<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year M.Tech (Food Technology), Part I, Semester I</td></tr>
<tr><td>Course Code</td><td colspan="5">FTAC1</td></tr>
<tr><td>Course Category</td><td colspan="5">Research Methodology</td></tr>
<tr><td>Course title</td><td colspan="5">Research Methodology</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>02</td><td>-</td><td>-</td><td>02</td><td>02</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">IOE:50</td><td colspan="2">EOE: 00</td><td>Total=50</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">The student should be familiarize with basic of research.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">This course aims to lay a foundation for your research. The goal is to help you to design and develop your future research projects.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">1. Familiarize students with basic of research and the research process.
2. Familiarize Research Design.
3. Introduce measurement and scaling techniques in research.
4. Familiarize methods of data collection and analysis
5. Introduce techniques of hypotheses, parametric or standard tests
6. Help to analyze variance and co-variance</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">1. Understand basic concepts of research and its methodologies
2. Select and define appropriate research problem and parameters
3. Apply Measurement and Scaling Techniques
4. Use Methods of Data Collection and Analysis
5. Apply techniques of hypotheses, parametric or standard tests
6. Present and defend research ideas using Analysis of variance and covariance</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1		2										
CO 2				3								
CO 3				2								
CO 4				3								
CO 5				3								
CO 6				3								

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1.	**Unit I Research Methodology: An Introduction** Objectives of Research, Types of Research, Research Methods and Methodology, Defining a Research Problem, Techniques involved in Defining a Problem	03
2.	**Unit II Research Design** Need for Research Design, Features of Good Design, Different Research Designs, Basic Principles of Experimental Designs, Sampling Design, Steps in Sampling Design, Types of Sampling Design, Sampling Fundamentals, Estimation, Sample size Determination, Random sampling	04
3.	**Unit III Measurement and Scaling Techniques** Measurement in Research, Measurement Scales, Sources in Error, Techniques of Developing Measurement Tools, Scaling, Meaning of Scale, Scale Construction Techniques.	05
4.	**Unit IV Methods of Data Collection and Analysis** Collection of Primary and Secondary Data, Selection of appropriate method, Data Processing Operations, Elements of Analysis, Statistics in Research, Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation	05
5.	**Unit V Techniques of Hypotheses, Parametric or Standard Tests** Basic concepts, Tests for Hypotheses I and II, Important parameters, Limitations of the tests of Hypotheses,. Chi-square Test, Comparing Variance, As a non-parameteric Test, Conversion of Chi to Phi, Caution in using Chi-square test	05
6.	**Unit V Analysis of Variance and Co-variance** ANOVA, One way ANOVA, Two Way ANOVA, ANOCOVA, Assumptions in ANOCOVA, Multivariate Analysis Technique, Classification of Multivariate Analysis, factor Analysis, R-type Q Type factor Analysis, Path Analysis	04
Sr.no.	**Text Books**	

1.	"Research Methodology", C.R. Kothari, Wiley Eastern.
Sr.no	**Reference Textbooks**
1.	"Formulation of Hypothesis", Willkinson K.P, L Bhandarkar, Hymalaya Publication, Bombay.
2.	"Research in Education", John W Best and V. Kahn, PHI Publication.
3.	"Research Methodology- A step by step guide for beginners", Ranjit Kumar, Pearson Education
4.	"Management Research Methodology-Integration of principles, methods and Techniques", K.N. Krishnaswami and others, Pearson Education.

Year, Program, Semester	First Year M.Tech (Food Technology), Part I, Semester I				
Course Code	FTC11				
Course Category	Professional Core Course				
Course title	Advances in Food Engg. and Technology (Theory)				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:40**			**ESE: 60**	**Total=100**
Pre-requisites(if any)	Knowledge of Principles of Food Preservation				
Course Rationale	The field of food processing and engineering is evolving rapidly, with new thermal and non-thermal techniques emerging to enhance food quality, safety, and shelf life. This course provides students with fundamental and advanced knowledge of thermal processing, drying, refrigeration, freezing, and modern food preservation techniques.				
Course Objectives	The course aims to: 1. Introduce students to fundamental and advanced thermal and non- thermal food processing techniques. 2. Explain death rate kinetics, sterilization, and thermal processing calculations in food engineering. 3. Familiarize students with drying and evaporation methods, including modern trends and equipment design. 4. Provide in-depth knowledge of refrigeration, freezing, and their applications in the food				

	industry. 5. Explore modern thermal and non-thermal food processing techniques such as microwave heating, high-pressure processing, and irradiation. 6. Introduce IoT, AI, and automation in food processing, focusing on emerging technologies.
Course Outcomes	Upon successful completion of the course, students will be able to: 1. Understand and apply death rate kinetics and thermal processing methods in food sterilization. 2. Design drying and evaporation systems using heat and mass balance equations. 3. Analyze refrigeration and freezing techniques, including ultra-low temperature systems. 4. Evaluate modern thermal processing technologies such as radio-frequency heating and pulsed electric fields. 5. Assess the effectiveness of non-thermal food processing methods like high hydrostatic pressure and modified atmosphere storage. 6. Demonstrate knowledge of IoT and AI applications in food engineering for automation and process optimization.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	3	3	2	1	2					
CO 2	3	3	3	3	2	2	1					
CO 3	3	2	3	3	3	2	2					
CO 4	3	3	3	3	3	2	2					
CO 5	3	3	3	3	3	2	3					
CO 6	3	3	3	3	3	3	3	2	2	3	2	1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1.	**Unit: I Thermal processing** Death rate kinetics, thermal process calculations, methods of sterilization, equipment involved latest trends in thermal processing.	07
2.	**Unit II Drying and Evaporation** Designing of dryers and evaporators by heat and mass balance equations. Recent trends in food processing by evaporation and drying, equipment and applications in food industries.	07
3.	**Unit III Refrigeration and Freezing** Refrigeration: Refrigeration cycles, components of vapour compression refrigeration system, different refrigeration systems for ultra-low refrigeration. Freezing: Enthalpy change during freezing, frozen food properties, Planks and other modified equations, Advances in freezing and refrigeration techniques.	07
4.	**Unit IV Modern thermal techniques** Radio-frequency heating Microwave for food cooking and dehydration, Ohmicheating. Pulsed electric field, high-intensity light pulses	06
5.	**Unit V Modern non-thermal techniques** Irradiation technique, thermo-sonication, high hydrostatic processing of foods, super critical CO 2 technique, modified atmosphere storage, membrane technology	05
6.	**Unit V Internet of Things (IoT) and AI in Food Processing** Role of IoT in Food processing , AI and Machine Learning Applications in Food Industry, Automation and Robotics in Food Engineering	07

Sr.no.	Reference Books
1	Rao, D. G. (2012). Fundamental of Food Engineering. PHI Learning Private Limited, New Delhi.
2.	Singh, R.P., and Heldman, D.R. (2001). Introduction to Food Engineering, 3 rd ed., Academic Press, San Diego, CA. Academic Press publications. 69–78, 144–157.
3.	Geankoplis, C. J. (2002). Transport processes and unit operations. Prentice Hall of India.
4.	Coulson and Richardsons. (1998).Chemical Engineering ,Vol I and II, Asiali Books Pvt ltd.
5.	McCabe and Smith “Unit Operations” McGraw-Hill, New York
Sr.no	**Reference Textbooks**
1	Treybal, R. E. (1981). Mass Transfer Operations. 3 rd edition. McGraw Hill.
2	Dennis, R.H. (1981). “Food Process Engineering. Academic Publishing and Press, King SaudUniversity..

3	Rao,M.A.SyedS.H.Rizvi,and AshimK.Datta.(2008).Engineeringpropertiesoffoods.CRCPress.
Sr.no	**Weblinks**
1.	*NPTEL Online Course: Food Engineering & Processing*
2.	*http://rpaulsingh.com/course/index.html*

Year, Program, Semester	First Year M.Tech (Food Technology), Part I, Semester I				
Course Code	FTC12				
Course Category	Professional core course				
Course title	Advances in Food Science and Nutrition				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:40**			**ESE:60**	**Total=100**
Pre-requisites(if any)	Prerequisites for this course typically include basic understanding of food chemistry, biochemistry, and human nutrition.				
Course Rationale	This course explores advanced concepts in food science and nutrition, focusing on the biochemical, functional, and therapeutic roles of food components. It equips students with the knowledge to analyze nutrient interactions, metabolism, and their impact on health and disease prevention.				
Course Objectives	1. Introduce food constituents, their sources, classification, and functions. 2. Explain properties and applications of food constituents in processing and quality. 3. Discuss food metabolism and nutritional needs of different groups. 4. Illustrate the health impact of food constituents and nutrient deficiencies. 5. Elaborate on therapeutic nutrition, functional foods, and nutraceuticals. 6. Apply food component knowledge to improve food quality and safety.				
Course Outcomes	By the end of the course, the students will be able to- 1. Identify and classify food constituents with their sources and functions. 2. Analyze structures and properties of carbohydrates, proteins, lipids, and vitamins.				

	3. Assess food quality changes during processing and storage. 4. Apply food metabolism and therapeutic nutrition in dietary planning. 5. Evaluate food components in disease prevention and health promotion. 6. Examine food constituents' impact on immunity and human performance.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	-	-	3	2	-	-	-	-	-	2
CO 2	3	3	3	3	3	2	-	-	-	-	-	2
CO 3	3	3	3	3	3	3	-	-	-	-	-	3
CO 4	2	3	3		3	3	2	-	-	-	-	3
CO 5	2	3	2	-	3	3	2	2	-	2	-	3
CO 6	3	3	2	-	3	3	2	2	-	-	-	3

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Carbohydrates** Sources and Classification of Carbohydrates, Functions of Carbohydrates,Structure of Carbohydrates, Properties of Carbohydrates, Applications ofCarbohydrates, Concept of Fiber and Its Effect on Human Health	05
2	**Proteins and Lipids** Sources and Classification of Proteins, Functions of Proteins, Structure of Proteins, Properties of Proteins, Applications of Proteins, Sources and Classification of Lipids, Functions of Lipids, Properties of Lipids, Hydrogenationof Fats, Rancidity of Fats and Oils, Changes in Fats and Oils During Processing,Application of Fats	06
3	**Unit III Water, Vitamins, and Minerals** Introduction to Water, Structure of Water, Different Forms of Water in Food, Concept of Water Activity, Effect of Water Activity on Food Quality, Sources andClassification of Vitamins, Functions of Vitamins, Deficiency of Vitamins,Sources and Classification of Minerals, Functions of Minerals, Deficiency ofMineral	08

4	**Unit IV Advances in Food Metabolism and Nutritional RequirementsRecent** advances in biochemistry of food metabolism and nutritional aspects offoods, Nutritional requirements of special groups (aged, infants, pregnant &lactating mothers, patients)	**07**
5	**Unit V Therapeutic Nutrition and Functional Foods** Therapeutic nutrition & formulation of special dietary foods, Relationship of foodand diseases, Deficiencies of essential nutrients, Assessment of nutritionalstatus & RDA, Effect of processing on nutrients, Functional foods andnutraceuticals for controlling cardiovascular diseases, cancer, obesity, andageing	**07**
6	**Unit VI Food Components and Their Functional Roles** Food components and nutrients affecting immune systems, behavior and performance, Functional aspects of dietary fibre, amino acids & peptides, lactic acid bacteria, antioxidants, vitamins, and fatty acids	06

Sr.no.	Reference Books
1	deMan, John M. “Principles of Food Chemistry”. 3rd Edition, Springer, 1999
2	Meyer, Lillian Hoagland “Food Chemistry”. CBS Publishers, 1987.
3	Belitz, H.D.. Grosch “Food Chemistry” 3rd revised ed. Springer Berlin,Heidelberg, New York.
4	O.R.Fennema “Food Chemistry” Marcel Dekker, Inc., New York.
5	Food Chemistry- Aurand L.W and Woods A.E, Avi Publishing Company, Inc, Westport, CT (1973).
6	Toldrá, F. (Ed.). (2019). Advances in food and nutrition research (Vol. 87). Academic Press.
7	Taylor, S. (Ed.). (2011). Advances in food and nutrition research (Vol. 54). Elsevier.
8	Carr, T., & Descheemaeker, K. (Eds.). (2008). Nutrition and health. John Wiley & Sons.

Sr.no	Weblinks
1	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=NuAs6SreCGryddEfs4kkBA==
2	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=iWHzbXYGExXDS52DSnAzdQ==
3	https://egyankosh.ac.in/handle/123456789/1056
4	https://www.youtube.com/watch?v=FoswKE7tUH8

Year, Program, Semester	First Year M.Tech (Food Technology), Part I, Semester I				
Course Code	FTC13				
Course Category	Professional Core Course				
Course title	Novel Techniques in Food Packaging				
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits
	03	-	-	03	03
Evaluation Scheme	ISE:40			ESE:60	Total=100
Pre-requisites(if any)	Basic knowledge of food packaging is required.				
Course Rationale	The curriculum is structured to optimize the use of packaging to improve product safety and quality.				
Course Objectives	The Course teacher will ensure to 1. Understand the mechanism of food packaging innovative techniques for the improvement of production yield and quality. 2. Understand the applications of novel processing techniques in the processing and preservation of foods. 3. Evaluate quality parameters of packaging materials which come Incontact with food product. 4. Develop the ability to build and assess novel food packaging techniques. 5. Illustrate the designing of different packaging materials. 6. Elaborate newer food packaging technologies.				
Course Outcomes	By the end of the course, the students will be able to- 1) Learn about consumer response for new packaging systems 2) Acquaint about food-package interaction between package-flavour, gas storage systems for food storage 3) Understand various types of scavengers and emitters for improving the food shelf life				

	4) Apply the recent technologies in food Packaging 5) Assess quality characteristics for different packaging materials 6) Know newer applications in food packaging technologies

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	-	-	3	2	-	-	-	-	-	2
CO 2	3	3	3	3	3	2	-	-	-	-	-	2
CO 3	3	3	3	3	3	3	-	-	-	-	-	3
CO 4	2	3	3		3	3	2	-	-	-	-	3
CO 5	2	3	2	-	3	3	2	2	-	2	-	3
CO 6	3	3	2	-	3	3	2	2	-	-	-	3

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Active Packaging:** Advances in active packaging Techniques; Current Use and consumer acceptance of Active packaging; Scavenging Technology- Oxygen and ethylene, scavenging technology ;concept and its food applications **Intelligent Packaging:** Time-temperature indicators (TTIs), Definition and classification of TTIs; Requirement and development of TTI; Quality or Freshness Indicators	**05**
2	**Non-migratory bioactive polymers (NMBP) in food packaging:** Advantages and limitations of NMBP; Inherently bioactive synthetic polymers-types and applications; Polymers with immobilized bioactive compounds. Permeability properties of polymer packaging; Measurement of permeability – water and gases.;Selection criteria opackaging films	**06**
3	**Packaging-flavour interactions:** Factors affecting flavour absorption; Role of the food matrix and different packaging materials; Packaging and lipid oxidation; Shelf life evaluation of packaged food	**08**
4	**Applications of Novel Packaging Techniques :** Principle and Technology of Controlled Atmosphere Packaging; Principle and Technology of Modified Atmosphere Packaging-Applications in red meat and poultry, Fish and other Sea foods, Fruitsand vegetables	**07**

5	**Recycling of packaging materials:** Recyclability of packaging plastics(HDPE); improving the recyclability of plastics packaging; Biodegradable packaging materials(OBD, hemicelluloses, Polylactic acid;Poly hydroxyl alkanoates, Bacterial cellulose)	**07**
6	**Safety and legislative aspects of packaging** Regulatory considerations of plastic, metal, paper and glass packaging;bar coding ; labelling	**06**
Sr.no.	**Text Books**	
1	Ahvenainen R. 2001. Novel Food Packaging Techniques. CRC.	
2	Mahadeviah M & Gowramma RV. 1996. Food Packaging Materials. Tata McGraw Hill	
3	Sacharow S & Griffin RC.1980. Principles of Food Packaging. AVI Publ	
4	Palling SJ. 1980. Developments in Food Packaging. App. Sci. Publ.	
Sr.No	**Reference Books**	
1	Painy FA. 1992. A Handbook of Food Packaging. Blackie.	
2	Ashutosh Kr Shukla, Food Packaging: The Smarter Way, Springer, 1st Ed, 2022	
8	Robertson, G. L. (2006). Food Packaging: Principles and Practice (2 ed.): CRCPublications, Boca Raton.	
Sr.no	**Weblinks**	
1	https://www.adelaide.edu.au/course-outlines/111548/1/sem-1/	
2	https://corsi.unipr.it/en/ugov/degreecourse/186724	

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year M.Tech (Food Technology), Part I, Semester I</td></tr>
<tr><td>Course Code</td><td colspan="5">FTE 11</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Elective Course</td></tr>
<tr><td>Course title</td><td colspan="5">Elective-I (Advances in Meat, Fish and Poultry processing)</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td>03</td><td>03</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">ISE:40</td><td colspan="2">ESE:60</td><td>Total=100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">-</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The aim of the course is to provide students with advanced knowledge in Meat, Fish and Poultry Processing Industries. The objective of this course is to make students aware of various advanced processing technologies, handling and quality standards of meat, fish and poultry products.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The Course Teacher will help to,
1. Understand the current status of livestock as well as the nutritional profile of meat, poultry (egg and chicken) and fish etc.
2. Learn muscle structure, chemical composition and physico-chemical properties of meat muscle.
3. Gain knowledge of slaughtering and dressing techniques of animals and poultry.
4. Learn different methods of processing and preservation of meat.
5. Learn processing methods used to preserve egg.
6. Understand fish types and fish products.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-
1. Learn about the current situation of livestock and the nutritional profile of meat, poultry (egg and chicken) and fish etc.
2. Describe the muscle structure, chemical composition and physico-chemical properties of meat muscle.
3. Apply slaughtering and dressing techniques of animals and poultry in the practical.</td></tr>
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	4. Comprehend different methods of processing and preserving meat. 5. Review the processing methods used to preserve egg. 6. Learn about the fish types and fish products.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	2	2	2	-	2	3	-	1	2	2	2
CO 2	2	2	2	2	-	2	2	-	1	2	2	2
CO 3	1	2	2	3	-	2	2	-	2	2	3	2
CO 4	3	2	2	2	-	2	3	-	2	2	2	2
CO 5	1	2	3	2	-	2	2	-	1	2	2	2
CO 6	2	2	1	3	-	3	2	-	3	2	2	2

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Meat Industry** Meat and meat products in India-an Industrial profile, Meat production and trade practices, Prospects and problems in production of fresh meat in India, Research and Development activities on meat, fish and poultry products	06
2	**Gross and microstructure of muscle, Mechanism of muscle contraction and relaxation** Organization of skeletal muscle from gross structure to molecular level, Muscle Communication (sarcolemma, sarcoplasmic reticulum, Innervation),Muscle metabolism, Different types of connective tissues and their relevanceto properties of meat, Myofilament proteins and their major functions,Nervous tissue, nerves and the nature of stimuli, membrane potential innerve and muscle, Events that occur during relaxation and contraction	06
3	**Meat inspection and grading:** Application and Enforcement of inspectionlaws, elements of inspection (sanitation, antemortem inspection, postmorteminspection, condemnation, product inspection, laboratory inspection,labeling). Identification of inspected products,	08

	product inspection, types of grades, factors used to establish quality grades, conformation, fleshing and finish	
4	**Unit IV Properties of fresh meat:** Perception of tenderness, Factors effecting tenderness, connective tissue, collagen, sarcomere contractile state, Myofibrillar tenderness, marbling, Methods to improve tenderness(Electrical stimulation, aging, Meat colour, Pigments associated with color, Chemical state of pigments, methods to improve meat colour, Water holding capacity	**07**
5	**Unit V** Poultry meat Kind of poultry, processing of poultry. Special poultry products, Breaded poultry, Packaged precooked chicken, Freeze dried poultry meat**.**	**06**
6	**Unit VI Food Components and Their Functional Roles** **Meat analogues and restructured meat products:** Textured plant proteins, processes for preparation of meat analogues and restructured meat products **Fish processing and fish products:** Selection of raw material for processing of streaking and filleting of fish; production of fish paste, fish oils, sauce, fish protein concentrates	**06**

Sr.no.	**Reference Books**
1.	Aberle Elton D., Forrest John C., Gerrard David E. and Mills Edward W. (2012). Principles of Meat Science.
2.	Hall, G. M. (Ed.). (2011). Fish processing: sustainability and new opportunities. John Wiley & Sons.
3.	Lawrie, R. A. (Ed.). (1980). Developments in meat science (Vol. 1). London: Applied Science Publishers.
4.	Lonergan, S. M., Topel, D. G., & Marple, D. N. (2018). The science of animal growth and meat technology. Academic Press.
5.	Ranken, M. D. (2000). Handbook of meat product technology (Vol. 246). Oxford: Blackwell science.

Sr.no	**Reference Books**
1	Frank Gerrad. (1951). Meat Technology: A Practical textbook for Students andbutcher
2	Owens, C. M. (2010). Poultry meat processing. CRC Press.
3	Sams, A. R., Alvarado, C., & Owens, C. M. (Eds.). (2001). Poultry meatprocessing (Vol. 7). Boca Raton, FL: CRC Press.
4	Sen, D. P. (2005). Advances in fish processing technology (Vol. 1). Allied Publishers.

Sr. No.	Important web links
1	https://apeda.gov.in/AnimalProducts

Year, Program, Semester	First Year M.Tech (Food Technology), Part I, Semester I					
Course Code	FTE 12					
Course Category	Professional Elective Course					
Course title	Elective-I (Modern Techniques in Fruits and Vegetables Processing)					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**	
	03	-	-	03	03	
Evaluation Scheme	**ISE:40**			**ESE:60**	**Total=100**	
Pre-requisites(if any)	Prerequisites for this course typically include the knowledge of Food Preservation, Food Chemistry, Food Biochemistry, Food Additives and Contaminants, Food Process Engineering subjects etc					
Course Rationale	The purpose of this course is to introduce and make aware the students about the preservation technologies of fruits and vegetables. To make them develop different processed products from fruits and vegetables and extend the shelf life of those.					
Course Objectives	The Course Teacher will help to, 1. Demonstrate understanding of the biochemistry and physiology of harvested fruits and vegetables 2. Describe the basic steps involved in the production of processed fruits and vegetables 3. Think and Design various processed products from fruits and Vegetables 4. Demonstrate the effect of processing in food processing sector. 5. Ensure to enhance Processing skills of students 6. Develop students skill to solve Indian farmers(Fruits and Vegetables) Problems.					
Course Outcomes	By the end of the course, the students will be able to- 1. Interpret the knowledge of preserved fruits and vegetable products 2. Know the importance of processed fruits and vegetable products 3. Asses the application of processing techniques in formulation of Processed products. 4. Design the processed products to store for a longer time without change in its nutritional value. 5. Learn to develop ability for value-added formulation of products, and will learn to solve Agriculture and engineering problems.					

	6. Provide solution for spoilage of fruit and vegetables while handling and storage.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	2	2	2	-	2	3	-	1	2	2	2
CO 2	2	2	2	2	-	2	2	-	1	2	2	2
CO 3	1	2	2	3	-	2	2	-	2	2	3	2
CO 4	3	2	2	2	-	2	3	-	2	2	2	2
CO 5	1	2	3	2	-	2	2	-	1	2	2	2
CO 6	2	2	1	3	-	3	2	-	3	2	2	2

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Present Status and future scope** Definition of fruits and vegetables, Types of fruits and vegetables, Present status and future prospects of processing industry, Post harvest physiology, Handling losses, Conservation of Fruits and Vegetables	06
2	**Processing of Fruits** Processed Products of fruits: Jam, Jelly, Squash, Cordial, Fermented Beverages, Carbonated beverages and Unfermented beverages of fruits ;Minimal processing strategies; Thermal and Non Thermal processing Techniques; Modified atmospheric packaging and Controlled atmospheric Packaging	06
3	**Processing of Vegetable** Processing Technology of vegetables Tomato Products: sauces, ketchups, puree, pastes, chutneys and pickles; Processing of Potato; Different types of pickling; causes of spoilage in pickles, shelf life study and role of preservatives in pickling	07

4	**Drying** Dehydrated fruits and vegetables: Powders, Dryers-Different types of dryers employed in fruits and vegetable Processing Technology	**07**
5	**Canning** Introduction and principle of canning; Cans and Container for packing, lacquering syrups and brine for canning; Spoilage in canned foods, problems in the storage of canned foods and; changes during canning of fruits and vegetables	**07**
6	**Equipment and FSMS system** Equipment used in fruits and vegetables processing unit; FSMS system in Fruits and Vegetable processing	**06**
Sr.no.	**Reference Books**	
1.	Shrivastava and Kunal. “Fruit and Vegetable Preservation”	
2.	Tressler D.K. & Joslyn M.A. “Fruits and vegetables juice processing technology” edited by AVIpublishing Co. Westport, Connecticut .1971	
3.	Girdharilal and Sidappa G.S. “Preservation of fruits &vegetables”, CAR. New Delhi.	
4.	RANGANA, S. Handbook of Analyzer and Quality Control For Fruit and VegetableProducts. 2 Ed. New	
Sr.no	**Reference Books**	
1	Wills, Lee, Graham, Mc Glasson & Hall “Post-Harvest Physiology & Handling of Fruits and Vegetables. 1996	
2	Ahvenainen, R. 1996. New approaches in improving the shelf life of minimally processed fruit and vegetables. Trends in Food Science and Technology. 179-197.	
3	Barbosa-Cánovas, G.V. and Vega-Mercado, H. 1996. Dehydration of Foods. Chapman & Hall, New York, 53-59.	
4	FAO. 1997. Guidelines for Small-Scale Fruit and Vegetable Processors. FAO. Agricultural Service Bulletin 127. Rome	
Sr. No.	**Important web links**	
1	https://onlinecourses.nptel.ac.in/noc22_ag13/preview	

Year, Program, Semester	**First Year M.Tech (Food Technology), Part I, Semester I**				
Course Code	FTE 13				
Course Category	Professional Elective Course				
Course title	**Elective-I (Waste utilization of Food Processing Industries)**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	**-**	**-**	**03**	**03**
Evaluation Scheme	**ISE:40**			**ESE:60**	**Total=100**
Pre-requisites(if any)	**-**				
Course Rationale	The aim of the course is to provide students with advanced knowledge in the field of waste utilization of Food Processing Industries. The focal point of the course is based on the importance and role of waste management in food industry sectors and possibilities of their reduction and eventually possible re-use.				
Course Objectives	**The Course Teacher will help to,** 1. Study various waste generated in food industries and evaluate its possible impact on the environment. 2. Recognize and communicate waste treatment and utilization. 3. Learn the working principles of treatment methods used for waste generated in food industries. 4. Understand different waste utilization techniques. 5. Learn different techniques used to prepare by products. 6. Understand legal aspects related to waste management.				
Course Outcomes	**By the end of the course, the students will be able to-** 1. Identify various waste generated in food industries and evaluate its possible impact on the environment. 2. Recommend a variety of ways to treat and utilize waste. 3. Identify various by products generated in food industry and ways to utilize them. 4. Suggest different waste utilization techniques				

	5. Judge the importance of development of by-products. 6. Analyse and apply legal aspects related to waste management.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	2	2	3	-	3	3	-	1	2	2	2
CO 2	2	2	2	3	-	3	2	-	1	2	2	2
CO 3	1	2	2	3	-	3	2	-	2	3	3	2
CO 4	3	2	2	2	-	2	3	-	2	3	2	2
CO 5	1	2	3	2	-	2	2	-	3	2	2	3
CO 6	3	3	1	3	-	3	2	-	3	2	2	2

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Introduction** Types of waste; Magnitude of waste generation in different food processing industries; Scope and importance of waste utilization; Environmental Protection Act	**06**
2	**Characterization and utilization of by-products of cereal processing industries** Bran, Germ, Milling Waste, Risk Husk, Corn Stover **Characterization and utilization of by-products of oil industries** Oil Cake, Oilseed Hulls, Palm Kernel Cake, Spent Bleaching Earth	**06**
3	**Characterization and utilization of by-products of fruits and vegetable processing industries** Peels, Pulp and Pomace, Seeds, Stems and Leaves, Pectin, Bioethanol, Animal Feed, Composting	**07**
4	**Characterization and utilization of by-products of dairy industries** Whey, Butter Milk, Casein, Dairy Sludge, Biogas, fertilizer	**07**
5	**Characterization and utilization of by-products of sugar industry** Bagasse, Molasses, Press Mud/ Filter Cake, Spent Wash	**07**
6	**Characterization and utilization of by-products of Meat, Fish and Poultry Processing Industries**	**06**

	Blood Meal, Blood Plasma, Cosmetics, Biodegradable Plastics, Bone Meal, Gelatine, Animal Feed, Soap, Pet Food , Pharmaceuticals	
Sr.no.	**Reference Books**	
1.	Norman G. Marriott, Robert B. Gravani. (2006). Principles of Food Sanitation, 5 thEdition. Springer Science and Business Media.	
2.	Verma L.R. Joshi and V.K. (2000). Postharvest Technology of Fruits and Vegetables:Handling, Processing, Fermentation and Waste Management. Indus Publishing Co.New Delhi	
3.	Bhide A. D. and Sundaresan B. B. (2010). Solid Waste Management in DevelopingCountries	
4.	Tchobanoglous, George, and Frank Kreith. (2002). Handbook of Solid WasteManagement. 2 nd ed. New York: McGRAW-HILL.	
Sr.no	**Reference Books**	
1	Joshi V. K. and Sharma S. K. (2011). Food Processing Waste Management: Treatment and Utilization Technology	
2	AFST (I) and CFTRI. Proceedings of the Symposium on By-products From food Industries: Utilization and Disposal	
Sr. No.	**Important web links**	
1	https://moef.gov.in/waste-management	

Year, Program, Semester	**First Year M.Tech (Food Technology), Part I, Semester I**				
Course Code	FTOE 11				
Course Category	Open Elective Course				
Course title	**Elective-II (Advances in Processing of Dairy Technology)**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	**-**	**-**	**03**	**03**
Evaluation Scheme	**ISE:40**			**ESE:60**	**Total=100**
Pre-requisites(if any)	Basic knowledge of dairy processing and technology is required.				
Course Rationale	The course rationale is to equip students with advanced knowledge and skills for the dairy industry.				
Course Objectives	**The Course Teacher will help to,** 1. To understand different physico-thermal properties and their applications 2. To understand homogenizations of milk and its applications and tanks,pumps				

	and stirrers in dairy industry. 3. To understand thermal processing of milk and quality changes therein. 4. To understand concentration of milk and drying of the milk solids. 5. To understand technology of the different milk and by products.
Course Outcomes	**By the end of the course, the students will be able to-** 1. To have knowledge to ensure delivery of safe and quality product from the dairy plant to the consumers 2. To process the milk and dairy products in such a manner that losses of milk solids are minimal 3. Be able to suggest to the dairy plant personnel, the latest type of tools that can be harnessed to produce quality products, without impairing the nutritive value of milk 4. To suggest the dairy industry personnel regarding the formulation of detergent and/or acid and sanitizers which would help in efficient cleaning and sanitization of dairy equipment

Course Outcome and Program Outcome Mapping

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	-	2	2	3	-	3	3	-	1	2	2	2
CO 2	2	2	2	3	-	3	2	-	1	2	2	2
CO 3	1	2	2	3	-	3	2	-	2	3	3	2
CO 4	3	2	2	2	-	2	3	-	2	3	2	2
CO 5	1	2	3	2	-	2	2	-	3	2	2	3
CO 6	3	3	1	3	-	3	2	-	3	2	2	2

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Introduction** Use of bio-protective factors for preservation of raw milk: effects on physico-chemical, micro-biological and nutritional properties of milk and milk products; Present status of preservation of raw milk.	06
2	**Thermal processing of milk** Methods of determining lethality of thermal processing; UHT processed milk products, their properties and prospects, types of UHT plants, aseptic fillers, heat stability and deposit formation aspects, effect on milk quality; techno-economic considerations; Nutritional aspects of UHT treated milk vis-à-vis retort sterilized/ HTST treated milk.	06
3	**Equipment's use in dairy industry** Principles and equipment for bactofugation and bactotherm processes; Partial Homogenization and its application in dairy industry, Low pressure homogenization; Micro fluidization of milk: Principle, equipment, effects and applications.	07
4	**Dairy products** Concentration processes and their impact on quality of finished products; Dehydration: advances in drying of milk and milk products; Freeze dehydration: physico-chemical changes and in-dustrial developments; Glass Transition Temperature and its relevance to dried milks	07
5	Quality parameters and self-life Water activity; Sorption behaviour of foods, energy of binding water, control of wateractivity of different milk products in relation to their chemical, microbiologi-cal andtextural properties; Hurdle technology and its application in development of shelf-stable and intermediate-moisture foods; Use of carbonation in extending the shelf lifeof dairy products.	07
6	**Cleaning and sanitization of dairy equipment** Current trends in cleaning and sanitization of dairy equipment; Automation, Ultrasonic techniques in cleaning; Bio-films; Bio-detergents, innovations in sanitizers - chemical, radiation; Mechanism of fouling and soil removal; Assessing the effectiveness of cleaning and sanitization of dairy equipment, Water conservation methods.	06
Sr.no.	**Text Books**	
1.	Barbosa-CA, GV, Fontana Jr, AJ, Schmidt SJ, and Labuza TP. (Eds.). 2008. Water Activity inFoods: Fundamentals and Applications (Vol. 13). John Wiley and Sons.	
2.	Britz T and Robinson RK. (Eds.). 2008. Advanced Dairy Science and Technology. John Wiley	

	and Sons
3.	Chandan RC and Kilara A. 2015. Dairy-based Ingredients. In: Dairy Processing and Quality Assurance. (2nd Edn.). Wiley-Blackwell.
4.	Chandan RC, Kilara A and Shah NP. (Eds.). 2015. Dairy Processing and quality Assurance. 2nd Edn, Wiley-Blackwell, pp. 1-696.
Sr.no	**Reference Books**
1	Thompkinson DK and Sabikhi L. 2012. Quality milk production and processing technology.New India Publishing Agency.
2	Subramaniam P and Wareing P. (Eds.). 2016. The stability and shelf life of food. Woodhead Publishing. TetraPak Dai
3	Koca N. (Ed.). 2018. Technological Approaches for Novel Applications in Dairy Processing. In Tech Open.
Sr. No.	**Important web links**
1	IndiaDairy.com-https://indiaDairy.com
2	National Dairy Council-https:/nationaldairycouncil.org/

Year, Program, Semester	**First Year M.Tech (Food Technology), Part I, Semester I**				
Course Code	FTOE 12				
Course Category	Open Elective Course				
Course title	**Elective-II (Food Trade Management)**				
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits
	03	-	-	03	03
Evaluation Scheme	ISE:40			ESE:60	Total=100
Pre-requisites(if any)	-				
Course Rationale	The Food Trade Management course equips students with the knowledge and skills needed to navigate the complexities of global food trade, including international regulations, logistics, and market trends. Students will learn about the economic, political, and legal aspects of food trade, ensuring they can manage trade operations efficiently and in compliance with international standards. The course also emphasizes sustainable practices, helping students understand the importance of ethical sourcing, reducing food waste, and minimizing environmental impacts in global food supply chains.				

Course Objectives	**The Course Teacher will help to,** 1. Recall the fundamental concepts, terminology, and regulations associated with food trade, including key international trade agreements, food safety standards, and import/export protocols. 2. Explain the economic principles, political factors, and legal frameworks that influence food trade, demonstrating an understanding of how these elements interact on the global scale. 3. Apply knowledge of logistics, international supply chains, and market trends to effectively manage the trade of food products across borders, ensuring compliance with relevant regulations. 4. Analyze global food trade dynamics, including trends in consumer demand, trade policies, and the impact of technological advancements on the movement of food products. 5. Evaluate the impact of sustainability and ethical issues in food trade, critically assessing factors like fair trade practices, environmental impact, and food security challenges. 6. Develop a comprehensive food trade management plan that incorporates strategies for market entry, compliance with regulations, sustainability considerations, and logistics optimization.
Course Outcomes	**By the end of the course, the students will be able to-** 1. Recall and describe key concepts in global food trade, such as trade agreements, regulatory frameworks, and food safety standards. 2. Explain how economic, political, and legal factors influence global food trade, providing real-world examples of how these factors interact in trade operations. 3. Apply best practices in logistics and supply chain management to optimize the international movement of food products, ensuring adherence to global food safety and quality standards. 4. Analyse current trends in food trade, such as the impact of digital platforms and sustainability practices, and assess their effect on global markets and trade strategies. 5. Critically assess the sustainability and ethical dimensions of food trade, making informed decisions regarding fair trade, environmental impact, and food security issues.

	6. Create actionable food trade strategies for international markets, integrating market analysis, logistics, compliance, and sustainability efforts to drive trade success.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	2	2	3	-	3	3	-	1	2	2	2
CO 2	2	2	2	3	-	3	2	-	1	2	2	2
CO 3	1	2	2	3	-	3	2	-	2	3	3	2
CO 4	3	2	2	2	-	2	3	-	2	3	2	2
CO 5	1	2	3	2	-	2	2	-	3	2	2	3
CO 6	3	3	1	3	-	3	2	-	3	2	2	2

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Introduction to Food Trade and Global Food Systems** Definition and scope of food trade; Key international trade organizations (WTO, FAO, etc.);Global food trade flows and key food-exporting/importing countries ;Overview of international food regulations	06
2	**Economics and Policies of Food Trade** Economic theories in food trade (comparative advantage, protectionism, etc.); Political and economic factors influencing food trade; Trade policies, tariffs, and non-tariff barriers; Trade agreements (EU, NAFTA, TPP, etc.)	06
3	**Logistics and Supply Chain Management in Food Trade** Global food supply chains: Structure, management, and challenges; Transportation modes and logistics of food products (air, sea, land);Cold chain logistics for perishable goods; Impact of technology on logistics: RFID, GPS tracking, digital platforms	07
4	**Regulatory Frameworks and Compliance in Food Trade** International food safety standards (HACCP, ISO); Certification and quality assurance in food exports; Regulatory compliance in food labelling, packaging, and Documentation; Customs procedures and import/export regulations	07

5	**Sustainable Practices in Food Trade** Environmental impact of food trade; air trade and ethical sourcing of food products; Sustainable food trade strategies and certifications; Case studies of successful sustainable food trade initiatives	**07**
6	**Emerging Trends and Future of Food Trade** The rise of digital trade platforms and e-commerce in food trading; The role of artificial intelligence and block chain in food trade; Plant-based and alternative food products in global markets; The future of global food security and trade post-pandemic	**06**
Sr.no.	**Text Books**	
1.	Acharya, S. S. (2004). Agricultural marketing in India. Oxford and IBH publishing.	
2.	Beierlein, J. G., Schneeberger, K. C., and Osburn, D. D. (2013). Principles of agribusiness management. Waveland Press.	
3.	Davis, B., Lockwood, A., Pantelidis, I. S., & Alcott, P. (2018). Food and beverage management. Routledge.	
4.	Kotler, P. (2009). Marketing management. Pearson Education India.	
5.	Park, S. (2020). Marketing management (Vol. 3). Seohee Academy.	
Sr.no	**Reference Books**	
1	Aaker, D. A., and Moorman, C. (2023). Strategic market management. John Wiley &Sons.	
2	Cundiff, E. W., and Hilger, M. T. (1988). Marketing in the international environment.	
3	Koul, A. K. (2005). Guide to the WTO and GATT. Kluwer Law International; NewDelhi.	
4	Krissoff, B., Bohman, M., and Caswell, J. A. (Eds.). (2002). Global food trade andconsumer demand for quality. Kluwer Academic.	
5	Lelieveld, H. L., and Motarjemi, Y. (Eds.). (2013). Food safety management: Apractical guide for the food industry. Academic Press.	
Sr. No.	**Important web links**	
1	https://apeda.gov.in	
2	https://mofpi.gov.in/	

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year M.Tech (Food Technology), Part I, Semester I</td></tr>
<tr><td>Course Code</td><td colspan="5">FTOE 13</td></tr>
<tr><td>Course Category</td><td colspan="5">Open Elective Course</td></tr>
<tr><td>Course title</td><td colspan="5">Elective-II (Advances in Grain Science and Technology)</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td>03</td><td>03</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">ISE:40</td><td colspan="2">ESE:60</td><td>Total=100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Basic knowledge of different grains i.e. cereal, pulses, oilseeds and post-harvest and is required.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The course is designed to equip students with the technical knowledge and practical skills required to handle the complex challenges in the post-harvest processing and storage of grains while ensuring high-quality, safe, and nutritious products.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The Course Teacher will help to,

1.To provide the general knowledge on the grains, production and trade of the above cereal grains in the domestic and global markets.
2. To provide the basics of the critical parameters involved in the utilization and subsequent handling involved in the preservation of their quality.
3. To provide the basic chemistry of cereal grains with focus in the understanding of the relevance of their physicochemical and biochemical properties in their functions as ingredients in foods.
4. To provide knowledge and understanding of the changes and reactions of the Cereal grains in the food system influencing the quality and shelf life of the finished food.
5. To provide the fundamentals of the metrics for assessing the quality of cereal Grains that is relevant to the safety of their usage as ingredient in the food system.
6. To provide the updated knowledge on the nutritional and health benefits of the constituents of the grains focusing on the myths and realities as ingredients in foods.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-

1. Understanding Grain Composition and Structure
2. Explain the anatomical structure and chemical composition of major grains</td></tr>
</table>

	(wheat, rice, corn, millets), pulses, and oilseeds. 3. Describe the nutritional value of grains and the impact of processing on nutrient, retention and enhancement. 4. Analyze the physical, chemical, and functional properties of grains, pulses, and Oilseeds. 5. Develop and implement improved post-harvest handling and storage methods to minimize losses and spoilage

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3	2	3	3	2	3	2	2	1	-	-
CO 2	2	2	2	3	2	3	2	2	1	1	-	-
CO 3	2	3	3	2	2	2	2	1	1	1	-	-
CO 4	1	2	3	2	2	2	3	2	-	1	-	-
CO 5	1	2	2	2	1	1	1	1	-	1	1	-
CO 6	1	1	1	1	1	-	1	1	2	-	-	1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Introduction to Cereals, Pulses, and Oilseeds** Introduction: Production and utilization trends; Production Trends: Global and Indian scenario, Structure and Composition of common cereals, pulses, and oilseeds; Understanding the anatomical structure of grains and seeds, Nutritional Value: Key nutrients, proteins, carbohydrates, and oils in cereals, pulses, and oilseeds.	06
2	**Technology of Cereal Processing** Wheat Technology; Types of Wheat; Milling Process; Wheat Products; By-products Utilization, Rice Technology; Classification of Rice; Milling Process; Parboiling; By-products Utilization; Corn Technology; Corn Milling Processes; Products; Special Corn Varieties; Barley, Oats, Sorghum, and Millets; Processing Methods; Products.	06
3	**Technology of Pulses and Oilseeds** Pulses Processing; Pulse Milling; Nutritional Value of pulses; Value-Added Products of pulses, Oilseed Varieties; Oil Extraction Methods; Processing of Oil Meals and	07

	Cakes; Refining of Edible Oils; Specialty Oil.	
4	**Quality Control and Storage** Grain Quality Analysis; Physical Characteristics: Shape, size, volume, density, porosity, surface area, water activity of different food grains; Storage Techniques; Spoilage Factors.	**07**
5	**Engineering Properties of Food grains** **Thermal Properties:** Specific heat, thermal conductivity, thermal diffusivity, phase transition; methods of determination; steady-state and transient heat flow. **Electrical Properties:** Dielectric loss factor, loss tangent, temperature-dependent electricalconductivity and dielectric constant; methods of determination; energy absorptionfrom high-frequency electric fields; **Mechanical Properties:** Contact stresses, firmness, hardness, mechanical damage, friction, flow of bulk granular materials,aerodynamics of agricultural products. **Rheological Properties:** Classification of fluidfoods; measurement methods; effect of temperature and composition; viscoelasticity; **Mechanical models;** texture profile analysis; instrumental measurements; food Structuring techniques.	**07**
6	**Post-Harvest Technology ,Industrial Applications and Value Addition** Understanding production and post-harvest losses; importance of loss reduction; wateractivity and its effect on enzymatic and non-enzymatic reactions; control of wateractivity and moisture. Handling Operations: Cleaning: Sorting and Grading: Separation and Drying: Parboiling: Milling: Materials Handling, Extrusion Technology; Fortification of Grains; Development of Functional Foods.	**06**
Sr.no.	**Text Books**	
1.	Kent's Technology of Cereals" – Kent, N.L. and Evers, A.D.	
2.	Post-Harvest Technology of Cereals, Pulses, and Oilseeds" – Chakraverty, A.	
3.	Cereal Chemistry" – Pomeranz, Y.	
4.	Technology of Cereals, Pulses and Oilseeds" – Dendy, D.A.V. and Dobraszczyk, B.J.	
Sr.no	**Reference Books**	
1	Handbook of Cereal Science and Technology" – Kulp, K. and Ponte, J.G.	
2	Snack Food Processing – Lusas, E.W. and Rooney, L.W.	
3	Grain Storage Techniques – FAO (Food and Agriculture Organization)	
Sr. No.	**Important web links**	

1	https://www.grains.k-state.edu/?utm
2	https://grainnet.org/?utm

Year, Program, Semester	**First Year M.Tech (Food Technology), Part I, Semester I**				
Course Code	**FTC14**				
Course Category	**Project Seminar Internship**				
Course title	**Seminar-I**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	**-**	**2**	**02**	**01**
Evaluation Scheme	**IOE:50**			**EPE/EOE: NIL**	**Total=50**
Pre-requisites(if any)	Soft Skills				
Course Rationale	The course aims to emphasize the value and significance of the seminar in the M. Tech program, showcasing how it contributes to the overall learning experience and the professional growth of the students.				
Course Objectives	The Course teacher will 1. Provide students with in-depth knowledge and understanding of a specific subject or research area within their field of study. 2. Enhance students' research skills, including critical analysis, literature review, data collection and analysis, experimental design, and problem-solving. 3. Help to improve students' ability to present technical information effectively, both orally and in writing, to an academic audience. 4. Promote collaboration and networking among students, faculty members, and experts in the field, fostering interdisciplinary discussions and potential research collaborations. 5. Explore and discuss the latest trends, advancements, and challenges in the field.				
Course Outcomes	**Students will be able to** 1. Demonstrate the ability to perform close and critical readings. 2. Demonstrate the ability to consider critically the motives and methods of scholarship and the relationship between them. 3. Demonstrate the ability to distinguish opinions and beliefs from researched claims and evidence and recognize that kinds of evidence will vary from				

	subject to subject. 4. Ask disciplinarily appropriate questions of the material and recognize when lines of inquiry fall outside of disciplinary boundaries. 5. Evaluate, credit, and synthesize sources

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1										3	2	
CO 2										3	2	
CO 3							3			3	2	
CO 4										3	2	2
CO 5										2	3	2
CO 6						3						

Level of Mapping as: Low 1, Moderate 2, High 3

Curriculum Content
Seminar-I shall be delivered preferably on the topic of dissertation or at least the area of dissertation. The concepts must be clearly understood and presented by the student. All modern methods of presentation should be used by the student. Preparation and presentation of a seminar is intended to investigate an in-depth review of literature, prepare a critical review, and develop confidence to present the material by the student. The seminar-I shall be evaluated by a Department Committee constituted for this purpose, based on a report submitted by the candidate and a viva-voce conducted at the end of the semester. A hard copy of the report (25 to 30 pages A4 size, 12 fonts, Times New Roman, singles pacing both sides printed, well formatted) should be submitted to the Department before delivering the seminar. A PDF copy of the report in soft form must be submitted to the guide along with other details if any.

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year M.Tech (Food Technology), Part I, Semester I</td></tr>
<tr><td>Course Code</td><td colspan="5">FTC15</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Core course</td></tr>
<tr><td>Course title</td><td colspan="5">Advances in Food Science and Nutrition Lab</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>-</td><td>-</td><td>2</td><td>02</td><td>01</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">IOE:50</td><td colspan="2">EPE/EOE: 00</td><td>Total=50</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Basic knowledge of food chemistry, nutrition, and laboratory techniques.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">This practical course equips students with hands-on skills to analyze and evaluate food components, ensuring a deeper understanding of advanced concepts in food science and nutrition for improved product development and quality assessment.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The Course teacher will
1. Understand the latest advancements in food science and nutrition through theoretical concepts and practical applications.
2. 2. Develop skills to analyze the impact of emerging food processing techniques on nutritional quality.
3. Explore innovative approaches for enhancing food functionality, safety, and sensory attributes.
4. Apply scientific knowledge to design and evaluate functional food and nutraceutical products.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">Students will be able to
1. Demonstrate an understanding of recent innovations in food science and their nutritional implications.
2. Analyze the effects of advanced food processing techniques on nutrient retention and bioavailability.
3. Develop and assess functional food formulations for improved health benefits.
4. Apply advanced analytical techniques to evaluate the quality and safety of</td></tr>
</table>

	modern food products.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1		3	2	1	1	2	1			1
CO 2	3	1	1	3	2	1	1	2	1			1
CO 3	2	2	1	3	2	1			1			1
CO 4	3	2	2	3	3	2			1	2		1
CO 5				3		1			1	1		1
CO 6	1				3	2			1	1		1

Level of Mapping as: Low 1, Moderate 2, High 3

Ex. No.	List of Experiments
1.	Calculation of BMR and body surface area
2.	Calculation of energy value of food
3.	Preparation of balance diet
4.	Anthropometric measurements
5.	Biochemical analysis of blood
6.	Proximate analysis of Food Samples
7.	Qualitative tests for determination of carbohydrate
8.	Qualitative tests for protein
9.	Determination of Crude Fiber
10.	Determination of Mineral content
11.	Determination of Vitamin C

Suggested Text Books/ Reference Books/Manual	
1.	Institute's Laboratory Course Manual and equipment wise Standard Operating Procedure to follow.
2.	Association of Official Agricultural Chemists, & Horwitz, W. (1975). Official methods of analysis (Vol. 222). Washington, DC: Association of Official Analytical Chemists.

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year M.Tech (Food Technology), Part I, Semester I</td></tr>
<tr><td>Course Code</td><td colspan="5">FTC16</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Core course</td></tr>
<tr><td>Course title</td><td colspan="5">Novel Techniques in Food Packaging Lab</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>-</td><td>-</td><td>02</td><td>02</td><td>01</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">IOE:50</td><td colspan="2">EPP/EOE: 00</td><td>Total=50</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Basic understanding of chemistry and Microbiology is required.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The purpose of this course is to provide the students hands-on experience in biotechnology experiment.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Implant the practical proficiency in Food Packaging
2. Explain the relation between shelf life and packaging material
3. Discuss different equipment’s used to assess the quality of packaging material
4. To learn quality parameters of packaging materials, which come in contact with food products
5. To give a detailed idea about global trends in food packaging and disposal methods.
6. To create packaging professional from design conception to manufacturing, who learns to speak the language of packaging and utilize it as a key differentiator for his relevant industry or business</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-
1. To study the active and intelligent packaging system and its application in foods
2. To study about different scavenging techniques used in food packaging.
3. To study about antimicrobial food packaging used for food packaging.
4. To acquaint with various food packaging materials, various aspects of packaging methods and technology.
5. Asses suitable packaging material for different food products
6. Acquire problem solving skills in Food industries</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1		1	1	1	2	1					
CO 2		2	1		3							
CO 3	3		1	2		2					3	
CO 4	3			1	2		1					
CO 5				3					3			
CO 6	1		1	1	3							

Level of Mapping as: Low 1, Moderate 2, High 3

Ex. No.	List of Experiments
1.	To study functions of food packaging
2.	To determine parameters of different packaging materials
3.	To study Novel packaging systems and their applications
4.	To predict the shelf life of food products inside the package using chemical
5.	To identify various packaging materials on the basis of physical and
6.	To acquaint with manufacturing technology of bio-degradable plastic
7.	To study standards of packaging materials
8.	To study packaging requirements of defence foods
9.	To acquaint with designing a package label
10.	Determination of oil and grease resistant test for packaging films
11.	Determination of respiration rate in fresh fruits and vegetables
Suggested Text Books/ Reference Books/Manual	
1.	Institute'sLaboratoryCourseManualandequipmentwiseStandardOperatingProcedure to follow etc.

2.	Paine, F. A., &Paine, H. Y. (2012). A handbook of food packaging. SpringerScience & Business Media.

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year M.Tech (Food Technology), Part I, Semester II</td></tr>
<tr><td>Course Code</td><td colspan="5">FTAC2</td></tr>
<tr><td>Course Category</td><td colspan="5">Value Education Course</td></tr>
<tr><td>Course title</td><td colspan="5">Intellectual Property Rights</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td></td><td>L</td></tr>
<tr><td>02</td><td>-</td><td>-</td><td></td><td>02</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">IOE:50</td><td colspan="2">EPE/EOE:00</td><td>IOE:50</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">-</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The course on Intellectual Property Rights (IPR) is designed to provide students with an in-depth understanding of the importance of intellectual property in fostering innovation, creativity, and economic development. As the global economy becomes increasingly knowledge-driven, protecting and managing intellectual property is critical for individuals, organizations, and nations.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Provide a comprehensive understanding of the
2. Introduce the legal framework of IPR, including the TRIPS agreement and its Familiarize students with the processes and
3. Laws related to patents, copyrights, and trademarks, along with their infringements and remedies.
4. Understand the significance of designs, geographical indications, and layout designs, as well as their protection under international and national laws.
5. Explore the legal provisions and ethical considerations related to the Information Technology Act, 2000, including cybercrime, e-commerce, and digital signatures.
6. Develop the ability to identify, register, and manage intellectual property rights in various domains, including traditional knowledge and modern technologies.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-
1. Explain the fundamental concepts, origin, and significance of various types of Intellectual Property Rights (IPRs) in protecting innovations and creations.
2. Apply the knowledge of patent laws, registration procedures, and infringement</td></tr>
</table>

	remedies in the protection of inventions and technologies. 3. Demonstrate an understanding of copyright laws, including software copyrights, piracy issues, and the remedies for infringement. 4. Analyze and manage issues related to trademarks, including registration, infringement, and offenses in cyberspace, such as domain name disputes. 5. Evaluate the legal framework for design protection, including the Semiconductor Integrated Circuits Layout Design Act and international conventions. 6. Assess the implications of the Information Technology Act, 2000, particularly in the areas of e- governance, e-commerce, digital signatures, and combating cybercrime.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2		2				
CO 2						3	3	2				
CO 3						3	2					
CO 4						3	2					
CO 5						3	2					
CO 6							2	2				

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1.	**Unit: I** Introduction to IPR: Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights, Introduction to TRIPS and WTO, Kinds of Intellectual property rights—Copy Right, Patent, Trade Mark, Trade; Secret and trade dress, Design, Layout Design, Geographical Indication, Plant.Varieties and Traditional Knowledge.	**05**
2.	**Unit II** Patent Rights and Copy Rights— Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee,	**05**

	Assignment and license, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties.	
3.	**Unit III** Copy Right—Origin, Definition &Types of Copy Right, Registration procedure, Assignment & license, Terms of Copy Right, Piracy, Infringement, Remedies, Copy rights with special reference to software**.**	**04**
4.	**Unit IV** Trade Marks: Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, and Offences relating to Trade Marks, Passing Off, and Penalties. Domain Names on cyber space.	**04**
5.	**Unit V** Design- Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000.	**04**
6.	**Unit VI** Basic Tenents Of Information Technology Act-2000, IT Act - Introduction, E-Commerce and legal provisions, E- Governance and legal provisions, Digital signature and Electronic Signature. Cybercrimes.	**04**
Sr.no.	**Text Books**	
1.	Intellectual Property Rights and the Law, Gogia Law Agency, by Dr. G.B. Reddy	
2.	Law relating to Intellectual Property, Universal Law Publishing Co, by Dr. B.L.Wadehra	
3.	IPR by P. Narayanan	
4.	Law of Intellectual Property, Asian Law House, Dr. S. R. Myneni.	

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year M.Tech (Food Technology), Part I, Semester II</td></tr>
<tr><td>Course Code</td><td colspan="5">FTC21</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Core Course</td></tr>
<tr><td>Course title</td><td colspan="5">Advances in Food Biotechnology</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td>03</td><td>03</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">ISE:40</td><td colspan="2">ESE: 60</td><td>Total=100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Basic understanding of biochemistry and microbiology are helpful.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The course provides knowledge about the basic concepts of food nutrients and its roles. It aims to equip students with the foundational knowledge necessary to understand the concept of biotechnology and promote better technological concepts in welfare of people.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Understand the fundamentals of food biotechnology and genetics.
2. To learn basic aspects of fermentation process.
3. To learn application of enzymes and its production.
4. Interpret microbial cultures used in food industry
5. To learn production of different products through fermentation
6. Make use of new techniques for production of fermented foods.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-
1. Explain basic knowledge of cell culture technology
2. Comprehend the techniques utilized in production of different useful secondary metabolites.
3. Describe the applications of cell culture technology at the industrial level.
4. Express role of fermented food products.
5. Summarize Plant Tissue culture and its types
6. Enumerate principles behind important analytical techniques</td></tr>
</table>

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1		1	2	1	2	1		1	3		
CO 2		2	1		3	1	2					
CO 3	3		1	2	2	2					1	
CO 4		1	3		2	1	1	1	3			
CO 5	1			2		3				1		
CO 6	1	2		1	3		3		1			

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1.	**Unit: I Introduction to Food Biotechnology** Microbiology and Biochemistry of fermented foods; Production of baker's yeast, starter cultures; Algae and single cell proteins from different substrates; Fermented cereal /legume products, including bread; Traditional fermented foods; Soya based Oriental fermented foods	**07**
2.	**Unit II Applications of Fermentation in food industry:** Production of Wine, Beer, and other alcoholic beverages; Production of lactic acid, citric acid, vinegar;Fermented dairy products such as cheese, yoghurt, sweet curd, paneer;shreekhand; Fermented pickles.	**07**
3.	**Unit III Manufacturing aspects of Food Nutrients:** Production of amino acids; fatty acids; vitamins; polysaccharides; flavours and colours.	**07**
4.	**Unit IV Overview of Biotechnological processes :** Aerobic and anaerobic treatment of effluents from food processingindustry; Activated sludge process; Biomethanation;Enzyme applications in industry; Advantages and constraints of immobilized enzymes and microbial cells	**06**
5.	**Unit V Tissue Culture Techniques:** Concept and problems of plant and animal tissue culture;Technology for cultivation of callus and suspension cultures from explants; Synthesis of natural products by plant tissue culture.	**05**
6.	**Unit V Genetic Engineering** Chemical structure of nucleic acid proteins; DNA replication, transcription and	**07**

	translation; cell division, cell cycle;DNA repair mechanism; Recombinant DNA technology, mutation and polymorphism;PCR, electrophoresis;Application to produce genetically modified foods.	
Sr.no.	**Text Books**	
1.	Fundamentals of food biotechnology by ByongH.Lee, 1996	
2.	Food biotechnology by Kalidas Shetty, 2006	
3.	Brock Biology of microorganisms, 12th ed., by M.Madigan, J.Martinko, J.Parkar,2009	
4.	Principles of genetics by R. H. Tamarin, 2004	
5.	Fundamental bacterial genetics by Nancy Trun and Janine Trempy, 2004	
Sr.no	**Reference Textbooks**	
4.	Bains W. 1993, Biotechnology from A to Z, Oxford Univ. Press, Oxford.	
5.	Crueger, W. and Crueger A. 1984. Biotechnology: A Textbook of Industrial Microbiology. Science Tech. Madison, USA	
6.	Joshi, V.K. and Pandey, A. Ed. 1999. Biotechnology. Food Fermentation, (2 Vol. set). Education Publ. New Delhi.	
Sr.no	**Weblinks**	
3.	*https://onlinecourses.nptel.ac.in/noc25_bt33/preview*	

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year B.Tech (Food Technology), Part I, Semester II</td></tr>
<tr><td>Course Code</td><td colspan="5">FTC22</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Core Course</td></tr>
<tr><td>Course title</td><td colspan="5">Chemical and Instrumental Analysis of Food Components</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td>03</td><td>03</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">ISE:40</td><td colspan="2">ESE: 60</td><td>Total=100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Basic knowledge of food chemistry and analytical techniques.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">This course equips students with essential skills to analyze food components using chemical and instrumental methods. It prepares them to ensure food quality, safety, and compliance with industry standards.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Introduce fundamental principles of food analysis and proximate composition.
2. Explain methods for analyzing carbohydrates, minerals, vitamins, and plant pigments.
3. Illustrate techniques for fat analysis, sensory evaluation, and texture analysis.
4. Discuss enzymatic analysis and rapid detection techniques in food safety.
5. Apply modern spectroscopic and electrophoretic methods for food analysis.
6. Demonstrate chromatographic, rheological, and thermal analysis techniques in food evaluation.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-
1. Perform proximate analysis of food components using standard methods.
2. Analyze carbohydrates, minerals, vitamins, and plant pigments in food samples.
3. Conduct fat analysis and sensory evaluation using advanced techniques.
4. Apply enzymatic and rapid detection methods for food safety assessment.
5. Utilize spectroscopic and electrophoretic methods for food composition analysis.
6. Implement chromatographic, rheological, and thermal techniques in food research.</td></tr>
</table>

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	3	2	1	1	2	1			1
CO 2	3	3	2	3	2	2	2		1			1
CO 3	2	3	3	3	3							1
CO 4	3		3	3	3		3		1			1
CO 5		2	3	3	3	1				2		1
CO 6		2		2	3				1	1		1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Unit: I Fundamentals of Food Analysis and Proximate Composition** Preparation & standardization of solutions, sample preparation and sampling, buffer methods, and principles for determining proximate composition (moisture, fat, protein, fiber, carbohydrate, ash).	07
2	**Unit II Analysis of Carbohydrates, Minerals, Vitamins, and Plant Pigments** Analysis of starch, reducing and non-reducing sugars, determination of minerals (iron, calcium, phosphorus) and vitamins (A, B, C), and analysis of plant pigments (carotene, lycopene, chlorophyll, anthocyanins).	07
3	**Unit III Fat Analysis and Sensory Evaluation** Analysis of fats and oils (FFA, PV, RM value), sensory evaluation (scales, training, consumer acceptance), quantification of sensory attributes usingartificial tongue and nose, and texture analysis.	07
4	**Unit IV Enzymatic Analysis and Rapid Detection Techniques in Food** Study of enzymes in food analysis, rapid methods for detecting food pathogens, biosensors, automation	06
5	**Unit V Modern Spectroscopic and Electrophoretic Methods** Application of modern techniques such as spectroscopy (atomic absorption, flame photometry), X-ray analysis, electrophoresis, mass spectroscopy,IR, and Nuclear Magnetic Resonance (NMR) for food analysis.	05
	Unit VIChromatographic, Rheological, and Thermal Analysis Techniques Food Overview of chromatography methods (GC, GC–MS, HPLC, HPTLC, gel permeation, ion-exchange), refractometry, rheology measurements,Differential Scanning Calorimetry (DSC), Scanning Electron Microscopy (SEM), and rapid thermal	07

Sr.no.	Text Books
1	Paré, J. R. J., & Bélanger, J. M. R. (Eds.). (1997). Instrumental methods in food analysis (Vol.
2	Müller, A., & Steinhart, H. (2007). Recent developments in instrumental analysis for food quality.
3	Wetzel, D. L., & Charalambous, G. (Eds.). (1998). Instrumental methods in food and beverage
4	Baur, F. J., &Ensminger, L. G. (1977). The association of official analytical chemists (AOAC).
5	McCabeandSmith “UnitOperations”McGraw-Hill,NewYork
Sr.no	**Weblinks**
1.	*https://fssai.gov.in/cms/manuals-of-methods-of-analysis-for-various-food-products.php*
2.	*https://krishi.icar.gov.in/jspui/bitstream/123456789/13848/1/43.pdf*

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year B.Tech (Food Technology), Part I, Semester II</td></tr>
<tr><td>Course Code</td><td colspan="5">FTC23</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Core Course</td></tr>
<tr><td>Course title</td><td colspan="5">Food Quality, Safety and Toxicology</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td>03</td><td>03</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">ISE:40</td><td colspan="2">ESE:60</td><td>Total=100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Knowledge of Food Science, Food Engineering, Biology, Chemistry, or a related field is required</td></tr>
<tr><td>Course Rationale</td><td colspan="5">Food Quality aims to equip students with the knowledge and skills to address these challenges and contribute to the development of innovative solutions in food quality management.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">1. To provide in-depth knowledge of food quality parameters, including sensory, chemical, and microbiological aspects.
2. To develop skills in food quality assessment, control, and management.
3. To enable students to apply scientific principles to ensure food safety and quality in food processing and manufacturing.
4. To understand the principles of food preservation and shelf-life extension.
5. 5. To develop an understanding of food regulations and standards.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">1. Students will be able to identify and evaluate various food quality parameter
2. Students will be able to apply appropriate quality control measures in food processing and manufacturing.
3. Students will be able to develop and implement food safety management systems.
4. Students will be able to conduct sensory evaluation and consumer research.
5. Students will be able to contribute to the development of new food, products and processes that meet quality and safety standards.
6. Students will be able to understand and apply relevant food regulations and Standards.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	3	3	1	2	1	2	2	1	
CO 2	2	3	2	3	2	3	2	2	2	2	1	
CO 3	2	3	3	3	2	2	1	1	1	1		
CO 4	2	2	3	2	2	2	1	2		1		
CO 5	2	2	2	3	1	1	1	1	2	1	1	
CO 6	2	1	2	3	1	1	1		1			1

Level of Mapping as: Low 1, Moderate 2, High

Unit No.	Course Content	Hours
1	**Unit: I Food Quality Control** Objectives, importance and functions of quality control. Quality of raw materials and finished products, statistical quality control. Good Hygienic Practices (GHP), Good Manufacturing Practices (GMP), ISO 9001 (Quality Management System). Food regulations, grades and standards, Licensing and registration.	**07**
2	**Unit II Food Safety and quality management** Types of food hazards: biological, chemical and physical; Concepts of quality management: Objectives, importance and functions of quality control; Quality management systems in India; Sampling procedures and plans; Food Safety and Standards Act, 2006; Domestic regulations; Global Food safety Initiative; Various organizations dealing with inspection, traceability and authentication, certification and quality assurance (PFA, FPO, MMPO, MPO, AGMARK, BIS); Labeling issues; International scenario, International food standard.	**07**
3	**Unit III Testing of food ingredients** Testing of food ingredients & additives; Ames test for teratogenicity; Natural toxic constituents in plant foods; Shellfish poisoning; Chemicals from processing such as fumigants, chlorinated solvents, autoxidation products, carcinogens in smoked foods and pyrolysis, pesticides and herbicides.	**07**
4	**Unit IV Intentional and Unintentional Additives**	**06**

	Intentional and unintentional additives; Toxicity due to microbial toxins including botulinum and staphylococcal toxins, mycotoxin and due to other food pathogens; Food allergy and intolerance; Detoxication strategy.	
5	**Unit V Food Contaminants** Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labelling (Packaging types, understanding labelling rules & Regulations, Nutritional labelling, labelling requirements for pre-packaged food as per CODEX).	**05**
6	**Unit VI Organic Food & GM Food in Food Quality** Organic food, Identifying Organic foods, Advantages, The Organic Certification Process, Organic Food labelling, GM food, Why are GM food produced, Main issues of concern for Human Health, How are GM Food regulated Internationally, Regulation in India.	**07**

Sr.no.	**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, InteazAlli, 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.
Sr.no	**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 Systems, 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
Sr.no	**Weblinks**
1	*https://www.fao.org/4/w9474t/w9474t03.htm*
2	*https://knowledge4policy.ec.europa.eu/food-fraud-quality/topic/food-quality_en*

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year B.Tech (Food Technology), Part I, Semester II</td></tr>
<tr><td>Course Code</td><td colspan="5">FTE 21</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Elective Course</td></tr>
<tr><td>Course title</td><td colspan="5">ElE-III (Newer developments in Bakery and Confectionery)</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td>03</td><td>03</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">ISE:40</td><td colspan="2">ESE: 60</td><td>Total=100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">The bakery and confectionery industry is evolving with advancements in food science, technology, and consumer preferences. This course explores recent developments in ingredient technology, processing techniques, functional bakery products, and sustainable innovations. It equips students with knowledge of modern formulations, processing improvements, and quality control strategies to enhance product quality and safety while meeting industry and regulatory requirements.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">-</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The Course Teacher will help to,
1. Provide an understanding of the latest trends and innovations in bakery and confectionery processing.
2. Explore advancements in ingredient technology, including functionaland alternative ingredients.
3. Analyse modern equipment and automation in bakery and confectionery manufacturing.
4. Evaluate the role of food safety, quality assurance, and regulatoryaspects in product development.
5. Study sustainable and eco-friendly approaches in the bakery andconfectionery industry.
6. Develop research and analytical skills for problem-solving in productdevelopment.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">Students will be able to,
1. Analyze the role of additives, enzymes and alternative ingredients in bakery and confectionery product formulation.</td></tr>
</table>

	2. Apply advanced baking and confectionery technologies, including automation and 3 D food printing in product development. 3. Evaluate quality parameters using sensory, rheological and shelf life assessment technique. 4. Implement food safety regulations, HACCP principles, and smart packaging solutions in bakery and confectionery manufacturing. 5. Design innovative bakery and confectionery products catering to gluten free, vegan, allergen-freeand health conscious consumer. 6. Adapt to emerging trends such as eco friendly packaging, low-GI confectionery and functional baked goods.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	1	1							1
CO 2	3	3	3	2	3							1
CO 3	2	3	2	3	2							1
CO 4		3	3	3		3		3				1
CO 5	3	3	3	3	3		2		2			1
CO 6		3	2	3		3	3	3	3	2		1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Unit: I Modern Ingredients and Their Role in Bakery Innovations** Role of Additives in Bakery Products; Enzyme applications in Bakery; Alternative sweeteners and sugar replacers; Fat replacers and emulsifiers; Gluten-free, vegan, and allergen-free bakery products; Health-oriented products: Low-calorie, high-protein, functional; bakery items	06
2	**Unit II Advanced Analysis, Baking Techniques and Equipment** Developments in oven technology (e.g., convection, infrared, andmicrowave-	08

	assisted baking); Technology for the manufacture of bakery products;3D food printing in bakery applications; Automation in bakery production; Texture and rheological analysis of bakery: Farinograph, Mixograph, Extensograph, Amylograph	
3	**Unit III Quality Control** Sensory evaluation and consumer preference studies; Food safety regulations in Bakery industries, HACCP; Effect of variations in formulation and process parameters on the;quality of the finished product, quality;Staling and losses in baking;Smart packaging solutions for bakery	**07**
4	**Unit IV Innovations in Confectionery Ingredients** Role of Additives in confectionery product;Chocolate Processing, Compound coatings, Candy Bars, Tempering;technology, Chocolate hollow figures, Chocolate shells, Enrobing technology, Manufacture of candy bars, chocolate mass	**06**
5.	**Unit V Advanced Processing and Quality Control in Confectionery** Advanced Technical aspects of industrial sugar confectionary; High boiled sweets, Centre filled, lollipops, coextruded products, gums and jellies, caramel, Toffee, fudge, Liquorices paste, aeratedconfectionery, Lozenges, Chewing gum**;** Quality control techniques: Rheological, sensory, and shelf-lifeevaluation; Food safety standards and HACCP in confectionery manufacturing	**08**
6.	**Unit VI Trends in Confectionery** Sensory evaluation and consumer preference studies; co-friendly packaging and biodegradable wrappers; Low-GI and diabetic-friendly confectionery developments Plant-based and vegan confectionery trends	**04**

Sr.no.	**Text Books**
1	Jackson, E. B. (Ed.). (1995). Sugar confectionery manufacture. Blackie Academic and Professional.
2	Krondl, M. (2011). Sweet invention: A history of dessert. Chicago Review Press.
3	Notter, E. (2012). The Art of the Confectioner: Sugarwork and Pastillage. John Wiley and Sons.
4	Rao, P. J. M. (1999). An overview of the co-products industries in India.
5	SUGAR, B. (1907). BOOKS AND PUBLICATIONS. American Sugar Industry and Beet Sugar Gazette, 9, 48.
Sr.no	**Reference books**
1	Davidson, I. (2023). Biscuit baking technology: processing and engineering manual. elsevier.
2	Edwards, W. P. (2007). The science of bakery products. Royal Society of chemistry.

3	Edwards, W. P. (2018). The science of sugar confectionery. Royal Society of Chemistry.
4	Hui, Y. H., Corke, H., De Leyn, I., Nip, W. K., and Cross, N. A. (Eds.). (2008). Bakery products: science and technology. John Wiley & Sons.
5.	Mudgil, D., and Mudgil, S. B. (2024). Unit Operations in Food Processing. Scientific Publishers.
Sr.no	**Web links**
1.	*https://fostac.fssai.gov.in/doc/Bakery%20Level%201.pdf*
2.	*Manual of methods-sugar and confectionary including sweetening agent.pdf*

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year M.Tech (Food Technology), Part I, Semester II</td></tr>
<tr><td>Course Code</td><td colspan="5">FTE 22</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Elective Course</td></tr>
<tr><td>Course title</td><td colspan="5">ElE-III (Nutraceutical and Functional Foods)</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td>03</td><td>03</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">ISE:40</td><td colspan="2">ESE:60</td><td>Total=100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">A prerequisite for functional food and nutraceutical development is a comprehensive understanding of Food Chemistry, Human Nutrition and bioactive compounds, their health benefits.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The course on Functional Foods and Nutraceuticals explores the role of bioactive compounds in promoting health and preventing diseases.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Evaluate trends in bioactive compounds and their applications.
2. Explain the benefits of probiotics, prebiotics, and symbiotic for health.
3. Explore sources, bioavailability, and health applications of vitamins, minerals, and bioactive.
4. Analyze functional ingredients like dietary fiber, omega-3s, and Phytochemical.
5. Discuss regulatory, safety, and quality aspects of nutraceutical.
6. Introduce functional foods and nutraceutical, their history, and classification.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-1. Evaluate emerging trends and research in bioactive compounds.
2. Assess the role of vitamins, minerals, and bioactive in health.
3. Analyze the nutritional benefits of dairy, seafood, fruits, and cereals.
4. Demonstrate the health benefits of probiotics, prebiotics, and symbiotic.
5. Apply regulatory and safety guidelines for nutraceuticals.
6. Understand the basics and significance of functional foods and nutraceutical.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	2	3	3	2	-	-	-	1	2
CO 2	1	3	-	-	3	3	1	-	2	-	1	1
CO 3	-	-	1	-	-	2	-	-	-	-		-
CO 4	-	-	-	-	-	2	-	-	-	-		-
CO 5	1	-	-	1	-	3	-	-	-	-	1	3
CO 6	3	3	3	2	3	2	2	2	-	-	-	3

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Unit: I Modern Ingredients and Their Role in Bakery Innovations** Role of Additives in Bakery Products; Enzyme applications in Bakery; Alternative sweeteners and sugar replacers; Fat replacers and emulsifiers; Gluten-free, vegan, and allergen-free bakery products; Health-oriented products: Low-calorie, high-protein, functional; bakery items	06
2	**Unit II Advanced Analysis, Baking Techniques and Equipment** Developments in oven technology (e.g., convection, infrared, andmicrowave-assisted baking); Technology for the manufacture of bakery products;3D food printing in bakery applications;Automation in bakery production;Texture and rheological analysis of bakery: Farinograph, Mixograph,Extensograph, Amylograph	08
3	**Unit III Quality Control** Sensory evaluation and consumer preference studies;Food safety regulations in Bakery industries, HACCP;Effect of variations in formulation and process parameters on the;quality of the finished product, quality;Staling and losses in baking;Smart packaging solutions for bakery	07
4	**Unit IV Innovations in Confectionery Ingredients** Role of Additives in confectionery product;Chocolate Processing, Compound coatings, Candy Bars, Tempering;technology, Chocolate hollow figures, Chocolate shells, Enrobing technology, Manufacture of candy bars, chocolate mass	06
5	**Unit V Advanced Processing and Quality Control in Confectionery** Advanced Technical aspects of industrial sugar confectionary; High boiled sweets, Centre filled, lollipops, coextruded products, gums and jellies, caramel, Toffee, fudge, Liquorices paste, aeratedconfectionery, Lozenges, Chewing gum**;** Quality control techniques: Rheological, sensory, and shelf-lifeevaluation; Food safety standards and HACCP in confectionery manufacturing	08

6	**Unit VI Trends in Confectionery** Sensory evaluation and consumer preference studies; co-friendly packaging and biodegradable wrappers; Low-GI and diabetic-friendly confectionery developments Plant-based and vegan confectionery trends	**04**

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5.	Mudgil, D., and Mudgil, S. B. (2024). Unit Operations in Food Processing. Scientific Publishers.
Sr.no	**Web links**
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<tr><td>Course Rationale</td><td colspan="5">The course on Functional Foods and Nutraceuticals explores the role of bioactive compounds in promoting health and preventing diseases.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Evaluate trends in bioactive compounds and their applications.
2. Explain the benefits of probiotics, prebiotics, and symbiotic for health.
3. Explore sources, bioavailability, and health applications of vitamins, minerals, and bioactive.
4. Analyze functional ingredients like dietary fiber, omega-3s, and Phytochemical.
5. Discuss regulatory, safety, and quality aspects of nutraceutical.
6. Introduce functional foods and nutraceutical, their history, and classification.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-1. Evaluate emerging trends and research in bioactive compounds.
2. Assess the role of vitamins, minerals, and bioactive in health.
3. Analyze the nutritional benefits of dairy, seafood, fruits, and cereals.
4. Demonstrate the health benefits of probiotics, prebiotics, andsymbiotic.
5. Apply regulatory and safety guidelines for nutraceuticals.
6. Understand the basics and significance of functional foods andnutraceutical.</td></tr>
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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	2	3	3	2	-	-	-	1	2
CO 2	1	3	-	-	3	3	1	-	2	-	1	1
CO 3	-	-	1	-	-	2	-	-	-	-		-
CO 4	-	-	-	-	-	2	-	-	-	-		-
CO 5	1	-	-	1	-	3	-	-	-	-	1	3
CO 6	3	3	3	2	3	2	2	2	-	-	-	3

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Unit: I Introduction to Functional Foods and Nutraceuticals** Introduction to nutraceuticals: definitions, synonymous terms, basis of claims for a compound as a nutraceutical, regulatory issues for nutraceuticalincluding CODEX; Classification of functional food, concept of angiogenesis and the role of;nutraceuticals/functional foods	**07**
2	**Unit II Nutraceuticals of microbial, plant and animal origin** Concept of prebiotics and probiotics - principle, mechanism, production andtechnology involved, applications - examples of bacteria used as probiotics,use of prebiotics in maintaining the useful micro flora – extraction from plantSources. Symbiotic for maintaining good health; Algae as source of omega - 3 fatty acids, antioxidants and minerals -extraction and enrichment.; Plant secondary metabolites, classification and sub-classification - Alkaloids, phenols, Terpenoids; Animal metabolites - Sources and extraction of nutraceutical of animalorigin. Examples: chitin, chitosan, glucosamine, chondroitin sulphate andother polysaccharides	**07**
3	**Unit III Role of Functional Foods and Nutraceuticals in nutrition related diseases and disorders -I** Functional foods and nutraceuticals as anticancerous, hypo-lipidemic, anti-stress, osteoarthritis, hypotensive, hypoglycemic, hypoallergenic food, neuro-protective food, Nutraceuticals in maternal nutrition	**07**
4	**Unit IV Role of Functional Foods and Nutraceuticals in nutrition related diseases and disorders -II** Functional food and nutraceutical for obesity and weight management,compounds and their mechanisms of action, dosage levels; Functional food andnutraceuticals for joint pain, age-related mascular;degeneration, compounds and their mechanisms of	**06**

	action, dosage level; Functional food and nutraceuticals for endurance performance and mood;disorders compounds and their mechanisms of action, dosage levels	
5	**Unit V Formulation and Manufacturing aspects of Nutraceuticals** Manufacturing aspects of selected nutraceutical such as lycopene,isoflavonoids, glucosamine, phytosterols; Formulation of functional foods containing nutraceutical – stability and; analytical issues, labelling issues**.**	**05**
6	**Unit VI Clinical Testing of Nutraceuticals** Clinical testing of Nutraceuticals and health foods; interactions of prescription drugs and Nutraceuticals; adverse effects and toxicity of Nutraceuticals	**07**

Sr.no.	**Text Books**
1	Egbuna, C., &Dable-Tupas, G. (2020). Functional foods and nutraceuticals. Springer Nature Switzerland AG, 1, 1-632.
2	Kesharwani, R. K., Keservani, R. K., & Sharma, A. K. (Eds.). (2022). Nutraceuticals and Functional Foods in Immunomodulators. Springer.
3	Galanakis, C. M. (Ed.). (2021). Nutraceutical and functional food components: Effects of innovative processing techniques. Academic Press.
4	Richard Neeser& J. Bruce German (2004) Bioprocesses and Biotechnology for Functional Foods and Nutraceuticals, Jean, Marcel Dekker, Inc.
5	Shahidi and Weerasinghe, Nutraceutical beverages Chemistry, Nutrition and health Effects, American Chemical Society,1st Edition, 2004.
Sr.no	Web links
1	*https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=NuAs6SreCGryddEfs4kkBA==*
2	*https://onlinecourses.swayam2.ac.in/ugc19_hs33/preview*

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year B.Tech (Food Technology), Part I, Semester II</td></tr>
<tr><td>Course Code</td><td colspan="5">FTE 23</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Elective Course</td></tr>
<tr><td>Course title</td><td colspan="5">ElE-III (Food Color and Flavor Technology)</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td>03</td><td>03</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">ISE:40</td><td colspan="2">ESE: 60</td><td>Total=100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Prerequisites for this course typically include Basic knowledge of food chemistry, biochemistry, and food processing techniques.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">This course explores the science behind food colors and flavors, their sources, extraction methods, and applications in the food industry. It equips students with knowledge of regulatory standards, quality evaluation, and the role of colors and flavors in food formulation and sensory perception.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Introduce the role, functions, and significance of food colors and flavors.
2. Explain types, sources, and properties of natural and synthetic colorants.
3. Illustrate extraction, development, and regulatory aspects of food colors.
4. Describe types, sources, and biogenesis of natural and synthetic flavors.
5. Demonstrate extraction, quality characterization, and sensory evaluation of flavors.
6. Explore knowledge of colors and flavors in industrial food applications and regulatory compliance.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-
1. Identify and classify food colors and flavors based on sources andproperties.
2. Analyze extraction techniques and composition of natural andsynthetic colorants.
3. Evaluate regulatory guidelines and safety aspects of food colorants.
4. Examine the biogenesis and formation of flavors in natural andprocessed foods.
5. Perform extraction, quality characterization, and sensory evaluationof flavors.</td></tr>
</table>

	6. Apply food colors and flavors in various industries while ensuring legal compliance.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	3	3	1	2	1	2	2	1	
CO 2	2	3	2	3	2	3	2	2	2	2	1	
CO 3	2	3	3	3	2	2	1	1	1	1		
CO 4	2	2	3	2	2	2	1	2		1		
CO 5	2	2	2	3	1	1	1	1	2	1	1	
CO 6	2	1	2	3	1	1	1		1			1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Unit: I Introduction of Food Colours and Flavours** Current status and future prospective of Colours and Flavours, Functions of colours and flavours	**07**
2	**Types of color** Types and sources of colours (natural and artificial), Properties of natural colourants, Synthetic Food Colourants	**07**
3	**Unit III Development, analysis and Applications of colours** Manufacturing Methods of Synthetic colours, Extraction of colours, Types of Extraction, Analysis of colours components (Subjective and objective), FSSAI regulations of natural and synthetic colorants, Application of natural and synthetic colorants	**07**
4	**Unit IV Types and Biogenesis of Flavors** Types and sources of flavours (natural, processed, and added), flavour composites (natural, semi-synthetic, and synthetic), and biogenesis of flavours in natural and processed foods (Fermentation, Maillard reaction, lipid oxidation, Fruit Ripening)	**06**
5	**Unit V Extraction and quality characterization of Flavors** Extraction of flavours, Types of Extraction, Machinery used for extraction of flavours, Powder flavor- Spray drying technology, Analysis of flavours components (Subjective	**05**

	and objective)	
6	**Unit VI Sensory Evaluation and Industrial Applications of Flavours** Sensory Evaluation and Industrial Applications of Flavours;Sensory evaluation of flavours, selection of flavours, flavours and legal standards for flavours and legal regulatory;bodies -FSSAI, Codex Alimentarius, Applications of Flavours,Formulations of flavours, Flavours of soft drinks, Baking; and Confectionery industries, Standards specification of flavours, Adulterations in Flavour emulsions.	**07**

Sr.no.	**Text Books**
1.	Taylor, A. J., & Linforth, R. S. (Eds.). (2002). Food flavour technology (p. 302). Sheffield, UK: Sheffield
2.	Fisher, C., & Scott, T. R. (2007). Food flavours: biology and chemistry. Royal Society of chemistry.
3.	Hutchings, J. B. (Ed.). (2011). Food colour and appearance. Springer Science & Business Media.
4.	Furia,T. E., (1980). Handbook of Food Additives, CRC Press, Boca Raton, Flor.
5.	Branen, A. F. et al (2001). Food Additive s, 2nd Edition, Marcel. Dekker.
6.	Msagati, T. A. (2013). The chemistry of food additives and preservatives. Wiley-Blackwell.
7.	Joint, F. A. O., WHO Expert Committee on Food Additives, and World Health Organization. (1993). Toxicological evaluation of certain food additives and contaminants. World Health Organization.
8.	Saltmarsh, M. (Ed.). (2020). Saltmarsh's Essential Guide to Food Additives. Royal Society of Chemistry
Sr.no	**Web links**
1	*https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=iWHzbXYGExXDS52DSnAzdQ==*
2	***https://www.foodsafetymantra.com/regulatory-insight/spices-condiments-and-additives/fssai-regulations-on-the-use-of-food- colours-and-flavors/***

Year, Program, Semester	First Year M.Tech (Food Technology), Part I, Semester II				
Course Code	**FTOE 21**				
Course Category	Open Elective Course				
Course title	**ElE-IV (Recent Developments in Processing of Plantation Crops)**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:40**			**ESE: 60**	**Total=100**
Pre-requisites(if any)	Knowledge of Food Processing, Food Chemistry and Food Biotechnology is required				
Course Rationale	The purpose of this course is to introduce and make aware the students about the preservation technologies of spices and plantation crops. To make them develop different processed products from spices and plantation crops and extend the shelf life of those.				
Course Objectives	The course teacher will help 1. To enable the students to study the major and minor spices available 2.To study the principles of spice processing 3. To learn the principles of extraction of active components from different spices 4.To learn various methods of processing of plantation crops 5.To understand the importance of cash crops 6.to learn the methods of extraction and analysis process				
Course Outcomes	The students will able to 1. Toidentify and classify the major and minor spices 2.To study the principles of spice processing 3. To learn the principles of extraction of active components from different spices 4.To learn various methods of processing of plantation crops 5.To understand the importance of cash crops 6.to learn the methods of extraction and analysis process				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	2		3	1						
CO 2	2	3	2	3	2	3	2					
CO 3	3	1	3	3	2	2	1					
CO 4	1	2	3	2	1	2	1					
CO 5	2	2	1	3	1	1	1					
CO 6	2	1	2	3	1	1	1					

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Unit: I current status and future scope of spices and plantation crops** Production and processing scenario of spice, flavor& plantation crops and its scope, Def of spices and condiments, classification of spices; world trade in spicess	07
2	**Unit II Major Spices:** Post Harvest Technology composition, processed products of following spices Ginger, Chilli, Turmeric, Onion and garlic, Pepper, Cardamom, Cashew nut, coco nut. Minor spices, herbs and leafy vegetables: processing and utilization, All spice, Annie seed, sweet Basil, Caraway seed, Cassia, Cinnamon, Clove, Coriander, cumin, Dill seed, Fern seed nutmeg mint marjoram, Rose merry, saffron, sage	07
3	**Unit III Cash crops processing** Tea, Coffee, Cocoa: Processing quality control;Vanilla and annatto-processing;Spice oil and oleoresins	07
4	**Unit IV** Different methods of drying and storage, microbial contamination of stored product, influence of temperature and time combination on active principles of plantation crops, viz., coconut, arecanut, cashew nut, oil palm, palmyrah, cocoa, tea, coffee and rubber,Savory, Thyme, Ajowan, Curry leaves, Asafoetida	06
5.	**Unit V** Different methods of drying and storage, microbial contamination of stored product, influence of temperature and time combination on active principles of medicinal crops, viz., dioscorea, gloriosa, stevia, coleus, ashwagandha, tulsi, isabgol, safedmusli, senna, aloe and catharanthus	05

	Under exploited Spice Crops: Anardana, angelica, aniseed ,asafoetida ,sage ,atis, vach and chandan Basil, tejpat, chives, galangal ,savory,chamomile and isabgul,Horse Radish ,hyssop, lovage, mustard, shallot ,kesar and amla,Parsely, poppy seed ,rosemary, saffron , star anise, haritaki and bahara	
6	**Unit VI**Extraction and analysis of active principles using TLC / HPLC / GC. Distillation, solvent extraction from aromatic plants– davana, mint, rosemary, rose, citronella, lavender and jasmine. Study of aroma compounds and value addition. Nano-processing technology in medicinal and aromatic crops.;Standards specification of spices and flavours;Packaging of spices and spice products	**07**

Sr.no.	**Text Books**
1	Kumar, N. (1997). *Introduction to spices, plantation crops, medicinal and aromatic plants*. Oxford and IBH Publishing.
2	Husen, A. (Ed.). (2024). *Medicinal Spice and Condiment Crops*. CRC Press.
Sr.no	**Reference books**
1	Spices Vol. I and II; Tropical Agril. Serie- Purseglove, J.W. Brown E.G., Green C.L. And Robbins SRJ.
2	Chopra, A. K. (2007). *Medicinal Plants: conservation, cultivation and utilization*. Daya Books.
Sr.no	**Web links**
1	*http://ecoursesonline.iasri.res.in/course/view.php?id=156*

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<tr><td>Course title</td><td colspan="5">ElE-IV (Project Management for Food Processing Industries)</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
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<tr><td>Evaluation Scheme</td><td colspan="2">ISE:40</td><td colspan="2">ESE:60</td><td>Total=100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Knowledge of food processing, quality and safety management</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The food industry is a rapidly growing and highly regulated sector that requires efficient project management for food production, processing, quality assurance, and supply chain management. This course is designed to equip students with the knowledge, tools, and skills needed to plan, execute, monitor, and control food-related projects effectively. It provides insights into handling food product development, processing technologies, regulatory compliance, risk management, and quality control—all essential in ensuring safe and sustainable food production.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course aims to:
1. Understand the fundamentals of project management and its application in food technology projects.
2. Develop and implement project plans tailored to food industry requirements.
3. Utilize project management tools and techniques to effectively manage food-related projects.
4. Ensure compliance with food safety regulations and quality standards in project management.
5. Manage financial aspects, resources, and supply chain logistics in food industry projects.
6. Evaluate and monitor project performance using industry-specific KPI sand best practices.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">Upon successful completion of the course, students will be able to:
1. Explain the principles of project management and their relevance to food</td></tr>
</table>

	technology. 2. Design a comprehensive project plan for food production, processing, or development. 3. Identify potential risks and implement mitigation strategies in food-related projects. 4. Implement food safety management systems (HACCP, GMP, ISO 22000) in projects. 5. Manage supply chain operations, including procurement, inventory, and distribution. 6. Develop and test innovative food products while ensuring regulatory compliance.

Course Outcome and Program Outcome Mapping

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CO 1	3	2	2	1	2	1	1	2	2	2	3	3
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CO 4	2	3	2	2	2	3	3	3	2	2	2	3
CO 5	2	3	3	2	3	2	3	2	2	2	3	2
CO 6	3	3	3	3	2	3	2	2	3	3	3	3

Level of Mapping as: Low 1, Moderate 2, High

Unit No.	Course Content	Hours
1	**Unit: I Introduction to Project Management** Definition and scope of project management, Importance of project management in the food industry, Project life cycle (Initiation, Planning, Execution, Monitoring, Closure), Case studies of food industry projects	06
2	**Unit II Project Planning and Scheduling**	07

	Project scope and objectives, Work Breakdown Structure (WBS), Gantt charts and Critical Path Method (CPM), Resource allocation and budgeting, Use of project management software (e.g., MS Project, Trello, Asana)	
3	**Unit III Risk, Safety and Quality Management in Food Projects** Identifying potential risks in food technology projects, Hazard Analysis and Critical Control Points (HACCP), Food safety standards and regulatory requirements (FDA, FSSAI, ISO 22000),Compliance with national and international food safety regulations, Food quality parameters and quality assurance techniques, Crisis management and contingency planning	**07**
4	**Unit IV Supply Chain and Logistics in Food Projects** Supply chain management principles, Inventory control and storage techniques, Distribution strategies and cold chain management, Sustainable packaging and waste management	**07**
5	**Unit V Financial and Resource Management in Food Projects** Budgeting and cost estimation,Funding and investment strategies, Return onInvestment (ROI) and feasibility analysis, Case studies of cost-effective food projects	**06**
6	**Unit VI Project Execution, Monitoring, and Closure** Team management and leadership skills, Key Performance Indicators (KPIs) in food projects, Documentation and reporting, Project evaluation and lessons learned	**06**

Sr.no.	**Text Books**
1	P. Gopalakrishnan and V E Rama Moorthy (2001) “Text book of Project Management”, Macmillan India Ltd., New Delhi
2	Project Management for the Food Industry – Beverley J. Holcomb
3	Project Management (A Strategic Managerial Approach) by Meredith
4	Vasant desai (2001) “Project Management”, Himalaya Publishing House, Mumbai
5	K. Natrajan (2005) “Project Management”, New Age International (P) Limited Publishers, New Delhi

Sr.no	Reference books
1	Clifford F. Gray and Erik W. Larson (2009) “Project Management- The Managerial Process”, Tata McGraw-Hill Companies
2	Industrial Engineering and Management by O.P. Khanna
3	Chandra Prasanna (1996); Projects: Planning, Analysis, Selection, Financing,Implementation and Review, Tata McGraw Hill Publishing Company Ltd., New Delhi
4	Maylor Harvey (1999): Project Management, Mc Millan Limited.
Sr.no	**Web links**
1	*NPTEL SWAYAM course on Introduction to Project Management: Principles & Practices By Dr. Nimisha Singh*
2	*NPTEL SWAYAM course on Project Management By Prof. Ramesh Anbanandam, IIT, Roorkee*

Year, Program, Semester	First Year M.Tech (Food Technology), Part I, Semester II				
Course Code	**FTOE 23**				
Course Category	Open Elective Course				
Course title	**ElE-IV (Sustainable Food Process Engineering)**				
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits
	03	-	-	03	03
Evaluation Scheme	ISE: 40			ESE:60	Total=100
Pre-requisites(if any)	Knowledge of food Engineering, Food Packaging and food safety				
Course Rationale	The course deals with sustainable practises to apply in the food processing industry. Topics presented illustrate applications of process engineering during the handling, processing, storage, packaging and distribution of food products in sustainable manner.				
Course Objectives	The course teacher will help 1. To enable the students to study the evolution of management. 2. To study the functions and principles of management. 3. To learn the application of the principles in an organization. 4. To enable the effective and barriers communication in the organization. 5. To study the system and process of effective controlling in the organization. 6. To study the communication skills in the organization.				
Course Outcomes	Students will be able to 7. Describe the importance of principles of management. 8. Associate the importance of planning and decision making in an organization. 9. Interpret the knowledge of organization and its types. 10. Acquire concepts in various authorizes and responsibilities of an organization. 11. Summarize the direct co-coordination and control in the management. 12. Practice the process of management functions.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	3	3	1	2	1	2	2	1	
CO 2	2	3	2	3	2	3	2	2	2	2	1	
CO 3	2	3	3	3	2	2	1	1	1	1		
CO 4	2	2	3	2	2	2	1	2		1		
CO 5	2	2	2	3	1	1	1	1	2	1	1	
CO 6	2	1	2	3	1	1	1		1			1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Unit: I Food production** Agroforestry, Crop rotation, Organic farming, Permaculture, Sustainable seafood, Water management, Cover crops, Conservation tillage	**07**
2	**Unit II Food ingredients:** Raw Material Sources Selection, carbon footprint target; Harmless material selection; reusable materials	**07**
3	**Unit III Food processing:** Mechanical, Biotechnological, Thermal, and Non-Thermal Techniques of food Processing ;computer-aided design;Instrumentation, and process control	**07**
4	**Unit IV Food packaging:** Bio plastics, bamboo, glass, paper, and plant-based materials method of production and utilization in food products;Quality control parameters for sustainable packaging material	**06**
5	**Unit V Food safety:** Digital food safety kits;Use of biotechnology, biosensors, and other technologies to ensure food safety ;prioritising local food suppliers to reduce food miles	**05**
6	**Unit VI Food waste management** Techniques for food waste reduction; Digital food safety records ;Energy Efficient techniques for food waste management	**07**

Sr.no.	**Text Books**
1	Sustainable Food Processing, Dr Brijesh K. Tiwari, Dr Tomas Norton, Professor Nicholas M. Holden ,December 2013, ISBN: 978-0-470-67223-5
2	Environmental Sustainability in Food Processing 39 ,Poritosh Roy, Takahiro Orikasa, Nobutaka Nakamura and Takeo Shiina
Sr.no	**Reference books**
1	Life Cycle Assessment and Sustainable Food Processing 63 *Nicholas M. Holden and Ming-Jia Yan*
2	Risk Analysis for a Sustainable Food Chain 103 *Uma Tiwari and Enda Cummins*
3	Environmental Sustainability in Food Processing 39,*Poritosh Roy, Takahiro Orikasa, Nobutaka Nakamura and Takeo Shiina*
Sr.no	**Web links**
1	*https://www.coursera.org/learn/sustainable-food-systems*

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year M.Tech (Food Technology), Part I, Semester II</td></tr>
<tr><td>Course Code</td><td colspan="5">FTC 24</td></tr>
<tr><td>Course Category</td><td colspan="5">Project Seminar Internship</td></tr>
<tr><td>Course title</td><td colspan="5">Seminar-II</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>-</td><td>-</td><td>02</td><td>02</td><td>01</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">IOE:50</td><td colspan="2">EPE/EOE: 00</td><td>Total=50</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Soft Skills</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The course aims to emphasize the value and significance of the seminar in the M.Tech program, showcasing how it contributes to the overall learning experience and the professional growth of the students.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The Course teacher will
6. Provide students with in-depth knowledge and understanding of a specific subject or research area within their field of study.
7. Enhance students' research skills, including critical analysis, literature review, data collection and analysis, experimental design, and problem-solving.
8. Help to improve students' ability to present technical information effectively, both orally and in writing, to an academic audience.
9. Promote collaboration and networking among students, faculty members, and experts in the field, fostering interdisciplinary discussions and potential research collaborations.
10. Explore and discuss the latest trends, advancements, and challenges in the field.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">Students will be able to
5. Acquire a comprehensive understanding of the seminar topic, its theoretical foundations, and its
6. Develop improved research skills, including the ability to critically analyze existing literature , design experiments or investigations, collect and analyze data, and draw meaningful conclusions.5. Evaluate, credit, and</td></tr>
</table>

	synthesize sources 7. Effectively present and communicate their research findings, ideas, and arguments through oral presentations and written reports. 8. Interact and establish connections with experts, professionals, and fellow researchers in the field, potentially 9. Develop critical thinking skills and the ability to identify and solve complex problems within their area of specialization. 10. Gain knowledge on latest developments, trends, and challenges within their field, enabling them to contribute to the advancement of knowledge and industry practices.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1								2		3	2	
CO 2										3	2	
CO 3							3			3	2	
CO 4										3	2	2
CO 5						3				2	3	2
CO 6										2		

Level of Mapping as: Low 1, Moderate 2, High 3

Curriculum Content
Seminar-II shall be delivered preferably on the topic of dissertation or at least the area of dissertation. The concepts must be clearly understood and presented by the student. All modern methods of presentation should be used by the student. Preparation and presentation of a seminar is intended to investigate an in-depth review of literature, prepare a critical review, and develop confidence to present the material by the student. The seminar-II shall be evaluated by a Department Committee constituted for this purpose, based on a report submitted by the candidate and a viva-voce conducted at the end of the semester. A hard copy of the report (25 to 30 pages A4 size, 12 fonts, Times New Roman, single spacing both side printed, well formatted) should be submitted to the Department before delivering the seminar. A PDF copy of the report in soft form must be submitted to the guide along with other details if any.

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year M.Tech (Food Technology), Part I, Semester II</td></tr>
<tr><td>Course Code</td><td colspan="5">FTC25</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Core Course</td></tr>
<tr><td>Course title</td><td colspan="5">Advances in Food Biotechnology Lab</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>-</td><td>-</td><td>02</td><td>02</td><td>01</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">IOE:50</td><td colspan="2">EPP/EOE: 00</td><td>Total=50</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Basic understanding of chemistry and Microbiology is required.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The purpose of this course is to provide the students hands-on experience in biotechnology experiment.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Implant the practical proficiency in Food Packaging
2. Explain the relation between shelf life and packaging material
3. Discuss different equipment’s used to assess the quality of packaging material
4. To learn quality parameters of packaging materials, which come in contact with food products
5. To give a detailed idea about global trends in food packaging and disposal methods.
6. To create packaging professional from design conception to manufacturing, who learns to speak the language of packaging and utilize it as a key differentiator for his relevant industry or business.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-
1. To study the active and intelligent packaging system and its application in foods
2. To study about different scavenging techniques used in food packaging.</td></tr>
</table>

	3. To study about antimicrobial food packaging used for food packaging. 4. To acquaint with various food packaging materials, various aspects of packaging methods and technology. 5. Asses suitable packaging material for different food products **6.** Acquire problem solving skills in Food industries

Course Outcome and Program Outcome Mapping

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	1		1	1	1	2	1					
CO 2		2	1		3							
CO 3	3		1	2		2					3	
CO 4	3			1	2		1					
CO 5				3					3			
CO 6	1		1	1	3							

Level of Mapping as: Low 1, Moderate 2, High

Ex. No.	**List of Experiments**
1.	Isolation of Amylase producing microorganisms from Soil sample and Starch-degradation activity of Amylase enzyme
2.	Isolation of protease enzyme producing microorganism from Soil sample and its protein-degradation activity
3.	To Isolate bacterial genomic DNA by CTAB method.
4.	To isolate the genomic DNA from plants.
5.	To determine activity of Invertase enzyme from yeast cell
6.	To analyze DNA from transformed cells by Agarose gel electrophoresis.

7.	Non denaturing Polyacrylamide Gel Electrophoresis of Proteins
8.	To study the production of organic acids
9.	Alcohol production
10.	Demonstration of Tissue Culture
11.	Preparation of Protoplasts
12.	Estimation of Reducing Sugars by the Dinitro Salicylic Acid (DNS) Method
Suggested Text Books/ Reference Books/Manual	
1.	Biotechnology procedures and experiments handbook by S.Harisha
2.	Guide to food biotechnology (1996) IFST
3.	Mosier, N S and Ladisch, M.R (2009) Modern biotechnology. John Wiley and sons
4.	Meenakshi Paul. 2007. Biotechnology and Food Processing Mechanics. Gene-Tech Books, New Delhi.

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">First Year M.Tech (Food Technology), Part I, Semester II</td></tr>
<tr><td>Course Code</td><td colspan="5">FTC 26</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Core Course</td></tr>
<tr><td>Course title</td><td colspan="5">Chemical and Instrumental Analysis of Food Lab</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>-</td><td>-</td><td>02</td><td>02</td><td>01</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">IOE:50</td><td colspan="2">EOE: 00</td><td>Total=50</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Basic knowledge of food chemistry and analytical techniques.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">This course equips students with essential skills to analyze food components using chemical and instrumental methods. It prepares them to ensure food quality, safety, and compliance with industry standards.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will help
1. Develop a comprehensive understanding of the principles and methods used in chemical and instrumental analysis of food components.
2. Equip students with practical skills in using advanced analytical instruments for food quality assessment.
3. Ensure students can accurately quantify and characterize major food components such as carbohydrates, proteins, lipids, vitamins, and minerals.
4. Foster the ability to interpret analytical data and relate findings to food safety, quality control, and product development</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">Students will be able to
1. 1. Demonstrate proficiency in performing chemical and instrumental analyses for identifying and quantifying food components.
2. Utilize advanced analytical techniques such as spectroscopy, chromatography, and rheological analysis for food characterization.
3. Apply appropriate safety protocols and quality control measures while conducting food analysis experiments.
4. Analyze and interpret experimental results, effectively linking data to food composition, functionality, and industry standards.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	3	2	1	1	2	1			1
CO 2	3	1	1	3	2	1	1	2	2			1
CO 3	2	2	2	3	3	1						1
CO 4	3	2	2	3	3	2			1	1		1
CO 5												
CO 6												

Level of Mapping as: Low 1, Moderate 2, High

Ex. No.	List of Experiments
1.	Determination of Moisture content of given food sample
2.	Determination of Ash content of given food sample
3.	Determination of Fat content of given food sample
4.	Determination of Protein content of given food sample
5.	Determination of different sugars of given food sample
6.	Determination of Fiber content of given food sample
7.	Determination of Viscosity of given food sample
8.	Determination of different qualities of oils
9.	Determination of color analysis of given sample
10.	To study the principle, working and application of spectrophotometer.
11.	Determination of minerals by Atomic absorption spectrophotometer.
12.	Determination of particle size analysis of given sample
Suggested Text Books/ Reference Books/Manual	

1.	Institute’s Laboratory Course Manual and equipment wise Standard Operating Procedure to follow.etc.
2.	Association of Official Agricultural Chemists, & Horwitz, W. (1975). Official methods of analysis (Vol. 222). Washington, DC: Association of Official Analytical Chemists.