M.Sc. in Food Science and Technology

SYLLABUS (2024-25)

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

Courses of Studies for the M.Sc Food Science and Technology
(Under Course Credit Semester System)

I Semester			
Course Code	**Course Name**	**Credit Hours**	**Marks**
FST.411	Food Commodities	4	100
FST.412	Food Biochemistry and Metabolic Disorder	4	100
FST.413	Food Microbiology	4	100
FST.414	Basic Concepts of Nutrition	4	100
FST.415	Practical-I	4	100
FST.416	EVS & Disaster Management	2	50
	Total	**22 CH**	
II Semester			
Course Code	**Course Name**	**Credit Hours**	**Marks**
FST.421	Food Ingredients	4	100
FST.422	Techniques in Food Analysis	4	100
FST.423	Food Quality Control	4	100
FST.424	Food Processing Technology	4	100
FST.425	Practical-II	4	100
FST.426	IDC (Inter Disciplinary Course)	3	75
	Total	**23 CH**	
III Semester			
Course Code	**Course Name**	**Credit Hours**	**Marks**
FST.511	Post harvest Technology	4	100
FST.512	Research Methodology and Biostatistics	4	100
FST.513	Industrial Food Biotechnology	4	100
FST.514	Nutrition & Dietetics	4	100
FST.515	Practical-III	4	100
FST.516	Entrepreneurship Development Programme	2	50
	Total	**22 CH**	
IV Semester			
Course Code	**Course Name**	**Credit Hours**	**Marks**
FST. 521	Food Preservation and Packaging	4	100
FST. 522	Elective (Anyone)	4	100
	a.Beverages,Bakery and Snacks Food Tech.		
	b.Dairy Technology		
	c. Food Engineering		
FST. 523	Industrial Tour Report	2	50
FST. 524	Project Work/Internship and Viva-voce	10	250
MOOC (ONLINEMODE)	**ANY ONE PAPER(IN2ND OR 3RDSEM)**	**3 CH**	
	Total	**23 CH**	
	TOTAL CREDITS:	**90 CH**	

DETAILED COURSES OF STUDIES

VISION:

Sambalpur University is committed to creating and sustaining a transformative educational environment for its students, staff and faculties in the fields of Liberal Arts, Sciences and Professional Studies so that they become globally competitive through competency in respective domain knowledge, research, innovation and entrepreneurship skills with heightened sense of meaningful community engagements and personal developments.

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	Educate society for generations by providing transformative education with deep disciplinary knowledge and concern for environment
M2	Develop problem solving, leadership and communication skill in student participants to serve the organization of today and tomorrow
M3	Aim for the holistic development of the students by giving them value based ethical education with concern for society
M4	Foster entrepreneurial skills and mindset in the students by giving life-long learning to make the them responsible citizens

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):

PO-1	Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions
PO-2	Effective Communication: Will be able to speak, read, write and listen clearly in person and through electronic media in English and in one Indian Language
PO-3	Social Interaction (Interpersonal Relation): Elicit views of others, mediate disagreements and prepared to work in team
PO-4	Entrepreneurship Capability: Demonstrate qualities to be prepared to become an entrepreneurship
PO-5	Ethics: Recognize different value systems including your own, understand the moral dimensions and accept responsibility for them
PO-6	Environment and Sustainability: Understand the issues of environmental contexts and sustainable development
PO-7	Life-Long Learning: Acquire the ability to engage in independent and life-long learning in the context of socio-technological changes

FIRST SEMESTER

Course Code: FST-411 (4CH)	Course Name: FOOD COMMODITIES
Pre-requisite: None	Co-requisite: FST-413

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Food commodities** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

UNIT	TOPICS	NO. OF LECTURES
1	Cereals: Structure of cereal grains, composition, processing and storage of some common cereals (Rice, Wheat, Maize, Oats), Nutritional Importance of Millets.	3
	Pulses and oilseeds: composition, nutritive value, processing and storage of some common pulses.	3
	Nuts & plantation crop: processing, nutritional value of some common nuts (Coconut, Ground nut, Almond, Cashew nut), tea, coffee and cocoa.	3
2	Fruits and Vegetables: Composition, nutritive value and classification	1
	Canning: Definition, processing steps, and equipment, cans and containers, quality assurance and defects in canned products.	2
	Preparation and preservation of juices, squashes, syrups, sherbets, nectars, cordials, etc; FSTSAI specification Preparation, preservation by jam, jelly and marmalades andvarious problems with remedies.	3
	Preparation and preservation for manufacture of preserve, candies, concentrate, chutney, sauce, puree, paste, ketchup; toffee, cheese, leather, dehydrated, potato wafers and pickles, soup powders; FSTSAI specification.	2
	Spices: Composition, flavoring compounds, processing, nutritive value, adulteration of some common spices of India.	2
3	Meat: classification and Muscle structure	1
	Chemical composition and physico-chemical properties of meat muscle, Abattoir design and layout, Pre-slaughter transport, care and ante-mortem inspection.	2
	Stunning types, slaughtering of animals and poultry, post-mortem inspection and grading of meat, Factors affecting post-mortem changes, quality characteristics of meat.	2
	Processing and preservation of meat- tenderization of meat, curing of meat- role of ingredients and types of curing, smoking of meat, different cooking methods and Restructured Meat- sausages, salami, Chicken wings, chunks (IQF)	2
	Egg structure: Composition, quality characteristics, processing and preservation of eggs.	2
	Fish: composition, classification, nutritive value and processing: surimi; Fish protein concentrates (FPC); Fish protein extracts (FPE), fish protein hydrolysates (FPH), Fish oils.	2
4	Milk and milk products: Operation Flood, composition, physico-chemical properties of milk and nutritional importance of milk, processing of milk.	2
	Dairy plant operations viz. receiving, separation, clarification, pasteurization, standardization, homogenization, sterilization, storage, transport and distribution of milk. Dairy plant sanitation and waste disposal.	3
	Classification and study of milk products (with specifications)- Cream, Butter, Ghee, condensed milk, Khoa, Milk powder, Channa, Paneer, Cheese, Ice-cream, Fermented milk products. Various defects in milk products.	5
	TOTAL LECTURES =	**40**

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Food commodities**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

TEXT BOOKS:	
1	Food Facts and Principles -N. Shakuntala Manay& M. Shadakshara swamy, New Age International (P) Limited, New Delhi.
2	Food Science – B. Srilakshmi, New Age international (P) Limited, New Delhi.
3	Post harvest technology of cereals: pulses and oilseeds, Chakravarty A., Oxford & ibh publishing company, 1988
4	Fruit and Vegetable Preservation, Principles and Practices, Srivastava R.P. and Sanjeev Kumar, International Book Distributing Company, New Delhi 2005
5	Principles of Meat Technology, Singh V. P., New India Publishing Agency, Delhi
6	Outline of Dairy Technology, Sukumar De, Oxford University Press, 2008

REFERENCE BOOKS:	
1	Handbook of Seed Science and Technology, Basra A., CRC Press, 2006
2	Handbook of Fruit and Vegetable Processing Sinha and Hui, John Wiley and Sons, 2010
3	Handbook of Meat, Poultry and Seafood Quality, Kerth Wiley Backwell, 2012
4	Technology of Milk Processing, Khan QA and Padmanabhan, ICAR, New Delhi
5	Food Science- N.Potter & J.H.Hotchkiss- CBS Publishers & Distributors, New Delhi.

Course Code: ND- 412 (4CH)	**Course Name: FOOD BIOCHEMISTRY AND METABOLIC DISORDER**

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Food and Nutrition** Relating to the **M.Sc. in Nutrition and Dietetics**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

UNIT	TOPICS	NO. OF LECTURES
1	Metabolic pathways: Carbohydrates- Aerobic and anaerobic degradation, glycogenesis, glycogenolysis, gluconeogenesis HMP shunt pathway. Hormonal regulations of blood glucose, brief about metabolic disorders with reference to CHO. Glycogen storage disease, Essential Pentosuria, Glalctosemia, Fructosuria and their MNT.	**7**
2	Bioenergetics- Principles of bioenergetics, free energy – endergonic and exergonic process, role of high energy compounds in energy storage, formation of ATP- Biological oxidation and electron transport chain- Reduction potentials, anatomical site and components of oxidative phosphorylation, enzymes involved membrane location of electron transport, chemiosmotic theory, inhibitors of respiratory chain.	**5**
	Lipids- Metabolism of triacylglycerol, oxidation of fatty acids, cholesterol. Regulation of lipid metabolism and ketone bodies. Oxidative stress and antioxidants – Free radicals – definition, formation in biological systems, defense against free radicals. Role of free radicals and antioxidants in health and disease Determination of free radicals, lipid peroxides and antioxidants and brief about metabolic disorders of lipids metabolism. Gaucher's diseases, Niemann pick disease, Fabry's disease, Tac-sach's	**5**

	disease and their MNT.	
3	Protein: Protein degradation, fate of nitrogen (urea cycle), metabolism of aromatic, Sulphur containing, BCAA and other amino acid pool. Glutamine and alanine cycle, protein biosynthesis. Nucleic acids metabolism of nucleic acid components, biosynthesis of nucleotides, brief about metabolic disorders of protein metabolism. Phenyl ketonuria, Alkaptonuria, Albinism, Cystinuria, Hypertyrosinemia, Homocystinuria ana their MNT.	**5**
	Regulation of metabolism: Interrelationship of carbohydrate protein and lipid metabolic, Role of Vitamins and Minerals in metabolism, metabolic adaptation during starvation, exercise, stress, and diabetes mellitus. Significances of enzymes in food metabolism classification, chemical nature-Enzyme inhibition, enzyme pattern in disease pattern.	**5**
4	Hormones: Classification- synthesis – regulatory functions and mechanism of hormone action – Prostaglandin structure, biosynthesis, metabolism and biological action and their role in pathology. Brief about metabolic disorders of hormones and enzyme. Down's syndrome, Turner's syndrome, Klinefelter's syndrome and their MNT.	**4**
	Metabolic disorders: Etiology, Clinical manifestation, MNT- Down's Syndrome, Turner's Syndrome, Klinefelter Syndrome, Maple Syrup Syndrome, CHO Counting, Inborn errors of protein and purine, PKU, MSUD, Tyrosinosis, Homocystinuria, Fructosuria, Organic Aciduria.	**9**
	TOTAL LECTURES =	**40**

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Biochemistry of Foods**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

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. Food Chemistry. Springer, Verlag
4	Lehninger Principles of Biochemistry, David L. Nelson and Michael M. Cox, 6th Ed. Macmillan Learning, NY, USA. 2012

REFERENCE BOOKS:	
1	Swaminathan M. 1974. Essentials of Foods and Nutrition. Vol. II. Ganesh& Co.
2	J.L. JAIN, Fundamentals of Biochemistry. S. Chand publication
3	Satyanarayan and Chakrapani, Biochemistry, 5th edition., Elsevier, 2013

Course Code: FST-413	Course Name: FOOD MICROBIOLOGY
Pre-requisite: None	Co-requisite: None

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Food Microbiology** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

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	Contamination, General principles of spoilage, Preservation and Spoilage of different kind of foods-cereal,	**2**
	Preservation and Spoilage of different kind of Pulses.	**2**
	Preservation and Spoilage of different kind of Fruit and Vegetable,	**2**
	Preservation and Spoilage of Meat, fish egg, poultry and their processed products	**2**
	Preservation and Spoilage of milk and different milk products	**2**
	Preservation and Spoilage of Canned foods and Beverages	**2**
3	Food toxicology & food borne illness: Food hazards- microbiological, nutritional, environmental, natural toxicants, pesticides, food additives, preservatives food borne illness: (Clostridium, botulinum, Escherichia coli, Brucella, Bacillus, Salmonella, Staphylococcus) Nonb acterial agent & food borne illness, (Helminths & Nematodes, protozoa, toxic algae, fungi & food borne viruses	**5**
	Method for microbial examination of food: indicator organisms, direct examination, cultural techniques, Rapid methods in detection of microorganisms.	**3**
4.	Microbial Food hygiene and sanitation: Contamination during handling, processing and its control	**3**
	Food fermentation products and beneficial microbes: Yoghurt, Cheese, Sauerkraut, Tofu, etc	**5**
	Characteristics feature of LAB, General fermentation idea, General concept of Prebiotics, probiotics and symbiotic anti-biotics; bacteriocins from lactic acid bacteria-production and application in food preservation	**5**
	TOTAL LECTURES =	**40**

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Food Microbiology**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

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.

REFERENCE BOOKS:	
1	Modern Industrial Microbiology & Biotechnology by N. Okafor. 1st edition. CRC Press, USA. 2007.
2	Industrial Microbiology Samuel C Press cott

Course Code: FST-414 (4CH)	Course Name: BASIC CONCEPTS OF NUTRITION
Pre-requisite: None	Co-requisite: FST-412

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Basic Concepts of Nutrition** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

UNIT	TOPICS	NO. OF LECTURES
1	Food as a source of nutrients: classification of nutrients; functions, recommended dietary allowances (RDA), Nutrition and Life style-BMR, SDA.	1
	Vitamins: (A, B complex, C, D, E & K) – functions, types, metabolism, sources, deficiency disease and RDA	6
	Major and minor mineral elements with their role in body- Ca, P, Mg, Fe, I, u, Zn, F, Chr and Se.	5
	Importance of Roughages in the diet.	1
	Water & electrolytes balance.	1
2	Nutritional Needs: Nutrition during infancy – Physiological changes, nutritional requirements, food requirements as per RDA, Human milk composition, weaning foods.	2
	Nutritional Needs: Nutrition during pre-school children, – Physiological changes, nutritional requirements, food requirements as per RDA,	2
	Nutritional Needs: Nutrition during school children – Physiological changes, nutritional requirements, food requirements as per RDA,	2
	Nutritional Needs: Nutrition during adolescence – Physiological changes, nutritional requirements, food requirements as per RDA,	2
	Nutrition and infection, nutrition and immunity, nutrition & stress.	1
3	Nutritional Needs: Nutrition during young adults - Physiological changes, nutritional requirements, food requirements as per RDA.	2
	Nutritional Needs: Nutrition during pregnancy - Physiological changes, nutritional requirements, food requirements as per RDA, problems in breast feeding.	2
	Nutritional Needs: Nutrition during lactation - Physiological changes, nutritional requirements, food requirements as per RDA.	2
	Nutritional Needs: Nutrition during old age- Physiological changes, nutritional requirements, food requirements as per RDA.	2
	Nutritional Needs: Nutrition in athletes/sports persons- Physiological changes, nutritional requirements, food requirements as per RDA.	
4	Nutritional Assessment: Assessment of nutritional status by direct & indirect methods,	1
	Anthropometric assessment, clinical examination, bio-physical or radiological measurement, functional assessment,	3
	Laboratory &biochemical assessment, dietary assessment, vital health statistics.	1
	Nutritional problems: Protein energy malnutrition- biochemical and metabolic changes,	2
	National nutrition policy and programmes, Role of National and International agencies in combating malnutrition	2
	TOTAL LECTURES =	**40**

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Basic Concepts of Nutrition**
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

TEXT BOOKS:	
1	Dietetics – B. Srilakshmi; New age International (P) Limited, New Delhi.
2	Nutrition Science – B. Srilakshmi; New age International (P) Limited, New Delhi.
3	Human Nutrition and Dietetics – Davidson, Passmore, East wood, English Language Book Society (ELBS).
4	Text Book of Human Nutrition – Mahtab. S. Bamji; N. Pralhadrao & Vinodini Reddy, Oxford & IBH Publishing Co. Pvt.Ltd

REFERENCE BOOKS:	
1	Swaminathan M. 1974. Essentials of Foods and Nutrition. Vol. II. Ganesh& Co.
2	Principles of Nutrition – Fisher and Fuqua, Wiley eastern Private Limited, New Delhi.
3	Nutrient Requirements and Recommended Dietary Allowances for Indians – Indian Council of Medical Research, National Institute of Nutrition, Hyderabad.
4	ABC of Nutrition (4thedition), Stewart Truswell, BMJ Publishing Group, 2003

Course No: FST. 415 Practical-I 4CH

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Practical –I** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Practical-I**
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

Course No: FST. 416 EVS and Disaster Management 2CH

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **EVS and Disaster Management** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **EVS and Disaster Management**
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

SECOND SEMESTER

Course Code: FST-421 (4CH)	Course Name: FOOD INGREDIENTS
Pre-requisite: FST-411	Co-requisite: None

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Food Ingredients** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

.

UNIT	TOPICS	NO. OF LECTURES
1	Properties of foods: Physical properties of solid and liquid foods (solutions, vapor pressure, boiling point, freezing point, osmotic pressure, viscosity, surface and interfacial tensions, specific gravity),	2
	Textural properties, Thermal properties, optical properties, electrical properties, flow properties, Visco-elastic properties	3
	Dispersion systems in of foods-Sol, Gel, Foam, Emulsion; Rheology of diphase systems.	3
	Sugar and Confectionary: Ingredients, Reaction of sugar, Sugar boiled, Indian confectionary.	2
2	Food pigments and colors: Some common pigments used in food industry (chlorophylls, myoglobin, anthocyanin, betalain, carotenoids, annatto, synthetic colors & lake /dye colors and other colorants)- structure and stability;	4
	Flavors: types of flavor, flavor compounds, extraction principles of flavor, flavor potentiator / enhancers.	2
	Sensation- smell sensation and sensation of taste.	1
	Sensation - texture sensation, visual appearance	2
	Sensation by trigeminal nerve, sensory thresholds	1
3	Food additives: definition, need and classification of food additives, Food Additives generally recognized as safe (GRAS);	1
	Preservatives-Natural and Artificial	2
	Antioxidants and pH control agents in food	1
	Chelating agents, coloring agents, curing agents,	1
	Nutritional supplements, Artificial and non-nutritive sweeteners,	2
	Leavening agents, firming agent, clarifying agent, flour bleaching and maturing agents,	2
	Stabilizer and thickeners, humectants, anti-caking agents, anti-foaming agents, packaging gases	1
	Fat mimetics and replacers	1
4	Nutraceuticals and phytochemicals: definition, Classification. Dietary supplements, Functional foods- their legislation and health claims, Natural occurrence of certain photo-chemicals. Antioxidants and flavonoids: omega – 3 fatty acids, carotenoids, dietary fiber, phytoestrogens.	2
	Nutraceuticals for effective control of disease or health benefit with adequate safety. Role of nutraceuticals against- skin health/ageing, bone health, eye health, mental health, cardiovascular health, cancer prevention etc	4
	Safety, adverse effect and interactions of nutraceuticals, Food omics- Proteomics, Genomics, Metabolomics and Nutrigenomics, Role of gene in Diet Therapy. Nutrients as Immunomodulators.	4
	TOTAL LECTURES =	**40**

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Food Ingredients**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

TEXT BOOKS:	
1	Physical properties of foods, Ignacio Arana, CRC Press, Tailor and Francis Group, 2012
2	Food Biochemistry and Food Processing, Benjamin K. S., Wiley-Blackwell, London, 1983
3	Fennema, O.R. Ed. 1976. Principles of Food Science: Part-I Food Chemistry. Marcel Dekker, New York.
4	Functional foods and Nutraceuticals, Egbuna C. & Tupas G.D., Springer, 2020

REFERENCE BOOKS:	
1	Food Chemistry, David Newton, Facts on File, Inc. New York, 2004
2	Belitz HD.1999. Food Chemistry. Springer, Verlag
3	Handbook of Nutraceuticals and Functional foods, 3rd ED, CRC Press, Tailor and Francis Group,

Course Code: FST-422 (4CH)	**Course Name: TECHNIQUES IN FOOD ANALYSIS**
Pre-requisite: FST-412	**Co-requisite: None**

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Techniques in Food Analysis** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

UNIT	TOPICS	NO. OF LECTURES
1	Nature and Concept of Food analysis, Basic instrumentation: Principle for pH meter, Dialysis	**2**
	Filtration and types, ultra filtration, Reverse osmosis	**2**
	Centrifugation: Principle, Theory (RCF, Sedimentation coefficient) and types of Rotors, Ultracentrifugation	**2**
	Calorimetry: Bomb calorimeter, Densimetry	**1**
	Refractometry	**1**
	Viscometers used in food industry.	**1**
2	Spectroscopic analysis of food components, Principle, instrumentation & application of Colorimetric (Hunter Lab colorimeter/ Munsell colorimeter/CIE-colour system).	**2**
	Principle, instrumentation & application of UV-Vis spectrophotometer & Spectro-flurometer,	**2**
	Principle, instrumentation & application of IR & Atomic Absorption Spectroscopy	**2**
	Principle, instrumentation & application of Mass spectroscopy	**2**
	Principle, instrumentation & application of NMR and ESR.	**2**
3	Chromatography: Theory & Principle, chromatographic parameter (partition coefficient, capacity factor, retention & dead time, Resolution & their calculation), components of chromatography & types (paper, thin layer, partition)	**3**
	Advance chromatography: GC, HPLC, HPTLC (principle, instrumentation &application). Separation technique & analysis	**4**
	Electrophoresis: Paper & gel electrophoresis, PAGE, iso-electric focusing, 2D electrophoresis, Immuno electrophoresis.	**3**

4	Isotopic & immune techniques: Principle & theory of isotopic method, types, measurement	**2**
	Detection of radioactivity, RIA, Autoradiography	**3**
	Immuno-techniques, Principle, antigen-antibody interaction, enzymatic immune assay- ELISA and its types.	**3**
	Different immune techniques of antigen detection in food sample.	**2**
	TOTAL LECTURES =	**40**

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Techniques in Food Analysis**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

TEXT BOOKS:	
1	Food Analysis -Theory and Practice, Pomrenz Y & Meloan CE, 3rd Ed. CBS. 1996
2	Food Analysis, S. Suzanne Nielsen, 3rd Ed. Kluwer Academic, New York, USA., 2003
3	Wilson and Walker‟s Principles and Techniques of Biochemistry and molecular Biology, 8th edition, Hoffmann A. & Clokie S., Cambridge University Press, 2018
4	Handbook of Food Analysis Instruments, Semih Ötles, CRC Press, Boca Raton, FL, USA. 2009.
REFERENCE BOOKS:	
1	Instrumental Methods of Food Analysis, Macleod AJ, Elek Sci. Marcel Dekker. 1973
2	Modern Techniques for Food Authentication, Da-Wen Sun, Elsevier Inc., Burlington, MA, USA. 2008
3	An Introduction to Practical Biochemistry. Plummer, D.T. 1971Mc-Graw Hill Pub.Co., New York.

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

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Food Quality Control** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

UNIT	TOPICS	NO. OF LECTURES
1	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**
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**
	Natural anti-nutritional factors, toxic phytochemicals, microbial toxins, toxins from fungi,	**2**
	Contaminations during handling and processing (PAHs), contaminants from industrial wastes, pesticide residues	**2**
	Toxicity of heavy metals and chemicals in food and their permissible limits,	**2**

	Food allergens.	**1**
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 HAACP 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, FSTS 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

CO-1	Remember and understand the basic concepts/Principles of **Food Quality Control**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

TEXT BOOKS:	
1	Fundamentals of Quality Control for Food Industry, Krammer and Twigg, Avi Publishing Company, 1966
2	Handbook of Food Toxicology, S.S Deshpande, Marcel Dekker, 2002
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	Sensory Evaluation Techniques, Civillie and Carr, CRC Press, 2015
2	Food Industry Quality Control Systesm, 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-424 (4CH)	**Course Name: FOOD PROCESSING TECHNOLOGY**
Pre-requisite: None	**Co-requisite: None**

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Food Processing Technology** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

UNIT	TOPICS	NO. OF LECTURES
1	Basic concept of food processing and preservation: Reason of food Spoilage and Scope of food processing preservation; principles of food processing and preservation	**2**
	Principle and preservation by low temperature: (refrigeration, freezing, and dehydro freezing; cold storage, frozen food), changes during freezing-physical and chemical changes	**2**
	Processing and preservation by drying: factors affecting drying rate, types of dryers –(kiln, tray, drum, spray, tunnel, fluidized bed drying),	**3**
	Types of drying technique (freeze drying, vacuum drying)	**3**
2	Processing and preservation by heat: (blanching, pasteurization, sterilization, UHT processing, heating, smoking, pickling, canning)	**3**
	Microwave cooking- (principle, changes during microwave cooking, advantages), difference between microwave and conventional heating	**2**
	Concentration and evaporation- (flash evaporator, falling film evaporator and multiple effect evaporators), changes during Concentration	**2**
	Ohmic heating	**2**
3	Irradiation	**1**
	High pressure processing	**2**
	Pulsed electric field	**1**
	Ultrasonic processing: Properties of ultrasonic, application of ultrasonic as processing techniques	**2**
	IR heating	**1**
	Hurdle technology: concept of hurdle technology and its application	**2**
4.	Food processing equipment: material handling, cleaning and grading, conveyors, size reduction	**4**
	Separation Technique: filtration (MF, UF, NF, RO), agitation and mixing.	**2**
	Baking, Frying	**2**
	Extrusion Technology-(principle, types of extruders).	**2**
	TOTAL LECTURES =	**40**

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Food Processing Technology**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

TEXT BOOKS:	
1	Fellows PJ. 2005. *Food Processing Technology: Principle and Practice*. 4thEd. CRC.
2	Potter NN & Hotchkiss 1997. *Food Science*. 5th Ed. CBS
3	Sahay KM & Singh KK. 1994. *Unit Operation of Agricultural Processing*. Vikas Publ. House.

REFERENCE BOOKS:	
1	Ramaswamy H &Marcotte M. 2006. *Food Processing: Principles and Applications*. Taylor & Francis
2	Wills, R.B.H., McGlasson, W.B., graham, D., Lee, T.H. and Hall, E.G. 1989. Postharvest: An Introduction to the Physiology

COURSE NO: FST.425 PRACTICAL-II 4CH

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Practical -II** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Practical-II**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

COURSE NO: FST. 426 Inter Disciplinary Course 4CH

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Inter Disciplinary Course** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Inter Disciplinary Course**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

THIRD SEMESTER

Course Code: FST-511 (4CH)	**Course Name: Post Harvest Technology**
Pre-requisite: None	**Co-requisite: None**

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Post-Harvest Technology** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

UNIT	TOPICS	NO. OF LECTURES
1	Post-harvest Technology: Importance, principles & scope of post-harvest treatments.	3
	Pre-harvest factors that affect post-harvest quality	2
	Respiration: Factor effecting respiration rate, Losses: causes of post-harvest losses, Diseases: Physical damage, Minimizing Losses	2
	Maturity: Maturity indices for harvesting crops, Handling: Techniques for crop harvesting, foods and vegetables harvesting	2
	Post harvest technology for cereals (cleaning, grading, milling), Hydrothermal treatment & conditioning of grains. Modern paddy Crop drying methods/systems and Crop dryers-selection. and parboiling-systems, equipment.	3

2	Post-harvest of fruits & Vegetables: physiological and biochemical changes in fruits and vegetables;	**3**
	Ripening of climacteric and non-climacteric fruits, Artificial ripening process.	**2**
	Physiological post-harvest disorders - chilling injury and disease;	**2**
	Prevention of post-harvest diseases and infestation;	**2**
	Handling and packaging of fruits and vegetables; factors affecting post-harvest losses; Standards and specifications for fresh fruits and vegetable.	**3**
3	Wheat and corn milling process	**3**
	Post harvest technology for legumes (cleaning, grading, milling)	**3**
	Post harvest technology for oilseeds (cleaning, grading, milling), Oil extraction	**3**
4	Processing: Importance of post-harvest processing, Quality, Nutritional content, Sensory attribute	**2**
	Different types of storage and preservation techniques for minimizing the post-harvest losses.	**2**
	Value added product development: Intermediate Moisture Foods, Tomato Products, Drying and Dehydration of Fruits and Vegetables products, Beverages.	**3**
	TOTAL LECTURES =	**40**

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Post-Harvest Technology**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

TEXT BOOKS:	
1	Unit operations of Agricultural Processing, Sahay and Singh, Viraj publishing House Pvt. Ltd.
2	Thompson AK. 1995. *Post Harvest Technology of Fruits and Vegetables*. Blackwell Sci.
3	Robertson, G.L. Food Packaging: Principles and Practice (2nd ed.), Taylor & Francis 2006
4	Han, J.H. (Ed.) Innovations in Food Packaging, Elsevier Academic Press, 2005

REFERENCE BOOKS:	
1	Lal G, Siddapa GS & Tandon GL.1986. *Preservation of Fruits and Vegetables*. ICAR.
2	Verma LR. & Joshi VK. 2000. *Post Harvest Technology of Fruits and Vegetables*. Indus Publ.
3	Ahvenainen, R., Novel Food Packaging Techniques, CRC Press, 2003
4	Food Packaging Technology Handbook. NIIR Board, National Institute of Industrial Research, 2003
5	Coles, R., McDowell, D. and Kirwan, M.J. (Eds.) Food Packaging Technology,CRC Press, 2003

Course Code: FST-512 (4CH)	Course Name: RESEARCH METHODOLOGY AND BIOSTATISTICS
Pre-requisite: None	Co-requisite: None

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Research Methodology and Biostatistics** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

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‟ 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

CO-1	Remember and understand the basic concepts/Principles of **Research Methodology and Biostatistics**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

TEXT BOOKS:	
1	Zar, Jerrold H.(1998). Biostatistical Analysis, Pretice Hal, 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-513	**Course Name: INDUSTRIAL FOOD BIOTECHNOLOGY**
Pre-requisite: FST-413	**Co-requisite: None**

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Industrial Food Biotechnology** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

UNIT	TOPICS	NO. OF LECTURES
1	Definition, Scope, and Application of Biotechnology - Application in Food Industries,	**1**
	Basic tools of r-DNA technology: Restriction endonuclease and DNA ligase, Cloning: -cloning vectors, cloning of foreign DNA, screening of recombinant clone, PCR technology, DNA sequencing technique, Blotting techniques.	**4**
	Role of DNA in Cell Metabolism; Cell and Tissue Culture; Cloning and Micromanipulation	**3**
2	Transgenic for food production: Development and current status of transgenic Crops (insect resistant and herbicide tolerant crops) for crop improvement and enhancedagronomic performance; molecular farming, Transgenic Animal, Hybridoma Technology	**4**
	GM foods: Ethical issues concerning GM foods; testing for GMOs; IPR. GMO Act 2004. Concept of genomics and proteomics.	**3**
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- Bioreactor design, types and components of fermenter- agitation, aeration, pH, temperature, dissolved oxygen- control and monitoring. Different types of fermenters	**3**
	Techniques of Downstream processes - recovery and purification- filtration, centrifugation. Purification of intracellular and extra cellular products- Chromatography and Distillation.	**4**
4.	Brief account of industrial production of beer, bread, industrial alcohol, vinegar and aceticacid, Cheese by microorganisms. Production of amino acids, Production of antibiotics, Production of food colorants, Production of beta carotene, Production of baker‟s yeast,	**6**

	Production of microbial enzymes and its importance- protease, alpha- amylase, Immobilization of enzymes.	**2**
	Effluent Treatment Plants and Solid Waste Utilization and Management – SCP, Biogas and vermi- composting	**3**
	Utilization of-agricultural waste (cereal, legume and oil seed based waste), dairy waste, fruit and vegetable waste, meat, poultry, egg and fish wastes, by-products of fermentation industries, Sugar and bakery industry.	**3**
	TOTAL LECTURES =	**40**

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Industrial Food Biotechnology**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

TEXT BOOKS:	
1	Genetics. Strickberger M W. Prentice, Hall of India, Pvt Limited, New Delhi.
2	Industrial Microbiology, Casida LE, Wiley, 1968
3	Microbial Biotechnology: Fundamentals of Applied microbiology - Hiroshi Nikaido, Alexander N Glazer
4	Biotechnology -Expanding Horizons, B.D. Singh, Kalyani Publishers, New Delhi. 2014

REFERENCE BOOKS:	
1	Introduction to Plant Biotechnology. Second Edition. Science Publishers. Chawla HS.
2	Utilization of By-Products and Treatment of Waste in the Food Industry. Oreopoulou V and Russ W. Springer, 2007.
3	Principles of Gene Manipulation and Genomics, S.B. Primrose and R.M. Twyman, 7thEd. , Blackwell Publishing, Victoria, Australia, 2006

Course Code: FST-514 (4CH)	Course Name: NUTRITION AND DIETETICS
Pre-requisite: None	Co-requisite: None

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Nutrition and Dietetics** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

UNIT	TOPICS	NO. OF LECTURES
1	Therapeutic Nutrition: Therapeutic adoption of normal diets (normal, soft & fluid diets) factors to be considered in planning therapeutic diets, role of dietician, Dietary calculation using food exchange lists, high & low-calorie diet, high protein, high fat, &low carbohydrate diets.	**10**
2	Therapeutic Diets: Etiology, physiological disturbances, biochemical & clinical Manifestations & dietary management of: Fever & infection	**3**
	Therapeutic Diets: Etiology, physiological disturbances, biochemical & clinical Manifestations &dietary management of: Allergy, burn and trauma complication and diet treatment.	**4**
	Therapeutic Diets: Etiology, physiological disturbances, biochemical & clinical Manifestations & dietary management of: HIV, AIDS and cancer.	**3**
3	Therapeutic Diets: Etiology, physiological disturbances, biochemical & clinical Manifestations & dietary management of: Obesity , underweight and eating disorder	**4**
	Therapeutic Diets: Etiology, physiological disturbances, biochemical & clinical Manifestations & dietary management of: diabetes mellitus.	**4**
	Therapeutic Diets: Etiology, physiological disturbances, biochemical & clinical Manifestations & dietary management of: GI Disease and disorders	**2**
4	Therapeutic Diets: Etiology, physiological disturbances, clinical & biochemical manifestation and dietary management of cardio vascular disorder. Arthrosclerosis (fat-controlled diet) heart disease, Hypertension, Coma.	**2**
	Therapeutic Diets: Etiology, Physiological disturbances, biochemical & clinical Manifestations &dietary management of: Liver and Pancreas, cirrhosis (High protein, high carbohydrate, moderate fat or fat restricted diet) pancreatitis, and cholelithiasis	**3**
	Therapeutic Diets: Etiology, physiological disturbances, biochemical & clinical manifestations & dietary management of: Diseases of kidney (Nephrosis, nephro sclerosis, glomerular nephiritis, uremia) CKD and K, Na diet.	**5**
	TOTALLECTURES=	**40**

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Nutrition and Dietetics**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

TEXT BOOKS:	
1	Nutrition and Dietetics – Subhangini A.Joshi – Tata McGraw-Hill Publishing Company Limited, New Delhi
2	Dietetics – B.Srilakshmi – New age international (P) limited New Delhi.
3	Clinical Dietetics and Nutrition – F.A. Antia, Oxford University Press, London.
4	Text Book of Human Nutrition- Mahtab S. Bamji, N.Rao & V. Reddy, Oxford & IBH Publishing Co. Pvt Ltd.

REFERENCE BOOKS:	
1	Normal and Therapeutic nutrition- C.H. Robinson & M.R Lawler – Macmillen Publishing Co. New York.
2	Essentials of Food and nutrition – M.Swaminathan, Vol I & II, The Bangalore Printing & Publishing Co. Ltd (BAPPCO)
3	Food, Nutrition & Diet Therapy-L.K.Mahan & Escott.Stump- W.B. Saunders Ltd
4	Nutrition& Diet Therapy- S.R.Williams-Times mirror Mosby college Publishing. Co.
5	Human Nutrition & Dietetics- J.S.Garrow ,W.P.T.James, A. Ralph –Churhill Livingstone.

FOURTH SEMESTER

Course Code: FST-521 CH 04	**Course Name: FOOD PRESERVATION AND PACKAGING**

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Food Preservation and Packaging** Relating to the **M.Sc.in Food Science & Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

UNIT	TOPICS	NO. OF LECTURES
1	Food and its preservation, Food Preservation Past, Present and Future, Natural food hazards, Principles of Fresh and refrigerated gas storage of food.	**2**
	Preservation of Milk and Milk products.	**2**
	Preservation of fermented products.	**2**
	Preservation of Meat, Fish and Eggs.	**2**
	Preservation of Fruit Vegetables and Grains.	**2**
2	Factor affecting the self-stability of acid foods, alternative food preservation technology: efficacy and mechanism.	**3**
	Responsibility of Home makers in processing storage and preservation, food storage and processing for house hold food security.	**2**
	Elevating antioxidant levels in food through organic farming	**1**
	Food Security and Nutrition Packaging	**2**
	Nanotechnologies for Food Packaging	**2**
3	Packaging Fresh and Processed Food: Packaging requirement for different foods and processing methods,	**1**
	Various Packaging Types (paper, glass, metal container)	**2**
	Plastic Fabrication varieties, and trends; protective packaging of foods;	**1**
	Packaging of food products sensitive to oxygen, light, moisture; special problems in canned foods.	**2**
	Aseptic packaging, Modified Atmosphere Packaging (MAP), Controlled Atmosphere Packaging (CAP),	**1**
	Active packaging, Intelligent packaging	**2**
	Food Labelling and barcode technology	**1**

	Bio-degradable packages, aseptic and edible package, Recyclability of packaging material	**2**
4.	Food packaging: Packaging material, Mass transfer in packing material	**3**
	Packaging system and methods-vacuum packaging, gas flush packaging, aseptic packaging	**2**
	Packaging of convenience foods; packaging of food products-fruits and vegetables; packaging requirements of fresh fruits and vegetables; packaging of fruit juices, spices, meat & poultry, fish, seafood; criteria for selection of proper packaging based on the shelf life desired, diary product, beverages, cake and snacks food.	**3**
	TOTALLECTURES=	**40**

Course Outcomes

CO-1	Rememberandunderstandthebasicconcepts/Principles of **Food Preservation and Packaging**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

TEXTBOOKS:	
1	Fellows PJ. 2005.*Food Processing Technology: Principle and Practice*.4thEd.CRC.
2	Potter NN & Hotchkiss 1997. *FoodScience*.5thEd.CBS
3	Sahay KM &Singh KK. 1994. *Unit Operation of Agricultural Processing*.VikasPubl.House.
4	Robertson,G.L.FoodPackaging: PrinciplesandPractice(2nded.),Taylor&Francis2006

REFERENCEBOOKS:	
1	RamaswamyH&Marcotte M. 2006. *Food Processing:PrinciplesandApplications*. Taylor &Francis
2	Wills,R.B.H.,McGlasson,W.B.,graham, D.,Lee,T.H.andHall, E.G.1989.
3	Food Packaging Technology Handbook.NIIRBoard,National Institute of Industrial Research,2003
4	Robertson, G.L.Food Packaging:Principles and Practice(2nded.),Taylor&Francis2006

Course Code: FST-522 (a) CH 04	**Course Name: BEVERAGES, BAKERY AND SNACKS FOOD TECHNOLOGY**

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Beverages, Bakery and Snacks Food Technology** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

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	**3**

	beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, equipment used for brewing and distillation	
	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, *savoury* and *farsans*	**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

CO-1	Remember and understand the basic concepts/Principles of **Beverages, Bakery and Snacks Food Technology**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

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

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

Course Code: FST-522 (b)	**Course Name: DAIRY TECHNOLOGY**

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 &	**4**

	double toned	
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 *yoghurt, dahi, khoa, burfi, kalakand, gulabjamun, rosogolla, srikhand, chhana, paneer, ghee, lassi*	**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. *Outlines of Dairy Technology*. Oxford Univ. Press. New Delhi
2	Rosenthal, I. 1991. Milk and Milk Products. VCH, New York.
3	Technology of Milk Processing, Khan QA and Padmanabhan, ICAR, New Delhi
4	Aneja RP, Mathur BN, Chandan RC & Banerjee AK. 2002. *Technology of Indian Mil Products*. Dairy India Publ.

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

Course Code: FST-522 (c) CH 04	**Course Name: FOOD ENGINEERING**

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Food Engineering** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

UNIT	TOPICS	NO. OFLECTURES
1	Introduction to food engineering & processes: principles of thermos dynamics and Heat transfer applied to food engineering;	3
	Size reduction equipment: Principal types, hammer mill sand impactors, at trition mills, buhr mill, tumbling mills, tumbling mills, colloid mill, cutting machines (slicing, dicing, shredding, pulping);	3
	Mixing: Theory of solid and liquid mixing, Mixing equipment: Mixers for low-or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices).	3
2	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;	5
	Energy balances; rate of heat transfer; thermal boundary layer; heat transfer byforced convections; heat transfer in flat plate and Newtonian fluids; heat Transfer in turbulent flow; heating and cooling of fluids in forced convection outside tubes.	5
3	Mass transfer, molecular diffusion and diffusivity, Fick's law, diffusion in solids, Liquids and gases equilibrium stage process,	4
	Convective mass transfer co-efficient, mass transfer with laminar and turbulent flow	3
	Heat and mass transfer analogy Design equations for convective mass transfer, Simultaneous momentum; Application of mass transfer in food processing.	3
4	Refrigeration system; components, refrigerants types, cooling load estimation, Refrigeration design and application in food processing	3
	Food chilling and freezing–Pre cooling and cold storage, freezing point depression;	2
	General introduction to enthalpy changes during freezing; Plank'sequationfor Predicting rates of product freezing;	3
	Cryogenic freezing and IQF.	3
	TOTALLECTURES=	**40**

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Food Engineering**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

TEXTBOOKS:	
1	Heldman DR & Singh RP. 1995. *Food Process Engineering*. AVIPubl.
2	Rao. D.G, Fundamentals of food engg, PHIpubl
3	Heldman, D.R. and Lund, D.B.Ed.1992. Handbook of Food Engineering marcel, Dekker, New York.
4	Fundamentals of food process Engineering, Toledo, Singh, Kong, Springer.

REFERENCEBOOKS:	
1	Brennan JG, Butter JR, CorellND&Lilly AVE. 1990. *Food Engineering Operations*. Elsevier.
2	CharmSE, Mc Cabe WL, Smith JC& Harriott P.1993. *Unit Operations of Chemical Engineering*. Mc Graw Hills.

Course Code: FST-523 (2CH)	**Course Name: INDUSTRIAL TOUR REPORT**
Pre-requisite: None	**Co-requisite: None**

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Industrial Tour Report** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts

PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Industrial Tour should be compulsorily carried out by students at least for 1 day. 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**

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Industrial Tour Report**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

Course Code: FST-524 (10 CH)	**Course Name: PROJECT WORK/INTERNSHIP AND VIVA VOCE**
Pre-requisite: None	**Co-requisite: None**

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Project Work/Internship and Viva Voce** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

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 analyzing 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

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 Outcomes

CO-1	Remember and understand the basic concepts/Principles of **Project Work/Internship and Viva Voce**
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

****

Course Code: MOOC	**Course Name: (As per choice of student)**
Pre-requisite: None	**Co-requisite: None**

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **MOOC** Relating to the **M.Sc. in Food Science and Technology**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Student should opt in 2nd or 3rd semester as per available from online platforms like- SWAYAM, IGNOU, CONSORTIUM FOR EDUCATIONAL COMMUNICATION, NPTEL etc. Evaluation shall be done by examination. Students should be assigned marks for the same.

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of **MOOC**
CO-2	Analyse the Various Concepts to understand them through case studies

CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/create the Project or field assignment as per the knowledge gained in the course

Course: MOOC	**Course Name: MOOC Alternative Course (DAIRY TECHNOLOGY)**

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Dairy Technology** RelatingtotheM.Sc.in **Food Science and Technology**
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

UNIT	TOPICS	NO.OF LECTURES
1	Present status of milk & milk products in India and Abroad; market milk-Composition Of milk of various species, Physiochemical properties, difference evaluation, defects in dried milk powder.	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	3
	Dried milk Powder-Definition, methods of manufacture of skim & whole milk powder, instantiation	3
	Cheese: Definition, composition, classification, methods of manufacture, cheddar, Gouda, cottage and processed cheese, evaluation, defects in cheese.	3
	Pre-biotic and pro biotic milk products.	1
	TOTALLECTURES=	**30**

****