



**LOYOLA COLLEGE (AUTONOMOUS)  
CHENNAI - 600 034.**

**DEPARTMENT OF CHEMISTRY  
M.Sc. Food Chemistry  
P.G. PROGRAMME  
SYLLABUS**

Effective from the Academic Year 2012-2013



**Loyola College (Autonomous)  
Chennai- 600 034**



**FP-1806: ORGANIC CHEMISTRY OF FOOD - I**

Semester I

No. of Credits: 4

Category: Major core (MC)

Hours per wk: 5

*Objectives: To prepare the students*

- 1. To understand the aspects of organic chemistry related to food.*
- 2. To understand the techniques adopted in processing of food.*
- 3. To understand and appreciate the concept of chemistry in Food Science & Food processing.*

**UNIT-1: CARBOHYDRATES:**

**(10 hrs)**

- 1.1 **Disaccharides** – Optical activity and chirality, Classification of chiral molecules asymmetric and dissymmetric of organic molecules. Maltose, lactose and sucrose - solubility, solution viscosity and stability.
- 1.2 **Polysaccharides:** Hydrolysis, starch granules, granule gelatinization and pasting. Retrogradation and staling. Modified food starch-swelling of starch and cellulose – Modifications and derivatives. Gels.
- 1.3 **Dietary fibre and carbohydrate digestibility**-Xanthan, carrageenans, algin, pectins and gum-arabic.
- 1.4 **Analysis of carbohydrates:** Extraction of total carbohydrate, phenol-sulphuric acid method. Total reducing sugar –Somoyogi Nelson method. HPLC analysis of mono and oligosaccharides- Principles and method. Enzymatic method. Determination of total starch in pectin.

**Self study:** Chemical properties of monosaccharides – mutarotation, test for reducing and non-reducing sugars. **Monosaccharides:** Classification and structure – ring form and glycosides. Reactions – oxidation to aldonic acids and aldo lactones. Reduction to carbonyl groups-uronic acids, hydroxyl group esters. Non-enzymic browning.



**UNIT -2: LIPIDS**

**(15 hrs)**

- 2.1 **Fatty acids** – A brief study of R&S, Fischer projection, erythro & threo compounds. Geometrical and optical isomerism. Nomenclature-R/S system and stereospecific numbering. Phospholipids, classification of lipids – milk fats, lauric acids, vegetable butters; simple, compound and derived lipids – Oleic and linoleic acids. Modification of fats- Hydrogenation.
- 2.2 **Animal fats** – Physical aspects – even and random distribution- Theories of triglycerol distribution pattern. Chemical deacylation.
- 2.3 **Positional distribution of fatty acids in natural fats** :Plants and animal triglycerol. Crystallization and consistency – crystal structures, polymorphism, melting, solid fat index, and consistency of commercial fats. Factors influencing consistency. Chemical aspects – Lipolysis, auto oxidation, formation of hydroperoxides (oleate) and decomposition of hydro peroxide. Cholesterol oxidation, formation of dimers and polymers, Diels- Alder reaction.
- 2.4 **Antioxidants**. Effectiveness and mechanism of action; Synergism – characteristics of commonly used antioxidants. Thermal non-oxidable and oxidable reactions of saturated fats.
- 2.5 **Quality of fats**: Test for assessing the quality of saturated fats and frying oils. Control measures, effects of ionizing radiation on fats. Determination of melting points, saponification value, R.M. and Polanski values.

**Self Study:**Chemistry of fat and oil processing & refining – Settling and degumming, neutralization, bleaching, deodorization, hydrogenation and selectivity: Mechanism. Inter esterification- Principle. Role of food lipids in flavor, rancidity, flavor reversion, dietary lipids.

**UNIT-3: AMINOACIDS, PEPTIDES AND PROTEINS**

**(15 Hrs)**

- 3.1 **Aminoacids**. Physiochemical properties of aminoacids. Structure and classification- stereochemistry of aminoacids. peptides and synthesis of tri peptide using amino



acids, glycine, alanine, lysine, cystine, Glutamine acid and arginine. Isoelectric point .  
Hydrophobic properties of amino acids. Chemical reactivity of amino acids – Reaction with ninhydrin & other reactions.

3.2 **Proteins.** Structural hierarchy in proteins – primary, secondary, tertiary and quaternary structure. Forces involved in the stability of protein structure-steric strain, hydrogen bond, electrostatic interactions, hydrophobic interactions, disulphide bonds, conformational stability and adaptability of proteins.

3.3 **Emulsifying properties:** Methods, emulsifying activity index, protein load, capacity and stability of emulsion–factors influencing emulsifications, foaming properties, flavour binding .

3.4 **Evaluation of protein nutritive value** - Biological methods- PER, DC, BV, NPU, NPR.  
Chemical methods-enzymic and microbial methods. Changes in nutritional quality and formation of toxic compounds. Compositional changes during extraction and fractionation. Protein cross linking and carbonyl amine reactions.

3.5 **Reactions of proteins in food.** Reaction with lipids, sulphites, chemical and enzymatic modifications of proteins – alkylation, acylation, phosphorylation, sulphitolysis, enzymatic hydrolysis, Maillard reaction.

3.6 **Analysis of proteins :** Kjeldahl , Biuret , Bradford , Ninhydrin and turbidimetric methods.  
UV-Visible and IR spectrometric methods

**Self study:** Basic structural aspects of amino acids, peptides, poly peptides and proteins.

#### **UNIT-4: ENZYMES**

**(15 Hrs)**

4.1 **Enzymes.** Chemical nature of enzymes. Catalysis-enzyme kinetics, steady state rate kinetics and reaction order. Nomenclature, classification, typical concentration of enzymes in some food, factors influencing concentration of enzymes in some food,

4.2 **Enzyme cofactors.** Feature of organic cofactors, coenzymes prosthetic group – Significance of metallo enzymes in food chemistry, enzyme inactivation and control, reversible inhibitors, competitive and uncompetitive inhibition. Irreversible inhibitors.



4.3 **Food modification.** Role of endogenous enzymes in food quality, colour-lipoxygenase, chlophyllase, texture-pectic enzymes; flavour and aroma changes, nutritional quality in food.

4.4 **Enzymes as processing aids:** Production of sweeteners, in modifying lipids, in milk and dairy products. Baking for the removal of unwanted constituents, brewing, for control of microorganism.

**Self study:** factors influencing enzyme reaction – Substrate activation, inhibition, reaction allosteric behaviour, enzyme concentration, pH, temperature. Chemical nature of prototropic groups in active site of enzyme. Stability of enzyme, enzyme activity at low temperature.

#### **UNIT-5: VITAMINS**

**(5 hrs)**

5.1 **Vitamins:** Classification, stability, toxicity and sources.

5.2 **Fat soluble vitamins.** Vitamin-A and provitamin-A. Vitamins-D and E –structure, stability and mechanism of degradation, Synthesis of vitamin A1

5.3 **Water soluble vitamins** –Vitamins-B and C. Folate-stability and degradation mechanism;

5.4 **Analysis of vitamins:** HPLC method of determination (Vitamins A, C and E). Determination of riboflavin assay by fluorescence study.

**Self study:** Structure of vitamin A<sub>1</sub>, A<sub>2</sub>, B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub>, C, D, E and K (structural elucidation not required)

#### **TEXT BOOKS**

1. O. R. Fennema (2003) Food Chemistry, 3<sup>rd</sup> Ed, Tata McGraw-Hill, New York.
2. Vogel(2006)Vogel's Text Book of Practical Organic Chemistry, 5<sup>th</sup> Ed., Pearson Education.

#### **REFERENCES**

1. S.J. Lippard (1998) *Bioinorganic Chemistry*, Viva Books (P) Limited.
2. P.K. Battacharya (2005) *Biochemistry*, Narosa Publishing House.



**FP-1807:HUMAN NUTRITION**

Semester I

No. of Credit: 4

Category: Major core (MC)

Hours per wk: 5hrs

***Objectives: To prepare the students***

- 1. To understand the relationship between nutrition and human well being.*
- 2. To understand the functions and importance of all nutrients for different age groups- normal and therapeutic groups.*

**UNIT-1: INTRODUCTION TO NUTRITION**

**[15 hrs]**

- 1.1 Food as a source of nutrients, functions of food, definition of nutrients .Adequate, optimum, good and malnutrition. Inter relationship between nutrients.
- 1.2 Food pyramid. Different food groups. Principles of planning diets.
- 1.3 Carbohydrates – glucose, fructose, lactose, sucrose, starch, glycogen, Inulin, dextrin, dextran, cellulose and hemicellulose – functions. Food sources- storage in the body, utilization of carbohydrates and recommended carbohydrate intake.
- 1.4 Proteins – essential and non-essential amino acids, sources, requirements, functions, protein energy malnutrition – Kwashiorkor, Marasmus and Marasmic Kwashiorkor.
- 1.5 Lipids – saturated and unsaturated fatty acids. Essential fatty acids – effects of deficiency of essential fatty acids. Functions of fat-triglycerides, phospholipids, lipoproteins and cholesterol. Requirements of fat, lipids and coronary artery disease – Blood Lipids and lipemia.Total cholesterol and triglycerides, LDL, VLDL & HDL.

***Self study: – Digestion, absorption and transport of carbohydrates, proteins and lipids.***



## **UNIT 2: ENERGY**

**[10 hrs]**

2.1 Units of energy. Food as a source of energy. Determination of energy value of food - direct and indirect calorimetry. Basal and resting metabolism. Factors influencing, energy requirements – recommendations for different age groups and special conditions – ICMR and FAO. Food sources.

2.2 Energy requirements for physical activity. Factors affecting energy requirements.

RDA –Recommended dietary allowances.

2.3 Influence of physical exercise on changes in body fat and body composition, utilization of energy by muscle tissue – adenosine triphosphate, phosphocreatine, glucose, fat and protein.

2.4 Shift in lipid and carbohydrate utilization in relation to exercise type, intensity and duration.

*Self study: Calculation of energy requirements for different age groups involved in different physical activities.*

## **UNIT- 3: PROTECTIVE NUTRIENTS**

**[15 hrs]**

3.1. Vitamins – Classification, sources and requirements. Units of measurement.

Functions and deficiency of the following vitamins – fat soluble : vitamins- A, D, E and K, water soluble vitamins : ascorbic acid, thiamine, riboflavin, niacin, B<sub>6</sub>, folic acid, B<sub>12</sub>, biotin and pantothenic acid

3.2 Minerals – Functions, sources, bioavailability, requirements (RDA). Deficiency of following minerals : Calcium, iron, sodium, potassium, magnesium, copper, manganese, selenium, zinc, chromium, iodine, sulphur, chloride, fluoride and phosphate. *Self study:*

*Planning diets for anemia and various vitamin deficiencies*

## **UNIT- 4: NUTRIENT AND DRUG INTERACTION**

**[10 hrs]**

4.1 Effect of drug therapy on absorption and utilization of nutrients.

4.2 Effect of the nutrients on drug utilization.

*Self study: Effect of specific drugs on the absorption and utilization of nutrients.*



**UNIT- 5: NUTRITION THROUGH LIFE CYCLE**

**[10 hrs]**

5.1.Nutrition through life cycle: Introduction and importance of nutrition through various age groups.

5.2 Infant nutrition – Nutrition through infancy and requirements of different nutrients as per RDA.

5.3 Nutrition of pre-schoolers, school going children, adolescents, pregnant and lactating mothers and geriatric nutrition.

5.4 Prevention of malnutrition – Applied Nutrition Programmes (ANP) globally and nationally.

*Self study: Planning normal and therapeutic diets for various age groups*

**TEXT BOOKS**

1. Kathleen.L.M and Stump.E.S ( 2007) - Krause's Food and Nutrition Therapy,Saunders Publishers,12<sup>th</sup> Ed.
2. Williams S.R and Schelenker .E (2002)- Essentials of Nutrition and Diet Therapy, Mirror Mosby Publishing Company,8<sup>th</sup> Ed
3. Manay S. N. and.Swamy S.(1987)., '*Food, facts and Principles*', Wiley eastern Ltd, New Delhi,

**REFERENCES:**

1. Joshi J.K(2005.) *Basics of Clinical Nutrition*, Jaypee brothers, Medical publishers © Ltd., New Delhi, 1<sup>st</sup> Ed., 2003,
2. Michael J.G., Barrie M. and Margetts M. (2005.) '*Public health nutrition*' Black Well Publishers, Reprint
3. Goplan .C, Ramashasthri B.V. and Balasubramanian F.C. ( 2004)- '*Nutritive Value of Indian foods*' NIN & ICMR publication, revised edition

**WEBSITE:** Nutrition Society Text Book Series, [www.nutritiontexts.com](http://www.nutritiontexts.com)





**FP-1808: ANALYTICAL AND INSTRUMENTATION TECHNIQUES**

Semester – I

No. of Credits: 3

Category: Major core (MC)

Hours per wk: 4

***Objectives: To prepare the students***

*1 .To learn the application of spectroscopy and other instrumental methods for the study and structural elucidation of molecules.*

**UNIT- 1: PREPARATION OF SOLUTIONS, ELECTRONIC AND ATOMIC ABSORPTION SPECTROSCOPY. (15HRS)**

- 1.1 Preparation of solutions: Preparation of solutions, percentage by weight, volume and strength. Normality, molarity, ppm, ppb.
- 1.2 Standard solutions: Dilutions to known concentrations
- 1.3 Buffer solutions :Determination of pH use of pH meter, calibration, pH and potentiometer titration preparation of buffer solutions, pH and buffers control in foods
- 1.4 UV-Visible spectroscopy, principle and instrumentation. Beer-Lambert's law verification and deviation, significance of molar extinction coefficient. Spectrophotometric titration Determination of Fe(III) in the presence of aluminum.
- 1.5 Atomic Absorption Spectroscopy(AAS): Principle and instrumentation-Nebuliser, burner system, graphite tube furnace, resonance line source, monochromators, detectors and spectral & chemical interferences. Determination of calcium & magnesium( in water) and tin (in canned fruit juices). Determination of Pb in petrol.
- 1.6 Spectrofluorimetry: Principles ,Description of fluorimetry, Analysis of riboflavin,thiamine.

***Self study:****Solvents used in electronic spectra. Effect of solvent polarity on the electronic transition – Solvent corrections, and solvent cut off region*



**UNIT- 2: IR SPECTROSCOPY**

**(12 hrs)**

- 2.1 Principle, molecular vibrations and selection rules - Quantitative studies. Calculation of force constants for vibrations. Hydrogen bonding: intra- and intermolecular hydrogen bonding.
- 2.2 Characteristic group absorptions of organic compounds: Carbon skeleton vibrations. Alcohols, phenols, ethers, peroxides, ketones, aldehydes, carboxylic acids, esters, lactones, amines, amino acids; groups absorbing in the fingerprinting region.
- 2.3 Study of isomerism: Linkage isomerism in coordination compounds: cyano-, isocyano-, thiocyanato- and isothiocyanato complexes, geometrical isomers of organic compounds.

*Self study: Instrumentation of IR Spectroscopy*

**UNIT-3: NMR SPECTROSCOPY**

**(15 hrs)**

- 3.1 Principle of NMR spectroscopy .Types of relaxation . Instrumentation , chemical shifts: Factors affecting chemical shift - shielding and deshielding.
- 3.2 Spin-Spin coupling – coupling constant , chemical exchange – study of hydrogen bonding , Interpretation of  $^1\text{H}$  NMR spectra of simple organic compounds
- 3.3  $^{13}\text{C}$  NMR spectroscopy: Basic principles. Comparison of  $^{13}\text{C}$  NMR and  $^1\text{H}$  NMR .

*Self study: Methods of simplifying complex NMR spectra-NMR shift reagents and their uses.*

**UNIT-4: MASS SPECTROMETRY**

**(8 hrs)**

- 4.1 *Principle* – Fragmentation – types and rules, factors influencing fragmentation, fragmentation patterns of hydrocarbons, hydroxyl compounds, alcohols, ethers, ketones, aldehydes, carboxylic acids, amines, nitro compounds, alicyclic and heterocyclic compounds
- 4.2 *Determination of molecular formula*: Molecular ion, nitrogen rule, isotope peak, and metastable ions.



*Self study: Nature of compounds and ionization methods employed in mass spectrometry.  
Common rearrangements of ions in mass spectrometry.*

**UNIT-5: CHROMATOGRAPHY (10 hrs)**

- 5.1 Introduction: Definition of chromatography. Theory and classification of chromatographic methods-paper, column and TLC chromatographies. Development of chromatogram-Applications.
- 5.2 HPLC- Introduction, principle of separation, components of an HPLC system.Pump,injector,column detectors and different type of detectors recorder, Application of HPLC.Super critical fluid chromatography(SFC).Instrumentation and components for SFC-Applications.
- 5.3 Gas Chromatography(GC) - Introduction. Principle-theory of gas chromatography Instrumentation.Types of detectors-evaluation of gas chromatogram. Application of GC.

*Self study:Flow programming chromatography,programmed temperature gas chromatography.*

**TEXT BOOKS**

1. Silverstein R.M and Webster F.X (2003) *Spectroscopic Identification of Organic Compounds*, 6<sup>th</sup> Ed., John Wiley & Sons, New York.
2. W. Kemp(1987), *Applications of Spectroscopy*, ELBS.
3. Srivastava .K and Jain P.C(1997) *Chemical Analysis, An Instrumental Approach*, 3<sup>rd</sup> Ed., S. Chand and Co., New Delhi.

**REFERENCES**

1. D. H. Williams and I. Fleming(1988)*Spectroscopic Methods in Organic Chemistry*, 4<sup>th</sup> Ed., Tata McGraw-Hill Publishing Company, New Delhi.
2. K. Nakamoto(1997) *Infrared and Raman Spectra of Inorganic and coordination Compounds*, Part B: 5<sup>th</sup> Ed., John Wiley & Sons Inc., New York.
3. J. A. Weil, J. R. Bolton and J. E. Wertz(1994) *Electron Paramagnetic Resonance*; Wiley Interscience.



**FP-1809: FOOD MICROBIOLOGY**

Semester: I

No. of credits : 3

Category: **Major core (MC)**

Hours per wk:4 hrs

***Objectives: To enable the students to***

- 1. To understand the microbial, biochemical and physiological aspects of food spoilage.*
- 2. To study the different types of micro organisms responsible for food deterioration and poisoning.*
- 3. To understand the various fermented foods and their importance.*

**UNIT- I: MICROBES AND FOOD**

**(10hrs)**

- 1.1 Scopes of Food microbiology-food as substrate for micro organism, food spoilage, food safety, fermented foods.
- 1.2 Micro organisms important in food microbiology.
- 1.3 Micro organism in water, air and soil. Water treatment and waste disposal.
- 1.4 Micro organisms as natural preservatives, probiotics and prebiotics
- 1.5 Factors affecting growth of micro organism in food- growth curve.

*Self study: Study of fish and meat products as substrates to bacterial growth.*

**UNIT- II: FOOD BIODETERIORATION (10hours)**

- 2.1 Types of biodeterioration- physiological and biochemical biodeterioration.
- 2.2 Specific spoilage organisms- characterization of SSO; CSI, MSL
- 2.3 Food- spoiling micro organisms- food spoiling reactions- interactions between food-spoiling bacteria- Acylated homoserine lactone-based communication and Quorum sensing
- 2.4 Microbial spoilage of cereal and cereal products, milk and dairy products, sea foods, meat and meat products, eggs and poultry, vegetables and fruits.

*Self study: Microbiology of food taints.*



**UNIT- III FOOD BORNE DISEASES**

**(10 hours)**

3.1 Food borne infections- epidemiology, clinical features, and route of contamination, laboratory diagnosis and identification of bacterial, viral, fungal, parasitic infections.

3.2 Food borne intoxications- bacteriotoxins, mycotoxigenic molds as agents of food poisoning, algal food poisoning.

*Self study: Food hygiene*

**UNIT- IV: MICROBIAL FOOD FERMENTATION**

**(10hours)**

4.1 Fermentation- fermentation biochemistry, basic principles of fermentation- organisms responsible for food fermentation-Manipulation of microbial growth and activity-controlled fermentation.

4.2 Microbiology of starters- roles of starters, classification of starter bacteria.

4.3 Fermentations in food processing- classification of fermentation- safety of Fermented foods.

4.4 Production and leavening of yeast-biosynthesis of ethanol

*Self study: Dynamics of microbial population- fermented meat and meat products.*

**UNIT- V: INDUSTRIAL MICROBIOLOGY**

**(10hours)**

5.1 Manufacture of ethyl alcohol from molasses- Beer production- composition and manufacture of beer, uses of ethyl alcohol

5.2 Vinegar production- Methods of manufacture- Defects of vinegar- uses of vinegar.

5.3 Bread production, production of substances added to food- dextran, xanthan and Monosodium glutamate (MSG).

5.4 Mushroom cultivation and single cell proteins.

*Self study: Selection of antibiotics in medicine- vitamin production.*



**TEXT BOOKS:**

1. Vijaya Ramesh K., (2007) *Food Microbiology*, MJP Publishers,
2. Frazier W.C. and Westhoff D.C (2008) *Food Microbiology*, (4<sup>th</sup> Edn), Tata McGrawhill Publishing Co ,New Delhi,
3. Adams M.R. and Moss( 2008) *Food Microbiology*, New age International pvt Ltd. New Delhi

**REFERENCE BOOKS:**

1. James M. Jay, Martin J.Loessner and David A (2005) Golden, *Modern Microbiology*, VII Edition, Springer Science Media Inc.,
2. Moshrafuddin Ahmed and Basumatary S.K. (2006) *Applied Microbiology*, MJP publisher,
3. Prescott, Hershy, and Klein|(2006) *Microbiology* ,2<sup>nd</sup> Edition, MJP publishers,

**JOURNALS:**

1. International Journal of Food Microbiology-Elsevier
2. Food Microbiology Elsevier
3. Indian Journal of Microbiology
4. Journal of pure and applied Microbiology



**FP-1810: QUANTITATIVE ANALYSIS: PRACTICAL-1**

Semester – I

No. of Credits : 2

Category: Major core (MC)

Hours per wk: 4 hrs

**Objectives: To prepare the students**

- 1. To develop analytical skill in organic quantitative analysis*
- 2. To understand the techniques involved in the preparation of standard solutions, standardization and calculations in the estimations of compounds.*
- 3. To appreciate and apply the techniques involved in the estimation of substances.*

**EXPERIMENTS**

- 1. Estimation of hardness of water – Analysis of water, total solid, total hardness, temporary and permanent hardness & estimation of  $Fe^{3+}$ ,  $Ca^{2+}$  and  $Mg^{2+}$  in water.*
- 2. Estimation BOD and COD*
- 3. Estimation of phosphate by gravimetric method – Estimation of phosphate from white bait*
- 4. Estimation of nitrogen by Kjeldhal method - Estimation of caffeine from beverage cola*
- 5. Estimation  $Pb^{2+}$  by visual colorimetry methods*
- 6. Estimation of phenols and polyphenols - Estimation of tannins by volumetric or by colorimetric method/ Estimation of total anthocyanin from fruit juices.*
- 7. Estimation of ketones (ethyl methyl ketone)*
- 8. Estimation of sugars (Glucose) - Estimation of % of reducing sugar, % of total sugars as invert sugar and % of sucrose in fruit juices, jams, jellies.*
- 9. Estimation of ascorbic acid from Vitamin-C (Tablets/ lime juice/ cabbage/green chillies).*
- 10. Estimation of  $Ca^{2+}$  in white bait by permanganometry.*
- 11. Estimation of Glycine – Sorensens Formol Titration.*
- 12. Analysis of vinegar and fruit juices – Total acidity*



**TEXT BOOKS:**

1. Ranganna S., (1977), Manual of analysis of fruits and vegetable products. Tata McGraw Hill Pub. Comp. Ltd., New Delhi,

**REFERENCE BOOKS:**

1. Vogel (1984) *Vogel's Text book of Practical Inorganic Chemistry*, 4<sup>th</sup> Edition, ELBS/Longman, England.

2. Gurtu J.N. and Kapoor R (1987) *Advanced Experimental Chemistry*, S. Chand and Co.,

**FP-1811:ORGANIC ANALYSIS AND PREPARATION-PRACTICAL-2**

Semester – I

No. of Credits : 2

Category : Major core (MC)

Hours per wk : 4hrs

**Objectives: :To enable the students**

1. *To enable the student to develop analytical skill in organic qualitative analysis and to develop preparative skills in organic preparations involving two or three stages.*
2. *To enable the students to understand better the concepts of organic analysis and appreciate better the applications of organic chemistry towards chemical, industrial and biological systems.*
3. *To enable the students to understand the mechanism involved in the name reactions and conditions of the reactions involving the preparations.*

**EXPERIMENTS**

1. a) **Analysis** of two component and three component mixtures; separation and characterization of compounds.  
b) **Separation** of organic preservatives and synthetic sweetening agents from food.





**2. Preparations** involving two or three stages comprising of the following processes.

- a) nitration
- b) halogenation
- c) diazotization
- d) rearrangement
- e) hydrolysis
- f) reduction
- g) acylation
- h) oxidation

**3. Separation** of components from food sources, adulterants and food poisons.

- a) Thin layer chromatography
- b) Column chromatography
- c) Paper chromatography.

#### **TEXT BOOKS**

1. Gnanapragasam N.S. and Ramamurthy G (1998.) *Organic Chemistry – Lab manual*, S. Viswanathan Co. Pvt. Ltd,
2. Gurtu J.N. and Kapoor R (1987) *Advanced Experimental Chemistry*, S. Chand and Co.,

#### **REFERENCE BOOKS**

1. Vogel(1984) *Vogel's Text book of Practical Organic Chemistry*, 4<sup>th</sup> Edition, ELBS/Longman, England,



**FP-1812:FOOD MICROBIOLOGY PRACTICALS**

Semester: I

No. of credits : 2

**Category : Major Core (MC)**

Hours per wk : 4hrs

***Objectives: To enable the students***

- 1. To understand different methods of sterilization ,staining techniques*
- 2. To study different types of micro organisms responsible for spoilage*
- 3. To study microbial destruction*

***EXPERIMENTS:***

1. Methods of sterilization
2. Preparation of culture media
3. Isolation & Enumeration of Bacteria from food ( Pour plate, Serial dilution method)
4. Gram staining of bacteria
5. Most probable number (MPN) method for coliforms in water
6. Microbiological examination of milk- Dye reduction test
7. Detection of E.coli, Salmonella , Staphylococcus in food samples.
8. Fungal examination –LPCB staining ,Slide culture technique
9. Abic sensitivity testing
10. Determination of thermal death point
11. Determination of thermal death time
12. Microbial examination of curd
13. Analysis of aflatoxins by Thin layer chromatography

***REFERENCE BOOKS :***

1. Rajan S. and Christy R. (2010) ‘ Experimental procedures in LIFE SCIENCE’ Anjanaa Book House.
2. Joanne W, Linda S, and Christopher (2010) ‘Laboratory Exercises In Microbiology’. Laboratory manual, ‘Mc Graw – Hill companies.



**FP-2806:ORGANIC CHEMISTRY OF FOOD - II**

Semester – II

No. of Credits: 5

Category: Major (MC)

Hours per wk: 5hrs

**Objectives:**

- 1. To enable the student to understand and identify heterocyclic systems encountered in life systems and in food sources and products.*
- 2. To help the student understand the variety of naturally occurring organic compounds that are used as food additives.*
- 3. To give a basic idea of color and constitution and synthetic food colors.*

**UNIT 1. HETEROCYCLIC SYSTEMS.**

**(15)**

5-membered ring with one hetero atom: pyrrole, furan, thiophene, indole and carbazole.

5-membered ring containing two hetero atoms: pyrazole, imidazole-oxazole-thiazole.

6-membered ring with one hetero atom: pyridine, quinoline, iso-quinoline, pyran and benzopyran.

6-membered ring with two hetero atoms: diazines, benzodiazines, quinazolines, phenazines, phenoxazine and thiazine.

basic structure-some important oxidized and reduced forms and derivatives-heterocyclic rings in DNA, RNA-in enzymes and co-enzymes - in chlorophyll and haemoglobin-in vitamins .

Biosynthesis of cholesterol & bile acids

**UNIT 2. TERPENES.**

**(10)**

Isolation-isoprene rules- application to simple systems

Geraniol, neral, ionones, geraniol,  $\alpha$ -terpeneol, carvone, limonene, 1,8-cineole,

Menthol, menthone,  $\alpha$ -pinene, camphor, borneol, farnesol, zingiberine, pyrethrosin,

$\alpha$ -cadinene, selinene, eudesmol, santonin,  $\alpha, \beta$ -vetivones, caryophyllenes, guaiacol,

longifolene, phylol, abietic acid, gibberellic acid, squalene.

Source, structure, properties - role as food ingredients wherever applicable.



**UNIT 3: ALKALOIDS.**

**(15 hours)**

Chemical nature- general methods of extraction- classification.

Phenethylamine group: ephedrine, Benzedrine, mescaline, adrenaline.

Hemlock alkaloids: conine; Pomogranate alkaloid - pelletrienenes; piperine;

Tobacco alkaloid-nicotine-solanaceous alkaloid-cocaine; cinchona alkaloid-cinchonine, quinine; phenanthrene alkaloid - morphine, codeine,

source, structure, effects on physiological system. Total synthesis of quinine, morphine, reserpine and cocaine

**UNIT 4: FLAVONOIDS.**

**(10)**

Sources, and structure of anthocyanins, - base hydrolysis - pH and color of anthocyanins- structures of cyanidin, pelargonidin, malvidin, hirsutidin and delphinidin chlorides; chromones – flavones – flavonols - base hydrolysis of quercetin;

Isoflavones- base hydrolysis - daidzein; color and heat stability of anthocyanins.

**UNIT 5. DYES.**

**(10)**

Color and constitution - chromophores – hypsochromes – auxochromes - nomenclature of dyes - dyes as indicators - phenolphthalein, methyl orange, indophenol.

Classification - chemical and method of application.

Azodyes –chrysoidine, methyl orange, Congored

Diaryl methane dyes- auramine

Triphenyl methane dyes-malachite green, crystal violet.

Phthalein dyes - florescein, eosin, phenolphthaleine, rhodamine-B.

Acridine dyes- acriflavin, acridin yellow.

Anthraquinone dyes: alizarine-indigo

Food colorants: sunset yellow, orange-B, citrus red No2, yellow No5, green No3.

Preparation of Anthroquinone from anthracene, methyl orange from sulphanic acid.

**Text books:**

1. Agarwal O.P. (1997), *Chemistry of organic natural products*, Vol I & II Goel Publishing House.



2. Gurdeep chatwal *Organic chemistry of natural products* Vol I & II, Himalaya Publishing House, 3<sup>rd</sup> edition.
3. Fennema. R, *Food chemistry*, Marcel & Decket Inc, 3<sup>rd</sup> edition.

**Reference books:**

1. John. M. de Man, (1999,) *Principles of food chemistry*, Aspen Publishers Inc.
2. Dr. Geetha Swaminathan & Mrs. Mary George, (2002), *Laboratory chemical methods in food analysis*, Margham Publishers.

**FP-2807:FOOD BIOCHEMISTRY**

Semester – II

No.of. Credits : 4

*Category – Major core(MC)*

Hours per wk : 4 hrs

**Objectives:**

- 1.To Impart knowledge of biochemistry to better understand the inference of food molecules in mammals.
- 2.To focus on the understanding of biochemical processes in the context of chemical principles
- 3.To inculcate the better understanding on the metabolism of nucleic acid and in vivo protein synthesis.

**1. Unit 1 - Bioenergetics:**

**(5 hours)**

- 1.1. Application of laws of thermodynamics to biochemical systems.
- 1.2. Role of high energy phosphate in bioenergetics and metabolism.
- 1.3. Redox reaction.electron transport chain and oxidative phosphorylation, mechanism-chemi osmotic hypothesis.



**2. Unit 2- Carbohydrate metabolism: (10hours)**

2.1 Metabolic pathways: glycolysis, glycogenesis, glycogenolysis, TCA cycle, HMP shunt, gluconeogenesis.

2.2 Disorders of carbohydrate metabolism.

**3. Unit 3- Lipid metabolism: (10hours)**

3.1 Saturated and unsaturated, essential fatty acids.

3.2 Function of acylglycerols, phospholipids, sphingolipids, Glycolipids, steroids.

3.3 Oxidation in biological systems: Factors influencing rate of lipid oxidation in food. Methods of measuring lipid oxidation- solid fat index, peroxide value, thio barbituric acid test, anisidine value, Kreis test, oxirane test and Iodine value.

3.4 Metabolic pathways: Fatty acid oxidation, biosynthesis of fatty acids, cholesterol, Metabolism of lipoproteins

**4. Unit 4 - Protein metabolism: (10 hours)**

4.1 Essential and nonessential amino acids, peptide bond, structure, function of amino acids.

4.2 Denaturation of proteins, Metabolic breakdown and synthesis of any two essential amino acids, method for separating proteins according to its molecular weight-SDS PAGE electrophoresis

4.3 Amino acid oxidation and production of urea –transamination and functions of pyridoxal phosphate, deamination, decarboxylation, urea cycle, regulation of urea cycle

4.4 Disorders of amino acid metabolism.

**5 Unit 5 - Nucleic acids , membrane biochemistry, and water,electrolytic,acid base balance : (15 hours)**

5.1 Structure of nucleotides, DNA replication, transcription and translation, gene regulation in prokaryotes .



5.2 Structure, supramolecular architecture , transport of substances through membranes- passive, active, facilitated.

5.3 Water balance-distribution,water intake and output,electrolytic composition ofthe bodyfluids and its regulation.production of acids and base in the body ,pH maintainence- respiratory and renal mechanism.

***TEXT BOOKS:***

1. Voet and Voet J.G (1999), 'Fundamentals of Biochemistry', 2nd Edition, John Wiley and Sons Inc, New York.
2. Sathya Narayana.V(1999), 'Biochemistry', Books and Allied (P) Ltd, Calcutta
3. Wilson .W ( 2005) Principles and techniques of practical biochemistry cambridge university press,England

***REFERENCE BOOKS:***

1. Zubay G.L, William W.P, and Vance D.E (1995), 'Principles of Biochemistry', W.C.Brown Publishers, England.
2. Murray R.K,Granner D.K,Meyo P.A and Rodwell V.W, (1993), 'Harper's Biochemistry', Newyork,Prentice Hall International Inc.
3. Deb A.C (1999), 'Fundamentals of bio chemistry', New central Book Agency(p) Ltd.



**FP-2808: FOOD PRESERVATION AND FOOD SAFETY**

Semester – II

No. of Credits: 5

Category: Major Core (MC)

Hours per wk: 5hrs

***Objectives: To enable the students***

- i. To gain knowledge on hazards and toxicity in food and their implication to health.*
- ii. To understand the regulations and monitoring agencies involved in food safety.*
- iii. To gain knowledge on food standards and food laws.*
- iv. To understand the various food preservation techniques.*

**Unit 1: Food preservation and Quality Control**

**( 12 hours)**

1.1 Basic principles of food preservation, types of food preservation.

1.2 Preservation- Background- Principles and industrial applications- Equipments- Packaging considerations- Shelf life and product safety .

1.3 Quality assurance programme: Quality plan, documentation of records, product standards, product and purchase specifications, process control, hygiene and sanitation, corrective action, continuous improvement.

1.4 Quality Control - General concepts, Objectives, Major quality control functions, sampling procedures and plans, methods of evaluation and testing of finished products.

**Unit 2: Food preservation Techniques**

**( 15 hours)**

2.1 Thermal processing- product classification- microbial destruction- end point

thermal death time curve- survivor curve- thermal resistance curve, quality attributes- retort systems, pasteurization.

2.2 Chilling of food- Operation, equipments, storage and transportation- Retail display- unwrapped and wrapped products.





2.3 Physical and chemical agents of freezing- Effect of freezing on micro organisms- food freezing operation- monitoring the quality and safety of frozen foods.

2.4 Drying to minimize biodeterioration- drying processes- air drying- vacuum drying- drying equipments- Bacteria deactivation kinetics during drying process.

**Unit 3: METHODS OF FOOD PRESERVATION ( 10 hours)**

3.1 Hurdle Technology

3.2 High pressure processing, Ohmic heating

3.3 Microwave and Radio frequency heating

3.4 Irradiation with ionizing radiations like X-rays and gamma radiation.

3.5 Chemical preservatives, preservation by use of acid, sugar and salt. High solid- high acid foods. Pectin and gel formation. Invert sugar, jelly making, other food products, food concentrates. Pickling and curing with microorganisms, use of salt, and microbial fermentation.

**Unit 4.- Food Safety – An Introduction ( 8 hours )**

4.1 Introduction to Food Safety- Definition , Safety, Hazards and Risks.

4.2 Food related Hazards- microbiological, nutritional, environmental, natural toxicants and food additives.

4.3 .Microbiological criteria of food and their significance.

4.4 Food Adulteration – Types of adulteration, Intentional and Incidental, Tests for adulteration.

**Unit 5: A Preventive Approach – HACCP. (15 hours )**

5.1. Food Protection systems – Pre-Requisite Programs, Good Manufacturing Practices (GMP's), Sanitary Standard Operating Principles (SSOP's)

5.2 HACCP system of Food Protection - Background, Benefits / Limitations, Principles- Applications in food industries.

Project: Develop a HACCP plan for a food industry.

5.3. Food laws and regulations –National – PFA ,Agmark grading ,BIS,Essential Commodities Act (FPO, MPO etc.) ,FSSAI,International – Codex Alimentarius, ISO,Regulatory Agencies - Consumer Protection Act.Certification systems ,Standardization and Testing laboratories.

**TEXT BOOKS:**



1. Gary S. Tucker, (2008), Food biodeterioration and preservation, Blackwell Publishing Ltd.,
2. Allsopp D., Seal K.J. and Gaylacgde, (2003), Introduction to biodeterioration, second edition, Cambridge University press,

#### **REFERENCES**

1. Mortimore S. E. and Wallace C. A. (2001), Food industry briefing series: *HACCP*, Oxford, Blackwell Publishing,
2. Xu H. and Wang Y. (2005,) The New Sterilization technologies- Scientific and Technical Documents Publishing house, Beijing.
3. Bhatia, R. and Ichhpujan, R.L. (2004), Quality assurance in Microbiology. CBS Publishers and Distributors, New Delhi.

#### **JOURNALS:**

1. Journal of Food Protection
2. International Journal on Food safety, Nutrition and Public health.

<b>FP2809: RESEARCH METHODOLOGY &amp; BIostatISTICS</b>
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Semester – II

No. of Credits: 2

Category: Major Core (MC)

Hours per wk: 2 hrs

#### **Objectives:**

1. *To introduce the purpose and importance of research for future development and Sustenance*
2. *To know the various indices and abstracts in science and technology as a source of all information in chemistry.*
3. *To know the methodology of writing thesis and journal articles.*

#### **Unit- 1: BASICS OF RESEARCH**

**(5hrs)**

- 1.1 Meaning and significance of research, basic types of research– Descriptive vs. analytical, fundamental vs. applied, quantitative vs. qualitative, conceptual vs. empirical.



1.2 Research Process – steps necessary to effectively carry-out research, characteristics of research, criteria of good research, problems encountered by researchers in India.

1.3 Techniques of defining a research problem, meaning and significance of a research design

**Unit- 2: REVIEW OF LITERATURE (5 hrs)**

2.1 Sources of information- Primary, secondary and tertiary sources.

2.2 Indices and abstracts in science and technology: applied science and technology index, biological abstracts, abstracts, titles, current contents, engineering index, index chemicus, index medicus, physics abstracts, science citation index.

2.3 Classical and comprehensive reference works in food chemistry. Beilstein, compilations of data, synthetic methods and techniques, treatises, reviews.

***Self study***

Locating the reference- Finding the abstract, finding the original document, chemical abstract service source index.

**Unit- 3: ANALYTICAL DATA AND DATA ANALYSIS (7hrs)**

3.1 Concepts in collecting data and statistical analysis: sample size, normal distribution, measures of central tendency - arithmetic mean, median and mode.

3.2 Measures of dispersion - range. Standard deviation, coefficient of variation, correlation coefficient and experimental designs.

3.3 Test of significance – ‘t’ test, ‘F’ test for equalities of the variances. Analysis of variance, Chi-square test of association.

***Self study***

Types of data and symmetrical distribution of data.

**Unit- 4: SCIENTIFIC WRITING (5hrs)**

4.1 Research reports, theses, journal articles, and books.

4.2 Requirement of technical communications- Eliminating wordiness and jargon-tautology, redundancy, imprecise words, superfluous phrases.

4.3 Steps to publish a scientific article in a journal- Types of publications-communications, articles, review; specific format required for submission, organization of the material.



4.4 Documenting- Abstracts-indicative or descriptive abstract, informative abstract, footnotes, end notes, referencing styles, bibliography-journal abbreviations (CASSI), abbreviations used in scientific writing.

***Self study***

Journals which publish only communications in food chemistry.

Journals which publish only reviews.

Standard journal abbreviations of select journals in food chemistry.

**Unit- 5: COMPUTER SEARCHES OF LITERATURE**

**(3 hrs)**

5.1 ASAP Alerts, CA Alerts, SciFinder, ChemPort, Science Direct, STN International.

5.2 Journal home pages.

5.3 e-publishing

**Text Books**

1. Kothari C.K. Research Methodology – Methods and Techniques, New Age International, New Delhi, 2004.
2. Gupta, S. P. Statistical Methods, Sultan Chand and Sons, New Delhi. 2011

**Reference Books**

1. Donald R. Cooper and Ramcis S. Schindler, Business Research Methods, Tata McGraw Hill Publishing Company Limited, New Delhi, 2000.
2. Richard I Levin & David S.Rubin: Statistics for Management, seventh edition. Pearson, 2008



**FP-2810: BIOCHEMISTRY PRACTICALS**

Semester – II

No.of.Credits : 2

Category : Major Core(MC)

Hours per wk : 4 hrs

***Objectives:***

- 1. To enable the students to develop analytical skill in biochemistry practical.*
- 2. To understand better the concepts of techniques and appreciate better the applications of bioorganic chemistry towards chemical, industrial and biological systems*

***I. Blood analysis:***

1. Estimation of glucose in blood – orthotoluidine method
2. Estimation of cholesterol in serum – Zak’s method
3. Estimation of inorganic phosphorus in blood – Fiske subbarow method
4. Estimation of alkaline phosphatase in blood
5. Estimation of protein in blood – Lowry method

***II .Molecular biology:***

6. Isolation of DNA
7. Agarose gel electrophoresis- DNA separation
8. Electrophoresis of serum

***III Enzyme analysis:***

9. Catalase: obtained from food source:
  - i)Effect of optimum pH
  - ii)Effect of optimum temperature
  - iii)Substrate concentration
  - iv)Enzyme concentration
10. Protease: obtained from food source:
  - i)Effect of optimum pH
  - ii)Effect of optimum temperature
  - iii)Substrate concentration



iv) Enzyme concentration

***IV Food analysis***

11. Enzymic inversion of sucrose
12. Sorenson's formol titration-casein.

***REFERENCES:***

1. J.Jayaraman (1988), Laboratory Manual in Biochemistry, Wiley Eastern Ltd.
2. 3. Pearson D (1973) 'Laboratory Techniques in food analysis' John Wiley and sons, New York.
4. Varley.H (1976)-Practical Clinical Biochemistry, 4th Edition, Arnold Heinemann.

**FP-2811: INSTRUMENTAL METHODS OF ANALYSIS PRACTICAL-4**

Semester : II

No. of credits : 3

Category: Major Core

Hours per wk: 4 hrs

***Objectives:***

01. To learn the operation of instruments.
02. To familiarize with sample handling techniques and data processing.
03. To analyse and estimate quantitative parameters using instrumental methods.
04. To analyse qualitatively the spectrum of certain chemical compounds relevant to food industry.

**List of Experiments:**

01. Estimation of food colours using UV-visible spectrophotometer
02. Determination of pH in food analysis
03. Estimation of Na/K : Flame photometer
04. Estimation of iron(II) by redox titration: potentiometry.
05. Estimation of strong and weak acid: conductometry
06. Estimation of vinegar : conductometry



07. Kinetics of inversion of canesugar: by polarimetry and comparison of acid strength  
Experiments for demonstration.

01. Determination of functional groups using IR spectrometer (vannillin)
02. Separation and estimation of compounds using column chromatography. \*
03. Estimation of concentration of glucose by Abbe's refractometer.
04. Determination of phosphate : Spectrophotometry.
05. Determination of chlorinated Hydrocarbons in a mixture by GC\*
06. Analysis of flavour – GC – HPLC \*
07. Analysis of analgesics: HPLC\*

**REFERENCE BOOKS:**

1. David.P.Shoemaker,CarlW.Garland and Joseph W.Nibler(1989)  
*Experiments in Physical Chemistry, Fifth edition*, McGraw Hill Book Company.
2. Sundaram.N, Krishnan and Raghavan.P.S (1996) *Practical Chemistry*  
*Part II* , S.Viswanathan (P) Limited.
3. Sadasivam.S and Manikkam.A(2006) *Biochemical Methods*, New  
Age International (P) Limited, Second Edition.

**FP-2952: SUSTAINABLE FOOD MANAGEMENT**

Semester – II

No. of Credits: 3

Category: Elective subject (ES)

Hours per wk: 4 hrs

***Objectives: To enable the students***

- 1.To understand the role of management in food technology*
- 2.To understand the basics on food costing and food control.*
- 3.To understand the food policies and trends .*

**Unit 1 PRINCIPLES OF MANAGEMENT**

**10 hours**

1.1 Management characteristics, objectives, principles, challenges, importance, levels of management, Food industry and management, planning, flow of work in the industry, work simplification techniques.



1.2 Business forecasting and decision making -definition and methods of forecasting, Demand and supply analysis .Characteristics, steps, techniques and types of decisions.

1.3 Food security: Green and white revolution. Steps to fight malnutrition. Food for everyone-possibility and steps. Food security and growing population – vision 2020.

## **Unit 2. DISTRIBUTION AND MANUFACTURING**

**10 hours**

2.1 Food and population, farming and agricultural subsidies, region wise distribution of commodities. Physical and social environment as factors of crop distribution and production, Food Supply Chain – PDS ,advantages and disadvantages, Agro ecology; cropping pattern as indicators of environments. Conservation of forests.

2.2 Machinery evaluation, appreciation and depreciation. Food manufacturing scenario in India. Agriculture as industrial setup. Agro based industries .

## **Unit 3: PRICING AND COST CONTROL**

**10 hours**

3.1 Pricing and distribution, kinds of pricing , product pricing strategies, channels of distribution, middlemen and franchise, wholesaler and retailer.

3.2 Introduction to Cost Control, Definition, Objectives and Advantages of Cost Control, Basic costing, Food costing

## **Unit 4 ORGANISATIONS**

**10 hours**

4.1 Overall view of central industries and the nature of work carried out. Facility and expertise available.

4.2 CFTRI, NDRL, NDRI, NABI,Spice board, coffee and tea development board, coordination committee on egg- Activities and role in food processing and manufacture





**Unit 5 FOOD POLICIES**

**10 hours**

5.1. National and international food policies. Food production and consumption trends in India. Production, procurement, distribution constraints. Availability of food grains, per capita expenditure on food.

5.2 Relation of food production to National Dietary Guidelines and food consumption pattern. Food based dietary approaches to eliminate hunger.

**REFERENCES :**

- 1.Kotler, P. Keller,K.L. (2006) Marketing management,12<sup>th</sup> edition. Pearson Education, Singapore.
- 2.Hayes, G. D. (2004.) Food Engineering data handbook. Longman scientific and Technical, New York .
- 4.Ramaswamy,V.S. and Namakumari,S. (2007)Marketing management- planning , implementation and control, 3<sup>rd</sup> edition. Macmillan India Ltd, New Delhi.

**Journals:** International journal of retail and distribution management.

**FP-2953: FUNCTIONAL FOODS AND NUTRACEUTICALS**

Semester – II

No. of Credits: 3

Category: Elective Subject (ES)

Hours per Wk: 4 hrs

***Objectives: To enable the students***

- i. To understand the growing importance of nutraceuticals and functional foods.*
- ii. To understand the basic concepts of functional food and nutraceuticals and their application in day today life.*
- iii. Identify major types of health foods and nutraceutical products in the market and evaluate their safety and efficacy.*



**Unit 1 Basic concepts of Nutraceuticals and Functional foods -An Introduction ( 10 hours)**

1.1 An overview of the relationship of food, nutrition health and disease - Defining functional foods and Nutraceuticals, Relation of Nutraceutical Science and Functional Foods with other Sciences: Medicine, Human physiology, genetics, food technology, chemistry and nutrition.

1.2. Regulatory issues-Legislation current and expected developments, Regulatory environment and health claims- Regulations governing nutrition and health claims for functional foods and Nutraceuticals from Cereals, vegetable, pulses and fruit products, Designer oils and oilseeds, milk and dairy products.

1.3 Identification of bioactive components-Chemical properties and analytical approaches for identification

1.4 Efficacy and safety of functional foods and nutraceuticals-relationship of bioactive compounds to health benefits and disease treatments, evaluation through animal models and human clinical trials, identification of appropriate biomarkers, safety issues and toxicity, interactions of bioactive compounds with nutrients, medications,

**Unit 2 - Nutraceuticals in health and diseases ( 10 hours)**

2.1 Properties, structure and functions of various Nutraceuticals- Chemical nature – Isoprenoid derivatives, phenolic substances, fatty acids and structural lipids, carbohydrates and derivatives, amino acid base substances, microbes, minerals.

2.2 Mechanism of action – Anticarcinogenic, Antiatherogenic, Antioxidative, Anti inflammatory, Osteogenetic

**Unit 3 – Nutraceutical supplements ( 10 hours)**

3.1 Brief idea about some Nutraceutical rich supplements e. g. Bee pollen, Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, Kelp and *Spirulina* etc. Anti-nutritional Factors present in Foods: Types of inhibitors present in various foods and how they can be inactivated.

3.2 Nutraceuticals -Forms of nutraceuticals e.g. tinctures, capsules, powders, extraction techniques, supercritical extraction, processing techniques e.g. drying, encapsulation, effects of extraction and processing on bioactive compounds, potential role of GMP, HACCP and ISO in product development



**Unit 4 – Role of Functional Foods (10 hours)**

- 4.1 Definition, Relation of functional foods to foods & drugs.
- 4.2 Extraction and processing - Technologies for extraction, concentration, processing of functional foods and nutraceuticals ,Delivery and stability of functional ingredients ,Digestion and absorption of food components and gastrointestinal (GI) challenges for stability and efficacy of functional foods,
- 4.3Active ingredients Sources, health benefits, safety fibre, short chain fatty acids, resistant starch Antioxidants and phytochemicals: sources, health benefits, safety, ingredients and applications in functional foods -Phytosterols, carotenoids, flavonoids, Prebiotics and probiotics; Functional oligosaccharides,Bioactive peptides and proteins: sources, health benefits, safety, ingredients and applications in functional foods Lipids and fatty acids: sources, health benefits, safety,ingredients and applications in functional foods - ALA, Long-chain PUFAs, CLA.
- 4.4 Measurement of functional component and their bioavailability - Need for measurement-chemical measurement and physical testing and microbiological testing- functional foods and vitro studies.

**Unit 5 – Nutrigenomics (10 hours)**

- 5.1 Nutrigenomics Definition , Recent trends and Relationship between nutritional supplementation and gene expression and disease prevention.- An overview
- 5.2 Transgenic plants for the large scale production of proteins for pharmaceutical and industrial uses. Plants as an alternative for biotransformation of raw materials into special chemicals.
- 5.3 Production technology for recombinant therapeutic products using *E.coli* with examples like human insulin, growth hormones, interferons, erythropoietin.

**Text Books**

1. Robert E.C. Wildman. Handbook of Nutraceuticals and Functional Foods, Second Edition, CRC Press, 2007
2. Brian Lockwood Nutraceuticals, A guide for healthcare professionals, Second edition, Pharmaceutical Press, 2007



### 3. Reference Books

1. Schmidl, M . K. and Labuza, T.P. Nutrition and Health Claims in Food Labeling J. Ralph Blanchfield Editor Woodhead Publ. Co. London, 2000
2. Labuza, T.P. Functional Foods and Dietary Supplements: Safety, Good Manufacturing Practice (GMPs ) and Shelf Life Testing in Essentials of Functional Foods M.K. Schmidl and T. P. Labuza eds . Aspen Press 2000

### Journals

1. Functional Foods and Nutraceuticals
2. Nutraceuticals World

<b>FP-3807: Fundamentals of Agro Products and Processing</b>	
Semester – III	No. of Credits : 4
Category: Major Core (MC)	No. of hrs per week: 4

### **Objectives:**

*To enable the students to understand*

- i) The basic concepts of the all the various food group, their structure and chemical and nutritive composition the chemical components in food stuffs*
- ii) The fundamentals involved in the various processing operations of food groups of agricultural origin.*

### **Unit -1: CEREALS AND CEREAL PRODUCTS**

**(15 hrs)**

- 1.1 Processing Principles and unit operations in a manufacturing plant – An Introduction
- 1.2 Structure, classification, composition and nutritive value of the common cereal grains – Rice , Wheat and Millets. Products of wheat, common cereal grains and their uses.
- 1.3 Processing Operations of the cereals- Rice milling – parboiling. Wheat Milling, chakki grinding – bread making –baking, role of ingredients in bread making, extrusion and pasta products processing-noodles, macroni, vermicelli, breakfast cereals



1.4 Processed Products of Rice ( Fermented and Unfermented products),Wheat( Whole wheat flour, maida and semolina) and millets ,maize, jowar, ragi and bajra.

1.5 Post harvest Losses, Chemical and nutritional changes , Prevention of losses, storage of cereal grains

## **Unit -2: PULSES**

**(10 hrs)**

2.1 Types, composition and nutritive value- Anti nutritional factors, toxic constituents, protein contents of pulses- Sprouting.

2.2 Processing of Pulses-Traditional processing of pulses-decortication, soaking, pounding and grinding, germination fermentation, parching of pulses, puffing, milling, agglomeration,methods of cooking of pulses, storage of pulses

2.3 Effect of Processing on the nutrient, quantity and quality of pulses

2.4 Processed products of pulses- Pulse powders, pulse snacks, Soy products

2. 5 New improved technologies of legume processing- Pulse milling,canning,Quick cooking legums, Instant legume powders,Legume protein concentrates, By-product utilization of legume processing

## **Unit -3: OIL SEEDS AND NUTS**

**(10 hrs)**

3.1 Composition, nutritive value and properties of common oilseeds and nuts.

3.2 Processing of oilseeds- General extraction methods Solvent extraction and Expeller methods, Refining techniques- Hydrogenation, randomization and interesterification, winterisation, plasticity

3.3 Processed products - Peanut-peanut milk and peanut butter. Coconut-desiccated coconut, coconut cake, coconut cream, coconut milk powder, Cashewnut processing, Unconventional oils

3.4 Role of fats and oils in cookery- Fat absorption, Fat turnover

3.5 Storage- Rancidity- Types and Prevention

## **Unit -4: FRUITS AND VEGETABLES AND SPICES**

**(15 hrs)**

4.1 Classification, Composition and Nutritive value of common vegetables and fruits, pigments and flavour constituents.



- 4.2 Ripening of fruits – Growing process, respiration and ripening- Changes during ripening and Senescence –Types of Ripening – Natural and Artificial ( Chemical)
- 4.3 Processing techniques – Harvesting and Preprocessing considerations, Post harvest Practices of Vegetables. Harvesting and Processing of fruits – Picking, Quality measurements, Freezing, Heat blanching, Ascorbic acid dip, Sulphur dioxide dip, Sugar syrup, Vacuum treatment. Effect of heat on colour and texture of vegetables – minimizing nutritional losses – qualitative and quantitative aspects.
- 4.4 Processed Products - Canned, pickled, frozen products - Fruit juices - Concentrates and Powders, Jams, Jellies and Marmalades. Natural and artificial preservatives used in processing.
- 4.5 Storage of fruits and vegetables – Commercial Storage operations - Types - Natural and artificial . Field Storage, Controlled atmosphere storage (CAS)
- 4.6 Definition, Classification, Uses of spices as flavouring and colouring agents.

**Unit -5: SUGAR AND BEVERAGE PROCESSING**

**(10 hrs)**

- 4.1 Sugar cane processing – extraction, neutralization, concentration and crystallization, separation and drying – sugar refining, grading of sugar
- 4.2 Confectionary - Caramels sugar related products, sugar coating, and sugar cookery. Chocolate manufacturing
- 4.3 Beverage Processing - Water Beverages, Soft Drink Beverages, Alcoholic Beverages - Wine and Beer Manufacture
- 4.4 Special Beverage Categories - Noncarbonated soft drinks, Powdered soft drinks

**Text Books**

1. Madambi S.R. and Rao, S.M. Food Science, New age international (I) limited, publishers 1997
2. Fellow P. Food Processing Technology: Principles and Practice, Second Edition, Woodhead Publishing Limited, 2000.

**Reference books**

1. Murano, P.S. Understanding food science and technology, Thomson Wordsworth, 2003



2. Meyer, L.H. Food Chemistry, CBS Publishing & Distributors, New Delhi, 2000.
3. Vickie A. V and Elizabeth W. C, Essentials of Food Science, Third Edition, Springer, New York, NY 2008
4. Potter, N.N. Food Science 5th edition. CBS publishers and distributors, New Delhi. 1996.

**FP3808: INORGANIC, PHYSICAL AND CHEMICAL COMPONENTS OF FOOD**

Semester – III

No. of Credits : 4

Category: Major core (MC)

Hours per week: 4

**Objectives: To enable the students to**

1. *To know the different kinds of acids and bases and their importance in hydrogen bonding.*
2. *To understand the structure and bonding of chemical compounds in food.*
3. *To know the physical process involved in food chemistry.*
4. *To know the applications of the concepts of colloids and thermodynamic factors in food chemistry and food processing.*

**UNIT-1: CONCEPTS IN INORGANIC CHEMISTRY**

**(6 hrs)**

- 1.1 **Chemical bond:** Ionic, covalent and coordinate bonds. Distinction between ionic and covalent compounds. Weak intermolecular forces- van der Waals forces.
- 1.2 **Water and ice :** Physical properties. Association of water molecules. Structure of ice. Ice in presence of solutes. Solute solvent - ion-dipole, dipole-dipole and dipole-induced dipole interactions – macroscopic level. Water binding and water holding capacity – molecular level (bound water). Hydrophilic and hydrophobic solutions with organic molecules.

**UNIT 2: WATER ACTIVITY AND TECHNICAL ASPECTS OF ICE**

**(8 hrs)**



**2.1 Water activity:** Relative vapor pressure, temperature dependence – Moisture sorption isotherms. Relative vapour pressure and food stability . Molecular mobility and food stability . State diagrams, key concepts underlying the molecular mobility ( $M_m$ ) approach to food stability

**2.2 Technological aspects of ice :** Freezing (state diagram).Over drying, vacuum freeze –drying (lyophilisation). Approach to food stability-Estimation of relative shelf life – relationship of  $T_g$  and  $M_m$  to relative vapour pressure and moisture sorption isotherms (MSI).

*Self study:Freezing: Air drying and vacuum freeze.*

### **UNIT-3: MINERALS:**

**(10 Hrs)**

**3.1 Minerals in food:** Essential metals as nutrients .Solubility of minerals. Acid-base theory – Lowry – Bronsted and Lewis theories–chelate effect. Dietary allowances for the mineral nutrients. Bioavailability – Ca, Fe, factors affecting the mineral composition.Nutritional aspects of minerals.

**3.2.Fortification:** Iron sources used in fortification-mineral composition of foods – any four (white bread, white rice cooked, whole milk, raw carrot). Chemical and functional properties of minerals in food – calcium, phosphate, iron, nickel and copper.

### **UNIT-4: PHYSICAL CONCEPTS**

**(15 Hrs)**

**4.1 Thermodynamics in food:** Significance of  $\Delta H$ ,  $\Delta S$  &  $\Delta G$ . Coupled reactions in biological systems. Significance of  $E_o$  (SRP).

**4.2 Chemical equilibrium:** Reactions involving gases and solutions-temperature dependence of equilibrium constants. Use of Kirchoff's equation for the calculation of equilibrium constant.

**4.3 Dispersed systems:** Food as dispersed system. Types of dispersion. Effects on reaction rate, surface phenomenon – interfacial tension and adsorption, surfactants, CMC, contact angles, curved interfaces, interfacial rheology. Surface Tension gradients, van der Waals attraction. Electric double layer, DLVO theory – Liquid dispersions, sedimentary aggregation





kinetics, reversibility of aggregation, Gels- food gels, plastic fats, caseinate gels, gelatin, polysaccharides, globular proteins. Concentrated starch gels- Mixed gels.

- 4.4 ***Kinetics to shelf life modeling*** – Chemical changes during processing and storage. Food quality function. Order of reaction. Temperature effects – Arrhenius approach- Simple shelf-life plot approach. Dehydrated products(ASLT scheme) – dry desert mix, dehydrated mashed potatoes, frozen pizza- General aspects of quality loss and shelf life test.

*Self study: Emulsion and foam – Oswald ripening*

## **UNIT-5 : ANALYSIS OF FOOD**

**(10 hrs)**

- 5.1. ***Moisture and ash analysis:*** Importance of moisture assay and moisture analysis. Sample collection ,handling and removal of moisture. Decomposition of other food constituents. Oven drying-vacuum oven, microwave and IR drying, Rapid moisture analyzer technology, Karl-Fischer titrations. Ash analysis- ash content in food, dry, wet, low temperature and plasma ashing.
- 5.2. ***Fibre and mineral analysis:*** Importance of dietary fiber. Determination of fiber. Major components of dietary fiber-lignin. Fiber analysis- sample preparation, gravimetric method- Englyst- Cummings procedure. Mineral composition analysis of food- Estimation of calcium by gravimetric and complexometric methods.

*Self study: Mineral composition of food and factors affecting food.*

### **TEXT BOOKS**

1. O. R. Fennema, *Food Chemistry*, 3<sup>rd</sup> Ed, Tata McGraw-Hill, New York, **2003**.
2. V. A. Vaclavik and E. W. Christien, *S Essentials of Food Science*, 3<sup>rd</sup> Ed., Springer, **2008**.
3. R. A. Day and A. L. Underwood, *Quantitative analysis*, Prentice-Hall of India, **2001**

### **REFERENCES**

1. D. F. Shriver, P. W. Atkins, and C. H. Langford, *Inorganic Chemistry*; 3<sup>rd</sup> Ed.; Oxford University Press: London, **2001**.



2. J. Mentham, R.C. Denney, J.D. Barnes and M. Thomas, *Vogel's Textbook of Quantitative Chemical Analysis*, Pearson Education Pvt. Ltd., 2004

**FP3809: CHEMISTRY OF DAIRY PRODUCTS**

Semester – III

No. of Credits: 3

Category: Major core (MC)

Hours per week: 4

**Objectives: To enable the students to**

- 1) To understand the chemistry of milk and milk products.
- 2) To encourage students to undertake more extensive study in milk.
- 3) To make the students to understand and appreciate the concept of chemistry in milk.

**UNIT 1: PHYSICAL PROPERTIES OF MILK**

**(8 hours)**

- 1.1 Physical properties of Milk: ionic strength, density, redox properties of milk, colligative properties of milk, Temperature-time curve for the freezing of milk- Interfacial Tension. Acid base equilibria- pH of milk, buffering capacity of milk, titrable acidity and freshness of milk. .
- 1.2 Thermal properties of milk-specific heat of milk fat, thermal diffusivity, Interaction of light with milk – refractive index, colour. - electrical conductivity
- 1.3 Rheological properties of milk, milk gels and .milk fat

**Self study:**

Estimation of acidity and total solid in milk.

**UNIT 2: MILK LACTOSE**

**(12 hours)**

- 2.1 Chemical and Physical properties of lactose-Koestler number and quality of milk. Structure and Solubility of lactose –  $\alpha$ -lactose,  $\beta$ -lactose; , mutarotation of lactose, effect of pH on mutarotation, significance of mutarotation. effect of temperature.



- 2.2 Crystallisation of lactose- lactose solubility curves and factors affecting solubility, Lactose glass-effect in milk powder, whey powder and concentrates, sweetened condensed milk, ice-cream, other frozen dairy products, Thermoplasticity of lactose, role of water instickiness and caking of powders.
- 2.2 Production of Lactose & derivatives of lactose- Maillard reaction and mechanism – Amadori rearrangement of glycosyl amine, determination of lactose concentration- by polarimetry, redox titrations.

***Self study:***

Lactose intolerance, Galactosaemia & metabolism of galactose.

**Unit 3: MILK LIPIDS AND MILK PROTEINS**

**(10 Hrs)**

- 3.1 Milk lipids: Factors affecting the fat content in milk, Fatty acids profile of milk lipids, milk fat as an emulsion, milk fat globules membrane (MFGM).
- 3.2 Milk proteins- heterogeneity of milk proteins – preparation of casein and whey proteins – acid isoelectric precipitation., ultrafiltration, gelfiltration and rennet coagulation. Chemical and physiochemical properties of milk proteins - Hydrolysis of primary caseins by plasmin - Structural hierarchy in proteins: –amino acid sequence in casein, primary structure, secondary & tertiary structure- micelle structure.

***Self study:***

Changes in the concentration of fat, protein, and lactose in milk during lactation,

**Unit 4: MINERALS, VITAMINS, ENZYMES AND HORMONES IN MILK (10 hours)**

- 4.1 Salts of milk: Factors influencing variation in salt composition, correlation between sodium and potassium, interrelations of milk salts & constituents - soluble salts and measurements of calcium and magnesium ions. Colloidal milk salts -changes in milk salts equilibria.
- 4.2 Vitamins – Vitamin in milk fat soluble and water soluble,role of vitamins in milk and milk products. Bioavailability of vitamins.

***Self study:***



Enzymes and hormones- Significance of any five enzymes in milk, role of exogenous enzymes in food analysis.

**Unit 5: DAIRY PRODUCTS**

**(10 hrs)**

- 5.1 Fermented milk products- - definition, conditions, cultured milk, cultured cream, yoghurt, cheese- rennet coagulated cheeses, conversion of milk into cheese, curd, Factors affecting rennet coagulation, Protocol in manufacturing cheese from rennet casein
- 5.2 Analysis of milk and milk products – sampling milk and milk products, Roese-Gottlich fat analysis, Gerber method of analysis, determination of specific gravity, total solid, acidity, sediment test, analysis of butter- modified Kohman test, detection of added water, total solid- Marshall rennet test, methylene blue test, Reazurin test, alcohol test, Arnold Guaiac test, phosphatase test. Milko tester.

**Self study:** Milk powder- need, drying process-types of drying. Pasteurisation- types in processing milk.

**Text books:**

- 1 Dairy Chemistry and biochemistry, P.F. Fox and P.L.H. McSweeng I, Blackie Academic & Professional 1998.
- 2 Fox, P.F. (ed.) (1982-1989) *Developments in Dairy Chemistry*, Volumes 1, 2, 3 and 4, Elsevier Applied Science Publishers, London.
3. Fox, P.F. (ed.) (1992-1997) *Advanced Dairy Chemistry*, Volumes 1, 2 and 3, Elsevier Applied Science Publishers and Chapman & Hall, London.

**Reference books:**

1. Wong, N.P., Jenness, R., Keeney, M. and Marth, E.H. (eds) (1988) *Fundamentals of Dairy Chemistry*, 3rd edn, Van Nostrand Reinhold, New York

**Journals :** Journal of Dairy science.



Semester – III

No. of Credits: 2

Category: Major Core (MC)

Hours per wk: 4

**Objectives::**

*To enable the students,*

- i. To gain knowledge on the concept of preparing the samples for analysis and to operate the instrument, which is used to analyze the foods.*
- ii. To understand principles of various methods of analysis and respective instruments*

**EXPERIMENTS:**

1. Determination of energy value of foods using bomb calorimeter (Parr oxygen bomb calorimeter). Demonstration only
2. Analysis of Protein content in by Kjeldal titration
3. Determination of Total carbohydrates in Foods colorimetrically – Anthrone and DNS method.
4. Estimation of fat by Soxhlet extraction
5. Ashing of foods, estimation of calcium, phosphorus and iron content of foods
6. Isolation and identification of synthetic food colors in sweets, confectionery, beverages.
7. Analysis of benzoic acid and sodium benzoate preservatives in processed food samples
8. Analysis of yeast, baking powder in baked food products
9. Analysis of fats and oils- Peroxide value, acid value, Saponification value, Iodine value, RM number, Free fatty acids
10. Estimation of sodium and potassium content of food using Flame Photometry
11. Estimation of Thiamin and Riboflavin content in food.
12. Analysis of adulterants in various food groups ( demonstration)
13. Determination of Insoluble and Soluble fibre using Fibraplus

**Mini Project:** Estimation of proximate composition of various food and food products.



**Visits:** Exposure visits to R & D lab in industry / research institutes / food testing lab

**TEXT BOOKS:**

1. S. Ranganna , ‘Manual of analysis of fruits and vegetable products’, Central food technological research institute, Mysore, Tata McGraw Hill publishing company Ltd, New Delhi, **1977**.
2. S. Sadasivam, and A. Manikam, ‘Biochemical methods’, New Age International(p) Ltd. publishers and Tamil Nadu Agricultural University (Coimbatore), 2nd edition, **1996**.
3. Nielsen Suzanne S (Ed) (2003) ‘Food Analysis’ Plenum Publishing Corporation, U.S.A.

**FP-3811: FOOD PROCESSING PRACTICAL-Practical VII**

Semester – III

No. of Credits: 2

Category: Major Core (MC)

Hours per week: 4

***Objectives:***

*To enable the students,*

- To gain knowledge on the basic principles of preservation of various food groups*
- To enhance their practical skills on increasing the shelf life of food products by appropriate processing techniques*
- To improve the storage quality and value addition of food products.*

**EXPERIMENTS:**

**1. Experiments on Preservation**

- a. Low Temperature processing -Studies on low temperature and ambient storage - Processed food / fruits / vegetables in various packaging material after giving appropriate pre-treatment.
- b. Freezing temperature - Frozen food Processing packaging and freezing and thawing (using various packaging material)



c. High Temperature processing -Experiments on Blanching, sterilization, pasteurization, concentration (paste)

d. Effect of chemical preservatives-Benzoate, So<sub>2</sub>, salts ( KMS, NaMS)Acetic Acid, Lactic Acid, Propionate, Sorbates

2. **Processing of cereal and pulse based products** : Products will be processed based on standardized recipes, costing will be done and value addition to enhance the nutritional value in the following food group and their products:

A . Baking technology- Breads,biscuits,cookies,cakes etc

B. Extrusion Technology – Noodles,Vermicelli,sago chips,pasta

C. Preparation of Indigenous products – Chappathi,Idli,Dokla,Vada etc

D. Preparation of pop corn and papads

E. Cereal and Pulse flour – health mixes – Regular, Roasted and Germinated

3. **Processing of Milk and milk Products**: Products will be processed based on standardized recipes, costing will be done and value addition to enhance the nutritional value in the following food groups and their products:

Paneer, Ice cream, kulfi, dahi, yoghurt, lassi,rabdi,milk based confectioned ( peda, burfi, Shriknad, rasagolla, gulab jamun and whey – based beverages.

4. **Fruit and vegetable based products**: Products will be processed based on standardized recipes, costing will be done and value addition to enhance the nutritional value in the following food groups and their products:

A. Tomato Products – Sauces,Ketchups,purees,

B. Mango products- Sqaush,Jam,pickle,juice,leather,mango preserve

C. Lemon Products - Juices, Squashes and Cordials

D. Processing of Seasonal fruits

5. **Processing of sugar based preserves** - Jam making process, Jelly/Synthetic jelly candies,Marmalades,Murabba

6. **Processing of salt preserves**:

A. Preparation of Brine

B. Salting of Fish, Vegetables using various containers



- C. Pickling -Fruits and vegetables,Fish products,Sauerkraut,Fish pickle,Traditional meat pickles
7. **Processing of spices and preparation of Masalas:** Products will be processed based on standardized recipes, costing will be done and value addition to enhance the nutritional value will be implemented.
- A. Masalas- Rasam powder, Sambar powder, Tea masala, Milk masala, Garam masala
  - B. Isolation of essential oil of coriander/cumin by steam distillation
  - C. Preparation of oleoresin from ginger/turmeric/pepper by solvent extraction
8. **Processing of Instant mixes - Milk mix- kheer, instant pulavs, instant traditional mixes- sambar etc., Instant mixes for gulab jamuns, jalebi etc.**
9. **Sensory Evaluation :** Difference tests, Paired comparison , Duo-Trio test, Difference from control, Ranking tests, Triangle tests, Magnitude estimation, Acceptance test, Hedonic rating and multiple sample ranking for preference.

**TEXT BOOKS:**

1. B.C.Muzumdar and K.Muzumdar, Methods of Physico-Chemical analysis of fruits: Daya publishers, New Delhi, **2003.**
2. E.B.Jackson, Sugar Confectionery Manufacture, 2nd edition, Blackie Academic and Professional, Glasgow, **1995.**
3. S.Ranganna, Manual of analysis of fruit and vegetable products, Tata McGraw-Hill Publishing company Ltd, New Delhi, **1979.**

**REFERENCES:**

- 1 G.R.E. Lionnet, Sugar Technology for Students, Lang Fred, Durban, S.Africa, **1999**
2. B.B. Min and C.C Akoh, Food lipids, Marcel Decker, **1998**
3. D.B. Min and R.E. McDonald, Food Lipids and Health, Marcel Decker, **1996.**





**FP-3951: COMPUTING TECHNIQUES- EXCEL FOR FOOD CHEMISTS**

Semester – III

No. of Credits: 3

Category: Elective Subject (ES)

Hours per week: 4

**Objectives:**

1. To equip the student to have a working knowledge of the application software Excel 2007.
2. To apply statistical tools to data and error analysis, standard equations to represent chemical processes and to curve-fit data.
3. To enable one to present relevant scientific data in plots, graphs or chart in various formats and if needed to get a hard copy of the results.

**Unit- 1: GENERAL INTRODUCTION TO MICROSOFT OFFICE 2007**

**AND EXCEL 2007**

**(10 hrs)**

- 1.1 Starting, getting help and quitting
- 1.2 Excel environment: rows, columns, cell, workbook, worksheet, toolbar, menubar, formula bar etc.
- 1.2 Details about standard toolbar and formatting toolbar buttons.

**Unit- 2: BUILDING WORKSHEETS**

**(8 hrs)**

- 2.1 Entering, copying, importing and editing data.
- 2.2 Saving and opening files

**Unit- 3: CALCULATIONS**

**(8 hrs)**

- 3.1 Simple calculations; use of standard mathematical functions.
- 3.2 Complex calculations involving user-made functions and statistical functions.

**Unit- 4: PLOTTING, PRINTING AND TRANSFER OF DATA**

**(9 hrs)**

- 4.1 Standard and customized charts and graphs
- 4.2 Editing and annotating and pasting
- 4.3 Add trendline, curve fitting and error analysis
- 4.4 Previewing and printing spreadsheet data and graphs
- 4.5 Transferring data and graphs interactively.



**Unit- 5: EQUATIONS FOR COMPUTATION**

**(10 hrs)**

5.1 Arrhenius equation:  $k = A \exp(-E_a/RT)$

5.2 Calculation of diffusion coefficient:  $D = k_a T / \pi \beta \eta r$

5.3 Henderson - Hasselbalch equation:  $\text{pH} = \text{pK}_a + \log\{[\text{salt}]/[\text{acid}]\}$

5.4 BET equation for the sorption of moisture on food materials:

$$A_w/m(1-a_w) = \{1/m_1c\} + \{(c-1)a_w/m_1c\}$$

5.5 Lambert-Beer equation:  $I/I_0 = \exp(-\epsilon cl)$

5.6 Dissociation constant of a weak acid:  $K_a = \alpha^2 c / (1-\alpha)$

5.7 Models for accelerated shelf-life study

5.8 Calculation of nutritive and energy value

5.9 Food composition data bases

**TEXT BOOK:**

John Pragasam, S.J., A Handbook on EXCEL FOR CHEMISTS,

Loyola College, 2008.

**REFERENCES:**

1. E.J. Billo, Excel for Chemists – A Comprehensive Guide, II edition, WILEY-VCH, New York, **2001**.
2. G. Courter and A. Marquis, Microsoft Office 2000, BPB Publications, New Delhi, **1999**.
3. J. Kelly, Using Microsoft Excel 2000, Prentice-Hall of India, New Delhi, **1999**.



**FP-3952: FOOD ENTREPRENEURSHIP**

Semester III

No.of Credits : 3

Category : Elective subject (ES)

No.of hours/week: 4

***Objectives:***

*To enable students to*

- *Develop entrepreneurship skills*
- *Analyze the environment related to small scale industry and business*
- *Understand the process and procures of setting up small enterprises.*
- *To acquaint with techniques of business management and international trade for food sector.*

**Unit 1. INTRODUCTION**

**10hrs**

- 1.1 Entrepreneurship – Types of entrepreneurs – entrepreneurship and Economic development.
- 1.2 Motivating factors- theory of motivation; barriers to entrepreneurship.-political, social ,technological.

**Unit 2. IDENTIFICATION OF BUSINESS ENVIRONMENT: 15 hrs**

- 2.1 Micro and macro environments; consumer Behavior; consumerism-legislations in India.
  - 2.2 Marketing research-components of marketing research, introduction, review of literature, research methodology, analysis and marketing Information systems- marketing communication
- Project: Development a proposal for establishing an enterprise and the techno-economic feasibility of the project.

**Unit 3. SMALL SCALE INDUSTRIES:**

**10 hrs**

- 3.1 Small scale units; Types of small scale units; Problems of small scale units remedial measures, Marketing with relevance to FMCG(with specific reference to Food),Personnel management.
- 3.2 Employer – employee relationship in food industry.

**Unit 4. MARKETING MIX (4 P's):**

**15 hrs**



- 4.1 Product, new product development, product life cycle
- 4.2 Place - Marketing channel decision, retailing, wholesaling and distribution.
- 4.3 Pricing decision, price determination
- 4.4 Promotion mix-(sales promotion, advertising, personnel selling, publicity)

**Unit 5. LEGAL ISSUES AND FUNDING AGENCIES: 10 hrs**

- 5.1 Government of India policy towards promotion of Entrepreneurship.
- 5.2 Ethics in marketing, legal and regular framework-microfinance and empowerment.
- 5.3 Joint ventures, Funding agencies -APEDA, MOFPI, MSME.

**TEXT BOOK**

1. C.B.Gupta(2012) ,Marketing management(14th reprint) Jain book depot,India
2. Deshpande V (1984) ‘Entrepreneurship of small scale food industries. Concept, growth and management ‘deep and deep pub, New Delhi.
3. Parek U and Rao T V (1978) ‘Personal efficacy in developing entrepreneurship ‘learning systems, New Delhi.
4. Rao T V Parekh L U (1982) ‘development entrepreneurship. A handbook ‘learning system, New Delhi.

**REFERENCES:**

1. Jhingan ML. 2005. International economics. 5<sup>th</sup> Ed. Virnda Publ.
2. Reddy SS, Ram PR, Sastry TVN and Bhavani IdD. 2004. Agricultural economics. Oxford and IBH.



**FP-3875: FOOD PROCESSING TECHNOLOGY**

Semester – III

No. of Credits: 5

Category: Interdisciplinary paper (ID )

Hours per wk : 6

**Objectives:**

*To enable the students to*

- i. To gain knowledge on the basic principles of food processing and the various methods used to process foods*
- ii. To be aware of the processed food products available in the market.*
- iii. To understand the basic principles of processing and the unit operations employed in a food processing plant.*

**UNIT I – Introduction to Processing - Unit Operations**

1.1 Introduction – Types of biodeterioration – Chemical, Physical and microbial deterioration

1.2 Food biodeterioration – Autolysis, Microbial spoilage, Contamination and Food spoilage, Mechanism of food deterioration – Factors affecting microbial growth – fermentation – fermentation biochemistry – putrefaction- lypolysis.

1.3 Operations in Food Processing – An overview – Handling, Cleaning, Separation Techniques, size reduction, pumping, mixing, heat exchange, concentration, drying, , forming and packaging

**UNIT -2 Storage of food in Low Temperatures**

2.1 Effect of cold storage and quality- storage of grains; Principles of refrigerated gas storage of food- Gas packed refrigerated foods; Sub atmospheric storage; gas atmospheric storage of foods.

2.2 Principles of freezing of food product, processes and equipment for freezing of fresh and processed foods. IQF of marine products. Frozen and cold storage. Changes during freezing and storage. Microbial aspects of frozen foods, Freeze drying and freeze concentration.



### **UNIT -3 Storage of foods in high temperatures**

3.1 Principles of thermal processing of food. Pasteurization, sterilization and canning. Spoilage of canned foods, storage of canned foods; Influence of canning on the quality of food; improvement in canning technology. Calculation of process time temperature-schedules.

3.2 Retort processing of Ready to eat (RTE) products. Drying Water activity, microbial spoilage due to moisture. Dehydration of fruits, vegetables, milk, animal products etc. Types of dryers. Osmotic dehydration.

3.3 Newer methods of thermal processing- batch and continuous; application of infra-red microwaves; ohmic heating. Intermediate moisture foods.

### **UNIT -4 Other Methods and Hurdle technology**

4.1 Preservation by Concentration of liquid foods :Control of water activity; preservation by concentration; reverse osmosis and membrane filtration with reference to fruit juice and milk.

4.2 Non-thermal methods, chemical preservatives, irradiation, high hydrostatic pressure, smoking. Application of Hurdle technology and minimal processing. GRAS and permissible limits for chemical preservatives and legal aspects for gamma irradiation.

4.3 Use of enzymes and microorganisms in processing and preservation of foods. Lactic acid fermentation, alcoholic fermentation, pickling, smoking.

### **UNIT 5 Processing Technology of the Basic five food groups – An overview of the various processed food products**

5.1 Cereals and Pulses -Milling of wheat, Milling of rice – parboiled rice, rice based instant food Processing of corn, barley and millets – pearling, flaking and puffing, corn starch products, Malting , Pulses – Decortication and dhal milling, elimination of toxic factors, fermentation and germination , Soy based products

5. 2. Milk and Milk products-Collection, Standardization, pasteurization, homogenization, UHT processing, manufacture of some of the common Indian dairy products-Paneer, khoa, curd, etc

5.3. Fruits and vegetables-Harvesting, physiological and bio chemical changes during ripening, handling and storage, general methods of processing - extraction and pulping, raw material and product specifications and standards.



5. 4. Meat, poultry, fish and egg - Ageing and tenderizing, curing, smoking and freezing of meat, fresh storage of meat. Meat based products: sausages, salaami, bacon. Fish processing and storage, pickling. Egg: storage, frozen egg, dehydrated egg powder.

5.5.Nuts and Oil seeds – Pressing, solvent extraction, purification – degumming, refining, bleaching, deodourizing. Hydrogenation – margarines, shortenings

5.6 Beverages – Alcoholic ( Beer and Wine ) , Non – Alcoholic (Tea, coffee and cocoa) – Processing and storage.

### **Text Books**

- a. Fellow P. Food Processing Technology: Principles and Practice, Second Edition, Woodhead Publishing Limited, 2000.
- b. Neelam K. Food Processing and Preservation', Daya Publications, New Delhi. 2005\
- c. Da-Wen Sun, Contributor Da-Wen Sun, Emerging Technologies for Food Processing, Published by Academic Press, 2005
- d.Sivasanker B. Food Processing and preservation– Prentice Hall India Pvt. Ltd., New Delhi.2002.

### **Reference books**

1. Murano, P.S. Understanding food science and technology, Thomson Wordsworth, 2003
2. Potter, N.N. Food Science 5th edition. CBS publishers and distributors, New Delhi. 1996.
3. Shafiur Rahman. Handbook of Food Preservation. Replika Press Pvt. Ltd. India 2006



**FP-4805:FOOD FROM ANIMAL SOURCES AND PROCESSING TECHNIQUES**

Semester – IV

No. of Credits: 4

Category: Major core (MC)

Hrs per week: 5

**Objectives:** *To enable the students*

- i. To understand the importance, composition and nutritive value of meat, meat products, seafoods and dairy products.*
- ii. To gain knowledge on the composition and nutritive value of foods of animal origin.*
- iii. To understand the various unit operations in animal food manufacturing plant*

**Unit-1:ANIMAL PRESERVATION AND PROCESSING - INTRODUCTION (10 hrs)**

- 1.1 Food deterioration– Consequences and causes of food autolysis, microbial spoilage, contamination and poisoning.
- 1.2 Unit Operations in animal food processing – Handling, cleaning, separating techniques, size reduction, pumping, mixing, heat exchange, concentration, drying, forming and packaging.
- 1.3 Recent trends in animal food preservation and processing. Concept of halal and kosher

**Unit-2: MILK AND MILK PROCESSING**

**(15 hrs)**

- 1.1 Composition and Nutritive value of milk. adulterants in milk. Microbial contaminants in milk
- 1.2 Processing of milk -Methodology of milking, Clarification, pasteurization, homogenization, fortification .Milk substitutes
- 1.3 Production of non-fermented milk products – whey protein concentrate, Skim milk, evaporated milk, condensed milk, dry milk, khoa, rabri, chhaina, ice cream, standardized milk, toned milk, double toned milk, recombined milk, sterilized milk, filled milk, flavoured milk, and cream.
- 1.4 Fermented milk products – butter, cheese, paneer, curd, shrikhand, yoghurt, kafir, kumiss, acidophilus milk and sour cream





**Unit-3: POULTRY AND POULTRY PRODUCTS**

**(8 hrs)**

- 2.1 Eggs–Formation, structure, composition and nutritive value of egg white and egg yolk (proteins, fats, pigments, vitamins and minerals)
- 2.2 Evaluation of egg quality - Candling, floating in water, and grading of eggs. Storage of Eggs. Egg Products – Frozen, Pasteurised, Dehydrated, Desugared. Egg substitutes
- 2.3 Poultry–Classes of poultry meat, classification, composition- tenderness flavor, colour and nutritive value
- 2.4 Processing of Poultry for meat – Production, consideration, processing plant operations– slaughtering and bleeding, scalding, defeathering, eviscerating, chilling Storage of poultry - Chilling, freezing (whole and cuts), canning, dehydration
- 2.5 Poultry meat products- Whole birds, parts, sausages, combination with other food groups.

**Unit-4 : MEAT AND MEAT PROPROCESSING**

**(15 hrs)**

- 3.1 Structure, muscle–connective tissue–collagen–elastin–adipose tissue–cartilage.
- 3.2 Composition and nutritive value Classes of meat and related products. Desirable characteristics of meat.
- 3.3 Post-mortem changes in meat. Changes in meat on cooking– denaturation of protein, hydrolysis of collagen. Colour change, drip formation, meat aroma, and dispersion of fat, decrease in vitamins, surface reddening and overcooking.
- 3.4 Processing- ageing of meat, tenderizing meat – mechanical, chemical (curing – salting, pickling), addition of enzymes – papain, bromelin, ficin, marinading, Chilling, freezing and thawing, canning, Cooking of meat- Dry heat and moist heat
- 3.5 Processed meat products and meat substitutes- Sausages and table ready meats, frankfurter. Meat substitutes – Textured protein products and vegetable protein products.

**Unit 5: SEA FOODS**

**(12 hrs)**

- 3.1 Composition and nutritive value of sea foods. Classification of fishes, Spoilage factors, Perishability of seafoods Selection criteria of fish, Fish allergy and remedies.



3.2 Processing stages for seafoods – Procurement and Preservation methods- Chilling, freezing, canning, curing and drying

3.3 Aquaculture – Fish farming – Types Extensive, Intensive and semi- intensive farming.  
Tuna fishery.

3.4 Fish Processing and fish products – Fish meal, fish flour, fish oil and fish byproducts.

**TEXT BOOKS :**

1.B. Srilakshmi, Food Science, New Age International Pvt. Ltd. Publishers, 3<sup>rd</sup> edition, **2003**.

2. P.S. Murano, Understanding food science and technology, Thomson Wordsworth, **2003**

3. R. Parker, Introduction to food science, **2003**.

**REFERENCES:**

1. N.N. Potter and J.H. Hotchkiss, Food Science, CBS Publishers and Distributors 5<sup>th</sup> edition, **1997**

2. P.S. Murano, Understanding food science and technology, Thomson Wordsworth, **2003**

3. R. Parker, Introduction to food science, **2003**.

**FP-4806: CHEMISTRY OF FOOD ADDITIVES**

Semester – IV

No. of Credits : 4

Category: Major Core (MC)

Hours per week: 5

**Objectives:**

1. To enable the student to understand the importance of
  - i) additives in food industry
  - ii) flavoring agents, food colors and sweeteners
2. To appreciate the changes in their properties on processing.

**Unit -1: PRESERVATIVES AND ANTIOXIDANTS**

**(15 hrs)**

1.1 Additives–contaminants–role of additives-intentional additives- Preservatives– benzoic acid–parabens–citric acid–sorbic acid–sulphites-nitrites–



nitrate–hydrogen peroxide.

- 1.2 Antioxidants: Generation–causes–effects–Naturally occurring antioxidants–role of Vitamin C– Vitamin E –tocopherols–lipoic acid–evaluation of antioxidant property.

## **Unit -2: COLORANTS**

**(15 hrs)**

- 2.1 Pigments in animals and plants tissues- myoglobin, oxymyoglobin, metmyoglobin - color of meat, color change on processing - pigment stability on packaging-
- 2.2 Chlorophyll - influence of pH on processing; technology of color preservation - enzymic - metallo complex formation; carotenoids-occurrence-distribution.
- 2.3 Betalains–structure–stability-effects of pH, heat and light.
- 2.4 Extraction of carotenes, lycopene, chlorophyll and curcumin.

## **Unit -3: FLAVOURS**

**(15 hrs)**

- 3.1 Taste: sensory assessment of flavors-structural basis-sweet, bitter and sour taste models– flavour enhancers–astringency-pungency-vegetable and spice flavors-allium, cruciferae-mushroom.
- 3.2 Odour: theory and sense of odour-flavours from shikimic acid pathway-pear, banana, apple, eugenol, vanillin.
- 3.3 Volatile terpenoids-noot ketone, geraniol, nerol,  $\pm$  carvone, flavour from lactic acid; ethanol fermentation - diacetyl
- 3.4 Fish food flavours; thermally induced flavors.
- 3.5 Biosynthesis of tomato flavour.

## **Unit -4: SWEETENERS**

**(5 hrs)**

- 4.1 Natural intense sweeteners - Sweetener index.
- 4.2 Non-nutritive-low calorie sweeteners–cyclamate–saccharin – aspartame-alitame acesulfame K-sucralose–polyhydric alcohols as sweeteners. Structure-comparison of different sweetness-adverse effects if any as food additives.



**Unit -5: FLOUR IMPROVERS**

**(10 hrs)**

- 5.1 Doughs: leavening agents- starters and cultures-nutritional needs of yeast- activity analysis of yeast-gas retention.
- 5.2 Batters- gas productive and retention-baked products- prevention of mold.
- 5.3 Anticaking agents-pH control.

**TEXT BOOKS:**

- 1. R.Fennema, Food chemistry, Marcel and Decker Inc, 3<sup>rd</sup> edition, **1996**.
- 2. F.D. Vargas, O.P. Copez, Natural colourants for food and nutraceutical uses, CRC Press New York, **2003**.

**REFERENCES:**

- 1. Anti-oxidants in food-practical application, Edt: Pokorny, Nedgalka Yanishliva & Michael Gordon, CRC Press New York, **2001**.
- 2. Food flavour technology, Sheffield academic press, Edt: Andrew J.Taylor, CRC Press New York, **2002**.

- 3. L.H. Meyer, Food chemistry, CBS Publishers and Distributors, New Delhi, **2000**.

**FP4807: FOOD PRODUCT DEVELOPMENT AND PACKAGING TECHNIQUES**

Semester – IV

No. of Credits : 5

Category: Major Core (MC)

Hours per week: 5

**Objectives:**

- i. *To impart the basic concepts and principles in formulation of new food products based on the consumer and market survey*
- ii. *Understand concepts about sensory evaluation of food, analyse and interpret sensory evaluation data*
- iii. *To understand the concepts, principles and types of Packaging and the laws pertaining to its efficiency and safety.*



**Unit 1 Designing new products – An Introduction ( 15 hours)**

1.1 Organisation and assignment of team. Definition of roles. Product. Concepts; how to proceed; factors to consider; concept methodology; consumer testing; product attributes – what they are and their significance. Concept testing approaches; sampling methods; role of sensory evaluation; preparation of concept testing documentation.

1.2 Tapping traditional foods and unconventional sources of foods. Minimizing post harvest losses.

1.3 Market Survey, Consumer survey to identify new products in terms of

- Line Extension
- Repositioning Existing Products
- New form/Reformulation
- New packaging of existing products
- Innovative products
- Creative Products.

**UNIT 2: Product formulation – Prerequisites and methods ( 15 Hours)**

2.1 Requirements for product development authorization. Development of product specifications. Prototype development; role of ingredients and processing in defining attributes; scale up.

2.2 Process flow sheet development; factors to consider in process development; process optimization. Factors to consider beyond formulation and processing - shelf life requirements; product performance testing; market positioning

2.3 Product Roll out and Road-blocks to successful product development.

**Unit 3 Sensory Evaluation ( 10 hours)**

3.1 Introduction to sensory analysis and uses of sensory tests. General testing conditions.

3.2 Establishing sensory panels: Selecting and recruiting panelists, orienting, screening for trained panels, training panelists, monitoring performance.

3.3 Recognition tests for 4 basic tastes, odour and aroma, Threshold tests. Analytical tests : (i) Difference, (ii) Ranking, (iii) Descriptive, (iv) Scoring and (v) Rating



3.4. Planning an Experiment for Sensory Evaluation : (i) Designing the questionnaire and score card, (ii) Identifying descriptors.

3.5 Conducting and Analyzing the Test: Preparing samples, Presenting samples, Using reference samples, Reducing panel response error, Consumer oriented tests and Product oriented test. Collecting and analyzing sensory data, statistical analysis, interpretations. Report Writing

**Unit 4- Basics to Packaging and Packaging methods ( 10 hours)**

4.1 Packaging- Definition, Functions ,Significance, Classification and types.

4.2 Packaging materials-types, various uses, merits & drawbacks.

4.3. Packaging systems and methods-Vacuum and gas flush packaging, CAP and MAP, Aseptic and retort packaging, box in box.

4.4 Modern concepts of packaging technology. Aseptic packaging - Form Fill Seal packaging- Edible Films Retort pouches Easy - Open - End, Boil -In- bags Closures

4.5 Food packaging Laws & Specifications

**Unit 5 Quality testing, safety and environmental aspects ( 10 hours)**

5.1. Packaging requirements for fresh and processed foods- Criteria for selection of proper packaging based on the required shelf life .

5.2. Quality testing of packaging materials- Transportation hazards -Shelf life testing of different packaged foods. - Oxygen interactions, moisture interchanges and aroma permeability.

5.3 Role of packaging- Packaging aesthetic and graphic design; Food labelling ,Coding and marking including barcoding.

5.4 Safety aspects of packaging materials- sources of toxic materials - Interaction of packages with foods.- global migration of plastics- tin can corrosion.

5.5 Environmental Issues- recycling and waste disposal.

**Text Books**

1. Gordon L. Robertson: Food Packaging- Principles and Practice Marcel Dekker Inc, USA 1993
2. Robertson, G.L. Food Packaging: Principles and Practice (2nd ed.), Taylor & Francis 2006



3. Fuller, G. W. (1994) 'New Food Product Development from Concept to Market Place' CRC Press, Boca Raton, USA
4. Gould W A 'Research and Development Guidelines for the Food Industry' CTI Pub, Baltimore. 1991

### **Reference**

1. Coles, R., McDowell, D. and Kirwan, M.J. (Eds.) Food Packaging Technology, CRC Press, 2003
2. Jung H. Han, Innovations in Food Packaging, Academic Press Pub. , 2005

### **Journals**

1. International Journal of Food Science and Technology
2. Critical Reviews in Food Science and Nutrition

<b>FP-4808: PROJECT WORK</b>		
Semester - IV	Hours per wk:	: 15
Category: Major Core(MC)	No. of credits	: 11

### **Objectives:**

1. *To introduce the purpose and importance of research for future development and sustenance*
2. *To make the students plan and carry out the research work*
3. *To learn the methodology of writing thesis and research articles in journals.*

### **Evaluation of the Project Work:**

The Controller of Examination appoints an External Examiner from the Panel of Examiners submitted by the Supervisor through the Head of the Department. Both the Supervisor and External Examiner will conduct the viva voce examination to the candidate and award marks.

Total Marks: 100



**LOYOLA COLLEGE (AUTONOMOUS)  
CHENNAI - 600 034.**

Quality of the Project Work and Dissertation : 50 Marks  
Oral Presentation : 25 Marks  
Viva-voce : 25 Marks

*There will be counseling for students regarding facilities available and about the Professors offering guidance. They can choose the topic of the project and the guide at the beginning of III semester. In case the student requires extension of time for submitting the dissertation, University rules will be followed.*

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