food technologist develops the manufacturing process and recipes. They work on existing and newly discovered ingredients and technologies to invent new products, recipes and concept. They are involved in conducting experiments and producing sample products as well as designing the processes and machinery for making products with a consistent flavor, color and texture.

- Modifying existing products, processes and new product development (NPD).
- Checking and improving quality control procedures from raw material stage to the finished product incorporating traceability.
- Addressing issues of safety and quality.
- Selecting raw material and other ingredients.
- Maintaining proper hygienic condition of entire food industry.
- Develop steps undertaken to meet the requirements with respect to hygiene, sanitation, good manufacturing practices, HACCP and nutritional quality.

PURPOSE OF COURSE

The purpose of this course is to enable the under-graduate to acquire the scientific, technical and professional skills for a career in the food industry through an understanding of science of food technology together with a deeper comprehension of food quality assurance.

The expected outcomes are that students acquire and demonstrate:

- Knowledge and competence in the principles of quality assurance and quality management system as they are applied in the food manufacture and distribution to produce safe, food meeting quality and legal requirements.
- Thorough knowledge of chemical, biological and physical principles which underlie food processing, package and storage.
- Ability to apply the principles of chemical analysis, microbiological and statistical control techniques to analyze and assure the quality and safety of food.
- Capacity for critical evaluation, presentation and interpersonal communication skills.

Table 2: Detailed Scheme for the Distribution of Credits and Period of Instruction for B Sc Food Technology & Quality Assurance

Sl No	Type of course	Course Code	Title of course	Exam duration	Credit per course	Contact hours per week	Total contact hours for the course	Total credits for the semester
First Semester								
1	CORE	FT1CRT01	Introduction to Food Technology	3	3	4	72	19
2	CORE	FT1CRT02	Biochemistry	3	4	4	72	
3	CORE	FT1CRT03	Food Processing Technology	3	4	4	72	
4	COMMON	EN1CCT01	Communication skills in English	3	4	5	90	
5	COMPLEMENTARY	CH1CMT01	Basic Theoretical & Analytical Chemistry	3	2	2	36	
6	COMPLEMENTARY	ZY1CMT02	Animal Diversity: Non-Chordata	3	2	2	36	
Second semester								
7	CORE	FT2CRT01	Food Engineering	3	4	4	72	21
8	CORE	FT2CRT02	Food Microbiology	3	3	4	72	
9	CORE	FT2CRP03	Food Microbiology Practical	3	2	4	72	
10	COMMON	EN2CCT02	Critical Thinking, Academic Writing & Presentation	3	4	5	90	
11	COMPLEMENTARY	CH2CMT01	Basic Organic Chemistry	3	2	2	36	
12	COMPLEMENTARY	ZY2CMT02	Animal Diversity: Chordata	3	2	2	36	
13	COMPLEMENTARY	CH2CMP01	Practical Complementary Chemistry- Volumetric Analysis (I & II SEM)	3	2	2+2	72	
14	COMPLEMENTARY	ZY2CMP02	Practical Complementary Zoology- Animal Diversity: Non-Chordata & Chordata (I & II SEM)	3	2	2+2	72	

Sl No	Type of course	Course Code	Title of course	Exam duration	Credit per course	Contact hours per week	Total contact hours for the course	Total credits for the semester
Third Semester								
15	CORE	FT3CRT01	Dairy Technology	3	4	5	90	19
16	CORE	FT3CRT02	Food Analytical Instrumentation	3	4	5	90	
17	CORE	FT3CRT03	Food Packaging Technology	3	3	5	90	
18	OJT	FT3OJ01	On-the-Job Industrial Training-I	Internal evaluation	2			
19	COMPLEMENTARY	CH3CMT01	Advanced Inorganic & Organic Chemistry	3	3	3	54	
20	COMPLEMENTARY	ZY3CMT02	Human Physiology & Immunology	3	3	3	54	
Fourth semester								
21	CORE	FT4CRT01	Principles of Food Spoilage & Preservation	3	4	4	72	19
22	CORE	FT4CRT02	Food Chemistry	3	3	5	90	
23	CORE	FT4CRP03	Food Chemistry Practical	3	2	6	108	
24	COMPLEMENTARY	CH4CMT01	Advanced Bio-organic Chemistry	3	3	3	54	
25	COMPLEMENTARY	ZY4CMT02	Applied Zoology (Aquaculture, Sericulture, Vermiculture & Apiculture)	3	3	3	54	
26	COMPLEMENTARY	CH4CMP01	Practical Complementary Chemistry- Organic Chemistry	3	2	2+2	72	
27	COMPLEMENTARY	ZY4CMP02	Practical Complementary- Human Physiology & Immunology and Applied Zoology	3	2	2+2	72	

Sl. No	Type of course	Course Code	Title of course	Exam duration	Credit per course	Contact hours per week	Total contact hours for the course	Total credits for the semester
Fifth Semester								
28	CORE	FT5CRT01	Technology of Beverages & Confectionaries	3	4	5	90	23
29	CORE	FT5CRT02	Technology of Fruits & Vegetables	3	3	5	90	
30	CORE	FT5CRT03	Cereal Chemistry	3	4	6	108	
31	CORE	FT5CRT04	Sensory Evaluation of Food	3	3	5	90	
32	CORE	ES5CRT05	Environmental Studies and Human Rights	3	4	5	90	
33	GE		Generic Elective	3	3	4	72	
34	OJT	FT5OJ02	On-the-Job Industrial Training-II	Internal evaluation	2			
Sixth semester								
35	CORE	FT6CRT01	Food Safety & Quality Assurance	3	4	5	90	19
36	CORE	FT6CRT02	Technology of Meat, Fish & Poultry Products	3	4	4	72	
37	CORE	FT6CRT03	Food Analysis	3	4	5	90	
38	CORE	FT6CRP04	Food Analysis Practical	3	2	5	90	
39	CBC ELECTIVE		Choice Based Core Elective	3	3	5	90	
40		FT6PR01	Project/Dissertation	0	2			

Consolidated Scheme for Practical's

Sl.No	Semester	Course	Hours Per Week	Credit
1.	I & II	Practical Complementary Chemistry- Volumetric Analysis	2+2	2
2.	I & II	Practical Complementary Zoology- Animal Diversity: Non-Chordata & Chordata	2+2	2
3.	II	Practical Core – Food Microbiology	4	2
4.	III & IV	Practical Complementary Chemistry- Organic Chemistry	2+2	2
5.	III & IV	Practical Complementary- Human Physiology & Immunology and Applied Zoology	2+2	2
6.	IV	Practical Core – Food Chemistry	6	3
7.	VI	Practical Core – Food Analysis	6	3

List of Generic Elective Course Papers available for Fifth Semester for Other Departments

No	Title of course	Exam duration (hours)	Credit per course	Contact hours per week
1	Basic Nutrition	3	3	4
2	Fermentation Technology	3	3	4
3	Food Hygiene & Sanitation	3	3	4

List of Choice Based Core Elective Course Papers available for Sixth Semester

No	Title of course	Exam duration (hours)	Credit per course	Contact hours per week
1	Equipment & Material Design for Food Processing Plant	3	3	5
2	Food Biotechnology	3	3	5
3	Technology of Flavors & Fragrances	3	3	5

Restructured Syllabus 2017
I, II, III, IV, V & VI
Semesters

I Semester

INTRODUCTION TO FOOD TECHNOLOGY

Credits - 3

72 h

OBJECTIVES

- To acquire an overall concept about food technology
- To enable students to apply scientific methods independently

Unit I **12 h**

Introduction to food science

Food science concept- Basic SI unit of length, volume and weight, temperature, relative density, pH or potential hydrogen, Physico-chemical properties of food- boiling point, evaporation, melting point, smoke point, surface tension, osmosis, humidity, freezing point and specific gravity.

Unit II **15 h**

Colloidal systems in foods

Constituents of food, true solution, suspension, stability of colloidal system, Type of colloidal system in food- sol, gel, emulsion, foam

Classification of food

Health food, ethnic food, organic food, functional food, nutraceuticals, fabricated foods, convenience foods, GM foods, space foods

Unit III **15 h**

Food additive and adulteration

Food additives, antioxidants – natural and artificial, sequestrants, preservatives- Class I and II, nutrient supplement, emulsifiers, stabilizers and thickening agents, bleaching and maturing agent, sweeteners- nutritive and non nutritive, humectants and anti-caking agents, coloring- natural and artificial and flavoring substance – natural and synthetic flavoring agents and flavor enhancers.

Food adulteration: Types of adulterants- intentional and incidental adulterants, methods of detection

20 h

Unit IV

Sampling and sample preparation

Population and sample, Methods of sampling-simple random sampling, systematic sampling, stratified random sampling, Measures of central Tendency – arithmetic mean, geometric mean, harmonic mean, median, mode

Unit V **10 h**

Food safety, quality and evaluation

Food safety and quality assurance- definition, Codex Alimentarious Commission, HACCP and ISO 22000 FSMS.

Evaluation of food- subjective and objective methods
Food standards - FSSAI

REFERENCES

- Blackburn, C. W. and McClure, P.J Food borne Pathogens Woodhead Publishing Limited Cambridge England 2005.
- Frederick, J.F. Encyclopedia of Food Science and Technology. Second edition vol 1-4, a Wiley Interscience publication, 2000
- Goldberg, I. Functional foods, designer foods, pharma foods and nutraceuticals. An Aspen publication, Gaithersburg, Marylamd, 1999.
- Roday, S., Food science and nutrition. Third edition, Oxford University Press, New Delhi, 2008.
- Joseph,K.X. Statistics third edition , Calicut University, Central co-operative stores Ltd. 2004.
- Khader,V. Text book of Food science and Technology. Published by India Council of Agricultural Research, NewDelhi 110012, 2001
- Kothari, C.R, Research Methodology- Methods and Techniques, 2nd edition, New age International (P) Ltd publishers, New Delhi. 2000
- Manay, N.S, Shadaksharaswamy, M., Foods- Facts and Principles, New Age International Publishers, New Delhi, 2004.
- Srilakshmi, B. Food Science (3rd edition), New Age International (P) Limited Publishers, New Delhi, 2003.
- Reddy Y.S, Newer concept and applications for food industry. Gene Tech Books, New Delhi 110002, 2006

BIOCHEMISTRY

Credits 4

Objectives **72 h**

- ❖ To understand the basic and applied aspects of biochemistry
- ❖ Enable the students to understand the biochemical pathways and how they are relevant to their lives

Unit I **15 h**

Carbohydrates

Classification, monosaccharides, oligosaccharides, polysaccharides, structure and configuration of aldose, ketoses, triose, tetrose, pentose, hexose, Polysaccharides- Homo-starch, inulin, glycogen, cellulose, Heteropolysaccharides

Unit II **15 h**

Lipids

Classification of lipids, fatty acids, essential fatty acids, triglycerols, phospholipids, glycolipids, lipoprotein, sterols, amphipathic lipids, fatty acid oxidation (β-oxidation), Functions, sources and requirements.

Unit III **10 h**

Amino acids and Proteins

Amino acid, classification, properties, essential amino acid, structure of proteins- primary, secondary, tertiary, quaternary structure of proteins; protein denaturation.

Unit IV **22 h**

Enzymes and Vitamins

Enzymes: Nomenclature and classification, kinetics of enzymic reactions, types of enzymes, enzyme inhibition, reversible inhibition, irreversible inhibition, conditions affecting enzymatic reactions, co-enzymes.

Vitamins: classification, functions, requirement and deficiency conditions, vitamin A, D, E, K, Ascorbic acid, Thiamine, Riboflavin, Niacin, Pyridoxine, Folic acid, Pantothenic acid, cyanocobalamine

10 h

Unit V

Metabolism of Carbohydrates and Proteins

Glycolysis and Tricarboxylic acid (TCA) cycle, HMP shunt, Gluconeogenesis
Transamination, deamination, urea cycle.

REFERENCES

- Berg, J. M., Tymocezko, J. L, Biochemistry, Sixth edition, W H Freeman and Company, New York, 2007
- Das, D. Biochemistry, Seventh Edition, Academic publishers, Calcutta, 1992
- Jain, J. L., Fundamentals of Biochemistry, Fifth Edition, S. Chand and Company Ltd, 2001
- Satyanarayana, U. and Chakrapani, U. Biochemistry, Third edition, Books and Allied Pvt Ltd, Kolkata, 2006

FOOD PROCESSING TECHNOLOGY

Credits 4 **72 h**

Objectives

- A logical basic sequence of steps to produce an acceptable and quality food product from raw materials.
- Study of scientific and technological advancements in food processing.

Unit I **12 h**

Fundamentals of Food Manufacturing

Raw materials handling, cleaning, separating, disintegrating and forming.
Processing and preservation techniques: heat application- heat exchangers for liquid foods, tanks or kettles for liquid foods, pressure cooker or retorts for packaged foods, tunnel ovens; heat removal or cold preservation- chilling and refrigeration process, freezing and frozen storage; water removal- evaporation and drying.

Unit II **16 h**

Processing of Coconuts and coconut Products

Coconut Processing, Introduction; Copra manufacture, grades of copra; Methods of Manufacture- traditional sun drying, smoke drying, hot air modern dryers; coconut oil extraction.
Products: coconut milk cream manufacture, Desiccated coconut, spray dried coconut milk powder, packed tender coconut water, vinegar from coconut, Toddy fermentation, Neera and other products from coconut.

Unit III **16 h**

Spices and Oleoresins

Indian Spices: Introduction; General function of spices; Different types of spices- Ginger, Garlic, Cardamom, Pepper, Cinnamon, Clove, Chilies, Coriander, and Turmeric; Processing of cardamom and pepper.
Spice oil and oleoresins: Introduction, Technology of manufacturing oleoresins and spice oils, application of spice oils and oleoresins in food industry

Unit IV **16 h**

Ethnic Foods and Its Processing

Processing of Ethnic Foods: Banana products- banana puree, banana chips, banana powder, Banana figs, banana flour; Tapioca products- Tapioca chips, tapioca powder; Fermented Products- Dosa, Idli, Appam
Processing of Modern Foods: Pasta, Noodles, Mayonnaise, Salad Dressing, Margarine, Potato chips, Corn flakes, Pop corn.

Unit V **12 h**

Novel Technologies of Food Processing

Micro wave and radio frequency processing, ohmic and inductive heating, high pressure processing, pulsed electric fields, pulse light technology, high voltage arc discharge, oscillating magnetic fields, ultra sound, ultra violet light, Pulsed X- rays

REFERENCES

- Brian E. Grimwood, Coconut Palm Products: Their Processing in Developing Countries, 1979.
- Hui, Y H and Associate Editors; Hand Book of Food Products Manufacturing Vol I, Wiley-Interscience, New Jersey 2007.
- Hui, Y H and Associate Editors; Hand Book of Food Products Manufacturing Vol II, wiley- Interscince, New Jersey 2007.
- Manay, N.S, Shadaksharaswamy, M., Foods- Facts and Principles, New Age International Publishers, New Delhi, 2004.
- Potter, N. N, Hotchkiss, J. H. Food Science. CBS Publishers, New Delhi. 2000.
- Srilakshmi, B. Food Science (3rd edition), New Age International (P) Limited Publishers, New Delhi, 2003.

II Semester

FOOD ENGINEERING

Credits 4 **72 h**

Objectives

- ❖ Students will know the basic concepts of thermodynamics, heat and mass transfer.
- ❖ Students will be able to apply material balances and energy balances to the field of food engineering.
- ❖ Students will be able to understand equipment used in the food industry.

Unit I **10 h**

Engineering Units

Dimensions – Primary, secondary
Engineering units- Base units, derived and supplementary units.
System – state of system, extensive properties and intensive properties. Phase diagram of water

Unit II **20 h**

Heat Transfer in Food Processing

Systems for heating and cooling food products, plate heat exchanger, tubular heat exchanger, scraped surface heat exchanger, steam infusion and steam injection heat exchanger
Thermal properties of foods- specific heat, thermal conductivity and thermal diffusivity
Modes of heat transfer (conductive, convective and radiative heat transfer), steady state heat transfer and role of insulation in reducing heat loss from process equipment.

Unit III **15 h**

Fluid Flow in Food Processing

Types of pumps, Properties of Liquids- Density and viscosity, the Continuity Equation, Reynolds number and Flow measurement – Pitot tube, orifice meter and venture meter.

Unit IV **15 h**

Mechanical Separation

Different types of equipments used for Mixing, clarification and evaporation.
Membrane separation techniques – reverse osmosis, ultra filtration, microfiltration
Concentration – freeze concentration. Sedimentation, Filtration and Distillation

Unit V **12 h**

Food Dehydration and Freezing systems

Freezing – freezing curve, changes during freezing and types of freezers
Drying – drying curve, changes during drying and types of driers – kiln, cabinet, drum, spray, fluidized bed dryer

REFERENCES

- Dincer, I. Heat Transfer Food Cooling Applications. Taylor and Francis Publishers, USA. 1997.
- Heldman, D. R. and Lund, D.B. Handbook of Food Engineering 2nd edition. CRC press, Newyork. 2007.
- Singh, R.P. Introduction to Food Engineering 3rd edition. Academic Press, London. 2004.

FOOD MICROBIOLOGY

Credits 3 **72 h**

Objectives

- To acquire an elementary knowledge about the aspects of interaction between micro-organisms, food borne illness and food fermentation

Unit I **15 h**

Introduction to Microbiology

History of Microbiology, Characteristics and morphology of bacteria, fungi, protozoa &virus. Control of micro-organisms- Growth curve; Influence of environmental factors on growth- pH, Water activity, O_2 availability, Temperature, Pressure and Radiation

Unit II **15 h**

Cultures and Media

Different type of media- Selective media and differential media; Preparation of media- PDA media, Nutrient agar, Mac Conkey agar;
Culturing techniques- Spread plate and streak plate, pour plate.
Indicator microorganisms: Sources, methods of detection, growth & survival; significance of coliforms, faecal streptococci, Enterobacteriaceae

Unit III **15 h**

Contamination and Spoilage of Foods

Cereals, sugar and their products, Milk & milk products, Fruits and vegetables, canned foods, Meat, fish, egg and poultry

Unit IV **12 h**

Food Borne Diseases

Food intoxication- Staphylococcal intoxication, botulism, *Bacillus cereus* gastroenteritis Food infection- *Salmonellosis, Clostridium perfringens, Shigella dysenteriae, Listeria monocytogenes E. coli* infection and others

Unit V **15 h**

Food fermentation

Dairy based fermented foods, - Kefir, yoghurt, cheese and butter; lactic acid bacteria fermented food- sauerkraut and pickles, Yeast based fermented foods- bread, wine and beer; vinegar, Oriental food fermentation- tempeh, soya sauce production
SCP- Microorganisms, growth and production, nutritive value and use of SCP;

REFERENCES

- Frazier, W.C. Food Microbiology. 4th edition. Mc Graw Hill. New York, 2008
- Khetarpaul, N. Food microbiology, Daya publishing house, New Delhi, 2009
- Narayanan, L.M. and Mani,L. Microbiology.Saras Publications, Nagercoil.
- Pelzar, H.J. and Rober, D. Microbiology 5th edition Mc Graw Hill. NewYork, 2009
- Prescott, L.M., Harley, J.P. and Klein, D.A. Microbiology. 4th edition McGraw-Hill, NewYork. 1999

FOOD MICROBIOLOGY PRACTICALS

Credits 2 **72 h**

Objectives

- To study the basic rules and requirements of a microbiology laboratory.
- Give emphasis towards the preparation of biological stains, reagents, media and their composition.
- To get thorough different methods for staining of microorganisms.

1. **Microbiology laboratory basic rules and requirements:** **12 h**

   Laboratory rules- basic rules of a microbiology lab

   Basic requirements of a microbiological lab- common glass ware; test tube, culture tube and screw capped tubes, Petri dish, pipette, Pasteur pipette, glass spreader, inoculation needle, Bunsen burner, water bath, autoclave, laminar air flow, incubator, hot air oven, Quebec colony counter, centrifuge, microscope.

   Disposal of laboratory waste and culture.

2. **Staining of microorganisms** **16 h**

   Methods for detection of specific bacteria:

   Wet mount preparation for motile bacteria by hanging drop mount method,

   Petri dish culture method for detection bacteria.

   Methods for staining of micro organism:

   Simple staining (Monochrome staining)

   Gram staining for differentiation of bacteria

   Negative staining of bacteria

   Endospore staining

3. **Composition, preparation and sterilization of media:** **14 h**

   PDA media

   Nutrient agar media

   Mac-Conkey agar media

4. **Demonstration of techniques for pure culture of microorganisms:** **14 h**

   Streak plate method

   Pour plate method

   Serial dilution agar plate method

5. **Microbiology of Milk:** **14 h**

   - Standard plate count method,
   - Methylene blue reduction test (MBRT)

REFERENCES

- Dubey, R.C. and Maheshwari, D.K. Practical microbiology. S.Chand and Company Limited, Ramnagar. New Delhi 2002.

III Semester

DAIRY TECHNOLOGY

Credits 4 **90 h**

Objectives

To enable the students

- ❖ To know the importance of milk as an agricultural commodity
- ❖ To be innovative in exploring various traditional and non traditional milk products

Unit I **18 h**

Introduction

Definition, different sources of milk and their composition, factors affecting composition of milk. Physico-chemical properties of milk constituents. Microbiology of milk, Collection and transportation of milk. Grading of milk, flavor defects, causes and prevention.

Special Milk Products:

Pasteurized milk, Sterilized milk, Homogenized milk, Flavored milk, frozen concentrated milk, Fermented milk, Reconstituted milk, Recombined milk, Toned milk, double toned milk, Vitaminised/ Irradiated milk.

Unit II **18 h**

Butter and cream

Cream: definition, classification, composition, manufacture of cream, packaging & storage. Uses of cream and its defects.

Butter: definition, classification, composition and nutritive value, method of manufacture, packaging & storage. Uses of butter and its defects

Unit III **18 h**

Cheese and Ice cream

Cheese: Introduction, definition, classification, composition and nutritive value, Manufacture of cheddar cheese and cottage cheese, defects in cheese, their causes and prevention, uses of cheese.

Ice-cream: Definition, composition and nutritive value, role of constituents, method of manufacture & storage. Uses of ice-cream, defects in ice-cream

Unit IV **18 h**

Condensed and Evaporated Milk

Condensed milk: Introduction, definition, classification, composition, nutritive value, method of manufacture.

Evaporated milk: Introduction, definition, classification, composition, nutritive value, method of manufacture.

Defects and uses of condensed and evaporated milk

Unit V **18 h**

Indigenous Dairy Products

- Fat rich products : Ghee, Makkan and Malai
- Concentrated Products : Khoa , Rabri and Basundi
- Coagulated Products : Chhana and Paneer
- Fermented Products : Dahi , Chakka, Shrikhand and Lassi
- Frozen Products : Kulfi and Kulfa

REFERENCES

- Godbole, N.N; Milk – The Most Perfect Food ; Biotechnology books, 2007
- Manay, N.S, Shadaksharaswamy, M., Foods- Facts and Principles, New Age International Publishers, New Delhi, 2004.
- Potter, N. N, Hotchkiss, J. H. Food Science. CBS Publishers, New Delhi. 2000.
- Spreer E and Mixa, A; Milk and Dairy Product Technology; Marcel Dekker, 2005
- Srilakshmi, B. Food Science (3rd edition), New Age International (P) Limited Publishers, New Delhi, 2003.
- Sukumar De; Outlines of dairy technology; Oxford University Press; 2001

Walstra A, Geurts T.J and Noomen, A; Dairy Technology – Principles of milk and Properties and Processes; Marcel Dekker, 2005

FOOD ANALYTICAL INSTRUMENTATION

Credits 4 **90 h**

Objectives

- To know the principles and applications of different techniques used in food and nutrition research
- To gain knowledge about different instruments used in food analysis.
- To understand different aspects of sensory science and its application

Unit I **18 h**

Chromatography

Introduction, principles of chromatography; Techniques and working principle and application in food industries of- Paper chromatography, GC, GLC, HPLC, TLC

Unit II **18 h**

Spectroscopy

Principles of spectroscopy, properties; Techniques and working of-Infrared spectroscopy, UV spectrophotometer, Atomic absorption, Atomic emission, Flourimetry and NMR

Unit III **18 h**

Radiotracer Techniques

Radiotracer techniques: Introduction, Nature of radioactivity, units, radioactive counters, solid, gas and liquid scintillation.

Unit IV **18 h**

Electrophoresis:

Definition, types of electrophoresis methods, free solution electrophoresis, paper or gel electrophoresis, SDS-PAGE. Agarose gel electrophoresis

Unit V **18 h**

Centrifugation

Centrifugation- principle, relative centrifugal force, types of centrifuges, rotor heads and modes of centrifugation

REFERENCES

- Jellinek, G., Sensory Evaluation of Food-Theory and Practice., Elis Horwood Ltd., England, 1985.
- Lawless H.T, Sensory Evaluation of Food, Food Science Text series, Springer Science, 2010
- Mahindru, S.N. Food additives. Characteristics, detection and estimation. Tata McGraw-Hill Publishing Company Limited, New Delhi. 2000
- Nielsen, S.S. Introduction to the chemical analysis of foods. Jones and Bartlett Publishers, Boston, London. 2004.
- Pearson, D. The Chemical Analysis of Foods, Churchill Livingstone, New York, 2002.
- Sharma, B.K. Instrumental Methods of Chemical Analysis. Goel Publishing House, New Delhi. 2004.
- Srilakshmi, B., Food Science., New Age International (P) Limited., New Delhi, 2005

FOOD PACKAGING TECHNOLOGY

Credits 3 **90 h**

Objectives

- To enable students
- To be familiar with different methods and materials used for packaging.
- To understand the technology behind packaging.
- To understand interaction of food with packaging.

Unit I **15 h**

Introduction to food packaging

Definition, functions and requirements for effective packaging, packaging criteria
Classification of packaging
Primary, secondary and tertiary packaging.
Flexible, rigid and Semi- rigid packaging.

Unit II **20 h**

Materials for food packaging – types, various uses, merits & drawbacks.

Paper, Glass, Tin, Aluminium: TFS, Polymer coated tin free steel cans, cellophane, plastics- LDPE, HDPE, LLDPE, HMHDPE, Polypropylene, polystyrene, polyamide, polyester, polyvinyl chloride

Unit III **15 h**

Different forms of food containers

Boxes, jars, cans, bottle. Packaging requirements for various products- fish, meat, spices, vegetables & fruits, canned foods, dehydrated foods

Unit IV **15 h**

Modern concepts of packaging technology.

Aseptic packaging, Form–Fill–Seal packaging, Edible Films, Retort pouch packaging, Easy-Open–End, Boil–In-Bags, Closures, tetra-pack, vacuum-packaging, MAP & CAP, Hyper baric storage, insect resistant packaging, intelligent packaging

Unit V **25 h**

Food packaging Laws & Specifications

Food packaging Laws & Specifications
Quality testing of packaging materials

- Paper & paper boards-thickness, bursting strength, grammage, puncture resistance, Cobbs test, tearing resistance
- Flexible packaging materials (plastics)-yield, density, tensile strength, elongation, impact resistance, WVTR, GTR, Overall Migration Rate, seal strength.

- Transportation hazards and testing
- Oxygen interactions, moisture interchanges and aroma permeability.

REFERENCES

- Cruess, W.V. Commercial Fruit & Vegetable Products. Allied Scientific Publishers, New Delhi. 2003
- Davis, E.G. Evaluation of tin & plastic containers for foods. CBS Publishers, New Delhi. 2004
- Gopal T.K.S. Seafood packaging, CIFT, Matsyapuri Cochin,2007
- Potter, N. N, Hotchkiss, J. H. Food Science. CBS Publishers, New Delhi. 2000.
- Sacharow, S., Griffin, R.C. Food Packaging. AVI Publishing Company, West Port, Connecticut. 2000
- Srilakshmi, B. Food Science. New Age International Publishers, New Delhi, 2003

INDUSTRIAL TRAINING – I

IV Semester

PRINCIPLES OF FOOD SPOILAGE AND PRESERVATION

Credits 4 **72 h**

Objectives

- The main objective of this is to study the different mode of spoilage in foods and minimize the contamination by different preservation technology.

Unit I **12 h**

Introduction

Food as a substrate for microorganisms- Hydrogen ion concentration, concept of water activity, oxidation-reduction potential, nutrient content;

Basic principles of food preservation, importance of preservation

Unit II **15 h**

Food Spoilage

Definition; Classification of foods according to the ease of spoilage; Types of spoilage- microbial spoilage, enzymatic spoilage, mechanical damage, spoilage by insects, parasites and rodents;
Characteristics and storage conditions of foods- carbohydrate fermenting microorganisms, proteolytic and lipolytic microorganism, acidity, moisture, temperature, humidity, oxygen, light and duration

Unit III **15 h**

Spoilage of Different Category of foods

Spoilage of meat- vacuum packed meats, fresh liver, ham and bacon
Spoilage of poultry; Spoilage of fish and shell fish;
Spoilage of Miscellaneous foods- Eggs, cereals, bakery products and dairy products

15 h

Unit IV

Methods Of Food Preservation

Preservation by using high temperature- Pasteurization, sterilization, canning;
Preservation by low temperature- Cellar storage, refrigeration or chilling;
Preservation by very low temperature- freezing, type of freezing- slow freezing, quick freezing, IQF, cryogenic freezing.
Preservation by removal of moisture- Drying and concentration

Unit V **15 h**

Irradiation and Hurdle Technology

Preservation by using ionizing radiation- sources, unit, merits and demerits, application of irradiation in food industry, photo electric effect of radiation, Hurdle technology

REFERENCES

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- Khetarpaul, N. Food microbiology, Daya publishing house, New Delhi, 2009
- McWilliams, M and Paine, H. Modern Food preservation. Surjeet Publications, Delhi, 1984.
- Potter, N.N. and Hotchkiss J. H. Food Science. CBS publishers and distributors. 1996.
- Srivastava, R.PO and Kumar, S. Fruit and vegetable preservation, International Book distribution Company, Lucknow, 1994.
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- Subalakshmi, G and Udipi, S.A. Food processing and preservation. New Age International Publishers, New Delhi, 2001.

FOOD CHEMISTRY

Credits 4 **90 h**

Objectives

- ❖ Know the structure and chemical characteristics of constituents of food
- ❖ To study the composition and properties of foods and its chemical changes during handling, processing and storage

Unit I **15 h**

Introduction

Physical properties of water, structure of water, water solute interactions – Macroscopic and molecular level, water activity – definition and measurement, and moisture sorption isotherms.

Unit II **15 h**

Carbohydrates

Monosaccharides- isomerization, ring forms and reactions. Oligosaccharides – maltose, lactose and sucrose.
Polysaccharides: starch – structure, granule gelatinization and pasting, retrogradation and staling, hydrolysis of starch, modified food starch and dextrinisation; cellulose- modified forms.

Unit III **20 h**

Proteins

Classification, Protein structure – primary, secondary, tertiary and quarternary; protein denaturation and denaturing agents; functional properties of proteins, Nutritional properties of proteins and changes of proteins during processing

Unit IV **20 h**

Chemistry of Oils and Fats

Classification, Chemical aspects of lipids- lipolysis, flavor reversion and auto-oxidation and methods of measuring lipid oxidation.
Chemistry of frying – behavior of frying oil, behavior of food during frying & chemical and physical changes during frying.
Chemistry of fat and oil processing – rendering, refining, Hydrogenation, interesterification and winterization

Unit V **20 h**

Enzymes

Enzyme nomenclature, Role of endogenous enzymes in food quality, immobilized enzymes, specificity of enzymes and Browning reaction in foods-Enzymatic and non-enzymatic browning reaction in foods.

REFERENCES

- Campbell, M K and Farrell, S O-Biochemistry 5th edition-international student, 2006
- Damodaran,S., Parkin , K L.,Fennema, O R., Fennema's Food Chemistry- 4th edition, CRC press Taylor and Francis Group, New York 2008.
- Fennema, O R. -Food Chemistry 3rd edition, Marcel Dekker Inc, New York., 1996.
- Manay, N.S, Shadaksharaswamy, M., Foods- Facts and Principles, New Age International Publishers, New Delhi, 2004.
- Meyer, L H-Food Chemistry. CBS publishers & distributors, New Delhi. 2002
- Potter, N. N, Hotchkiss, J. H. Food Science. CBS Publishers, New Delhi. 2000.
- Srilakshmi, B. Food Science (3rd edition), New Age International (P) Limited Publishers, New Delhi, 2003.

FOOD CHEMISTRY PRACTICALS

Credits 3 **108 h**

Objectives

- To test the presence of carbohydrates and proteins in food samples
- To estimate the nutrients in different food samples
- To standardize the solution

Qualitative Test **20 h**

- Qualitative tests for carbohydrates
- Qualitative tests for proteins.

Standardization of Solutions **20 h**

Standardization of Fehling's solution.
Standardization of Sodium hydroxide with standard oxalic acid.

Estimation of Sugar Solutions **20 h**

- Estimation of Glucose by Lane and Eynon's method.
- Estimation of Sucrose by Lane and Eynon's method.
- Estimation of Aldose by Willstalter's Iodometric titration.

Estimation of Protein **20 h**

- Biuret method
- Lowry's method

Estimation of Starch **14 h**

Estimation of crude fibre by Weende's method. **14 h**

REFERENCES

- Nielsen, S.S. Introduction to the chemical analysis of foods. Jones and Bartlett Publishers, Boston, London. 2003
- Sadasivam,S. Manickam, A. Biochemical Methods, 2nd edition. New Age International (P) Limited, New Delhi. 2001

V Semester

TECHNOLOGY OF BEVERAGES & CONFECTIONERIES

Credits 4 **90 h**

Objectives

To enable the students

- To get an up to date knowledge about fermented foods and beverages
- To be creative in exploring new shapes, aromas and flavors and the science behind the confectionary making.

Unit I **20 h**

Alcoholic Beverages

Beer Making and Types of Beer: ale, lager, pilsner, stout and porter beer.
Wine making and Types of wine: white wine, red wine, dry wine, sweet wine and sparkling wine.
Whisky manufacture and types of whisky: Scotch whisky, malt whisky, Irish whisky and Canadian whisky. Manufacture of rum, vodka, brandy and gin.

Unit II **15 h**

Carbonated Beverages

Carbonated soft drinks: Ingredients and preservatives used in carbonation. Syrup room operation and equipments involved and Types of packaging materials used

Unit III **10 h**

Mineral Water

Water source and deionization of mineral water. Water treatment process: Filtration, Adsorption, ion exchange, Chemical oxidation and Biological process. Microbiology of bottled water

Unit IV **20 h**

Tea and Coffee

Steps involved in processing of tea and coffee. Types of tea: Black tea, Green tea and Oolong tea.
Types of coffee: Vacuum coffee, drip coffee, percolator coffee, steeped coffee, espresso coffee, iced coffee and Instant coffee. Decaffeination of coffee and types of decaffeination: Roselius process, Swiss water process, direct and indirect method, triglyceride method, carbon dioxide method

25 h

Unit V

Confectionery Science

Introduction, Classification of confections: rock candy, hard candy, fondants and creams, marshmallows, caramel and fudge. Chocolate: steps involved in making of chocolate and production of cocoa powder and cocoa butter. Types: milk chocolate, sweet chocolate, white chocolate and wafer coated chocolate. Defects in chocolate: Fat bloom.
Indian confectionery: Khoa, Peda, Gulab Jamun, Rasogolla, Rasa malai. Colors and flavors used in confectionery, reactions of sugars in confectionery making: caramelisation, hydrolysis and crystallization.

REFERENCES

- Bernard W Minifie, Chocolate, cocoa and confectionary : Science and Technology., Aspen publications., 1999
- Manay, N.S, Shadaksharaswamy, M., Foods- Facts and Principles, New Age International Publishers, New Delhi, 2004.
- Nicholas Dege. Technology of Bottled water. Blackwell publishing Ltd, UK.,2011
- Potter, N. N, Hotchkiss, J. H. Food Science. CBS Publishers, New Delhi. 2000.
- Srilakshmi, B. Food Science. New Age International Publishers, New Delhi, 2003
- Varnam A. H and Sutherland P.J., Beverages: Technology, Chemistry and Microbiology, Aspen Publications, 1999.

TECHNOLOGY OF FRUITS AND VEGETABLES

Credits 4 **90 h**

Objectives:

- ❖ To provide a knowledge on the pre- and post-harvest technology of fresh fruits and vegetables
- ❖ To introduce the emerging trends in minimal processing of fruits and vegetables.

Unit I **18 h**

Introduction

Nutritive value and Pigments. Antinutritional and toxic factors, health benefits of fruits and vegetables. Stability of nutrients – chemical changes, flavor changes, changes in nutritive value (Physical and biological changes). Post-harvest losses in fruits and vegetables, Control of post-harvest losses. Freezing injury, chilling injury and heat injury

Unit II **18 h**

Maturity, ripening and harvesting of fruits and vegetables

Ripening – Changes during ripening, Classification of fruits – climacteric and non climacteric fruits. Maturity indices and its importance, determination of harvest maturity indices – Computational methods, physical methods, chemical methods and physiological methods. Harvesting of fruits and vegetable- manual and mechanical methods and mode of transportation

Unit III **18 h**

Packing house operations and storage

Post harvest operations– reception, drenching, washing, cleaning, pre-cooling, trimming, presorting, sorting/ grading, waxing, physical treatments, chemical treatments, packaging and labeling.

Storage-factors affecting storage, methods of storage – Traditional storage (on site storage, pit storage, high altitude storage, clamp storage, under-ground storage and evaporative cool storage) and improved storage methods (MAP, CAP, active packaging, vacuum packaging and hypobaric storage)

Unit IV **18 h**

Processing of fruits and vegetables

Peeling, slicing/ dicing, blanching and nutritional quality of blanched food. Canning of fruits and vegetables

Unit V **18 h**

Processed Products from fruits and vegetables

Jam, jelly and marmalade – definition, standards and processing.

Tomato products – juice, ketchup, sauce – definition, standards and processing

Candied fruits, glazed and crystallized fruits – definition, standards and processing
Fruit juice, squash, crushes and cordials - definition, standards and processing
Pickles - definition, standards and processing

REFERENCE

- Post Harvest Technology of Horticultural Crops; K. P. Sudheer, V. Indira; Series – 7; New India Publishing Agency; 2007.
- David Arthey; Fruit Processing; Second edition, 2001; Springer publishers.
- Girdhari Lal; Siddappa G, S. Tandon G.L;1999; Preservation of fruits and vegetables ICAR ,New Delhi
- Achaya KT; 1986, Every day indian processed foods; National Book Trust India
- Desrosier N W; 1999; Technology of food preservation, the AVI Publishing Co, west fort.

CEREAL CHEMISTRY

Credits 4 **108 h**

Objectives

- To give a general outline about the principles, structure and composition, economic importance and storage of different cereals and their products.

Unit I **20 h**

Rice Chemistry and Technology

Cereal grain structure, composition of rice, Processing of cereals- Milling of rice, parboiling– Avorio process, conversion process, Malek process and Fernandez process and its advantages, by-products of cereals – starch, gluten, dextrose, dextrin, bran, broken grains, parched rice, puffed rice, flaked rice, popped rice, hulls, rice pollards, bran oil, germ and germ oil, husk, straw.

Unit II **20 h**

Wheat Chemistry and Technology

Classification of wheat, structure and composition of wheat, Harvesting and storage: Harvesting the grain, cleaning the grain and storage, wheat milling, wheat products: whole wheat flour, maida, semolina, macaroni products and its method of preparation: macaroni, spaghetti and vermicelli

Unit III **20 h**

Corn Chemistry and Technology

Origin, types of corn, structure and composition of corn, nutritive value, processing of corn: dry milling, wet milling and alkali processing, products of corn: degerminated flour, corn germ oil, pop corn, corn starch.

Unit IV **20 h**

Breakfast cereals

Breakfast cereals: Definition, Nutritive value of breakfast cereals, classification of breakfast cereals: uncooked breakfast cereals and ready to eat cereals: processing of ready –to-eat cereals (Batch cooking, continuous cooking and extrusion cookers) and products (flaked cereals, puffed cereals, shredded products, granular products)

28 h

Unit V

Fermented and unfermented products

Fermented products: Biscuits and Bread

Ingredients and its role in making bread and Method of preparation of bread (straight dough and sponge dough method) and biscuits. Defects of bread and biscuits

Unfermented Products: Cakes and role of ingredients in cake making and method of manufacture and its defects.

REFERENCES

- David Dendy A.V, etal; Cereals and Cereal Products: Technology and Chemistry, - 2000
- Manay, N.S, Shadaksharaswamy, M., Foods- Facts and Principles, New Age International Publishers, New Delhi, 2004.
- Potter, N.N. and Hotchkiss J. H. Food Science. CBS publishers and distributors. 1996.
- Srilakshmi, B. Food Science. New Age International Publishers, New Delhi, 2003.
- Subalakshmi, G and Udipi, S.A. Food processing and preservation. New Age International Publishers, New Delhi, 2001.

SENSORY EVALUATION OF FOOD

Credits 3 **90 h**

OBJECTIVES

- To enlighten the students on the fundamental aspects of sensory science
- To provide an updated knowledge on sensory measurements and various sensory factors affecting subjective evaluation

Unit I **18 h**

Introduction

Subjective evaluation, Sensory evaluation: Definition, and applications, Sensory attributes of food: Appearance, Texture and Flavor;
Difference between objective and subjective evaluation
Sensory perception of food flavor: mechanism of taste, smell, retronasal smell, somesthesis, kinesthesis, chemesthesis- pepper heat, carbonation, metallic taste etc
Multimodal perception.

Unit II **18 h**

Sensory evaluation requirements

Requirements of sensory evaluation: Sensory laboratory design, Sensory booths, Sensory panels- Types of panels, Requirements, Recruitment Criteria & Selection, Training. Sample preparation and serving procedures such as sample size, sample serving temperature, palate cleansers, swallowing and expectoration, Score card, Sensory scaling- Line scales, Numeric scales, Hedonic scales;

Unit III **18 h**

Sensory measurement

Kinds of sensory tests- Difference:- Triangle, Duo-trio tests, Paired comparison test, Descriptive tests:- Texture profile, Flavor profile, Affective tests:- Preference test, Ranking, Hedonic tests.
Factors affecting sensory measurements: Psychological- Expectation error, Mutual suggestion effect, Distraction error etc; Physiological: Adaptation, Mixture interactions-Enhancement, Synergy & Suppression, Health& Environmental factors

Unit IV **18 h**

Food texture

Definition, Kinds of Texture: Visual texture, Auditory texture- crunchiness, crumbliness, Oral tactile texture- Size and shape, Mouth feel, Phase changes, Oral crispiness, crumbliness and crunchiness, Hand tactile feel, Texture measurement- Texture Profile

Unit V **18 h**

Food appearance

Normal human color vision mechanism and color blindness, Measurement of Appearance & Color attributes, Appearance attributes such as turbidity, glossiness, translucency; Visual Color Measurement. Instrumental Color Measurement: Munsell Color Solids, Tricolorimetry, Standard observer.

REFERENCE

1. Harry T Lawless, Hildegarde Heymann (2010) Sensory evaluation of Food: Principles and Practices, Second Edition, Springer, New York.
2. Sarah Kemp, Tracey Hollywood, Joanne Hort (2011) Sensory evaluation: A Practical Handbook, Wiley-Blackwell, New York
3 Nielsen, S.S, 2004 Introduction to the chemical analysis of foods.Jones and Bartlett Publishers, Boston, London.
4 Srilakshmi,B., 2005,Food Science., New Age International (P) Limited., New Delhi

GENERIC ELECTIVES

BASIC NUTRITION

Credits 3 **72 h**

Objectives

- To enable the students to understand the general principles of nutrition as well as the practical aspects involved in nutritional planning and management.

Unit I **12 h**

Introduction to Nutrition

Definition, optimum nutrition, nutritional status, good nutritional status, poor nutritional status, malnutrition, under nutrition, signs of good nutritional status, signs of poor nutritional status, definition and functions of nutrients

Unit II **12 h**

Food and Our Body

Food and its functions, digestion, absorption and metabolism of food
Buccal digestion, gastric digestion and intestinal digestion, factors that affect digestion, absorption and metabolism, Five food groups.

Unit III **14 h**

Energy Metabolism and Carbohydrates

Introduction, unit of measurement, energy value of food- calorimetry or bi proximate composition; energy needs of the body- reference man and reference woman; basal metabolic rate, factors affecting the BMR

Carbohydrates
Introduction, classification of carbohydrates, digestion, absorption and metabolism, functions, deficiency, recommended dietary intake and sources.
Role of dietary fibre in prevention and treatment of diseases

Unit IV **14 h**

Lipids and Proteins

Lipids
Introduction , classification of lipids, saturated and unsaturated fatty acid, functions of fat, digestion, absorption and metabolism of fat, deficiency, food sources and RDA

Proteins
Introduction, classifications of proteins, nutritional classification of amino acids protein quality - biological value, net protein utilization, protein efficiency ratio.
Function, deficiency, sources and requirements.

Unit V **20 h**

Vitamins, Minerals and Water

Vitamins: Classification- fat soluble and water soluble vitamins;
Fat soluble vitamins, A, D, E and K - introduction, function, deficiency, sources, RDA
Water soluble vitamins- B complex and C-introduction, functions, deficiency, sources, RDA

Minerals: major or macro minerals- General functions of minerals, deficiency, sources and RDA
Major minerals- calcium, phosphorus, sodium, potassium, iron
Minor minerals- iron and manganese
Trace elements – iodine, fluorine, zinc

Water: Introduction, functions, water, daily intake of water, daily loss of water, body water, water balance, deficiency of water, retention of water, daily requirements, fat.

REFERENCES

- Begum, R. A text book of Foods, Nutrition and Dietetics. Second revised edition, Sterling Publishers (P) Ltd, New Delhi, 1991.
- Joshi, S. A Nutrition and dietetics. Third edition, Tata McGraw Hill education pvt ltd, New Delhi, 2010
- Mudambi, S. R., Rajagopal M. V., Fundamentals of food and Nutritions, 2nd edition, Wiley Eastern Ltd, New Delhi 1990.
- Roday, S., Food science and nutrition. Third edition, Oxford University Press, New Delhi, 2008.
- Srilakshmi, B, Nutrition Science, New age international (P) Ltd publishers, New Delhi, 2006.
- Swaminathan, M., Hand book of Food & Nutrition, Bappco Ltd, Bangalore, 1978.
- Swaminathan, M. Essential of Food and Nutrition, Vol.I. Bangalore Printing and Publishing Co. Ltd Bangalore.

FERMENTATION TECHNOLOGY

Credits 3 **72 h**

OBJECTIVES

- To enlighten the students on the fundamental aspects of fermentation technology, microbial growth and design and control of bioreactors
- To give a brief introduction on down-stream processing and details on various food fermentations & their manufacture.

Unit I **14 h**

Microbial growth kinetics

Introduction on fermentation, Growth curve- Lag, Exponential, Stationary & Decline Phases Growth kinetics:- Batch culture: Growth rate, Specific growth rate, Generation time, Continuous culture: Chemostat and Turbidostat.

Unit II **16 h**

Design of fermenters & Sterilization

Basic function, design & control, Control in fermentors: Aeration, pH, Agitation, Types of fermentors.

Sterilization of vessels; Media sterilization: Different methods of media sterilization for batch & continuous cultures; Air sterilization: types of air filters

Unit III **14 h**

Factors affecting fermentation & its control

Media: Energy & carbon source requirement, Carbon: Nitrogen ratio, Oxygen demand and supply, stationary & agitation methods, Effect of temperature & pH on growth & metabolism and their control.

Unit IV **14 h**

Downstream Processing

Recovery & purification of fermentation products, removal of microbial cells and other solids, distillation, filtration: factors affecting filtration, precipitation, centrifugation, chemical cell disruption, liquid extraction, drying & crystallization.

Unit V **14 h**

Fermented and unfermented products

Fermentation methods, production mechanism, micro-organisms involved and main changes during development of following fermented products: Ethanol; Organic acids; Fermented meat; Fermented fish products; Fermented dairy products; Fermented vegetables; Fermented bakery products: bread, Fermented fruit & malt beverages. Fermented products of orient.

REFERENCES

- Stanbury P F, Whitaker A, Hall S J (1995) *Principles of Fermentation Technology*, Butterworth-Heinemann, Massachusetts, United States.
- James M. Jay, Martin J. Loessner, David A. Golden (2005) *Modern Food Microbiology*, 7th edn. Springer.
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- L E Casida Jr (1968) *Industrial Microbiology*, John Wiley & Sons Inc
- L E Casida Jr (1968) *Industrial Microbiology*, John Wiley & Sons Inc

FOOD INDUSTRIAL SANITATION & HYGIENE

Credits 3 **72 h**

Objectives:

- ❖ To provide a basic understanding of sanitary concepts and practice in food industry
- ❖ To give a basic acquaintance with sanitary standards and agents.

Unit I **14 h**

Introduction

Sanitation: Definition. Sources of food contamination, Prevention and control of contamination of food. Physical and chemical agents used in food industry.

Unit II **16 h**

Sanitizers and methods of sanitation

Sanitizers, Chemical and physical properties of sanitizers, Mechanism of activity of most frequently used sanitizers. Sanitizing methods, Sanitation equipments and systems, Mechanized sweepers and scrubbers, high pressure cleaners, CIP and COP equipment.

.

Unit III **14 h**

Cleaning compounds

Cleaning compounds, Classification of cleaning compounds, Sequestrants, Chemical and physical characteristics of detergents

Unit IV **14 h**

Personal hygiene and pest control

Food handling and personal hygiene. Hygienic food handling. Hand-washing. GMP for Personal Hygiene. Pest control methods

Unit V **14 h**

Waste water treatment

Criteria for evaluating quality of water used for food processing, Water quality standards. Waste product handling, Suspended solids, Total solids, BOD & COD requirements. Wastewater treatment and disposal.

REFERENCES:

- Marriot N G, Gravani R B (2006) Principles of Food Sanitation, 5th edition, Springer, New York
- Roday S (2011) Food Hygiene and Sanitation with case studies, 2nd edition, Tata Mc Graw Hill, New York.
- Marriot N G (1997) Essentials of Food Sanitation, Robertson G (Ed.) Chapman & Hall, New York.

INDUSTRIAL TRAINING – II

VI Semester

FOOD SAFETY & QUALITY ASSURANCE

Credits 4 **90 h**

Objectives:

- ❖ To provide a basic understanding of quality concepts and practice in food companies.
- ❖ To provide approaches to the planning and organization of a quality control system.
- ❖ To provide a basic acquaintance with standards and specifications.

Unit I **14 h**

Basic Quality Concepts

Basic concepts of Quality control & Quality Assurance, Total Quality Management, Current Good Manufacturing Practices (GMP), Standard Sanitary Operation Procedures, Good Laboratory Practices (GLP), ISO 22000 FSMS

Unit II **18 h**

Physical and Chemical Hazards

Definition of food safety and concept of safe food; characterization of food hazards- Physical hazards (Glass, Wood, Stones, Metal Fragments, Insulation Materials, Plastic and Bones)
Chemical hazards:
1. Naturally occuring chemical hazards – Natural occuring toxicants in foods and antinutritional factors in foods.
2. Unintentional Chemicals: Pesticides, Fertilizers, Pollutants, Toxic metals (Lead, Cadmium, Mercury, Aluminium and Arsenic)
3. Intentional Chemicals (Food preservatives Food additives)

Unit III **18h**

Microbial Hazards

Microbial Hazards

1. **Bacterial**

Food Infections: *Salmonella*, *Shigella* and *Listeria monocytogenes*
Food Intoxications: *Clostridium botulinum*, *Clostridium perfringens*, *Bacillus cereus* and *Staphylococcus aureus*
Toxin mediated infections: *Vibrio cholerae*, *E.coli*
Sources, diseases and symptoms and prevention and control

2. **Fungal** : Aflatoxin, Ochratoxin, Patulin , Sterigmatocystin and Tricothecenes

Sources, diseases and symptoms and prevention and control

Unit IV **20 h**

Monitoring and Regulation

HACCP – definition, principles, steps involved
Food standards - Voluntary and mandatory food laws and Food Safety and Standards Act of India, 2006.

Unit V **20 h**

Quality Assessment& Quality Control

Microbiological Tests, Tests for Adulterants, Tests for Filth, Tests for Moisture & Ash Definition, Statistical Quality Control: Definition, Seven tools for SQC- Flow chart, Check sheet, Fishbonediagram, Pareto charts, Histogram, Runcharts &Control chart – definition, uses, process control. Attributes & Variable Sampling.

REFERENCES

- Bhatia,R. and Ichhpujan,R.L. Quality assurance in Microbiology. CBS Publishers and Distributors, New Delhi. 2004.
- Kher, C.P. Quality control for the food industry. ITC Publishers, Geneva. 2000.
- Philip,A.C. Reconceptualizing quality. New Age International Publishers, Bangalore. 2001.

TECHNOLOGY OF MEAT, FISH & POULTRY PRODUCTS

Credits 4 **72 h**

Objectives

- To provide an extensive description of meat, fish and poultry processing
- To introduce the latest technologies , manufacturing processes and tools for effective control of safety and quality during processing

Unit I **14 h**

Meat

Basic meat science: Chemical composition & structure of meat, Post-mortem changes in muscle & meat quality Classification. Meat preservation methods- Chilling, freezing, curing, salting, pickling, smoking and canning. Abattoir practices. PSE and DFD meat

Unit II **16 h**

Fish

Composition of fish, Preservation of fish by drying, salting and smoking, Chilling and freezing of fish and seafood. Application of freezing system in fish processing- IQF method. Canning of fish and fish products. Packaging of fish products.

Unit III **14 h**

Egg

Egg formation and structure, composition, preservation: Refrigeration,drying and freezing. Egg quality parameters: interior and exterior. By-products and waste utilization.

Unit IV **14 h**

Poultry

Poultry composition, classification, slaughtering techniques, preservation of poultry meat. Byproducts and waste utilization.

Unit V **14 h**

Quality Control in Meat and Fish

Meat**:** Test for assessment of raw meat-TVN, FFA, PV, Nitrate & nitrite in cured meat, Establishment of HACCP in meat industry.
Fish: Quality assurance in sea food processing: GMP, HACCP

REFERENCES

- Manay, N.S, Shadaksharaswamy, M., Foods- Facts and Principles, New Age International Publishers, New Delhi, 2004.
- Potter, N. N, Hotchkiss, J. H. Food Science. CBS Publishers, New Delhi. 2000.
- Subalakshmi, G and Udipi, S.A. Food processing and preservation. New Age International Publishers, New Delhi, 2001.
- Srilakshmi, B. Food Science. New Age International Publishers, New Delhi, 2003
- Warriss P. D, Meat Science: An Introductory Text,Cambridge university press – 2010

FOOD ANALYSIS

Credits 4 **90 h**

Objectives

To enable the students

- ❖ To understand different sampling techniques employed in chemical analysis of foods.
- ❖ To learn various chemical methods of food analysis.

Unit I **10 h**

Introduction

Introduction to food analysis: Official methods of analysis, Regulations and recommendations related to food analysis, Evaluation of analytical data and nutritional labeling

Unit II **20 h**

Compositional Analysis of Foods

Moisture and Total solids- Importance of moisture assay, Oven drying methods, Distillation Procedures, Physical and chemical methods of moisture analysis

Ash analysis: Importance of ash in food analysis and different ashing methods

Carbohydrate analysis: Importance, Method of analysis- Phenol – Sulphuric acid method, Lane and Eynon method, Somogyi – Nelson method and Anthrone method

Crude fat analysis: Semicontinous Solvent Extraction Methods (Soxhlet method) and Non solvent Wet extraction Methods (Babcock method, Gerber method and detergent method).

Protein analysis- Methods of protein analysis: Kjeldahl method, Dumas method, Biuret method, Ninhydrin method and Lowry method

Vitamin analysis- Chemical methods of analysis of Vitamin A and C

Mineral analysis: EDTA Complexometric Titration, Precipitation titration and colorimetric methods

Unit III **20 h**

Physical Properties and Characterisation of Foods

Densitometry: hydrometer, pycnometer, buoyance.

Refractometry: Refractive index, Lorenz equation, refractometers- Abbe, Pulfrich and immersion

Colour measurement- CIE system, visual colorimeters, tristimulus, photoelectric colorimeters, applications.

Rheology- capillary viscometer, falling ball viscometer, rotational viscometer; texture meter.

Unit IV **20 h**

Chemical Properties and Characterisation of Foods

Fat Characterization: refractive index, melting point, smoke, flash and fire points, cold test, cloud point, iodine value, Saponification value, FFA, peroxide value.

Protein separation and characterization: Separation by differential solubility characteristics, separation by size, separation by adsorption and separation by electrophoresis
Titratable acidity

Unit V **20 h**

Analysis of Dietary fiber

Definition, importance of dietary fiber, gravimetric and chemical methods of crude fiber estimation

REFERENCES

- Kalia, M. Food Analysis and Quality Control. Kalyani Publishers, New Delhi. 2002.
- Winton, A.L and Winton, K.B. Techniques of food analysis. Allied Scientific Publishers, New Delhi. 1999.
- Nielsen, S.S. Introduction to the chemical analysis of foods. Jones and Bartlett Publishers, Boston, London. 2003.
- Connell, J.J. Control of fish quality. Blackwell Scientific Publications, Cambridge.2000.

FOOD ANALYSIS PRACTICALS

Credits 3 **108 h**

Objectives

- To understand the principles behind analytical techniques and to select appropriate method for analysis.
- To demonstrate practical proficiency in food analysis laboratory

Analysis of Squash **30 h**

- Estimation of Titratable Acidity
- Estimation of Reducing and Non Reducing sugar
- Estimation of Total Solids
- Estimation of Vitamin C
- Qualitative test for preservatives – KMS , Sulphur dioxide, Sodium benzoate

Analysis of Jam **10 h**

- Estimation of Titratable Acidity
- Estimation of Reducing and Non Reducing sugar
- Estimation of Total Solids

Analysis of Honey **20 h**

- Estimation of Titratable Acidity
- Estimation of Reducing and Non Reducing sugar
- Estimation of Total Solids
- Qualitative test –
  1. Test for Commercial glucose
  2. Test for Artificial invert sugar

Analysis of Wheat Flour **8 h**

- Estimation of gluten content

Analysis of Vinegar **20 h**

- Estimation of total solids
- Estimation of Titratable Acidity

Analysis of Milk and milk products **20 h**

- Alkaline Phosphatase test
- Estimation of acidity
- Estimation of non reducing sugar

- Estimation of protein by Sorenson's formol titration
- Estimation of salt content in butter
- Adulteration tests

REFERENCES

- Nielsen, S.S. Introduction to the chemical analysis of foods. Jones and Bartlett Publishers, Boston, London. 2003.
- Plummer D T (1998) An Introduction to Practical Biochemistry, Third edition, Tata McGraw Hill, New Delhi
- Sadasivam S, Manickam A (1996) Biochemical Methods, Second edition, New Age International Ltd, New Delhi.

CHOICE-BASED ELECTIVES

EQUIPMENT AND MATERIAL DESIGN FOR FOOD PROCESSING PLANT

Credits 3 **90 h**

Objectives

- To gain the empirical knowledge and practical experience on design of processes, process equipment and processing plants in the food industry.

Unit I **15 h**

Introduction

Process design: Definition, Types of process design, Material and Energy balance, design of equipments, plant layout and buildings, Economic analysis in plant design: fixed capital investment, Cost of Equipment, Engineering cost indices, Manufacturing cost and profitability: manufacturing cost, profitability and break-even point

Elements of food plant design: General aspects, new food plants, plant improvements, plant expansion, mobile food plants and advanced food plants.

Unit II **20 h**

Design and Selection of Food Processing Equipments

Sizing and costing of equipments, Materials of construction: Metals (steel, stainless steel, aluminium, copper), plastic rubbers, glass ceramics and wood.

Fabrication of equipment: Strength of construction (general aspects, sensitive construction points, proper engineering), Fabrication and installation of equipment (general process equipment, food processing equipment and installation of process equipments)

Hygienic design of food processing equipments: Hygienic standards and regulations, cleaning of food equipment

Selection of food processing equipments: Selection of equipment, construction characteristics, operational characteristics, testing of equipments.

Unit III **20 h**

Mechanical Processing Equipments

Size Reduction Equipments: Size reduction of fibrous foods, dry foods and liquid foods and its effect on foods.

Mixing and Forming Equipments: Mixers for dry powders and particulate solids, mixers for low or medium viscosity liquids and mixers for high viscosity liquids and pastes. Forming equipments: bread moulders, pie and biscuit formers and confectionery moulders.

Unit IV **15 h**

Thermal Processing Equipments

Blanching: Steam blanchers, hot water blanchers and their effect on foods

Extrusion: I) Method of operation: cold extruders and extruder cookers II) Method of construction: single and twin screw extruders. Application of extrusion in food industry and its effect on food.

Unit V **20 h**

Post Processing Operations

Coating or Enrobing: Coating materials – batters, powders and bread crumbs, chocolate and compound coatings. Enrobers, Dusting or Breading and Pan coating – hard coatings, soft coatings and chocolate coatings

REFERENCES

- Fellows P,J; Food Processing Technology, Principles and Practice, Third edition, Woodhead publishing, 2009
- Saravacos, G.D and Kostaropoulos, A.E ; Handbook of Food Processing Equipments, Springer publications, 2006
- Subalakshmi, G and Udipi, S.A. Food processing and preservation. New Age International Publishers, New Delhi, 2001.

FOOD BIOTECHNOLOGY

Credits - 3 **72 h**

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OBJECTIVES

- To acquire an elementary knowledge about the aspects of applications of biotechnology to food products

UNIT I:

Structure of Genetic material:- **12 Hrs.**

DNA, Structure of DNA Watson and Crick model of DNA, types of DNA, RNA, types of RNA, functions of nucleic acids, codons, deciphering genetic code.

UNIT II:

Fundamentals of Genetic Engineering:- **15 Hrs**

Concept of Recombinant DNA Technology, Gene cloning, Restriction Endonucleases, Choice of organism for genetic experimentation, cloning vectors, types of vectors: plasmid, cosmids, and phagemids.

Unit III:

Expression of Genetic Material:- **15Hrs**

Mechanism of DNA replication, transcription and translation. Extraction, isolation and sequencing of genetic material, Polymerase chain reaction.

Unit IV:

Food biotechnology and Food science:- **10Hrs**

Biotechnological approaches to improve nutritional quality and shelf life of fruits and vegetables. Solution to peanut allergy, Recombinant lypoxygenases and oxylipin metabolism. International aspects of the quality and safety assessment of foods, patenting inventions in food biotechnology.

Unit V:

Application of genetic engineering in food science:- **20Hrs**

Transgenesis, GMO (Micro organism, plants and animals and their products), Genomic basis for food improvement, genetic modification of plant starches for food applications, Plant oils for food uses, Nutraceutical enrichment of food crops. Production of traits in farm animals. Recombinant milk. Transgenic fish technology in sea food production. Fish protein hydrolysates.

REFERENCES

- Modern Food Microbiology by James M Jay, Aspen Publishers
- Essentials of Food Sciences Vickie A. Vaclavik, Elizabeth W. Christian, Springer.
- Food Science by N. Potter & Hotchkiss, ASPEN Publication.
- An introduction to Food Science by Rick Parker and Delmar, Thomson Learning.
- Food Technology by N W Desroisier, Springer.
- Food Science & Nutrition by Sunitha Reddy, Publishing House Pvt. Ltd., Delhi.
- Enzymes in Food Processing by Paramjit S Paneswar, IK Intl. Ltd.
- Food Biotechnology by Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto Robert E. Levin, Taylor & Francis**.**
- Biotechnology-Fermented foods and their processing by Naduka Okafor

TECHNOLOGY OF FLAVORS AND FRAGRANCES

Credits 3 **72 h**

Objectives

To enable the students

- To give a broad introduction to the formulation, origins, analysis and performance of flavours
- To provide an understanding of all aspects of flavour, in the food, the production chain, the perception by consumers and their contentment during and after eating

Unit I **12 h**

An overview of flavour perception

Flavour perception, taste perception, anatomy of taste, chemesthesis: chemesthesis responses, tactile response, olfaction, anatomy of olfaction and signal encoding.

Unit II **15 h**

Flavouring Materials

Definitions: flavouring, natural flavouring and artificial flavouring. Natural flavouring materials (plant sources): Herbs and spices, derivatives of spices (essential oils by distillation, oleoresins by solvent extraction, expressed essential oils (citrus oils), cocoa, coffee and tea flavourings and aromatic vegetables

Unit III **15 h**

Flavouring Materials Made by Processing

Process flavours (meat flavours): Evolution of process meat like flavourings, creation of process flavourings, Hydrolysed Vegetable Protein (HVP) and Autolysed Yeast Extracts (AYE).
Enzymatically derived flavourings: Enzyme modified butter/ butter oil, enzyme modified cheese and enzymes used
Flavours developed by fermentation: Yeasts, vinegar and derived inactive yeast powder.
Flavours made by pyrolysis (smoke flavours): Natural liquid smoke flavourings, pyroligneous acid and smoke condensate.
Production of natural flavouring materials by enzymatic and microbial action

Unit IV **15 h**

Artificial Flavouring Materials

Artificial flavourings, classification of aroma compounds by molecular structure and sensory characteristics of odour compounds like hydrocarbons, carboxylic acids, acetals, alcohols, carbonyls (aldehydes and ketones), esters, ethers, heterocyclic compounds, lactones, phenols, sulphur and nitrogen containing compounds.

Unit V **15 h**

Flavour Applications

Culinary and meat products: soups and stocks, sauces, seasonings and marinades and meat products
Baked goods and bakery products: problems in flavouring baked goods, flavouring baked goods and heat resistant flavourings.
Snack foods: problems in flavouring snack goods, snack flavourings, flavouring materials and means of applying flavours
Sugar based confectionery products and chewing gum: Hard candies, Toffees and chewing gum
Dairy products: Flavoured milk, flavoured yoghurt and flavoured dairy desserts
Soft drinks: Carbonated beverages

REFERENCES

- Reineccius.G; Flavor Chemistry and Technology; CRC press; 2006
- Reineccius.G; Source books of flavors; 2nd edition; CBS publishers, 1999

PROJECT/ DISSERTATION