

M.Tech. in Food Science & Technology

SYLLABUS (2018-19)



**P.G.DEPARTMENT OF FOOD SCIENCE
TECHNOLOGY AND NUTRITION
SAMBALPUR UNIVERSITY
JYOTI VIHAR**

COURSE CONTENT
M.TECH PROGRAMME IN FOOD SCIENCE & TECHNOLOGY
Effective from the Academic session 2010-2011

Course No.	Title of the Course	Credit Hours
F I R S T S E M E S T E R		
FST-611	Food processing & Post harvest Technology	04
FST-612	Food Engineering-I (Upstream Processing of foods)	04
FST-613	Food Microbiology & Fermentation Technology	04
FST-614	Statistical Methods in Food Science	04
FST-615	Practicals Related to FST-611 & FST-612	04
FST-616	Practicals Related to FST-613 & FST-614	04
	Total Credits	24
S E C O N D S E M E S T E R		
FST-621	Food Chemistry and Analysis	04
FST-622	Food Engineering-II (Downstream Processing of foods)	04
FST-623	Marketing and Quality of Food products	04
FST-624	Elective Paper (Any One)	04
	<ul style="list-style-type: none"> a. Technology of Dairy Products b. Functional foods c. Bakery and Confectionary Technology d. Beverages and Snacks food Technology 	
FST-625	Practicals Related to FST-621	04
FST-626	Practicals Related to FST-622	04
	Total Credits	24
T H I R D S E M E S T E R		
FST-711	Term Paper	04
FST-712	Industrial Tour Report	04
FST-713	Seminar-I	04
FST-714	Interim Project Report	08
	Total Credits	20
F O U R T H S E M E S T E R		
FST-721	Project Report Presentation and Evaluation	15
FST-722	Seminar-II	04
FST-723	Comprehensive Viva-voce	03
	Total Credits	22
	Total Course Credits	90

Objective: To develop the skills for post harvest processing of food and use them as preservation techniques in food processing industries.

Learning Outcome:

- ❖ Students will have a thorough understanding of various food processing techniques.
- ❖ The students will know the importance of various preservation techniques.
- ❖ Students will have a thorough understanding on the working principle of various instruments used in food processing units.
- ❖ The students will know the importance application of various preservation methods in food industries.

UNIT I

Scope and importance of food processing. National and international perspectives. Principles and methods of food processing and preservation (freezing, heating, dehydration, canning, additives, fermentation, irradiation, extrusion cooking, hydrostatic pressure cooking, dielectric heating)

UNIT-II

Microwave and radio frequency processing: Definition, Advantages, mechanism of heat generation, application in food processing; High Pressure processing: Concept, equipments for HPP treatment, mechanism of microbial inactivation and its application in food processing. Ultrasonic processing: Properties of ultrasonic, application of ultrasonic as processing techniques; Newer techniques in food processing: Application of technologies of high intensity light, pulse electric field, ohmic heating, IR heating; Nanotechnology: Principles and applications in foods; Hurdle technology: concept of hurdle technology and its application.

UNIT-III

Food Packaging: Packaging materials & its advancement, Mass transfer in packing material, Innovation in food packing(active, passive, intelligent), Package testing, CA & MA, Kinetics of biological reactions - kinetics of reactions occurring in processed foods, reaction velocity constant, order of reaction; quality changes during storage of foods; application of Arrhenius equation to biological reactions.

UNIT-IV

Principles of Post-harvest treatments, value-addition, and traceability; Post harvest technology for cereals, legumes, oilseeds, and spices, Hydrothermal treatment & conditioning of grains, Modern paddy and wheat parboiling-systems, equipment, Advances in heat transfer and fluid flow in grain processing operations. Humidification and dehumidification operations applied to post harvest engineering. Crop drying principles, moisture migration theories, advances in crop drying theories & mathematical modeling, Crop drying methods/systems and Crop dryers-selection, design and testing.

Suggested Readings

1. Arsdel WB, Copley MJ & Morgan AI. 1973. *Food Dehydration*. 2nd Ed. Vols. I, II. AVI Publ.
2. Desrosier NW & James N.1977. *Technology of Food Preservation*. 4th Ed. AVI. Publ.
3. Fellows PJ. 2005. *Food Processing Technology: Principle and Practice*. 2nd Ed. CRC.
4. Potter NN & Hotchkiss 1997. *Food Science*. 5th Ed. CBS.
5. Potty VH & Mulky MJ. 1993. *Food Processing*. Oxford & IBH.
6. Ramaswamy H & Marcotte M. 2006. *Food Processing: Principles and Applications*. Taylor & Francis.
7. Jelen, P. 1985. Introduction to Food Processing. Prentice Hall, Reston Virginia, USA.
8. Lewis, M.J. 1990. Physical Properties of Food and Food Processing Systems. Woodhead, UK.
9. Wildey, R.C. Ed. 1994. Minimally Processed Refrigerated Fruits and Vegetables. Chapman and Hall, London.
10. Haard, N.F. and Salunkhe, D.K. 1975. Postharvest Biology and Handling of Fruits and Vegetables. AVI, Westport.

Objective: To develop the skills for engineering properties of food and processes also developing ideas regarding design of food processing equipments.

Learning Outcome:

- ❖ Students will have a thorough understanding of various engineering properties of food.
- ❖ The students will know the importance of thermodynamics in food processing.
- ❖ Students will have a thorough understanding on the effectiveness of mass transfer in food processing units.
- ❖ The students will get complete knowledge of food chilling and freezing and importance in food storage.

UNIT I

Introduction to food engineering & processes: principles of thermodynamics and heat transfer applied to food engineering;. Engineering properties of foods (electrical, Optical, Frictional, Aerodynamic, Rheology, Physical), their significance in equipment design, processing and handling of food and food products. Fluid flow in food processing; continuity equation, Bernoulli's equation, Flow through pipes & conduits, Flow measurement, pump types & performance evaluation.

UNIT-II

Process Heat Transfer – Thermal properties of food, Modes of heat transfer and overall heat transfer; 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; Method for thermal process evaluation - Commercial sterility, pasteurization and sterilization methods based on slowest heating region; determination of the process time based on region of greatest temperature lag; calculation of process time for fluids on stream line flow and turbulent flow heated in heat exchangers

UNIT III

Mass transfer, molecular diffusion and diffusivity, Fick's law, diffusion in solids, liquids and gases equilibrium stage process, convective mass transfer co-efficient, mass transfer with laminar and turbulent flow. Heat and mass transfer analogy Design equations for convective mass transfer, simultaneous momentum; Separation by equilibrium stages, immiscible phases, distillation of binary mixtures and multi-component separations.

UNIT-IV

Refrigeration system; components, refrigerants types, cooling load estimation, refrigeration design and application in food processing., Food chilling and freezing – Precooling and cold storage, freezing point depression; general introduction to enthalpy change during freezing; Plank's equation for predicting rates of product freezing; Cryogenic freezing and IQF; design of food freezing equipment (air blast freezers, plate freezers and immersion freezers).

Suggested Readings

1. Batty, J.C. and Folkman, S.L. 1983. Food Engineering Fundamentals. John Wiley and Sons, New York.
2. Fennema O.R. Ed. 1985, Principles of Food Science: Part-II Physical Principles of food Preservation. Marcel Dekker, New York.
3. Harper, J.C. 1975. Elements of Food Engineering. AVI, Westport.
4. Heldman, D.R. and Lund, D.B. Ed. 1992. Handbook of Food Engineering marcel Dekker, New York.
5. Brennan JG, Butter JR, Corell ND & Lilly AVE. 1990. *Food Engineering Operations*. Elsevier.
6. Charm SE, McCabe WL, Smith JC & Harriott P.1993. *Unit Operations of Chemical Engineering*. McGraw Hills.
7. Heldman DR & Singh RP.1995. *Food Process Engineering*. AVI Publ.
8. McCabe WL & and Smith JC. 1971. *Fundamental of Food Engineering*.AVI Publ.
9. Sahay KM & Singh KK. 1994. *Unit Operation of Agricultural Processing*. Vikas Publ. House.

FST-613. Food Microbiology & Fermentation Technology

4CH

Objective: To develop the skills for structural variation of micro-organisms, various types of spoilage in food and its remedy.

Learning Outcome:

- ❖ Students will have a thorough understanding of various factors responsible for food spoilage.
- ❖ The students will know the specifications of various contamination sources and disease developed in certain processed products.
- ❖ Students will have a thorough understanding of importance of hygiene and sanitation in during food processing.
- ❖ The students will know the types of fermentation and various fermented products with engineering aspect.

UNIT I

Microbial growth in food: Microorganisms in foods (Yeast, Mould, Bacteria); Sources, Microbial growth Analysis, Factors affecting growth of microorganism: Intrinsic, Extrinsic; Physical and chemical methods to control microorganisms, Microbial metabolism of food

UNIT II

Microbial spoilage and its effects on food: Contamination, Preservation and Spoilage of different kind of foods-cereal, Pulses, Fruit and Vegetable, Meat, fish egg, poultry and their processed products, Milk and milk Products, Canned foods and Beverages. Indication of food spoilage, food borne diseases, intoxication, infection and microbial toxin; Principle and use of biosensor in fermenter. Production of vitamins, amino acids, organic

acids, enzymes (amylase, pectinase, proteases), antibiotics, alcohols and single cell proteins; Fermentation Kinetics, Product recovery.

UNIT III

Introduction to fermentation: microbes and food fermentations, measurement and control in fermentation, Substrate utilization and product formation. Fermenter design, instruments and operation; Aeration and agitation in fermentation: Types of fermentation: sub-merged and solid state. Batch and continuous fermentation, scale up in fermentation. Fermentation Kinetics, Product recovery. Biological waste treatment and in plant sanitation.

UNIT-IV

Fermented food: origin, scope and development, saurkraut, yoghurt, cheese, miso, tempeh, idli, dosa. Regulatory and social aspects of biotechnology of foods, application of enzymes in food industry, production of food flavour, colour, enzymes, Immobilised enzymes.

Suggested Readings

1. Branen A.L. and Davidson, P.M. 1983. Antimicrobials in Foods. Marcel Dekker, Newyork.
2. Jay J.M. 1986. Modern Food Microbiology. 3rd Edn. VNR, New York.
3. Robinsont, R.K. Ed. 1983. Dairy Microbiology. Applied Science, London.
4. Banawart GJ. 1989. *Basic Food Microbiology*. 2nd Ed. AVI Publ.
5. Frazier J & Westhoff DC. 1988. *Food Microbiology*. 4th Ed. McGraw Hill.
6. Garbutt J. 1997. *Essentials of Food Microbiology*. Arnold Heinemann.
7. Jay JM, Loessner MJ & Golden DA. 2005. *Modern Food Microbiology*. 7th Ed. Springer.
8. Ray B. 2004. *Fundamentals of Food Microbiology*. 3rd Ed. CRC.
9. Robinson RK. (Ed.). 1983. *Dairy Microbiology*. Applied Science.
10. Steinkraus KS. 1996. *Handbook of Indigenous Fermented Foods*. Marcel Dekker.
11. Stanburry P.P. and Whitaker, A. 1984. Principles of Fermentation Technology. Pergamon Press, Oxford UK.
12. Steinkraus, K.H. 1983. Handbook of Indigenous Fermented Foods. Marcel Dekker, New York.
13. Food, Fermentation, and Micro-Organisms by Charles W. Bamforth
14. Food Fermentation edited by Rob Nout, Willem de Vos and Marcel Zwietering
15. Fermented Beverage Production edited by A.G.H. Lea

FST. 614

Statistical Methods in Food Science

4CH

Objective: To develop the skills on statistical methods and to understand data analysis for writing up a dissertation/ thesis/research article.

Learning Outcome:

- ❖ Students will have a thorough understanding the arrangement of data to draw an analytical conclusion.
- ❖ The students will know the importance of various methods to design the research work.
- ❖ Students will have a thorough understanding on relation, deviation and accuracy of their experimental data..
- ❖ The students will know the importance of research work and have some contribution towards science.

UNIT-I

Research Methodology: Meaning, aim & objective of research, significance of research, Research types, Different types of research design. Fundamentals of statistics: Research process, Population, Variables, Primary and secondary data, Collection of data, Classification and tabulation of data, Need and usefulness of Diagrams & Graphs, Different types of diagrams and graphs. Frequency distribution: Discrete and continuous frequency distribution, population & sample, sampling methods and its types, sampling errors.

UNIT-III

Descriptive statistics: Measure of central tendency: (Arithmetic mean, mean ,median, mode), relation between mean median and mode ;Measure of dispersion: Range, Mean deviation & Standard deviation; Skewness and Kurtosis .

UNIT-IV

Theoretical Probability Distribution: Binomial, Poisson and normal distribution; Testing of Hypothesis: Null and Alternative Hypothesis, level of significance, Student 't' distribution and its application, Chi-square(χ^2) test & its application, 'F' test and its application.

UNIT-V

Correlation, Regression and ANOVA analysis: Types of correlation; simple, partial and multiple correlation, Method of study & testing the significance of correlation coefficient, Rank Correlation, Regression analysis: regression equations and regression lines, Properties of regression lines, regression coefficient, testing the significance of regression coefficient. Analysis of variance (ANOVA): One way and two way classification and their applications.

References:

1. Statistical Methods – S.P.Gupta, Sultan Chand & Sons Publisher- New Delhi
2. Research Methodology, Methods and Techniques – C.R. Kothari Wiley Eastern Limited – New Delhi
3. Elements of Statistics, Theory & Practice – M.Singhal. Lakshmi Narain Agarwal, Educational Publisher – Agra
4. An Introduction to Statistical Methods – C.B.Gupta & V.Gupta- Vikas Publishing House PVT Ltd. New Delhi.
5. Research Methods & Measurements in Behavioural & Social Sciences – G.L.Bhatnagar – Agri. Cole. Publishing Academy, New Delhi.
6. Statistical Methods – S.P.Gupta, Sultan Chand & Sons Publisher- New Delhi
7. Research Methodology, Methods and Techniques – C.R. Kothari Wiley Eastern Limited – New Delhi
8. An Introduction to Statistical Methods – C.B.Gupta&V.Gupta- Vikas Publishing House PVT Ltd. New Delhi.

FST-615	Practicals Related to FST-611 & FST-612	04
FST-616	Practicals Related to FST-613 & FST-614	04

FST-621. Food Chemistry and Analysis:

4CH

Objective: To develop the skills for structure, functions, metabolism of various components of food and their role in body.

Learning Outcome:

- ❖ Students will have a thorough understanding of structure and classification various components of food.
- ❖ The students will know the process of complete digestion and assimilation of food component.
- ❖ Students will have a thorough understanding on the working principle and instrumentation of various instruments used in food analysis.
- ❖ The students will know the importance of various methods to identify any malfunction aspect of food.

UNIT-I

Food chemistry- definition and importance, Shelf life of food. Water relationships in foods: water activity and its relevance to deteriorative processes in foods (chemical, enzymic, physical and microbial changes). Food Carbohydrates: structural, analytical, physicochemical, nutritional and functional aspects of small mol. wt. carbohydrates and polysaccharides of plant and microbial origin. Lipids: classification, and use of lipids in foods, physical and chemical properties, effects of processing on functional properties and nutritive value.

UNIT-II

Protein and amino acids: physical and chemical properties, distribution, amount and functions of proteins in foods, functional properties, effect of processing.-Losses of vitamins and minerals due to processing. Pigments in food, food flavours, browning reaction in foods. Enzymes in foods, and food industry, bio-deterioration of foods, food contaminants, additives and toxicants.

UNIT-III

Buffer: pH meter, Dialysis, ultrafiltration, Reverse osmosis. Centrifugation, Ultracentrifugation, Calorimetry: Bomb calorimeter. Spectroscopic analysis of food components, Principle, instrumentation & application of Colorimetric (colorimeter,colourflex), UV-Vis spectrophotometer, Spectrofluorometer, IR, Atomic Absorption Spectroscopy, Mass spectroscopy, NMR and ESR.

UNIT-IV

Chromatography: Theory & Principle, chromatographic parameter, components of chromatography & types, Advance chromatography: GC,HPLC,HPTLC. Separation technique & analysis: Electrophoresis: Paper & gel electrophoresis, PAGE, iso-electric focusing, 2D electrophoresis, Immuno electrophoresis. Isotopic & immune techniques: Principle & theory of isotopic method, types, Autoradiography, Immuno-techniques, antigen-antibody interaction, enzymatic immune assay- ELISA and its types.

Suggested Readings

1. Aurand, L.W. and Woods, A.E. 1973. Food Chemistry. AVI, Westport.
2. Birch, G.G., Cameron, A.G. and Spencer, M. 1986. Food Science, 3rd Ed. Pergamon Press, New York.
3. Fennema, O.R. Ed. 1976. Principles of Food Science: Part-I Food Chemistry. Marcel Dekker, New York.
4. Meyer, L.H. 1973. Food Chemistry. East-West Press Pvt. Ltd., New Delhi. Potter, N.N. 1978. Food Science. 3rd Ed. AVI, Westport.
5. Bamji MS, Rao NA & Reddy V. 2003. *Textbook of Human Nutrition*.Oxford & IBH.
6. Belitz HD.1999. *Food Chemistry*. Springer Verlag.

7. Fennema OR.1996. *Food Chemistry*. Marcel Dekker.
8. Meyer LH. 1987. *Food Chemistry*. CBS.
9. Swaminathan M. 1974. *Essentials of Foods and Nutrition*. Vol. II. Ganesh& Co.
10. Joslyn, M.A. Ed. 1970. *Methods in Food Analysis*. Academic Press, New York.
11. King, R.D. Ed. 1978. *Developments in Food Analysis Techniques-1*. Applied Science Publishers Ltd., London.
12. Morris, C.J. and Morris, P. 1976. *Separation Methods in Biochemistry* 2nd Ed. PitmanPub., London.
13. Plummer, D.T. 1971. *An Introduction to Practical Biochemistry*. Mc-Graw Hill Pub.Co., New York.
15. AOAC International. 2003. *Official methods of analysis of AOACInternational*. 17th Ed. USA, Association of Analytical Communities.

FST-622. Food Engineering-II (Downstream processing of foods):

4CH

Objective: To develop the skills for downstream processing of foods, product recovery and bio separation techniques.

Learning Outcome:

- ❖ Students will have a thorough knowledge of basic concepts of bio separation technology also get application of filtration and centrifugation in food industry.
- ❖ The students will know uses of extraction and electrophoresis in food processing.
- ❖ Students will have a thorough understanding on the new direction on drying techniques
- ❖ The students will get complete knowledge of material and energy balance of food process engineering.

UNIT-I

Basic concepts of bio separation Technology, Separation characteristics of Food products (Carbohydrates, proteins, fats and enzymes)- size, stability, properties; purification methodologies, Characteristics of food-products; Flocculation and conditioning of broth, overview of reaction processes involved in separation; Filtration at constant pressure and at constant rate; empirical equations for batch and continuous filtration, centrifugal and cross-flow filtration, Centrifugation: basic principles, design characteristics

UNIT-II

Techniques involved in Separation Processes: Foam-fractionation; Solvent extraction of bio-processes, aqueous two-phase extraction, IMAC, adsorption-desorption process; Salt precipitation; Chromatographic separation based on size, charge hydrophobic interactions and metal ion affinity. Affinity chromatography, inhibitors: their preparation and uses, method of linkages, Electrophoresis SDS-PAGE (Polyacrylamide Gel), horizontal and vertical type, methods, case studies.

UNIT III

Thermodynamic properties of moist air, kinetics of water absorption, Evaporation and dehydration of foods, design of single and multi-effect evaporators, mechanics of movement of air through stationary bed, thin layer and thick layer bed drying, simulation models for drying systems, use of weather data for drying operations, design of dryers; New direction in freeze bed drying, cyclic pressure freeze drying. and vacuum drying, efficient drying systems, freezing of foods, freeze concentration and drying, freezing point curves, phase diagrams, methods of freeze concentration, design problems.

UNIT-IV

Membrane based filtration of food products: Micro filtration, Ultra filtration, Nano filtration and Reverse osmosis. Supercritical fluid extraction: Concept, property, extraction methods; Pneumatic handling and transportation of food products; Size reduction and separation; Material and energy balance of food process engineering; Process plant waste management.

Suggested Readings

1. Batty, J.C. and Folkman, S.L. 1983. *Food Engineering Fundamentals*. John Wiley and Sons, New York.
2. Fennema O.R. Ed. 1985, *Principles of Food Science: Part-II Physical Principles of Food Preservation*. Marcel Dekker, New York.
3. Harper, J.C. 1975. *Elements of Food Engineering*. AVI, Westport.
4. Heldman, D.R. and Lund, D.B. Ed. 1992. *Handbook of Food Engineering* Marcel Dekker, New York.
5. Brennan JG, Butter JR, Corell ND & Lilly AVE. 1990. *Food Engineering Operations*. Elsevier.
6. Charm SE, McCabe WL, Smith JC & Harriott P.1993. *Unit Operations of Chemical Engineering*. McGraw Hills.
7. Earle RL. 1985. *Unit Operations in Food Processing*. Pergamon Press.
8. Fellows P. 1988. *Food Processing Technology*. VCH Ellis Horwood.
9. Heldman DR & Singh RP.1995. *Food Process Engineering*. AVI Publication
10. McCabe WL & Smith JC. 1971. *Fundamental of Food Engineering*.AVI Publ.
11. Sahay KM & Singh KK. 1994. *Unit Operation of Agricultural Processing*. Vikas Publ. House.

Objective: To develop the skills on the standardization of food products with respect to quality and its marketability worldwide.

Learning Outcome:

- ❖ Students will have a thorough understanding on marketing strategy for commercialization of the product.
- ❖ Students will have a thorough understanding on the quality attributes, their measurement principle and instrumentation of various instruments used in food quality analysis.
- ❖ The students will know the importance of various methods to identify any adulteration aspect of food.
- ❖ Students will have a thorough understanding on various food laws with their amendments and regulation guidelines followed in national and international level.

UNIT I

Concept and functions of marketing of food products; Concepts and elements of marketing mix. Concept of market structure, micro and macro environments; Market forecasting; market segmentation, targeting and positioning, Product-mix; product line; product life cycle, New product development process. Product brand,. Retailing, wholesaling and distribution, Pricing Decisions, Advertising; Deciding advertising objectives, advertising budget and advertising message, Media Planning, Personal Selling, Publicity; Sales Promotion.

UNIT II

Concept of quality: quality attributes: physical, chemical, nutritional and microbial evaluation and measurement, Sensory evaluation: objective, type, application and limit; Objective evaluation: basic, physiochemical method, microscopic examination and physical method; Instruments used for quality assessment. Food adulteration: common adulterant in food (milk and milk products, edible oils, cereals & pulses, prepared foods, spices, beverages); simple screening, control of food adulteration, Assessment of toxicity of evaluation of limits of contaminants in contexts of food safety;

UNIT-III

Food Safety and Hygiene, Quality assurance, Quality Control, Total Quality Management; GMP, GHP; GLP, GAP; Sanitary and hygienic practices; HACCP; Quality manuals, documentation and audits;

UNIT-IV

Food laws and regulation: Mandatory and voluntary food laws, International quality systems and standards like ISO and Food Codex, BRC; Indian act-Food Safety and Standards Act, 2006, Various food acts-PFA,FPO,AGMARK, MMPO,MFPO, edible oil acts, standard weight acts.

Suggested Readings

1. Amerine MA, Pangborn RM & Rosslos EB. 1965. *Principles of Sensory Evaluation of Food*. Academic Press.
2. Early R.1995.*Guide to Quality Management Systems for Food Industries*. Blackie Academic.
3. Jellinek G. 1985. *Sensory Evaluation of Food - Theory and Practice*. EllisHorwood.
4. Krammer A & Twigg BA.1973. *Quality Control in Food Industry*. Vol. I,II. AVI Publ. Westport.
5. Macrae R, Roloson R & Sadlu MJ. 1994. *Encyclopedia of Food Science &Technology & Nutrition*. Vol. XVI. Academic Press.
6. Ranganna S. 2001. *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. 2nd Ed. Tata-McGraw-Hill. New Delhi
7. Pattee, H.E. Ed. 1985. Evaluation of Quality of Fruits and Vegetables. AVI, Westport.
8. Chowdhry, N.K. and Aggarwal, J.C. 1994. Dunkel Proposals. Vol. III. Shipra Pub., New Delhi.
9. Darrah, L.B. 1971. Food Marketing. The Ronald Press Comp. New York.
10. Kacker, M. Ed. 1982. Marketing and Economic Development, Deep and Deep Pub.,New Delhi.
11. Rich, S.U. 1970. Marketing of Forest Products: Text and Cases, McGraw Hill BookComp., New York.
12. Shepherd, G.S. 1947. Marketing of Farm Products. The Lows State College Press,Ames, Iowa.

Objective: To develop the skills for dairy processing and know about different dairy products its processing and importance.

Learning Outcome:

- ❖ Students will understand the quality parameter of dairy products and its market demand.
- ❖ The students will get better idea behind manufacture technology of different dairy products.

- ❖ Students will have a thorough knowledge of composition and classification of various dairy products available in commercial market.
- ❖ The students will get complete knowledge of fermented dairy products.

UNIT I

Present status of milk & milk products in India and Abroad; market milk- Composition of milk of various species, quality evaluation and testing of milk, procurement, transportation and processing of market milk, Special milks such as flavoured, sterilized, recombined & reconstituted toned & double toned.

UNIT II

Condensed milk- Definition, methods of manufacture, evaluation of condensed & evaporated milk; dried milk- Definition, methods of manufacture of skim & whole milk powder, instantiation, physiochemical properties, evaluation, defects in dried milk powder; Cheese: Definition, composition, classification, methods of manufacture, cheddar, Gouda, cottage and processed cheese, evaluation, defects in cheese.

UNIT III

Cream- Definition, classification, composition, cream separation, sampling, neutralization, sterilization, pasteurization & cooling of cream, evaluation, defects in cream; Butter- Definition, composition, classification, methods of manufacture, theories of churning, evaluation, defects in butter. Ice cream- Definition, composition and standards, nutritive value, classification, methods of manufacture, evaluation, defects in ice cream, and technology aspects of softy manufacture.

UNIT IV

Microbiology of fermented milk products: microbiology and function of starter and secondary flora; Laboratory control in milk product manufacture; Cleaning and Sanitizing in Milk Production and Processing: Hygiene in milk product manufacture, assessment of hygiene requirements, CIP, HACCP outline, Testing of Milk and Milk Products, Treatment of Dairy Wastes; Indigenous milk products - Present status, method of manufacture of *yoghurt, dahi, khoa, burfi, kalakand, gulabjamun, rosogolla, srikhand, chhana, paneer, ghee, lassi* etc.

Suggested Readings

1. Aneja RP, Mathur BN, Chandan RC & Banerjee AK. 2002. *Technology of Indian Milk Products*. Dairy India Publ.
2. Dey. S.1980. *Outlines of Dairy Technology*. Oxford Univ. Press. New Delhi
3. Henderson JL. 1971. *Fluid Milk Industry*. AVI Publ.
4. Rathore NS *et al.* 2008. *Fundamentals of Dairy Technology - Theory & Practices*. Himanshu Publ
5. Spreer E. 1993. *Milk and Dairy Products*. Marcel Dekker.
6. Walstra P. 1999. *Dairy Technology*. Marcel Dekker.
7. Walstra P. (Ed.). 2006. *Dairy Science and Technology*. 2nd Ed. Taylor & Francis.
8. Web BH, Johnson AH & Lford JA. 1987. *Fundamental of Dairy Chemistry*. 3rd Ed. AVI Publ.
9. Considine, D.M. Ed. 1982. *Foods and Food Production Encyclopaedia*, VNR, New York.

FST-624b.

Functional Foods:

Objective: To develop the skills for role of functional foods and nutraceutical and its importance in human life.

Learning Outcome:

- ❖ Students will understand the role of nutraceuticals and photochemical.
- ❖ The students will get better idea how nutraceuticals helps in disease prevention.
- ❖ Students will have a thorough knowledge of molecular farming with GM crops.
- ❖ The students will get brief knowledge of nutrigenomics.

UNIT-I

Nutraceuticals and phytochemicals: definition, Nutraceuticals in controlling diseases. Natural occurrence of certain photochemicals .Antioxidants and flavonoids: omega – 3 fatty acids, carotenoids, dietary fiber, phytoestrogens; Prebiotic and probiotics.

UNIT-II

Role of Neutraceuticals in Disease prevention: Dosage for effective control of disease or health benefit with adequate safety. Care in handling and storage of raw materials with minimal damage to sensitive bioactive compounds; extractive methods for maximum recovery and minimal recovery and minimal destruction of active material.

UNIT-III

Transgenic for food production: Development and current status of transgenic crops for crop improvement and enhanced agronomic performance; molecular farming, Transgenic Animal, GM foods: Ethical issues concerning GM foods; testing for GMOs; IPR.GMO Act 2004.

UNIT-IV

Foodomics- Proteiomics, Genomics, Metabolomics and Nutrigenomics, Role of gene in Diet Therapy. Nutrients as Immunomodulators: General aspects of different types of immunity & their interrelationship, Nutrients on cellular & hormonal immunity.

Suggested Readings

1. Bains W.1993.Biotechnology from A to z. Oxford Univ.Press
2. Joshi VK and Pandey A.1999.Biotechnology: Food fermentation.vol.1,2.Education publ.
3. Knorr D.1982.Food Biotechnology. Marcel Dekker.
4. Lee BH.1996.Fundamentals of Food Biotechnology.VCH
5. Perlman D.1977-1979.Annual Reports of fermentation processes.
6. *Technological, Toxicological and Health Perspective*. MarcelDekker.
- 7.Morton ID & Macleod AJ .1990. *Food Flavours*. Part A, BC. Elsevier.

FST-624c. Bakery and confectionary Technology:

Objective: To develop the skills for processing of confectionary, chocolate and bakery products and its marketing strategy.

Learning Outcome:

- ❖ Students will know the basic knowledge of raw materials used and quality parameter of bakery items.
- ❖ The students will have better idea regarding manufacturing techniques of bakery and snacks products.
- ❖ Students will have a thorough knowledge of different types of chocolate and the technology behind its processing.
- ❖ The students will get brief knowledge of color, texture, and flavor of different types of confectionary items.

UNIT I

Bakery and confectionary industry; raw materials and quality parameters; dough development; methods of dough mixing; dough chemistry; rheological testing of dough-Farinograph, Mixograph, Extensograph, Amylograph / Rapid Visco Analyzer, Falling number, Hosney's dough stickiness tester and interpretation of the data.

UNIT II

Technology for the manufacture of bakery products-bread, biscuits, cakes and the effect of variations in formulation and process parameters on the quality of the finished product; quality consideration and parameters; Staling and losses in baking; machineries used in bakery industry.

UNIT III

Chocolate Processing Technology, Compound Coatings & Candy Bars, Tempering technology, Chocolate hollow figures, Chocolate shells, Enrobing technology, Manufacture of candy bars, Presentation and application of vegetable fats. Production of chocolate mass. Sugar Confectionery manufacture, General technical aspects of industrial sugar confectionery manufacture, Manufacture of high boiled sweets– Ingredients, Methods of manufacture–Types–Center–filled, lollipops, coextruded products. Manufacture of gums and jellies–Quality aspects.

UNIT IV

Quality characteristics of confectionery ingredients; technology for manufacture of flour, fruit, milk, sugar, chocolate, and special confectionary products; colour, flavour and texture of confectionary; standards and regulations; machineries used in confectionery industry. Manufacture of Miscellaneous Products, Caramel, Toffee and fudge– Liquorices paste and aerated confectionery, Lozenges, sugar panning and Chewing gum, Count lines Quality aspects, fruit confections.

Suggested Readings

1. Dubey SC. 2002. *Basic Baking*. The Society of Indian Bakers, New Delhi.
2. Francis FJ. 2000. *Wiley Encyclopedia of Food Science & Technology*. John Wiley & Sons.
3. Manley D. 2000. *Technology of Biscuits, Crackers & Cookies*. 2nd Ed. CRC Press.
4. Pylar EJ. *Bakery Science & Technology*. 3rd Ed. Vols. I, II. Sosland Publ.
5. Qarooni J. 1996. *Flat Bread Technology*. Chapman & Hall.

FST-624d. Beverages & Snack food Technology:

Objective: To develop the skills for processing of different types of alcoholic and non alcoholic type of beverages with a brief knowledge of packaged drinking water manufacturing industry and Indian snack food markets.

Learning Outcome:

- ❖ Students will know the basic knowledge of different types of beverages found in Indian as well as international market.
- ❖ The students will have better idea regarding alcoholic and non alcoholic beverages with water industry.

- ❖ Students will have a thorough knowledge of different types of cereal based snacks food item available in the market.
- ❖ The students will get brief knowledge of fruits and vegetables based snacks with a brief knowledge on extruded snacks food.

UNIT-I

Types of beverages and their importance; Manufacturing technology for juice-based beverages; synthetic beverages; spices, dairy and imitation dairy-based beverages. Technology of carbonated beverages, carbonation of soft drinks. low-calorie and dry beverages ; role of various ingredients of soft drinks, isotonic and sports drinks, Cultivation and processing of Tea, Coffee and cocoa.

UNIT-II

Alcoholic beverages- types, manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, wine and related beverages, Processing of distilled spirits- (whisky, rum, brandy, vodka, gin, sake, champagne). Packaged drinking water- definition, types, manufacturing processes, quality evaluation and raw and processed water, methods of water treatment, BIS quality standards of bottled water; flavored water, carbonated water.

UNIT-III

Bakery products: role of bakery ingredients, bread manufacturing process (straight and sponge dough method), bread faults (staleness, ropiness, retrogradation of starch), quality evaluation of dough and bread, manufacturing process of cookies, crackers, biscuits, cakes (and its types), pizza, pastry, noodles, pasta, vermicelli.

UNIT-IV

Technology for grain-based snacks: whole grains – roasted, toasted, puffed, popped and flakes, coated grains- salted, spiced and sweetened, chocolate processing, papads, and instant premixes of traditional Indian snack foods. Technology for fruit and vegetable based snacks: Chips, wafers; Extruded snack foods: Formulation and processing technology, colouring, flavouring and packaging. Confectionary products- high boiled sweets, toffee, fondant, tablets, lollipop, jellies, Lozenges, sugar panning and Chewing gum.

References:

1. Edmund WL. *Snack Foods Processing*. AVI Publ.
2. Frame ND .1994. *The Technology of Extrusion Cooking*. Blackie Academic.
3. Gordon BR.1997 *Snack Food*. AVI Publ
4. Dubey SC. 2002. *Basic Baking*. The Society of Indian Bakers, New Delhi.
5. Francis FJ. 2000. *Wiley Encyclopedia of Food Science & Technology*. John Wiley & Sons.
6. Manley D. 2000. *Technology of Biscuits, Crackers & Cookies*. 2nd Ed. CRC Press.
7. Pyle EJ. *Bakery Science & Technology*. 3rd Ed. Vols. I, II. Sosland Publ.
8. Qarooni J. 1996. *Flat Bread Technology*. Chapman & Hall.
9. Samuel AM. 1976. *Snack Food Technology*. AVI Publ.
10. Hui YH. *et al* 2004. *Handbook of Food and Beverage Fermentation Technology*. Marcel Dekker.
11. Woodroof JG & Phillips GF. 1974. *Beverages: Carbonated and NonCarbonated*. AVI Publ.

FST-625	Practicals Related to FST-621 & FST-622	04
FST-626	Practicals Related to FST-623 & FST-624	04

THIRD SEMESTER		
FST-711	Term Paper	04
FST-712	Industrial Tour Report	04
FST-713	Seminar-I	04
FST-714	Interim Project Report	08
	Total Credits	20
FOURTH SEMESTER		
FST-721	Project Report Presentation and Evaluation	15
FST-722	Seminar-II	04
FST-723	Comprehensive Viva-voce	03
	Total Credits	22

M.TECH. IN FOOD SCIENCE & TECHNOLOGY
P.G. DEPARTMENT OF FOOD SCIENCE TECHNOLOGY AND NUTRITION

Name of the HOD: The Chairman, P.G. Council, Sambalpur University

Name of the Course Coordinator: Dr. Binata Nayak

Mob. No. 9439896178, 7978477327

Email id: cordcfst@suniv.ac.in

- 1. MINIMUM ELIGIBILITY:** A candidate with a minimum Master Degree in any Science Subject or B.E and B. Tech. Food Technology/ Biotechnology/ Dairy Technology/ Agriculture Engineering degree holder or in related subjects of four years study after +2 Science, with a minimum of 45% marks are eligible.
- 2. SELECTION CRITERIA:** There will be a Common Entrance Test for the admission into, Career-30 marks, Written test-70 marks, (Total-100 Marks) with the following distribution.

For General M.Sc students	First Division	Second	Third
H.S.C.E/ or equivalent	6.0	4.5	3.0
+2 Or equivalent	6.0	4.5	3.0
+3 Honours	9.0	7.0	5.0
Distinction	1.0	1.0	1.0
M.Sc	8.0	6.0	4.0
For Professional Degree Student	First class Honours	First Class	SecondCl ass
B.E/B.Tech.(after+2)	18	13	8

(When the number of application is less than the sanctioned strength, merit list will be prepared on the basis of, career marks only.)

*In special Cases (selection from other specialization except mentioned above)

Total Marks Secured / Maximum Marks X 100"

75% and above = 15

60% and above but less than 75% = 12

45% and above but less than 60% = 10

All other eligible candidates = 08

3. DURATION OF THE COURSE: 2 YEARS

4. NUMBER OF SEATS: Annual intake of 20 seats with reservation rules

5. COURSE FEE: Rs. 25,000/- per Semester for regular Students and Rs 35,000/- per Semester for Sponsored Students. This is in addition to the fee prescribed at clause 11 of the prospectus.

* **N.B. Fees once deposited shall not be refunded in any circumstance except caution money**

6. COURSE STRUCTURE

Course No.	Title of the Course	Credit Hours
F I R S T S E M E S T E R		
FST-611	Food processing & Post harvest Technology	04
FST-612	Food Engineering-I (Upstream Processing of foods)	04
FST-613	Food Microbiology & Fermentation Technology	04
FST-614	Statistical Methods in Food Science	04
FST-615	Practicals Related to FST-611 & FST-612	04
FST-616	Practicals Related to FST-613 & FST-614	04
	Total Credits	24
S E C O N D S E M E S T E R		
FST-621	Food Chemistry and Analysis	04
FST-622	Food Engineering-II (Downstream Processing of foods)	04
FST-623	Marketing and Quality of Food products	04
FST-624	Elective Paper (Any One)	04
	e. Technology of Dairy Products	
	f. Functional foods	

	g. Bakery and Confectionary Technology	
	h. Beverages and Snacks food Technology	
FST-625	Practicals Related to FST-621	04
FST-626	Practicals Related to FST-622	04
	Total Credits	24
THIRD SEMESTER		
FST-711	Term Paper	04
FST-712	Industrial Tour Report	04
FST-713	Seminar-I	04
FST-714	Interim Project Report	08
	Total Credits	20
FOURTH SEMESTER		
FST-721	Project Report Presentation and Evaluation	15
FST-722	Seminar-II	04
FST-723	Comprehensive Viva-voce	03
	Total Credits	22
	Total Course Credits	90

- * From the beginning of the Third Semester, a student shall select a topic related to the COURSE and write a term paper on the selected topic which will be evaluated at the end of the Third Semester.
- * At the end of Second semester each student shall visit one Industrial Establishment or Scientific Institution or any other course-related organization and submit a report on the activities for evaluation during Third Semester.
- * From the beginning of the Third Semester, a student shall work on a Dissertation under the supervision of a suitable Guide from the P.G. Departments or outside including scientist and technocrats from Industries and Corporate sector with the approval of the Academic Committee. The dissertation will be evaluated both during Third Semester (Interim) and Fourth Semester (Final).

7. INFRASTRUCTURE AVAILABLE: P.G. Department of Food Science Technology and Nutrition has been established by the University to offer courses on Food Science and Technology and to carry out research in areas of Food Science, Food Technology, Food Processing and Nutrition.

Major Equipments Available: The laboratories are well equipped with sophisticated equipments like UV- Visible spectrophotometer, Millipore water purification system, laminar air flow, Packaging machine, Vacuum rotary evaporator, Hot air oven, Bacteriological Incubator, Freeze Drier, Vacuum concentrator, Flame photometer, Colour flex, Cooling centrifuge, Orbital shaking Incubator, Centrifuge, TLC assembly, Electrophoresis, Deep freezer, Autoclave, Projection microscope, Texture analyzer, Gas Chromatography, Canning unit, Emulsifying machine, Humidity convection oven, Refractometer, Melting point Apparatus, Package testing machine etc.

8. SPECIAL FEATURE OF THE COURSE: The new M.Tech. Programme in Food Science & Technology is interdisciplinary in nature. Food Science & Technology is a discipline concerned with all the technical aspects of food, beginning with harvesting / slaughtering, and ending with its packaging and marketing. It incorporates concepts from many different fields including microbiology, chemical engineering, biochemistry, nutrition, marketing, and others. It is an exciting area that applies a blend of basic sciences such as biology, chemistry, and physics with microbiology, biochemistry, mathematics and engineering to improve the taste, nutrition and value of the world's food supply. Food scientists extend this knowledge to the development of new food products, packaging, processes, and equipments. Examples of the activities of food scientists include the development of new food products, design of processes to produce these foods, choice of packaging materials, shelf-life studies, and sensory evaluation of the product with trained expert panels or potential consumers, as well as microbiological and chemical testing. M.Tech in Food Science & Technology can successfully prepare students to compete in this market. They will learn innovative technology that has been successful in placing nearly 100 percent of students in careers in product development, research, sales and marketing, quality assurance, production management, analytical and technical services, and regulatory food inspection as well as into higher education or professional programs.

9. CAREER PROSPECT: Food Processing Industry is a very fast emerging industry with good job prospects in India and abroad. Processed and preserved foodstuffs have been instrumental in bringing about a change in the food habits of a large urban populace. . From eating merely for subsistence, people now prefer to supplement their diet with ‘value-added food’. Increase in consumption of processed foods is noticeable across various sections of the population and the trend of ‘eating out’ has grown manifold. In tune with these trends, the market for processed food is growing significantly. The food industry is the fifth largest industry in the country. Currently, it generates employment for about 20 lakhs people and will generate new jobs to the extent of 2.5 lakhs every year. It is estimated that the ratio of various types of jobs available in today’s scenario in the country are: i). Factory production: 60%; ii) Research & Development (R&D): 15%; iii). Government laboratories: 3%; iv) Teaching: 2%; v). Other jobs: 20%. The stepping-in of multi-national companies (MNCs) has further increased job prospects and lucrative salary packages in this industry. There is a plethora of opportunities for Food technologists and Food Scientists, mainly in institutions like processing industries, hotels, food industries, quality control, hospitals, packaging industries, distilleries, bakery industries, soft drink factories, product design, pharmaceutical industry, biochemical engineering, spice, cereal and rice mills etc. Some of the exciting opportunities available as a career in Food Science include; new product development and product improvement; food packaging; technical service and sales; food safety; and regulatory food inspection and quality control. Self-employment through establishing startup projects is an important area for the post graduates of food technology. There are several government schemes for establishing small and medium enterprises. Even the Government of India is giving some subsidy and providing loans through nationalized banks to encourage entrepreneurship programmes, which work out to be an easy route to set-up their own business.

10. TRAINING AND PLACEMENT: Till now department has recommended students for hands on training in both on-campus and off-campus institutions. 38 no’s of students have already completed their M.Tech. Research Projects from reputed institutions like IIT, Delhi, CFTRI, Mysore, IICPT, Tanjur, CRRI, Cuttack and Biotechnological Park. About 90% of the students passed from the department got placed in different industries. The Department is expecting to excel in training. The Department is expecting to excel in training and placement in future.
