

M.Tech. in Food Science & Technology

SYLLABUS (2021)



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

COURSE CONTENT
M.TECH PROGRAMME IN FOOD SCIENCE & TECHNOLOGY

Course No.	Title of the Course	Credit Hours
F I R S T S E M E S T E R		
FST-611	Food Chemistry and Analysis	04
FST-612	Food Engineering-I	04
FST-613	Research Methodology and Biostatistics	04
FST-614	Food Microbiology & Fermentation Technology	04
FST-615	Practical Related to FST-611 & FST-612	04
FST-616	Practical 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	Advance Food Preservation Techniques	04
FST-622	Food Engineering-II	04
FST-623	Marketing and Food Quality	04
FST-624	Elective Paper (Any One)	04
	a. Beverages, Bakery and Snacks food Technology b. Dairy Technology c. Food Plant Layout and Equipment Design	
FST-625	Practical Related to FST-621 & FST-622	04
FST-626	Practical Related to FST-623 & FST-624	04
	Total Credits	24
T H I R D S E M E S T E R		
FST-711	Interim Project Report	12
FST-712	Seminar-I	04
FST-713	Industrial Tour Report	04
	Total Credits	20
F O U R T H S E M E S T E R		
FST-721	Final Project Report	15
FST-722	Seminar-II	04
FST-723	Entrepreneurship Development Proposal	03
	Total Credits	22
	Total Course Credits	90

Instruction to Paper Setters

1. In theory papers questions will be set unit-wise with 2 questions from each unit (total 8 questions).The students shall answer any one question from each unit.
2. 60% of the questions shall be long-answered type and 40% short-answered type

**Courses of Studies for the M. Tech. Food Science & Technology Examination
(Under Course Credit Semester System)**

DETAILED COURSES OF STUDIES

VISION:

To impart a solid understanding of standards of food science, practice and develop essential leadership skills to play a pivotal role to promote new techniques of food process, preserve, packaging, storage with healthy lifestyle choices in our society and beyond.

MISSION:

P.G Department of Food Science Technology & Nutrition of Sambalpur University , Burla strives to impart quality education to the students with enhancement of their skills to make them globally competitive through:

M1: Maintaining state of the art research facilities to provide conducive environment to create, analyze, apply and disseminate knowledge.

M2. Fortifying collaboration with world class R&D organizations, educational institutions, industry and alumni for excellence in teaching, research and consultancy practices to fulfill “Make In India” policy of the Government.

M3. Providing the students with academic environment of excellence, leadership, ethical guidelines and lifelong learning needed for a long productive career

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO1	Critical Thinking: To take an informed and analytical approach to learning and demonstrate in-depth knowledge of the subject and give opinion(s) supported by logical reasoning that one have judged to be appropriate and understanding different approaches and using them
PEO2	Effective Communication: To demonstrate proficiency in communicating competently in groups and organizations, competence in interpersonal communication; possess skills to effectively deliver formal and informal presentations to a variety of audiences in multiple contexts
PEO3	Development of solutions: To design solutions for management problems by applying the contemporary methods in food sciences to enhance organizational / industrial efficiency and to find innovative business solutions.
PEO4	Ethical Standards: To recognize values such as justice, trust, equity, fairness, kindness and develop a commitment to meeting and upholding standards of ethical behavior in all walks of life and comprehending the moral dimensions of decisions and actions
PEO5	Entrepreneurial Perspective: To identify business opportunities and acquire entrepreneurial traits to evaluate and manage their own business successfully.
PEO6	Life-long Learning: To acquire the skill to be an independent lifelong learner embracing real-time changes in the socio-technological context, promoting continuous development and improvement of the knowledge and skills needed for employment and personal fulfillment

PROGRAM SPECIFIC OUTCOME (PSO):

PSOs: At the end of the PG Food Science program, the student will be able to:

PSO1	To develop analytical skills in food industry and apply knowledge in the field of community nutrition.
PSO2	To solve complex problems and acquire analytical skills using latest techniques and tools to find out the solution for food, environmental safety
PSO3	To extend the knowledge on various food processing technologies by further research
PSO4	To design project in formulation, standardization of new products and clinical supplementation for starting Small Scale Industries (SSI) or Medium Scale Industries (MSI)

PROGRAM OUTCOMES (POs):

PO1:	Acquaint with production and consumption trends, structure, composition, quality evaluation, and processing technologies for product development and value addition of various Food commodities.
PO2:	Gain an understanding of the chemical bases of food component reactivity and functionality which will provide them an opportunity to test various approaches for manipulating the chemical and/or functional properties of foods.
PO3:	Acquaint with different groups of micro-organisms associated with food, their activities, destruction and detection in food.
PO4:	Understand the role of food and nutrition for the welfare of the community.
PO5:	Acquaint with different Micronutrient constituents in different foods and its role in health benefits.
PO6:	Use concepts, tools and techniques related to Chemistry and biological science and its application in Family and Community Science (Food Science)
PO7:	Apply the acquired conceptual knowledge of food quality assurance and sustainable waste management for holistic living
PO8:	Familiarize the students about the processing and preservation techniques of pulses, oilseeds, spices, fruits and vegetables, meat, fish, poultry, milk & milk products
PO9:	To understand the concepts of physiological characteristics of different food commodities and to provide an insight about losses during storage and ways to prevent it.
PO10:	Identify and discuss the complex issues inherent in selecting a research problem, selecting an appropriate research design, and implementing a research project thus the role and importance of research in the social sciences
PO11:	Solve complex problems and acquire analytical skills using latest industrial techniques and tools to find out the solution for food & environmental safety
PO12:	To discover the biotechnological approaches in the field of Food Science and communicate common processes which allow the different food processing waste to be converted into valuable products.
PO13:	Established ethical entrepreneur through projects field, industrial visit and other programmes.
PO14:	Explore research interest with creativity, updated technology and sensitivity towards various social issues which make an interest to pursue higher education and research.

FIRST SEMESTER

Course Code: FST-611 (4CH)	Course Name: FOOD CHEMISTRY AND ANALYSIS
Pre-requisite: None	Co-requisite: None

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

UNIT	TOPICS	NO. OF LECTURES
1	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).	3
	Food Carbohydrates: structural, analytical, physicochemical, nutritional and functional aspects of small mol. wt. carbohydrates and polysaccharides of plant and microbial origin.	4
	Lipids: classification, and use of lipids in foods, physical and chemical properties, effects of processing on functional properties and nutritive value.	3
2	Protein and amino acids: physical and chemical properties, distribution, amount and functions of proteins in foods, functional properties, effect of processing.	3
	Vitamins and minerals.	2
	Pigments in food, food flavours, browning reaction in foods	2
	Enzymes in food industry.	3
3	Buffer: pH meter,	1
	Dialysis, ultrafiltration,	1
	Reverse osmosis.	1
	Centrifugation, Ultracentrifugation,	1
	Calorimetry: Bomb calorimeter.	1
	Spectroscopic analysis of food components, Principle, instrumentation & application of Colorimetric (colorimeter, colorflex), UV-Vis spectrophotometer, Spectrofluorometer, IR, Atomic Absorption Spectroscopy, Mass spectroscopy, NMR and ESR	5
4	Chromatography: Theory & Principle, chromatographic parameter, components of chromatography & types, Advance chromatography: GC,HPLC, HPTLC. Separation technique & analysis:	4
	Electrophoresis: Paper & gel electrophoresis, PAGE, iso-electric focusing, 2D electrophoresis, Immuno electrophoresis.	3
	Isotopic & immune techniques: Principle & theory of isotopic method, types, Autoradiography, Immuno-techniques, antigen-antibody interaction, enzymatic immune assay- ELISA and its types.	3
	TOTAL LECTURES =	40

COURSE OUTCOMES:

Upon completion of the subject the students will be able to:

CO1	Demonstrates awareness of basic structure of carbohydrates and lipids with their role.
CO2	Expresses importance of protein, vitamin and mineral requirement for growth.
CO3	Elaborates the quality of food products and changes in components during food preparations.
CO4	Analyzes the importance of natural components stability during processing and handling.

TEXT BOOKS:

1	Fennema, O.R. Ed. 1976. Principles of Food Science: Part-I Food Chemistry. Marcel Dekker, New York.
2	Meyer, L.H. 1973. Food Chemistry. East-West Press Pvt. Ltd., New Delhi.
3	Belitz HD.1999. <i>Food Chemistry</i> . Springer Verlag
4	Pomrenz Y & Meloan CE. 1996. <i>Food Analysis - Theory and Practice</i> . 3rdEd. CBS.

REFERENCE BOOKS:	
1	Swaminathan M. 1974. <i>Essentials of Foods and Nutrition</i> . Vol. II. Ganesh& Co.
2	Robinson JW. 1970. <i>Undergraduate Instrumental Analysis</i> . Marcel Dekke
3	J.L.JAIN, <i>Fundamentals of Biochemistry</i> . S. Chand publication
4	Satyanarayan and Chakrapani, <i>Biochemistry</i> , 5 th edition.

Course Code: FST-612. (4CH)	Course Name: FOOD ENGINEERING-I
Pre-requisite: None	Co-requisite: None

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

UNIT	TOPICS	NO. OF LECTURES
1	Introduction to food engineering & processes: principles of thermodynamics and heat transfer applied to food engineering;	1
	fundamentals of heat and analogy to mass transfer in food processing	1
	Engineering properties of foods (electrical, optical, frictional, aerodynamic, rheology, physical), processing and handling of food and food products.	7
	processing and handling of food and food products	1
2	Process Heat Transfer - Modes of heat transfer and overall heat transfer; thermal properties of foods such as specific heat and thermal conductivity	2
	Fourier's law, steady state and unsteady state conduction	2
	heat exchange equipment	1
	rate of heat transfer; thermal boundary layer; heat transfer by forced convections; heat transfer to flat plate and in nonnewtonian fluids	3
	heat transfer in turbulent flow; heating and cooling of fluids in forced convection outside tubes; natural convection	2
3	Mass transfer, molecular diffusion and diffusivity, Fick's law, diffusion in solids, liquids and gases equilibrium stage process,	2
	Convective mass transfer co-efficient, mass transfer with laminar and turbulent flow.	2
	Heat and mass transfer analogy Design equations for convective mass transfer, simultaneous momentum	3
	Separation by equilibrium stages, immiscible phases	2
	Distillation of binary mixtures and multi-component separations	2
4	Food chilling and freezing – Precooling and cold storage; CA and MA; Properties of frozen foods; freezing point depression	3
	general introduction to enthalpy change during freezing; Plank's equation for predicting rates of product freezing	4
	Cryogenic freezing and IQF	1
	Design of food freezing equipment (air blast freezers, plate freezers and immersion freezers).	2
	TOTAL LECTURES =	40

COURSE OUTCOMES:	
Upon completion of the subject the students will be able to:	
CO1	Demonstrate a thorough understanding of various engineering properties of food.
CO2	Create a fundamental idea on the importance of thermodynamics in food processing.
CO3	Construct a basis understanding on the effectiveness of mass transfer in food processing units.
CO4	Plan to get a complete knowledge of food chilling and freezing and importance in food storage

TEXT BOOKS:	
1	Heldman, D.R. and Lund, D.B. Ed. 1992. Handbood of Food Engineering marcel Dekker, New York.
2	Singh RP & Heldman DR. 1993. <i>Introduction to Food Engineering</i> . Academic Press
3	D.G. Rao. Fundamental of Food Engineering. PHI Learning Pvt. Ltd., 2009
4	Sahay KM & Singh KK. 1994. <i>Unit Operation of Agricultural Processing</i> . Vikas Publ. House.

REFERENCE BOOKS:	
1	Sahay KM & Singh KK. 1994. <i>Unit Operation of Agricultural Processing</i> . Vikas Publ. House.
2	Batty, J.C. and Folkman, S.L. 1983. Food Engineering Fundamentals. John wiley and Sons, New York.
3	Earle RL. 1985. <i>Unit Operations in Food Processing</i> . Pergamon Press.
4	McCabe WL & and Smith JC. 1971. <i>Fundamental of Food Engineering</i> .AVI Publ

Course Code: FST-613 (4CH)	Course Name: RESEARCH METHODOLOGY AND BIOSTATISTICS
Pre-requisite: None	Co-requisite: None

Objective: The course is intended to give an overview of research and statistical models commonly used in medical and biological sciences. The goal is to impart an intuitive understanding and working knowledge of research designs and statistical analysis. The strategy would be to simplify, analyze the treatment of statistical inference and to focus primarily on how to specify and interpret the outcome of research.

UNIT	TOPICS	NO. OF LECTURES
1	Research Methodology: Meaning, aim & objective of research, significance of research, Research types, Research methods vs methodology, Different types of research design. Different Steps in Writing Report, Technique of Interpretation, Precaution in interpretation, Significance of Report Writing, Layout of the Research Report.	3
	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 (Bar charts, Histograms, Frequency polygons, one way scatter plots, Box plots, two way scatter plots, line graphs)	2
	Frequency distribution: Discrete and continuous frequency distribution, population & sample, Sample Size and its Determination	2
	Sampling Designs: Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, sampling errors.	2
2	Descriptive statistics: Measure of central tendency: (Arithmetic mean, harmonic mean , geometric mean, median, mode), relation between mean, median and mode ;	2
	Measure of dispersion: Range, Mean deviation & Standard deviation;	4
	Skewness and Kurtosis,	2
	Probability.	2
3	Testing of Hypotheses: Definition, Basic Concepts, Procedure for Hypothesis Testing, Measuring the Power of a Hypothesis Test, Normal distribution, data transformation, Null and Alternative Hypothesis, level of significance.	3
	Chi-square Test: Chi-square as a Non-parametric Test, Conditions for the Application Chi-square test, Steps Involved in Applying Chi-square Test	2
	Student't' distribution and its application , 'f' test and its application,	2

	Analysis of Variance and Covariance: Analysis of Variance (ANOVA): Concept and technique of One-way ANOVA, Concept of Two-way ANOVA & Analysis of Co-variance (ANOCOVA)	4
4	Measures of Relationship: Need and meaning, Correlation and Simple Regression Analysis, Types of correlation; simple, partial and multiple correlation, Method of study & testing the significance of correlation coefficient.	4
	Regression analysis: regression equations and regression lines, Properties of regression lines, regression coefficient, testing the significance of regression coefficient.	4
	Concept of cluster Analysis and Principal component Analysis.	2
	Computer Application: Use of Computer in data analysis and research, Use of Software and Statistical package. Introduction to SPSS. Importing data from excel, access, entering data, labeling a variable, coding and recoding a categorical and continuous variable. Converting data from string to numeric variables, sorting & filtering, merging, appending data sets.	10
	TOTAL LECTURES =	40

COURSE OUTCOMES:

CO1	Student will be able to understand design statistical models, research designs with the understating of background theory of various commonly used statistical techniques as well as analysis interpretation, reporting of results and use of statistical software.
CO2	
CO3	
CO4	

TEXT BOOKS:

1	Zar, Jerrold H.(1998). Biostatistical Analysis, Prentice Hall, NJ
2	Statistics for Management, Levin and Rubin, Owls Books, Toledo, USA
3	Business Mathematics and Statistics, N.K.Nag & S.K.Nag, Kalyani publishers.
4	Handbook on Data Envelopment Analysis, Cooper, Seiford, Lawrence & Zhu, Springer

REFERENCE BOOKS:

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

Course Code: FST-614	Course Name: FOOD MICROBIOLOGY AND FERMENTATION TECHNOLOGY
Pre-requisite: None	Co-requisite: None

Objective: This course acquaints students with various industrial and food products, their production techniques and prevention of spoilage.

UNIT	TOPICS	NO. OF LECTURES
1	Introduction to food Microbiology: Growth and survival of microorganisms in foods (Yeast, Mould, Bacteria)	2
	Factors affecting growth of microorganism: Intrinsic, Extrinsic; Physical and chemical methods to control microorganisms,	3
	Biochemical changes caused by microorganisms; microbes in food fermentation, putrefaction, lipolysis; Antagonism and synergism in microorganism;	2
2	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.	8

	Indication of food spoilage, food borne diseases, intoxication, infection and microbial toxin.	4
3	Fermentation and Industrial Microbiology Upstream processing: media for industrial fermentation-submerged and solid state fermentation. sterilization, development of inoculum for fermentation. Screening techniques-primary and secondary, strain improvement of industrially important microorganisms.	4
	Introduction to fermentation processes- fermentor- design and components of fermentor- agitation, aeration, pH, temperature, dissolved oxygen- control and monitoring. Types of fermentation: sub-merged and solid state. Batch and continuous fermentation, scale up in fermentation. Fermentation Kinetics,	4
	Techniques of Downstream processes - product recovery and purification- filtration, centrifugation. Purification of intracellular and extra cellular products- Chromatography and Distillation.	4
	Effluent Treatment Plants and Solid Waste Utilization and Management – SCP, Biogas and utilization of food industrial by product	3
4.	Brief account of industrial production of beer, bread, industrial alcohol, vinegar and acetic acid, Cheese by microorganisms. Production of aminoacids- glutamic acid production.	3
	Production of microbial enzymes and its importance- protease, alpha-amylase.	3
TOTAL LECTURES =		40

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

CO1	Explain the interactions between microorganisms and the food environment, and factors influencing their growth and survival.
CO2	Acquaints with various types of food contamination and spoilage by different microorganisms and their preservation techniques.
CO3	Develop processes for utilization of food waste with the help of bioprocess
CO4	Explain various industrial relevant microbial products and their production process

TEXT BOOKS:

1	Frazier W C . Food Microbiology, McGraw Hill
2	Modern Food Microbiology. James M Jay, Martin J Lossner, David A Golden
3	Food Microbiology Adams M R & Moss. The Royal Society of Chemistry, Cambridge.
4.	Industrial microbiology - L E Casida.

REFERENCE BOOKS:

1	Modern Industrial Microbiology & Biotechnology by N. Okafor. 1 st edition. CRC Press, USA. 2007.
2	Industrial Microbiology Samuel C Presscott
3.	Utilization of By-Products and Treatment of Waste in the Food Industry. Springer. Oreopoulou V and Russ W. 2007.

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

SECOND SEMESTER

Course Code: FST-621(4CH)	Course Name: ADVANCE FOOD PRESERVATION TECHNIQUES
Pre-requisite: None	Co-requisite: None

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

UNIT	TOPICS	NO. OF LECTURES
1	Principles of Post-harvest treatments, value-addition, and traceability	1
	Postharvest technology for cereals, legumes, oilseeds, vegetable and spices, Hydrothermal treatment & conditioning of grains, Modern paddy and wheat parboiling-systems, equipment.	5
	Crop drying principles, moisture migration theories, advances in crop drying theories & mathematical modeling, Crop drying methods/systems.	4
2	Scope and importance of food processing. National and international perspectives. Principles and methods of food processing and preservation	1
	freezing, heating, dehydration, canning, additives, fermentation, smoking, pickling	6
	Irradiation,	1
	Extrusion Technology	2
3	High Pressure processing: Concept, equipment for HPP treatment, mechanism of microbial inactivation and its application in food processing	2
	Ultrasonic processing: Properties of ultrasonic, application of ultrasonic as processing techniques	2
	Newer techniques in food processing: Application of technologies of high intensity light, pulse electric field, ohmic heating, IR heating, and pulsed X-rays in food processing and preservation	4
	Hurdle technology	2
4	Food Packaging: Packaging materials & its advancement	3
	Mass transfer in packing material	2
	Innovation in food packing(active, passive, intelligent),	2
	Package testing, CA & M, quality changes during storage of foods	1
	Kinetics of biological reactions - kinetics of reactions occurring in processed foods, reaction velocity constant, order of reaction, application of Arrhenius equation to biological reactions.	2
TOTAL LECTURES =		40

COURSE OUTCOMES:

Upon completion of the subject the students will be able to:

CO1	Develop the skill for a basic understanding of various postharvest process for food processing techniques.
CO2	Construct a knowledge for the importance of various thermal preservation techniques.
CO3	Produce a thorough understanding on the working principle of various techniques used in nonthermal food preservation methods
CO4	Express a thorough knowledge of importance of packaging and its application in food industries

TEXT BOOKS:	
1	Fellows PJ. 2005. <i>Food Processing Technology: Principle and Practice</i> . 4 th Ed. CRC.
2	Singh RP & Heldman DR. 1993. <i>Introduction to Food Engineering</i> . Academic Press
3	Fellows, P. and Ellis H. 1990. <i>Food Processing Technology: Principles and Practice</i> , New York.
4	Sahay KM & Singh KK. 1994. <i>Unit Operation of Agricultural Processing</i> . Vikas Publ. House.
5	Potter NN & Hotchkiss 1997. <i>Food Science</i> . 5th Ed. CBS.

REFERENCE BOOKS:	
1	Ramaswamy H & Marcotte M. 2006. <i>Food Processing: Principles and Applications</i> . Taylor & Francis.
2	Wills, R.B.H., McGlasson, W.B., graham, D., Lee, T.H. and Hall, E.G. 1989. <i>Postharvest: An Introduction to the Physiology</i>
3	Arsdel WB, Copley MJ & Morgan AI. 1973. <i>Food Dehydration</i> . 2nd Ed. Vols. I, II. AVI Publ.
4	Willey, R.C. Ed. 1994. <i>Minimally Processed Refrigerated Fruits and Vegetables</i> . Chapman and Hall, London.

Course Code: FST-622. (4CH)	Course Name: FOOD ENGINEERING II
Pre-requisite: Food Engineering I	Co-requisite: None

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

UNIT	TOPICS	NO. OF LECTURES
1	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	3
	Filtration at constant pressure and at constant rate; empirical equations for batch and continuous filtration	3
	centrifugal and cross-flow filtration, Centrifugation: basic principles, design characteristics; Ultracentrifuges	4
2	Techniques involved in Separation Processes: Foam-fractionation; Solvent extraction of bio-processes, aqueous two-phase extraction, IMAC, adsorption-desorption process; Salt precipitation;	6
	Chromatographic separation based on size, charge hydrophobic interactions and metal ion affinity. Affinity chromatography, inhibitors: their preparation and uses, method of linkages	2
	Electrophoresis SDS-PAGE (Polyacrylamide Gel), horizontal and vertical type, methods	2
3	Thermodynamic properties of moist air, kinetics of water absorption	2
	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	4
	simulation models for drying systems, use of weather data for drying operations, design of dryers	2
	New techniques in drying: freeze drying, vacuum drying, microwave drying	3
4	Membrane based filtration of food products: Micro filtration, Ultra filtration, Nano filtration and Reverse osmosis	2
	Supercritical fluid extraction: Concept, property of near critical fluids NCF and extraction methods	2
	Pneumatic handling and conveying of food products	2

	Material and energy balance of food process engineering	2
	Plant waste management	1
	TOTAL LECTURES =	40

COURSE OUTCOMES:

Upon completion of the subject the students will be able to:

CO1	Demonstrate basic concepts of bio separation technology also get application of filtration and centrifugation in food industry.
CO2	Incorporation of extraction and electrophoresis in food processing
CO3	Explain the new direction on drying techniques
CO4	Optimize material and energy balance during food process engineering

TEXT BOOKS:

1	Heldman, D.R. and Lund, D.B. Ed. 1992. Handbook of Food Engineering Marcel Dekker, New York.
2	Singh RP & Heldman DR. 1993. <i>Introduction to Food Engineering</i> . Academic Press
3	D.G. Rao. Fundamental of Food Engineering. PHI Learning Pvt. Ltd., 2000
4	Sahay KM & Singh KK. 1994. <i>Unit Operation of Agricultural Processing</i> . Vikas Publ. House.
5	McCabe WL & and Smith JC. 1971. <i>Fundamental of Food Engineering</i> . AVI Publ.

REFERENCE BOOKS:

1	Fellows P. 1988. <i>Food Processing Technology</i> . VCH Ellis Horwood..
2	Lewis MJ. 1987. <i>Physical Properties of Food processing Systems</i> . LewisPubl.
3	Harper, J.C. 1975. Elements of Food Engineering. AVI, Westport.
4	Charm SE, McCabe WL, Smith JC & Harriott P.1993. <i>Unit Operations of Chemical Engineering</i> . McGraw Hills.

Course Code: FST-423 (4CH)	Course Name: MARKETING AND FOOD QUALITY
Pre-requisite: None	Co-requisite: None

Objective: To develop the skills on the standardization of food products with respect to quality assessment.

UNIT	TOPICS	NO. OF LECTURES
1	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,	2
	Product-mix; product line; product life cycle, New product development process. Product brand,. Retailing, wholesaling and distribution, Pricing Decisions,	2
	Advertising; Deciding advertising objectives, advertising budget and advertising message, Media Planning, Personal Selling, Publicity; Sales Promotion.	3
2	Concept of quality: quality attributes: physical, chemical, nutritional and microbial evaluation.	2
	Objective evaluation: Tests used for objective evaluation, application and limit, Instruments used for quality assessment-color & gloss, size & shape, defects, texture, Viscosity & consistency	5
	Sensory evaluation: Sensory characteristics of food, sensory requirements, Types of sensory evaluation..	2
	Food adulteration and food toxins: common adulterant in food (milk and milk products, edible oils, cereals & pulses, prepared foods, spices, beverages); simple screening, control of food adulteration	2
	Food Toxins: Terms in toxicology; Safety evaluation using traditional and modern approach;	2
3	Quality assurance, Quality Control, Total Quality Management;	1
	GMP, GHP;	2

	GLP, GAP;	1
	Sanitary and hygienic practices;	1
	physical, chemical and biological hazards in foods,	1
	HACCP- Principles of HACCP, application of HACCP system, implementation steps for HACCP system ;	2
	HACCP-systems for food safety,	1
	Quality manuals, documentation and audits.	1
4	Food laws and regulation: Mandatory and voluntary food laws,	1
	International quality systems and standards like ISO (9000 & 22000) series, Codex, BRC;	3
	Indian Food acts-Food Safety and Standards Act, 2006, FSS Regulations: Regulations on Licensing and Registration, Regulations on Contaminants, toxins and residues, Food product standards, food additives, Laboratory and sampling analysis; Packaging and Labelling; Prohibition and Restriction on sales.	3
	Various food acts- Environment (Protection) Act, 1986, Standards of Weights and Measures Act, 1976, Essential Commodities Act, 1955, The Export (Quality Control and Inspection) Act, 1963, The Insecticides Act, 1968, Consumer Protection Act, 1986. Introduction to various food laws (Voluntary) -Agmark Standards (AGMARK), BIS Standards and Specifications.	3
TOTAL LECTURES =		40

COURSE OUTCOMES:

Upon completion of the subject the students will be able to:

CO1	Design marketing strategy for commercialization of the product.
CO2	Define food behavior appropriate quality characteristics for food formulations/preparations.
CO3	Implementation of hygiene and sanitation conditions for different foods.
CO4	Implementation of suitable specifications for different foods formulations/ industries.

TEXT BOOKS:

1	Fundamentals of Quality Control for Food Industry, Krammer and Twigg, Avi Publishing Company, 1966
2	Branson, R.E. and Norvell, D.G. 1983. Introduction to Agricultural Marketing McGrawHill Book Comp., New York.
3	Food Quality Assurance –Principles and Practices, Inteaz Alli, CRC Press Boca Raton
4	Food Hygiene and Sanitation, Roday S. McGraw Hill Education, 2011
5	An Introduction to Food Science Technology and Quality Management, Bhatt D.K. & Tomar P., Kalyani publishers.

REFERENCE BOOKS:

1	Rich, S.U. 1970. Marketing of Forest Products: Text and Cases, McGraw Hill Book Comp., New York
2	Food Industry Quality Control System, Clute M., CRC Press, 2008
3	Food Safety Management and ISO 22000 –Food Industry Briefing, Early Ralph, Food Industry Briefing Publication
4	Food Safety and Standards Act, Rules & Regulations., Vidhi Jain & Akalank Kumar Jain

Course Code: FST-624 (4CH)	Course Name: ELECTIVE PAPERS
Pre-requisite: None	Co-requisite: None

Course Code: FST-424 (A)	Course Name: BEVERAGES, BAKERY AND SNACKS FOOD TECHNOLOGY
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Objective: To develop the skills for processing of different types of alcoholic and nonalcoholic type of beverages with a brief knowledge of packaged drinking water manufacturing industry and Indian snack food markets.

UNIT	TOPICS	NO. OF LECTURES
1	Types of beverages and their importance	1
	Synthetic beverages; technology of still, carbonated, low-calorie and dry beverages	1
	Manufacturing technology for juice-based beverages	3
	Isotonic and sports drinks, Role of various ingredients of soft drinks	1
	carbonation of soft drinks	1
	Specialty beverages based on tea, coffee, cocoa	3
	Dairy and imitation dairy-based beverages	1
	Status of beverage industry in India	1
2	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, equipment used for brewing and distillation	3
	Wine fermentation and related beverages	3
	Distilled spirits (Rum, Whisky, Brandy, Vodka)	2
	Packaged drinking water- definition, types, manufacturing processes, quality evaluation and raw and processed water, methods of water treatment, BIS quality standards of bottled water, Types: mineral water, flavored water, carbonated water.	3
3	Bakery products: Batter and dough based products, role of bakery ingredients	1
	Bread manufacturing process (straight and sponge dough method), bread faults (staleness, ropiness, retrogradation of starch), quality evaluation of dough and bread,	1
	manufacturing process of cookies, crackers, biscuits, cakes(and its types), pizza, pastry, noodles, pasta, vermicelli	3
	Confectionary products- high boiled sweets, toffee, fondant, tablets, lollipop, jellies, Lozenges, sugar panning and Chewing gum, <i>savoury</i> and <i>farsans</i>	3
4	Technology for grain-based snacks: whole grains: coated grains-salted, spiced and sweetened, papads, instant premixes of traditional Indian snack foods	2
	Technology for fruit and vegetable based snacks: Chips, chikki	2
	Technology for coated nuts – salted, spiced and sweetened	1
	Extruded snack foods: Formulation and processing technology, colouring, flavouring and packaging	2
	Blending, frying, baking, toasting, puffing and flaking	3
	TOTAL LECTURES =	40

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1	Develop the basic knowledge of different types of beverages found in Indian as well as international market.
CO2	Create a better idea regarding alcoholic and nonalcoholic beverages with water industry.
CO3	Demonstrate a thorough knowledge of different types of cereal based snacks food item available in the market.
CO4	Produce a brief knowledge of fruits and vegetables based snacks with a brief knowledge on extruded snacks food

TEXT BOOKS:

1	Fellows P. 1988. <i>Food Processing Technology</i> . VCH Ellis Horwood..
2	Alan H. V & J. P. Sutherland, Springer International Edition
3	Samuel AM.1976. <i>Snack Food Technology</i> . AVI Publ.
4	Pyler EJ. <i>Bakery Science & Technology</i> .3rd Ed. Vols.I, II.Sosland Publ.

REFERENCE BOOKS:	
1	Hui YH. <i>et al</i> 2004. <i>Handbook of Food and Beverage Fermentation Technology</i> . Marcel Dekker
2	Gordon BR. 1997 <i>Snack Food</i> . AVI Publ
3	Woodroof JG & Phillips GF. 1974. <i>Beverages: Carbonated and Non Carbonated</i> . AVI Publ.
4	Francis FJ. 2000. <i>Wiley Encyclopedia of Food Science & Technology</i> . John Wiley & Sons.

Course Code: FST-624 (B)	Course Name: DAIRY TECHNOLOGY
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Objective: To develop the skills on milk, its standards, processing and development of popular milk based products present in Indian Market.

UNIT	TOPICS	NO. OF LECTURES
1	Present status of milk & milk products in India and Abroad; market milk- Composition of milk of various species	3
	quality evaluation and testing of milk, procurement, transportation and processing of market milk, cleaning & sanitization of dairy equipment	3
	Special milks such as flavored, sterilized, recombined & reconstituted toned & double toned	4
2	Cream- Definition, classification, composition, cream separation, sampling, neutralization, sterilization, pasteurization & cooling of cream, evaluation, defects in cream	4
	Butter- Definition, composition, classification, methods of manufacture, theories of churning, evaluation, defects in butter	4
	Ice cream- Definition, composition and standards, nutritive value, classification, methods of manufacture, evaluation, defects in ice cream, and technology aspects of softy manufacture.	2
3	Condensed milk- Definition, methods of manufacture, evaluation of condensed & evaporated milk	4
	Dried milk Powder- Definition, methods of manufacture of skim & whole milk powder, instantiation	3
	Physiochemical properties, difference evaluation, defects in dried milk powder	3
4	Cheese: Definition, composition, classification, methods of manufacture, cheddar, Gouda, cottage and processed cheese, evaluation, defects in cheese	4
	Present status, method of manufacture of <i>yoghurt, dahi, khoa, burfi, kalakand, gulabjamun, rosogolla, srikhand, chhana, paneer, ghee, lassi</i>	4
	Probiotic milk products	2
TOTAL LECTURES =		40

COURSE OUTCOMES:	
CO1	Create a basic understanding of the quality parameter of dairy products and its market demand
CO2	Produce a better idea behind manufacture technology of different dairy products
CO3	Define a thorough knowledge of composition and classification of various dairy products available in commercial market
CO4	Implement the fundamentals to get a complete knowledge of fermented dairy products

TEXT BOOKS:	
1	Dey. S. 1980. <i>Outlines of Dairy Technology</i> . Oxford Univ. Press. New Delhi
2	Rosenthal, I. 1991. <i>Milk and Milk Products</i> . VCH, New York.
3	<i>Technology of Milk Processing</i> , Khan QA and Padmanabhan, ICAR, New Delhi
4	Aneja RP, Mathur BN, Chandan RC & Banerjee AK. 2002. <i>Technology of Indian Mil Products</i> . Dairy India Publ.

REFERENCE BOOKS:	
1	Walstra P. 1999. <i>Dairy Technology</i> . Marcel Dekker.
2	Rathore NS <i>et al.</i> 2008. <i>Fundamentals of Dairy Technology - Theory & Practices</i> . Himanshu Publ
3	Walstra P. 2006. <i>Dairy Science and Technology</i> . 2nd Ed. Taylor & Francis.
4	Robinson, R.K. (2 vol. set). 1986. <i>Modern Dairy Technology</i> Elsevier Applied Science, UK.

Course Code: FST-624 (C)	Course Name: FOOD PLANT LAYOUT AND EQUIPMENT DESIGN
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Objective: To develop the skills for equipment design and plant layout for different food processing plants

UNIT	TOPICS	NO. OF LECTURES
1	Overall design of an enterprise: Plant design, sales planning for plant design	3
	Strength of material –engineering materials, material science, use of various metals, including plastic, glass, etc in food industry	3
	Selection and specification –material design, concepts and manufacturing of various equipment and machineries for food processing plant.	3
2	Plant Location, levels of Plant location, Location of layout: location factors, plant site selection, Location Theory and models, industrial buildings and grounds	3
	Classification of Dairy and Food Plants, farm level collection and chilling center, space requirement,	3
	Estimation of Services and Utilities, Office layout, line balancing, Flexibility, Practical Layouts	3
	Maintenance of Food Plant Building, Illumination and ventilation, Cleaning and sanitization, painting and color coding, Fly and insect control	3
3	Preparation of a Plant Layout: Plant Layout problem, importance, objectives, classical types of layouts	3
	Evaluation of Plant Layout, Organizing for Plant Layout, Data forms Common Problems in Plant Layout and Process scheduling, Setting of Process sections	2
	Equipment selection and capacity determination, Arrangement of process, and service equipment, Layout of multi-product and composite food Plants	2
	Waste treatment and management of food plant.	2
4	Materials and properties: Materials for fabrication, Design of pressure and storage vessels: Operating conditions, design conditions and stress;	3
	Design of tank and its component, mountings and accessories, Design of heat exchangers: Design of shell and tube heat exchanger, plate heat exchanger, scraped surface heat exchanger	3
	Sterilizer and retort, Design of evaporators: Design of dryers, Design of extruders: Cold and hot extruder design, design of screw and barrel, design of twin screw extruder	2
	Safety measures in equipment design, pressure relief devices.	2
	TOTAL LECTURES =	40

COURSE OUTCOMES:	
Upon completion of the subject the students will be able to:	
CO1	Create a basic fundamental regarding the equipments used in food industries and its construction.
CO2	Design the plant layout for different food processing units
CO3	Evaluate the problems facing during the construction of a food processing plant
CO4	Incorporate the safety standards during building a process plant

TEXT BOOKS:	
1	Milk Plant Layout, H.S. Hall, FAO Pub., Rome 1968
2	Plant Layout and Design, James M. Moore Mac Millan, New York, 1971
3	Applied guide to process and plant design, Sean Moran, Elsevier, 2015
4	Handbook of Food Processing Equipment, Sarvacos G and Athanacios EK, 2nd Edition, Springer 2016
5	Peter F. Stanbury, Allan Whitakar and Stephen J. Hall, Principles of Fermentation Technology, 2nd Ed. Elsevier Science Ltd., Burlington, MA, USA. 1995

REFERENCE BOOKS:	
1	Facility Planning and Layout Design, Chandrashekar Hiregoudar, Technical Publications, 2017
2	Engineering for Dairy and Food Products, A.W. Faral, Rebert E., Kriger Pub Co., New York, 1980
3	Introduction to Food Engineering, R. Paul Singh and Heldman DR, 5th Ed. Elsevier, Amsterdam, The Netherlands. 2014
4	Unit Operations in Food Engineering, Ibarz A. and Barbosa-Cánovas G, CRC Press, Boca Raton, FL, USA. 2010
5	Chemical Engineering, Vol. 6, Chemical Engineering Design, R. K. Sinnott, 3rd Ed. Butterworth-Heinemann, Oxford, UK. 1999
6	Handbook of Food Engineering Practice. Kenneth JV, Enrique R and RP Singh, CRC Press, Boca Raton, FL, USA. 1997

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

T H I R D S E M E S T E R		
FST-711	Interim Project Report	12
FST-712	Seminar-I	04
FST-713	Industrial Tour Report	04
	Total Credits	20

Course Code: FST-711 (12CH)	Course Name: INTERIM PROJECT REPORT
Pre-requisite: None	Co-requisite: FST-713

Objective: To develop the skills for research.

1. Basic concepts of project planning

a) Defining objectives- Need, problem, project, feasibility, planning, formulation. - . Identifying resources

b) Methods/approaches,

2. Guideline for project writing –

Title of the project - Name of the person - Duration of the project, type of project. – Aims and objectives - summary of the proposed project - Project information, location, people and personnel involved. - Working/methodology – Evaluation - Writing and reporting

3. Internship Tenure– 6months-

After successful completion of the course the candidate is eligible to undergo 6months internship in the following departments.

Modules for Project Work:

1. Drying and Dehydrations of fruits and vegetables
2. Fruits and Vegetable Products
3. Beverages and other Innovative Products
4. Spice Products
5. Postharvest management and marketing of Fresh Fruits and Vegetables
6. Egg, Poultry and Meat Processing
7. Bakery Products
8. Grain based Products (Cereal, Legumes/pulses and oilseeds)
9. Chocolate, Confectionary and Snack Products
10. Milk and Milk products
11. Processing of Fish and Fish Products
12. Functional Foods and Nutraceuticals
13. Innovative Food Packaging

A Good Project should have:

- i) Originality, Innovation and creativity and should commensurate with understanding the problem and finding solution.
- ii) Relevance of the project to the community and impact of the project on society.
- iii) Proper understanding of the subject, quality and quantity of the work and efforts to validate the data collected.

Project Report Writing:

The structure of the project report shall be in the format is as follows:

- i) The Cover Page-
It should have
 - Title of the project
 - Name and address of department
 - Name and address of Supervisor/Guide/ teacher
- ii) Abstract -500 words
- iii) Contents:
 - List of tables/figures
 - Abbreviations
- iv) Introduction-Description on background of the study
- v) Aims and Objectives
- vi) Relevance of the project work
- vii) Methodology
- viii) Observations: This shall include the observations during the experiment. Observation can be both qualitative as well as quantitative.
- ix) Data analysis and interpretation: The data generated/ obtained from the experiments/observations should be processed for better understanding in a more structured manner. Tools and methods (e.g. statistical methods) may be used for analysing data to understand the patterns that emerges from it to form results and conclusions.
- x) Results: Results are the output of compilation of the data into meaningful outcomes/ interpretations and sometimes, there is a need to redo the experiments to get consistent results. In case it is not possible to “repeat the experiments”, there should be adequate replicates so that adequate data is available for interpretation, and arriving at results.
- xi) Conclusions: This is the logical end of the project to arrive at specific conclusions from the observed phenomena. In a way, the whole objective of the project is to arrive at some conclusion, either positive or negative which would lead to a better understanding of the problem.
- xii) Acknowledgement
- xiii) References

Evaluation shall be done by external members. Students should be assigned marks for project report based on following Criteria:

Sl.No.	Topics	%Marks
1	Originality of Idea and Concept	5
2	Relevance of the project to the theme/problem	5
3	Data collection and analysis	10
4	Research Plan and Methodology	10
5	Experimentation/ execution of research work	10
6	Research Report Writing	30
7	Oral Presentation	20
8	Clarification of queries raised	20
	Total=	100

COURSE OUTCOMES:

The word 'Project' essentially means that learning and development are achieved through personally determined experience and involvement, rather than on received teaching or training, typically in group, by observation, study of theory or hypothesis, bring in innovation or transfer of skills or knowledge. Experiential learning during project work is a business curriculum-related endeavour which is interactive.

Course Code: FST-712 (4CH)

Course Name: SEMINAR-I

Pre-requisite: None

Co-requisite: None

Objective: To develop the skills for improving the verbal and non-verbal communication skills and acquire leadership skill and team work capabilities through participation.

Evaluation shall be done by members. Students should be assigned marks for presentation skill based on following Criteria:

Sl.No.	Topics	%Marks
1	Report Evaluation	50
2	Recent / innovative/ unique idea/ topics	10
3	Technical knowledge related to product/process/ technique	20
4	PPT Presentation	20

COURSE OUTCOMES:

The student utilizes the knowledge in detail to build self-confidence.

Course Code: FST-713 (4CH)

Course Name: INDUSTRIAL TOUR REPORT

Pre-requisite: FST-621, 624

Co-requisite: None

Objective: To develop the skills for industrial processing and application of knowledge approach.

Industrial Tour should be compulsorily carried out by students at least for 1 week. The Industrial Tour should be planned to make students acquaint with different sectors of Food Processing Industries (viz. Bakery, fruits and vegetables, snacks, meat processing, etc). The students should be shared with the details of industries being visited to and given an assignment to collect the basic details of the types of products and technicalities related to it.

Formats for Study Tour or Educational Tour Report and For Its Evaluation:

1. Name of the student:
2. Reg. No and Roll No. :
3. Name of the plant (address):
4. Period of Tour:

Place	Date and Time	Organization	Learning Outcomes

Evaluation shall be done by members. Students should be assigned marks for Industrial Tour based on following Criteria:

Sl.No.	Topics	%Marks
1	Tour report Evaluation	50
2	Technical knowledge related to products	20
3	Presentation of Tour Report with Pictures in	30

F O U R T H S E M E S T E R		
FST-721	Final Project Report	15
FST-722	Seminar-II	04
FST-723	Entrepreneurship Development Proposal	03
	Total Credits	22

Course Code: FST-721 (15CH)	Course Name: FINAL PROJECT REPORT
Pre-requisite: FST-711	Co-requisite: None

Objective: To develop the skills for research.

Evaluation shall be done by external members. Students should be assigned marks for project report based on following Criteria:

Sl.No.	Topics	%Marks
1	Report Evaluation	50
2	Technical knowledge related to product/ process	20
3	Presentation of Report (PPT)	30

COURSE OUTCOMES:

The word 'Project' essentially means that learning and development are achieved through personally determined experience and involvement, rather than on received teaching or training, typically in group, by observation, study of theory or hypothesis, bring in innovation or transfer of skills or knowledge. Experiential learning during project work is a business curriculum-related endeavour which is interactive.

Course Code: FST-722 (4CH)	Course Name: SEMINAR-II
Pre-requisite: FST-711	Co-requisite: None

Objective: To develop the skills for improving the verbal and non-verbal communication skills and acquire leadership skill and team work capabilities through participation.

Evaluation shall be done by members. Students should be assigned marks for presentation skill based on following Criteria:

Sl.No.	Topics	%Marks
1	Research Paper Evaluation	50
2	Conference proceeding certificate	10
3	Technical knowledge related to product/process/ technique	20
4	Oral/Poster Presentation	20

COURSE OUTCOMES:

The student will be able to publish a paper.

Course Code: FST-713 (4CH)	Course Name: ENTREPRENEURSHIP DEVELOPMENT PROPOSAL
Pre-requisite: FST-621, 624	Co-requisite: None

Objective: Objective: To develop the skills for Job Provider rather than Job Seekers.

Evaluation shall be done by members. Students should be assigned marks for presentation skill based on following Criteria:

Sl.No.	Topics	%Marks
1	Report Writing	60
	-subject knowledge	(20)
	-disease management	(20)
	-cause and diet requirements	(20)
2	PPT presentation	40

COURSE OUTCOMES:

It is for building (or reinforcing) skills in project development and execution, decision-making, individual and team coordination, approach to problem solving, accounting, marketing and resolving conflicts, etc. The programme has end to end approach. Carefully calibrated activities help the participants to explore and discover their own potential and both activities and facilitation play a critical role in enhancing team performance. Experiential Learning (EL) helps the student to develop competence, capability, capacity building, acquiring skills, expertise, and confidence to start their own enterprise and turn job creators instead of job seekers. This is a step forward for “Earn while Learn” concept. Experiential Learning is an important module for high quality professional competence and practical work experience in real life situation to Graduates.
