



# बिलासपुर विश्वविद्यालय, बिलासपुर (छत्तीसगढ़)

SYLLABUS  
UNIVERSITY TEACHING DEPARTMENT  
M.Sc. FOOD PROCESSING & TECHNOLOGY

## SEMESTER-I

### FPT-411      SENSORY EVALUATION OF FOOD PRODUCTS

#### UNIT - 1

Introduction- definition and importance of sensory evaluation in relation: to consumer acceptability and economic aspects, Using the Senses in Sensory Analysis, sensory judges, Terminology related to sensory evaluation- quality, quantity, nutritional and other hidden attributes, sensory quality, appearance, kinesthetics, flavour & odour.

#### UNIT - 2

Evaluation of Sensory qualities, Laboratory Set-up and equipments, Panel selection and training- judging quality. Comparison between subjective & objective evaluations. Mechanical characteristics, geometrical characteristics and other characteristics of texture.

#### UNIT - 3

Difference (Qualitative) test - paired comparison test for trained panelists and untrained panelists, duo-trio test for trained panelists and triangle (triad) test for trained panelists.

#### UNIT - 4

Rating (Quantitative differences) test - ranking test, single sample (monadic) test, two sample difference test, multiple sample and quality difference test, hedonic test, numerical scoring test and composite test for trained/semi-trained/untrained panelists.

#### UNIT - 5

Sensitivity - Threshold and dilution test for trained/untrained panelists; TPA test - parameters measured by texture profile analysis test (Hardness, Elasticity, Adhesiveness Cohesiveness, Brittleness, Chewiness and Gumminess), Sensory applications on foods.

#### TEXT BOOKS/ REFERENCES:

1. Ranganna S. 2001. *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. 2nd Ed. Tata-McGraw-Hill.
2. Amerine MA, Pangborn RM & Rossles EB. 1965. *Principles of Sensory Evaluation of Food*. Academic Press.
3. Lawless HT & Klein BP. 1991. *Sensory Science: Theory and Applications in Foods*. Marcel Dekker.
4. Maslowitz H. 2000. *Applied Sensory Analysis of Foods*. Vols. I, II. CRC Press.
5. Rai SC & Bhatia VK. 1988. *Sensory Evaluation of Agricultural Products*.



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## FPT-412 FERMENTATION TECHNOLOGY

### UNIT 1:

Definition of Fermentation, Types of fermentation, Primary and Secondary metabolites, Pure cultures, methods of isolating pure cultures, maintenance and preservation of pure cultures.

### UNIT 2

Principal types of fermentor: Factors involved in fermentor design, Fermentor Configurations: Batch Fermentor, Continuous Stirred-tank fermentor, Tubular Fermentor, The fluidized Bed fermentor, Principal operating characteristics of fermentors.

### UNIT 3

Fermented Dairy Products: Cheese, Butter, Yoghurt, Kefir, Koumiss, Srikhand, Cultured butter milk; Spoilage and defects of fermented dairy products, Concept of probiotics.

### UNIT 4

Soy-fermented products: Soy sauce, Miso and Tempeh

### UNIT 5

Organic acids and enzymes by fermentation process

### TEXT BOOKS/ REFERENCES

1. Principles of Fermentation Technology- Wittaker and Stanby.
2. Fermented Foods of the world. (A Dictionary & Guide) –by Geoffrey Champbell, Platt, Butterworths, London.
3. Industrial Microbiology by Brinton M miller & Warren Litsky. MGH.
4. Pickle & Sauce Making, Binsted, Devey&& Dakin (2nd edn), Food Trade Press Ltd, London.



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## FPT-413 PRINCIPLES OF FOOD PROCESSING

### UNIT 1

Principles of fresh food storage: Nature of harvested crop, plant, storage; effect of cold storage and quality- storage of grains.

### UNIT 2

Processing and preservation by heat: Blanching, pasteurization, sterilization and UHT processing, canning, extrusion cooking, dielectric heating, microwave heating, baking, roasting and frying.

### UNIT 3

Retort processing of Ready to eat (RTE) products. Drying - water activity, microbial spoilage due to moisture. Dehydration of fruits, vegetables, milk, animal products Newer methods of thermal processing - batch and continuous.

### UNIT 4

Processing and preservation by low Temperature - refrigeration, freezing, CA, MA, and dehydro-freezing. Food irradiation, history and mechanism, the electromagnetic spectrum, forms of radiant energy. Principles of using electromagnetic radiation in food processing. ionizing radiations and non ionizing radiations, advantages and disadvantages. Controlling undesirable changes in food during irradiation

### UNIT 5

Principles of other food processing such as membrane filtration (ultra, osmosis and reverse osmosis, dialysis), pulsed electric, irradiation and other non-thermal technologies'

### TEXT BOOKS/ REFERENCES:

1. Das, H. "Food Processing Operations Analysis", Asian Books, 2005.
2. Fellows, P.J. (2005). Food processing technology: Principle and Practice. 2<sup>nd</sup> Ed. CRC Publishers.
3. Jelen, P. (1985). Introduction to Food Processing, Prentice Hall.



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## STAT-414 STATISTICAL METHODS

### UNIT 1

Sampling techniques, simple random sampling, stratified random sampling and systematic sampling.

### UNIT 2

Mean, Mode, Median, Harmonic mean and Geometric mean; Mean Deviation, Standard Deviation, Variance, Correlation and Regression..

### UNIT 3

Theory of Probability: equally likely, mutually exclusive events, definition of probability, addition & multiplication theorems of probability & problems on theorems of probability & problems based on them.

### UNIT 4

Testing of Hypothesis: Concepts of Hypothesis, Degrees of freedom, Level of significance, Type I & Type II errors. Chi square ( $X^2$ ), Student - t test, F- test (definition, applications & problems based on these tests).

### UNIT 5

Analysis of variance (ANOVA) techniques, definitions and assumptions, classification of ANOVA: One way and two way.

### TEXT BOOKS/ REFERENCES:

1. Statistics for Agricultural Sciences by Nageshwara Rao G Oxford & IBH Publishing Co., New Delhi.
2. Fundamentals of Mathematical Statistics by S C Gupta & V K Kapoor S. Chand & Sons.
3. Statistical Methods G. W. Snedecor & W. Cochran Oxford & IBH Publishing Cop. New Delhi.
4. S M Sukla and S P Sahai. 2011. Business Statistics. Sahitya Bhawan Publications.



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## FPT-415      ADVANCED LABORATORY COURSE-I

1. Determination of moisture content of wheat flour.
2. Determination of ash content of wheat flour sample.
3. Determine the total soluble solids of different food samples (e.g. jam, jelly & marmalade).
4. Production of lactic acid in milk products through fermentation.
5. Production of ethanol by fermentation.
6. Production of amylase by fermentation.
7. Cost estimation of drying process.
8. Modified Storage of fruits and vegetables.
9. Controlled Storage of fruits and vegetables.



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## SEMESTER-II

### FPT-421 TECHNOLOGY OF CEREALS AND PULSES

#### UNIT 1

Status, production and major growing areas of cereals and pulses in India and World, Chemical composition of cereals and pulses, Nutrition Importance, Scientific Names of cereals and pulses, Storage of cereals and pulses.

#### UNIT 2

Wheat: Wheat classification, wheat grain structure, quality and milling, wheat products.  
Maize: Varieties, Structure, Milling

#### UNIT 3

Rice: Indian classification of rice, Parboiling, Milling, Rice Products, Byproducts of rice, Brown rice, Basmati rice and glutinous rice

#### UNIT 4

Sorghum: Structure and Milling, Barley: Milling and Malting, Millets: Pearl millet and finger millet, Oats and Rye: processing.

#### UNIT 5

Pulses: Pulse proteins, processing, utilization of pulses, Toxic constituents of pulses, Pulses in human nutrition, Some important pulses: Bengal gram, Red gram, Black gram, Green gram, Moth Bean, Lentil, Horse gram, Field Bean, Pea and others.

#### TEXT BOOKS/ REFERENCES:

1. Sahay KM & Singh KK. 1994. Unit Operation of Agricultural Processing. Vikas Publ. House.
2. Hosney RS. 1994. *Principles of Cereal Science and Technology*. 2nd Ed. AACC.
3. Kent NL. 1983. *Technology of Cereals*. 4th Ed. Pergamon Press.
4. Kulp K & Ponte GJ. 2000. *Handbook of Cereal Science and Technology*. 2nd Ed. Marcel Dekker.
5. Lorenz KL. 1991. *Handbook of Cereal Science and Technology*. Marcel Dekker.
6. Pomeranz Y. 1987. *Modern Cereal Science & Technology*. VCH Publ.



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## FPT-422 FATS AND OILS TECHNOLOGY

### UNIT 1:

Lipids: Introduction. Role of lipids in biological systems, Difference in fats and oils, Fats and oils classification, saturated and unsaturated fatty acids, Polymorphism of fats. Fat emulsions.

### UNIT 2:

Physical characteristics of triglycerides: melting point, specific heat, viscosity, density, solid fat index, titer, cold test and refractive index. Chemical parameters of fats and oils: Acid Value, Free Fatty acid, Peroxide value, Smoke point, Saponification number, Iodine value.

### UNIT 3:

Processing Technology of fats and oils: Rendering, Expeller pressing and solvent extraction, refining: degumming, neutralization, bleaching deodorization. Hydrogenation, winterizing and fractionation, interesterification, plasticizing and tempering.

### UNIT 4:

Fats and oils reactions: hydrolysis and oxidation. Mechanisms of lipid oxidation and antioxidants. Cooking in fat, Deep fat frying: Changes in fats and oils during frying, Flavour reversion

### UNIT 5:

Different categories of fats and oils: edible oils, dairy fats, Shortening: introduction, manufacturing and uses of shortening, Margarine: manufacturing process and its uses, Mayonnaise and salad dressings.

### TEXT BOOKS/ REFERENCES

- 1 Introduction to Fats and Oils Technology. O'Brien, Richard D.; Farr, Walter E.; Wan, Peter J. AOCS Press 2000.
- 2 Chemistry and Technology of Oils and Fats. M. M. Chakrabarty. Allied Publishers 2003.
- 3 Oilseeds Processing and Technology. Dr B D Shukla, Dr Prabhat K Srivastava and Er. Ram K Gupta. CIAE, ICAR.



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## FPT-423 FOOD ENGINEERING

### UNIT 1

Introduction to food process engineering, Material and energy balances: Basic principles, Total mass balance and component mass balance. Material balance calculations involved in dilution, concentration and dehydration. Heat balance calculations.

### UNIT 2

Material handling - Theory, classification of various material handling equipments - conveyors (gravity and powered conveyors), elevators (bucket and screw type elevators), trucks (high lift and pallet trucks), cranes and hoists. Cleaning - types of contaminants found on raw foods, aims of cleaning; methods of cleaning- dry, wet and combination methods. Dry cleaning methods: screening, aspiration, magnetic cleaning and abrasive cleaning. Wet cleaning methods: soaking, spray washing, flotation washing and ultrasonic washing.

### UNIT 3

Fluid Mechanics: Properties of fluids, nature of fluid and fluid flow, Flow of fluids past a stationary particle for low, medium and high Reynolds numbers; Manometers, Mechanism of on Compressible fluid flow, Reynolds's no, Distribution of velocities, Viscosity, Friction losses in pipe line, Losses in pipe fittings, transportation of fluids. Measurement of fluid flow, Orifice meter and Venturi meter, Pitot tube, Rotameter, Notches and weirs and other miscellaneous meters.

### UNIT 4

Heat transfer: Conduction, Convection: Free & forced convection dimensionless numbers in heat transfer, expressions for calculating heat transfer coefficients, Laminar and turbulent heat transfer inside and outside tubes, annuli finned tubes, Natural convection and its applications. Radiation: Kirchoff's Law, Stephen's Law, Heat flux by radiation.

### UNIT 5

Psychrometrics: Properties of dry-air: composition of air, specific volume of air, specific heat of dry air, enthalpy of dry air, dry and wet bulb temperature. Refrigeration: Basic refrigeration cycles and concepts: Elementary vapour compression refrigeration cycle with reciprocating, rotary and centrifugal compressor.

### TEXT BOOKS/ REFERENCES:

1. Introduction to Food Engineering by R. P. Singh & D. R. Heldman Academic Press, INC, London.
2. Fundamentals of Food Engineering by R.C. Verma & S.K. Jain Himanshu Publ. New Delhi.



**FPT-424**

**EXTRUSION TECHNOLOGY IN FOOD**

**UNIT 1**

Definition & Objectives of Extrusion, examples of extruded foods, Function of an extruder, Advantages of Extrusion, Development of extruders, important terminologies, advantages and disadvantages of an extruders.

**UNIT 2**

Theory, Rheological properties of the food, Operating characteristics, Determination of operating point for a single screw extruder, Operating data for different types of extruder, Types of extruders: Single screw classification- classification based on extent of shear, classification based on heat generation, solid single screw extruders, interrupted-flight extruder-expander, single segmented-screw extruders. Advantages and disadvantages of single screw extruders.

**UNIT 3**

Twin screw extruders- classification of twin screw extruders (Counter-rotating twin screw extruders & co-rotating twin screw extruders), advantages and disadvantages of twin screw extruders.

**UNIT 4**

New generation extruders, advantages of new generation extruders. Preconditioning- Introduction, Benefits of preconditioning, preconditioning hardware and preconditioner operation.

**UNIT 5**

Ancillary equipment (Preconditioner, Feeder, Pumps, Kneading blocks), Applications of extrusion- Cold extrusion & Extrusion cooking: Confectionery products, Cereal products (Crispbread & breakfast cereals), Protein-based foods (Texturised vegetable protein (TVP) & Meat and fish products), other developments. Effect on foods (Sensory characteristics & Nutritional value). Future trends in extrusion.

**TEXT BOOKS/ REFERENCES:**

1. Riaz Mian N. 2000. Extruders in food applications, Technomic Publishing Company, Inc., Lancaster, USA.
2. Fellows P.J. 2000. Food Processing Technology: Principles and Practices, Second Edition, Woodhead Publishing Limited, Cambridge, England.
3. Extrusion of Food, Vol 2; Harper JM; 1981, CRC Press.
4. Frame ND .1994.*The Technology of Extrusion Cooking*. Blackie Academic.
5. Guy, Robin. 2001. Extrusion cooking: Technologies and applications, Woodhead Publishing Limited, Cambridge, England.



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**FPT-425      ADVANCED LABORATORY COURSE-II**

1. Sun drying of potatoes
2. Determination of beta-carotene in fruits and vegetables.
3. Determination of Grammage of A4 size paper.
4. Determination of refractive index of different oils
5. Determination of saponification number of fats and oils
6. Determination of iodine value of different fats and oils.
7. Study of HTST pasteurizer and sterilizing equipment-vertical retorts.
8. Determination of water activity of foods.
9. Determination of F-values by General method and Formula method.



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## SEMESTER-III

### **FPT-511      TECHNIQUES OF FOOD ANALYSIS**

#### **UNIT 1**

Introduction to Food Analysis, Types of Samples Analyzed, Choice and Validity of method, Official methods

#### **UNIT 2**

Sampling and sample preparation, Preparation of samples, Moisture and Total Solids Analysis

#### **UNIT 3**

Ash analysis: Dry and wet ashing. Fat Analysis: Solvent extraction,

#### **UNIT 4**

Protein analysis and Carbohydrate analysis

#### **UNIT 5**

Vitamin Analysis: Importance of analysis, vitamin units, methods.

#### **TEXT BOOKS/ REFERENCES:**

1. AOAC International. 2003. *Official Methods of Analysis of AOAC International*. 17<sup>th</sup> Ed. Gaithersburg, MD, USA, Association of Analytical Communities.
2. Kirk RS & Sawyer R. 1991. *Pearson's Chemical Analysis of Foods*. 9th Ed. Longman Scientific & Technical.
3. Leo ML. 2004. *Handbook of Food Analysis*. 2nd Ed. Vols. I-III.
4. Linden G. 1996. *Analytical Techniques for Foods and Agricultural Products*. VCH.
5. Nielsen S. (Eds.). 1994. *Introduction to Chemical Analysis of Foods*. Jones & Bartlett.
6. Pomrenz Y & Meloan CE. 1996. *Food Analysis - Theory and Practice*. 3<sup>rd</sup> Ed. CBS.
7. Ranganna S. 2001. *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. 2nd Ed. Tata-McGraw-Hill.



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## FPT-512 DRYING TECHNOLOGY

### UNIT 1

Drying/Dehydration: Definition, principles of drying, theory of drying, advantages and disadvantages of drying, importance of drying & dehydration over other methods of drying/dehydration.

### UNIT 2

Concept of water activity, dehydration fundamental, drying curve, Equilibrium moisture content (EMC), Importance of EMC, classification of food solids, sorption isotherms, bound and free moisture, end point of drying process; Rehydration.

### UNIT 3

Psychometric charts : Air moisture relationships - dry bulb temperature, wet bulb temperature, dew point temperature, specific volume and humid volumes. Moisture content determination. Effect of drying on foods- Texture, Flavour & aroma, Colour and Nutritional value.

### UNIT 4

Dryer selection, common drying system- sun/ solar drying, atmospheric hot air drying, cabinet or tray dryer, tunnel dryer, conveyor, belt or band dryer, pneumatic conveyor dryer, rotary spray dryer and Fluidized bed dryer.

### UNIT 5

Contact dryers - Drum/Roller dryers, vacuum dryer, freeze dryer and foam drying; Novel drying techniques- microwave drying, radio frequency drying, infrared drying, refractance drying and acoustic drying. Dryer performance.

### TEXT BOOKS/ REFERENCES:

1. Sahay KM & Singh KK. 1994. *Unit Operation of Agricultural Processing*. Vikas Publ. House.
2. Fellows PJ. 2005. *Food Processing Technology: Principle and Practice*. 2<sup>nd</sup> Ed. CRC.
3. Potter NN & Hotchkiss 1997. *Food Science*. 5th Ed. CBS.
4. Salunkhe DK & Kadam SS. 1995. *Handbook of Vegetables Science & Technology: Production, Composition, Storage and Processing*. Marcel Dekker.

Hosahalli Ramaswamy and Michele Marcotte. 2006. *Food Processing: Principles and Applications*. CRC Press, Tylor & Francis, Raton.



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## FPT-513 EMERGING TRENDS IN FOOD PROCESSING AND TECHNOLOGY

### UNIT 1

Membrane technology: Introduction to pressure activated membrane processes: micro-filtration, UF, NF and RO and their industrial application.

### UNIT 2

Supercritical fluid extraction: Concept, property of near critical fluids NCF and extraction methods.

### UNIT 3

Microwave and radio frequency processing: Definition, Advantages, mechanism of heat generation, application in food processing: microwave processing, sterilization and finish drying.

### UNIT 4

High Pressure processing: Concept and its application in food processing.

### UNIT 5

Ultrasonic processing: Properties of ultrasonic, application of ultrasonic as processing techniques, application of technologies of high intensity light, pulse electric field, ohmic heating, IR heating, inductive heating and pulsed X-rays in food processing and preservation.

### TEXT BOOKS/ REFERENCES:

1. Barbosa-Canovas 2002. Novel Food Processing Technologies. CRC.
2. Frame N D. (Ed.). 1994. The Technology of Extrusion Cooking. Blackie.
3. Gould G W. 2000. New Methods of Food Preservation. CRC.



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## **FPT-514      ADVANCED LABORATORY COURSE-III**

- 1) Determination of non-enzymatic browning in various types of foods.
- 2) Determination of acids (citric and acetic acids) in fruits and vegetables.
- 3) Determination of chlorophyll in leafy vegetables.
- 4) Quantitative analysis of pepperidin in black pepper.
- 5) Determination of crude fibre content in food samples
- 6) Determination of ascorbic acid content in food samples
- 7) Purification of water by using Reverse Osmosis technology
- 8) Microwave drying of fruits like apple, banana and sugar beet
- 9) Microwave drying of vegetables like cauliflower, cabbage and potatoes

## **FPT-515      SYNOPSIS & SEMINAR**

### **SEMESTER-IV**

#### **FPT-521      Master's Research**