

**P.K. UNIVERSITY Shivpuri (M.P.)**

**M.Sc. Food Technology**

**Course Structure, Scheme of Examination & Syllabus**

**SEMESTER- I**

<b>Subject Name</b>	<b>Total credits</b>	<b>Internal T</b>	<b>Internal T</b>	<b>Internal P</b>	<b>Internal P</b>	<b>External T</b>	<b>External T</b>	<b>External P</b>	<b>External P</b>	<b>Total Marks</b>
Food Biochemistry & Nutrition	3	30		25		70		25		150
Food Chemistry	3	30		25		70		25		150
Food Microbiology	3	30		25		70		25		150
Food Processing & Preservation	3	30		25		70		25		150

**SEMESTER- II**

<b>Subject Name</b>	<b>Total Credits</b>	<b>Internal T</b>	<b>Internal T</b>	<b>Internal P</b>	<b>Internal P</b>	<b>External T</b>	<b>External T</b>	<b>External P</b>	<b>External P</b>	<b>Total Marks</b>
Fruit and Vegetable Technology	3	30		25		70		25		150
Food Engineering	3	30		25		70		25		150
Food Packaging-I	3	30		25		70		25		150
Food Quality Control, Laws & Management	3	30		25		70		25		150

**SEMESTER- III**

Subject Name	Total Credits	Internal T	Internal T	Internal P	Internal P	External T	External T	External P	External P	Total Marks
Processing of Cereals, Pulses, Oil Seed & Sugar Crops	3	30		25		70		25		150
Processing of milk and Milk Products	3	30		25		70		25		150
Processing of Meat, Poultry & Egg Products	3	30		25		70		25		150
Entrepreneurship in Food Processing, Food Standards & Food laws	3	30		25		70		25		150

**SEMESTER- IV**

Subject Name	Total Credits	Internal T	Internal T	Internal P	Internal P	External T	External T	External P	External P	Total Marks
Advances in Food Technology	3	30		25		70		25		150
Food Packaging-II	3	30		25		70		25		150
Seminar	2									
<b>Optional (any one from two)</b>										
Food Processing, Chemistry and Microbiology	12	30		25		70		25		150
<b>Or</b>										
Thesis Research	12	50% Internal + 100% External								150



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## **SYLLABUS- I SEMESTER**

### **FT 101 FOOD BIOCHEMISTRY AND NUTRITION**

#### **UNIT -I**

Introduction to different food groups and its importance in nutrition.

**Carbohydrate:** Introduction, digestion, food sources. Metabolic pathways for breakdown of carbohydrates: glycolytic pathway, pentose phosphate pathway, citric acid cycle, electron transport chain, ATP balance, gluconeogenesis, deficiency, metabolic defects such as diabetes associated with carbohydrates.

#### **UNIT -II**

**Protein:** Introduction, Essential amino acids. food sources, metabolic defects, Metabolism of proteins – outlines (digestion and absorption); Nitrogen balance & nitrogen pool; Evaluation of quality of proteins, deficiency symptoms, prevention and cure.

**Fat: Digestion:** Introduction, digestion, metabolism outlines, essential fatty acids, food sources, metabolism of fat and fatty acid, nutritive functions, effects of excess and deficiency: obesity, cardiovascular diseases. Nutritional significance of lipo proteins.

#### **UNIT –III**

**Fat soluble vitamins:** Salient features, requirements, food sources, effects of excess and deficiency, principles.

**Water soluble vitamins:** salient features, requirements, food sources, effects of excess and deficiency.

**Minerals:** salient features, requirements, food sources, effects of excess (if any) and deficiency factors affecting utilization.

Principles and outlines of estimation of micro and macro elements.

Principles and outlines of estimation of fat soluble vitamins and water soluble vitamins.

#### **Unit IV**

**Energy metabolism:** Basal metabolic requirements and activity, SDA- specific dynamic action of food, respiratory quotient of food, caloric requirement of humans.

**Recommendatory dietary allowance:** concept of balance diet, menu planning in different ages and diseases.



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Shivpuri (M.P.)

### **Unit V**

Introduction to sensory evaluation, Selection of sensory panelists; Factors influencing sensory measurements; Sensory quality parameters -Size and shape, texture, aroma, taste, color and gloss; Detection, threshold and dilution tests Different tests for sensory evaluation–discrimination, descriptive, affective; Flavour profile and tests; Ranking tests; Methods of sensory evaluation of different food products. Selection and training of sensory panel; Detection and threshold tests; Ranking tests for taste, aroma colour and texture; Sensory evaluation of various food products using different scales, score cards and tests;

### **Text Books / References :**

1. Lehninger, Nelson & Cox, Principle of Biochemistry, CBS Publication
2. Modern Experimental Biochemistry, Boyer, Pearson Education
3. Lubert stryer, Biochemistry, Freeman & Co, N.Y.
4. Voet & Voet, Fundamentals of Biochemistry, Jonh Willey & Sons
5. Hames, B. D. (Ed), Biochemistry, Viva Books
6. Essentials of Food and Nutrition, Swaminathan, Vol 1 & 2
7. Fundamentals of Food and Nutrition by Sumati. R. Muldambi
8. Nutrition and dietetics by Rose
9. Nutrition and dietetics by Joshi



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## **FT 102 FOOD CHEMISTRY**

### **UNIT -I**

**Carbohydrate** : General introduction, classification, structure, properties and functions of carbohydrates, role of carbohydrate in food industries, sugars, starch, cellulose, glucans, hemicelluloses, gums, pectic substances, polysaccharides, Modified starch.

**Browning reactions in food:** Enzymatic and non-enzymatic browning in foods of vegetable and animal origin during storage and processing of foods.

**Non-calorific sweeteners:** Artificial and Natural

Methods of estimation of carbohydrates-principles and outlines

### **UNIT -II**

**Proteins** : General introduction, classification, structure, properties, purification and denaturation of proteins, protein derived from milk, egg protein, meat protein, fish muscle protein, oil seed protein and cereal protein. Allergens associated with food proteins. Modified proteins and application in food industry. Single Cell Protein. Methods of estimation of protein-principles and outlines.

**Food Adulteration**-Outlines and detection methods.

### **UNIT -III**

**Lipids** : General introduction, classification, properties, functions and requirements of food lipids, refining of crude oil, hydrogenation and winterization. Vegetable and animal fat, margarine, lard, butter. Frying and shortenings. Flavor changes in fats and oils, lipid oxidation & factors affecting lipid oxidation.

Methods of estimation of lipids-Principles and outlines.

### **Unit IV**

**Vitamins:** General introduction, Fat and Water soluble Vitamins, effect of various processing treatments and fortification of foods.

**Minerals:** General introduction, effect of various processing treatments

**Water:** Chemistry, role in food storage, water activity and growth of microorganisms, physical, chemical and microbiological characteristics of water.

### **Unit V**

**Enzymes:** General introduction, Nature, function, nomenclature & structure, its classification and properties of enzymes and its activity in different food systems, factors affecting rate of enzymatic action .Flavor production by enzymes.

**Plant pigments and their role in Food Industry:** Carotenes, Xanthophylls, Chlorophyll, Bitter Substances and Tannins.



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### **Text books and Reference materials**

1. Beltz, H.D. 2005. *Food Chemistry*. Springer Verlag.
2. Fennema, O.R, 2006, *Food Chemistry*, Academic Press.
3. Meyer, L.H. 1987. *Food Chemistry*. CBS publishers and Distributors, New Delhi.
4. Potter, N.N. and Hotchkiss, J.H. (2006), *Food Sciences*, Fifth edition, CBS publishers and Distributors, New Delhi.
5. Fennema, O.R.2006. *Food Chemistry*. Marcel D

## **FT 103 FOOD MICROBIOLOGY**

### **UNIT I**

Definition, Historical Development, Classification and importance of Yeast, Mold and Bacteria. Importance and significance of microorganisms in Food science. Micro-organisms importance in food - Factors affecting the growth of micro organisms in food – Intrinsic and Extrinsic parameters that affect microbial growth.

### **UNIT II**

Food Hygiene and Sanitation: Contamination during handling and processing and its control ; indicator; indicator organisms; rapid methods in detection of microorganisms. Thermal inactivation of microbes- Concept,determination & importance of TDT, F, Z & D values,factors affecting heat resistance, pasteurization and sterilization.

### **UNIT III**

Protection and preservation of Foods: Modified atmosphere, Radiation in foods from the microbiological angle. Outlines of indicators of water and food safety and quality-Microbiological criteria of foods and their significance.

### **UNIT IV**

**Food spoilage:** Characteristic features, dynamics and significance of spoilage of different groups of foods - Cereal and cereal products, vegetables and fruits, meat, poultry and sea foods, milk and milk products, packed and canned foods.

*s: Bacterial food borne diseases* ( Staphylococcal intoxicification, Botulism, Salmonellosis, Shigellosis, Enteropathogenic Escherichia Coli Diarrhoea, Clostridium Perfringens gastroenteritis, Bacillus cereus Gastroenteritics), *Mycotoxins:* Aflatoxicosis, Deoxyni valenol Mycotoxicosis, Ergotism.

### **UNIT V**

**Colorimetry :** Introduction,beers & lamberts law,extinction coefficient,general principles of colorimeter,application in food industry.

**Flourimetry:** Introduction,principle,instrumentation & application.,  
Flame photometry: Instrumentation & application.



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**Spectroscopy:** General principle, instrumentation, types-atomic absorption spectrophotometer, UV-Visible, principle, instrumentation & applications.

**Text Books / References :**

1. Essentials of Microbiology; K. S. Bilgrami; CBS Publishers, Delhi
2. Food Microbiology; WC Frazier; Tata McGraw Hill, Delhi
3. Modern Food Microbiology; James M Jay; CBS Publishers, Delhi
4. Microbiology; Pelczar, Chan and Krieg; Tata McGraw Hill, Delhi
5. Basic Food Microbiology; Bannett, Chapman and Hall
6. Food Microbiology; M. R. Adams
7. Hand Book of Microbiology; Bisen

**FT104 PRINCIPLES OF FOOD PROCESSING & PRESERVATION**

**UNIT -I**

**Introduction:** Definition and scope of Food science and technology, historical development of food processing and preservation, general principles of food preservation

**Processing and preservation by heat:** Blanching, pasteurization, sterilization and UHT processing,

canning, extrusion cooking, dielectric heating, microwave heating, baking, roasting and frying. Retort processing of ready to eat (RTE) products.

**Baking:** Milling, Principle of baking various of baked products.

**UNIT -II**

**Radiation:** Source of radiations, mode of action effect on microorganisms and different nutrients dose requirements for radiation preservation of food. **Microwave heating:** Principles and application in Food processing

**UNIT -III**

**Refrigeration and Freezing Preservation:** Refrigeration and storage of fresh food major requirement of refrigeration plant atmospheric storage, refrigerated storage of various food freezing point of selected food influence of freezing and freezing rate of quality of the food product. Method of freezing storage, and thawing of frozen food

**Unit IV**

**Chemical Preservation:** Preservation of food by use of sugar, salt, chemicals, antibiotics & by smoking



**P.K. University**  
Shivpuri (M.P.)

**Concentration:** Application in food industry processes and equipment for manufacture of various concentrated foods and their keeping quality

**Fermentation:** Application in preservation of food pickling, curing etc

### **Unit V**

**Drying:** Processing and preservation by drying, concentration and evaporation, various methods employed in production of dehydrated food products, selection of methods based on characteristics of foods to be produced, advantages and disadvantages of different methods, sun-drying, tray or tunnel drying, spray drying, drum drying, freeze drying, fluidized bed drying. Physical and chemical changes during drying control of chemical changes, desirable and undesirable changes. Packaging and storage of dehydrated food products. Outlines of moisture analysis.

### **Text books and Reference materials**

1. Desrosier NW & James N. (2007). Technology of food preservation. AVI. Publishers
2. Fellows, P.J. (2005). Food processing technology: Principle and Practice. 2nd Ed. CRC Publishers
3. Jelen, P. (2005). Introduction to Food Processing. Prentice Hall
4. N.M.Potter, Food Science and Technology.

### **FT 105: LAB COURSE-I**

1. Qualitative analysis of carbohydrates
2. Qualitative analysis of Proteins
3. Analysis of lipids: acid value, iodine value, saponification value etc
4. Estimation of carbohydrates in food materials
5. Estimation of proteins in food materials
6. Estimation of crude fibre in food materials
7. Estimation of ascorbic acid in food materials
8. Estimation of calcium in food materials
9. Estimation of cholesterol in food materials
10. Estimation of calorific value of foods
11. **Sensory evaluation:**
  - a. Taste panel
  - b. Basic taste
  - c. Difference test
  - d. Ranking test for color, aroma and texture
  - e. Threshold test
  - f. Hedonic scale





**P.K. University**  
Shivpuri (M.P.)

## **FT 106: Lab course-II**

### **A) Processing Of Food And Food Microbiology**

1. Determination of moisture in different food samples.
2. Determination of TSS in different food samples.
3. Quality assessment by Blanching and browning control
4. Quality assessment by different drying methods.
5. Determination of acidity and PH different food samples.
6. Determination of ash in food samples.
7. Instruments used for food processing.
8. Determination of gelatinization
9. Stages of sugar cookery
10. Estimation of gluten content

### **B) Food Microbiology Lab**

1. Preparation of common laboratory media and study of a compound microscope.
2. Staining: Gram's staining,
3. Sub culturing of a bacterial strain in liquid and solid medium.
4. Study of growth of E. coli by a spectrophotometer.
5. Study of microbiological quality of milk by MBRT test.
6. Preparation of synthetic medium for yeast and mould and inoculation with standard strains of yeasts and moulds.
7. Microbiological analysis of typical processed food and unprocessed food.
8. Dilution and Plating by spread –plate and pour –plate techniques.
9. Isolation of pure culture.
10. Test for adulteration in different food samples.

## **FT 107: SEMINAR / ASSIGNMENT**

Every student shall deliver atleast one seminar on topic of the curriculum/ advances in food technology which will individually be assessed by every available teacher on the basis criteria laid down by the Staff council. Students in audience will also be encouraged to assess the seminar on the given criteria and their evaluation will also be given due consideration. The average marking will be taken into consideration.



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Shivpuri (M.P.)

**FT 108: PERSONALITY DEVELOPMENT/ SKILL DEVELOPMENT IN FOOD PRODUCT FORMULATION**

Every student will be imparted skills in development of new products and will be evaluated by the concerned teacher.

**FT 109: COMPREHENSIVE VIVA**

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of semester of the programme by a board of four examiners.



**P.K. University**  
Shivpuri (M.P.)

## **SYLLABUS- II SEMESTER**

### **FT 201: FRUITS AND VEGETABLE TECHNOLOGY**

#### **UNIT -I**

Introduction, definition, role, importance and status of post harvest technology.

Fruits and vegetables: Morphology of fruits and vegetables, maturity indices and methods of maturity determinations. Post-harvest physiological and biochemical changes in fruits and vegetables, ripening of climacteric and non climacteric fruits; regulations, methods.

#### **UNIT –II**

**Post harvest disorders-** Factors affecting post harvest changes, handling and packaging of fruits and vegetables, chilling injury & disease, storage practices: CA and MA, hypobaric storage, pre-cooling and cold storage, Zero energy cool chamber, commodity pretreatments - chemicals, wax coating, VHT and irradiation.

#### **UNIT –III**

Drying and dehydration of fruits and vegetables, problems related to storage of dehydrated products., Canning of fruits and vegetables, its process, spoilage in canned foods. Changes during freezing of fruits of vegetables and problems related to storage of frozen products.

#### **UNIT –IV**

**Vinegar:** Method of preparation and quality control

**Tea, Coffee and Cocoa:** Production and manufacturing.

**Pectin:** Raw material processes and uses of pectin, products based on pectin, manufacturing and quality control.

#### **UNIT –V**

**Fruits and Vegetables:** Preparation of juice, syrup, squashes, jam, jellies, marmalades, cordials and nectars, fortification and soft drinks.

**Tomato products:** Preparation of various tomato products and quality control.

**Pickles and chutney:** Preparation of various pickles, sauces and chutneys, problems related to shelf life of pickles and chutneys, quality control.

#### **References :**

1. Bose, T.K. Ed. 1985. Fruits of India: Tropical and Sub-tropical. Naya Prokash, Calcutta. Dauthy, M.E. 1997. Fruit and Vegetable Processing. International Book Distributing Co. Lucknow, India.
2. Hamson, L.P. 1975. Commercial Processing of Vegetables. Noyes Data Corporation, New Jersey.



**P.K. University**  
Shivpuri (M.P.)

3. Lai, G., Siddappa, G. and Tondon G.L. 1986. Preservation of Fruits and Vegetables, Indian Council of Agril. Research, New Delhi.
4. Salunkhe, D.K. and Kadam, S.S. Ed. 1995. Handbook of Fruit Science and Technology: Production, Composition and Processing. Marcel Dekker, New York. Salunkhe, D.K. and Kadam, S.S. Ed. 1995. Handbook of Vegetable Science and Technology. Production, Composition, Storage and processing Marcel Dekker, New York.
5. Srivastava, R.P. and Kumar, S. 1998. Fruit and Vegetable Preservation: Principles and Practices. 2nd Ed. International Book Distributing Co. Lucknow.

## **FT 202: FOOD ENGINEERING**

### **UNIT -I**

**Introduction:** General concept, essential scope & scenario

**Size Reduction process:** Principles, theories & laws, energy consideration, equipments & size reduction of various food products

**Mixing & forming:** Theory & applications, mixing indices, equipments for solid and liquid foods products.

### **UNIT –II**

**Process Heat Transfer** - Modes of heat transfer and overall heat transfer; thermal properties of foods such as specific heat and thermal conductivity, Fourier's law, steady state and unsteady state conduction, heat exchange equipment; energy balances; rate of heat transfer; thermal boundary layer, heat transfer by forced convections, heat transfer to flat plate and in non Newtonian fluids, heat transfer in turbulent flow; heating and cooling of fluids in forced convection outside tubes, natural convection

### **UNIT –III**

**Food dehydration:** Mechanism of drying, moisture & drying rate curves, constant and falling rate periods, spray, drum, cabinet, tunnel, fluidized bed dryer, batch & continuous operation, osmotic dehydration & freeze drying.

**Evaporation:** Properties of liquid, heat & mass balance, single & multiple effect evaporation, steam economy, heat recovery, efficiency, equipments & systems.

### **UNIT - IV**

**Chilling, refrigeration & freezing** : Introduction, types of freezers, precooling & cold storage, Shelf life extension requirements, theories, characteristic curve, cooling rate calculations, chilling & freezing equipments, cryogenics, freeze drying, properties of frozen foods.



**P.K. University**  
Shivpuri (M.P.)

## **UNIT-V**

### **Separation processes:**

**Centrifugation:** General principles, instrument & types of centrifuges, preparatory & analytical centrifugation & applications

**Chromatographic Techniques:** General introduction to principles, partition & adsorption chromatography-paper, thin layer, gas & liquid, ion exchange & affinity chromatography, gel filtration, HPLC and application in food industry

**Membrane filtration technology:** Principles of other food processing such as- RO, UF, Dialysis, osmosis, microfiltration, and nano filtration-outlines

## **FT 203 : FOOD PACKAGING**

### **UNIT I**

Introduction to Food Packaging: Packaging terminology- definition, types of packaging. Functions of food packaging, characteristics of food stuff that influences packaging selection.

### **UNIT II**

Packaging material and their properties: Glass, paper and paper board, corrugated fiber board (CFB), Metal containers-Tin Plate and Aluminum, composite containers, collapsible tubes, plastic films, laminations, metalized films, Co-extruded films, testing of packaging material.

### **UNIT III**

Packaging systems and methods: vacuum packaging, controlled atmospheric packaging, modified atmospheric packaging, aseptic packaging, retort processing, microwave packaging, active packaging, intelligent packaging, edible packaging, shrink and stretch packaging.

### **UNIT IV**

Packaging of fresh and processed foods: Packaging of fruits and vegetables, fats and Oils, spices, meat, Poultry and sea foods, dairy Products, bakery, beverages, dehydrated and frozen foods. Liquid and powder filling machines – like aseptic system, form and fill (volumetric and gravimetric), bottling machines. Form Fill Seal (FFS) and multilayer aseptic packaging machines.

### **UNIT V**

Packaging Laws, Regulations, Evaluation and Quality control- Toxicity, shelf life testing, corrosion, tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength, tear strength, their methods of testing and evaluation, barrier properties of packaging materials-Theory of permeability, factors affecting permeability, permeability coefficient, gas



**P.K. University**  
Shivpuri (M.P.)

transmission rate (GTR) and its measurement, water vapour transmission rate (WVTR) and its measurement, prediction of shelf life of foods, selection and design of packaging material for different foods.

#### **Text Books and Reference materials**

1. Robertson, G.L. 2006 Food Packaging: Principles and Practice (2nd ed.), Taylor & Francis
2. NIIR. (2003). Food Packaging Technology Handbook, National Institute of Industrial Research Board, Asia Pacific Business Press Inc.
3. Ahvenainen, R. (Ed.) 2003 Novel Food Packaging Techniques, CRC Press,
4. Han, J.H. (Ed.) 2005 Innovations in Food Packaging, Elsevier Academic Press,
5. Coles, R., McDowell, D. and Kirwan, M.J. (Eds.) 2003 Food Packaging Technology,

### **FT 204: FOOD QUALITY CONTROL, LAWS AND MANAGEMENT**

#### **UNIT -I**

##### **Food safety and hygiene**

**Food safety concept- Importance** of food safety in food processing. Food hygiene and its practices (GMP/GHP, GAP, GLP). Hygiene verification on food industry, cleaning and sanitation (CIP, ETP, WTP, Pest control) prevention and control.

#### **UNIT –II**

**Concept of quality:** Quality attributes- physical, chemical, nutritional, microbial and sensory, their measurement and evaluation. Quality measurement techniques, process design and control and product design and control, TQM, IPR and Patent.

#### **UNIT –III**

**Food laws and regulations:** Food safety 2006, 2011 act and regulation, FSSAI. Various organizations dealing with inspection and traceability and authentication, Certifications (BIS, AGMARK, ISO, FPO, MFPO, PFA, MPO, etc.)

#### **UNIT –IV**

**International food laws and regulations:** US Federal laws, USDA, FDA, FAO, WHO, CODEX, HACCP.

**Differential financial institutions:** NABARD, WTO, World Bank.

#### **UNIT –V**

**Entrepreneurship in food processing:** Concept of entrepreneur and entrepreneurship, quality, functions of an entrepreneur. Current status of entrepreneurship in Indian food industries.



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Introduction to marketing (demand, supply, sample survey techniques, marketing information, consumer trends and behavior), and HRM (concept, planning and appraisal).

**References:**

1. Early R.1995.*Guide to Quality Management Systems for Food Industries*. Blackie Academic.
2. Krammer A & Twigg BA.1973. *Quality Control in Food Industry*. Vol. I, II. AVI Publ.
- 3.Chhabra TN & Suria RK. 2001. *Management Process and Perspectives*. Kitab Mahal.
- 4.Jhingan ML. 2005. *International Economics*. 5th Ed. Virnda Publ.
- 5.Kotler P. 2000. *Marketing Management*. Prentice Hall.
6. Reddy SS, Ram PR, Sastry TVN & Bhavani ID. 2004. *Agricultural Economics*. Oxford & IBH.

**FT – 205: LAB COURSE I**

1. Canning of fruits and vegetables.
2. Dehydration of fruits and vegetables.
3. Preparation of tomato juice.
4. Preparation of tomato puree.
5. Preparation of tomato paste.
6. Preparation of various types of pickles.
7. Preparation of tomato ketchup.
8. Preparation of tomato mock tail.
9. Preparation of tomato soup.
10. Preparation of tomato chutney.
11. Preparation of jackfruit pickles.
12. Preparation of jams
13. Preparation of lime squashes.
14. Preparation of jellys.
15. Preparation of jam marmalades.
16. Pectin determination
17. Determination of chemical preservatives in fruits and vegetables.
18. Blanching of fruits and vegetables for quality estimation.





**P.K. University**  
Shivpuri (M.P.)

### **FT- 206: LAB COURSE II**

1. Testing of different types of packaging materials.
2. Determine moisture content in given package samples.
3. Test for modified starch in different package materials.
4. Test for water absorbency in corrugated fibre board box.
5. Test for types of adhesive used in CFB.
6. Development of new food products and formulations.
7. To perform flap bend test in CFB.
8. Test for formal shock resistance in glass bottles.
9. Graphical representation of moisture contents in different food products.
10. Determination of shelf lives.

### **FT 207: SEMINAR / ASSIGNMENT**

Every student shall deliver at least one seminar on topic of the curriculum/ advances in food technology which will individually be assessed by every available teacher on the basis criteria laid down by the Staff council. Students in audience will also be encouraged to assess the seminar on the given criteria and their evaluation will also be given due consideration. The average marking will be taken into consideration.

### **FT 208: PERSONALITY DEVELOPMENT/ SKILL DEVELOPMENT IN FOOD PRODUCT FORMULATION**

Every student will be imparted skills in development of new products and will be evaluated by the concerned teacher.

### **FT 209: COMPREHENSIVE VIVA**

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