Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR
416 004, MAHARASHTRA
PHONE : EPABX – 2609000, BOS Section – 0231-2609094, 2609487
Web : www.unishivaji.ac.in Email: bos@unishivaji.ac.in

शिवाजी विद्यापीठ, कोल्हापूर
४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४, २६०९४८७
वेबसाईट : www.unishivaji.ac.in ईमेल : bos@unishivaji.ac.in

SU/BOS/Sci & Tech/ 445 **Date: 01/08/2024**

To,

The Director,
Departments of Technology,
Shivaji University, Kolhapur.

Subject: Regarding New syllabus of **B. Tech. Programme (Department of Technology)** Part - II (Sem-III-IV) under the Faculty of Science and Technology as per National Education Policy 2020.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabus B. Tech. Part - II (Sem - III & IV) under the Faculty of Science & Technology as per National Education Policy 2020.

As per NEP 2020 **B. Tech (Deparment of Technolgy) Syllabus -2024-25**		
No.	**BOS/Ad-hoc Board**	**Course Syllabus**
1	Civil Engineering and Technology	B.Tech. Part-II, (Sem- III – IV) Civil Engineering
2	Mechanical Engineering and Technology	B.Tech. Part-II, (Sem- III – IV) Mechanical Engineering
3	Computer Science Engineering and Technology	B.Tech. Part-II, (Sem- III – IV) Computer Science and Technology
4	Chemistry & Chemical Engineering	B.Tech. Part-II, (Sem- III – IV) Chemcial Engineering
5	Electronics Sciences, Electronics Engineering and Technology	B.Tech. Part-II, (Sem- III – IV) Electronics and Telecommunication Engineering
6	Food Science and Technology	B.Tech. Part-II, (Sem- III – IV) Food Technolgy

B. Tech First Year (Sem – I & II) all Branches syllabus and Rules, Regulation, Guidelines, Structure and equivalence shall be implemented from the academic year 2023- 2024 onwards. A soft copy containing syllabus is attached herewith and it is available on university website **www.unishivaji.ac.in. (Student Online Syllabus).**

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dr. S. M. Kubal
Dy. Registrar

Copy to:

1	The I/c Dean, Faculty of Science & Technology	6	Appointment Section A & B
2	The Chairpersan, Respective Board of Studies	7	Affiliation Section (T.1) (T.2)
3	OE 4	8	P.G.Admission Section, P.G Seminar Section
4	Eligibility Section,	9	Computer Centre

Shivaji University

Vidya Nagar, Kolhapur, Maharashtra 416004

Department of Technology

As per NEP2020 guidelines

Second Year B. Tech (Food Technology) Detailed Curriculum Structure 2024-25 onwards

A. Engineering Graduate Attributes

1. Domain specific Engineering Knowledge
2. Problem Analysis Ability
3. Acquiring Skills that enable them to Design & Develop Solutions to the Problems
4. Capacity to investigate Complex Problems
5. Familiarity of using Modern Tools
6. Understanding Engineer's role and connectivity towards Society
7. Awareness about Environment & Sustainability
8. Practicing ethics and values
9. Ability to work as an Individual & in a Team also
10. Acquiring Communication skills
11. Becoming well verse with task of Project management & Finance aspects
12. Developing Lifelong Learning attitude

B. B. Tech (Food Technology) Program: Vision, Mission, PEOs and POS.

Vision

To develop competent Food Technologists through proactive teaching-learning process, research, entrepreneurship and extension activities leading towards sustainable growth of the society

Mission

- To produce competent Food Technologist with sound knowledge of hygienic food processing, preservation, food standards & regulation, packaging and storage in order to reduce the food losses
- To nurture research acumen and entrepreneurship skills amongst students
- To promote and practice high standards of professional ethics and social values.

Program Educational Objectives (PEOs)

PEO 1- To develop graduates with sound knowledge in the field of food engineering and technology by integrating engineering and basic sciences

PEO 2- To produce competent graduates who shall pursue careers in the field of food processing, quality control, product development and techno-marketing

PEO 3- To inculcate innovative ideas and project management skills in order to make them capable to grow as an entrepreneur

PEO 4- To prepare graduates who will apply the technical knowledge and know-how to solve the problems related to food processing and preservation for the benefit of the society

Program Outcomes (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and

need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

C. Component wise distribution of credits

(Expected range of credits as per AICTE & NEP2020 guidelines is 160-176)

Sr. No.	Category Suggested	Course Code	No. of Credits	Components %
1.	Humanities and Social Sciences including Management & Environment Courses	HSMEC	06	3.42
2.	Indian Knowledge System	IKS	05	2.85
3.	Ability Enhancement Course	AEC	02	1.14
4.	Value Education Courses	VEC	02	1.14
5.	Basic Science courses	BSC	24	13.63
6.	Engineering Science Courses including workshops, drawing, basics of civil/electrical/mechanical/computer etc.	ESC	27	15.34
7.	Professional Core Courses	PCC	56	31.81
8.	Professional Elective Courses relevant to chosen specialization/branch	PEC	12	6.81
9.	Open subjects – Electives from other technical and /or emerging subjects	OEC	06	3.42
10.	Project , Seminar and Internship	PSI	14	7.95
11.	Vocational and Skill Enhancement Courses	VSEC	08	4.54
12.	Multidisciplinary Minor	MDM	14	7.95
11.	Vocational and Skill Enhancement Courses	VSEC	Audit Courses	-
12.	Project Based Learning	PBL		
13	Mandatory Audit Courses [Some other courses Decided at the Institute level but that do not get fit in the credits]	MAC (HSMEC)*		
	Total		176	**100**

* Please note that most of the courses under HSMEC have been covered under audit courses.

Shivaji University, Kolhapur

Department of Technology

Second Year B.Tech (Food Technology), Semester- III

Teaching & Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1	Professional Core Courses	PCC211	Food Chemistry	03	–	02	05	04	30:70	00:50
2	Basic Science course	BSC211	Food Biochemistry and Human Nutrition	03	–	02	05	04	30:70	50:00
3	Professional Core Courses	PCC 212	Principles of Food Preservation Technology	03	–	02	05	04	30:70	00:50
4	Vocational and Skill Enhancement Courses	VSEC 211	Fruits and Vegetable Processing Technology	03	–	02	05	04	30:70	50:50
5	Engineering Science Courses	ESC211	Fluid Mechanics	03	-	–	03	03	30:70	00:00
6.	Ability Enhancement Courses	AEC211	Soft Skills Development	01	-	-	01	01	-	50:00
							-	**20**	**500**	**300**
7	Project Based Learning	PBL211	Mini Project I & Industrial Visit	-	01	-	01	ISE at Course in charge end		
8	Humanities, Social Sciences, Management, Environment	HSMEC 211	Environmental Studies	02	-	-	02	University Exam at Year End		
			Total Hours	18	01	08	**27**	-		

Shivaji University, Kolhapur

Department of Technology

Second Year B.Tech (Food Technology), Semester- IV

Teaching & Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1	Basic Science Course	BSC 221	Food Microbiology	03	-	02	05	04	30:70	50:00
2	Professional Core Course	PCC 221	Food Process Engineering I	03	-	02	05	04	30:70	50:00
3	Professional Core Course	PCC 222	Food Additives and Contaminants	03	-	02	05	04	30:70	00:50
4	Professional Core Course	PCC 223	Heat Transfer	03	-	-	03	03	30:70	00:00
5	Professional Core Course	PCC 224	Dairy Technology	03	-	02	05	04	30:70	50:50
6.	MDM Course	MDM 221	Multidisciplinary Minor Course I*	03	-	-	03	03	30:70	00:00
7.	Indian Knowledge Systems	IKS221	Introduction to Performing Arts	01	-	-	01	01	-	50:00
								23	**600**	**300**
8.	Mandatory Audit Course	MAC 222	Aptitude Enhancement Course I	-	01	-	01	ISE at Course in charge end		
9.	Project Based Learning	PBL221	Mini Project II & Industrial Visit	-	01	-	01			
10.	Humanities, Social Sciences, Management Environment	HSMEC 221	Environmental Studies	02	-	-	02	University Exam at Year End		
			Total Hours	21	02	08	**31**	**-**		

*Note: The MDM course will be from the chosen multidisciplinary title.

Year, Program, Semester	Second Year B.Tech (Food Technology), Part I, Semester III				
Course Code	PCC211				
Course Category	Professional Core Courses				
Course title	Food Chemistry (Theory)				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**		**ESE: 70**		**Total=100**
Pre-requisites (if any)	Prerequisites for this course typically include Engineering Chemistry and Engineering Physics.				
Course Rationale	Food chemistry deals with the structure, properties and application of different food constituents and the chemical changes of these constituents undergo during handling, processing and storage.				
Course Objectives	The course teacher will ensure to- 1. Introduces the different constituents of Foods 2. Describe the various functions of Food Constituents 3. Illustrate the structures of different Food Constituents 4. Explain the properties of the different Food Constituents 5. The Teacher will be elaborate the applications of different Food Constituents 6. Apply course concepts in solving problems related to food constituents				
Course Outcomes	The students will be able to- 1. Justify the sources and functions of Food constituents 2. Understand the structures and properties of Food constituents 3. Asses the quality changes in food during processing, transportation and storage 4. Apply the modified food constituents in different food products 5. Explain the role of nutrients on human health 6. Evaluate the quality of food products based on their chemical composition.				

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	1				1		1
CO 2	3	3	2	1	2	2				1		1
CO 3	3	3	2	2	2	1				1	1	1
CO 4	3	1	2	2	2	3					1	1

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

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

Unit No.	Course Content	Hours
I	**Introduction to Food Chemistry** • Introduction to Food Chemistry • Sources and Classification of Food • Importance of Food Chemistry • Classification of Food Composition	05
II	**Water** • Introduction to Water • Structure of Water • Different Forms of Water in Food • Concept of Water activity • Effect of Water activity on Food Quality	06
III	**Carbohydrate** • Sources and Classification of Carbohydrates • Functions of Carbohydrates • Structure of Carbohydrates • Properties of Carbohydrates • Applications of Carbohydrates • Concept of fiber and its effect on Human Health	07
IV	**Protein** • Sources and Classification of Proteins • Functions of Proteins • Structure of Proteins • Properties of Proteins • Applications of Proteins	06
V	**Lipids** • Sources and Classification of Lipids • Functions of Lipids • Properties of Lipids • Hydrogenation of Fats • Rancidity of Fats and Oils • Changes occurring in fats and oils during processing • Application of Fats	06
VI	**Vitamins & Minerals** • Sources and Classification of Vitamins • Functions of Vitamins • Deficiency of Vitamins • Sources and Classification of Minerals	06

	• Functions of Minerals • Deficiency of Minerals	

Sr. No.	Reference Books/ Text Book
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).
Sr. No.	**Important web links**
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

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B.Tech (Food Technology), Part I, Semester III</td></tr>
<tr><td>Course Code</td><td colspan="5">PCC211</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Core Courses</td></tr>
<tr><td>Course title</td><td colspan="5">Food Chemistry (Practical)</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 = 00</td><td colspan="2">EOE = 50</td><td>Total=50</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="5">Prerequisites for this course typically include Engineering Chemistry and Engineering Physics.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">Food chemistry deals with the structure, properties and application of different food constituents and the chemical changes these constituents undergo during handling, processing and storage.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Apply theoretical knowledge to hands-on experiments, assessing the functionality and effects of various food additives.
2. Develop practical skills in quantifying and analyzing food additives using laboratory techniques.
3. Adhere to safety protocols while conducting food additives experiments.
4. Interpret and communicate experimental results, linking practical findings to real-world applications.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-
1. Demonstrate proficiency in conducting practical experiments to assess the roles and functions of diverse food additives.
2. Master the use of laboratory techniques for quantifying and analyzing different types of food additives.
3. Implement safety measures effectively, ensuring a secure environment during food additives practical sessions.
4. Communicate and interpret experimental results, fostering a practical understanding of the applications and implications of food additives in the food industry.</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	1			1

CO 3	2	2	2	3	3	1			1	2		1
CO 4	3	2	2	3	3	2			1	1		1

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

Ex. No.	**List of Experiments**	**Hours**
1.	Determination of moisture by hot air oven method	02
2.	Estimation of crude protein by Micro-Kjeldal's method	02
3.	Estimation of gluten	02
4.	Estimation of ash / mineral matter	02
5.	Estimation of crude fat	02
6.	Determination of acid value of oil	02
7.	Determination of saponification value/number of an oil or fat	02
8.	Determination of reducing sugar and total sugar	02
9.	Estimation of starch by Anthrone reagent	02
10.	Determination of vitamin C content	02
11.	Extraction of chlorophyll from leaf tissue	02
12.	Extraction of carotenoids from leaf tissue	02
Suggested Text Books/ Reference Books/Manual		
1.	Food Chemistry: Laboratory Manual by Connie M. Weaver and James R. Daniel	
2.	Association of Official Agricultural Chemists, & Horwitz, W. (1975). Official methods of analysis (Vol. 222). Washington, DC: Association of Official Analytical Chemists.	
3.	Handbook of Food Analysis - Two Volume Set edited by Leo M.L. Nollet	
4.	Experimental Food Science by Margaret McWilliams	

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B.Tech (Food Technology), Part II, During Semester III & IV</td></tr>
<tr><td>Course Code</td><td colspan="5">BSC211</td></tr>
<tr><td>Course Category</td><td colspan="5">Basic Science Course</td></tr>
<tr><td>Course title</td><td colspan="5">Food Biochemistry and Human Nutrition (Theory)</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:30</td><td colspan="2">ESE: 70</td><td>Total=100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Basic understanding of chemistry and biology 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 nutrients and promote better nutrition to people.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure that students will able to-
1. Understand the basic concept of nutrition
2. Understand the fundamentals of biochemical principles, structure/function of bio-molecules, metabolic pathways and the regulation of biochemical processes
3. Understand and be able to control the major chemical and biochemical (enzymatic) reactions that influence food quality with emphasis on food industry applications
4. Understand how the properties of different food components and interactions among these components modulate the specific quality attributes of food systems
5. Interpret the basic foundation in human nutrition in preparation for any of the health professions
6. Formulate dietary recommendations</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">The students will be able to-
1. Explain the digestion, absorption and transportation of nutrients in blood
2. Explain the biosynthesis of carbohydrates, proteins and lipids
3. Summarize the role of hormones in digestion
4. Express role of enzymatic activity
5. Enumerate undesirable Constituents and toxic substances and their disorders
6. Familiarize nutritional assessment, RDA and Dietary Recommendations and guidelines</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		1	3		
CO 2		2	1		3	1	2	2				
CO 3	3		1	2	2	2						
CO 4		1	3	1	2	1	1		3			

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

Unit No.	Course Content	Hours
I	**Digestion and Absorption:** • Human Digestive System • Disorders of human Digestive System • Absorption of Carbohydrates, Proteins and Fats • Gastrointestinal Hormonal Control	06
II	**Nutritional Biochemistry I:** • Anabolism and Catabolism of Carbohydrates • Glycolysis, TCA Cycle, pentose phosphate pathway, electron transport chain, Oxidative phosphorylation. • Gluconeogenesis, Glycogenesis, Glycogenolysis	06
III	**Nutritional Biochemistry II:** • Biosynthesis of amino acids in the Liver • Transamination and Oxidative Deamination • Lipoprotein Metabolism • B-Oxidation	06
IV	**Human Nutrition:** • Nutritive values of foods; Basal metabolic rate; • Techniques for assessment of human nutrition • Dietary requirements and deficiency diseases of different nutrients	06
V	**Biochemical changes in food:** • Biochemical changes in fruits and vegetables during post-harvest handling. • Biochemical changes in meat and meat products during processing. • Biochemical changes in milk and milk products during storage.	05
VI	**Enzymes:** • Nomenclature, Classification and specificity of enzymes and cofactors • Enzyme Kinetics: Factors affecting the rate of enzyme catalyzed reaction, regulation and control • Application of enzymes in food processing	07

Sr.No.	Reference Books
1.	AL Lehninger, (2017)“ Principle of Biochemistry”, 7th Edition, W H Freeman & Co
2.	Lubert Stryen,(2006)” Biochemistry”, 6th Edition, W H Freeman & Co.
3.	Shubhangini A. Joshi’(2002) “Nutrition and Dietetics” 2nd Edition Tata Mc GrawHill publishing Company Ltd.
4.	Eastwood, M. A. (2013). *Principles of human nutrition*. Springer.
5.	JH Weil,(1990) “ General Biochemistry”, 6th Edition, New Age International Private Limited
Sr.No	**Reference Textbooks**
1.	Benjamin K. Simpson, Leo M. L. Nollet, Fidel Toldrá, Soottawat Benjakul, Gopinadhan Paliyath, Y. H. Hui, (2012) Food Biochemistry and Food Processing, John Wiley & Sons
Sr.No	**Weblinks**
1.	https://onlinecourses.swayam2.ac.in/cec24_ag05/preview

Year, Program, Semester	Second Year B.Tech (Food Technology), Part II, During Semester III & IV				
Course Code	BSC211				
Course Category	Basic Science Course				
Course title	Food Biochemistry and Human Nutrition (Practical)				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	-	02	02	01
Evaluation Scheme	**IOE:50**			**EOE: 00**	**Total=50**
Pre-requisites(if any)	Basic understanding of chemistry and biology is required.				
Course Rationale	The course provides knowledge about the basic concepts of food biochemistry.				
Course Objectives	The course teacher will ensure that students will able to- 1. Evaluate the food component on qualitative and quantitative basis. 2. Conduct qualitative analysis of protein, lipid and fats. 3. Develop a practical proficiency in a food biochemistry and analysis laboratory 4. Describe the methods used to carry out nutrition research.				
Course Outcomes	The students will be able to- 1. Evaluate the food component on qualitative and quantitative basis. 2. Explain the laboratory techniques and different methodology for biological assay. 3. Understand the food composition and energy balance required in diet planning. 4. Understand the methods used to carry out nutrition research.				

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						
CO 4		1		1	2	1						

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

Experiment No.	Experiment Title/Objective	Hours
1.	Preparation of standard solutions and buffers	02
2.	Isolation and characterization of starch	02
3.	Isolation and characterization of casein	02
4.	Quantitative determination of carbohydrate by DNSA method	02
5.	Estimation of Protein by Biuret method/Lowry's method	02
6.	Quantitative analysis of lipids (Benedict's method etc.)	02
7.	Calculation of energy value of food	02
8.	Preparation of balance diet	02
9.	Immobilization of enzymes	02
10.	Computation of energy requirement on the basis of physical activity ACU units(changed)	02
11.	Anthropometric measurements	02
12.	Determination of energy value of food by bomb calorimeter	02
Sr. No.	**Suggested Text Books/ Reference Books/Manual**	
1.	Swaminathan, M. (2006). Advanced Text Book on Food and Nutrition (Volume I and II). The Bangalore Printing and Publishing Co.Ltd, Bangalore.	
2.	Stewart, Truswell. (2003) ABC of Nutrition (4th edition). BMJ Publishing Group. ISBN 0727916645.	
3.	Carolyn D. Berdanier, Elaine B. Feldman and Johanna Dwyer. (2008). Handbook of Nutrition and Food. 2nd Ed. CRC Press, Boca Raton, FL, USA.	
4.	Institute's Laboratory Course Manual and equipment wise Standard Operating Procedure to follow.	
Sr.No	**Weblinks**	
1.	https://onlinecourses.swayam2.ac.in/cec24_ag05/preview	

Year, Program, Semester	Second Year B. Tech. (Food Technology), Part II, During Semester III				
Course Code	PCC 212				
Course Category	Professional Core Course				
Course Title	Principles of Food Preservation Technology (Theory)				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**		**ESE: 70**		**Total = 100**
Pre-requisite (if any)	Engineering Chemistry (BSC111)				
Course Rational	The subject focuses on the principles of the food processing technologies commonly employed in food industry.				
Course Objective	The course teacher will ensure to- 1. Provide the basic knowledge of principles of food preservation. 2. Introduce students to different food processing techniques. 3. Educate students on the technical mechanism for preserving food. 4. Introduce students to food preservation methods to avoid waste. 5. Introduce students to different non thermal ways of food processing. 6. Introduce students to different modern ways of processing and conserving food.				
Course Outcome	The students will be able to- 1. Memorize the basic knowledge of principles of food preservation. 2. Describe the various food processing techniques. 3. Understand the different preservation technique. 4. Analyse the principles of food spoilage and the ways to prevent. 5. Explain the various principles involved in non-thermal food processing. 6. Students will be able to interpret the various principles involved in the various modern ways of food processing.				

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	3	3		3	3		3	3	3	3
CO 2	3	3	3	3		3	3		3	3	3	3
CO 3	3	3	3	3		3	3		3	3	3	3
CO 4	3	3	3	3		3	3		3	3	3	3

CO 5	3	3	3	3		3	3		3	3	3	3
CO 6	3	3	3	3		3	3		3	3	3	3

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

Unit No.	Course Content	Hours
I	**Principles of Food Preservation** • Scope and Importance of food processing • Causes of quality deterioration and spoilage of perishable foods • Food Safety and Food Security • National and International perspectives • Objectives and techniques of food preservation	05
II	**Food preservation by low temperature** • Cooling • Refrigeration • Freezing • Thawing of foods	06
III	**Food preservation by heating** • Blanching • Pasteurization • Sterilization • Extrusion cooking of food • Freeze Drying	07
IV	**Food Preservation by drying** • Drying • Traditional Methods of Drying • Modern Methods of Drying • Types of Dryer	06
V	**Food preservation by Non-thermal method** • Chemical preservation • Fermentation methods for food preservation • Irradiation • Membrane technology	06

VI	**Recent methods for food preservation** • Pulsed electric field processing • High pressure processing • Processing by using ultrasound • Dielectric Heating • Ohmic Heating • Infrared heating	**06**

Sr. No.	**Text Books**
1.	G Subbulakshmi and Shobha a Udipi. (2006). Food Processing And Preservation, New Age International (P) Ltd.
2.	Ayoub Anjum Fozia Hameed & Nadira Anjum. (2022). Fundamentals of Food Processing and Preservation. Daya Publishing House.
Sr. No.	**Reference Books**
1.	Fellows, P. and Ellis H. (1990). "Food processing technology: principles and practice", Wood Head Publishing Ltd.
2.	Manoranjan Kalia and Sangita Sood. (2019). "Food preservation and processing", Kalyani Publishers. New Delhi.
3.	Richardson, T. and Finley, J.W. (2003). "Chemical changes in food during processing". Macmillon Publishers. Canada.
4.	Desrosier, N.W. (2018). The Technology of Food Preservation.3rd Edition. Medtech Publishers.
5.	Jelen, P. (1985). Introduction to Food Processing. Prentice Hall, Reston Virginia, USA.
6.	Heldman, D.R. and Singh R. P. (2016). Introduction to Food Engineering.5th Edition. Elsevier India
7.	William C. Frazier and Dennis C. Westoff (2017). Food Microbiology 5th Edition, McGraw Hill Education.
8.	Singh, Anju. (2017). Handbook of Food Preservation. Agrotech Press.
Sr. No.	**Important web links**
1.	https://fostac.fssai.gov.in/doc/Food%20Safety%20training%20manual%20storage,%20transportation%20v2%20-%20June%2014,%202017%20with%20checklist.pdf

Year, Program, Semester	Second Year B. Tech. (Food Technology), Part II, During Semester III				
Course Code	PCC 212				
Course Category	Professional Core Course				
Course Title	Principles of Food Preservation Technology (Practical)				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	-	02	02	01
Evaluation Scheme	**IOE:00**		**EPE: 50**		**Total = 50**
Pre-requisite (if any)	Engineering Chemistry (BSC111)				
Course Rational	Principles of Food Preservation Technology Lab has wide applications in food processing industry. The course is completely Industry oriented which includes all the practical techniques that are expected in commercial industry. Hence the student will be well versed with basic and advanced technique which is need of the hour for providing employment opportunities.				
Course Objective	The course teacher will ensure to- 1. Knowledge and expertise on preservation and food processing methods. 2. Familiarize themselves with good manufacturing practices and standard operating procedures used in laboratory activities. 3. Preserve food through drying. 4. Preserve food through freezing. 5. Preserve food with the help of sugar, salt and acids. 6. Assist with the quality assessment of conservation products.				
Course Outcome	The students will be able to- 1. Identify processing equipment and select suitable processing equipment for food preservation. 2. Memorize the good manufacturing practices and standard operating procedures used in lab exercises. 3. Preserve food through drying. 4. Preserve food through freezing. 5. Preserve food with the help of sugar, salt and acids. 6. Evaluate the quality of the preserved 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	3	3	3		3	3		3	3	3	3
CO 2	3	3	3	3		3	3	3	3	3	3	3

CO 3	3	3	3	3		3	3		3	3	3	3
CO 4	3	3	3	3		3	3		3	3	3	3
CO 5	3	3	3	3		3	3		3	3	3	3
CO 6	3	3	3	3		3	3		3	3	3	3

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

Experiment No.	Experiment Title/Objective	Hours
1.	Demonstration of various machineries used for food preservation	02
2.	To study effect of blanching on quality of foods	02
3.	To study the effect of peeling methods	02
4.	Preservation of food by low temperature	02
5.	Preservation of food using Tray dryer/other dryer	02
6.	Preparation of food by using sugar as preservative	02
7.	Preparation of food by using salt as preservative	02
8.	Preservation of food by using chemical preservatives	02
9.	Preparation of fermented product	02
10.	Preparation of RTS	02
11.	Sensory evaluation of food	02
12.	Market research survey	02
Sr. No.	**Text Books**	
1.	G Subbulakshmi and Shobha A Udipi. (2006). Food Processing And Preservation, New Age International (P) Ltd.	
2.	Ayoub Anjum Fozia Hameed & Nadira Anjum. (2022). Fundamentals of Food Processing and Preservation. Daya Publishing House.	
Sr. No.	**Reference Books**	
1.	Fellows, P. and Ellis H. (1990). “Food processing technology: principles and practice”, Wood Head Publishing Ltd.	
2.	Manoranjan Kalia and Sangita Sood. (2019). “Food preservation and processing”, Kalyani Publishers. New Delhi.	

3.	Richardson, T. and Finley, J.W. (2003). "Chemical changes in food during processing". Macmillon Publishers. Canada.
4.	Desrosier, N.W. (2018). The Technology of Food Preservation.3rd Edition. Medtech Publishers.
5.	Jelen, P. (1985). Introduction to Food Processing. Prentice Hall, Reston Virginia, USA.
6.	Heldman, D.R. and Singh R. P. (2016). Introduction to Food Engineering.5th Edition. Elsevier India
7.	William C. Frazier And Dennis C. Westoff (2017). Food Microbiology 5th Edition, McGraw Hill Education.
8.	Singh, Anju. (2017). Handbook of Food Preservation. Agrotech Press.
Sr. No.	**Important web links**
1.	https://fssai.gov.in/

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B.Tech (Food Technology), Semester- III</td></tr>
<tr><td>Course Code</td><td colspan="5">VSEC 211</td></tr>
<tr><td>Course Category</td><td colspan="5">Vocational and Skill Enhancement Course</td></tr>
<tr><td>Course title</td><td colspan="5">Fruits and Vegetables Processing Technology (Theory)</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:30</td><td colspan="2">ESE: 70</td><td>Total=100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Prerequisites for this course typically include the knowledge of Food Preservation, Food Chemistry, Food Biochemistry, Food Additives and Contaminants, Food Process Engineering subjects etc</td></tr>
<tr><td>Course Rationale</td><td colspan="5">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.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure 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.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">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.</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	2	3		1						
CO 2	1	3	2		3		3	1				
CO 3	1	2				2		2				
CO 4	2	1	1	1	2	3	2	2				
CO 5	2		3		3		1					
CO 6		2	2	1		2		1				

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

Unit No.	Course Content	Hours
I	**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
II	**Processed products** • Processing Technology of fruits Technology of Jams, Jellies, marmalade, Glazed fruits, Crystallized fruits, fruits candy, and fruit preserve. Technology of beverages Juices and pulps, RTS, concentrates squashes, cordials, nectars, carbonated beverages, Sharbat	06
III	**Tomato processing** • Processing Technology of vegetables Tomato Products: sauces, ketchups, puree, pastes, chutneys and pickles, • Different types of pickling; causes of spoilage in pickles, shelf life study and role of preservatives in pickling	06
IV	**Drying** • Dehydrated fruits and vegetables: Powders, Dryers-Different types of dryers employed in fruits and vegetable Processing Technology	06
V	**Canning** • Introduction and principle of canning	06

	• 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	
VI	**Equipment and FSMS system** • equipment used in fruits and vegetable processing unit. • FSMS system in F and V processing	06

Sr.no.	**Text Book**
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 Vegetable Products. 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://iisdt.in/product/diploma-in-fruits-and-vegetable-processing/
2.	https://www.udyogwardhini.com/programs/food/fruit-and-vegetable-processing/

Year, Program, Semester	Second Year B.Tech (Food Technology), Semester- III				
Course Code	VSEC 211				
Course Category	Vocational and Skill Enhancement Course				
Course title	Fruits and Vegetables Processing Technology (Practical)				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	-	02	02	01
Evaluation Scheme	**IOE:50**		**EPE: 50**		**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 ensure 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.				
Course Outcomes	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.				

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	1	1	2	1	2		3	1				
CO 3	1	2	1	2	3	2	1	1				
CO 4		1	1	1	2	3	2	2				

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

Sr.no	**List of Experiments**	**Hours**
1.	Preparation of Jam	02
2.	Preparation of Jelly	02
3.	Preparation of Marmalade	02
4.	Preparation of Syrup	02
5.	Preparation of Blended juice	02
6.	Preparation of Tomato products	02
7.	Preparation of Squash	02
8.	Preparation of Nectar	02
9.	Preparation of fruits candy	02
10.	Development of different varieties of pickle	02
11.	Preparation of fruits and vegetable powder	02
Suggested Text Book		
1.	Institute's Laboratory Course Manual and equipment wise Standard Operating Procedure to follow etc.	
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.	
Important web links		
1	https://egyankosh.ac.in/bitstream/123456789/12292/1/Experiment-2.pdf	
2.	https://ubblab.weebly.com/uploads/4/7/4/6/47469791/handbook_of_fruits_&_fruit_processing,_2nd_ed.pdf	

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B.Tech (Food Technology), Semester- III</td></tr>
<tr><td>Course Code</td><td colspan="5">ESC211</td></tr>
<tr><td>Course Category</td><td colspan="5">Engineering Core Courses</td></tr>
<tr><td>Course title</td><td colspan="5">Fluid Mechanics</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:30</td><td colspan="2">ESE: 70</td><td>Total=100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Prerequisites for this course typically include the knowledge of Introductory concepts and mathematical modelling</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The process control part begins with the introductory concepts, and mathematical modelling and its use for control purposes. Subsequently, the dynamic behaviour of chemical processes will be discussed. The instrumentation part will elaborate the valve characteristics along with the working principle, specifications, design and selection aspects of various measuring sensors.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Demonstrate understanding of the mathematical modelling
2. Describe the dynamic behaviour of chemical processes
3. Think and Design Controller
4. Demonstrate the measuring devices for flow, temperature, pressure and level.
5. Determine of a flow system the losses
6. Inculcation of the importance of fluid flow measurement and its applications in Industries.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">The students will be able to-
1. Interpret the mechanics of fluids at rest and in motion by observing the fluid phenomena.
2. Know to examine energy losses in pipe transitions and sketch energy gradient lines
3. Asses computation force of buoyancy on a partially or fully submerged body and analyse the stability of a floating body
4. Design Euler’s Equation of motion and Deduce Bernoulli’s equation.
5. Evaluate pressure drop in pipe flow using Hagen-Poiseuille’s equation for laminar flow in a pipe
6. Distinguish the types of flows and Determine sonic velocity in a fluid</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	2	3		1						
CO 2	1	3	2		3		3	1				
CO 3	1	2				2		2				
CO 4	2	1	1	1	2	3	2	2				
CO 5		3	2	1		2		2				
CO 6	2	1		3	3	2	1	1				

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

Unit No.	Course Content	Hours
I	**Introduction to Fluids:** • Definition, Ideal fluids, real fluids, Newtonian and non-Newtonian fluids. • Properties of Fluids: Units of measurement, Mass density, Specific weight, Specific volume, Specific Gravity, Viscosity, Surface tension and Capillarity, Compressibility and Elasticity, Control volume concept.	06
II	**Hydrostatics:** • Pressure and its measurement, fluid pressure at a point, Pascal's law, pressure and its relation with height, atmospheric, absolute, gauge and negative pressure, measurement of pressure through piezo-meter. • Various types of manometer. Total pressure, intensity of pressure, center of pressure. Pressure on horizontal, vertical, inclined and curved surface. • Buoyancy, center at Buoyancy, Meta center and Meta center height. Condition of equilibrium of floating and submerged body. Experimental and analytical method to determine Meta-centric height. Pressure in case of accelerated rigid body motion.	06
III	**Fluid Kinematics:** • Types of fluid motion, • Methods of describing fluid flow -Langrangian and Eulerian method, In viscid flows, velocity and acceleration, flow rate, Continuity equation, Potential flows, flow lines, velocity potential and stream function, • Flow net its characteristic and utility, circulation and vorticity, Vortex flow - forced vortex flow, free vortex flow, equation of motion for vortex flow, equation of forced vortex flow and free vortex flow	06

IV	**Fluid Dynamics:** • Energy processed by a fluid body, • Types of forces, Forces influencing fluid motion, head-energy correction factor, • Euler and Bernoulli's equations, application of Bernoulli's equation, • Flow measurement, momentum of fluid in motion, momentum equation and momentum correction factor, Application of momentum equation, • forces on a pipe bend, free jets	06
V	**Flow Through Pipes** • Introduction, Major and minor losses of energy in pipes, • hydraulic gradient • total energy line • pipes in series, pipes in parallel • flow through branched pipes • hydraulic transmission of power.	06
VI	**Measurement of Flow:** • Orifice & Mouth piece Classification, • hydraulic coefficients, • experimental determination of hydraulic coefficient, • discharge through all types of office & mouthpiece, • time of emptying the tank through orifice and mouthpiece, • Notches and Weirs Classification, • discharge through various types of Notches and weirs, time of emptying a reservoir or a tank with notches & weirs, • Orifice meter Venturimeter ,Nozzles and bendmeter,	06

Sr.no.	Text Book
1.	Fluid Mechanics V.L Streeter, and E.B Wylie,., , McGraw Hill, 1985, New York
2.	Theory and Applications of Fluid Mechanics, K Subramanya , Tata-McGraw Hill
3.	Introduction to Fluid Mechanics E.J Shaughnessy,., I.M Katz,. and J.P Schaffer,. SI edition,2005, Oxford University Press, New Delhi
4.	Fluid Mechanics, F.M., White, 5th Edition, McGraw Hill, New York.
Sr.No.	***Suggested Reference Books:***
1.	Bansal, R.K., Fluid Mechanics, Laxmi Publications
2.	Engineering Fluid Mechanic By R.J.Garde & A.C.Mirajgaoker
3.	Hydraulic Fluid mechanics & Fluid Machines By S.Ramamurthan
4.	Fluid mechanics By Dr.A.K.Jain
Sr. No.	**Important web links**
1	https://archive.nptel.ac.in/courses/112/105/112105269/

Year, Program, Semester	Second Year B. Tech. (Food Technology), Part II, During Semester III				
Course Code	AEC 211				
Course Category	Ability Enhancement Course				
Course Title	Soft Skills Development				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	01	-	-	01	01
Evaluation Scheme	**ISE:** at Course in charge end				
Pre-requisite (if any)	Humanity and Arts				
Course Rational	In today's competitive professional landscape, technical skills alone are insufficient. Soft skills such as communication, teamwork, problem-solving, and adaptability are essential for engineering graduates to thrive in their careers. This course aims to equip students with the necessary soft skills to complement their technical expertise and enhance their employability and success in the workplace.				
Course Objective	The course teacher will ensure to- 1. Help to enhance communication, teamwork, problem-solving skills. 2. Help to foster adaptability and resilience in engineering contexts.				
Course Outcome	The students will be able to- 1. Proficient in oral and written communication. 2. Effective as regards teamwork and collaboration skills. 3. Able to apply critical thinking to industrial problems. 4. Able to demonstrate adaptability and resilience in profession.				

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	-	-
CO 2	-	-	-	-	-	-	-	-	3	-	-	-
CO 3	-	3	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	-	2

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

Unit No.	Course Content	Hours
I	**Written communication** • Email Writing • Technical Report	03
II	**Oral Communication** • Presentation Skills	02
III	**Soft Skills** • Importance of Soft Skills • Overview of Various Soft Skills	02
IV	**Team Spirit and Leadership Ability** • Understanding team dynamics and roles • Building trust and rapport within team	02
V	**Assessment** • Discussion on incorporating soft skills development into daily practice • Case Studies or Role-Play	03

Course Assessment Method

For the internal assessment of the course, with a total evaluation is of 50 marks. Combination of different evaluation methods can be utilized to ensure comprehensive assessment of the students' performance. Following Evaluation Components are suggested:

1. **Quizzes/Tests (10 marks)**
   Periodic quizzes or tests to evaluate students' understanding of key concepts and their ability to apply them.
2. **Activity 1 (10 marks)**
   Group activity focusing application of creative thinking and teamwork; designed to assess both individual and group performance
3. **Activity 2 (20 marks)**
   Group activity focusing application of creative thinking and teamwork; designed to assess both individual and group performance
4. **Classroom Participation and Engagement (10 marks)**
   Demonstrating engagement with course material and Active participation in class discussions, group activities and question-answer sessions.

Sr. No.	Reference Books

1.	Sharma R. & Krishna Mohan (2017), Business Correspondence and Report Writing, McGraw Hill Education
2.	P. D. Chaturvedi & Mukesh Chaturvedi (2013), Business Communication: Skills, Concepts & Applications, Pearson Publications, New Delhi, 3rd Edition, Seventh Impression
3.	K. K. Sinha (2006), Business Communication, 2nd Edition (Reprint), Galgotia Publishing, New Delhi
4.	Khera, S. (1998). "You Can Win: A Step by Step Tool for Top Achievers." New Delhi: Macmillan Publishers India.
5.	Covey, S. R. (2004). "The 7 Habits of Highly Effective People." New York: Free Press.
6.	Carnegie, D. (2009). "How to Win Friends and Influence People." New York: Pocket Books.
7.	Bradberry, T., & Greaves, J. (2009). "Emotional Intelligence 2.0." San Diego, CA: TalentSmart.
8.	Dweck, C. S. (2006). "Mindset: The New Psychology of Success." New York: Ballantine Books.

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B. Tech. (Food Technology), Part II, During Semester III</td></tr>
<tr><td>Course Code</td><td colspan="5">PBL211</td></tr>
<tr><td>Course Category</td><td colspan="5">Project Based Learning</td></tr>
<tr><td>Course Title</td><td colspan="5">Mini Project I & Industrial Visit</td></tr>
<tr><td>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>01</td><td>-</td><td>01</td><td>01</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="3">ISE: at Course in charge end</td><td></td><td></td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">-</td></tr>
<tr><td>Course Rational</td><td colspan="5">This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in mini projects and industrial visits, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena. The course aligns with NEP 2020's emphasis on experiential learning and Outcome Based Education (OBE) principles, ensuring graduates are equipped with the competencies needed to excel in the dynamic global workforce.</td></tr>
<tr><td>Course Objective</td><td colspan="5">The course teacher will ensure to-
1. Facilitate application of theoretical knowledge.
2. Guide the students about enhancement of practical skills.
3. Explain about development of industry-relevant competencies.</td></tr>
<tr><td>Course Outcome</td><td colspan="5">The students will be able to-
1. Demonstrate application of theoretical concepts with instructor guidance.
2. Collaborate effectively in instructor-led team-based projects.
3. Communicate findings and insights professionally under instructor supervision.</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	2	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

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

Course Description

Mini Project I and Industrial Visit is a dynamic course designed to bridge the gap between classroom learning and real-world application. Throughout the semester, all students will engage themselves in a series of mini projects that challenge them to apply theoretical concepts learned in previous courses to solve practical problems. These projects, conducted in small groups, will cover a range of topics relevant to their field of study, allowing students to explore different facets of their discipline and develop versatile skill sets.

Complementing the mini projects, students will participate in an industrial visit to domain relevant organizations in nearby regions, providing first hand exposure to industry operations, practices, and challenges. These visits will offer valuable insights into the application of theoretical knowledge in real-world settings, helping students understand the relevance and implications of their academic studies.

The course structure is carefully crafted to align with NEP 2020 and Outcome Based Education principles, emphasizing experiential learning, competency development, and holistic skill enhancement. Through active participation in mini projects and industrial visits, students will not only deepen their understanding of academic concepts but also cultivate essential soft skills such as teamwork, problem-solving, and effective communication.

Each week, students will dedicate one hour to course activities, including project discussions, progress updates, and preparation for industrial visits. Faculty guidance and mentorship will be provided to support students throughout their project work and industrial experiences, ensuring they maximize their learning outcomes and derive meaningful insights from their engagements.

By the end of the semester, students will emerge with a comprehensive understanding of how theoretical knowledge translates into practical applications within the industry, equipping them with the competencies and confidence to thrive in their future careers.

Course Assessment Process

The course evaluation will be at the course teacher end. The teachers will follow the instructions as below:

Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:

- Rubric-based assessment for mini projects and industrial visit reports.
- Peer evaluation for team-based projects.
- Written exams or quizzes to assess theoretical knowledge.
- Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
- Overall course grading based on a weighted average of individual assessments and participation.

The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

Reference Books:

Burns, P. (2022). *Entrepreneurship and small business*. Bloomsbury Publishing.
Fried-Booth, D. L. (2002). *Project work*. Oxford University Press.
Mahadevan, B. (2015). *Operations management: Theory and practice*. Pearson Education India.
Blumberg, B., Cooper, D., & Schindler, P. (2014). *EBOOK: Business research methods*. McGraw Hill.
Troller, J. A. (2012). *Sanitation in food processing*. Academic Press.

Suggested Reference Links:

https://www.ficsi.in
https://cftri.res.in/
https://www.indianspices.com

Additional students can search on you-tube for the following key words:

1. Food Processing Mini Projects"
2. Food Processing Industrial Visits"
3. "Hands-on Projects for Food Processing “
4. "Industrial Visits in Food Processing Industries"

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B.Tech (Food Technology), Part I, Semester IV</td></tr>
<tr><td>Course Code</td><td colspan="5">HSMEC 211</td></tr>
<tr><td>Course Category</td><td colspan="5">Humanities, Social Sciences, Management, Environment</td></tr>
<tr><td>Course title</td><td colspan="5">Environmental Studies</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>-</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">ISE:00</td><td colspan="2">ESE: 50</td><td>50</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="5">Knowledge of Basic Environmental Science</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The course is all about learning the way we should live and how we can develop sustainable strategies to protect the environment. It helps individuals to develop an understanding of living and physical environment and how to resolve challenging environmental issues affecting nature.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Introduce students to the fundamental concepts and principles of environmental science.
2. Describe the components of various ecosystems and their interrelationships.
3. Classify different types of natural resources and assess their availability and distribution.
4. Define biodiversity and its significance to ecosystem functioning and human well-being.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">The students will be able to-
1. Define key terms and concepts related to environmental science.
2. Analyse ecosystem services and their importance to human well-being.
3. Identify various types of natural resources and their significance.
4. Describe the levels and patterns of biodiversity and their importance.</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	2	-	-	-	-	3	3	-	-	-	-
CO 2	-	3	3	-	-	-	3	3	3	2	-	-
CO 3	-	2	3	-	-	-	3	3	3	3	-	-
CO 4	-	2	-	-	-	-	3	3	3	3	-	-

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

Unit No.	Course Content	Hours
I.	**Nature of Environmental Science:** Definition, scope and importance. Multidisciplinary nature of environmental studies Need for public awareness. Introduction to sustainable development: Sustainable Development Goals (SDGs) -targets and indicators, challenges and strategies for SDGs.	04
II.	**Ecosystem:** Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession. Food chains, food webs and ecological pyramids, Introduction, types, characteristics features, structure and function of theFollowing ecosystem: -Forest ecosystem, b) Grassland ecosystem, c) Desert ecosystem, d) Aquaticecosystems (ponds, streams, lakes, rivers, oceans, estuaries) Degradation of ecosystems and its impacts.	06
III.	**Natural Resources and Associated Problems:** Overview of natural resources: Definition of resource; Classification of natural resources-biotic and abiotic, renewable and non-renewable. Forest resources: Use and over-exploitation, deforestation, dams and their effectson forests and tribal people. Water resources: Use and over-utilization of surface and ground water, floods,drought, conflicts over water, dams-benefits and problems. Water scarcity and stress; Conflicts over water. Soil and Mineral resources: Soil as resource and its degradation, Usage and exploitation, Environmental effects of extracting and using mineral resources.,Wasteland reclamation, Energy resources: Growing energy needs, renewable and non- renewable energy resources, use of alternate energy sources. Solar energy, Biomass energy, Nuclearenergy, Role of Indian traditions and culture in conservation of the environment	08
IV.	**Biodiversity and its conservation:** Introduction- Definition: genetic, species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: consumptive use,	06

	productive use, social, ethical, aesthetic and option values, India as a mega-diversity nation. Western Ghats as a biodiversity region. Hot-spots of biodiversity, Threats to biodiversity habitat loss,poaching of wildlife, man- wildlife, Conflicts, Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation Ramsar sites; Biosphere reserves; Protected Areas; Ecologically Sensitive Areas; CoastalRegulation Zone;	
	Nature Visits / Field Work /Field Tour/ Industrial visits / Activities related to Campus environmental management (05 Hrs.)	
Sr. No.	**Suggested Text Books:**	
1.	Agarwal, K. C., 2001, Environmental Biology, Nidi Publ. Ltd., Bikaner.	
2.	Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad, 380013, India.	
3.	Brunner R. C., 1989, Hazardous Waste Incineration, McGraw Hill Inc,	
Sr. No.	**Suggested Reference Books:**	
1.	Cunningham, W. P. Cooper, T. H. Gorhani, E. & Hepworth, M. T. ,2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai,	
2.	Gleick, H., 1993, Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute. Oxford Univ. Press.	
3.	Hawkins R. e., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R).	
4.	Heywood, V. H. & Watson, R. T., 1995, Global Biodiversity Assessment, Cambridge Univ. Press.	
5.	Jadhav, H. & Bhosale, V. M., 1995, Environmental Protection and Laws, Himalaya Pub. House, Delhi.	
6.	Mckinney, M. L. & Schocl. R. M. ,1996, Environmental Science Systems & Solutions, Web enhanced edition.	
7.	Odum, E. P., 1971, Fundamentals of Ecology, W. B. Saunders Co. USA.	
8.	Rao M. N. & Datta, A. K. ,1987, Waste Water Treatment, Oxford & IBH Publ. Co. Pvt. Ltd.	
9.	Sharma B. K., 2001, Environmental Chemistry, Goel Publ. House, Meerut.	
10.	Trivedi R. K. and P. K. Goel, Introduction to air pollution Techno-Science Publications (TB).	
11.	Trivedi R. K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media (R).	
12.	Wagner K. D., 1998, Environmental Management, W. B. Saunders Co. Philadelphia, USA.	
Sr. No.	**Suggested Reference Links:**	
1.	https://onlinecourses.swayam2.ac.in/cec19_bt03/preview	
2.	http://nitttrc.edu.in/nptel/courses/video/109105203/L41.html	

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B.Tech (Food Technology), Part I, Semester IV</td></tr>
<tr><td>Course Code</td><td colspan="5">BSC 221</td></tr>
<tr><td>Course Category</td><td colspan="5">Basic Science Course</td></tr>
<tr><td>Course title</td><td colspan="5">Food Microbiology (Theory)</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:30</td><td colspan="2">ESE: 70</td><td>100</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="5">Knowledge of basic science</td></tr>
<tr><td>Course Rationale</td><td colspan="5">This course covers the characteristic of microbial growth, intrinsic and extrinsic factors and their relationship to microbial growth. The role of microorganisms and food spoilage; pathogenic microorganisms, infection and intoxication, mycotoxin, viruses and parasites; the principles to control microbial growth. Microorganisms are also responsible for food spoilage and food poisoning which result in loss of food products and also cause damage to human and animal health causing health and economic losses.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Describe general principles of food microbiology and understanding the various microbes associated with food and food groups.
2. Explain the roleof microbes in food spoilage and food preservation.
3. Detect pathogens in food.
4. Beneficial role of microorganisms in fermented foods and in food processing.
5. Explain the various activities of microorganisms as they relate to food spoilage and food poisoning, food processing and preservation.
6. Utilize laboratory techniques to detect, quantify, and identify microorganisms infoods.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">The students will be able to-
1. Investigate pathogens in food.
2. Evaluate laboratory techniques to detect, quantify, and identify microorganisms in foods.
3. Analyze the various microbes associated with food andfood groups and aware with the basic information of food microbiology.
4. Apply thetheories and principles of food microbiology in practical, real-world situations and problems.
5. Describe the beneficial role of microorganisms infermented foods and in food processing.
6. Remember the role of microbes in food spoilage and food</td></tr>
</table>

	preservation.

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

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

Unit No.	Course Content	Hours
I.	**Introduction to microbiology** Evaluation and Scope of microbiology. History of microbiology, General Microbiology, Cultural characteristics and reproduction of bacteria, yeasts, fungi, algae, protozoa and rickettsia. Genetic recombination, transduction, transformation and bacterial conjugation, mutation and mutagenesis.	07
II.	**Growth curve** Introduction, Microbial growth curve, Physical and Chemical factors affecting growth and destruction of micro-organisms. Intrinsic factors; pH, water activity, nutrients etc and Extrinsic factors: Relative humidity, temperature and gaseous atmosphere	06
II.	**Contamination, Preservation, and Spoilage of Different Kinds of Foods** Food spoilage**, Causes of Spoilage ,** Contamination, Preservation, and Spoilage of Cereals and Cereal Products, milk and milk products, fruit and Vegetable products,	06

	sugar and Sugar Products.	
V.	**Contamination, Preservation, and Spoilage of Different Kinds of Foods** Contamination, Preservation, and Spoilage of Meats and Meat Products, Fish and Other Sea foods, Eggs and poultry products, Spoilage of Heated Canned Foods, Miscellaneous Foods.	06
V.	**Food borne viruses** Viruses, Food borne viruses, types of food born viruses Structure and reproduction of food viruses. Polio, hepatitis A and E, noroviruses, rota viruses, prion diseases, types of food involved, toxicity and symptoms, **Detection Methods of Foodborne viruses.**	06
VI.	**Food poisoning** Introduction, symptoms, causes Intoxication, Food borne illness, Food poisoning and food borne infections.	05

Sr. No.	**Suggested Text Books:**
1.	Michael P. Doyle, Francisco Diez-Gonzalez, Colin Hill, (2019) Food Microbiology, Fundamentals and Frontiers. First edition.
2.	**Osman Erkmen, T. Faruk Bozoglu, (2016) Food Microbiology: Principles into Practice, John Wiley & Sons, Ltd Print ISBN:9781119237761, Online ISBN:9781119237860**
3.	Neelam Khetarpaul , (2022), Food Microbiology, Daya Publishing House,ISBN: 9788170355847.
4.	William C. Frazier and Dennis C. West off. (2017). Food Microbiology 5th Edition, McGraw Hill Education.
Sr.No.	**Suggested Reference Books:**
1.	Jay, J. M. (2005). Modern Food Microbiology. 4th ed. Chapman & Hall. New York, N.Y.
2.	Mossel, D.A.A., Corry, J. E. L., Struijk, C. B., and Baird, R. M. (1995). Essentials of the Microbiology of Foods. John Wiley & Sons. New York, NY.
3.	Bibek Ray (2005) Fundamental Food Microbiology, Third Edition, CRC PRESS Boca Raton London New York Washington, D.C.
Sr.No.	**Suggested Reference Links:**
1.	https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/food_technology/food_microbiology/23.meat_and_sea_foods_spoilage_/et/103_et_m23.pdf

2.	https://egyankosh.ac.in/bitstream/123456789/12422/1/Unit-1.pdf
3.	https://mis.alagappauniversity.ac.in/siteAdmin/dde-admin/uploads/2/PG_M.Sc._Microbiology_364%2023_Food%20and%20Dairy%20Microbiology.pdf

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B.Tech (Food Technology), Part I, Semester IV</td></tr>
<tr><td>Course Code</td><td colspan="5">BSC 221</td></tr>
<tr><td>Course Category</td><td colspan="5">Basic Science Course</td></tr>
<tr><td>Course title</td><td colspan="5">Food Microbiology (Practical)</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">Knowledge of basic science</td></tr>
<tr><td>Course Rationale</td><td colspan="5">This course covers the characteristics of microbial growth, intrinsic and extrinsic factors and their relationship to microbial growth. The role of microorganisms and food spoilage; pathogenic microorganisms, infection and intoxication, mycotoxin, viruses and parasites; the principles to control microbial growth; as well as qualitative and quantitative microbiological analysis. Microorganisms are also responsible for food spoilage and food poisoning which result in the loss of food products and also cause damage to human and animal health causing health and economic losses. Studying food microbiology and the effects of microbial contamination is vital to various food safety, production, processing, preservation, and storage aspects.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure that students will able to-
1. Understand isolation, characterization of various microbes associated with foods and food groups.
2. Familiarize with microbiological techniques for the study of foods.
3. Understand the activities of microorganisms in food.
4. Describe the characteristics of food borne, waterborne and spoilage microorganisms, and methods for their isolation, detection and identification.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">The students will be able to-
1. Understand isolation, characterization of various microbes associated with foods and food group.
2. Analyze the activities of microorganisms in food and detect and quantify the microorganisms present in food.
3. Describe the characteristics of food borne, water borne spoilage microorganisms, and methods for their isolation, detection and identification.
4. Familiarize with microbiological techniques for the study of foods.</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	3	3	3	2	2	2	1			1
CO 2	3	3	2	3	3	2	1	2	1	1	1	1
CO 3	3	3	2	3	3	2	2	2	1	1		
CO 4	3	2	3	3	3	3	3	1	1	2	3	1

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

Ex. No.	List of Experiments	Hours
1.	Study of instruments used for microbiology, cleaning and sterilization of glassware	02
2.	Preparation of media, techniques of incubation	02
3.	Staining methods (monochrome staining, gram staining, flagella staining, capsule staining and endo spore staining)	02
4.	Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in food products– TVC	02
5.	Experiments on pure culture techniques (streak plate/pour plate).	02
6.	Experiments on isolation of bacteria from food sample	02
7.	Experiments on microbial examination of water	02
8.	Experiments on microbial examination of different food products	02
9.	Experiments on microbial examination of fermented food	02
10.	Experiments on determination of Total Plate Count in food sample	02
11.	Experiments on detection and determination of Coliforms, and E.coli in different foods	02
12.	Experiments on determination of yeast and mold in food sample.	02
	Suggested Text Books	
1.	Frazier, W.C., and Westhoff, D.C. 1988. Food Microbiology, 4th ed. McGraw-Hill, New York.	
2.	Ahmed E. Yousef, Carolyn Carlstrom, (2003) Food Microbiology: A Laboratory Manual,John wiley and sons,Inc publication.	
3.	Purohit S. S. (2003). "Microbiology fundamentals and applications" Edition, 6. Publisher, Agrobios.	
4.	Bibek Ray (2005) Fundamental Food Microbiology, Third Edition, CRC PRESS Boca Raton London New York Washington, D.C.	
	Suggested Reference Books:	
1.	Jay, J. M. (2005). Modern Food Microbiology. 4th ed. Chapman & Hall. New York, N.Y.	
2.	Mossel, D.A.A., Corry, J. E. L., Struijk, C. B., and Baird, R. M. (1995). Essentials of the Microbiology of Foods. John Wiley & Sons. New York, NY.	
	Suggested Links	
1.	https://www.fssai.gov.in/upload/uploadfiles/files/Manual-Microbiology-Methods.pdf	
2.	https://www.icmrfoodnet.in/static/assets/ResearchPapers/FASSAI_MICROBIOLOGY_MANUAL-1.pdf	
3.	https://mis.alagappauniversity.ac.in/siteAdmin/dde-admin/uploads/2/PG_M.Sc._Microbiology_364%2023_Food%20and%20Dairy%20Microbiology.pdf	

Year, Program, Semester	Second Year B.Tech (Food Technology), Part II, Semester IV				
Course Code	PCC 221				
Course Category	Professional Core Course				
Course title	Food Process Engineering I (Theory)				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**		**ESE: 70**		**Total=100**
Pre-requisites (if any)	Knowledge of Principles of Food Preservation				
Course Rationale	The course deals with basic principles of food process engineering 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.				
Course Objectives	The course teacher will ensure to- 1. Explain the basic concepts of mass balance and energy balance with its applications in food processing 2. Describe the basic theory and concept involved in food processing unit operations. 3. Explain the working of various processing equipment with its application in food processing industries. 4. Enable the students to solve problems in food processing industries.				
Course Outcomes	The students will be able to- 1. Recognize the scope and need of the unit operations 2. Understand all unit operations and its applications in food processing 3. Apply the principles of mass and energy balance to food processing systems. 4. Analyze and solve issues with the working of the food processing equipment used for the different unit operations 5. Evaluate how various unit operations work individually and together 6. Design and construct the food processing equipment and operation/s.				

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	2	1	2	1	1	1	1	1
CO 2	3	3	3	3	2	1	2	2	2	2	2	1
CO 3	3	3	3	3	3	1					2	2

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

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

Unit No.	Course Content	Hours
I	**Mass balance & Energy balance and Size Reduction** Mass and energy balance, Unit operations in food engineering **Size Reduction** : Particle size analysis, equipment, application to food industries	06
II	**Mixing** Basic theory of solid–solid mixing, liquid-liquid mixing, equipment, applications to foodindustries.	06
III	**Filtration and Centrifugation** Filtration: Theory of filtration, industrial filters, applications to food industries Centrifugation: Theory of centrifugation, equipment, applications to food industries	06
IV	**Psychometric chart &Drying** The psychometric chart: construction and use of psychometric chart for food unit operations. Drying: Principles of drying, drying rate kinetics, Dehydration systems, and dehydration system design by mass and energy balance, drying time prediction.	07
V	**Evaporation** Principles of evaporation, types and selection of evaporators, Design of single and multiple effect evaporators, applications in food industries.	06
VI	**Extraction** Solvent extraction, leaching, equipment, applications for food industries	05

Sr. No.	***Suggested Text Books:***
1.	Rao, D. G. (2012). Fundamental of Food Engineering. PHI Learning Private Limited, NewDelhi.
2.	Singh, R.P., and Heldman, D.R. (2001). Introduction to Food Engineering, 3rd ed., AcademicPress, San Diego, CA. Academic Press publications. 69–78, 144–157.
3.	Geankoplis, C. J. (2002). Transport processes and unit operations. 3rd Edition. 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.	***Suggested Reference Books:***
1.	Treybal, R. E. (1981). Mass Transfer Operations. 3rd edition. McGraw Hill.
2.	Dennis, R.H. (1981). “Food Process Engineering. Academic Publishing and Press, King SaudUniversity.
3.	Rao, M.A. Syed S.H. Rizvi, and Ashim K. Datta. (2008). Engineering properties of foods.

	CRCPress.
4.	ZekiBer. (2018). Food Process Engineering and Technology. 3rdEdition. Academic Press.
5.	Sahay, K.M. and Singh, K. K. (2003). UNIT Operations in Agricultural Processing. Vikas Publishing House Pvt. Ltd., New Delhi.
Sr. No.	***Suggested Links:***
1	https://onlinecourses.nptel.ac.in/noc24_ag03/preview
2	http://rpaulsingh.com/course/index.html
3	https://encyclopedia.che.engin.umich.edu/dryers/

Year, Program, Semester	Second Year B.Tech (Food Technology), Part II, Semester IV				
Course Code	PCC 221				
Course Category	Professional Core Course				
Course title	Food Process Engineering I (Practical)				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	-	02	02	01
Evaluation Scheme	**IOE:50**		**EOE: 00**		**Total=50**
Pre-requisites (if any)	Knowledge of principles of food processing and preservation				
Course Rationale	The course deals with understanding and hands-on experience of various unit operations applied in food industries.				
Course Objectives	The course teacher will ensure to- 1. Understanding of the unit operations of food processing 2. Explaining the working of various processing equipment with its application in food processing industries. 3. Having the practical experience of all unit operations 4. Enabling students to solve problems in food processing industries.				
Course Outcomes	The students will be able to- 1. Understand basic principles and workings of the various mechanical operations of the food industry 2. Apply different unit operations in the food industry 3. Evaluate the performance of different equipment and accessories used in various unit operations 4. Analyse and solve issues with the working of the food processing equipment used for the different unit operations				

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	3	3					2			
CO 2	3	3	3	3					2			
CO 3	3	3	3	3					2			
CO 4	3	3	3	3					2			

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

Experiment No.	Experiment Title	Hours
1.	Experiment on Particle size analysis	02
2.	Study of various size reduction equipment	02
3.	Experiment on working of a hammer mill/ ball mill/ rod mill	02
4.	Experiment on working of mixer and determination of mixing index	02
5.	Experiment on study of plate and frame filter press	02
6.	Experiment on the determination of filtration rate constant	02
7.	Experiment on study of cream separators	02
8.	Experiment on cream separation	02
9.	Experiment on evaporation	02
10.	Experiment on determination of air properties by use of psychrometric chart	02
11.	Experiment on drying of food sample	02
12.	Experiment on Solvent extraction	02

Sr. No.	***Suggested Text Books:***
1.	Gustavo V Barbosa-Canovas, Li Ma, Blas J Barletta (1997)Food Engineering Laboratory Manual CRC Press
2.	Margarida Vieira, Peter Ho (2008)Experiments in Unit Operations and Processing of Foods, Springer Publication
3.	Rao, D. G. (2012). Fundamental of Food Engineering. PHI Learning Private Limited, NewDelhi
4.	Singh, R.P., and Heldman, D.R. (2001). Introduction to Food Engineering, 3rd ed., AcademicPress, San Diego, CA. Academic Press publications
Sr.No.	***Suggested Reference Books:***
1.	Treybal, R. E. (1981). Mass Transfer Operations. 3rd edition. McGraw Hill.
2.	Dennis, R.H. (1981). "Food Process Engineering. Academic Publishing and Press, King SaudUniversity.
3.	ZekiBer. (2018). Food Process Engineering and Technology. 3rdEdition. Academic Press.
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.	***Suggested Links:***
1	https://www.rpaulsingh.com/learning/virtual/virtual.html
2	http://rpaulsingh.com/course/index.html
3	https://encyclopedia.che.engin.umich.edu/dryers/

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B.Tech (Food Technology), Part I, Semester IV</td></tr>
<tr><td>Course Code</td><td colspan="5">PCC 222</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Core Course</td></tr>
<tr><td>Course title</td><td colspan="5">Food Additives and Contaminants (Theory)</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:30</td><td colspan="2">ESE: 70</td><td>Total=100</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="5">This course includes a foundational understanding of inorganic and organic chemistry concepts and Physics.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The Food Additives course is important as it educates individuals on the chemicals added to foods to keep them fresh, enhance the qualities like color, flavor, or texture, and other different types of additives.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Introduce the roles and functions of food additives in enhancing sensory attributes, preservation, and safety
2. Classify food additives and food Contaminants
3. Explore global regulatory frameworks governing the intentional use of food additives in the food industry
4. Describe the working principles of food additives, considering their chemical and physical mechanisms in different applications
5. Explain the applications of food additives in food processing, focusing on optimizing quality and shelf life
6. Helps to investigate the sources, types, and health implications of food contaminants in the food industry</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-
1. Demonstrate a comprehensive understanding of the diverse roles and functions of food additives
2. Classify food additives based on their intended purposes, identifying key categories and subcategories
3. Interpret and apply regulatory guidelines, ensuring compliance with international standards in the use of food additives
4. Analyze the working principles of food additives, linking their chemical properties to practical applications in food systems
5. Evaluate the impact of food additives on sensory attributes, preservation, and safety in various food products
6. Apply proficiency in analyzing and implementing strategies to minimize or eliminate contaminants, ensuring the production of safe and high-quality food products</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	2	2	3	3	3	1	1			1	1
CO 2	2	2	2	2	3	3				1	2	1
CO 3	2		2	2	3	2	2	1	1	1	1	
CO 4	3	2	2	2	3	2			1		1	2
CO 5	3	2	2	3	3	3	1		1		2	1
CO 6	2	3	2	2	2	3	1	1	1			1

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

Unit No.	Course Content	Hours
I	**Basics of Food Additives** • Introduction to Food Additives • Classification of Food Additives • Functions of Food Additives • Food Adulteration	**05**
II	**Acids, Chelating Agents, Antioxidants, and Antimicrobial Agents** • Sources, Working principle, functions and Applications of Buffers and Acidulants • Sources, Working principle, functions and Applications of Chelating agents • Sources, Working principle, functions and Applications of Antioxidants • Sources, Classification, functions and Applications of Antimicrobial Agents	**07**
III	**Emulsifiers, Hydrocolloids, Sweeteners, and Anticaking Agents** • Sources, Working principle, functions and Applications of Emulsifiers • Sources, Classification, Working principle, functions and Applications of Thickening Agents, Stabilizers and gelling agents • Sources, Classification, Working principle, functions and Applications of Sweeteners • Sources, Working principle, functions and Applications of Anticaking Agents	**07**
IV	**Preservatives, Bakery Additives** • Sources, Working principle, functions and Applications of Flour bleaching agents and Bread Improvers • Sources, Classification, Working principle, functions and Applications of Preservatives • Sources, Working principle, functions and Applications of Firming Agents	**07**
V	**Colour and Flavours** • Sources, Classification, functions and Applications of Colours	**05**

	• Sources, Classification, functions and Applications of Flavours	
VI	**Contaminants** • Introduction to contaminants • Classification of Contaminants • Safety evaluation using traditional and modern approach contaminants	**05**

Sr. No.	**Reference Books/ Text Books**
1.	Furia,T. E., (1980). Handbook of Food Additives, CRC Press, Boca Raton, Flor.
2.	Branen, A. F. et al (2001). Food Additive s, 2nd Edition, Marcel. Dekker.
3.	Msagati, T. A. (2013). The chemistry of food additives and preservatives. Wiley-Blackwell.
4.	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.
5.	Saltmarsh, M. (Ed.). (2020). Saltmarsh's Essential Guide to Food Additives. Royal Society of Chemistry
Sr. No.	**Important web links**
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/results?search_query=Food+Additives+Animated

Year, Program, Semester	Second Year B.Tech (Food Technology), Part I, Semester IV				
Course Code	PCC 222				
Course Category	Professional Core Course				
Course title	Food Additives and Contaminants (Practical)				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	-	02	02	01
Evaluation Scheme	**IOE = 00**			**EOE = 50**	**Total=50**
Pre-requisites (if any)	This course include a foundational understanding of inorganic and organic chemistry concepts and Physics.				
Course Rationale	The Food Additives course is important as it educates individuals on the chemicals added to foods to keep them fresh, enhance the qualities like color, flavor, or texture, and other different types of additives.				
Course Objectives	The course teacher will ensure to- 1. Apply theoretical knowledge to hands-on experiments, assessing the functionality and effects of various food additives. 2. Develop practical skills in quantifying and analyzing food additives using laboratory techniques. 3. Adhere to safety protocols while conducting food additives experiments. 4. Interpret and communicate experimental results, linking practical findings to real-world applications.				
Course Outcomes	By the end of the course, the students will be able to- 1. Demonstrate proficiency in conducting practical experiments to assess the roles and functions of diverse food additives. 2. Master the use of laboratory techniques for quantifying and analyzing different types of food additives. 3. Implement safety measures effectively, ensuring a secure environment during food additives practical sessions. 4. Communicate and interpret experimental results, fostering a practical understanding of the applications and implications of food additives in the food industry.				

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	1			1
CO 3	2	2	2	3	3	1			1	2		1

CO 4	3	2	2	3	3	2			1	1		1

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

Ex. No.	List of Experiments	Hours
1.	Write the applications of additives used in given food products	02
2.	Detection/Estimation of adulterants in some foods	02
3.	Effect of Acidulants in food products	02
4.	Effect of thickener in food products	02
5.	Effect of Gelling agents in food products	02
6.	Effect of natural sweeteners/ artificial sweeteners in food products	02
7.	Effect of emulsifier in food products	02
8.	Effect of bread improvers in bread	02
9.	Effect of Flavours in food products	02
10.	Effect of Colours in food products	02
11.	Estimation of Sodium Benzoate Percentage	02
12.	Estimation of Salt Percentage	02
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.	
Sr. No.	**Important web links**	
1.	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=NuAs6SreCGryddEfs4kkBA==	
2.	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=iWHzbXYGExXDS52DSnAzdQ==	

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B.Tech (Food Technology), Part II, During Semester III & IV</td></tr>
<tr><td>Course Code</td><td colspan="5">PCC 223</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Core Course</td></tr>
<tr><td>Course title</td><td colspan="5">Heat Transfer (Theory)</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:30</td><td colspan="2">ESE: 70</td><td>Total=100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Knowledge of Engineering Physics, Engineering Mathematics I and Engineering Mathematics II</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The course is prepared to provide the detailed understating of heat transfer principles, numerical analysis, and heat exchanger and evaporation process.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Understand modes of heat transfer and formulate the equations for calculating heat rate of conduction.
2. Derive the empirical equations of free or forced convection for different fluid flow.
3. Derive expressions related to the heat flow in fluids and analyze a heat exchanger.
4. Explain the basic rules of heat transfer to fluids with phase change.
5. understand phase-change phenomena and latent heat of vaporization, including free convective, nucleate and film boiling, as well as drop wise and film condensation.
6. Design and analyze heat transfer equipment and to further make selection of heat exchangers.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">The students will be able to-
1. Analyze and evaluate the radiation heat transfer between two bodies.
2. Interpret and analyze evaporation process to heat transfer.
3. recognize the key parameters which affect the convective heat transfer mode either forced or free convection
4. Identify the various mechanisms of heat transfer and formulate models to solve one- dimension steady state heat conduction process.
5. Calculate overall heat transfer coefficient for a heat exchanger.
6. Perform design of heat exchange equipment.</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	2	2	2	2						
CO 2	1		1	2	1	3	2	2				
CO 3	1	2		3	2	1	1	1				
CO 4	1	1	3	2	3	1	3					
CO 5	1		1		1	1	1					
CO 6	1	2	3	3		2						

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

Unit No.	Course Content	Hours
I	**Conduction:** • Basic concepts of conduction in solids, liquids and gases • Fourier law of heat conduction. Material properties of importance in heat transfer: • Thermal conductivity • Specific heat capacity. • General equation of heat conduction in cartesian co-ordinate, • heat conduction through plane and composite walls, cylinders and spheres • Critical and optimum insulation thickness. • Principles of convection, Newton's law of cooling.	06
II	**Convection:** • Types of convection and relationship between individual and overall heat transfer coefficient, dimensional co-relation for convective heat transfer, fouling factors. • Forced convection: In laminar Flow-Heat transfer in plate and tubes. In turbulent Flow-Empirical equations for individual coefficients: inside tubes, outside tubes, outside bundle of tubes, flow past spheres. • Significance of Prandtl number, Nusselt number, Grashof number, Graetz number and Peclet number etc. • Correction for tube length. • Corrections for heating and cooling the fluid. • Various analogies between heat & momentum transfer, Problems.	06
III	**Radiation:** • Basic laws of heat transfer by radiation, • Absorptivity, • reflectivity and • transmissivity, • black, white and grey body, • emissive power and emissivity,	06

	• laws of • Radiation – Planck, Stefan-Boltzmann, Wien's displacement, Kirchhoff's law.	
IV	**Heat transfer with phase change:** • Boiling of liquids, • Pool boiling curve, • different types of pool boiling, • Condensation of vapour, • film wise and drop wise condensation, • Energy balance.	**06**
V	**Heat Exchange equipment**: • Heat exchange equipment's and its classification, • LMTD-LMTD correction factors and Flow arrangements in heat exchanger. • Shell and tube heat exchanger, • double pipe, • plate type, • Graphite block, • fin tube heat exchanger.	**06**
VI	**Evaporation:** • Introduction of Evaporation • capacity • steam economy • material and enthalpy balance for single effect evaporators • Classification and application of evaporators.	**06**

Sr.No.	**Reference Books**
1.	McCabe, W. L., Smith, J. C.and Harriott, P. (2005). Unit Operations of Chemical Engineering. 7 th Edition. McGraw Hill.
2.	Lienhard, John H. (2011). A Heat Transfer Textbook.4th Edition., Dover Publications Inc.
3.	J. P. Holman. Heat Transfer.10th Edition. McGraw Hill.
Sr.No.	**Suggested Reference Books:**
1.	McAdams, W. H. Heat Transmission.3rd Edition. McGraw Hill.
2.	Kern, D. Q. Process Heat Transfer. 1st Edition. McGraw Hill.
3.	Don W. Green, Robert H. Perry. Perry's Chemical Engineer's Handbook. 8th Edition. McGraw-Hill: New York.
4.	Warren, M. Rohsenow, James, P. Hartnett and Young I. Cho (1998). Handbook of Heat Transfer, McGraw-Hill Education: New York.
Sr.No	**Weblinks**
1.	https://www.anadolu.edu.tr/en/academics/faculties/course/99023/heat-transfer/

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B. Tech (Food Technology), Part I, Semester IV</td></tr>
<tr><td>Course Code</td><td colspan="5">PCC 224</td></tr>
<tr><td>Course Category</td><td colspan="5">Professional Core Course</td></tr>
<tr><td>Course title</td><td colspan="5">Dairy Technology (Theory)</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:30</td><td colspan="2">ESE: 70</td><td>100</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="5">Knowledge of Food Process Eng. I and II, Food Chemistry, Food Biochemistry, Food Microbiology</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The course is all about a science and engineering field that deals with the study of milk processing and its products. It is part of processing industry that involves processing, packaging, distribution and transportation of various dairy products such as milk, ice-cream, cheese, butter and various indigenous products including dahi, buttermilk, ghee, channa, channa-based sweets, paneer, khoa etc.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Explain knowledge and technical proficiency in Clean milk production and handling Processing of milk Manufacture of western and indigenous dairy products Testing and quality control of milk and milk products
2. Describe emphasis on the principles of operation of equipment used in the milk processing industry
3. Illustrate the principles of handling and processing of milk and milk products
4. Explain Engineering principle and concepts to handle store and process of milk and milk products
5. Categorize the role of information about the importance of quality control in dairy industry
6. Demonstration of Hygiene, Sanitation & cleaning in Dairy Industry</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">The students will be able to-
1.Explain processes involved in production of milk and milk products
2. Classify and explain the different types of milk products
3. Identify purpose and functions of hygiene in dairy industry
4. Analyze flow chart for the production processes of various milk products
5. Explain and Relate organization and operations involved in milk processing unit also precautions that should be taken when processing</td></tr>
</table>

	milk and dairy products 6. Understand the application of different unit operations performed in milk processing industry.

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

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

Unit No.	Course Content	Hours
I.	**Introduction to Dairy Industry** Advances in milking process, Developmental history of dairy industry in India, future Prospectus of Indian dairy industry & milk products & National milk quality survey	04
II.	**Quality & Safety in Dairy Industry** Definition of milk, composition of milk from different species, Colostrums, Nutritive value of milk and milk products. Physico – Chemical properties of milk. Quality evaluation of milk products, Testing of market milk, Adulteration of milk & milk products, Prevention of milk products from spoilage	07
III.	**Modern Development in Preservation of Milk & Milk Products** Collection, Processing: Pasteurization and sterilization of milk, Distribution of milk, Dairy equipment's Pasteurization, Homogenization, UHT, HTST, LTLT, Spry Drying, Fermentation, Coagulation, Freezing.	08
IV.	**Innovative Technology for Dairy Products** Butter and butter oil (Ghee), yoghurt and cheese: Classification, manufacturing process and quality controls, Ice-cream: Types of ice creams and manufacturing process**,** Dahi, Khoa, Channa, Shrikhand, Paneer, Lassi, Butter milk, Rasgolla, Pedha and Burfi Atomization of traditional dairy sweets, Packaging technology for extending shelf life	08

V.	**Condensation & Evaporation of milk** Condensed milk, Kheer, Basundi, Milk powder: Skim milk powder and whole milk powder,	05
VI.	**Hygiene & Sanitation in Dairy Industry** Hygiene & Sanitization practices in dairy industry CIP pro different dairy processing machineries, effective methods of cleaning dairy equipment	04
Sr. No.	**Suggested Text Books:**	
1.	Sukumar De. Outlines of Dairy Technology, Oxford University Press. 2001	
2.	**Walter**, P., **Wouters**, J. T. M., **Geurts**, T. J., *Dairy science and technology*, Taylor & Francis, Boca Raton, USA, 2006.	
3.	Webb B. H. & Whittier E. O "By-products from milk", AVI publishing Co., Connecticut,1970	
Sr. No.	**Suggested Reference Books:**	
1.	Garret Smit. G., Dairy Processing. Woodhead Publishing Limited, England. 2005.	
2.	Edger Spreer: Milk and Dairy Product Technology Marcel Dekkar Inc. New York, USA (2005).	
3.	James N. Warner "Principles of Dairy Processing" ,Wiley Eastern Ltd.	
1.	Eckles, Combs and Macy "Milk and Milk Products", Tata McGraw Hill.	
Sr. No.	**Suggested Reference Links:**	
1.	IndiaDairy.com-https://indiaDairy.com	
2.	National Dairy Council-https:/nationaldairycouncil.org/	
3.	https://www.nddb.coop/	

Year, Program, Semester	Second Year B.Tech (Food Technology), Part I, Semester IV				
Course Code	PCC 224				
Course Category	Professional Core Course				
Course title	Dairy Technology (Practical)				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	-	02	02	01
Evaluation Scheme	**IOE = 50**			**EPE = 50**	**Total=100**
Pre-requisites (if any)	Knowledge of Food Process Eng. I and II, Food Chemistry and Food Microbiology				
Course Rationale	The course is all about learning the way we should evaluate sampling, analysis and standardization of milk. It helps to determine and understanding of micro and macro nutrients and their requirement for human body. It helps to understand of processing of milk and various milk products. The course is all about learning of purpose and functions of hygiene in dairy industry				
Course Objectives	The course teacher will ensure to- 1. Describe the knowledge of analytical skills of milk and milk products 2. Elaborate students to starter culture technology and selection of starters for production of different dairy products. 3. Describe latest developments in milk processing technologies 4. . Explain exposure of different equipment's used in dairy industry 5. Determine and inculcate the practical proficiency in a Milk and milk processing laboratory. Also introduce the students to latest developments in milk processing technologies and new product development				
Course Outcomes	The students will be able to- 1. Explain processes involved in production of milk and milk products 2. Classify and explain the different types of milk products 3. Understand purpose and functions of hygiene in dairy industry 4. Produce and explain flow chart for the production processes of various milk products 5. Recognize organization and operations involved in milk processing and Precautions that should be taken when processing milk and dairy 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	1	3	2	1	1	2	1			1

CO 2	3	1	1	3	2	1	1	2	1			1
CO 3	2	2	2	3	3	1			1	2		1
CO 4	3	2	2	3	3	2			1	1		1

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

Ex. No.	**List of Experiments**	**Hours**
1.	Sampling and analysis of milk – physio-chemical properties and composition	02
2.	DMC and DYC reduction tests, presence of adulterants and preservatives.	02
3.	Standardization of milk for markets.	02
4.	Clarification and separation of milk.	02
5.	Preparation of butter and ghee	02
6.	Ice-cream preparation	02
7.	Preparation of dahi, shrikhand, lassi etc.	02
8.	Preparation of khoa and khoa based sweets.	02
9.	Preparation of channa, paneer and chana based sweets	02
10.	Visit to Dairy plant	02
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.	
	Suggested Reference Links:	
1.	https://www.nddb.coop/	

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B.Tech (Food Technology), Part I, Semester IV</td></tr>
<tr><td>Course Code</td><td colspan="5">IKS221</td></tr>
<tr><td>Course Category</td><td colspan="5">Indian Knowledge Systems</td></tr>
<tr><td>Course title</td><td colspan="5">Introduction to Performing Arts (Theory)</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>01</td><td>-</td><td>-</td><td>01</td><td>01</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">ISE:50</td><td colspan="2">ESE: 00</td><td>50</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="5">This course includes area of the general education curriculum encourages students to explore how the humanities and fine arts can illuminate our world and the experience of being human. For as long as humans have been on Earth, they have recorded their experiences through literature, art, music, philosophy, language, and other subjects. The study of human experience is essential to make sense of our contemporary world and our place in it.</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The course "Introduction to Performing Arts" seeks to broaden the horizons of engineering students by integrating the rich and diverse realm of performing arts into their curriculum. By exploring various performing arts forms, students will not only develop a deeper understanding of human expression but also enhance their creativity, communication skills, and cultural awareness. This interdisciplinary approach aligns with NEP 2020's vision of holistic education and fosters the development of well-rounded individuals equipped to thrive in a rapidly evolving world.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure
1. Introduce fundamental concepts, history, and theoretical frameworks of various performing arts forms.
2. Cultivate appreciation for cultural, social, and aesthetic dimensions of performing arts.
3. Develop critical thinking and analytical skills through performance analysis.
4. Enhance communication and presentation skills through practical exercises.
5. Foster creativity and imagination through exploration of diverse performing arts mediums.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">The students will be able to
1. Identify and analyse key elements and techniques across theatre, dance, music, and visual arts.</td></tr>
</table>

	2. Demonstrate understanding of historical, cultural, and social contexts in performing arts. 3. Critically evaluate performances using appropriate terminology. 4. Apply performance principles to effectively communicate ideas and emotions. 5. Engage in creative expression through original performances.

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	2	-	2	-	2	-	-	-	-	-
CO 2	-	-	-	-	-	3	2	-	-	-	-	-
CO 3	-	-	-	-	-	-	2	-	3	3	-	-
CO 4	-	-	-	-	-	2	-	2	3	3	-	-
CO 5	-	-	-	-	-	-	-	-	-	-	3	-
CO 6												

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

Unit No.	Course Content	Hours
I	**Foundations of Performing Arts** • Introduction to Performing Arts: Definition, scope, and significance. • Historical overview: Evolution of performing arts across cultures and civilizations.	02
II	**Theatrical Arts** • Introduction to theater: Origins, elements, and dramatic conventions. • Major theatrical movements and styles: Realism, surrealism, absurdism, etc. • Analysis of selected plays and playwrights.	03
III	**Dance Forms** • Introduction to dance: Styles, techniques, and cultural contexts. • Exploration of classical, folk, and contemporary dance forms. • Practical exercises and choreography workshops.	02
IV	**Musical Expressions**	02

	• Introduction to music: Basic principles, genres, and traditions. • Appreciation of classical, folk, and popular music styles. • Analysis of musical compositions and performances.	
V	**Visual Performing Arts** • Introduction to visual arts in performance: Set design, costume, and makeup. • Role of visual elements in enhancing the theatrical experience. • Case studies and practical demonstrations.	02
VI	**Performance and Presentation** • Practical application of performing arts principles: Group performances and presentations. • Rehearsal techniques, stage presence, and audience engagement. • Reflection and feedback on individual and group performances.	02

Course Assessment Method

For the internal assessment of the course, with a total evaluation is of 50 marks. Combination of different evaluation methods can be utilized to ensure a comprehensive assessment of the students' performance. Following Evaluation Components are suggested:

- Written Assignments: 20 Marks
- Practical Assessments: 20 Marks
- Class Participation and Engagement: 10 Marks

Sr. No.	**Reference Books**
1.	Bharata Muni, *Natyashastra*, An ancient Indian treatise on performing arts covering various aspects of classical dance, music, and drama, composed between 200 BCE and 200 CE, influencing the theory and practice of Indian performing arts for centuries.
2.	Girish Karnad. (2005). Collected Plays: Volume 1. Oxford University Press.
3.	Mohan Khokar. (2000). Traditions of Indian Classical Dance. Clarion Books.
4.	Sunil Kothari. (2001). Kathak, Indian Classical Dance Art. Abhinav Publications.
5.	Sangeet Natak Akademi. (2005). Indian Music: Tradition and Trends. Sangeet Natak Akademi.
6.	P. Sambamurthy. (2010). South Indian Music, Vol. 1. The Indian Music Publishing House.
7.	Kapila Vatsyayan. (2007). Indian Classical Dance: Tradition in Transition. Publications Division, Ministry of Information and Broadcasting, Government of India.
8.	Vijay Tendulkar. (2010). Collected Plays in Translation. Oxford University Press.

Sr.No.	Links
1.	https://www.youtube.com/watch?v=W7bEzgZrN7s
2.	https://www.youtube.com/watch?v=DQbNpx_CfJY
3.	https://www.youtube.com/watch?v=eGiz50aVYWQ

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B.Tech (Food Technology), Part I, Semester IV</td></tr>
<tr><td>Course Code</td><td colspan="5">MAC 222</td></tr>
<tr><td>Course Category</td><td colspan="5">Mandatory Audit Course</td></tr>
<tr><td>Course title</td><td colspan="5">Aptitude Enhancement Course I</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>01</td><td>-</td><td>01</td><td>01</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="5">ISE at the course in charge end</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="5">NA</td></tr>
<tr><td>Course Rationale</td><td colspan="5">This Aptitude Enhancement Course I aims to nurture holistic development among second-year B. Tech. Engineering students by focusing on enhancing their critical thinking, problem-solving skills, creativity, and emotional intelligence. Aligned with the NEP 2020 and Outcome-Based Education (OBE) philosophy, the course seeks to empower students with the essential aptitudes required for success in both academic and professional domains.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure
1. Equip students with critical thinking skills through analytical exercises and problem-solving tasks.
2. Foster creativity and innovation by engaging students in structured workshops and practical projects.
3. Develop students' emotional intelligence through self-awareness activities and stress management techniques.
4. Enhance collaborative skills and effective communication through group discussions and team-based projects.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">The students will be able to
1. Demonstrate proficiency in critical thinking by analysing complex problems and proposing effective solutions.
2. Exhibit creativity through the development of innovative projects and solutions.
3. Display heightened emotional intelligence by managing stress, communicating empathetically, and resolving conflicts constructively.
4. Showcase collaborative skills by actively participating in group activities, contributing to team goals, and communicating ideas effectively.</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	-	-
CO 2	-	2	-	-	2	1	-	-	-	-	-	-
CO 3	-	-	-	-	-	3	2	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	3	3	2	1

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

Sr. No.	Course Content	Hours
1.	Inter-Personal & Inter-Organizational Communication.	02
2.	Creative & Critical Thinking.	02
3.	Group Dynamics & Decision-Making Techniques.	02
4.	Emotional Intelligence & Stress Management Strategies.	03
5.	Assessment.	04
6.	Inter-Personal & Inter-Organizational Communication.	02

Course Assessment Method

For the internal assessment of the course, with a total evaluation is of 50 marks. Combination of different evaluation methods can be utilized to ensure comprehensive assessment of the students' performance. The assessment will focus real-world scenarios that require the application of critical thinking, problem-solving, creativity, emotional intelligence, and teamwork.

Following Evaluation Components are suggested:

1.Activity 1- Group Presentation (20 marks)

2.Activity 2- Group Discussion (20 marks)

3.Classroom Participation and Engagement (10 marks)

Active participation in class discussions, group activities and question-answer sessions.

Sr. No.	Reference Books
1.	Chakravarthi T. Kalyana and Chakravarthi T. Latha, 2014, Soft Skills for Managers (Biztantra Publications, (ISBN: 978-81-7722-568-6)
2.	Kumar Sanjay and Pushp Lata, (2015), *Communication Skills*, 2nd Edition, Oxford University Press, (ISBN: 9780199457069)

3.	P. D. Chaturvedi and Mukesh Chaturvedi, (2017), The Art and Science of Business Communication- Skills, Concepts, Cases and Applications, 4th Edition, Pearson India Education Services Pvt. Ltd., (ISBN 978-93-325-8728-1)
4.	Wright. L., (2001), Critical Thinking: An Introduction to Analytical Reading and Reasoning. Oxford University Press.
5.	Kallet, M., (2014), Think Smarter: Critical Thinking to Improve Problem-Solving and Decision-Making Skills. Wiley.
6.	Bradberry, T., & Greaves, J., (2009), Emotional Intelligence 2.0. TalentSmart.
7.	Dweck, C. S., (2007), Mindset: The New Psychology of Success. Ballantine Books.

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B.Tech (Food Technology), Part I, Semester IV</td></tr>
<tr><td>Course Code</td><td colspan="5">PBL 221</td></tr>
<tr><td>Course Category</td><td colspan="5">Project Base Learning</td></tr>
<tr><td>Course title</td><td colspan="5">Mini Project II & Industrial Visit</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>01</td><td>-</td><td>01</td><td>01</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="5">ISE at the course in charge end</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="5">Thorough revision of all the courses studied till Semester III with a vigor to undertake small survey type of project work</td></tr>
<tr><td>Course Rationale</td><td colspan="5">Mini Project II and Industrial Visit provide students with an opportunity to further develop and apply the knowledge and skills acquired in their previous coursework. It allows them to engage in hands-on experiential learning through project activities and real-world exposure gained from industrial visits. This course aims to bridge the gap between theoretical learning and practical application, fostering a deeper understanding of Food Processing principles and practices in industrial settings.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Enhance students' understanding of real-world Food Processing Industries through industrial visits.
2. Provide students with an opportunity to apply theoretical knowledge to practical projects effectively.
3. Develop students' skills in problem-solving, teamwork, and project management.
4. Encourage critical thinking and innovation in approaching engineering challenges.
5. Cultivate professional ethics and attitudes essential for the workplace environment.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">The students will be able to-
1. Analyse and evaluate Food Processing Industries observed during industrial visits.
2. Apply theoretical concepts to practical projects, showcasing proficiency in problem-solving and decision-making.
3. Collaborate effectively with team members to achieve project objectives within specified timelines.
4. Demonstrate innovation and creativity in proposing solutions to engineering problems encountered during project activities.</td></tr>
</table>

	5. Exhibit professional conduct and ethical behaviour in interactions with industry professionals during industrial visits.

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	-	-	-	-	-
CO 2	3	3	-	-	3	1	-	-	2	-	-	-
CO 3	-	3	-	-	3	3	-	-	3	-	3	-
CO4	-	3	-	3	2	-	-	-	1	-	-	2
CO5	-	-	-	-	-	2	-	3	2	2	-	2

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

Course Content
Mini Project II and Industrial Visit is a continuation of the experiential learning journey initiated in Semester III. Building upon the foundations laid in Mini Project I and the previous industrial visit, students will delve deeper into project activities related to their chosen area of interest within Food Processing Sector. The course encompasses two main components: 1. **Mini Project II:** Students will continue their project activities from the preceding semester, further refining their research objectives, conducting experiments, analyzing data, and presenting findings. Emphasis will be placed on applying advanced concepts and techniques to address specific challenges or opportunities identified in the chosen project area. 2. **Industrial Visit:** Students will participate in guided tours to various industrial facilities relevant to Food Processing Sector. These visits offer first-hand exposure to industrial processes, technologies, and practices, allowing students to gain insights into real-world applications of theoretical concepts learned in the classroom. Through interactions with industry professionals, students will gain valuable perspectives on the challenges and opportunities present in the field of Food Processing Sectors.
Course Assessment Process
The course assessment process will be similar to that mentioned under Mini Project I & Industrial Visit.

Sr. No.	Reference Books
1.	Kennedy, J. F. (5). The value of industrial visits. *Effective Management of Benchmarking Projects*, *96*.
2.	Fellows, P. J. (2022). *Food processing technology: principles and practice*. Woodhead publishing.
3.	Goyal, M., & Choudhary, S.K., (2016), Industrial Visits and Study in Chemical Process Industries. IK International Publishing House Pvt. Ltd.
Sr. No.	**Useful Web link**
1.	https://apeda.gov.in/apedawebsite/
2.	https://www.teaboard.gov.in/home
3.	https://www.icrisat.org/
4.	The students can search on you-tube for the following key words: 1. Food Processing Sectors Mini Projects" 2. Food Processing Sectors Industrial Visits" 3. "Hands-on Projects for Food Processing Sectors" 4. "Industrial Visits in Food Processing Sectors."

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Second Year B.Tech (Food Technology), Part I, Semester IV</td></tr>
<tr><td>Course Code</td><td colspan="5">HSMEC 221</td></tr>
<tr><td>Course Category</td><td colspan="5">Humanities, Social Sciences, Management, Environment</td></tr>
<tr><td>Course title</td><td colspan="5">Environmental Studies</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>-</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="5">50 Marks University Exam at Semester End</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="5">Knowledge of Basic Environmental Science</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The course is all about learning the way we should live and how we can develop sustainable strategies to protect the environment. It helps individuals to develop an understanding of living and physical environment and how to resolve challenging environmental issues affecting nature.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Describe the various types and sources of environmental pollution.
2. Explore other global environmental issues, such as biodiversity loss, deforestation, and ocean acidification.
3. Explain key environmental laws and regulations at the national and international levels.
4. Explain the relationship between human society and the environment.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">The students will be able to-
1. Classify different types of environmental pollutants and their sources.
2. Analyze the interconnections between climate change and other global environmental issues.
3. Understand the legal frameworks and regulations governing environmental protection and management.
4. Describe the socio-economic drivers of environmental degradation and inequality</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	-	-	-	-	3	3	-	-	-	-
CO 2	-	3	3	3	-	-	3	3	3	2	-	-
CO 3	-	2	3	3	-	-	3	3	3	3	-	-
CO 4	-	2	-	-	-	-	3	3	3	3	-	-

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

Unit No.	Course Content	Hours
V.	**Environmental Pollution:** Definition: Causes, effects and control measures of: Air pollution, Water pollution: Causes, effects and control measures, Marine pollution, Soil pollution: Causes, effects and control measures, Noise pollution: Causes, effects and control measures, Thermal pollution: Causes, effects and control measures, Nuclear hazards and their effects. Solid waste Management: Causes, effects and control, measures of urban and Industrial wastes, Role of an individual in prevention of pollution.	07
VI.	**Understanding climate change and other global environmental issues:** -Structure of atmosphere; greenhouse gas emissions; Projections of global climate change, Importance of 1.5 °C and 2.0 °C limits to global warming; Carbon foot print, -Impacts of climate change: on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health, urban infrastructure;-Mitigation of climate change: Green House Gas (GHG) reduction, sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policies for mitigation, net zero targets for the future; Energy efficiency measures; Renewable energy sources for carbon reduction; Carbon capture and storage, Acid Rain: Causes, effects and mitigation, Ozone Layer Depletion: Causes, effects and mitigation	07
VII.	**Environmental legislation:** Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g), Environmental Protection Act., Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.	06
VIII.	**Social Environment:** Environmental ethics, Environmental movements- Chipko Movement, Appiko Movement, Silent Valley Movement. Water conservation: rain water harvesting,	04

	watershed management, Disaster management: floods, earthquake, cyclone, tsunami and landslides.	
	Nature Visits / Field Work /Field Tour/ Industrial visits / Activities related to Campus environmental management (05 Hrs.)	
Sr. No.	**Text Books:**	
1.	Agarwal, K. C., 2001, Environmental Biology, Nidi Publ. Ltd., Bikaner.	
2.	Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad, 380013, India.	
3.	Brunner R. C., 1989, Hazardous Waste Incineration, McGraw Hill Inc,	
Sr. No.	**Reference Books:**	
1.	Cunningham, W. P. Cooper, T. H. Gorhani, E. & Hepworth, M. T. ,2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai,	
2.	Gleick, H., 1993, Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute. Oxford Univ. Press.	
3.	Hawkins R. e., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R).	
4.	Heywood, V. H. & Watson, R. T., 1995, Global Biodiversity Assessment, Cambridge Univ. Press.	
5.	Jadhav, H. & Bhosale, V. M., 1995, Environmental Protection and Laws, Himalaya Pub. House, Delhi.	
6.	Mckinney, M. L. & Schocl. R. M. ,1996, Environmental Science Systems & Solutions, Web enhanced edition.	
7.	Odum, E. P., 1971, Fundamentals of Ecology, W. B. Saunders Co. USA.	
8.	Rao M. N. & Datta, A. K. ,1987, Waste Water Treatment, Oxford & IBH Publ. Co. Pvt. Ltd.	
9.	Sharma B. K., 2001, Environmental Chemistry, Goel Publ. House, Meerut.	
10.	Trivedi R. K. and P. K. Goel, Introduction to air pollution Techno-Science Publications (TB).	
11.	Trivedi R. K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media (R).	
12.	Wagner K. D., 1998, Environmental Management, W. B. Saunders Co. Philadelphia, USA.	
Sr. No.	**Suggested Reference Links:**	
1.	https://onlinecourses.swayam2.ac.in/cec19_bt03/preview	
2.	http://nitttrc.edu.in/nptel/courses/video/109105203/L41.html	

Equivalence for the curriculum revision at B. Tech Food technology

The above curriculum structure is a revised version of the Second Year B. Tech (Food Technology) Program being conducted by Shivaji University at its Technology Department. A special mention rather feature of this revision is, ***it is aligned with New National Education Policy 2020 guidelines, and also it follows the directives of National Credit Framework.*** This curriculum is to be implemented from June 2024, (Academic year 2024-25).

The Equivalence for the Courses of Food Technology at Second Year B Tech Semester III and IV pre-revised Program under the faculty of Science and Technology is as follows.

SEM – III

Sr. No.	Second Year B. Tech Semester III Pre-revised syllabus	Second Year B. Tech Semester III Revised syllabus	Remark
1	Principles of Food Preservation (Theory & Lab)	Principles of Food Preservation (Theory & Lab)	The content is revised
2	Engineering Mathematics-III	-	Based on discussions with PAB Members, faculty members and considering applications to the present programme, the subject is removed and new subjects are introduced
3	Food Microbiology (Theory & Lab)	-	Shifted to the next semester.
4	Food Chemistry (Theory & Lab)	Food Chemistry (Theory & Lab)	The content is revised
5	Heat Transfer (Theory & Lab)	-	Shifted to the next Semester
6	-	Food Biochemistry and Human Nutrition(Theory & Lab)	Clubbing two courses Food Biochemistry and Human Nutrition of next semester in a single course
7	-	Fruits and Vegetable Processing Technology (Theory & Lab)	Shifted from next Semester.
8	-	Fluid Mechanics	Shifted from next Semester.
9	Programming Practices for Food Technologists(Lab)	-	Clubbed in other courses.
11	Environmental Studies	Environmental Studies	No change as it is centrally offered by the University.
12	Soft Skills Development	Soft Skills Development	Content is revised and converted as a Credit course
13	-	Mini Project I & Industrial Visit	Newly introduced audit course.

SEM – IV

Sr. No.	Second Year B. Tech Semester IV Pre-revised syllabus	Second Year B. Tech Semester IV Revised syllabus	Remark
1	Food Process Engineering-I(Theory & Lab)	Food Process Engineering I(Theory & Lab)	The content is revised
2	Food Additives and Contaminants	Food Additives and Contaminants(Theory & Lab)	The content is revised
3	Food Biochemistry (Theory & Lab)	-	Clubbing two courses Food Biochemistry and Human Nutrition in a single course Shifted to the previous semester. Content revision.
4	Human Nutrition(Theory & Lab)	-	
5	Fluid Mechanics(Theory & Lab)	-	Shifted to the previous Semester
6	-	Heat Transfer	Shifted from the previous Semester
7	-	Dairy Technology (Theory & Lab)	Shifted from the next Semester
8	-	Aptitude Enhancement Course I	Newly introduced.
9	Environmental Studies	Environmental Studies	No change as it is centrally offered by the University.
10	-	Multidisciplinary Minor Course I	As per NEP feature, MDM is introduced.
11	Introduction to Performing Arts	Introduction to Performing Arts	Content is revised and converted as a Credit course
12	-	Mini Project II & Industrial Visit	Clubbing of courses with modification
13	-	Food Microbiology	Shifted from the previous Semester

Shivaji University Vidyanagar, Kolhapur, Maharashtra416004

Department of Technology

As per NEP 2020 guidelines

Pool of Multidisciplinary Minors for
MDM Featured B.Tech (Food Technology), Detailed Curriculum

Multidisciplinary Minor
In
Artificial Intelligence and Machine Learning
For
B.Tech (Food Technology)

Shivaji University, Kolhapur
Department of Technology

Multidisciplinary Minor in Artificial Intelligence and Machine Learning

Teaching & Evaluation Scheme										
Sr. No.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluationscheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Preferably on SWAYAM(NPTEL) or any other MOOCs(Minor Program Core) Or In a Face-to-Face mode	MDM 1.1	Introduction to AI & Machine Learning	03	-	-	03	03	30:70	00:00
2.		MDM 1.2	Deep Learning and Neural Network	03	-	-	03	03	30:70	00:00
3.		MDM 1.3	Special topics in Artificial Intelligence	03	-	-	03	03	30:70	00:00
4.	Program Based Internship	MDM 1.4	Industry Internship	One Month				03	-	50:50
5.	Project Based Learning	MDM 1.5	Mini Project	-	-	-	-	02	-	50:50
				-	-	-	-	14	300	200
			Total Hours	09	00	00	09	-	-	-

Note: MDM Program's Internship and Mini Project need to be planned during winter or summer vacation days after 4th semester while respective evaluations will be the part of 7th and 8th Semesters of the B.Tech Major structure.

Multidisciplinary Minor I: Artificial Intelligence and Machine Learning

Year, Program, Semester	Multidisciplinary Minor I , 4th Semester Onwards							
Course Code	MDM-1.1							
Course Category	Minor Program Core							
Course Title	**Introduction to AI & Machine Learning**							
Teaching Scheme and Credits	L	T	P	Total Contact Hours		Total Credits		
	03	-		03		03		
Evaluation Scheme	ISE		ESE	IOE	IPE	EOE	EPE	Total
	30		70	-	-	-	-	100
Pre-requisites(if any)	Mathematical concepts such as statistics, calculus, probability, and linear algebra.							
Course Rationale	This course introduces students to the mathematical concepts required for AI &ML							
Course Objectives	The Course is aimed to- 1. To review and strengthen important mathematical concepts required for AI &ML. 2. Introduce the concept of learning patterns from data and develop a strong theoretical foundation for understanding state of the art Machine Learning algorithms							
Course Outcomes	Upon completion of this course, student should be able to – 1. Design and implement machine learning solutions to classification, regression and clustering problems. 2. Evaluate and interpret the results of the different ML techniques. 3. Design and implement various machine learning algorithms in a range of Real-world applications.							

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	2	-	-	3	-	-	-	-	-	-	-
CO 2	2	-	2	-	3	-	-	-	-	-	-	-
CO 3	-	-	2	-	2	-	-	-	-	-	-	-

Level of Mapping as: Low 1,Moderate 2,High3

Unit No.	Course Content	Hours
I	Defining Artificial Intelligence, Defining AI techniques, Using Predicate Logic and Representing Knowledge as Rules, Representing simple facts in logic, Computable functions and predicates, Procedural vs Declarative knowledge, Logic Programming, Mathematical foundations: Matrix Theory and Statistics for Machine Learning.	08
II	Idea of Machines learning from data, Classification of problem –Regression and Classification, Supervised and Unsupervised learning.	07
III	Linear Regression: Model representation for single variable, Single variable Cost Function, Gradient Decent for Linear Regression, Gradient Decent in practice.	07
IV	Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multi-classification (One vs All), Problem of Over fitting.	07
V	Discussion on clustering algorithms and use-cases cantered around clustering and classification.	07

Text Books	
1.	Saroj Kaushik, Artificial Intelligence, Cengage Learning, 1st Edition 2011
2.	Anindita Das Bhattacharjee, "Practical Workbook Artificial Intelligence and SoftComputing for beginners, Shroff Publisher-X team Publisher.
3.	Yuxi (Hayden) Liu, "Python Machine Learning by Example", Packet PublishingLimited, 2017.
4.	Tom Mitchell, Machine Learning, McGraw Hill, 2017.
5.	Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011.
6.	T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2011.

Lab Work	
1.	Implementation of logical rules in Python
2.	Using any data apply the concept of: a. Liner regression b. Gradient decent c. Logistic regression
3.	To add the missing value in any data set.
4.	Perform and plot under fitting and overfitting in a data set.
5.	Implementation of clustering and classification algorithms.

Assessment	
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. **10 marks will be given based on the assignments of lab work**. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.

Year, Program, Semester	Multidisciplinary Minor I, 4th Semester Onwards						
Course Code	MDM 1.2						
Course Category	Minor Program Core						
Course Title	**Introduction to Data Analytics**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	03	-		03		03	
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	30	70	-	-	-	-	100
Pre-requisites(if any)	Solid foundation in basic mathematics, including algebra, calculus, and probability.						
Course Rationale	This course would focus on expertise to become a proficient data scientist.						
Course Objectives	The Course is aimed to- 1. Provide the knowledge and expertise to become a proficient data scientist 2. Demonstrate an understanding of statistics and machine learning concepts that are vital for data science 3. Produce Python code to statistically analyse a dataset. 4. Critically evaluate data visualizations based on their design and use for communicating stories from data.						
Course Outcomes	Upon completion of this course, student should be able to – 1. Explain how data is collected, managed and stored for data science. 2. Understand the key concepts in data science, including their real- world applications and the toolkit used by data scientists. 3. Implement data collection and management scripts using MongoDB.						

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	-	-	-	3	-	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	-	-	-	-
CO3	-	-	2	2	-	-	-	-	-	-	-	-

Level of Mapping as: Low 1, Moderate 2, High3

Unit No.	Course Content	Hours
I	Introduction to Data Science, Different Sectors using Data science, Purpose andComponents of Python in Data Science.	07
II	Data Analytics Process, Knowledge Check, Exploratory Data Analysis (EDA), EDA- Quantitative technique, EDA- Graphical Technique, Data Analytics Conclusion and Predictions	07
III	Feature Generation and Feature Selection (Extracting Meaning from Data)- Motivating application: user (customer) retention- Feature Generation (brainstorming, role of domain expertise, and place for imagination)- Feature Selection algorithms.	08
IV	Data Visualization- Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects- Exercise: create your own visualization of a complex dataset.	07
V	Applications of Data Science, Data Science and Ethical Issues- Discussions on privacy, security, ethics- A look back at Data Science- Next-generation data scientists	07

Text Books	
1.	Joel Grus, Data Science from Scratch, Shroff Publisher Publisher /O'Reilly PublisherMedia.
2.	Annalyn Ng, Kenneth Soo, Numsense! Data Science for the Layman, Shroff PublisherPublisher
3.	Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from TheFrontline. O'Reilly Publisher Media
4.	Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press
5.	Jake VanderPlas, Python Data Science Handbook, Shroff Publisher Publisher /O'Reilly Publisher Media
6.	Philipp Janert, Data Analysis with Open Source Tools, Shroff Publisher Publisher /O'Reilly Publisher Media.

Lab Work	
1.	Python Environment setup and Essentials.
2.	Mathematical computing with Python (NumPy).
3.	Scientific Computing with Python (SciPy).
4.	Data Manipulation with Pandas.
5.	Prediction using Scikit-Learn
6.	Data Visualization in python using matplotlib

Assessment

a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. **10 marks will be given based on the assignments of lab work**. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work.

b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.

Year, Program, Semester	Multidisciplinary Minor I, 4th Semester onwards						
Course Code	MDM 1.3						
Course Category	Minor Program Core						
Course Title	**Deep Learning and Neural Network**						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	03	-		03	03		
Evaluation Scheme	ISE	ESE	IOE	IPE	EOE	EPE	Total
	30	70	-	-	-	-	100
Pre-requisites(if any)	Basic Mathematics, matrix arithmetic, probability.						
Course Rationale	This course is aimed to make students understand advanced algorithms of neural networks.						
Course Objectives	The Course is aimed to- 1. Strengthen important Mathematical concepts required for Deep learning and neural network. 2. Get a detailed insight of advanced algorithms of neural networks. 3. Introduce different deep learning network.						
CourseOutcomes	Upon completion of this course, student should be able to – 1. Design and implement Artificial Neural networks. 2. Decide when to use which type of NN. 3. Implement and analyze various deep learning architectures						

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	-	-	2	-	2	-	-	-	-	-	-	-
CO 2	-	2	-	-	2	-	-	-	-	-	-	-
CO 3	-	2	3	-	3	-	-	-	-	-	-	-

Level of Mapping as: Low 1,Moderate 2,High3

Unit No.	Course Content	Hours
I	Information flow in a neural network, understanding basic structure and ANN.	**07**
II	Training a Neural network, how to determine hidden layers, recurrent neural network.	**08**
III	Convolutional neural networks, image classification and CNN.	**07**

IV	RNN and LSTMs. Applications of RNN in real world.	**07**
V	Creating and deploying networks using tensor flow and keras	**07**

Text Books	
1.	John Paul Mueller, Luca Massaron, Deep Learning for Dummies, John Wiley & Sons.
2.	Adam Gibson, Josh Patterson, Deep Learning, A Practitioner's Approach, ShroffPublisher /O'Reilly Publisher Media
3.	Christopher M. Bishop, Neural Networks for Pattern Recognition, Oxford.
4.	Russell Reed, Robert J MarksII, Neural Smithing: Supervised Learning in Feedforward Artificial Neural Networks, Bradford Book Publishers

Lab Work	
1.	Introduction to Kaggle and how it can be used to enhance visibility.
2.	Build general features to build a model for text analytics.
3.	Build and deploy your own deep neural network on a website using tensor flow.

Assessment	
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. **10 marks will be given based on the assignments of lab work**. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.

Year, Program, Semester	Multidisciplinary Minor I, 4th Semester onwards						
Course Code	MDM 1.4						
Course Category	Program Based Internship						
Course Title	**Industry Internship**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	One Month				03		
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00	50	-	50	-	100
Pre-requisites(if any)	Basics Mathematics, matrix arithmetic, probability.						
Course Rationale	The course caters specifically to B.Tech Food Technology students as the part of multidisciplinary Minor in areas such as Artificial Intelligence and Machine Learning. This course offers practical exposure to industry settings aligned with their chosen discipline, aiming to bridge the gap between theoretical knowledge and practical application. By engaging in a one-month internship, students gain firsthand experience, essential skills, and insights crucial for their future careers in additional sector of industry.						
Course Objectives	The course teacher will 1. Help expose students to the 'real' working environment; 2. Promote hands-on experience to the students' in their related field; 3. Develop synergetic collaboration between industry and the university in promoting a knowledgeable society; 4. Assist in providing the opportunity for students to test their interest in a particular career before permanent commitments are made. 5. Elaborate the dynamic and challenging nature of industrial environments.						
Course Outcomes	Upon completion of this course, student should be able to 1. Understand industrial processes and operations related to their minor sub-specializations. 2. Apply theoretical concepts to solve practical problems in the industry. 3. Communicate effectively with industry professionals, colleagues, and supervisors. 4. Collaborate efficiently in team environments to complete tasks and projects. 5. Adapt to the dynamic and challenging nature of industrial environments. 6. Reflect on internship experiences for personal and professional growth.						

Course Outcome and Program Outcome Mapping

CO/PO	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	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	2	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-	3
CO6	-	-	-	-	-	-	-	-	-	-	-	2

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

Course Content	Hours
The course consists of a one-month internship in Food Industry. Students will be placed in companies or organizations that align with the particular sector. During the internship, students will engage in various activities, including but not limited to: 1. Shadowing industry professionals to observe and learn about different processes and operations. 2. Assisting with ongoing projects or research initiatives within the organization. 3. Participating in hands-on tasks related to their minor sub-specialization, under the guidance of experienced mentors. 4. Attending training sessions, workshops, and seminars conducted by the industry to enhance their knowledge and skills. 5. Engaging in discussions and meetings with supervisors and colleagues to gain insights into industry practices, challenges, and innovations. 6. Documenting their internship experience through reports, presentations, or reflective journals. The period of one month for this internship will be during the winter or summer vacations, any such slots4th Semester onwards.	4 weeks

Course Evaluation Method

This particular evaluation will be the part of the structure of 7th Semester.
The evaluation for the Industrial Internship course will be conducted as follows:

- **Internal Evaluation (50 marks):**
  - Assessment by course teachers based on students' performance during the internship, including attendance, participation, attitude, and contribution to assigned tasks.
  - Evaluation by industrial supervisors on students' professional conduct, technical skills, problem-solving abilities, and overall performance in the workplace.
- **External Evaluation (50 marks):**
  - Evaluation by an external examiner appointed by the institute, who will assess students' internship reports, presentations, or any other documentation submitted at the end of the internship period.
  - The external examiner will review the quality of students' reflections on their internship experience, their ability to apply theoretical knowledge to practical situations, and the depth of their understanding of industry practices and challenges.

The final grades for the Industrial Internship course will be determined based on the combined assessment from both internal and external evaluations.

ReferenceBooks

1.	Russell Reed, Robert J MarksII, Neural Smithing: Supervised Learning in Feedforward Artificial Neural Networks, Bradford Book Publishers
2.	Anindita Das Bhattacharjee, “Practical Workbook Artificial Intelligence and SoftComputing for beginners, Shroff Publisher-X team Publisher.

Year, Program, Semester	Multidisciplinary Minor I, 4th Semester onwards						
Course Code	MDM 1.5						
Course Category	Project Based Learning						
Course Title	**Mini Project**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	-	-	-	-		02	
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics Mathematics, matrix arithmetic, probability.						
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this field project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena in the Food Industry.						
Course Objectives	The course teacher will 1. Facilitate application of theoretical knowledge. 2. Guide the students about enhancement of practical skills. 3. Explain about development of industry-relevant competencies.						
Course Outcomes	Upon completion of this course, student should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.						

Course Outcome and Program Outcome Mapping

CO/PO	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	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

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

Course Content
Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets. This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.
Course Assessment Process
This particular evaluation will be the part of 8th Semester of the major structure. The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work. The teachers will follow the instructions as below: Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including: • Rubric-based assessment for the project work and its report. • Peer evaluation for project. • Instructor-led discussions or presentations to evaluate communication skills and critical thinking. • Overall course grading based on a weighted average of individual assessments and participation. The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

Multidisciplinary Minor
In
Alcohol Technology

For
B.Tech (Food Technology)

Shivaji University, Kolhapur
Department of Technology

Multidisciplinary Minor in Alcohol Technology

Teaching & Evaluation Scheme

Sr. No.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Preferably on SWAYAM(NPTEL) or any other MOOCs(Minor Program Core) Or In a Face-to-Face mode	MDM 2.1	Industrial Fermentation	03	-	-	03	03	30:70	00:00
2.		MDM 2.2	Alcohol Manufacturing	03	-	-	03	03	30:70	00:00
3.		MDM 2.3	Technology of Malting and Brewing	03	-	-	03	03	30:70	00:00
4.	Program Based Internship	MDM 2.4	Alcohol Industry Internship	One Month			-	03	-	50:50
5.	Project Based Learning	MDM 2.5	Mini Project	-	-	-	-	02	-	50:50
				-	-	-	-	14	300	200
			Total Hours	09	00	00	09	-	-	-

Note: MDM Program's Internship and Mini Project need to be planned during winter or summer vacation days after 4th semester while respective evaluations will be the part of 7th and 8th Semesters of the B.Tech Major structure.

Multidisciplinary Minor II: ALCOHOL TECHNOLOGY

Year Program, Semester	Multidisciplinary Minor II , 4th Semester Onwards							
Course Code	MDM-2.1							
Course Category	Minor Program Core							
Course title	**Industrial Fermentation**							
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**		
	03	-	-	03		03		
Evaluation Scheme	ISE	ESE	IOE	IPE	EOE	EPE	Total	
	30	70	-	-	-	-	100	
Pre-requisites(if any)	Basics of biochemistry and microbiology							
Course Rationale	This course emphasizes the application of biological and engineering principles to problems involving microbial, mammalian, and biological/biochemical systems. The course aims to review fundamentals and provide an up-to-date account of current knowledge in biological and biochemical technology. Industrial fermentation is a base of numerous industrial processes, ranging from the production of antibiotics and vaccines to the manufacture of biofuels and specialty chemicals. Understanding the principles and practices of fermentation is essential for students aspiring to work in these sectors.							
Course Objectives	The Course Teacher will 1. Explain the principles of industrial fermentation including microbial growth kinetics, substrate utilization, and product formation. 2. Describe knowledge of various types of fermentation processes used in industry, such as aerobic and anaerobic fermentation. 3. Illustrate about the different types of microorganisms involved in industrial fermentation and their characteristics. 4. Explore the various raw materials and media used in industrial fermentation and their impact on the fermentation process. 5. Enhance about downstream processing techniques for the purification and recovery of fermentation products. 6. Develop the importance of safety, quality control, and regulatory compliance in industrial fermentation operations.							
Course Outcomes	Upon completion of this course, student should be able to 1. Describe the fundamental principles underlying microbial growth and metabolism in industrial fermentation. 2. Differentiate between different types of fermentation processes and their applications in various industries. 3. Identify and characterize key microorganisms used in industrial fermentation and their respective roles. 4. Design fermentation media and optimize process parameters for specific fermentation applications. 5. Designandimplementdownstreamprocessingstrategiesforthepurificationandrecoveryoffermentationproducts. 6. Evaluate the safety, quality, and regulatory aspects of industrial fermentation processes.							

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-
CO 3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	2	2	3	1	1	1	1	-	2	-	-	-
CO5	2	2	3	1	1	1	1	-	2	-	-	-
CO6	2	-	2	-	-	2	2	-	-	-	1	-

Level of Mapping as: Low1, Moderate2,High3

Unit No.	Course Content	Hours
I	**Introduction to fermentation** History and development fermentation, Definition and scope of industrial Fermentation ,Importance and applications in various industries	6
II	**Fermentation Process Fundamentals** Substrate selection and preparation, Sterilization techniques, Inoculum preparation, Fermentation kinetics and monitoring	6
III	**Microorganisms Used in Industrial Fermentation** Introduction to Microbial Growth Kinetics, Batch culture(Quantifying cell concentration, Growth patterns and Kinetics), Continuous culture, Comparison of batch and continuous cultures in industrial processes, Fed batch culture, Examples of use of fed batch cultures. Isolation, preservation and improvement of industrial microorganisms Isolation methods utilizing selection of the desired characteristics, Isolation methods not utilizing selection of the desired characteristics, The preservation of industrially important microorganisms, Improvement of industrial microorganisms	6
IV	**Media for industrial fermentations & sterilization** Introduction, Typical media, Energy sources, Carbon sources, Nitrogen sources, Buffers, Oxygen requirements, Antifoams, Medium optimization, Medium sterilization: The design of batch sterilization processes, The design of continuous sterilization processes, Sterilization of the fermenter, feed sand air, Filter sterilization, The development of inocula for industrial fermentations, The development of inocula for yeast, bacterial and fungal processes, The aseptic inoculation of plant fermenters	6
V	**Various Industrial Fermentation Processes, Equipment and Facilities** Aerobic anaerobic fermentation, Batch, fed-batch, and continuous fermentation, Solid-state fermentation Bioreactor design and operation, Aeration and agitation systems, Downstream processing equipment	7
VI	**Industrial Fermentation Applications** Food and beverage production, Pharmaceutical and biopharmaceutical manufacturing, Biofuel production, Enzyme production, Organic acid production, Industrial microbiology and biotechnology	5
	Reference Textbooks	
1.	James E. Bailey and David F. Ollis, (July2017), Biochemical Engineering Fundamentals, (2ndedition), McGraw Hill Education	
2.	Jurgen Krause and Oswald Fleischer, ((18May2010),Industrial Fermentation :Food Processes, Nutrient Sources & Production Strategies, Nova Science Publishers Inc.	

3.	Yuxi(Hayden)Liu,"PythonMachineLearningbyExample",PacketPublishingLimited,2017
Reference Books	
1.	E. M. T. El Mansi , C. F. A. Bryce ,B. Dahhou ,and S. Sanchez, (January2000),Fermentation Microbiology and Biotechnology,(3rd edition),Taylor and Francis Books Limited U.K.

Year, Program, Semester	Multidisciplinary Minor II , 4th Semester Onwards							
Course Code	MDM-2.2							
Course Category	Minor Program Core							
Course title	**Alcohol Manufacturing**							
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**			**Total Credits**	
	03	-	-	03			03	
Evaluation Scheme	ISE		ESE	IOE	IPE	EOE	EPE	Total
	30		70	-	-	-	-	100
Pre-requisites(if any)	Basic understanding of mathematics. First year undergraduate level of (bio) chemistry and biology and overview of the fundamental courses of Chemical Engineering							
Course Objectives	Alcohol manufacturing involves a variety of industrial processes and technologies, including fermentation, distillation, filtration, and aging. Teaching students about these processes equips them with practical knowledge applicable to various industries, such as brewing, distilling, and wine making.							
Course Outcomes	Upon completion of this course, student should be able to 1. Demonstrate a comprehensive understanding of the principles and processes involved in alcohol manufacturing. 2. Identify and evaluate the suitability of different raw materials for alcohol production based on their chemical composition and availability. 3. Apply microbial and enzymatic techniques t optimize fermentation processes for alcohol production. 4. Operate and maintain equipment used in various stages of alcohol manufacturing, including fermentation tanks, stills, and purification systems. 5. Interpret and comply with regulatory requirements and safety standards relevant to alcohol production facilities.							

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	1	-	-	-	-	-	-	-	-
CO4	2	2	3	1	-	-	-	-	-	-	-	-
CO5	2	2	2	1	1	-	-	-	-	-	-	-

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

Unit No.	Course Content	Hours
I	**Introduction to Alcohol Manufacturing** Introduction to Alcohol Technology, Raw Material of Alcohol Industry, Storage and handling of raw material.	6
II	**Raw Materials** Study of different yeast strains used in alcohol industries, Study of yeast production as Single protein cell, Wet milling of grain for alcohol production, Grain dry milling cooking for alcohol production, Use of cellulosic feed stocks for alcohol production.	6
III	**Fermentation** Study of different alcoholic fermentation techniques, Biochemical processes in fermentation, Batch fermentation, Continuous fermentation, Modern techniques of Continuous fermentation, Bio still fermentation, Fermentation vessel design and operation, By product of alcoholic fermentation.	7
IV	**Distillation** Principles of distillation, Batch and continuous distillation techniques Distillation equipment and operation, Steps for optimizing Performance of Distillation Columns, Effective utilization of column heat. Pinch Technology. Principles of distillation.	7
Text / Reference Books		
1.	T.P. Lyons, K.A. Jacques, D.R Kensal,(November1999),The Alcohol Textbook: A Reference for the Beverage, Fuel and Industrial Alcohol Industries, (3rdedition), Nottingham University Press	
2.	T.P. Lyons(Editor),D. R Kelsall (Editor),J.E. Murtagh (Editor), (1October 1995),The Alcohol Textbook :Ethanol Production by Fermentation and Distillation ,Nottingham University Press	
Reference Books		
3.	Johann G. Stichlmair, James R. Fair, (29September1998) ,Distillation :Principles and Practices, (1stedition), Wiley-VCH.	

Year, Program, Semester	Multidisciplinary Minor II , 4th Semester Onwards						
Course Code	MDM-2.3						
Course Category	Minor Program Core						
Course title	**Technology of Malting & Brewing**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**			**Total Credits**
	03	-	-	03			03
Evaluation Scheme	ISE	ESE	IOE	IPE	EOE	EPE	Total
	30	70	-	-	-	-	100
Pre-requisites(if any)	Basic understanding of biochemistry and microbiology						
	This course provides students with a comprehensive understanding of the scientific, technical, and practical aspects of beer production. Understanding the technology behind malting and brewing is crucial for students aspiring to work in this industry.						
Course Objectives	The Course Teacher will 1. Discuss the fundamental principles and processes involved in malting and brewing. 2. Explore the anatomy and biochemistry of grains used in malting and brewing, with a focus on barley. 3. Explain the malting process, including steeping, germination, and kilning, and its impact on grain modification and enzyme development. 4. Illustrate about the role of enzymes, particularly amylases and proteases, in the malting and mashing processes. 5. Enlist brewing techniques, including mashing, lautering, boiling, fermentation, and conditioning, and their effects on flavor, aroma, and alcohol content. 6. Describe the microbiology of brewing, including the role of yeast and other microorganisms in fermentation and the prevention of spoilage.						
Course Outcomes	Upon completion of this course ,student should be able to 1. Demonstrate a comprehensive understanding of the malting and brewing processes, including their chemical and biochemical principles. 2. Identify and evaluate different types of grains suitable for malting and brewing based on the characteristics and quality parameters. 3. Apply malting techniques to produce malt with desired attributes for brewing purposes. 4. Utilize brewing equipment and techniques to produce various styles of beer while controlling factors such as color, flavor, and alcohol content. 5. Analyze and interpret data from laboratory tests and sensory evaluations to assess the quality of malt and beer. 6. Acquire proficiency in trouble shooting common issues encountered during the malting and brewing processes.						

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	1	-	-	-	-	-	-	-	-
CO4	2	2	3	1	-	-	-	-	-	-	-	-
CO5	2	2	2	1	1	-	-	-	-	-	-	-
CO6	2	2	2	2	-	-	-	-	-	-	-	-

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

Unit No.	Course Content	Hours
I	**Introduction to Malting and Brewing** Introduction of brewing, history of brewing; Raw materials :barley ,hops, water, yeast; Adjuncts for beer production :Maize ,rice ,millet, wheat, sugar etc	6
II	**Malting Process** Malt production, role of enzymes for malting; Barley storage, steeping, germination, kilning, cooling, storage; Malt from other cereals, caramel malt, roasted malt, smoked malt, malt extract; Malt quality evaluation ,Wort production, malt milling, Mashing, Mashing vessels; Wort boiling ,clarification ,cooling and aeration	6
III	**Brewing Process Overview** Beer production methods, fermentation technology, changes during fermentation; Filtration procedure and equipment, beer stabilization conditions and durations, beer carbonation process	6
IV	**Yeast and Brewing Equipment** Types of brewing yeast, Yeast propagation and handling ,Fermentation kinetics, Brew house equipment and layout, Fermentation vessels ,Packaging equipment.	6
V	**Brewing Techniques and Styles** Ale brewing, Lager brewing, Specialty beer styles, Craft brewing techniques, Sustainable sourcing of ingredients.	6
VI	**Emerging Trends in Malting and Brewing,** Novel ingredients and flavors, Brewing with alternative grains, Non-alcoholic brewing	6
Text / Reference Books		
1.	KunzeWolfgang, (January 1, 2014), Technology Brewing and Maltin, (5th edition), VLB Berlin.	
2.	J. S. Hough, D. E. Briggs , R. Stevens , T. W. Young ,(1 March 2013), Malting and Brewing Science: Volume II Hopped Wort and Beer, (1st ed. 1982 edition) Springer-Verlag New York Inc. Softcover reprint of the original.	
Reference books		
1.	D.E. Briggs, R. Stevens, Tom W. Young, J.S. Hough, ((December 1, 1981), Malting and Brewing Science, Volume 1: Malt and Sweet Wort, (2nd edition), Springer.	

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards						
Course Code	MDM 2.4						
Course Category	Program Based Internship						
Course Title	**Alcohol Industry Internship**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	One Month				03		
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.						
Course Rationale	The course caters specifically to B.Tech Food Technology students as the part of multidisciplinary Minor with respect to Alcohol Industry applications in Food and allied Engineering. This course offers practical exposure to industry settings aligned with their chosen discipline, aiming to bridge the gap between theoretical knowledge and practical application. By engaging in a one-month internship, students gain firsthand experience, essential skills, and insights crucial for their future careers in additional sector of industry.						
Course Objectives	The course teacher will 1. Help expose students to the 'real' working environment; 2. Promote hands-on experience to the students' in their related field; 3. Develop synergetic collaboration between industry and the university in promoting a knowledgeable society; 4. Assist in providing the opportunity for students to test their interest in a particular career before permanent commitments are made. 5. Elaborate the dynamic and challenging nature of industrial environments.						
Course Outcomes	Upon completion of this course, student should be able to 1. Understand industrial processes and operations related to their minor sub-specializations. 2. Apply theoretical concepts to solve practical problems in the industry. 3. Communicate effectively with industry professionals, colleagues, and supervisors. 4. Collaborate efficiently in team environments to complete tasks and projects. 5. Adapt to the dynamic and challenging nature of industrial environments. 6. Reflect on internship experiences for personal and professional growth.						

Course Outcome and Program Outcome Mapping

CO/PO	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	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	2	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-	3
CO6	-	-	-	-	-	-	-	-	-	-	-	2

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

CourseContent	Hours
The course consists of a one-month internship with respect to applications of AI & ML. Students will be placed in companies or organizations that align with the particular requirement. During the internship, students will engage in various activities, including but not limited to: 1. Shadowing industry professionals to observe and learn about different processes and operations. 2. Assisting with ongoing projects or research initiatives within the organization. 3. Participating in hands-on tasks related to their minor sub-specialization, under the guidance of experienced mentors. 4. Attending training sessions, workshops, and seminars conducted by the industry to enhance their knowledge and skills. 5. Engaging in discussions and meetings with supervisors and colleagues to gain insights into industry practices, challenges, and innovations. 6. Documenting their internship experience through reports, presentations, or reflective journals. The period of one month for this internship will be during the winter or summer vacations, any such slots 4th Semester onwards.	4 weeks

Course Evaluation Method

This particular evaluation will be the part of the structure of 7th Semester.
The evaluation for the Industrial Internship course will be conducted as follows:

- **Internal Evaluation (50 marks):**
    - Assessment by course teachers based on students' performance during the internship, including attendance, participation, attitude, and contribution to assigned tasks.
    - Evaluation by industrial supervisors on students' professional conduct, technical skills, problem-solving abilities, and overall performance in the workplace.
- **External Evaluation (50 marks):**
    - Evaluation by an external examiner appointed by the institute, who will assess students' internship reports, presentations, or any other documentation submitted at the end of the internship period.
    - The external examiner will review the quality of students' reflections on their internship experience, their ability to apply theoretical knowledge to practical situations, and the depth of their understanding of industry practices and challenges.

The final grades for the Industrial Internship course will be determined based on the combined assessment from both internal and external evaluations.

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards						
Course Code	MDM 2.5						
Course Category	Project Based Learning						
Course Title	**Mini Project**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	-	-	-	-		02	
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00	50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.						
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this field project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena for AI ML applications.						
Course Objectives	The course teacher will 1. Facilitate application of theoretical knowledge. 2. Guide the students about enhancement of practical skills. 3. Explain about development of industry-relevant competencies.						
Course Outcomes	Upon completion of this course, student should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.						

Course Outcome and Program Outcome Mapping

CO/PO	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	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

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

Course Content

Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets with respect to application of AI & ML.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

Course Assessment Process

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:

Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:

• Rubric-based assessment for the project work and its report.

• Peer evaluation for project.

• Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
• Overall course grading based on a weighted average of individual assessments and participation.

The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

Multidisciplinary Minor
In
Internet of Things

For
B.Tech (Food Technology)

Shivaji University, Kolhapur
Department of Technology

Multidisciplinary Minor in Internet of Things

Teaching & Evaluation Scheme											
Sr. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Contact Hours**	**Credits**	**Evaluation scheme**	
									Theory	**Practical**
				L	**T**	**P**			**ISE:ESE**	**IE:EE**
1.	Preferably on SWAYAM(NPTEL) or any other MOOCs(Minor Program Core) Or In a Face-to-Face mode	MDM 3.1	Introduction to Internet of Things	03	-	-	03	03	30:70	00:00
2.		MDM 3.2	Embedded Systems for IoT	03	-	-	03	03	30:70	00:00
3.		MDM 3.3	IoT with Arduino, ESP, and Raspberry Pi	03	-	-	03	03	30:70	00:00
4.	Program Based Internship	MDM 3.4	Internship	One Month			-	03	-	50:50
5.	Project Based Learning	MDM 3.5	Mini Project	-	-	-	-	02	-	50:50
				-	**-**	**-**	**-**	**14**	**300**	**200**
			Total Hours	**09**	**00**	**00**	**09**	**-**	**-**	**-**

Note: MDM Program's Internship and Mini Project need to be planned during winter or summer vacation days after 4th semester while respective evaluations will be the part of 7th and 8th Semesters of the B.Tech Major structure.

Multidisciplinary Minor III: Internet of Things

Year, Program, Semester	Multidisciplinary Minor III, 4th Semester onwards						
Course Code	MDM 3.1						
Course Category	Minor Program Core						
Course title	**Introduction to Internet of Things**						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	03	-	-	03	03		
Evaluation Scheme	ISE	ESE	IOE	IPE	EOE	EPE	Total
	30	70	-	-	-	-	100
Pre-requisites(if any)	Knowledge of Embedded systems, microcontroller, computer networking						
Course Rationale	The Introduction to Internet of Things (IoT) course aims to provide students with a foundational understanding of the principles, technologies, and applications of the IoT. In the modern world, the proliferation of connected devices has become integral to various industries and daily life. This course is designed to equip students with the knowledge and skills necessary to comprehend, design, and implement IoT solutions. By exploring the fundamental concepts, architectures, and practical applications of IoT, students will be prepared to engage with the evolving landscape of connected systems.						
Course Objectives	1. To make students know the IoT ecosystem. 2. To provide an understanding of the technologies and the standards relating to the Internet of Things. 3. To develop skills on IoT technical planning. 4. To learn the basics of security and various types of security issues 5. To study different cryptography techniques available and various security attacks. 6. Explore network security and how they are implemented in real world.						
Course Outcomes	1. To understand the technology and standards relating to IoTs. 2. To understand the critical ecosystem required to mainstream IoTs. 3. To Acquire skills on developing their own national and enterprise level technical strategies. 4. Analyze and compare different IoT architectures and frameworks. 5. Select and configure appropriate sensors for specific IoT applications. 6. Identify and implement suitable communication protocols for IoT applications.						

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-
CO3	3	-	3	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-
CO6	2	-	-	-	-	-	-	-	-	-	-	-

Level of Mapping as: Low 1, Moderate 2,High3

Unit No.	Course Content	Hours
I	**Introduction to Internet of Things:** IoT& Web Technology: The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.	06
II	**M2M to IoT –** A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, an emerging industrial structure for IoT, the international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	06
III	**IoT Architecture -State of the Art –** Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views	06
IV	**IoT Applications for Value Creations** Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry,	06
V	**Internet of Things Privacy, Security and Governance** Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities, Security.	06
VI	**IoT application in different areas:** IOT for health application, IoT for Environment application	06

	ReferenceBooks
1.	NiteshDhanjani, Abusing the Internet of Things, Shroff Publisher/O'Reilly Publisher.
2.	Internet of Things, RMD SundaramShriram K Vasudevan, Abhishek S Nagarajan, John Wiley and Sons.
3.	Internet of Things, Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, John Wiley & Sons.
4.	Cuno Pfister, "Getting Started with the Internet of Things", Shroff Publisher/Maker Media.
5.	Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, A press Publications.
6.	Massimo Banzi, Michael Shiloh Make: Getting Started with the Arduino, Shroff Publisher/Maker Media Publishers.
Sr. No.	**Important web links**
1.	https://www.coursera.org/specializations/internet-of-things

Year, Program, Semester	Multidisciplinary Minor III, 4th Semester onwards							
Course Code	MDM 3.2							
Course Category	Minor Program Core							
Course title	**Embedded Systems for IoT**							
Teaching Scheme and Credits	L	T	P	TotalContactHours		TotalCredits		
	03	-		03		03		
Evaluation Scheme	ISE	ESE	IOE	IPE	EOE	EPE	Total	
	30	70	-	-	-	-	100	
Pre-requisites(if any)	Knowledge of Embedded systems, microcontroller, computer networking							
Course Rationale	The proliferation of the Internet of Things (IoT) has led to an increased demand for professionals skilled in designing and developing embedded systems tailored for IoT applications. This course is designed to provide students with a deep understanding of embedded systems and their integration within the IoT ecosystem. It aims to equip students with the knowledge and skills necessary to design, program, and optimize embedded systems for efficient communication, data processing, and control in IoT environments.							
Course Objectives	1. To make students know the basic concept and architecture of embedded systems. 2. Different design platforms used for an embedded system for IoT applications. 3. To have knowledge about the IoT enabled technology.							
Course Outcomes	1. Understand the embedded system concepts and architecture of embedded systems. 2. Understand the different hardware/software co-design techniques for microcontroller-based embedded systems, apply techniques in IoT applications. 3. Understand and implement communication protocols suitable for IoT devices. 4. To be able to design web/cloud based IoT applications. 5. Design and implement interfaces for connecting sensors and actuators to embedded system 6. Identify and address security challenges specific to embedded systems in IoT.							

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	-	2	2	-	-	-	-	-	-	-	-
CO 2	3	-		2	-	-	-	-	-	-	-	-
CO 3	3	-	2	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	-	3	-	3	-	-	-	-	-	-	-
CO 6	-	-	3	-	3	-	-	-	-	-	-	-

Level of Mapping as: Low 1,Moderate 2,High3

Unit No.	Course Content	Hours
I	**Purpose and requirement specification, IoT level specification**, Functional view specification, Operational view specification, Device and component integration, Pillars of Embedded IoT and Physical Devices: The internet of devices.	**06**
II	**Design of Embedded Systems:** Common Sensors, Actuators, Embedded Processors, Memory Architectures, Software architecture	**06**
III	**Inputs and Outputs**: Digital Inputs and Outputs, Digital Inputs, Digital Outputs, BusIn, BusOut, and BusInOut, Analog Inputs and Outputs, Analog Inputs, Analog Outputs, Pulse Width Modulation (PWM), Accelerometer and Magnetometer, SD Card, Local File System (LPC1768).	**06**
IV	**IoT Enabling Technologies**: Communications, RFID and NFC (Near-Field Communication), Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee, Z-Wave, LoRa, Protocols, HTTP, Web Socket, MQTT, CoAP, XMPP, Node-RED, Platforms, IBM Watson IoT—Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT, Thing Worx, GE Predix, Xively, macchina.io, Carriots.	**06**
V	**Web of Things and Cloud of Things**: Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Cloud of Things. IoT Physical Servers,	**06**
VI	**Cloud Offerings and IoT Case Studies**: Introduction to Cloud Storage Models, Communication API.	**06**

Reference Books	
1.	RMD SundaramShriram K Vasudevan, Abhishek S Nagarajan, Internet of Things, John Wiley and Sons.
2.	Klaus Elk, “Embedded Software for the IoT”.
3.	Elizabeth Gootman et. al, “Designing Connected Products”, Shroff Publisher/O’Reilly Publisher.
4.	Perry Xiao, “Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed”.
Sr. No.	**Important web links**
1.	https://www.coursera.org/learn/iot

Year, Program, Semester	Multidisciplinary Minor III, 4th Semester onwards						
Course Code	MDM 3.3						
Course Category	Minor Program Core						
Course title	IoT with Arduino, ESP, and Raspberry Pi						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	03	-	-	03	03		
Evaluation Scheme	ISE	ESE	IOE	IPE	EOE	EPE	Total
	30	70	-	-	-	-	100
Pre-requisites(if any)	Knowledge of Embedded systems, microcontroller, computer networking						
Course Rationale	The Internet of Things (IoT) has become a pivotal aspect of modern technology, and understanding how to create IoT solutions using popular platforms like Arduino, ESP (Espressif), and Raspberry Pi is essential. This course is designed to provide students with hands-on experience in building IoT applications using these widely used hardware platforms. It aims to enable students to design, develop, and deploy IoT projects by combining hardware, software, and connectivity elements.						
Course Objectives	To give students hands-on experience using different IoT architectures. 1. To provide skills for interfacing sensors and actuators with different IoT architectures. 2. To develop skills on data collection and logging in the cloud.						
Course Outcomes	1. To understand Arduino Uno, NODE MCU 8266 and Raspberry PI along with critical protocols and its communication to cloud. 2. To apply commonly used IOT protocols such as REST API, MQTT through IOT based demonstration. 3. To solve analog sensor and digital sensor Interfacing with IOT devices. 4. Program ESP devices for IoT applications, including setting up wireless connectivity. 5. Use Raspberry Pi as an IoT gateway and implement data processing tasks. 6. Successfully integrate sensors and actuators with the chosen platforms to achieve specific IoT functionalities.						

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	-	2	2	-	-	-	-	-	-	-	-
CO 2	3	-		2	-	-	-	-	-	-	-	-
CO 3	3	-	2	-	-	-	-	-	-	-	-	-
CO 4	-	-	3	-		-	-	-	-	-	-	-
CO 5	-	-	3	-	3	-	-	-	-	-	-	-
CO 6	-	-	-	-	3	-	-	-	-	-	-	-

Level of Mapping as: Low1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**IoT- introduction and its components** IoT building blocks, Sensors and Actuators, IoT Devices, IoT boards (Arduino Uno, ESP 8266-12E Node MCU, and Raspberry Pi 3).	06
II	**Arduino Uno – getting started with the Uno boards** blink program, connection of sensors to the Uno board, reading values of sensors from the Uno board, interrupts. Case study: Temperature/Humidity Control; Case Study: Sending values Temperature/Humidity values to the Internet via GSM module	06
III	**ESP 8266-12E Node MCU – getting started with the ESP board** Micropython and Esplorer IDE, Flushing the ESP8266 board with micropython, connecting sensors to the ESP board, Connecting ESP board to WiFi, Interfacing ESP with the Cloud (REST API-GET, POST, MQTT), interrupts, comparison of ESP 32 board with the ESP 8266 board. Case Study: Switching light on /off remotely. Case Study: Voice-based Home Automation for switching lights on/off (Android phone – Google Assistant (Assistant <-> IFTTT), MQTT (ESP <-> IFTTT), ESP 8266 <-> Lights).	06
IV	**Raspberry Pi 3 - Rpi3 introduction and installing the Raspbian Stretch OS** Headless - Computer and Rpi3 configuration to connect through SSH via Ethernet, Headless - connecting Rpi3 remotely without Ethernet cable via SSH, IP address, Rpi 3 - Testing the GPIO pins through Scripts.	06
V	**Raspberry pi3 interfacing with Sensor** DHT11, Raspberry pi3 python library install and reading sensor feed, 'Plug and play ' type cloud platform overview for integration to IOT devices, 'Plug and play' cloud platform for integration to IOT device - actuator (LED), Plug and play platform - Custom widget (DHT11-Sensor) integration through Python. New - Raspeberry Pi 4 Vs Raspberry Pi3 Mobel B Comparison, LoRawan /LPWAN – Overview.	06
VI	**IoT Case Studies:** Introduction to Cloud Storage Models, Communication API.	06

Reference Books	
1.	. Rao, M. (2018). Internet of Things with Raspberry Pi 3: Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects. Packt Publishing Ltd
2.	Baichtal, J. (2013). Arduino for beginners: essential skills every maker needs. Pearson Education.
3.	Schwartz, M. (2016). Internet of Things with ESP8266. Packt Publishing Ltd.
4.	Richardson, M., & Wallace, S. (2012). Getting started with raspberry PI. " O'Reilly Publisher Media, Inc."
Sr. No.	**Important web links**
1.	https://www.coursera.org/learn/iot

Year, Program, Semester	Multidisciplinary Minor III, 4th Semester onwards						
Course Code	MDM 3.4						
Course Category	Minor Program Based Internship						
Course title	**Industry Internship**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	One Month					03	
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00	50	-	50	-	100
Pre-requisites(if any)	Prerequisites for this course typically include a solid background in digital electronics, microcontrollers						
Course Rationale	The course caters special need of B.Tech Food technology students to upgrade themselves with respect to internet of things aspects. The course offers practical exposure to industry settings aligned with their chosen area of interest, aiming to bridge the gap between theoretical knowledge and practical application. By engaging in a one-month internship, students gain firsthand experience, essential skills, and insights crucial for their future careers in piping design engineering.						
Course Objectives	The course teacher will 1. Help expose students to the 'real' working environment. 2. Promote hands-on experience to the students' in their related field. 3. Develop synergetic collaboration between industry and the university in promoting a knowledgeable society. 4. Elaborate the dynamic and challenging nature of industrial environments.						
Course Outcomes	Upon completion of this course, student should be able to 1. Understand industrial processes and operations related to piping design. 2. Apply theoretical concepts to solve practical problems in the industry. 3. Communicate effectively with industry professionals, colleagues, and supervisors. 4. Collaborate efficiently in team environments to complete tasks and projects. 5. Adapt to the dynamic and challenging nature of industrial environments. 6. Reflect on internship experiences for personal and professional growth.						

Course Outcome and Program Outcome Mapping

CO/PO	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	1	-	-	-	-	-	-	3	-
CO 2	3	2	3	3	-	-	-	-	-	-	3	-
CO 3	3	2	3	3	3	-	-	-	-	-	3	-
CO 4	3	1	3	3		-	-	-	-	-	3	-
CO 5	3	3		1		2	-	-	-	-	3	-
CO 6	3	2	3	3	3	-	-	-	-	-	3	3
PSO1	3	3	3	3	2	-	-	-	-	-	1	-
PSO2	3	3	1	3	2	-	-	-	-	-	2	-

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

Course Content	Hours
The course consists of a one-month internship in a relevant sector to undergo tasks with respect to piping design. Students will be placed in companies or organizations that align with their chosen MDM within the field of chemical engineering. During the internship, students will engage in various activities, including but not limited to: 1. Shadowing industry professionals to observe and learn about different processes and operations. 2. Assisting with ongoing projects or research initiatives within the organization. 3. Participating in hands-on tasks related to their minor sub-specialization, under the guidance of experienced mentors. 4. Attending training sessions, workshops, and seminars conducted by the industry to enhance their knowledge and skills. 5. Engaging in discussions and meetings with supervisors and colleagues to gain insights into industry practices, challenges, and innovations. 6. Documenting their internship experience through reports, presentations, or reflective journals. The period of one month for this internship will be during the winter or summer vacations, any such slots 4th Semester onwards.	4 weeks

Course Evaluation Method

This particular evaluation will be the part of the structure of 7th Semester.

The evaluation for the Industrial Internship course will be conducted as follows:

- **Internal Evaluation (50 marks):**
  Assessment by course teachers based on students' performance during the internship, including attendance, participation, attitude, and contribution to assigned tasks.
  Evaluation by industrial supervisors on students' professional conduct, technical skills, problem-solving abilities, and overall performance in the workplace.
- **External Evaluation (50 marks):**
  Evaluation by an external examiner appointed by the institute, who will assess students' internship reports, presentations, or any other documentation submitted at the end of the internship period.
  The external examiner will review the quality of students' reflections on their internship experience, their ability to apply theoretical knowledge to practical situations, and the depth of their understanding of industry practices and challenges.

The final grades for the Industrial Internship course will be determined based on the combined assessment from both internal and external evaluations.

Reference Books

1.	Articles from reputed journals, magazines, websites, real world problems, case studies, Survey reports
2.	Institute’s Laboratory Course Manual and equipment wise Standard Operating Procedure to follow.

Year, Program, Semester	Multidisciplinary Minor III, 4th Semester onwards						
Course Code	MDM 3.5						
Course Category	Project Based Learning						
Course Title	**Mini Project**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	-	-	-	-		02	
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.						
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this field project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena for piping design engineering.						
Course Objectives	The course teacher will 1. Facilitate application of theoretical knowledge. 2. Guide the students about enhancement of practical skills. 3. Explain about development of industry-relevant competencies.						
Course Outcomes	Upon completion of this course, student should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.						

Course Outcome and Program Outcome Mapping

CO/PO	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	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

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

Course Content

Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets with respect to application of piping design basics.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

Course Assessment Process

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:

Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:
• Rubric-based assessment for the project work and its report.
• Peer evaluation for project.
• Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
• Overall course grading based on a weighted average of individual assessments and participation.
The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

Shivaji University

Vidya Nagar, Kolhapur, Maharashtra 416004

Department of Technology

As per NEP2020 guidelines

Exit after SY B. Tech (Food Technology) Claim for Diploma, Curriculum w.e.f. 2023-24 and onwards

Shivaji University, Kolhapur

Department of Technology

B. Tech (Food Technology), Exit after Second Year (Diploma in Food technology)

Teaching & Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1	SWAYAM (NPTEL) or any other MOOCs Or In face to face mode (Program Core Courses))	DC- FT 1	Fundamentals of Food Technology	02	-	-	02	02	30:70	00:00
2		DC- FT 2	Basics of Food Analysis	02	-	-	02	02	30:70	00:00
3		DC- FT 3	Introduction to Food Safety	02	-	-	02	02	30:70	00:00
4	Program Based Internship	DC-PBI	In-plant Training	One Month				04	00:00	50:50
							-	**10***	**300****	**100**
			Total Hours	**06**	**-**	**-**	**06**	**-**		

Note: The Workload against the Diploma Course will be finalised at the Program Level considering the strength of the students seeking for the Diploma.

*Obtaining these credits will be in addition to 85 regular credits up to SY B. Tech. Also in such cases, acquiring certificate after First Year is mandatory.

** There is an option for End Semester Examination either on respective MOOC platform if any or through the University System.

Note: Program Specific Industry Internship to be completed by such students before commencement of TY B. Tech.

Year, Program, Semester	Exit after SY B. Tech (Food Technology) Claim for Diploma				
Course Code	DC - FT 1				
Course Category	Diploma in Food Technology				
Course title	**Fundamentals of Food Technology**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	02	-	-	02	02
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites(if any)	Prerequisites for this course typically include the knowledge of basic science				
Course Rationale	The course provides knowledge about the basic concepts of various areas of food technology. After learning this course student will be able to understand the advanced subjects in food technology.				
Course Objectives	The course teacher will ensure to- 1. Explain the basic concept of food technology 2. Explore the principles of various core areas of food technology 3. Describe the processed products based on plant or animal origin 4. Illustrate the handling of various plant and animal based raw material 5. State the roles of food and its function 6. Explain the characteristics of certain food products				
Course Outcomes	By the end of the course, the students will be able to- 1. Interpret the knowledge of various food sectors 2. Know the importance of plant and animal based raw material for further processing 3. Asses the application of processing in increasing shelf life 4. Design the product based on extended shelf life 5. Develop nutrition rich food products 6. Create value added food products with different resources				

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	1	2	1				
CO 2	1	3	2	2	3	3	3	1				
CO 3	1	2	3	1	3	2	1	2				
CO 4	2	1	1	1	2	3	2	2				

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

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

Unit No.	Course Content	Hours
I	**Overview of food** • Food and its function • Physico-chemical properties of foods • Food preparation techniques • Relation of nutrition to good health • Characteristics of well and malnourished population	04
II	**Cereals and Millets**- • Structure and composition of cereals • Wheat- structure and composition, types (hard, soft/ strong, weak) Diagrammatic representation of longitudinal structure of wheat grain. • Malting, gelatinization of starch, types of browning- Maillard & caramelization. • Rice- structure and composition, parboiling of rice- advantages and disadvantages.	04
III	**Pulses** • Structure and composition of pulses, toxic constituents in pulses, processing of pulses- • soaking, germination, decortications, cooking and fermentation	04
IV	**Fruits and Vegetables** • Classification of fruits and vegetables, general composition, enzymatic browning, names and sources of pigments, Dietary fiber. • Post-harvest changes in fruits and vegetables – Climacteric rise, horticultural maturity, Physiological maturity • Physiological changes, physical changes, chemical changes, pathological changes during the storage of fruits and vegetables.	04
V	**Milk and Milk Products** • Definition of milk, chemical composition of milk, its constituents, processing of milk, pasteurization, homogenization. • An overview of types of market milk and milk products.	04
VI	**Flesh Foods - Meat, Fish, Poultry** • Meat - Definition of carcass, concept of red meat and white meat, composition of meat, marbling, and post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat. • Fish - Classification of fish (fresh water and marine), aquaculture , composition of fish, characteristics of fresh fish, spoilage of fish- microbiological, physiological, biochemical.	04

	• Poultry - Structure of hen's egg, composition and nutritive value, egg proteins, characteristics of fresh egg, deterioration of egg quality, difference between broiler and layers.	

Sr.no.	**Text Book**
1.	Post-harvest technology of cereals, pulses and oilseeds by A. Chakraverty.
2.	Shrivastava and Kunal. "Fruit and Vegetable Preservation"
3.	De Sukumar., Outlines of Dairy Technology, Oxford University Press, 2007
4.	Khetarpaul Neelam, Grewal Raj Bala and Sudesh Jood (2013). Bakery Science and Cereal Technology. Daya Publishing House
5.	Swaminathan, N. (1987). Food Science and experimental foods. Ganesh Publications, Madras.
Sr.no.	**Reference Books**
1.	Swaminathan, M. (2006). Advanced Text Book on Food and Nutrition (Volume I and II). The Bangalore Printing and Publishing Co. Ltd., Bangalore.
2.	Roday,S. Food Science, Oxford publication, 2011.
3.	B. Srilakshmi, Food science, New Age Publishers,2002
4.	Meyer, Food Chemistry, New Age,2004
Sr. No.	**Important web links**
1.	http://ecoursesonline.iasri.res.in/course/view.php?id=131
2.	https://elearning.icar.gov.in

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Exit after SY B. Tech (Food Technology) Claim for Diploma</td></tr>
<tr><td>Course Code</td><td colspan="5">DC-FT 2</td></tr>
<tr><td>Course Category</td><td colspan="5">Diploma in Food Technology</td></tr>
<tr><td>Course title</td><td colspan="5">Basics in Food Analysis</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">ISE:30</td><td colspan="2">ESE: 70</td><td>Total=100</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="5">The Basics of Food Analysis course requires foundational knowledge in Chemistry and Microbiology</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The Basics of Food Analysis course equips essential skills for analyzing food samples accurately, ensuring food safety, quality, and regulatory compliance. It covers analytical chemistry principles, sampling techniques for reliable results, and proximate analysis methods for assessing food quality and stability.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-
1. Introduce the definition and importance of food analysis, including its role in ensuring food safety and quality
2. Explain the fundamental principles of analytical chemistry and the various techniques used in food analysis
3. Describe the significance of representative sampling techniques and factors influencing sample representativeness
4. Help to gain knowledge of proximate analysis methods for determining moisture, ash, fat, and protein content in food samples and their implications for food quality and stability
5. Help to acquire proficiency in analyzing carbohydrates and fiber in food, including techniques for total carbohydrate determination and fiber analysis, and understand their role in assessing dietary energy and composition
6. Explore the microbiological analysis techniques for enumerating microorganisms and detecting foodborne pathogens, essential for evaluating food safety</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-
1. Demonstrate a clear understanding of the definition, importance, and regulatory requirements of food analysis.
2. Apply basic principles of analytical chemistry to effectively utilize various techniques in food analysis
3. Implement appropriate sampling techniques to obtain representative samples and minimize sampling errors
4. Conduct proximate analysis of food samples, including moisture determination, ash content determination, crude fat analysis, and protein analysis, and interpret the results accurately
5. Perform analysis of carbohydrates and fiber in food using suitable techniques, and interpret the results to assess dietary energy and fiber content
6. Utilize microbiological analysis techniques to enumerate microorganisms and detect foodborne pathogens, ensuring food safety compliance</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 1	PO 11	PO 12
CO 1	3	2	2	2	2	2	1	2	2	2	1	1
CO 2	2	2	2	2	3	2	1	2	2	2	1	1
CO 3	2	2	3	2	2	2	1	2	2	2	1	1
CO 4	2	2	2	3	2	2	1	2	2	2	1	1
CO 5	2	2	2	2	3	2	1	2	2	2	1	1
CO 6	2	2	2	2	3	2	1	2	2	2	1	1

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

Unit No.	Course Content	Hours
I.	**Introduction to Food Analysis** • Overview of Food Analysis: Definition and importance, Role in ensuring food safety and quality, Regulatory requirements and standards • Principles of Food Analysis: Basic principles of analytical chemistry, Techniques used in food analysis	04
II.	**Sampling Techniques** • Importance of representative sampling • Methods for obtaining representative samples • Factors affecting sample representativeness	04
III.	**Proximate Analysis of Food** • Moisture Determination: Methods for moisture content determination (e.g., oven drying, Karl Fischer titration), Importance in food quality and stability • Determination of Ash Content: Techniques for ash determination (e.g., dry ashing, wet ashing) • Crude Fat Analysis: Extraction methods for fat determination (e.g., Soxhlet extraction, solvent extraction) • Protein Analysis: Methods for protein determination (e.g., Kjeldahl method, Dumas method)	04
IV.	**Analysis of Carbohydrates and Fiber** • Total Carbohydrate Determination: Techniques for total carbohydrate analysis (e.g., enzymatic methods, spectrophotometry), Role in assessing dietary energy and carbohydrate content • Fiber Analysis: Methods for dietary fiber determination (e.g., gravimetric methods, enzymatic-gravimetric methods)	04
V.	**Microbiological Analysis** • Techniques for microbial enumeration (e.g., plate count, MPN method) • Detection of foodborne pathogens (e.g., PCR, immunological methods)	04
VI.	**Sensory Analysis in Food Evaluation** • Importance of sensory evaluation in food analysis	04

	• Requirements of Sensory Evaluation • Methods of Sensory Evaluation Techniques	

Sr. No.	**Reference Books/Text Book**
1	White, W. B. (1957). AOAC Method of Analysis. Food Drug Cosm. LJ, 12, 327.
2	Nielsen, S. S. (2017). Introduction to food analysis. Food analysis, 3-16.
3	Baur, F. J., & Ensminger, L. G. (1977). The association of official analytical chemists (AOAC). Journal of the American Oil Chemists' Society, 54(4), 171-172.
4	Aurand, L. W. (Ed.). (2013). Food composition and analysis. Springer Science & Business Media.
Sr. No.	**Important web links**
1	https://fssai.gov.in/cms/manuals-of-methods-of-analysis-for-various-food-products.php

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Exit after SY B. Tech (Food Technology) Claim for Diploma</td></tr>
<tr><td>Course Code</td><td colspan="5">DC-FT 3</td></tr>
<tr><td>Course Category</td><td colspan="5">Diploma in Food Technology</td></tr>
<tr><td>Course title</td><td colspan="5">Introduction to food safety</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">ISE:30</td><td colspan="2">ESE: 70</td><td>Total=100</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="5">The course requires foundational knowledge in Chemistry and Microbiology</td></tr>
<tr><td>Course Rationale</td><td colspan="5">This course covers the food safety including current issues regarding microbiological threats from food, origins of foodborne illnesses, and the mitigation of biological, chemical, and physical threats through the use of Hazard Analysis and Critical Control Point (HACCP), Food Safety regulations.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The course teacher will ensure to-

1. Introduce Food safety system is to prevent illnesses by focusing food-manufacturing attention and activities on preventing or minimizing exposure of the consumer to pathogens.
2. Recognize the importance of food safety to ensure public health.
3. Describe the role of federal agencies in regulating and monitoring food safety.
4. Explain potential biological, chemical and physical hazards that pose a food safety challenges to food products.
5. Describe the principles of HACCP and its prerequisite programs (GMPs, SOPs, and SSOPs) as a tool for controlling safety problems in food production.
6. Explore the fundamentals of food safety and environmental sanitation</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">By the end of the course, the students will be able to-

1. Remembering causes of food borne illnesses.
2. Understanding the growth and prevention of disease causing bacteria, foodborne illnesses, and suspect foods in a commercial kitchen.
3. Applying proper techniques for storing supplies.
4. Analyzing proper handling techniques for potentially hazardous foods.
5. Justify proper hygienic requirements for food handlers and food poisoning, chemical food poisoning, and food infection.
6. Create a HACCP plan.</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 1	PO 11	PO 12
CO 1	3	3	3	3	3	3	2	2	2	2	1	1
CO 2	3	3	3	3	3	2	2	2	2	1	1	
CO 3	3	3	3	3	3	3	2	1	2	2		2
CO 4	3	3	3	3	3	3	3	2			2	2
CO 5	3	3	3	2	3	2	3		2	1		
CO 6	3	2	3	3	3	3	2	2	2	1	2	2

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

Unit No.	Course Content	Hours
I.	**Introduction to food safety** Introduction to food safety and safe food, importance of food safety, Historical perspectives of food safety, Significance of food safety, naturally-occurring & environmental contaminants, and toxicants. Factors affecting food safety through the supply chain, Hazards to Safe Food.	04
II.	**Contamination and Spoilage** Sources of contaminants- physical, chemical and microbial hazards in foods, prevention of food contamination, Identify the types of food contamination and their sources, Food spoilage, principles underlying spoilage- chemical changes caused by microorganisms in: Cereals, pulses and their products, Vegetables and fruits, Flesh foods, eggs and poultry, Milk and milk products, Food adulteration, types of adulteration in common foods, impact on human health and tests to detect common adulterants and ad-mixtures.	04
III.	**Regulatory framework and standards** Government agencies and their roles, FDA, USDA (United States Department of Agriculture), CDC (Centres for disease control and prevention), WHO (World Health Organization), Current Status and Future Needs of food safety, Food Safety Challenge, Developing a Food Safety Plan.	04
IV.	**Food Safety Regulations** Food safety management systems- Importance and application of food regulation in the Indian and Global context, responsibilities for maintaining and enforcing food safety FSSAI, CODEX ALIMENTARIUS, HACCP, ISO 22000 series, TQM and codes of GMP. Auditing and accreditation (BIS, QCI, AGMARK etc). Food safety management systems (FSMS)	04
V.	**Importance of personal hygiene** Importance of personal hygiene, Basic rules regarding personal hygiene, personal cleanliness, Food hygiene, Foodborne Illnesses , Causes of	04

Year, Program, Semester	Exit after Second Year of B. Tech (Food technology), Diploma Claim

	Foodborne Illnesses, The principal causes of food borne illness, The principal symptoms of food borne illness, Food borne illness affects consumers and retailers, Poor safety practices affect food products, Food safety procedures in retail stores, Preventing food borne illness	
VI.	**Assessment of food safety** General and acute toxicity – Mutagenicity and carcinogenicity. Additives (Intention – direct) – Preservatives – antioxidants, sweeteners, flavors, colours, vitamins, stabilizers – indirect additives – organic resides – inorganic residues and contaminants. Food allergy, food intolerance, contaminants of processed foods, solvent residue, contaminants of smoked foods. Cleaner production in food industry, fruit and vegetable processing, sea food processing, brewing and wine processing.	04

Sr. No.	**Reference Books/Text Book**
1	Julie Lewthwaite . (2012). An Introduction to Food Safety, Kindle Edition.
2	Roday, S. 1998. Food Hygiene and Sanitation, Tata McGraw-Hill Education.
3	Yasmine Motarjemi (2013) Encyclopedia of Food Safety ,ISBN: 0123786134
4	Ram Lakhan Singh, SukantaMondal (2019), Food Safety and Human Health,Elsevier Science, ISBN:9780128163344, 0128163348.
5	Paul Knechtges (2012), Food Safety: Theory and Practice,Jones & Bartlett Learning, ISBN:9780763785567, 0763785563.
Sr. No.	**Important web links**
1	https://www.intechopen.com/chapters/88421
2	https://egyankosh.ac.in/bitstream/123456789/42837/1/Unit-1.pdf
3	https://www.ficsi.in/blog/an-introduction-to-food-safety-guidelines/

Course Code	DC-PBI						
Course Category	Course for Diploma in Food Technology						
Course title	**In Plant Training**						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	One Month				04		
Evaluation Scheme	ISE	ESE	IOE	IPE	EOE	EPE	Total
	-	-	50	-	50	-	100
Pre-requisites(if any)	Completion of All the course of FY B. Tech Food Technology Major, also the completion of all the courses to claim Certificate in Food Technology.						
Course Rationale	The purpose of the In Plant Training course is to provide students with practical exposure to the food technology industry. This hands-on experience allows students to apply theoretical knowledge gained in the classroom to real-world scenarios. By engaging in industrial training, students develop essential skills, gain industry insights, and enhance their employability in the food technology field.						
Course Objectives	The training will ensure students 1. To gain practical exposure to industrial processes in food technology.						
Course Outcomes	Upon completion of the In-Plant Training course, students will be able to 1. Understand industrial processes in food technology. 2. Apply theoretical knowledge to practical situations. 3. Utilize tools and techniques effectively in experiments. 4. Identify and mitigate workplace safety hazards. 5. Collaborate effectively in multidisciplinary teams. 6. Communicate findings professionally.						

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	-	-	-	-	-	-	-	-	-	-
CO 3	-	-	2	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	2	-	-	-	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	3	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	3	-	-

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

Course Content

The In-Plant Training course encompasses a comprehensive blend of theoretical learning and hands-on experience in an industrial setting. The course content includes:

1. Introduction to Food technology Industry: Overview of different sectors, processes, and applications within the food technology domain.
2. Safety Procedures and Protocols: Training on safety regulations, hazard identification, emergency procedures, and personal protective equipment (PPE) usage.
3. Equipment Familiarization: Hands-on experience with common equipment and instrumentation used in food technology processes, including pumps, reactors, distillation columns, and control systems.
4. Process Simulation and Optimization: Practical exercises on process simulation software and optimization techniques to enhance efficiency and productivity.
5. Troubleshooting and Maintenance: Practical sessions on diagnosing and resolving equipment malfunctions, conducting routine maintenance, and ensuring operational integrity.
6. Industrial Visits and Guest Lectures: Field trips to industrial facilities and guest lectures by industry experts to provide first hand insights into real-world applications and challenges.
7. Project Work: Collaborative projects or case studies addressing specific engineering problems or process improvements relevant to the host industry.
8. Evaluation and Assessment: Continuous evaluation based on performance during training, report submissions with the components of the report has been separately mentioned under Evaluation Method.

Evaluation Method

1. **Attendance and Participation:** Regular attendance and active participation in training sessions, workshops, and industrial visits will be monitored.
2. **Skills Assessment:** Evaluation of practical skills demonstrated during hands-on training activities, including equipment operation, experimentation, troubleshooting, and safety compliance.
3. **Performance Review:** Ongoing assessment of individual and group performance based on assigned tasks, projects, and team collaborations.
4. **Supervisor Feedback:** Feedback from industry supervisors regarding student performance, professionalism, attitude, and adaptability in the workplace.
5. **Training Report:** Submission of a comprehensive training report summarizing the learning outcomes, experiences, observations, and insights gained during the In Plant Training period.

Training Report Format: The training report should follow a structured format to ensure clarity,

coherence, and completeness. Here's a suggested outline:

1. **Title Page:**
    - Title of the report: "In Plant Training Report"
    - Student's name
    - Enrolment number
    - Department/Program
    - Name of the institution
    - Duration of the training period
    - Name and address of the host industry
2. **Acknowledgments (Optional):**
    - Acknowledge any individuals, organizations, or institutions that contributed to the training experience.
3. **Table of Contents:**
    - List of sections and subsections with corresponding page numbers.
4. **Introduction:**
    - Brief overview of the training objectives, scope, and significance.
    - Description of the host industry and the specific department or division where the training was conducted.
5. **Training Objectives:**
    - Recapitulation of the objectives outlined at the beginning of the training period.
6. **Training Activities:**
    - Detailed account of the activities undertaken during the training, including:
        - Description of the tasks assigned and responsibilities undertaken.
        - Summary of workshops, seminars, industrial visits, and hands-on training sessions participated in.
        - Highlights of any notable experiences, challenges faced, and lessons learned.
7. **Skills Acquired:**
    - Discussion of the practical skills and knowledge gained throughout the training period.
    - Reflection on the application of theoretical concepts in real-world industrial scenarios.
8. **Observations and Insights:**
    - Analysis of observations made during the training, including:
        - Observations regarding industry practices, processes, and technologies.
        - Insights into workplace dynamics, organizational culture, and professional etiquettes.
        - Suggestions for improvement or areas of further learning identified during the training.
9. **Conclusion:**
    - Summary of key takeaways and learning outcomes from the training experience.
10. **References:**

- List of sources referenced or consulted during the preparation of the report (if applicable).

11. **Appendices (Optional):**
    - Additional materials such as photographs, diagrams, charts, or supplementary documents supporting the content of the report.
12. **Declaration:**
    - Statement affirming the authenticity and originality of the report, along with the student's signature and date.

The training report should be well-organized, concise, and professionally presented, demonstrating the student's ability to articulate their learning experiences and insights gained during the In-Plant Training period.

Reference Books	
1.	"Introduction to Food Engineering" by R. Paul Singh and Dennis R. Heldman
2.	"Food Safety Management: A Practical Guide for the Food Industry" edited by Yasmine Motarjemi
3.	Quality Control for the Food Industry" by A. Krammer and B. Ainsworth
4.	Food Industry Quality Control Systems" by Mark Clute
5.	Food Processing Technology: Principles and Practice" by P.J. Fellows
6.	Dairy Processing and Quality Assurance" by Ramesh C. Chandan, Arun Kilara, and Nagendra P. Shah
Useful web links	
1.	www.internshala.com

Shivaji University
Vidya Nagar, Kolhapur, Maharashtra 416004

Department of Technology

As per NEP2020 guidelines

MDM Featured B. Tech (Food Technology) Honor and Honor with Research, Detailed Curriculum

Shivaji University, Kolhapur

Department of Technology

MDM Featured B. Tech (Food Technology) with Honors

Teaching and Evaluation Scheme

S.N.	Category	Code	Course Title				Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1	SWAYAM (NPTEL) Or any other MOOCs (Program Core Courses) or Self-study mode with University's End Semester Examination	HN-1	Research Methodology	03	-	-	03	03	30:70	00:00
2		HN-2	Total Quality Management	03	-	-	03	03	30:70	00:00
3		HN-3	Applications of Nanotechnology in Food Technology	03	-	-	03	03	30:70	00:00
4		HN-4	Nutraceuticals and Functional Foods	03	-	-	03	03	30:70	00:00
5		HN-5	Extrusion Technology	03	-	-	03	03	30:70	00:00
6	Ability Enhancement Course	HN-AEC1	Advanced Laboratory Practice	-	-	04	04	02	-	50:50
				-	-	-	-	**17**	**500**	**100**
			Total Hours	**15**	-	**04**	**19**	-	-	-

.

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">B. Tech Food Technology (Honors/Honors with Research)</td></tr>
<tr><td>Course Code</td><td colspan="5">HN-1</td></tr>
<tr><td>Course Category</td><td colspan="5">Program Core</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>03</td><td>-</td><td>-</td><td>03</td><td>03</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td>ISE</td><td>ESE</td><td>IE</td><td>EE</td><td>Total</td></tr>
<tr><td>30</td><td>70</td><td>--</td><td>--</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">NA</td></tr>
<tr><td>Course Rationale</td><td colspan="5">The course is designed to equip students with the necessary knowledge and skills to conduct research effectively in engineering fields. The course will cover various aspects of research design, data collection, analysis, and reporting. Emphasis will be placed on understanding different research methodologies, ethical considerations, literature review techniques, and research proposal development.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The Course Teacher will
1. Introduce diverse research methodologies and approaches in scientific inquiry.
2. Foster critical thinking and analytical skills essential for research.
3. Offer practical guidance in designing research studies, including formulating questions and hypotheses.
4. Develop skills in conducting literature reviews, data analysis, and interpreting findings.
5. Instill ethical research practices and integrity in the research process.
6. Prepare students for effective communication of research findings through presentations, reports, and scholarly publications.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">Upon completion of this course, student should be able to
1. Understand various research methodologies, encompassing quantitative, qualitative, and mixed methods approaches.
2. Assess existing research literature, pinpointing gaps, and formulate pertinent research questions and hypotheses.
3. Demonstrate proficiency in research design, encompassing the selection of appropriate methodologies, sampling techniques, and data collection methods.
4. Acquire practical skills in data analysis techniques, including statistical analysis, qualitative coding, and thematic analysis.</td></tr>
</table>

	5. Uphold ethical guidelines and principles in research, encompassing obtaining informed consent, ensuring confidentiality, and preventing plagiarism. 6. Effectively communicate research findings through written reports, oral presentations, and academic publications.

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	-	3	2	-	1	-	3	-	3	-	-
CO 2	-	3	-	3	-	-	-	-	-	3	-	2
CO 3	-	3	3	2	-	-	2	-	1	-	3	-
CO 4	-	2	-	3	3	-	-	1	-	-	3	-
CO 5	-	-	-	-	3	-	-	3	-	-	-	-
CO 6	-	-	-	-	-	3	-	-	3	3	-	3

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

Unit No.	Course Content	Hours
I	**Introduction to Research Methodology:** Understanding the Research Process, Importance of Research in Engineering, Types of Research: Basic vs. Applied, Quantitative vs. Qualitative, Research Paradigms: Positivism, Interpretivism, Pragmatism, Formulating Research Questions and Objectives, Literature Review: Search Strategies, Critical Analysis, Research Ethics and Integrity, Research Design: Experimental, Descriptive, Exploratory, Case Study.	06
II	**Research Design and Sampling Techniques:** Research Variables and Hypothesis Formulation, Experimental Design: Control Groups, Randomization, Replication, Survey Design: Questionnaire Construction, Scaling Techniques, Sampling Methods: Probability Sampling, Non-probability Sampling, Sample Size Determination and Power Analysis, Case Study Research Design, Qualitative Research Design: Interviews, Focus Groups, Observations, Mixed-Methods Research Design.	06
III	**Data Collection and Analysis: Data Collection Techniques:** Surveys, Interviews, Observations, Experiments, Instrumentation and Measurement Tools, Data Quality and Validation, Data Analysis Methods: Descriptive Statistics, Inferential Statistics, Statistical Software Tools: SPSS, R, MATLAB, Qualitative Data Analysis: Coding, Theme Analysis, Narrative Analysis.	06
IV	**Research Proposal Development:** Components of a Research Proposal: Title, Abstract, Introduction, Literature Review, Methodology, Timeline, Budget, Writing and Organizing a Research Proposal, Proposal Review Process and Feedback Incorporation, Presentation Skills for Research Proposals, Grant Writing Techniques and Funding Opportunities, Ethical Considerations in	06

	Research Proposal Development.	
V	**Advanced Research Methods:** Longitudinal and Cross-Sectional Studies, Meta-Analysis and Systematic Reviews, Action Research and Participatory Research, Simulation and Modeling Techniques, Big Data Analytics in Engineering Research, Emerging Trends in Research Methodology.	**06**
VI	**Research Project Management and Publication:** Project Planning and Time Management, Collaboration and Teamwork in Research Projects, Data Management and Documentation, Intellectual Property Rights and Patents, Writing and Publishing Research Papers, Peer Review Process and Journal Selection.	**06**
Text Books		
1.	Creswell, J. W., & Creswell, J. D. (2017). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. SAGE Publications.	
2.	Bryman, A., & Bell, E. (2015). Business Research Methods, Oxford University Press.	
3.	Kumar, R. (2019). Research Methodology: A Step-by-Step Guide for Beginners, SAGE Publications.	
Reference Books		
1.	Neuman, W. L. (2013). Social Research Methods: Qualitative and Quantitative Approaches. Pearson.	
2.	Kothari, C. R. Garg, G. (2019). Research Methodology: Methods and Techniques, 5th Edition, New Age Int. Publisher.	
Useful web links		
1.	https://www.researchgate.net/topic/Research-Methodology	
2.	https://www.coursera.org/learn/research-methods	
3.	https://www.socialresearchmethods.net/kb	
4.	https://onlinecourses.nptel.ac.in/noc23_ge36/preview	

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">B. Tech Food Technology (Honors/Honors with Research)</td></tr>
<tr><td>Course Code</td><td colspan="5">HN- 2</td></tr>
<tr><td>Course Category</td><td colspan="5">Program Core</td></tr>
<tr><td>Course Title</td><td colspan="5">Total Quality Management</td></tr>
<tr><td>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>03</td><td>-</td><td>-</td><td>03</td><td>03</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">ISE:30</td><td colspan="2">ESE: 70</td><td>Total = 100</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">TQM approach in education involves not only achieving high quality but also influencing all segments of the educational process: organization, management, interpersonal relations, material and human resources, etc. TQM is an evolving concept that changes as new concepts and methods which develops.</td></tr>
<tr><td>Course Rational</td><td colspan="5">This course introduces students to the concepts, tools, and techniques used in Total Quality Management, quality cultures, and effective team structures, measurement of quality, productivity, and competitiveness in an industrial environment.</td></tr>
<tr><td>Course Objective</td><td colspan="5">The course teacher will
1. Enable students to understand the importance of quality in modern business scenarios to individuals, organizations, customers, suppliers, and society.
2. Identify and describe the key components and challenges of total quality management (TQM) and understand how organizations approach TQM deployment.
3. Acknowledge the role of attitudes, beliefs, behaviours, and ethics on quality.
4. Differentiate between quality assurance and quality control.
5. Familiarize students with effectiveness and efficiency principles as related to quality, productivity, and supply chain management.
6. Demonstrate problem solving with the use of quality tools</td></tr>
<tr><td>Course Outcome</td><td colspan="5">Students will be able to
1. Apply the Quality Function Deployment, Taguchi principles, Total</td></tr>
</table>

	Productive Maintenance and Failure Mode and Effect Analysis concepts to solve industrial problems. 2. Differentiate between internal and external customers and the impact of perceptions on the organization. 3. Explain error tolerances and rationalize the impact of over-control and under-control and standard operating procedures. 4. Discuss key elements of quality improvement strategies using PDCA and Lean tools. 5. Understand the purpose and fundamentals of the auditing process and comprehend traceability and chain of custody advantages and disadvantages. 6. Recognize the impact of documentation, reporting, inspecting, and auditing in product liability and costs to the individual and company.

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

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

Unit No.	Course Content	Hours
I.	**Introduction of Total Quality Management** Meaning and Definition Concept and Evolution of Total Quality Management, Objectives of Total Quality Management, Need and Significance of Total Quality Management **Principles of Total Quality Management (TQM) in Food Industry,** Implementation **of Total Quality Management,** Requirements of Success in TQM, **Concept and Features of TQM, Eight building blocks of TQM.**	6
II.	**Total Quality Management at Domestic level** Bureau of Indian Standards (BIS) National Productivity Council. National Centre for Quality Management Chambers of Commerce and Industry such as FICCI, CII, ASSOCHAM and AIMO.	6
III.	**Total Quality Management Tools and Techniques** Benchmarking: Definition, concepts, benefits, elements, reasons for benchmarking, process of benchmarking, FMEA, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept and need.	6
IV.	**Application of Total Quality Management** QM thinkers and Thought – Juran Trilogy, PDSA cycle, 5S, Kaizen, Crosby's theory on Quality Management, Quality Performance Excellence Award- Deming Application Award, European Quality Award, Malcolm Baldrige National Quality Award n.	6
V.	**Six Sigma and Stastical Tools** Six Sigma- Features of six sigma, Goals of six sigma, DMAIC, Six Sigma implementation Statistical Process Control- Central Tendency, The seven tools of quality, Normal curve, Control charts, Process Capability.	6
VI.	**Quality Management Systems** Quality Systems- ISO 9000, ISO 9000:2000, ISO 14000, ISO 22000 & other quality systems.	6

Sr. No.	Text Books
1.	Sallis, E. (2014). Total quality management in education. Routledge.

2.	Oakland, J. S. (2014). Total quality management and operational excellence: text with cases. Routledge.
3.	Aized, T. (Ed.). (2012). Total quality management and six sigma. BoD–Books on Demand.
Sr. No.	**Reference Books**
1.	Hackman, J. R., & Wageman, R. (1995). Total quality management: Empirical, conceptual, and practical issues. Administrative science quarterly, 309-342.
2.	Zbaracki, M. J. (1994). The rhetoric and reality of total quality management. Stanford University.
Sr. No.	**Important web links**
1.	https://ebooks.inflibnet.ac.in/hsp05/chapter/total-quality-management/
2.	http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1031

Year, Program, Semester	B. Tech Food Technology (Honors/Honors with Research)				
Course Code	HN- 3				
Course Category	Program Core				
Course Title	Applications of Nanotechnology in Food Technology				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total = 100**
Pre-requisite (if any)	Prerequisites for this course typically include the basic knowledge of physics and chemistry				
Course Rational	The course provides knowledge about the basic concepts of nanotechnology. This course also deals with the methods for synthesis of nanoparticles. This course provides the knowledge of application of nanotechnology in food technology.				
Course Objective	The course teacher will 1. Explain the basic concept of nanoscience. 2. Help to Learn the types of methods employed for nanoparticles formulation. 3. Help to think and design the nanobased packaging material. 4. Demonstrate the effect nano based techniques in food technology. 5. Describe the role of nano particles in combating environmental pollution. 6. Enable the students to interpret the role of nanoparticles in various areas				
Course Outcome	Students will be able to 1. Interpret the role of different nanomaterials. 2. Know the importance of nanomaterials in food technology. 3. Asses the application of nanotechnology application in combating pollution. 4. Design the nanobased packaging material. 5. Develop the application of nano-particles in food sector. 6. Analyse the characteristics of various nano-particles.				

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

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

Unit No.	Course Content	Hours
I.	**Background and history of Nano materials:** • Background, historical development of nanomaterials, units, Scaling laws: (in mechanics, electricity, electromagnetism, optics, heat transfer, fluids), organization of matter- atoms, molecules, clusters and supramolecules. Need based introduction to quantum effects. • Structure and Bonding: Chemical bonds (types and strength), Intermolecular forces, Molecular and crystalline structures- Bulk to surface transition, density of states, band gap and dimensionality of nonmaterial, surface reconstruction, self-assembly.	**06**
II.	**Synthesis of Nanomaterials:** • Physical Methods: Mechanical, evaporation, chemical vapour deposition, ion beam techniques, molecular beam epitaxy, laser deposition. • Chemical methods: Colloids and colloids in solution, Langmuir-Blodgett (L-B) method, micro emulsion, sol gel methods, electrochemical methods etc.; uniformity of nanomaterials (size, properties distribution and yield) Bio inspired methods: Microorganisms, plant based, using proteins and DNS templates, etc.	**06**
III.	**Examples of special nano material's:** • 2D materials, Carbon based materials, aerogels, zeolites, self-assembled nano materials, core shell particles, Nano Metals, Nano Ceramics, Nano	**06**

	Composites, other current interest nano structured / nano materials.	
IV.	**Applications of nanotechnology in food** • Processing, preservation, packaging and safety assessment • Functional food development, detection of food borne pathogens, and shelf-life extension of food and/or food products.	**06**
V.	**Scope of nanomaterials and their applications** • Mechanical, magnetic, electrical, optical, biocompatibility, toxicity, chemical, emergent quantum properties. • Nano-electronics, Nano-optics, Nano magnetic-, chemical- and bio-sensing, energy applications, textiles, cosmetics, biotechnology, medical, construction, defence, and other contemporary applications.	**06**
VI.	**Nanotechnology - Environmental and health effects** • Environmental pollutants in air, water, soil, hazardous and toxic wastes, • Application of nanotechnology in remediation of pollution • The challenge to occupational health and hygiene, toxicity of nano particles, • Effects of inhaled nano sized particles, skin exposure to nano particles • Impact of CNT s on respiratory systems	**06**

Sr. No.	**Text Books**
1.	Research Methodology- Methods and Techniques, C.K.Kothari, New Age International, 2nd Edn., New Delhi (2004)
2.	Research Methods, Donald H.McBurney, Thomson Asia PVT Ltd., Singapore (2002).
3.	Computational methods in Physics and Engineering, 2nd Edition, Samuel S.M. Wong, World Scientific-Singapore (2003)
4.	Introduction to Computer simulation methods, Gould, Tobochnik, 2006.
Sr. No.	**Reference Books**
1.	Springer Handbook of Nanomaterials, -by Robert Vajtai
2.	Nanotechnology: principles and practices, -by S. K. Kulkarni
3.	Nanotechnology the whole story, -by B. Rogers, J Adams and S. Pennathur
4.	Ferziger, J. H., Numerical Methods for Engineering Applications, 2nd ed., Wiley-Interscience (1998).
Sr. No.	**Important web links**
1.	https://alison.com/course/advancements-in-food-processing-and-nanotechnology
2.	https://coursesity.com/free-tutorials-learn/nanotechnology

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">B. Tech Food Technology (Honors/Honors with Research)</td></tr>
<tr><td>Course Code</td><td colspan="5">HN- 4</td></tr>
<tr><td>Course Category</td><td colspan="5">Program Core</td></tr>
<tr><td>Course Title</td><td colspan="5">Nutraceuticals and Functional Foods</td></tr>
<tr><td>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>03</td><td>-</td><td>-</td><td>03</td><td>03</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">ISE:30</td><td colspan="2">ESE: 70</td><td>Total = 100</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">Prerequisites for this course typically include the knowledge of basic Biochemistry and food science and nutrition.</td></tr>
<tr><td>Course Rational</td><td colspan="5">The course provides knowledge about the basic concepts of functional and nutraceutical food. This course also deals with the application aspects of functional and nutraceutical food. This course imparts the knowledge of various disease preventive function of functional and nutraceutical food.</td></tr>
<tr><td>Course Objective</td><td colspan="5">The course teacher will
1. Explain the basic concept of Functional and nutraceutical food
2. Help to Learn the sources for functional and nutraceutical food
3. Help to think and design the formulation of functional and nutraceutical food
4. Demonstrate the effect of functional and nutraceutical food on various disease prevention
5. Describe the role various active components in development of functional food
6. Develop the skills of developing various nutraceutical food</td></tr>
<tr><td>Course Outcome</td><td colspan="5">Students will be able to
1. Interpret the knowledge in developing functional and nutraceutical food
2. Know the importance of Functional and nutraceutical food
3. Asses the application of various sources in development of functional and nutraceutical food
4. Design the functional and nutraceutical food for the various disease prevention</td></tr>
</table>

	5. Develop the various functional and nutraceutical food 6. Demonstrate the active components role in development of various functional and nutraceutical food

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

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

Unit No.	Course Content	Hours
I.	**Functional Foods** • Definition, Relation of functional foods & Nutraceutical (FFN) to foods& drugs. Applications of herbs to functional foods. Concept of free radicals and antioxidants; • Nutritive and Non-nutritive food components with potential health effects. Effect of processing on Nutrients. • Soy proteins and soy isoflavone in human health; Role of nuts in cardiovascular disease prevention. Functional foods from wheat and rice and their health effects. • Role of Dietary fibers in disease prevention.	**06**
II.	**Sources of Functional Food** • Sources and role of Isoprenoids, Isoflavones, Flavonoids, carotenoids,	**06**

	Tocotrienols, polyunsaturated fatty acids, sphingolipids, lecithin, choline. Terpenoids. • Vegetables, Cereals, milk and dairy products as Functional foods. • Health effects of common beans, Capsicum, annum, mustards, Ginseng, garlic, grape, citrus fruits, fish oils, and sea foods.	
III.	**Active Biodynamic Principles in Spices, Condiments and Plant extracts** • Resveratrol, Kaempferol, Quercetin, Cinnamaldehyde, Crocin, Lutoline, Capsaicin, Piperine, Gingerol, Eugenol, Rosemarinic acid, Apigenine,Thymoquinone, Fenugreek and Diosgenin • Specific Nutrients: Conjugated Linoleic Acid, Omega 3 Fatty acids,Non Nutrient Effect of Specific Nutrients : Proteins and Peptides and Nucleotides, Vitamins, Minerals	**06**
IV.	**Nutraceuticals as Science** • Historical perspective, classification, scope & future prospects • Applied aspects of the Nutraceutical Science • Sources of Nutraceuticals • Relation of Nutraceutical Science with other Sciences: Medicine, Human physiology, genetics, food technology, chemistry and nutrition	**06**
V.	**Properties, structure and functions of various Nutraceuticals** • Plant Based Nutraceuticals: Glucosamine, Octacosanol, Carnitine, Melatonin and Ornithine alpha ketoglutarate, Chlorophyll, Caffeine, Green tea, Lecithin, soyabean • Fruit based nutraceuticals: grape products, Lycopene, carotene, proanthocyanidins. • Animal and Algae based nutraceuticals • Novel nutraceutical ingredients.	**06**
VI.	**Nutritional Factors- Promoters and Inhibitor** • Types of inhibitors • General idea about role of Probiotics, Prebiotics and Synbiotic. • FODMAP (Fermentable Oligo, Di, Mono-saccharides and polyols) Insulin, Resistant starch	**06**

	• Dietary fibers – Soluble and Insoluble health benefits and its role in control of disease conditions and impact of excess fiber.	

Sr. No.	Text Books
1.	Wildman, R. E. (2016). Handbook of Nutraceuticals and Functional Foods. CRC Press
2.	Gupta, R. C. (2016). Nutraceuticals: Efficacy, Safety and Toxicity. Academic Press.
3.	Vattem, D.A. and Maitin V. (2016). Functional Foods, Nutraceuticals and Natural Products, Concepts and Applications. DEStech Publications, Inc
4.	Gibson, G. R. and Williams, M. C. (2001). Functional Foods Concept to Product. CRC Press.
Sr. No.	**Reference Books**
1.	Modern Nutrition in health and disease by Goodhearth R., S. Shills.
2.	Krause's Food, Nutrition and Diet Therapy, 10th Edition by Mahan, L.K. & Ecott-Stump, S. (2000), W.B. Saunders Ltd.
3.	B. Srilakshmi, Dietetics, New Age International Publishers, 7th Edition.
4.	Yashwant Pathak, Handbook of Nutraceuticals, Volume 1, CRC Press, 2010
Sr. No.	**Important web links**
1.	https://onlinecourses.swayam2.ac.in/cec22_ag02/preview
2.	https://www.shiksha.com/online-courses/functional-foods-and-nutraceuticals-course-swayl10

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">B. Tech Food Technology (Honors/Honors with Research)</td></tr>
<tr><td>Course Code</td><td colspan="5">HN- 5</td></tr>
<tr><td>Course Category</td><td colspan="5">Program Core</td></tr>
<tr><td>Course Title</td><td colspan="5">Extrusion Technology</td></tr>
<tr><td>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>03</td><td>-</td><td>-</td><td>03</td><td>03</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">ISE:30</td><td colspan="2">ESE: 70</td><td>Total = 100</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5"></td></tr>
<tr><td>Course Rational</td><td colspan="5">This course will provide you with a broad knowledge of extrusion technology to learn important process correlations as well as machine and tool technology basics for the main types of extrusion.</td></tr>
<tr><td>Course Objective</td><td colspan="5">The course teacher will ensure to
1. Describe general principal of extrusion technology and understanding the various extrusion process.
2. Categorize the role of information about the importance of quality parameters of the varied combinations of ingredients in food extruder.
3. Familiarize attendees with practical aspects of snack foods processing technology.
4. Introduce student about use of extrusion technology in food industry.
5. Understand the suitability of raw materials, preconditioning, process variables and extruder types for extrusion and its impact on extrusion process, rheological behaviour and product quality
6. Explain chemical and nutritional changes occurring in extrusion process and packaging requirement of extruded products</td></tr>
<tr><td>Course Outcome</td><td colspan="5">The students will be able to
1. Knowledge about preparation of breakfast cereals and snack foods using extruder.
2. Evaluate processing parameters of extruders for preparing different food products and Prepare extruded products, snack foods and texturized Vegetable Protein by extruder.
3. Analyze recent trends and future aspects of food extrusion.</td></tr>
</table>

	4. Apply basic fundamentals, design considerations, processing of different extruded products and selection of food extrusion equipment 5. Understanding suitability of raw materials, preconditioning, process variables and extruder types for extrusion and its impact on extrusion process, rheological behaviour and product quality 6. Explain chemical and nutritional changes occurring in extrusion process and packaging requirement of extruded 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	3	2	3	3	2	3	2	1	1	2	2
CO 2	3	3	3	3	3	2	2	2	2	2	2	2
CO 3	3	3	3	2	2	3	2	2	2	2	2	2
CO 4	3	3	3	2	3	4	3	2	1	2		2
CO 5	3	3	3	3	2	3	2	2	2		2	
CO 6	3	2	3	3	3	3	2	1	1		3	2

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

Unit No.	Course Content	Hours
I.	**Introduction to Food Extrusion** Food Extrusion: Definition, introduction to extruders, History of extrusion technology, principles and types, Uses of extruders in the food industry, Pre-conditioning of raw materials used in extrusion process, Extruder Selection, Design, and Operation for Different Food Applications	06
II.	**Extrusion Equipment** Single screw extruder: Principle of working, Net Flow, Operations, Twin screw extruder: Counter rotating and co-rotating twin screw extruder, Process characteristics of the twin screw extruder, Rheological Properties of Materials during the Extrusion Process, Advantages of Twin Screw Extruder	06
III.	**Effect of extrusion on food products** Chemical and nutritional changes in food during extrusion, factors affecting	06

	extrusion, Net Flow, Packaging materials for extruded product, Use of extruders in extrusion.	
IV.	**Different product by extrusion technology** Classification of Breakfast cereals: Raw materials, process and quality testing for ready-to-eat breakfast cereals extrusion, process and quality testing of vermicelli and spaghetti Raw materials, process and quality testing of pasta and macaroni products, weaning foods.	**06**
V.	**Industrial Food extrusion processing line** Breakfast cereals extrusion processing, aqua feed extrusion cooking process, high moisture extrusion cooking process, application of Texturized vegetable protein: Definition, Manufacturing process and quality parameters of TVP, Chemical and nutritional changes in food during extrusion	**06**
VI.	**Recent Advances in extrusion technology** Carbon dioxide or Nitrogen assisted extrusion technology, Extrusion in confectionary technology, Non-thermal Extrusion of Protein Products	**06**

Sr. No.	**Text Books**
1.	Matza S, (2000), Extruded foods, Publisher springer
2.	N.D. Frame (2012), Technology of Extrusion Cooking, Publisher springer
3.	Riaz M.N. (2000), Extruders in Food Application Publisher CRC Press.
Sr. No.	**Reference Books**
1.	Maskan and Altan (2000), Advances in Food Extrusion Technology, Publisher CRC Press.
2.	Harper JM (1981), Extrusion of Foods, Publisher CRC Press.
3.	Medeni Maskan, Aylin Altan (2012), Advances in Food Extrusion Technology, 1st Edition, CRC Press
Sr. No.	**Important web links**
1.	https://download.e-bookshelf.de/download/0002/3454/10/L-G-0002345410-0003216004.pdf
2.	http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">B. Tech Food Technology (Honors/Honors with Research)</td></tr>
<tr><td>Course Code</td><td colspan="5">HN-AEC1</td></tr>
<tr><td>Course Category</td><td colspan="5">Ability Enhancement Course</td></tr>
<tr><td>Course Title</td><td colspan="5">Advanced Laboratory Practice</td></tr>
<tr><td>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>-</td><td>04</td><td>04</td><td>02</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="2">IPE:50</td><td colspan="2">EOE: 50</td><td>Total = 100</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">Basic Knowledge of food analysis lab is required</td></tr>
<tr><td>Course Rational</td><td colspan="5">The curriculum is structured to ensure students acquire a deep understanding of practical proficiency in a food analysis.</td></tr>
<tr><td>Course Objective</td><td colspan="5">The course teacher will ensure to-
1. Train students towards the selection of correct method based on the precision, accuracy, food system and availability.
2. Educate the students on the significance, purpose and principle of food analysis using instruments (basics and advanced)
3. Design the product and process formulations in food industry.
4. Assist in analysis of various food constituents, additives present in the food.</td></tr>
<tr><td>Course Outcome</td><td colspan="5">By the end of the course, the students will be able to-
1. Demonstrate practical proficiency in a food analysis laboratory using advanced instruments.
2. Understand the appropriate instrumental method when presented with a practical problem.
3. Choose appropriate techniques for foods and when/how to use them in a food processing environment/situation such as QA and QC.
4. Describe basic methods of instrumental and subjective sensory evaluation, including when certain methods might be used, the type of data derived, and how that data might be used in decision-making.</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	2	2	2	1		1				
CO 2	1		1	2	1	3	2					
CO 3	1	3	3	2	2	1		1				
CO 4	1	2	3	2	2		3					

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

Experiment No.	Experiment Title/Objective	Hours
1.	Preparation of synthetic medium for yeast and mould and inoculation with standard strains of yeasts and moulds.	02
2.	Separation and isolation of proteins/amino acids by Paper Electrophoresis	02
3.	Determination of Pressure drop for flow through packed bed & verification of Ergun Equation, Kozeny-Karman equation, Blake-Plummer Equation.	02
4.	Analysis of non-alcoholic beverages.	02
5.	Analysis of lysine content in animal /vegetable sources.	02
6.	Estimation of sugar by Resorcinol method & Anthrone method	02
7.	Estimation of polyphenols by Folin-Denis method & Ferrous Tartarate method	02
8.	Estimation of Sucrose by Lane and Eynon's Method	02
9.	Protein Precipitation Reaction	02
10.	Damaged starch analysis	02
11.	Identification of hydrocolloids	02
12.	Atomic absorption spectroscopic analysis of heavy metals in foods	02
13.	UV-Vis Spectro-photometric analysis of a carotenoid	02
14.	Use of experimental design and sensory evaluation in product formulation: Beverage (fermented and non-fermented); premix	02
General Instructions: Any 6 experiments to be performed from the list, any 2 experiments to be studied as demonstration		

Sr. No.	Reference Books
1.	Fuller, G.W. (2011). New Food Product Development: From Concept to Marketplace, 3rd ed, CRC Press, UK.
2.	Ranganna, S. (1986). Handbook of analysis and quality control for fruit and vegetable products. Tata McGraw-Hill Education.
3.	Kirk, S., & Sawyer, R. (1991). Pearson's composition and analysis of foods (No. Ed. 9). Longman Group Ltd
4.	Biochemistry Laboratory: Modern Theory and Techniques – by Rod Boyer. (2010). Publisher: Pearson Prentice Hall. ISBN: 013604302X

Shivaji University, Kolhapur

Department of Technology

MDM Featured B. Tech (Food Technology) Honors with Research

Teaching and Evaluation Scheme											
S.N.	**Category**	**Code**	**Course Title**				**Contact Hours**	**Credits**	**Evaluation scheme**	
									Theory	**Practical**
				L	**T**	**P**			**ISE:ESE**	**IE:EE**
1	SWAYAM (NPTEL) Or any other MOOCs (Program Core Courses) or Self-study mode with University's End Semester Examination	HN-1	Research Methodology	03	-	-	03	03	30:70	00:00
2		HN-2	Total Quality Management	03	-	-	03	03	30:70	00:00
3		HN-3	Applications of Nanotechnology in Food Technology	03	-	-	03	03	30:70	00:00
4		HN-4	Nutraceuticals and Functional Foods	03	-	-	03	03	30:70	00:00
5		HN-5	Extrusion Technology	03	-	-	03	03	30:70	00:00
6	Ability Enhancement Course	HN-AEC1	Advanced Laboratory Practice	-	-	04	04	02	-	50:50
7.	Project Based Learning	HNR –PBL	*Additional Research Project	-	-	06	06	03	-	50:50
				-	-	-	-	**20**	**500**	**200**
			Total Hours	**15**	-	**10**	**25**	-	-	-

Note: For Honors with Research, the courses and the credits as that for Honors will be the same. In addition, there will be 3 credits against an additional research project completion with success in publishing at least one research paper in a peer reviewed journal.

.

<table>
<tr><td>Year, Program, Semester</td><td colspan="7">B. Tech Food Technology (Honors with Research)</td></tr>
<tr><td>Course Code</td><td colspan="7">HNR-PBL</td></tr>
<tr><td>Course Category</td><td colspan="7">Programe Core</td></tr>
<tr><td>Course title</td><td colspan="7">Additional Research Project</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td colspan="2">Total Credits</td></tr>
<tr><td>-</td><td>-</td><td>06</td><td colspan="2">06</td><td colspan="2">03</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IOE</td><td>IPE</td><td>EOE</td><td>EPE</td><td>Total</td></tr>
<tr><td colspan="2">-</td><td>-</td><td>-</td><td>50</td><td>50</td><td>-</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="7">All the courses underlying MDM Featured B.Tech (Chemical Engineering) Major.</td></tr>
<tr><td>Course Rationale</td><td colspan="7">The Additional Research Projects course allows B.Tech Chemical Engineering Major students to pursue advanced research, enhancing their skills and contributing to the field. This course aims to foster critical thinking, problem-solving skills, and research acumen among students while allowing them to explore topics of personal interest and relevance to the discipline. Completion of this course and the attainment of the B.Tech Honors with research Degree make students eligible for Ph.D. studies, facilitating their academic and research progression in chemical engineering or related fields.</td></tr>
<tr><td>Course Objectives</td><td colspan="7">The Course Teacher will
1. To facilitate exploration of focused research areas in chemical engineering.</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">Upon completion of this course, student should be able to
1. Formulate research questions and design methodologies.
2. Analyze and interpret data effectively.
3. Synthesize literature to contextualize research.
4. Present findings effectively through oral and written communication.
5. Demonstrate critical thinking and problem-solving in research.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

CO/PO	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	-	-	2
CO 2	3	-	-	3	2	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	2	-	-	-	-	-	2

CO 4	-	-	-	-	-	-	-	-	-	3	2	-
CO 5	-	3	2	-	-	-	-	2	2	-	-	-

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

Unit No.	Course Content
I	**Topic Selection and Proposal Development:** • Identifying research gaps and formulating research questions. • Writing a research proposal outlining objectives, methodology, and expected outcomes. • Conducting rigorous ‘ research topic relevant literature survey’
II	**Research Methodologies:** • Introduction to research design and planning. • Data collection techniques and tools. • Statistical analysis methods.
III	**Conducting Research:** • Implementing the proposed methodology. • Data collection, analysis, and interpretation. • Troubleshooting research challenges.
IV	**Presentation and Communication:** • Preparing and delivering oral presentations. • Writing research reports following standard scientific formats. • Communicating research findings effectively to diverse audiences.

Course Assessment Method

Assessment in this course will be based on the following criteria:

1. Research Proposal (20%): Evaluation of the clarity, feasibility, and originality of the research proposal.
2. Research Progress (30%): Assessment of the student's progress in conducting the research project, including data collection, analysis, and interpretation.
3. Final Research Report (30%): Evaluation of the quality of the written research report, including organization, clarity, depth of analysis, and adherence to scientific standards.
4. Oral Presentation (20%): Assessment of the student's ability to effectively communicate research findings through a formal presentation.

Additionally, continuous engagement, participation in research discussions, and adherence to deadlines will be considered in the overall assessment of the course.

Text Books/ Reference Books

1.	deMan, John M. “Principles of Food Chemistry”. 3rd Edition, Springer, 1999
2.	Meyer, Lillian Hoagland “Food Chemistry”. CBS Publishers, 1987.
3.	O.R.Fennema “Food Chemistry” Marcel Dekker, Inc., New York.
4.	Food Chemistry- Aurand L.W and Woods A.E, Avi Publishing Company, Inc, Westport, CT (1973).

5.	AL Lehninger, (2017)“ Principle of Biochemistry”, 7th Edition, W H Freeman & Co
6.	Fellows, P. and Ellis H. (1990). “Food processing technology: principles and practice”, Wood Head Publishing Ltd
7.	Heldman, D.R. and Singh R. P. (2016). Introduction to Food Engineering.5th Edition. Elsevier India
8.	William C. Frazier and Dennis C. Westoff (2017). Food Microbiology 5th Edition, McGraw Hill Education
9.	Manoranjan Kalia and Sangita Sood. (2019). “Food preservation and processing”, Kalyani Publishers. New Delhi.
10.	G Subbulakshmi and Shobha a Udipi. (2006). Food Processing And Preservation, New Age International (P) Ltd.

Shivaji University Vidyanagar, Kolhapur, Maharashtra 416004

Department of Technology

As per NEP2020 guidelines

Pool of Specialization Minors for
MDM Featured B. Tech (Food Technology), Detailed Curriculum

Specialization Minor
In
Packaging Technology
For
B.Tech (Food Technology)

Shivaji University, Kolhapur

Department of Technology

Specialization Minor in Packaging Technology

Teaching & Evaluation Scheme

Sr. No.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode	SPM.1.1	Packaging Materials	03	-	-	03	03	30:70	00:00
2.		SPM.1.2	Quality Assessment of Packaging Materials	03	-	-	03	03	30:70	00:00
3.		SPM 1.3	Designing and Labelling of Packaging	03	-	-	03	03	30:70	00:00
4.	Program Based Internship	SPM.1.4	Packaging Industry Internship	One Month				03	00:00	50:50
4.	Minor Program Based Internship	SPM.1.5	Mini Project				-	02	00:00	50:50
				-	-	-	-	14	300	200
			Total Hours	**09**	**00**	**00**	**09**	-	-	-

Note: If opted the Specialization Minor Program, Internship may be planned during winter or summer vacation days after 4th semester while respective evaluations will appear on a separate mark sheet.

Specialization Minor I: Packaging Technology

Year, Program, Semester	Specialization Minor I, 4th Semester onwards							
Course Code	SPM 1.1							
Course Category	Specialization Minor Program Core							
Course Title	Packaging Materials							
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**		
	03	-	-	03		03		
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	30	70		-	-	-	-	100
Pre-requisites(if any)	Prerequisites for this course typically include the knowledge of Basic food science, principles of food preservation and food chemistry							
Course Rationale	The main objective of this subject is to impart knowledge and skills relatedto designing packaging system in food products and developing skills in handling of packaging equipment in the students. This course explains the different types of packaging materials, its characteristics and wide application in food industry							
Course Objectives	The course teacher will 1. Demonstrate understanding the role of different packaging materials 2. Describe the properties packaging materials of different 3. Think and Design food grade packaging materials 4. Demonstrate different packaging materials for different food products 5. Understand the regulations in packaging industry 6. Develop the skills of various quality control skills							
Course Outcomes	The student will be able to 1. Illustrate the designing of different packaging materials 2. Know newer technologies food packaging 3. Assess quality characteristics for different packaging materials 4. Design food grade packaging materials 5. Understand the phenomenon of packaging materials 6. Develop the innovative packaging material							

Course Outcome and Program Outcome Mapping

CO/PO	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	2	1	2	3	-	-	-	-
CO 2	1	1	2	1	2	2	3	1	-	-	-	-
CO 3	1	2	1	2	3	2	1	1	-	-	-	-
CO 4	2	1	1	1	2	3	2	2	-	-	-	-
CO 5	2	1	1	1	2	3	2	2				-
CO 6	2	1	1	1	2	3	2	2				

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

Unit No.	Course Content	Hours
I	**Introduction to Principles of Packaging** Introduction, Components, Permeability, Mechanisms of Spoilage, Corrosion and Prevention of Corrosion, Package Evaluation, Ecological Aspects, Bar-coding Applications in Packaging.	6
II	**Paper & Paper Board** Cellulosic Materials, Processes in Cellulose Industries, Paper and Board Manufacture, Testing of Cellulose and Paper Materials, Specialty Papers, Folding Cartons, Multiwall Paper Sacks, Composite Containers	6
III	**Glass Technology** Glass Containers**,** Manufacture**,** Properties, Applications and Testing	6
IV	**Introduction to Plastics & Polymers** Polymeric Material, Properties, Applications ,Polymer Composites, Polymer Blends, Additives for Plastics, Testing & Evaluation	6
V	**Packaging of Specific Foods** Packaging Machineries, Packaging of specific foods with its properties like bread, biscuits, Snackfoods, Packaging of specific foods with its properties like coffee, milk powder, eggpowder, carbonated beverages, Packages type i.e. FFS, Standable pouches	6
VI	**Food Packaging Techniques** Food and Packaging material interactions, Migration, scalping of flavor, Aseptic processing and packaging, Biodegradable packaging	6
Text Books		
1.	Coles, R., McDowell, D., & Kirwan, M. J. (Eds.). (2003). Food packaging technology (Vol. 5). CRC press.	
2.	Robertson, G. L. (2005). Food packaging: principles and practice. CRC press.	
3.	Lee, D. S., Yam, K. L., & Piergiovanni, L. (2008). Food packaging science and Technology. CRC press.	
Reference Books		
1.	Paine, F. A., & Paine, H. Y. (2012). A handbook of food packaging. Springer Science &Business Media.	

2.	Grumezescu, A. M. (Ed.). (2016). Food packaging. Academic Press.
3.	Kadoya, T. (Ed.). (2012). Food packaging. Academic Press.
4.	Ahvenainen, R. (Ed.). (2003). Novel food packaging techniques. Elsevier
Important web links	
1	https://onlinecourses.nptel.ac.in/noc23_ge32/preview

Year, Program, Semester	Specialization Minor I, 4th Semester onwards							
Course Code	SPM 1.2							
Course Category	Specialization Minor Program Core							
Course Title	Quality Assessment of Packaging Materials							
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**		
	03	-	-	03		03		
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	30	70		-	-	-	-	100
Pre-requisites(if any)	Prerequisites for this course typically include the knowledge of testing methods Packaging Material							
Course Rationale	The course provides knowledge about the basic concepts of Quality assessment in packaging technology. This course also deals with the various tests involved in packaging material used for food products.							
Course Objectives	The course teacher will 1. Demonstrate an understanding of the role of different packaging materials 2. Describe the properties of packaging materials of different 3. Think and Design food grade packaging materials 4. Demonstrate different packaging materials for different food products 5. Understand the regulations in the packaging industry 6. Develop the skills of various quality control skills							
Course Outcomes	By the end of the course, students will be able to 1. Illustrate the design of different packaging materials 2. Know newer technologies in food packaging 3. Assess quality characteristics for different packaging materials 4. Design food-grade packaging materials 5. Interpret the knowledge of novel techniques in packaging 6. Understand the role of active packaging							

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO 1	1	2	3	2	1	2	2	2	-	-	-	-
CO 2	1	2	1	2	2	3	1	1	-	-	-	-
CO 3	2	1	2	3	2	1	1	1	-	-	-	-
CO 4	1	1	1	2	3	2	2	1	-	-	-	-
CO 5	1	1	1	2	3	2	2	1	-	-	-	-
CO 6	1	1	1	2	3	2	2	1	-	-	-	-

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

Unit No.	Course Content	Hours
I	**Introduction to quality assessment of packaging material** Objectives, Laboratory Analysis, Quality control and testing standards, Sterile product validation, Non sterile product validation	**06**
II	**Quality Control Tests for Paper and Board** Moisture content, Folding endurance, Air permeability, Tensile strength, Tear strength, Stiffness, Burst resistance	**06**
III	**Quality Control Tests for glass container** Evaluation of Glass Bottles, Powdered glass test, Hydrolytic resistance of glass containers, Arsenic test, Leakage test, Collapsibility test	**06**
IV	**Quality Control Tests for plastic container** Water vapor permeability, Light transparency test, Clarity or aqueous extract	**06**
V	**Quality control Tests for cartons and closures** Compression, Carton opening force, Sterility test, Fragmentation test, Self-seal ability test, Light absorption test, Reducing substance, Penetrability test	**06**
VI	**Regulation in packaging industry** FSSAI regulations on packaging and labelling requirements, Packaging Requirements under PFA, Agricultural Grading & Marking (AGMARK) Rules, BIS standards for the packaging industry	**06**
Text Books		
1.	Robertson GL. 1993. *Food Packaging Principles and Practice*. Marcel Dekker INC. New York	
2.	Paine, F.A. and Paine, H.Y. 1992. *A Hand Book of Food Packaging*. Blackie Academic & Professional.	
3.	Griffin C. R. and Sacharow, S. 1972. *Principles of Package Development*. The AVI Publishing Company Inc.	
4.	C, Rambabu, V, Ananth, R. T, Srikanth, S. K, Dona, K. G, Arun, T, Tinu, Manavalan, B. M, Venkanna, S. H, Viswa, J. K, Ghaharin. A Concise Textbook of QC & QA.KMCH College of Pharmacy, Coimbatore. 2011. 179-189.	
Reference Books		
1.	Grumezescu, A. M. (Ed.). (2016). Food packaging. Academic Press.	
2.	Ahvenainen, R. (Ed.). (2003). Novel food packaging techniques. Elsevier	
Important web links		
1	https://onlinecourses.nptel.ac.in/noc23_ge32/preview	

<table>
<tr><td>Year, Program, Semester</td><td colspan="7">Specialization Minor I, 4th Semester onwards</td></tr>
<tr><td>Course Code</td><td colspan="7">SPM 1.3</td></tr>
<tr><td>Course Category</td><td colspan="7">Specialization Minor Program Core</td></tr>
<tr><td>Course Title</td><td colspan="7">Designing and labelling of Packaging</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td colspan="2">Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td colspan="2">03</td><td colspan="2">03</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IOE</td><td>IPE</td><td>EOE</td><td>EPE</td><td>Total</td></tr>
<tr><td colspan="2">30</td><td>70</td><td>-</td><td>-</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="7">Prerequisites for this course typically include a solid background in Food packaging.</td></tr>
<tr><td>Course Rationale</td><td colspan="7">The course provides knowledge about the basic concepts of designing and labelling of packaging products.</td></tr>
<tr><td>Course Objectives</td><td colspan="7">The course teacher will ensure to
1. Discuss the need to use renewable and sustainable materials in the design of packaging.
2. Examine environmental, green and sustainable issues in the package Design industry.
3. Identify and utilize the methods, materials, and production Considerations involved in package design.
4. Define sustainable packaging industry terminology.
5. Access the objectives and advantages for labelling.
6. Understand the print quality between digital and traditional printing.</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">By the end of the course, students will be able to
1.Examine package design substrates for design considerations
2. Analyze the results of actions and inactions with the likely effects on the larger local and/or global communities
3. Design and create various types of packages with specified parameters to meet needs of identified market.
4. Create awareness of environmental considerations and consequences in relation to the design of packaging.
5. Selects the right type of printing technique which suits the design.
6. Develop packaging prototypes in support of a given product</td></tr>
</table>

Course Outcome and Program Outcome Mapping

CO/PO	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	2	3	2	1	2	1	-	-	-	-	-
CO 2	1	2	1	2	2	3	1	-	-	-	-	-
CO 3	2	1	2	3	2	1	2	-	-	-	-	-
CO 4	1	1	1	2	3	2	1	-	-	-	-	-
CO 5	1	2	3	2	1	2	1	-	-	-	-	-
CO 6	1	2	1	2	2	3	1	-	-	-	-	-

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

Unit No.	Course Content	Hours
I	**Modern Merchandising** Marketing Requirements, Product Lifecycle, Planning for change, Design considerations structural development, packaging coordination,graphics, packaging line engineering, cost of development, Economic considerations: package cost vs. product cost, Environmental Considerations-Life cycle Assessment, Legal issues, Recenttrends	6
II	**PACKAGE DEVELOPMENT:** Managing the Packaging Function, Eye Tracking and the features of package, Optimizing Package Design, Package Design Process, Specifications, Benchmarks, Package Designer's Checklist, Package Design Evaluation ocular tests, questionnaires.	6
III	**Graphic and Structural design:** Demographics and Psychographics, Fundamental Messages, Equity and Brand Names Typography, Color and Illustration, Package and Decoration Aesthetics, Layout and Feature Selection, Structural design- Predicting package performance and Role of Structure	6
IV	**Coding & Marking system:** Coding & marking- batch code, batch number, QR code, MRP, manufacturing date, expiry date, types of coding, Generation of Bar code, Security numbering process, Tag identification through radio frequency identification & detection, Bar code reader technology, Coding and marking asper ISO standards, Inks, colorants: Dyes & pigments used for Coding & Marking of packagedproduct	6
V	**Labels and Labelling:** Labels Classification, Objectives and application, Labels Stocks specification and applications, Smart and intelligent labels	6
VI	**Technology of Package Printing:** Advantages and Limitations of-Screen printing, Offset printing, Flexographic printing, Gravure printing, Security printing, Digital printing, Print quality between digital and traditional, Variable data printing, Future trends in printing	6
	Text Books	
1.	Marianne R. Klimchuk and Sandra A. Krasovec, "Packaging Design: Successful ProductBranding from Concept to Shelf", Wiley, 2006,	
2.	Lien hard, John H. (2011). A Heat Transfer Textbook.4th Edition., Dover Publications Inc.	

3.	Du Puis, Steven and Silva, John. Package Design Workbook: The Art and Science of Successful Packaging. Beverly, MA: Rockport Publishers, Inc., 2011.
Reference Books	
1.	Aaron L. Brody and Kenneth S. Marsh, "The Wiley Encyclopedia of Packaging Technology",1997
2.	Steven Du Puis, John Silva," Package Design Workbook: The Art and Science of Successful Packaging", Rockport Publishers, 2008
3.	Helmut Kipphan, handbook of Print Media, Springer.
Important web links	
1.	packagedesignmag.com

<table>
<tr><td>Year, Program, Semester</td><td colspan="7">Specialization Minor I, 4th Semester onwards</td></tr>
<tr><td>Course Code</td><td colspan="7">SPM-1.4</td></tr>
<tr><td>Course Category</td><td colspan="7">Program Based Internship</td></tr>
<tr><td>Course Title</td><td colspan="7">Internship in Packaging Industry</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td colspan="2">Total Credits</td></tr>
<tr><td colspan="4">One Month</td><td colspan="2">03</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IOE</td><td>IPE</td><td>EOE</td><td>EE</td><td>Total</td></tr>
<tr><td colspan="2">00</td><td>00</td><td>50</td><td>-</td><td>50</td><td>-</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="7">Basics of unit processes and unit operations</td></tr>
<tr><td>Course Rationale</td><td colspan="7">The Industrial Internship course caters specifically to B.Tech Food Technology students pursuing additional specialization through the B.Tech Minor program in areas such as Packaging Technology This course offers practical exposure to industry settings aligned with their chosen sub-specialization, aiming to bridge the gap between theoretical knowledge and practical application. By engaging in a one-month internship, students gain firsthand experience, essential skills, and insights crucial for their future careers in sectors of Food Technology</td></tr>
<tr><td>Course Objectives</td><td colspan="7">The course teacher will
1. Help expose students to the 'real' working environment;
2. Promote hands-on experience to the students in their related field;
3. Develop synergetic collaboration between industry and the university in promoting a knowledgeable society;
4. Assist in providing the opportunity for students to test their interest in a particular career before permanent commitments are made.
5. Elaborate the dynamic and challenging nature of industrial environments</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">Upon completion of this course, students will be able to
1. Understand industrial processes and operations related to their minor sub-specializations.
2. Apply theoretical concepts to solve practical problems in the industry.
3. Communicate effectively with industry professionals, colleagues, and supervisors.
4. Collaborate efficiently in team environments to complete tasks and projects.
5. Adapt to the dynamic and challenging nature of industrial environments.
6. Reflect on internship experiences for personal and professional growth.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

CO/PO	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	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	2	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-
CO 4	-	-	-	-	-	-	-	-	3	-	-	-
CO 5	-	-	-	-	-	2	-	-	-	-	-	3
CO 6	-	-	-	-	-	-	-	-	-	-	-	2

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

Course Content	Hours
The course consists of a one-month internship in a relevant specialized industry. Students will be placed in companies or organizations that align with their chosen sub-specialization within the field of food technology. During the internship, students will engage in various activities, including but not limited to: 1. Shadowing industry professionals to observe and learn about different processes and operations. 2. Assisting with ongoing projects or research initiatives within the organization. 3. Participating in hands-on tasks related to their minor sub-specialization, under the guidance of experienced mentors. 4. Attending training sessions, workshops, and seminars conducted by the industry to enhance their knowledge and skills. 5. Engaging in discussions and meetings with supervisors and colleagues to gain insights into industry practices, challenges, and innovations. 6. Documenting their internship experience through reports, presentations, or reflective journals. The period of one month for this internship will be during the winter or summer vacations, any such slots 4th Semester onwards.	4 weeks

Course Evaluation Method

This particular evaluation will be the part of the structure of 7th Semester.

The evaluation for the Industrial Internship course will be conducted as follows:

- **Internal Evaluation (50 marks):**
    - Assessment by course teachers based on students' performance during the internship, including attendance, participation, attitude, and contribution to assigned tasks.

- Evaluation by industrial supervisors on students' professional conduct, technical skills, problem-solving abilities, and overall performance in the workplace.

- **External Evaluation (50 marks):**
  - Evaluation by an external examiner appointed by the institute, who will assess students' internship reports, presentations, or any other documentation submitted at the end of the internship period.
  - The external examiner will review the quality of students' reflections on their internship experience, their ability to apply theoretical knowledge to practical situations, and the depth of their understanding of industry practices and challenges.

The final grades for the Industrial Internship course will be determined based on the combined assessment from both internal and external evaluations.

Reference Books	
1.	Coles, R., McDowell, D., & Kirwan, M. J. (Eds.). (2003). Food packaging technology (Vol. 5). CRC press.
2.	Robertson, G. L. (2005). Food packaging: principles and practice. CRC press.

Year, Program, Semester	Specialization Minor I, 4th Semester onwards							
Course Code	SPM 1.5							
Course Category	Project Based Learning							
Course Title	**Mini Project**							
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**		
	-	-	-	-		02		
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.							
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this mini project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena in the Packaging Industry							
Course Objectives	The course teacher will 1. Facilitate the application of theoretical knowledge. 2. Guide the students about the enhancement of practical skills. 3. Explain about the development of industry-relevant competencies.							
Course Outcomes	Upon completion of this course, students should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.							

Course Outcome and Program Outcome Mapping

CO/PO	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	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

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

Course Content

Specialization Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

Course Assessment Process

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:

Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:

- Rubric-based assessment for the project work and its report.
- Peer evaluation for project.
- Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
- Overall course grading based on a weighted average of individual assessments and participation.

The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

Specialization Minor
In
Food Supply Chain Management
For
B.Tech (Food Technology)

Shivaji University, Kolhapur

Department of Technology

Specialization Minor in Food Supply Chain Management

Teaching & Evaluation Scheme

Sr. No.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode	SPM 2.1	Fundamentals of Food Supply Chain Management	03	-	-	03	03	30:70	00:00
2.		SPM 2.2	Logistics and Transportation Management	03	-	-	03	03	30:70	00:00
3.		SPM 2.3	Technology and Innovation in Food Supply Chain	03	-	-	03	03	30:70	00:00
4.	Program Based Internship	SPM 2.4	Internship in Food Supply Chain Management	One Month				03	00:00	50:50
5.	Minor Program Based Internship	SPM 2.5	Mini Project					02	00:00	50:50
				-	-	-	-	14	300	200
			Total Hours	09	00	00	09	-	-	-

Note: If opted the Specialization Minor Program, Internship may be planned during winter or summer vacation days after 4th semester while respective evaluations will appear on a separate mark sheet.

Specialization Minor II : Food Supply Chain Management

Year, Program,Semester	Specialization Minor II, 4th Semester onwards						
Course Code	SPM 2.1						
Course Category	Specialization Minor Program Core						
Course title	Fundamentals of Food Supply Chain Management						
Teaching Scheme andCredits	L	T	P	Total Contact Hours	Total Credits		
	03	-		03	03		
Evaluation Scheme	ISE	ESE	IOE	IPE	EOE	EPE	Total
	30	70	-	-	-	-	100
Pre-requisites(if any)	Prerequisites for this course typically include Principles of FoodPreservation Technology, Professional Communication, Food Quality and Safety Management						
Course Rationale	This course is essential for understanding the management of foodproduct flow from farm to fork to ensure food safety, quality, and sustainability in the supply chain.						
Course Objectives	The Course Teacher will ensure to 1. Define the scope and evolution ofFood Supply Chain management. 2. Recognize the importance of effective Food Supply Chain Management and its key components. 3. Analyze challenges within Food Supply Chain management and strategies for overcoming them. 4. Develop skills in food supply chain planning, including demand forecasting, inventory management, and risk mitigation. 5. Explore procurement and sourcing techniques,including strategic sourcing and supplier relationship management. 6. Gain insights into operations, logistics, quality management, and the role of information technology in Food SupplyChains.						

Course Outcomes	Upon completion of this course, student should be able to 1. Understand the definition and scope of Food Supply Chain management in the context of the food industry. 2. Analyze the key components of a Food SupplyChain and the challenges associated with managing it effectively. 3. Develop skills in Food Supply Chain planning, including demand forecasting Inventory management, and riskmanagement. 4. Gain knowledge of procurement and sourcing strategies, such as strategic sourcing and supplier relationship management. 5. Learn about operations and logistics management, including warehouse management, transportation management, and order fulfillment processes. 6. Acquire an understanding of quality and performance management, including key performance indicators, continuous improvement strategies, and benchmarking best practices.

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	2	2	1	2	1	3	3	3	3	3	1
CO 2	3	3	2	2	2		2	2	2	2	2	2
CO 3	2	2	3	3	2	2	2	2	3	2	-	2
CO 4	3	1	2	2	2	1	2	3	3	2	3	2
CO 5	2	1	2	1	1	2	3	2	3	3	3	2
CO 6	2	1	2	2	2	1	2	2	2	3	-	2

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

Unit No.	Course Content	Hours
I	**Introduction to Food Supply Chain management** Definition and Scope of Food Supply Chain Management, Evolution of Food Supply Chain Management, Importance of Effective Food Supply Chain Management, Key Components of a Food Supply Chain, Challenges in Food Supply Chain Management	**06**
II	**Food Supply Chain Planning** Demand Forecasting and Planning, Inventory Management, Production Planning and Scheduling, Sales and Operations Planning, Risk Management in Food Supply Chain Planning	**06**
III	**Procurement and Sourcing** Strategic Sourcing, Supplier Relationship Management, Contract Management, Supplier Diversity and Ethics, Global Sourcing Strategies	**06**

IV	**Operations and Logistics** Warehouse Management, Transportation Management, Distribution Network Design, Order Fulfilments Process, Lean and Agile Principles in Operations	**06**
V	**Quality and Performance Management** Key Performance Indicators (KPIs) in Food Supply Chain, Continuous Improvement Strategies, Six Sigma in Food Supply Chain, Benchmarking Best Practices	**06**
VI	**Information Technology in Food Supply Chain** Role of IT in Food Supply Chain Management, Enterprise Resource Planning (ERP) Systems, Food Supply Chain Analytics and Big Data, Internet of Things (IoT) in Food Supply Chain, Block chain Technology in Food Supply Chain	**06**

Text Books	
1.	Choi, T. Y., Li, J. J., Rogers, D. S., Schoenherr, T., & Wagner, S. M. (Eds.). (221). Theoxford handbook of Supply Chain management. Oxford University Press.
2.	Dani, S. (221). Food Supply Chain Management and Logistics: Understanding the Challenges of Production, Operation and Sustainability in the Food Industry. Kogan Page Publishers.
3.	Li, L. (27). Supply Chain Management: Concepts, Techniques and Practices: Enhancingthe Value through Collaboration. World scientific publishing company.
4.	Ross, D. F., Weston, F. S., & Stephen, W. (21). Introduction to supply chain Management technologies. Crc Press.
Reference Books	
1.	Hugos, M. H. (224). Essentials of supply chain management. John Wiley & Sons.
2.	Sunil, C. (213). Supply Chain Management: Strategy, Planning, And Operation, 5/e.Pearson India.
3.	Vandeput, N. (22). Inventory optimization: Models and simulations. Walter de GruyterGmbH & Co KG.
4.	Silver, E. A., Pyke, D. F., & Thomas, D. J. (216). Inventory and production management in supply chains. CRC Press.
Important web links	
1.	https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/278
2.	https://aims.education/supply-chain-management-notes/

Year, Program, Semester	Specialization Minor II, 4th Semester onwards						
Course Code	SPM 2.2						
Course Category	Specialization Minor Program Core						
Course Title	Logistics and Transportation Management						
Teaching Scheme andCredits	L	T	P	Total Contact Hours	Total Credits		
	03	-		03	03		
Evaluation Scheme	ISE	ESE	IOE	IPE	EOE	EPE	Total
	30	70	-	-	-	-	100
Pre-requisites(if any)	Prerequisites for this course typically include Principles of Food Preservation Technology, Professional Communication, Food Quality and Safety Management.						
Course Rationale	This course equips individuals with the necessary skills to manage the transportation, handling, and storage of food products effectively, ensuring safety, quality, and timelydeliveries in the complex food supply chain						
Course Objectives	The Course Teacher will ensure to 1. Understand logistics, transportation, intermodal systems, role of logistics in the economy, and future trends. 2. Develop skills in transportation planning, execution, and cost analysis 3. Gain knowledge of warehouse design, operations, and safety. 4. Understand inventory management, including ABC analysis,EOQ, JIT, VMI, and RFID. 5. Learn about reverse logistics, including returns, remanufacturing, recycling, and compliance. 6. Develop skills in risk management, including identification,security, contingency planning, insurance, and recovery.						
Course Outcomes	Upon completion of this course, students should be able to 1. Demonstrate understanding of logistics, transportation, intermodal systems, the role of logistics in the economy, and future trends. 2. Apply skills in transportation planning, execution, and costanalysis. 3. Design and operate warehouses with safety in mind. 4. Apply knowledge of inventory management, including ABCanalysis, EOQ, JIT, VMI, and RFID. 5. Manage reverse logistics, including returns, remanufacturing, recycling, and compliance. 6. Apply risk management strategies, including identification,security, contingency planning, insurance, and recovery.						

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	2	2	2	1	1	1	1	1	2	2	2	2
CO 2	2	3	2	3	1	-	-	-	3	2	3	2
CO 3	2	2	3	1	1	2	2	3	2	2	2	3
CO 4	2	1	2	3	3	-	-	-	2	2	3	2
CO 5	2	2	-	1	2	2	1	1	3	2	2	1

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

Unit No.	Course Content	Hours
I	**Introduction to Logistics and Transportation** Definition and Scope of Logistics, Modes of Transportation, Intermodal Transportation Systems, Role of Logistics in the Economy, Future Trends in Logistics	**06**
II	**Transportation Planning and Execution** Route Optimization, Freight Consolidation, Carrier Selection, Last Mile Delivery, Transportation Cost Analysis	**06**
III	**Warehouse Design and Operations** Warehouse Layout Planning, Material Handling Equipment, Inventory Control Systems Cross-Docking Operation, Warehouse Safety and Security	**06**
IV	**Inventory Management** ABC Analysis, Economic Order Quantity (EOQ), Just-in-Time (JIT) Inventory Systems Vendor-Managed Inventory (VMI), RFID Technology in Inventory Tracking	**06**
V	**Reverse Logistics** Product Returns Management, Remanufacturing and Refurbishing, Recycling and Disposal Operations, Closed-Loop Supply Chains, Regulatory Compliance in Reverse Logistics	**06**
VI	**Risk Management in Logistics** Risk Identification and Assessment, Security Measures in Transportation, Contingency Planning, Insurance and Liability Issue, Disaster Recovery Strategies	**06**
	Text Books	
1.	Choi, T. Y., Li, J. J., Rogers, D. S., Schoenherr, T., & Wagner, S. M. (Eds.). (221). The oxford handbook of Supply Chain management. Oxford University Press.	
2.	Dani, S. (221). Food Supply Chain Management and Logistics: Understanding the Challenges of Production, Operation and Sustainability in the Food Industry. Kogan Page Publishers.	
3	Li, L. (27). Supply Chain Management: Concepts, Techniques and Practices: Enhancing the Value through Collaboration. World scientific publishing company.	
4.	Ross, D. F., Weston, F. S., & Stephen, W. (21). Introduction to supply chain management Technologies. Crc Press.	

Reference Books	
1.	Hugos, M. H. (224). Essentials of supply chain management. John Wiley & Sons.
2.	Sunil, C. (213). Supply Chain Management: Strategy, Planning, And Operation, 5/e. Pearson India.
3.	Vandeput, N. (22). Inventory optimization: Models and simulations. Walter de Gruyter GmbH & Co KG.
4.	Silver, E. A., Pyke, D. F., & Thomas, D. J. (216). Inventory and production management in supply chains. CRC Press.
Important web links	
1.	https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/278
2.	https://aims.education/supply-chain-management-notes/

<table>
<tr><td>Year, Program, Semester</td><td colspan="7">Specialization Minor II, 4th Semesters onwards</td></tr>
<tr><td>Course Code</td><td colspan="7">SPM 2.3</td></tr>
<tr><td>Course Category</td><td colspan="7">Specialization Minor Program Core</td></tr>
<tr><td>Course Title</td><td colspan="7">Technology and Innovation in Food Supply Chain</td></tr>
<tr><td rowspan="2">Teaching Scheme andCredits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td colspan="2">Total Credits</td></tr>
<tr><td>03</td><td>-</td><td></td><td colspan="2">03</td><td colspan="2">03</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IOE</td><td>IPE</td><td>EOE</td><td>EPE</td><td>Total</td></tr>
<tr><td colspan="2">30</td><td>70</td><td>-</td><td>-</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="7">Prerequisites for this course typically include Principles of Food Preservation TechnoProfessional Communication, Food Quality and Safety Management.</td></tr>
<tr><td>Course Rationale</td><td colspan="7">The importance of Technology and Innovation in the Food Supply Chain lies in the revolution industry through advancements like block chain for transparency, IoT devices for mon analytics for risk identification, and AI for efficiency, sustainability, and consumer</td></tr>
<tr><td>Course Objectives</td><td colspan="7">The Course Teacher will ensure to
1. Understand digital transformation's impact on the Food Supply chain
2. Learn e-commerce fulfillment strategies
3. Gain knowledge of block chain apps in Food Supply Chain ManProc., Advantages, Smart Contracts, Traceability, & Transparency
4. Develop skills in data analytics for Food Supply Chain Manage
5. Study sustainability technology in the Food Supply Chain
6. Understand emerging technologies in Food Supply Chain management</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">By the end of the course, students will be able to
1. Understand the definition and scope of Food Supply Chain of the food industry.
2. Analyze the key components of a Food Supply Chain and the cassociated with managing it effectively.
3. Develop skills in Food Supply Chain planning, including management, and risk management.
4. Gain knowledge of procurement and sourcing strategies, such asourcing and supplier relationship management.
5. Learn about operations and logistics management, including warehouse management, transportation management, and order fulfillment processes.
6. Acquiring an understanding of quality and performance manage e key performance indicators, continuous improvement strategies, and benchmarking</td></tr>
</table>

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	2	2	1	1	1	1	2	2	1	1	1
CO 2	1	3	2	2	2	1	2	2	2	1	1	1
CO 3	2	1	3	1	1	2	1	2	1	2	1	1
CO 4	1	1	1	3	1	2	1	1	2	1	1	1
CO 5	1	1	2	2	3	2	2	1	2	2	1	1
CO 6	1	1	1	2	2	3	1	1	1	1	1	1

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

Unit No.	Course Content	Hours
I	**Digital Transformation in the Food Supply Chain** Industry 4 Technologies, Cloud Computing, Artificial Intelligence, Robotic Process Automation, Digital Twins	**06**
II	**E-Commerce Fulfilments** Omni-Channel Distribution, Order Processing Automation, Same-Day Delivery Strategies Last-Mile Delivery Innovations, Customer Experience Enhancement	**06**
III	**Block chain Applications in Food Supply Chain Management** Process of Block chain in Food Supply Chain management, Purpose and Advantages of Block chain, Application of Block chain in Food Supply Chain management,Smart Contracts, Traceability and Transparency	**06**
IV	**Data Analytics for Food Supply Chain Management** Predictive Analytics, Prescriptive Analytics, Descriptive Analytics, Real-Time Data Insights, Data-Driven Decision Making	**06**
V	**Sustainability Technologies in Food Supply Chain** Renewable Energy Solutions, Green Fleet Technologies, Energy-Efficient Warehousing Sustainable Packaging Innovations, Environmental Impact Assessments	**06**
VI	**Emerging Technologies in Food Supply Chain management** Internet of Things (IoT) Applications, Drones and Autonomous Vehicles, Augmented Reality in Warehousing, Additive Manufacturing Impacts on Food Supply Chain Management, Quantum Computing Potential for Food Supply Chain Management	**06**
Textbooks		
1.	Choi, T. Y., Li, J. J., Rogers, D. S., Schoenherr, T., & Wagner, S. M. (Eds.). (221). The oxford handbook of Food Supply Chain management. Oxford University Press.	
2.	Dani, S. (221). Food Supply Chain Management and Logistics: Understanding the Challenges of Production, Operation and Sustainability in the Food Industry. Kogan Page Publishers.	
3.	Li, L. (27). Food Supply Chain Management: Concepts, Techniques and Practices: Enhancing the Value through Collaboration. World scientific publishing company.	
4.	Ross, D. F., Weston, F. S., & Stephen, W. (21). Introduction to Food Supply Chain management Technologies. CRC Press.	

Reference books	
1.	Hugos, M. H. (224). Essentials of Food Supply Chain management. John Wiley & Sons.
2.	Sunil, C. (213). Food Supply Chain Management: Strategy, Planning, And Operation, 5/e. Pearson India.
3.	Vandeput, N. (22). Inventory optimization: Models and simulations. Walter de Gruyter GmbH & Co KG.
4.	Silver, E. A., Pyke, D. F., & Thomas, D. J. (216). Inventory and production management in Food Supply Chains. CRC Press.
Important web links	
1.	https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/278
2.	https://aims.education/supply-chain-management-notes/

Year, Program, Semester	Specialization Minor II, 4th Semester onwards						
Course Code	SPM-2.4						
Course Category	Program Based Internship						
Course Title	Internship in Food Supply Chain Management						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	One Month				03		
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00	50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations						
Course Rationale	The Industrial Internship course caters specifically to B.Tech Food Technology students pursuing additional specialization through the B.Tech Minor program in areas such as Food Supply Chain Management This course offers practical exposure to industry settings aligned with their chosen sub-specialization, aiming to bridge the gap between theoretical knowledge and practical application. By engaging in a one-month internship, students gain firsthand experience, essential skills, and insights crucial for their future careers in specialized sectors of Food Technology						
Course Objectives	The course teacher will 1. Help expose students to the 'real' working environment. 2. Promote hands-on experience to the students' in their related field. 3. Develop synergetic collaboration between industry and the university in promoting a knowledgeable society. 4. Assist in providing the opportunity for students to test their interest in a particular career before permanent commitments are made. 5. Elaborate the dynamic and challenging nature of industrial environments.						
Course Outcomes	Upon completion of this course, student should be able to 1. Understand industrial processes and operations related to their minor sub-specializations. 2. Apply theoretical concepts to solve practical problems in the industry. 3. Communicate effectively with industry professionals, colleagues, and supervisors. 4. Collaborate efficiently in team environments to complete tasks and projects. 5. Adapt to the dynamic and challenging nature of industrial environments. 6. Reflect on internship experiences for personal and professional growth.						

Course Outcome and Program Outcome Mapping

CO/PO	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	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	2	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-	3
CO6	-	-	-	-	-	-	-	-	-	-	-	2

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

Course Content	Hours
The course consists of a one-month internship in a relevant specialized industry. Students will be placed in companies or organizations that align with their chosen sub-specialization within the field of food technology. During the internship, students will engage in various activities, including but not limited to: 1. Shadowing industry professionals to observe and learn about different processes and operations. 2. Assisting with ongoing projects or research initiatives within the organization. 3. Participating in hands-on tasks related to their minor sub-specialization, under the guidance of experienced mentors. 4. Attending training sessions, workshops, and seminars conducted by the industry to enhance their knowledge and skills. 5. Engaging in discussions and meetings with supervisors and colleagues to gain insights into industry practices, challenges, and innovations. 6. Documenting their internship experience through reports, presentations, or reflective journals. The period of one month for this internship will be during the winter or summer vacations, any such slots 4th Semester onwards.	4 weeks

Course Evaluation Method

This particular evaluation will be the part of the structure of 7th Semester.

The evaluation for the Industrial Internship course will be conducted as follows:

- **Internal Evaluation (50 marks):**
    - Assessment by course teachers based on students' performance during the internship, including attendance, participation, attitude, and contribution to assigned tasks.

- Evaluation by industrial supervisors on students' professional conduct, technical skills, problem-solving abilities, and overall performance in the workplace.

- **External Evaluation (50 marks):**
  - Evaluation by an external examiner appointed by the institute, who will assess students' internship reports, presentations, or any other documentation submitted at the end of the internship period.
  - The external examiner will review the quality of students' reflections on their internship experience, their ability to apply theoretical knowledge to practical situations, and the depth of their understanding of industry practices and challenges.

The final grades for the Industrial Internship course will be determined based on the combined assessment from both internal and external evaluations.

Reference Books	
1.	Hugos, M. H. (224). Essentials of supply chain management. John Wiley & Sons.
2.	Choi, T. Y., Li, J. J., Rogers, D. S., Schoenherr, T., & Wagner, S. M. (Eds.). (221). The oxford handbook of Food Supply Chain management. Oxford University Press

Year, Program, Semester	Specialization Minor II, 4th Semester onwards							
Course Code	SPM 2.5							
Course Category	Project Based Learning							
Course Title	**Mini Project**							
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**		
	-	-	-	-		02		
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.							
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this mini-project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the Professional arena of Food Supply Chain Management.							
Course Objectives	The course teacher will 1. Facilitate the application of theoretical knowledge. 2. Guide the students about the enhancement of practical skills. 3. Explain about the development of industry-relevant competencies.							
Course Outcomes	Upon completion of this course, students should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.							

Course Outcome and Program Outcome Mapping

CO/PO	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	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

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

Course Content

Specialization Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

Course Assessment Process
This particular evaluation will be the part of 8th Semester of the major structure. The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work. The teachers will follow the instructions as below: Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including: • Rubric-based assessment for the project work and its report. • Peer evaluation for project. • Instructor-led discussions or presentations to evaluate communication skills and critical thinking. • Overall course grading based on a weighted average of individual assessments and participation. The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

Specialization Minor
In
Food Safety and Quality Management
For
B.Tech (Food Technology)

Shivaji University, Kolhapur
Department of Technology

Specialization Minor in Food Safety and Quality Management

Teaching & Evaluation Scheme

Sr. No.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode	SPM 3.1	Principles of Food Safety and Quality Management	03	-	-	03	03	30:70	00:00
2.		SPM 3.2	Food Safety and Quality Management Systems	03	-	-	03	03	30:70	00:00
3.		SPM 3.3	Food Laws and Regulations	03	-	-	03	03	30:70	00:00
4.	Program Based Internship	SPM 3.4	Internship in Food Safety and Quality Management	One Month				03	-	50:50
5.	Project Based Learning	SPM 3.5	Mini Project	-	-	-	-	02	-	50:50
				-	**-**	**-**	**-**	**14**	**300**	**200**
			Total Hours	**09**	**00**	**00**	**09**	**-**	**-**	**-**

Note: If opted the Specialization Minor Program, Internship and Mini Project may be planned during winter or summer vacation days after 4th semester while respective evaluations will appear on a separate mark sheet.

Specialization Minor III:
FOOD SAFETY AND QUALITY AND MANAGEMENT

<table>
<tr><td>Year, Program, Semester</td><td colspan="8">Specialization Minor III, 4th Semester Onwards</td></tr>
<tr><td>Course Code</td><td colspan="8">SPM 3.1</td></tr>
<tr><td>Course Category</td><td colspan="8">Specialization Minor Program Core</td></tr>
<tr><td>Course Title</td><td colspan="8">Principles of Food Safety and Quality Management</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="3">Total Contact Hours</td><td colspan="2">Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td colspan="3">03</td><td colspan="2">03</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IOE</td><td>IPE</td><td>EOE</td><td>EPE</td><td>Total</td></tr>
<tr><td colspan="2">30</td><td>70</td><td>-</td><td>-</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="8">Basic understanding of food science and technology</td></tr>
<tr><td>Course Rationale</td><td colspan="8">1. Ensuring the safety of food products is paramount to public health.
2Compliance with food safety standards is essential for international tradeand market access.</td></tr>
<tr><td>Course Objectives</td><td colspan="8">The Course Teacher will ensure
1. To develop qualified and competent human resource in the field of the food safety and quality management for regulators Identify and describe
2. To acknowledge the various aspects of food safety and quality management i.e. food standards, harmonization with global benchmarks
3. To nurture a positive and disciplined food safety culture among the professionals
4. To conduct research studies on emerging food safety issues and formulation of science based regulatory framework.
5. Understand the mechanism of Traceability Studies with the help of Packaged Food Label
6. Explain the Risk Assessment & its management done in the food Processing with the help of Case Studies</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">Upon completion of this course, student should be able to
1. Comprehend the issues of safety and quality in food production, Handling, and processing and trade.
2. Build technical proficiency in undertaking food safety and quality Assurance in food processing chain i.e., from farm tofork.
Ensure the safety and quality of food products as per mandatory
3. Learn legal requirements and voluntary standards including export regulations
4. Design and implement Good Hygienic Practices (GHP), Good Manufacturing Practices (GMP), Hazard Analysis and Critical Control Point (HACCP), Quality Management Systems (QMS):ISO 9001 & Food Safety Management Systems(FSMS):ISO22000, Laboratory Management System: ISO
5. Be able to effectively plan, conduct, report and audit as per the guidelines of the Food Safety Management System
6. Apply the knowledge of Good Manufacturing PracticesGood Laboratory Practices in Food Processing industry</td></tr>
</table>

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	2	2	2	1	1	1	2	2	1	1	1	1
CO 2	2	2	2	2	2	2	3	1	1	1	1	1
CO 3	2	2	2	2	2	2	3	3	1	1	1	1
CO 4	2	2	2	2	2	2	3	3	1	1	1	1
CO 5	2	2	2	2	2	2	3	3	1	1	1	1
CO 6	2	2	2	2	2	2	3	3	1	1	1	1

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

Unit No.	Course Content	Hours
I	**Food Safety and Quality Management Systems** Introduction to Food Safety, Food Safety System, Total Quality Management Schedule 4 of FSSR	**06**
II	**Risk Analysis** An Introduction to Risk Analysis, Risk Management**,** Risk Assessment**,** Risk Communication	**06**
III	**HACCP** History, Background and Structure of HACCP,HACCP Prerequisites and Good Hygienic Practice, Principles and Implementation of HACCP, Case Studies on HACCP	**06**
IV	**Other Food Safety Practices** Good Agriculture Practices, Good Animal Husbandry Practices and Good Manufacturing Practices, Good Retail Practices, Good Transport Practices and Nutrition Labelling, Traceability Studies	**06**
V	**Quality Management system** ISO-9001:2015 - An Overview**,**ISO-9001:2015 – Structure, Clause wise Interpretation of ISO 9001:2015	**06**
VI	**Food Safety Management Systems** ISO 22000:2018 - An overview, Clause Wise Interpretation of ISO 22000,ISO 22000:2018 - Food Safety Plan, ISO 22000:2018 - Case Studies	**06**
	Text Books	
1.	Amihud Kramer, Bernard A. Twigg, "Quality Control for the Food Industry: Fundamentals v. 1, The AVI Publishing Company. Inc., Westport, USA	
2.	Maynard A. Amerine, Rose Marie Pangborn and Edward B. Roessler, "Principles of Sensory Analysis of Foods", Academic Press, NY	

Reference Books	
1	Alli, I. (2003). Food quality assurance: principles and practices. CRC Press.
2	Lelieveld, H. L., Holah, J., & Napper, D. (Eds.). (2014). *Hygiene in food processing: principles and practice*.Elsevier.
3	Hayes, R. (2013). Food microbiology and hygiene. Springer Science & Business Media.
Suggested Reference Links	
1.	https://ebooks.inflibnet.ac.in/hsp05/chapter/total-quality-management/
2.	https://www.fssai.gov.in › cms › act-2006 [FSSAI Act, 2006]

Year, Program, Semester	Specialization Minor III, 4th Semester onwards							
Course Code	SPM 3.2							
Course Category	Specialization Minor Program Core							
Course Title	Food Safety and Quality Management Systems							
Teaching Scheme andCredits	L	T	P	Total Contact Hours		Total Credits		
	03	-		03		03		
Evaluation Scheme	ISE	ESE	IOE	IPE	EOE	EPE	Total	
	30	70	-	-	-	-	100	
Pre-requisites(if any)	Basic understanding of food safety principles.							
Course Rationale	1. Understanding the role of regulatory authorities helps innavigating compliance requirements. 2 Knowledge of global and Indian standards in food safetymanagement is vital for industry competitiveness							
Course Objectives	The Course Teacher will ensure that students will 1. Gain knowledge about the scope & basic principles of food safety 2. Understand the food quality aspects and the need of food safety 3. Demonstrate compliance with food safety requirements 4. Develop effective communication of food safety issues to their suppliers, customers and relevant interested parties in the food chain 5. Ensure that the organization is consistent with thedeclaration of food safety policy 6. Interpret the role of Indian and global regulatory authorities concerning food safety							
Course Outcomes	Upon completion of this course, students should be able to 1. To understand the important parameters of food safetysystems 2. To prepare HACCP-based Standard Operating Procedure 3. To conduct quality auditing in the food industries 4. To Distinguish between safety, hazard and toxicity 5. Evaluate the hygiene and sanitation conditions in food processing plant, equipment, storage and handling 6. Understand the various regulatory aspects for food businessoperators							

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	2	2	2	1			2	2			-	-
CO 2	2	2	1				2	2			-	-
CO 3	2	1	2				2	2	2		-	-

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

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

Unit No.	Course Content	Hours
I	**Food Safety and Quality Management Systems** Introduction to Food Safety, Food Safety System, Total Quality Management, Schedule 4 of FSSR	06
II	**Management Systems, Auditing and Accreditation** Introduction to Management Systems, Auditing, Standardization and Accreditation	06
III	**Quality Management System** ISO-9001:2015 - An Overview,ISO-900:2015 – Structure, Clause wise Interpretation of ISO 9001:2015,ISO 9001:2015- Case Studies	06
IV	**Food Safety Management Systems** ISO 22000:2018 - An overview, Clause Wise Interpretation of ISO 22000,ISO 22000:2018 - Food Safety Plan, ISO 22000:2018 - Case Studies	06
V	**Laboratory Quality Management System** An Overview and Requirements of ISO 17025, Requirements Specific to Food Testing Laboratories - Physical and ChemicalParameters, Requirements Specific to Food Testing Laboratories - Biological Parameters, General Topics: Related to Food Testing Laboratories	06
VI	**Retailer Standards** BRC Food and BRC/IOP Standards - An Overview, International Food Standard (IFS),SQF 1000 and SQF 2000,Global GAP and India GAP	06

Text Books

1. Andres Vasconcellos J. 2005. Quality Assurance for the Food industry - A practical approach. CRCpress
2. InteazAlli. 2004. Food quality assurance - Principles & practices. CRC Press. New York.
3. Sara Mortimore and Carol Wallace. 2013. HACCP - A practical approach. Third edition. Chapman andHall, London.

Reference Books

1. Roday, S. 1998. Food Hygiene and Sanitation, Tata McGraw-Hill Education.
2. Naomi Rees. David Watson. 2000. International standards for food safety, An Aspen Publications.
3. O'Rourke. 2005. European Food law, 3rd Edition, Thomson, Sweet and Maxwell.

Suggested Reference Links

1. https://ebooks.inflibnet.ac.in/hsp05/chapter/total-quality-management/

<table>
<tr><td>Year, Program, Semester</td><td colspan="8">Specialization Minor III, 4th Semester onwards</td></tr>
<tr><td>Course Code</td><td colspan="8">SPM 3.3</td></tr>
<tr><td>Course Category</td><td colspan="8">Specialization Minor Program Core</td></tr>
<tr><td>Course Title</td><td colspan="8">Food Laws and Regulations</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="3">Total Contact Hours</td><td colspan="2">Total Credits</td></tr>
<tr><td>03</td><td>-</td><td></td><td colspan="3">03</td><td colspan="2">03</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IOE</td><td>IPE</td><td>EOE</td><td>EPE</td><td>Total</td></tr>
<tr><td colspan="2">30</td><td>70</td><td>-</td><td>-</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="8">Basic Understanding of Food Science:</td></tr>
<tr><td>Course Rationale</td><td colspan="8">1. Ensuring compliance with food laws and regulations is crucial for maintaining food safety and quality standards.
2. Understanding food laws helps professionals in food technology navigate the complexities of the industry and ensure adherence to legal requirements.</td></tr>
<tr><td>Course Objectives</td><td colspan="8">The Course Teacher will ensure
1. To familiarize students with the regulatory bodies and agencies responsible for governing food laws and standards.
2. To understand the legal requirements and regulations related tofood production, processing, packaging, and labelling.
3. To analyze the impact of food laws and standards on food safety, quality control, and consumer protection.
4. To explore international food standards and their significance in global trade and market access.
5. To develop skills in interpreting and applying food laws and standards in practical scenarios.
6. To foster awareness of ethical considerations and responsibilities in food processing and engineering practices</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">Upon completion of this course, students should be able to
1. Identify and explain the roles of regulatory agencies involved in overseeing food laws and standards.
2. Interpret and apply relevant laws and regulations governing food production, processing, and labelling.
3. Evaluate the compliance of food products with legal requirements and quality standards.
4. Analyze the implications of non-compliance with food laws and standards on public health and industry reputation.
5. Demonstrate proficiency in navigating international food standards and regulations.
6. Develop strategies for ensuring ethical and responsible practicesin food processing and engineering.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1						3		2		1		
CO 2	1	1	1									
CO 3		3		3			2					
CO 4				3				2				
CO 5					3					2		1
CO 6						3			3			2

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

Unit No.	Course Content	Hours
I	**Indian Food Regulatory Regime** PFA Act and Rules Food Safety and Quality Requirements, Food Safety and Standards Act, 2006 and Supplementary Material Essential Commodities Act, 1955	**06**
II	**Global Scenario** Codex Alimentations Commission (CAC), CAC : Implications, Other International Standards Setting Bodies	**06**
III	**Export & Import Laws and Regulations** FTDR Act, 1992 and Foreign Trade Policy, Export (Quality Control and Inspection) Act, 1963, Export Related Regulations and Standards set by export promotion bodies, Plant and Animal Quarantine, Customs Act and Import Control Regulations & Export & Import Laws and Regulations	**06**
IV	**Other Laws and Standards Related to Food** Other Laws Related to Food Products, Voluntary National Standards: BIS and AGMARK, National Agencies for Implementation of International Food Laws and Standards, Accreditation System for Conformity Assessment Bodies	**06**
V	**Indian Food Regulatory Ecosystem** Licensing and registration Regulation, Food packaging, Labelling and Advertisement and Claims Regulations, Laboratory and Sampling Regulation, Food Product Standards Regulation & other important Regulations	**06**
VI	**Consumer Awareness initiatives** FOSTAC Training (Food Safety Supervisor), Fortification, BHOG, Eat Right India Movement, Swasth Bharat Yatra and Eat right Campuses	**06**
Text Books		
1.	Rees, N., & Watson, D. (2000). International standards for food safety. Springer Science & Business Media.	

2.	Fortin, N. D. (2016). Food regulation: law, science, policy, and practice. John Wiley & Sons.
3.	Processed packaged foods with Indian food laws (FSSAI, 2011 regulations). International Journal of Food and Nutritional Sciences, 2(4), 14-19.
4.	Motarjemi, Y., & Lelieveld, H. (Eds.). (2013). Food safety management: a practical guide for the food industry. Academic Press.
Reference Books	
1.	Joint FAO/WHO Food Standards Programme. (2007). Codex Alimentarius: Food import and export inspection and certification systems. Food & Agriculture Org..
2.	Mortimor, S., & Wallace, C. (2013). HACCP: A practical approach. Springer Science & Business Media
3.	Singh, M., Iyer, U., & Chandorkar, S. (2012). Nutrition labeling compliance of branded
Suggested Reference Links	
1.	https://ebooks.inflibnet.ac.in/hsp05/chapter/total-quality-management/
2.	https://fssai.gov.in/
3.	https://www.fao.org/fao-who-codexalimentarius/en/

Year, Program, Semester	Specialization Minor III, 4th Semester onwards						
Course Code	SPM-3.4						
Course Category	Program Based Internship						
Course Title	Internship in Food Safety and Quality Management						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	One Month				03		
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00	50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.						
Course Rationale	The Industrial Internship course caters specifically to B.Tech Food Technology students pursuing additional specialization through the B.Tech Minor program in areas such as Food Safety and Quality Management. This course offers practical exposure to industry settings aligned with their chosen sub-specialization, aiming to bridge the gap between theoretical knowledge and practical application. By engaging in a one-month internship, students gain firsthand experience, essential skills, and insights crucial for their future careers in specialized sectors of Food Technology.						
Course Objectives	The course teacher will 1. Help expose students to the 'real' working environment. 2. Promote hands-on experience to the students' in their related field. 3. Develop synergetic collaboration between industry and the university in promoting a knowledgeable society. 4. Assist in providing the opportunity for students to test their interest in a particular career before permanent commitments are made. 5. Elaborate the dynamic and challenging nature of industrial environments.						
Course Outcomes	Upon completion of this course, student should be able to 1. Understand industrial processes and operations related to their minor sub-specializations. 2. Apply theoretical concepts to solve practical problems in the industry. 3. Communicate effectively with industry professionals, colleagues, and supervisors. 4. Collaborate efficiently in team environments to complete tasks and projects. 5. Adapt to the dynamic and challenging nature of industrial environments. 6. Reflect on internship experiences for personal and professional growth.						

Course Outcome and Program Outcome Mapping

CO/PO	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	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	2	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-	3
CO6	-	-	-	-	-	-	-	-	-	-	-	2

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

Course Content	Hours
The course consists of a one-month internship in a relevant specialized industry. Students will be placed in companies or organizations that align with their chosen sub-specialization within the field of food technology. During the internship, students will engage in various activities, including but not limited to: 1. Shadowing industry professionals to observe and learn about different processes and operations. 2. Assisting with ongoing projects or research initiatives within the organization. 3. Participating in hands-on tasks related to their minor sub-specialization, under the guidance of experienced mentors. 4. Attending training sessions, workshops, and seminars conducted by the industry to enhance their knowledge and skills. 5. Engaging in discussions and meetings with supervisors and colleagues to gain insights into industry practices, challenges, and innovations. 6. Documenting their internship experience through reports, presentations, or reflective journals. The period of one month for this internship will be during the winter or summer vacations, any such slots 4th Semester onwards.	4 weeks

Course Evaluation Method

This particular evaluation will be the part of the structure of 7th Semester.

The evaluation for the Industrial Internship course will be conducted as follows:

- **Internal Evaluation (50 marks):**
  - Assessment by course teachers based on students' performance during the internship, including attendance, participation, attitude, and contribution to assigned tasks.
  - Evaluation by industrial supervisors on students' professional conduct, technical skills, problem-solving abilities, and overall performance in the workplace.
- **External Evaluation (50 marks):**
  - Evaluation by an external examiner appointed by the institute, who will assess students' internship reports, presentations, or any other documentation submitted at the end of the internship period.
  - The external examiner will review the quality of students' reflections on their internship experience, their ability to apply theoretical knowledge to practical situations, and the depth of their understanding of industry practices and challenges.

The final grades for the Industrial Internship course will be determined based on the combined assessment from both internal and external evaluations.

Reference Books

1.	Amihud Kramer, Bernard A. Twigg, "Quality Control for the Food Industry: Fundamentals v. 1, The AVI Publishing Company. Inc., Westport, USA
2.	Alli, I. (2003). Food quality assurance: principles and practices. CRC Press.

Year, Program, Semester	Specialization Minor III, 4th Semester onwards						
Course Code	SPM 3.5						
Course Category	Project Based Learning						
Course Title	**Mini Project**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	-	-	-	-		02	
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.						
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this mini project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena in the Food Safety and Quality Management.						
Course Objectives	The course teacher will 1. Facilitate application of theoretical knowledge. 2. Guide the students about enhancement of practical skills. 3. Explain about development of industry-relevant competencies.						
Course Outcomes	Upon completion of this course, student should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.						

Course Outcome and Program Outcome Mapping

CO/PO	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	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

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

Course Content

Specialization Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

Course Assessment Process

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the

external evaluation of the Project work.

The teachers will follow the instructions as below:

Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:

- Rubric-based assessment for the project work and its report.
- Peer evaluation for project.
- Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
- Overall course grading based on a weighted average of individual assessments and participation.

The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.