

KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

TAMILNADU INDIA



Estd : 1984

REGULATIONS, CURRICULUM & SYLLABI – 2024

(CHOICE BASED CREDIT SYSTEM AND
OUTCOME BASED EDUCATION)

(For the students admitted from the academic year 2024 - 2025)

MASTER OF TECHNOLOGY DEGREE IN FOOD TECHNOLOGY

DEPARTMENT OF FOOD TECHNOLOGY

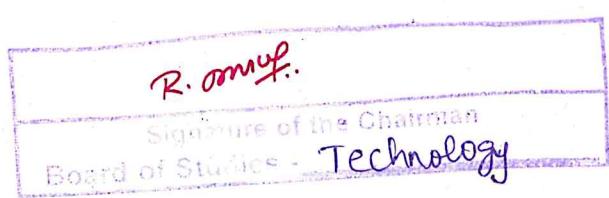


M.TECH. FOOD TECHNOLOGY CURRICULUM – R2024
(For the candidates admitted in the academic year 2024-25 onwards)

SEMESTER – I														
Course Code	Course Title	Hours / Semester						Credit	Maximum Marks			Category	Type	
		CI		LI	TW	SL	TH		CA	ESE	Total			
		L	T	P										
Theory/Theory with Practical														
24AMT14	Applied Statistics for Food Technology	45	15	0	60	0	120	4	40	60	100	FC	A	
24GET11	Introduction to Research	30	15	0	45	0	90	3	40	60	100	FC	C	
24MFT11	Advanced Drying Technology	45	15	0	60	0	120	4	40	60	100	PC	A	
24MFT12	Food Chemistry and Microbiology	45	0	0	45	0	90	3	40	60	100	PC	C	
24MFT13	Advanced Food Processing Technology	45	0	0	45	0	90	3	40	60	100	PC	C	
24MFT14	Lipid Science and Technology	45	0	0	45	0	90	3	40	60	100	PC	C	
Practical / Employability Enhancement														
24MFL11	Food Chemistry and Microbiology Laboratory	0	0	30	0	0	30	1	60	40	100	PC		
24MFL12	Food Process Technology Laboratory	0	0	30	0	0	30	1	60	40	100	PC		
Total Credits to be earned									22					

CI – Classroom Instructions, LI – Laboratory Instructions, TW – Term Work, SL – Self Learning, L – Lecture, T – Tutorial, P – Practical, C – Credit, TH – Total Hours, CA – Continuous Assessment, ESE – End Semester Examination

Type: A – Analytical, D – Design using Hardware, S – Simulation using Coding, C – Concept, OC – Online course, OT - others

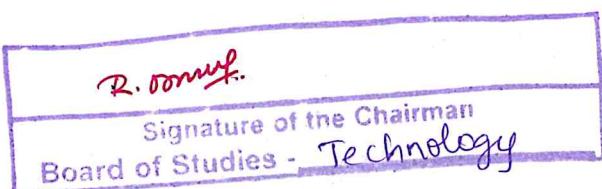


M.TECH. FOOD TECHNOLOGY CURRICULUM – R2024
(For the candidates admitted in the academic year 2024-25 onwards)

SEMESTER – II																
Course Code	Course Title	Hours / Semester						Credit	Maximum Marks			Category	Type			
		CI		LI	TW	SL	TH		CA	ESE	Total					
		L	T													
Theory/Theory with Practical																
24MFT21	Advanced Refrigeration and Cold Chain Management	45	15	0	60	0	120	4	40	60	100	PC	A			
24MFT22	Instrumental Techniques and Methods for Food Analysis	45	0	0	45	0	90	3	40	60	100	PC	C			
24MFT23	Food Safety and Quality Control	45	0	0	45	0	90	3	40	60	100	PC	C			
	Professional Elective – I	45	0	0	45	0	90	3	40	60	100	PE				
	Professional Elective – II	45	0	0	45	0	90	3	40	60	100	PE				
	Professional Elective – III	45	0	0	45	0	90	3	40	60	100	PE				
Practical / Employability Enhancement																
24MFL21	Applied Food Analysis Laboratory	0	0	30	0	0	30	1	60	40	100	PC				
24MFL22	Food Products Development Laboratory	0	0	30	0	0	30	1	60	40	100	PC				
Total Credits to be earned									21							

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Type: A – Analytical, D – Design using Hardware, S – Simulation using Coding, C – Concept, OC – Online course, OT - others

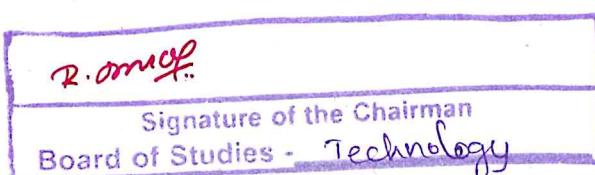


M.TECH. FOOD TECHNOLOGY CURRICULUM – R2024
(For the candidates admitted in the academic year 2024-25 onwards)

SEMESTER – III													
Course Code	Course Title	Hours / Semester						Credit	Maximum Marks			Category	Type
		CI		LI	TW	SL	TH		CA	ESE	Total		
L	T	P											
Theory/Theory with Practical													
	Professional Elective – IV	45	0	0	45	0	90	3	40	60	100	PE	
	Professional Elective – V	45	0	0	45	0	90	3	40	60	100	PE	
	Professional Elective – VI	45	0	0	45	0	90	3	40	60	100	PE	
Practical / Employability Enhancement													
24MFP31	Project Work - I	0	0	240	0	0	240	8	50	50	100	EC	
Total Credits to be earned								17					

CI – Classroom Instructions, LI – Laboratory Instructions, TW – Term Work, SL – Self Learning, L – Lecture, T – Tutorial, P – Practical, C – Credit, TH – Total Hours, CA – Continuous Assessment, ESE – End Semester Examination

Type: A – Analytical, D – Design using Hardware, S – Simulation using Coding, C – Concept, OC – Online course, OT - others



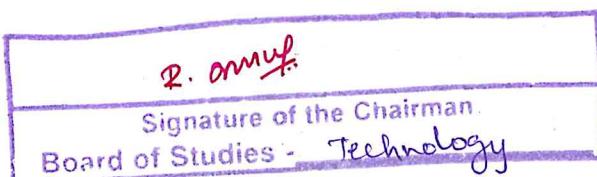
M.TECH. FOOD TECHNOLOGY CURRICULUM – R2024
(For the candidates admitted in the academic year 2024-25 onwards)

SEMESTER – IV														
Course Code	Course Title	Hours / Semester						Credit	Maximum Marks			Category	Type	
		CI		LI	TW	SL	TH		CA	ESE	Total			
		L	T	P										
Practical / Employability Enhancement														
24MFP41	Project Work - II	0	0	360	0	0	360	12	50	50	100	EC		
Total Credits to be earned								12						

CI – Classroom Instructions, LI – Laboratory Instructions, TW – Term Work, SL – Self Learning, L – Lecture, T – Tutorial, P – Practical, C – Credit, TH – Total Hours, CA – Continuous Assessment, ESE – End Semester Examination

Type: A – Analytical, D – Design using Hardware, S – Simulation using Coding, C – Concept, OC – Online course, OT - others

Total Credits : 72



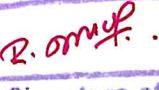
M.TECH. FOOD TECHNOLOGY CURRICULUM – R2024
(For the candidates admitted in the academic year 2024-25 onwards)

LIST OF PROFESSIONAL ELECTIVE COURSES

S. No.	Course Code	Course Title	Hours / Week					Credit	Maximum Marks			Cate gory	Type							
			CI		LI	TW	SL	TH	CA	ESE	Total									
			L	T	P															
SEMESTER - II																				
ELECTIVE – I																				
1	24MFE01	Advanced Fruit and Vegetable Processing Technology	45	0	0	45	0	90	3	40	60	100	PE C							
2	24MFE02	Novel Technologies in Food Processing	45	0	0	45	0	90	3	40	60	100	PE C							
3	24MFE03	Heat and Mass Transfer Operations in Food Processing	45	0	0	45	0	90	3	40	60	100	PE C							
4	24MFE04	Industrial Engineering	45	0	0	45	0	90	3	40	60	100	PE C							
5	24MFE05	Industrial Waste Management	45	0	0	45	0	90	3	40	60	100	PE C							
ELECTIVE – II																				
6	24MFE06	Advanced Baking and Confectionery Technology	45	0	0	45	0	90	3	40	60	100	PE C							
7	24MFE07	Advanced Separation Techniques in Food Processing	45	0	0	45	0	90	3	40	60	100	PE C							
8	24MFE08	Food Packaging and Storage Engineering	45	0	0	45	0	90	3	40	60	100	PE C							
9	24MFE09	Enzyme Engineering and Technology	45	0	0	45	0	90	3	40	60	100	PE C							
10	24MFE10	Machine Vision for Food Technology	45	0	0	45	0	90	3	40	60	100	PE C							
ELECTIVE – III																				
11	24MFE11	Technology of Food Colours and Flavours	45	0	0	45	0	90	3	40	60	100	PE C							
12	24MFE12	Food Product Design and Development	45	0	0	45	0	90	3	40	60	100	PE C							
13	24MFE13	Transport Phenomena in Food Processing	45	0	0	45	0	90	3	40	60	100	PE C							
14	24MFE14	Operational Research	45	0	0	45	0	90	3	40	60	100	PE C							

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Signature of the Chairman d of Studies - Technology	



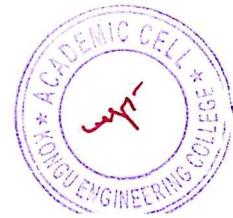
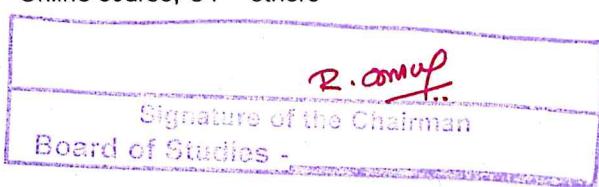
M.TECH. FOOD TECHNOLOGY CURRICULUM – R2024

(For the candidates admitted in the academic year 2024-25 onwards)

S. No	Course Code	Course Title	Hours / Week					Credit	Maximum Marks			Cate gory	Type					
			CI		LI	TW	SL	TH	CA	ESE	Total							
			L	T	P													
SEMESTER - III																		
ELECTIVE – IV																		
15	24MFE15	Advanced Grain Science and Technology	45	0	0	45	0	90	3	40	60	100	PE	C				
16	24MFE16	Food Additives, Nutraceuticals and Functional Foods	45	0	0	45	0	90	3	40	60	100	PE	C				
17	24MFE17	Food Process Plant Layout and Design	45	0	0	45	0	90	3	40	60	100	PE	C				
18	24MFE18	Food Rheology	45	0	0	45	0	90	3	40	60	100	PE	C				
19	24MFE19	Internet of Things in Food and Agriculture	45	0	0	45	0	90	3	40	60	100	PE	C				
ELECTIVE – V																		
20	24MFE20	Sensory Evaluation of Foods	45	0	0	45	0	90	3	40	60	100	PE	C				
21	24MFE21	Advanced Meat Processing Technology	45	0	0	45	0	90	3	40	60	100	PE	C				
22	24MFE22	Food Supply Chain Management	45	0	0	45	0	90	3	40	60	100	PE	C				
23	24MFE23	Scaleup Methods in Process Engineering	45	0	0	45	0	90	3	40	60	100	PE	C				
24	24MFE24	Design and Analysis of Experiments	45	0	0	45	0	90	3	40	60	100	PE	C				
ELECTIVE – VI																		
25	24MFE25	Plantation Crops and Spices Technology	45	0	0	45	0	90	3	40	60	100	PE	C				
26	24MFE26	Advanced Dairy Technology	45	0	0	15	30	90	3	40	60	100	PE	OC				
27	24MFE27	Computational Fluids Dynamics	45	0	0	45	0	90	3	40	60	100	PE	C				
28	24MFE28	Industrial Process Automation	45	0	0	45	0	90	3	40	60	100	PE	C				
29	24MFE29	Project Engineering and Management	45	0	0	45	0	90	3	40	60	100	PE	C				
30	24GET13	Innovation Entrepreneurship and Venture Development	45	0	0	45	0	90	3	40	60	100	PE	C				

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24AMT14 - APPLIED STATISTICS FOR FOOD TECHNOLOGY

Programme & Branch	MTech& Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit								
Prerequisites	Nil	1	FC	45	15	0	60	120	4								
Preamble	This course will help the students to identify, formulate and optimize processes using statistical tools in order to achieve the best products in food industry.																
Unit – I Testing of Hypothesis:																	
Sampling Distributions – Large sample tests – Testing the significance of single mean - difference of means – Small sample tests – Testing the significance of means (student's t-test) – Testing the significance of Variances (F-test) - Testing the significance of goodness of fit - Independence of attributes (χ^2 - test).																	
Unit – II Nonparametric Tests:																	
Introduction – Sign test: One sample sign test – Sign test for paired samples – Signed rank test – Rank Sum test: Mann Whitney U test- Kruskal-Wallis test – One sample run test – Tests of randomness.																	
Unit – III Design of Experiments:																	
Analysis of variance – One-way classification – Completely Randomized Design – Two way classification – Randomized block design – Latin Square Design.																	
Unit – IV Time Series Analysis:																	
Significance of time series analysis - Components of Time series - Secular trend - Graphical method - Semi-average method - Method of Moving Averages - Method of Least squares - Seasonal variations - Method of Simple Averages - Ratio to trend method - Ratio to moving average method.																	
Unit – V Statistical Quality Control:																	
Introduction to Statistical quality control – Control charts – Control chart for variables: \bar{X} -chart – R-chart – s-chart – Charts for attributes: np-chart – p-chart – c-chart.																	
REFERENCES:																	
1.	S.C.Gupta, "Fundamentals of Statistics", 7 th Revised Edition, Himalaya Publishing House Private Limited, Mumbai, 2019.																
2.	G.C.Beri, "Business Statistics", 3 rd Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2011.																
3.	Johnson, R.A, "Miller and Freund's Probability and Statistics for Engineers", 8 th Edition, Pearson Education Inc., New Jersey, 2011.																

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES: On completion of the course, the students will be able to					BT Mapped (Highest Level)		
CO1	apply statistical tests in testing hypotheses on experimental data.						
CO2	use appropriate non-parametric test to analyze experimental data.						
CO3	adopt design of experiments techniques in engineering problems.						
CO4	apply ideas to real time series data and interpret outcomes of analysis						
CO5	apply suitable control charts for monitoring processes.						
Mapping of COs with POs							
COs/POs	PO1	PO2	PO3	PO4	PO5		
CO1		3			2		
CO2		3			2		
CO3		3			3		
CO4		3					
CO5		3			2		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy							
ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		15	85				100
CAT2		15	85				100
CAT3		15	85				100
ESE		15	85				100
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)							

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Signature of the Chairman
Board of Studies - Technology





24GET11 - INTRODUCTION TO RESEARCH

(Common to all ME / MTech Branches & MCA)

Programme & Branch	All ME/MTech branches & MCA	Sem.	Category	L	T	P	SL*	Total	Credit									
Prerequisites	NIL	1 / 3 [#]	FC	30	15	0	45	90	3									
Preamble	This course will familiarize the fundamental concepts/techniques adopted in research, problem formulation and patenting. also, will disseminate the process involved in collection, consolidation of published literature and rewriting them in a presentable form using latest tools.																	
Unit - I Concept of Research:																		
Meaning and Significance of Research: Skills, Habits and Attitudes for Research - Time Management - Status of Research in India. Why, How and What a Research is? - Types and Process of Research - Outcome of Research - Sources of Research Problem - Characteristics of a Good Research Problem - Errors in Selecting a Research Problem - Importance of Keywords - Literature Collection – Analysis - Citation Study - Gap Analysis - Problem Formulation Techniques.																		
Unit - II Research Methods and Journals:																		
Interdisciplinary Research - Need for Experimental Investigations - Data Collection Methods - Appropriate Choice of Algorithms / Methodologies / Methods - Measurement and Result Analysis - Investigation of Solutions for Research Problem - Interpretation - Research Limitations. Journals in Science/Engineering - Indexing and Impact factor of Journals - Citations - h Index - i10 Index – Journal Policies - How to Read a Published Paper - Ethical issues Related to Publishing - Plagiarism and Self-Plagiarism.																		
Unit - III Paper Writing and Research Tools:																		
Types of Research Papers - Original Article/Review Paper/Short Communication/Case Study - When and Where to Publish? - Journal Selection Methods. Layout of a Research Paper - Guidelines for Submitting the Research Paper - Review Process - Addressing Reviewer Comments. Use of tools / Techniques for Research - Hands on Training related to Reference Management Software -End Note, Software for Paper Formatting like LaTeX/MS Office. Introduction to Origin, SPSS, ANOVA etc., Software for detection of Plagiarism.																		
Unit - IV Effective Technical Thesis Writing/Presentation:																		
How to Write a Report - Language and Style - Format of Project Report - Use of Quotations - Method of Transcription Special Elements: Title Page - Abstract - Table of Contents - Headings and Sub-Headings - Footnotes - Tables and Figures - Appendix - Bibliography etc. - Different Reference Formats. Presentation using PPTs.																		
Unit - V Nature of Intellectual Property:																		
Patents - Designs - Trade and Copyright. Process of Patenting and Development: Technological research - innovation - patenting - development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents.																		
REFERENCES:																		
1.	DePoy, Elizabeth, and Laura N. Gitlin, "Introduction to Research-E-Book: Understanding and Applying Multiple Strategies", Elsevier Health Sciences, 2015.																	
2.	Walliman, Nicholas, "Research Methods: The basics", Routledge, 2017.																	
3.	Bettig Ronald V., "Copyrighting culture: The political economy of intellectual property", Routledge, 2018.																	

*includes Term Work(TW) & Online / Certification course hours

Semester1: ME / MTech , Semester 3: MCA



COURSE OUTCOMES:			BT Mapped (Highest Level)
On completion of the course, the students will be able to			
CO1	list the various stages in research and categorize the quality of journals.		Analyzing (K4)
CO2	formulate a research problem from published literature/journal papers		Evaluating (K5)
CO3	write, present a journal paper/ project report in proper format		Creating (K6)
CO4	select suitable journal and submit a research paper.		Applying (K3)
CO5	compile a research report and the presentation		Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1		
CO2	3	2	3		
CO3	3	3	1		
CO4	3	2	1		
CO5	3	2	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Blooms Category*	Remembering (K1) %	Understanding (K2) %	Applying(K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		30	40	30			100
CAT2		30	40	30			100
CAT3			30	40	30		100
ESE		30	40	30			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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Signature of the Chairman
Field of Studies - Technology





24MFT11- ADVANCED DRYING TECHNOLOGY										
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	I	PC	45	15	0	60	120	4	
Preamble	This course imparts knowledge on various advanced drying techniques and selection of suitable dryers.									
Unit- I	Introduction to Drying: Drying and dehydration - Principles - Mechanism of drying - Internal and external conditions of drying - Drying rate characteristic curves- Diffusion theories of drying –Effective Fickian diffusivity -Water-activity-Water activity predictive models–Calculations – Sorption Isotherm -Hysteresis-Determination of sorption isotherms–Gravimetric method, Manometric method and Hygroscopic methods									
Unit- II	Spray drying and Freeze drying: Spray drying - Concept - Components of spray drier - Spray dryer nozzle - Mechanism of atomization - Drop size and drop distribution. Drying of droplets - Fundamentals, residence time - Heat and mass balance -drier efficiency - New developments in Spray drying- Spray freeze drying. Freeze drying- Concept, principle. Stages in freeze drying-Heat and mass transfer, calculations, design considerations – Industrial freeze dryers- Advances in freeze drying–Microwave freeze drying.									
Unit- III	Drying on inert particles and Fluidized bed drying Introduction- Inert particle drying- Pneumatic drying- Principle- Mechanism - Working and its applications. Fluidized bed drying – Principles of fluidization- Components of fluidized bed system- Classification of fluidized bed dryers - Conventional and modified FBD.									
Unit- IV	Novel drying methods: Super-heated steam drying - Principles - Classification - Selection - Applications. Heat pump drying (HPD) – Principle - Low temperature HPD - Chemical HPD. Contact-Sorption drying -Mechanism -Characteristics of sorbents/carriers –High electric field drying – Foam mat drying – Principle - Applications									
Unit- V	Advanced dryers: Microwave dryers - Basic concepts- Industrial applications - Hybrid microwave dryers- Infra-red drying- Principles -Industrial dryers - Applications - Sonic drying - Slush drying - Refractance Window drying.									
REFERENCES:										
1.	Mujumdar A.S., "Handbook of Industrial Drying",3 rd Edition, Taylor and Francis group, UK, 2007.									
2.	Xiao Dong Chen and Mujumdar A.S. "Drying Technologies in Food Processing",1 st Edition, Wiley-Blackwell,2008.									
3.	Kudra T. and Mujumdar A.S., "Advanced Drying Technologies", 2 nd Edition, CRC Press, Taylor and Francis Group, UK, 2009.									

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:			BT Mapped (Highest Level)
On completion of the course, the students will be able to			
CO1	apply drying mechanism and calculate water-activity		Applying(K3)
CO2	make use of spray and freeze-drying techniques for food materials		Applying(K3)
CO3	outline inert particle drying, pneumatic and fluidized-bed drying		Understanding (K2)
CO4	select appropriate novel drying techniques		Applying(K3)
CO5	choose suitable advanced dryers for different food materials		Applying(K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1		1
CO2	3	3	1		1
CO3	3	3	1		1
CO4	3	3	1		2
CO5	3	3	1		2

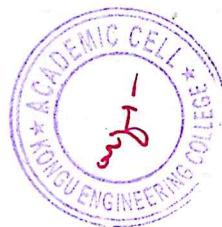
1–Slight, 2–Moderate, 3–Substantial, BT-Bloom's Taxonomy

ASSESSMENT PATTERN-THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total%
CAT1		50	50				100
CAT2		60	40				100
CAT3		50	50				100
ESE		60	40				100

*±3%may be varied (CAT1,2,3– 50marks&ESE –100marks)

<i>R. Omay..</i>
Signature of the Chairman
Board of Studies - Technology



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24MFT12- FOOD CHEMISTRY AND MICROBIOLOGY																				
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit											
Prerequisites	NIL	I	PC	45	0	0	45	90	3											
Preamble	This course provides knowledge about water activity, influence of biomolecules on food quality and understanding the microbial spoilage and food infection																			
Unit - I	Water relationships in Food and Carbohydrates:																			
Water in foods – structure and physical properties of water and ice – Growth of ice crystals – solidification without crystallization – Glass transition – water activity and reaction rate – water activity and food spoilage. Structure and properties of simple and complex food carbohydrates-Modified starch and cellulose- Manufacture of maltodextrins and corn syrup- Cyclodextrins-Chemistry and food applications-Polyols and its applications- Carbohydrates as fat substitutes.																				
Unit - II	Lipids:																			
Classifications -Structure and roles of fatty acids. Food lipids and health – trans fatty acid, ω -3 fatty acid, conjugated linolenic acid, phytosterols, carotenoids. Processing of oils and fats - refining - hydrogenation - interesterification and winterization. Deterioration of oils - hydrolytic rancidity - oxidative rancidity and their prevention.																				
Unit - III	Proteins:																			
Protein structure and conformation - Properties and reactions of proteins in food systems -Dissociation -Optical activity - solubility - hydration - swelling - foam formation - stabilization - gel formation - emulsifying effect -Denaturation of proteins - Food sources - functional role in foods - Texturized Proteins - methods.																				
Unit - IV	Microbial growth and Microbial Spoilage:																			
Types of microorganism normally associated with food-mold, yeast, and bacteria - Physical and chemical factors influencing growth of microorganisms - Biochemical changes caused by microorganisms - Microbial food fermentation- Microbiological standards for different foods - Food poisoning and microbial toxins. Principle and types of food spoilage - Microbial spoilage of different types of foods - Spoilage of fruits and vegetables - Fresh and processed meats, poultry, sea foods, cereals products, bakery products, dairy products, fermented foods and canned foods.																				
Unit - V	Microbiology and Food Preservation:																			
Effect of high temperature on microbes - TDT, D value, Z value, 12D concept - Calculation of process time. Effect of low temperature, radiation, drying on microbes. Chemical preservatives. Advances in preservation of food by various biotechnological processes.																				
REFERENCES:																				
1.	Belitz H. D., Grosch W., and Schieberle P., "Food Chemistry", 3 rd Edition, Springer Verley, Berlin, 2008.																			
2.	Vaclavik V.A. , Christian E.W., "Essential of Food Science", 5 th Illustrated Edition, Springer, 2020.																			
3.	John M. deMan , John W. Finley , W. Jeffrey Hurst , Chang Yong Lee., "Principles of Food Chemistry" , 4 th Edition, Springer,2018																			
4.	Vijaya R.K., "Food Microbiology", 5 th edition, MJP Publishers, Chennai, 2021.																			

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:		BT Mapped (Highest Level)
On completion of the course, the students will be able to		
CO1	infer the role of water in food stability	Understanding (K2)
CO2	analyze the structure and functional role of food biomolecules	Analyzing(K4)
CO3	identify suitable technique for the modification of biomolecules	Applying (K3)
CO4	outline the significance of microbes in fermentation, spoilage and food borne infectious diseases	Understanding (K2)
CO5	apply suitable preservation techniques in microbial control	Applying(K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	2	1
CO2	3	3	1	2	2
CO3	3	3	1	2	2
CO4	3	3	1	3	2
CO5	3	3	1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		45	35	20			100
CAT2		45	35	20			100
CAT3		45	55				100
ESE		45	35	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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24MFT13- ADVANCED FOOD PROCESSING TECHNOLOGY										
Programme& Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	I	PC	45	0	0	45	90	3	
Preamble	To gain insight on the selected advanced food processing, fortification and products forming technology									
Unit- I	Extraction Processes: Introduction, Extraction of bioactive compounds. Conventional extraction, Advanced extraction techniques and applications in food – enzyme assisted extraction; ultrasound assisted extraction, microwave assisted extraction, high pressure extraction, supercritical fluid extraction and pressurized liquid extraction. Challenges and future trends in extraction techniques.									
Unit- II	Encapsulation: Introduction, wall materials used for encapsulation, Methods of encapsulation process – nano and micro encapsulation– physical and chemical methods. Bioavailability. Controlled release techniques in food industry. Applications and current trends.									
Unit- III	Instantization and Agglomeration: Introduction, Instantization and agglomeration process, Methods - pressure, extrusion, tumbling of powders, straight through, spray bed dryer agglomeration, steam jet and agglomeration by heating. Characteristics of agglomerated products, Applications – instant food products.									
Unit- IV	Cold Plasma and impregnation methods in Food Processing: Plasma, properties of plasma, chemistry of plasma, plasma generation methods, Applications of plasma in food processing, Limitations and toxicology. Current research trends. Food modification – vacuum impregnation, osmotic dehydration – parameters influencing food modification by vacuum impregnation and osmotic dehydration – traditional and future applications – combination of osmotic dehydration and vacuum impregnation with pre-treatment and downstream processes.									
Unit- V	3D & 4D Food Printing: Introduction, Food printing platform, food printing materials – natively printable and non-printable foods, 3D food printing technologies-Extrusion-Based Printing, Selective Sintering, Inkjet Printing, Binder Jetting. 4D Printing: Concept and Functionality, Key requirements, Recent Advancements in 4D Food Printing									
REFERENCES:										
1.	Sahu, Jatindra Kumar, (Eds), "Introduction to Advanced Food Process Engineering", 1 st Edition, CRC Press, 2014.									
2.	Bhattacharya, Suvendu, (Eds), "Conventional and Advanced Food Processing Technologies", 1 st Edition, John Wiley & Sons, 2014.									
3.	Misra N.N., Oliver Schlüter, Patrick J.Cullen, (Eds), "Cold plasma in Food and Agriculture: Fundamentals and Applications", 1 st Edition, Academic Press, 2016.									
4.	C. Anandharamakrishnan, Jeyan A. Moses, T. Anukiruthika., "3D Printing of Foods", 1 st Edition, John Wiley & Sons Ltd, 2022.									

*includes Term Work(TW) & Online / Certification course hours



COURSEOUTCOMES: On completion of the course, the students will be able to				BT Mapped (Highest Level)
CO1	examine different techniques for extraction of active components			Analyzing(K4)
CO2	identify suitable encapsulation techniques for food ingredients			Applying(K3)
CO3	utilize agglomeration process for the production of instant food products			Applying(K3)
CO4	inspect the effect of cold plasma, fortification and impregnation methods on food process and products			Analyzing(K4)
CO5	explain 3D and 4D food printing techniques			Understanding (K2)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	1	1
CO2	3	3	1	1	2
CO3	3	3	1	1	2
CO4	3	3	1	1	2
CO5	3	3	1	1	3

1-Slight, 2-Moderate, 3-Substantial, BT-Bloom's Taxonomy

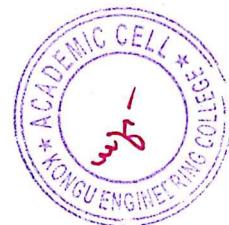
ASSESSMENT PATTERN-THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total%
CAT1		40	50	10			100
CAT2		40	60				100
CAT3		60	30	10			100
ESE		50	40	10			100

*±3%may be varied (CAT1,2,3– 50marks&ESE –100marks)

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24MFT14- LIPID SCIENCE AND TECHNOLOGY										
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	I	PC	45	0	0	45	90	3	
Preamble	This course imparts an idea about the different techniques of lipid processing and its products.									
Unit - I	Food Lipids: Classification, composition, Sources - Nutritional profile and its significance in food industries - Physical properties: Color, odour, specific gravity. Chemical constant: Iodine value - Saponification value - Polenske Number - ReichertMeissl Value - Acetyl Value. Optical properties - Refractive index - Absorption spectra - Rheological and Thermal properties - Importance of flavour emulsion and its stability in food systems.									
Unit - II	Processing of Oils and Fats: Extraction and refining of oils and fats - Traditional Method - Solvent Extraction - Mechanical Extraction - Modern trends in extraction of oils and fats - Supercritical technology - Membrane technology - Liquid-liquid extraction - Wipe film evaporation - Application of encapsulation and nano-encapsulation - Bioactive lipids extraction and stabilization – Basic Processing steps of refining -oil-degumming, neutralization, bleaching and deodorization - Chemical adjuncts - lecithin, mono-glycerides and its derivatives - Applications in food industries.									
Unit - III	Modification of Oils and its Applications in Food Industries: Modification of oil - Recent developments in plant and processes – Hydrogenation – Fractionation – Blending – Winterization – Interesterification - Types of Interesterification - Applications of Interesterification - Cocoa butter alternatives - CBR, CBS, CBE - Fat mimetics and substitutes - Dairy Imitation Products - Enzymatic Modification -Structured Lipids - Speciality fats - Lipid as micronutrients and nutraceuticals.									
Unit - IV	Formulation and Characterization: Margarines, Low-fat spreads - Peanut butter - Vegetable ghee –mayonnaise - whipped creams - salad oils and dressings - cooking oils - fat powders - cream, butter, cod liver - Formulation and technological aspects of bakery and confectionery shortenings – Rendering - dry and wet methods - lard and tallow.									
Unit - V	Frying and Storage of Oils: Frying of oil - Role of fat and oil in frying - Applications of frying oil - Selection of frying oil - Changes occurring in food and oil during frying - Rancidity - Types - Causes – Prevention. Measurement of lipid degradation parameters during storage. Quality standards of oil - Shortenings - Cooking oils - Salad oils. Packaging standards and requirements of fats and oils.									
REFERENCES:										
1.	Chakrabathy M.M., "Chemistry and Technology of Oils and Fats", 1st Edition Allied Publishers Pvt. Ltd., 2003.									
2.	Bailey., "Bailey's Industrial Oil and Fat Products", 6th Edition, Volume 1- 6, John Wiley & Sons, 2005.									
3.	Wolf Hamm and Richard J. Hamilton., "Edible Oil Processing", 2nd Edition Blackwell Science Ltd., 2013.									
4.	Richard D. O'Brien., "Fats and Oils: Formulating and Processing for Application", 3rd Edition CRC Press, 2009.									

*includes Term Work(TW) & Online / Certification course hours



COURSEOUTCOMES:				BT Mapped (Highest Level)
On completion of the course, the students will be able to				
CO1	explain the composition and properties of fats and oils			Understanding (K2)
CO2	apply suitable technology for processing of fats and oils			Applying(K3)
CO3	choose appropriate techniques for modifying oil and fat			Applying(K3)
CO4	select the formulations for development of different lipid products			Applying(K3)
CO5	outline the changes during frying and storage of fats and oils			Understanding (K2)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	1	1
CO2	3	3	1	1	2
CO3	3	3	1	2	2
CO4	3	3	1	1	2
CO5	3	3	1	3	2

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

ASSESSMENT PATTERN-THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total%
CAT1		60	40				100
CAT2		40	60				100
CAT3		40	60				100
ESE		40	60				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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24MFL11 - FOOD CHEMISTRY AND MICROBIOLOGY LABORATORY										
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Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites	Nil	1	PC	0	0	30	0	30	1

Preamble To deal about analysis and estimation of biomolecule and to identify, characterize microbes associated with foods.

LIST OF EXPERIMENTS / EXERCISES:

1.	Assessment of freshness and characterization of oil
2.	Determination of total polyphenols and flavonoids in food products
3.	Determination of moisture content by oven, IR and distillation methods
4.	Estimation of total carbohydrates in food products
5.	Estimation of protein by Lowry's method and kjeldhal method
6.	Study on degradation kinetics of pigments
7.	Cultivation and enumeration of microorganisms using different plating methods
8.	Microbial examination and enumeration of microorganisms in spoiled bakery/ fruits and vegetable products
9.	Study on Antibiotic sensitivity/antimicrobial activity of plant extract
10.	Accelerated shelf-life study of a food product

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	"Manual of methods for the Analysis of Foods", Ministry of Health and Family Welfare, Government of India, New Delhi, 2016.
3.	Sadasivam, S., Manickam, A., "Biochemical Methods", 3 rd Edition, New Age International, Delhi, 2018.
4.	James G. Cappuccino, Natalie Sherman, "Microbiology A Laboratory Manual", 12 th , illustrated, Pearson, 2019.

COURSE OUTCOMES:

On completion of the course, the students will be able to

**BT Mapped
(Highest Level)**

CO1	analyze and estimate macronutrients in food products	Analyzing (K5), Precision (K3)
CO2	extract and estimate phytochemicals in food products	Evaluating (K5), Precision (K3)
CO3	enumerate microorganisms in food products	Evaluating (K5), Precision (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2
CO2	3	3	2	2	2
CO3	3	3	2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

*includes Term Work(TW) & Online / Certification course hours

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24MFL12 - FOOD PROCESS TECHNOLOGY LABORATORY									
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites	Nil	1	PC	0	0	30	0	30	1

Preamble | To apply various food process technologies in food applications

LIST OF EXPERIMENTS / EXERCISES:

1.	Determination of different properties of grains
2.	Comparative studies oneffectiveness of size reduction equipment
3.	Encapsulation characteristics using freeze-drying
4.	Experiment on batch drying characteristics of food material and fitting drying models using MATLAB
5.	Experiment on drying characteristics of food material using microwave dryer
6.	Experiment on osmotic dehydration characteristics of food materials
7.	Experiment on drying characteristics of food material using fluidized bed dryer
8.	Experiment on drying characteristics of food material using foam-mat dryer
9.	Encapsulation and anti-caking characteristics using spray-drying
10.	Experiment on ultrasound and microwave assisted solvent extraction of bioactive components
11.	Virtual lab: Experiment on rheological and thermophysical properties of food

REFERENCES/MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Kavitha Marwaha., "Food Process Engineering: Theory & Laboratory Experiments", 1 st Edition, GeneTech Books, 2010.
3.	Xiao Dong Chen, Majumdar A.S., "Drying Technologies in Food Processing", John Wiley & Sons, 2009.
4.	http://www.rpaulsingh.com/learning/virtual/virtual.html

COURSE OUTCOMES:

On completion of the course, the students will be able to

**BT Mapped
(Highest Level)**

CO1	Estimate the engineering properties of food materials and determine the size reduction effectiveness	Evaluating(K5), Precision (K3)
CO2	Assess the drying characteristics and kinetics of food materials	Evaluating(K5) Precision(K3)
CO3	Evaluate the encapsulation and anti-caking characteristics of food products	Evaluating(K5) Precision(K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	1	1
CO2	3	3	2	1	2
CO3	3	3	2	1	2

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

*includes Term Work(TW) & Online / Certification course hours

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24MFT21- ADVANCED REFRIGERATION AND COLD CHAIN MANAGEMENT

Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites	NIL	II	PC	45	15	0	60	120	4
Preamble	To impart the knowledge on concepts of refrigeration and cold chain management.								
Unit - I	Introduction to Refrigeration: Refrigeration, Ton of refrigeration, refrigeration capacity calculations, Single vapour compression and vapour absorption systems - COP determinations and calculations. Refrigerants - characteristics of different refrigerants, ozone depletion potentials, pressure enthalpy charts.								
Unit - II	Components of Refrigeration System: Types of Compressors - positive displacement and roto-dynamic type and performance, Evaporators and their functional aspects, Condensing units and cooling towers, Expansion valves, humidifying systems, piping and different controls.								
Unit - III	Low Temperature Storage of Foods: Effect of temperature on food spoilage, Low temperature storage Methods-Chilling, Freezing, Evaporative cooling and its applications. Novel freezing methods and freezer types, Freezing rates, growth rate of ice crystals, crystal size and its effect on texture and quality of foods.								
Unit - IV	Cold and Frozen Storage: Construction, Operation – Insulation, Types of storage rooms, Design and requirements of cold store and frozen store, total refrigeration load calculations, Automated cold store, temperature requirements in frozen storage, maintenance, packaging, energy conservation.								
Unit - V	Cold Chain Management: Scope and importance of cold chain in food processing industry and retail chain, Cold chain – overview, planning and designing, transport of frozen foods – different modes, Time temperature indicators - data loggers, safety aspects, Flexibility storage systems, cold chain transportation inland and export, retail and supermarket cold chain- Retail display cabinets.								
REFERENCES:									
1.	Rajput R.K., "Refrigeration and Air-conditioning", 3rd Edition, S.K. Kataria& Sons, Delhi, 2013.								
2.	Dellino C.V.J., "Cold and Chilled Storage Technology", 2nd Edition, Springer, 2012.								
3.	Kennedy C.J., "Managing Frozen Foods", 1st Edition, Woodhead Publishing Ltd.,2000.								
4.	Fellows P J "Food Processing Technology: Principles and Practice" 3rd Edition, Woodhead Publishing Ltd.,2009.								

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:

On completion of the course, the students will be able to

		BT Mapped (Highest Level)
CO1	apply drying mechanism and analyze water-activity using models	Applying (K3)
CO2	make use of spray and freeze-drying techniques for food materials and examine its heat and mass transfer rates	Applying (K3)
CO3	examine the effect of low temperature storage on product quality	Analyzing(K4)
CO4	classify and construct cold storage unit and calculate cooling loads	Applying (K3)
CO5	develop cold chain system for transporting food products	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1		1
CO2	3	2	1		1
CO3	3	3	1	1	2
CO4	3	3	1	1	2
CO5	3	3	1	1	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		50	50				100
CAT2		40	40	20			100
CAT3		50	50				100
ESE		40	40	20			100

* ±3% may be varied (CAT 1,2, 3 – 50 marks & ESE – 100 marks)

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24MFT22 - INSTRUMENTAL TECHNIQUES AND METHODS FOR FOOD ANALYSIS

Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites	NIL	2	PC	45	0	0	45	90	3
Preamble	To gain knowledge about the principle and applications of different instrumental techniques used in food analysis.								
Unit - I	Introduction to Instrumental Methods and UV-Visible and IR Spectroscopy:								
Classification of instrumental methods based on physical properties of molecules - The Electromagnetic spectrum - Interaction of photons with matter - Absorbance and transmittance - Beer and Lambert's laws. Deviation from Beer- Lambert's Law. Ultra violet and Visible spectrometry: Theory - Types of Transitions - Red and blue shifts - Instrumentation - Single beam and double beam spectrophotometers and applications. Fluorimetry: Theory - Factors affecting fluorescence - Instrumentation and applications. Infrared spectrometry: Requirements for IR absorption - Modes of vibrations-Instrumentation- Applications - Finger print region.									
Unit - II	X-Ray and Flame Photometer and Thermal Methods and Morphology Analysis:								
X-ray - Interaction of X-ray with matter -Absorption - Non-dispersive Method - Diffraction - Rotating and powder crystal methods – Instrumentation, Applications. Flame photometer, Polarimetry and Refractometry - Principle and instrumentation - Saccharimetry - Analysis of sugar. Thermogravimetry - Differential Thermal Analysis - Differential scanning calorimetry - Factors affecting the results - Instrumentation and applications. Morphology Analysis - Scanning Electron Microscopy - Transmission Electron Microscopy and Laser diffraction for particle analysis - Principle and Applications.									
Unit - III	Electrophoresis and Rapid Techniques:								
Basic Principle of paper - Starch gel, agarose, PAGE, SDS-PAGE electrophoresis Immuno affinity techniques - Radio Assay Electrophoresis and applications. Isoelectric focusing, capillary electrophoresis- Microchip and 2D electrophoresis. Recent Development of Rapid Techniques - E sensors - e-nose, e-tongue instrumentation - Applications and working principles - Flow cytometry - Epifluorescence microscopy - Principle and Applications.									
Unit - IV	Atomic Absorption Spectrophotometer and NMR and Mass spectroscopy:								
Principle, Advantages of ASS over FES - Instrumentation - Interference and applications. Nuclear Magnetic Resonance: Introduction to NMR - Energy levels of nucleus - Equivalent and non-equivalent protons - Chemical shift - Shielding - TMS - Factors affecting chemical shift - instrumentation (proton NMR) - Applications. Theory – components of mass spectrometer – Mass spectrum. Resolution of mass spectrometer. Types of ions produced –General rules for Interpretation of mass spectra - Applications of mass spectra.									
Unit - V	Chromatography Techniques and Hyphenated Techniques:								
Introduction - Classification of chromatographic methods: Column chromatography, Thin Layer chromatography, Paper chromatography, Gas chromatography and High-Performance Liquid Chromatography (HPLC) - Principle, important components and their functions mode of separation, Instrumentation and applications. ICP-MS, HR-MS, HPTLC, GC-MS, LC-MS and GC-FTIR – Principle, Instrumentations and applications.									

REFERENCES:

1.	V. K. Ahluwalia, "Instrumental Methods of Chemical Analysis", 1st edition, Springer Cham, 2023.
2.	S. Suzanne Nielsen, "Food Analysis", 5th Edition, Springer Cham, 2017.
3.	Yeshasahupomeranz , Clifton E. Meloan., "Food Analysis", 2nd Edition, CBS Publishers & Distributors, Delhi, 1996.
4.	Rouessac F., "Chemical Analysis: Modern International Method and Techniques", 7th Edition Wiley, New Delhi, 2007.

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:

On completion of the course, the students will be able to

BT Mapped
(Highest Level)

CO1	apply UV-Visible and IR spectroscopy in food analysis	Applying (K3)
CO2	select suitable technique for internal structure, thermal and morphology analysis of food materials	Applying (K3)
CO3	choose appropriate electrophoretic and rapid techniques to separate and identify food components	Applying (K3)
CO4	make use of AAS, NMR and mass spectroscopy to analyse different food materials	Applying (K3)
CO5	Identify suitable chromatographic methods to separate and quantify the food components.	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	1	1
CO2	3	3	1	1	2
CO3	3	3	1	1	2
CO4	3	3	1	1	2
CO5	3	3	1	1	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		60	40				100
CAT3		60	40				100
ESE		60	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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24MFT23- FOOD SAFETY AND QUALITY CONTROL										
Programme& Branch	M.Tech& Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	2	PC	45	0	0	45	90	3	
Preamble	This course delivers the knowledge of food hazards, food safety, quality control methods and regulatory aspects									
Unit- I	Contemporary Food Safety Strategies: Principles and need for quality control and safety, strategy and criteria for food safety. Consumer lifestyle and demand, issues in food safety, food traceability and recall, case against food biotechnology and irradiation. Case studies in food safety.									
Unit- II	Food Hazards and Contaminants: Characterization of food hazards, Food borne diseases and their control, food contaminants and their control. Naturally available toxins in foods, Cross contamination: toxicants resulting from food processing. Management of food allergens. Risk analysis of food hazards, emerging food contaminants.									
Unit- III	Microbial Growth and Modelling: Inactivation of microbial growth - thermal and non-thermal methods, process dependent microbial modelling, integration of process and microbial growth modelling. Applications of predictive microbial modelling. Advanced methods for rapid detection of food spoilage.									
Unit- V	Food safety-National and International Regulatory Agencies: BIS, AGMARK, FSSAI. Organizational structure and functions of United States Food and Drug Administration (USFDA), Global Food Safety Initiative(GFSI),International Consultative Group on Food Irradiation(ICGFI), European Food Safety Authority(EFSA), British Retail Consortium (BRC) global standards ,Codex Alimentarius, Sanitary and Phyto-Sanitary measures (SPS), Plant Quarantine Act.									
Unit- IV	Food Quality Management System: Quality control Importance, measures and procedures. Duties and responsibilities of food safety regulators, food safety and standards for food products, implementation, validation, verification and improvement of food safety management systems. Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Good Laboratory Practices (GLP) Good retail Practices (GRP), ISO 22000, FSSC 22000, Food Safety Audit.									
REFERENCES:										
1.	Da-WenSun., "Handbook of Food Safety Engineering", 1 st Edition, John Wiley & Sons, New Jersey, 2011.									
2.	Ronald H. Schmidt, GaryE Rodrick., "Food Safety Handbook", 1 st Edition, John Wiley & Sons, New Jersey, 2003.									
3.	Yasmine Motarjemi, HuubLelieveld., "Food Safety Management -A Practical Guide For The Food Industry", 1 st edition Elsevier, New York, 2013.									
4.	S.P.Singh "Food safety Quality Assurance and Global Trade: Concerns and Strategies", 1 st Edition, International Book Distribution Company, India, 2009									

*includes Term Work(TW) & Online / Certification course hours



COURSEOUTCOMES:

On completion of the course, the students will be able to

		BT Mapped (Highest Level)
CO1	infer the food quality strategies and food hazards	Understanding (K2)
CO2	Identify the different food contaminants and their control measures	Applying(K3)
CO3	select suitable method for microbial inactivation and microbial growth modeling	Applying(K3)
CO4	outline the functions of various national and international food agencies	Understanding (K2)
CO5	identify suitable foods safety management systems for food product	Applying(K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	3	2
CO2	3	2	1	3	2
CO3	3	2	1	3	3
CO4	3	1	1	3	3
CO5	3	2	1	3	3

1--Slight,2--Moderate,3--Substantial, BT-Bloom's Taxonomy

ASSESSMENT PATTERN-THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total%
CAT1		60	40				100
CAT2		40	60				100
CAT3		40	60				100
ESE		40	60				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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24MFE01- ADVANCED FRUIT AND VEGETABLE PROCESSING TECHNOLOGY									
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites	NIL	2	PE	45	0	0	45	90	3
Preamble	To study about the advanced techniques in fruit and vegetable processing and its effects on quality of finished product								
Unit - I	Post-harvest Processing and Improving the shelf-life of vegetables by genetic modification:								9
Pre-harvest factors on postharvest life, Maturity index, Precooling, Post-harvest treatments- curing, sprout suppressants, de-greening. Storage – Refrigerated storage, Hypobaric storage. Controlled atmosphere stores. MAP. Fruit ripening – changes during ripening, ripening rooms. Ethylene – sources, alternatives. Genetic control of leaf senescence and fruit ripening, future trends.									
Unit - II	Edible Coatings and Vacuum Technology:								9
Introduction, Principle, selection of edible coatings, Polysaccharide, protein and lipid-based coatings. Gas permeation properties, Wettability, coating effectiveness, Diffusivities of fruits – determination. Measuring internal gas composition. Future trends. Introduction, principles – mass transfer and product behavior. Applications and future trends.									
Unit - III	Minimal Processing:								9
Introduction, quality changes, Processing – physiological and microbiological impacts, Fresh cut products – Fresh produces quality and safety. Strategies for minimizing quality loss improving quality, bio-control agents, browning inhibition. Storage and packaging. Fresh-cut chain – harvest to market. Equipment requirements. Traceability of fresh cut products. Layout of a fresh cut processing facility.									
Unit - IV	Fruit and Vegetable Product:								9
Manufacturing: jams and jellies – gelling agent, sweetening agent, acidulants, coloring and flavoring agents, method of manufacturing. Fruit Beverages – Classification, Production of filtered and cloudy fruit drinks – preparation steps, Juice extraction, clarification, concentrate production. Production of fruit nectars – preparation steps, freezes concentration.									
Unit - V	Ozonation and Enzyme Maceration:								9
Introduction, ozone properties, ozone generation methods – electrical, electrochemical, radiochemical and ultraviolet method. Ozone in fruit juice processing – gaseous and aqueous applications, factors affecting efficacy of ozone processing – Extrinsic and intrinsic parameters. Mechanism of microbial inactivation. Effect on food quality. Industrial health and safety. Introduction-function of enzymes in fruit juice processing- Applications and future trends.									
REFERENCES:									
1.	Jongen W., "Fruit and Vegetable Processing: Improving Quality", 1st Edition, Woodhead Publishing Series in Food Science, Technology and Nutrition, 2002								
2.	Nirmal Sinha, Jiwan Sidhu, Jozsef Barta, James Wu, M. Pila Cano, "Handbook of Fruits and Fruit Processing", 2nd Edition, Blackwell Publishing, 2012.								
3.	Srivastava R.P, Sanjeev Kumar, "Fruit and vegetable preservation: Principles and practices", 3rd Edition, CBS Publishers & Distributors, New Delhi, 2014.								
4.	Rodrigues Sueli, Fabiano Andre NarcisoFernandes, (Eds), "Advances in Fruit Processing Technologies", 1st Edition, CRC Press, 2012.								

*includes Term Work(TW) & Online / Certification course hours



COURSEOUTCOMES: On completion of the course, the students will be able to					BT Mapped (Highest Level)
CO1	choose suitable post-harvest processing methods and genetic modification for fresh produce				Applying(K3)
CO2	summarize suitable edible coatings for fruits and vegetables and outline role of vacuum technology in fruit processing				Understanding (K2)
CO3	apply minimal processing techniques for the production of fresh cut fruits and vegetables				Applying(K3)
CO4	develop fruit and vegetable-based jam, jelly and juice products				Applying(K3)
CO5	outline the effect of ozone and enzyme maceration in fruit processing				Understanding (K2)

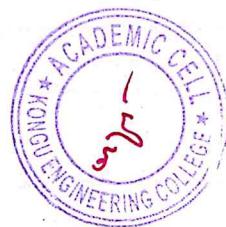
Mapping of COs with POs					
COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	1	2
CO2	3	3	1	1	2
CO3	3	3	1	1	2
CO4	3	3	1	1	2
CO5	3	3	1	2	2

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy
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ASSESSMENTPATTERN-THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total%
CAT1		60	40				100
CAT2		60	40				100
CAT3		60	40				100
ESE		60	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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24MFE02- NOVEL TECHNOLOGIES IN FOOD PROCESSING																				
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit											
Prerequisites	NIL	2	PE	45	0	0	45	90	3											
Preamble	To impart knowledge on novel processing techniques in the field of food technology																			
Unit- I	Hurdle Technology, Super Critical Fluid Extraction & High Pressure Processing of Foods 9																			
Emerging technologies in food processing –necessity and advantages. Hurdle technology –concepts, applications – nonthermal processing methods as hurdles. Supercritical and subcritical extraction of functional ingredients in food materials. High Pressure Processing – Principles – applications to food systems – effect on food quality.																				
Unit- II	Pulsed Electric Field Processing, Light Based Technologies and Microwave Processing 9																			
Pulsed Electric Field Processing – Equipment and mechanisms – microbial and enzyme inactivation - PEF enhanced drying, brining marinating and by-products valorization. Light based technology for food processing: Principles of microbial inactivation of UV, IR and Pulsed light - Effect of pulsed light Technology on food products and food properties. Microwave processing of fluid foods – principle – processing – factors influencing dielectric processing properties of foods – interaction of microwave with food components–equipment–challenges.																				
Unit- III	Irradiation, Ultrasound and Ohmic Heating 9																			
Irradiation – types of radiations used for food preservation - lethal effects on microorganisms and food constituents- dosimetry and applications. Ultrasound: Principles–Ultrasound assisted extraction, decontamination, preservation, freezing, thawing and drying– parameters influencing ultrasound processing. Ohmic Heating: Fundamentals of Ohmic Heating–Basic Principles, electrical heat generation – electrical conductivity. Generic Configurations -Product suitability for thermal treatments.																				
Unit- IV	Vacuum Cooling and Osmotic Membrane Distillation 9																			
Vacuum Cooling - Principles – Process – Equipment – Application – Fruits and Vegetables, Bakery, Fishery, Particulate foods, ready meals. Advantages and Disadvantages – Process Parameters. Osmotic Membrane Distillation: Fundamentals – OMD membranes – Process parameters – Osmotic agent, Concentration, Temperature, Membrane. Direct osmosis. Applications.																				
Unit-V	Other Novel Food Processing Methods 9																			
Shockwaves–principles and applications. Novel crosslinking enzymes applications in food. Vacuum frying –effect on food quality – combination with microwave drying. Computer vision technology to prevent quality loss of products.																				
REFERENCES:																				
1.	Da-wen Sun, "Emerging Technologies for Food Processing", 2 nd Edition, Elsevier Academic Press, USA, 2005																			
2.	Howard Q. Zhang, GustavoV. Barbosa-Canovas, Bala Balasubramaniam V.M., Patrick DunneC., Daniel F. Farkas, James T.C. Yuan, "Non-Thermal Processing Technologies for Food", 1st edition, Wiley- Blackwell, IFT Press, 2011																			

*includes Term Work(TW) & Online / Certification course hours



COURSEOUTCOMES:

On completion of the course, the students will be able to

			BT Mapped (Highest Level)
CO1	apply the concepts of hurdle technology, super critical fluid extraction and high-pressure processing in food preservation		Applying(K3)
CO2	outline the basics of pulsed electric-field, light technologies and microwave processing for food materials		Understanding (K2)
CO3	make use of the concept of irradiation, ultrasound and ohmic heating for food treatments		Understanding (K3)
CO4	apply the concepts of vacuum cooling and osmotic membrane distillation in food processing		Applying (K3)
CO5	explain the concepts of shockwaves, vacuum frying and computer vision technology for food processing applications		Understanding (K2)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	2	2
CO2	3	3	1	2	2
CO3	3	3	1	2	2
CO4	3	3	1	1	2
CO5	3	3	1	2	2

1–Slight,2–Moderate,3–Substantial, BT-Bloom's Taxonomy

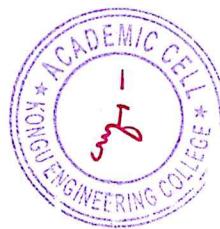
ASSESSMENTPATTERN-THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total%
CAT1		75	25				100
CAT2		75	25				100
CAT3		75	25				100
ESE		65	35				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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J. M





24MFE03- HEAT AND MASS TRANSFER OPERATIONS IN FOOD PROCESSING										
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	2	PE	45	0	0	45	90	3	
Preamble	This course provides in-depth knowledge on selected heat and mass transfer operations.									
Unit - I	Condensation, Boiling and Evaporation:									
Condensation number – Film condensation – Boiling heat transfer - Simplified relations. Single and multiple effect evaporators – Performance of evaporators and boiling point elevation – capacity – economy and heat balance – Types of evaporators.										
Unit - II	Heat Exchangers:									
Overall heat transfer coefficients – Fouling factor - Types of Heat Exchanger- LMTD - Heat exchanger effectiveness by NTU method- Compact Heat Exchangers.										
Unit - III	Distillation:									
Batch Distillation – Flash Vaporization – Continuous fractionation- Design of multistage tray towers for binary systems: McCabe Thiele method and Panchon Savorit method. Introduction to multicomponent distillation										
Unit - IV	Extraction:									
Single stage, multistage cross current and multi stage counter current operations - Introduction to newer extraction techniques: Super critical extraction, pulsed electric field extraction, microwave extraction, ultrasound assisted extraction, subcritical water extraction, High pressure assisted extraction.										
Unit - V	Leaching:									
Solid liquid equilibria, single stage leaching, multistage crosscurrent and counter current leaching, Calculations for number of stages - leaching equipment. Batch percolators – Fixed bed multistage systems – continuous contactors.										
REFERENCES:										
1.	McCabe W. L., Smith J. C., Harriott P., "Unit Operations of Chemical Engineering", 5th Edition, McGraw Hill Education, 2010.									
2.	Holman J.P., "Heat Transfer", 10th Edition, McGraw-Hill, New York, 2012.									
3.	Treybal R.E., "Mass Transfer Operations", 3rd Edition, McGraw-Hill, New York, 2012.									
4.	Albert Ibarz, "Unit Operations in Food Engineering", 1st Edition, CRC Press, 2003.									

*includes Term Work(TW) & Online / Certification course hours





COURSE OUTCOMES:		BT Mapped (Highest Level)
On completion of the course, the students will be able to		
CO1	explain condensation and evaporative heat transfer phenomena	Understanding (K2)
CO2	analyze the heat exchanger performance	Analyzing (K4)
CO3	explain distillation process and estimate number of stages	Analyzing (K4)
CO4	apply the acquired knowledge to perform extraction and leaching calculations	Applying (K3)
CO5	explain the constructional features and working principle of leaching and extraction equipment	Understanding (K2)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1		1
CO2	3	3	1		1
CO3	3	3	1		1
CO4	3	3	1	1	2
CO5	3	2	1	1	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		30	50	20			100
CAT2		30	45	25			100
CAT3		30	70				100
ESE		25	40	35			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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24MFE04- INDUSTRIAL ENGINEERING

Programme & M.Tech & Food Technology Branch	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites NIL	2	PE	45	0	0	45	90	3
Preamble	This course gives deep insight in Industrial Engineering, productivity as well as significance of forecasting and planning.							
Unit - I	Productivity:							
Industrial Engineering–Role of Industrial Engineering - System concept of production-Types of production system-flow, job, batch and project- Productivity- Factors affecting productivity- Productivity measures-Productivity improvement techniques -Business Process Reengineering (BPR)								
Unit - II	Work Study:							
Method, basic procedure-Selection-Recording of process -Critical analysis, Development - Implementation -Micromotion and memo motion study –Principles of motion economy-Work measurement Techniques of work measurement -Time study – computation of standard time-Work sampling -Predetermined motion time standards-Job Evaluation, Merit Rating-Ergonomics and Safety.								
Unit - III	Modules of pre-planning:							
Introduction - Forecasting: Need for forecasting -demand patterns-Forecasting models -Judgmental Techniques, Time series analysis, moving average, exponential smoothing, Regression and correlation method-Forecast error costs and accuracy of forecasts.								
Unit - IV	Facility Planning:							
Facility location-factors influencing plant location-single and multi facility location problems-Minimax, Gravity and Euclidean –Distance location problem. Capacity planning, Models for Facility Decisions - Plant layout- Layout classification-Layout Design Procedures-CRAFT, ALDEP, CORELAP-Material handling systems unit load concept-material handling principles- Types of material handling equipments and its selection								
Unit - V	Value Engineering:							
Value engineering–function, aims, procedure. Make or buy decision, Interest formulae and their applications: Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor-equal payment series capital recovery factor - Uniform gradient series, annual equivalent factor, Effective interest rate, Introduction to comparison of alternatives								

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:			BT Mapped (Highest Level)
On completion of the course, the students will be able to			
CO1	outline the role of industrial engineering and concept of productivity		Understanding (K2)
CO2	make use of concepts of work study and apply existing methods of working for specified job		Applying (K3)
CO3	explain the significance of forecasting and facility planning		Understanding (K2)
CO4	select suitable layout design procedures of facility		Applying (K3)
CO5	identify the importance of industrial engineering in cost analysis		Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1		1
CO2	3	2	1	1	1
CO3	3	3	1		2
CO4	3	3	1		2
CO5	3	2	1		1

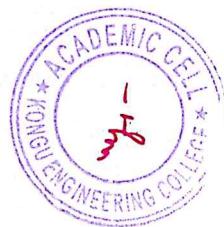
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		60	40				100
CAT3		60	40				100
ESE		60	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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24MFE05- INDUSTRIAL WASTE MANAGEMENT

Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites	NIL	2	PE	45	0	0	45	90	3
Preamble	To educate the students on management of waste water and solid waste starting from source identification to reuse concepts.								
Unit - I	Industries and Environment:								
Industrial scenario in India – Industrial activity and Environment – Uses of water by industry – Sources and types of industrial wastewater – Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater generation rates, characterization and variables – Population equivalent – Toxicity of industrial effluents and Bioassay tests.									
Unit - II	Management of Industrial Waste Water and Treatment Plants:								
Treatments: Aerobic and anaerobic biological treatment – batch and high rate reactors – Chemical oxidation – Ozonation – Photo catalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies. Individual and common Effluent Treatment plants – Joint treatment of industrial wastewater – Zero effluent discharge systems – Quality requirements for wastewater reuse – Industrial reuse – Disposal on water and land – Residuals of Industrial wastewater treatment.									
Unit - III	Solid Waste Sources and Segregation:								
Sources: Types and Sources of solid wastes – Need for solid waste management – Elements of integrated waste management and roles of stakeholders – Salient features of Indian legislations on management and handling of municipal solid wastes. Handling and segregation of wastes at sources – storage and collection of municipal solid wastes – Analysis of collection systems – Need for transfer and transport – Transfer stations - Optimizing waste allocation – compatibility.									
Unit - IV	Energy Recovery and Waste Disposal:								
Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of composting – energy recovery and other modern techniques in managing solid waste – case studies. Energy Auditing. Waste disposal options – Disposal in landfills – Landfill classification, types and methods – site selection – design and operation of sanitary landfills, secure landfills – leachate and landfill gas management – landfill closure of landfills– landfill remediation.									
Unit - V	Waste Management in different industrial segments:								
Industrial manufacturing process description- wastewater and solid waste characteristics - source reduction options and waste treatment flow sheet for Textiles – Tanneries – pulp and paper – petroleum refining – pharmaceuticals – sugar and distilleries – Food processing – fertilizers – Thermal power plants and Industrial Estates.									

REFERENCES:

- | | |
|----|--|
| 1. | Arceivals S.J., "Wastewater Treatment for Pollution Control", 3rd Edition, Tata McGraw-Hill, 2017. |
| 2. | Eckenfelder W.W., "Industrial Water Pollution Control", 3rd Edition, McGraw-Hill, 2017. |
| 3. | Landreth R.E., Rebers P.A., "Municipal Solid Wastes - Problems and Solutions", 1st Edition, CRC Publishers,2019. |

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES: On completion of the course, the students will be able to			BT Mapped (Highest Level)
CO1	summarize the present industrial impact on environment		Understanding (K2)
CO2	select suitable waste water treatment options and reuse		Applying (K3)
CO3	outline the sources and segregation of solid waste.		Understanding (K2)
CO4	utilize solid waste for energy recovery and disposal		Applying (K3)
CO5	apply waste management principles in different industries		Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	2	1
CO2	3	3	1	2	2
CO3	3	3	1	2	1
CO4	3	3	1	2	2
CO5	3	3	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		70	30				100
CAT2		70	30				100
CAT3		50	50				100
ESE		60	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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**24MFE06- ADVANCED BAKING AND CONFECTIONERY TECHNOLOGY**

Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites	NIL	2	PE	45	0	0	45	90	3
Preamble	This course will provide in depth knowledge in context of ingredients, equipment and technical aspects in manufacturing of various bakery and confectionery products.								
Unit- I	Bakery Ingredients and Equipment:								
	Essential bakery ingredients: Flour, yeast and sour dough, water, salt. Other ingredients: Sugar, color, flavor, fat, milk, bread improvers, leavening agents, shortenings, enzymes, emulsifiers and antioxidants. Role of fat and sugar replacers, clean label ingredients. Bulk handling of ingredients, dough mixers, dividers, rounders, sheeters, laminators, Fermentation enclosures and Brew equipment, ovens and slicers.								
Unit- II	Rheological Properties of Dough and Batter:								
	Rheological methods-Fundamental testing and Empirical methods, Rheological testing equipment, compression, penetration, modified penetrometers, transient tests, dynamic tests, extensional viscosity. Effect of ingredients, mixing, dosing and temperature on rheological properties, cake batter rheology and bread dough rheology.								
Unit- III	Technology of Bakery Products:								
	Bread making - various stages and methods, Formulation and production - frozen dough, refrigerated dough and partially baked bread. Cake types - Foam style and shortened style, industrial preparation and baking of cakes. Production process and quality control, healthy biscuit formulation. Manufacture of cookies, pretzels and pastries. Requirement of dietetic bakery.								
Unit- IV	Ingredient Interactions and their implications in bakery and confectionery products:								
	Basic concepts of heat and mass transfer mechanism in bakery products. Foam to sponge conversion and the collapse of bakery products, Effect of ingredient, recipe and product interactions. Classification of Confectionery products, Ingredients sources and their role for various products: sweeteners – alternative and high intensity sweeteners, water, lipids, emulsifiers, starch, protein, pectin, gums and other ingredients. Factors influencing rheology of candy mass and chocolates.								
Unit- V	Technology of confectionery products:								
	Formulation and Processing – Hard candy, fondant, creams, jellies, gummies, licorices, compressed tablets, chocolates and compound coatings, sugar free confections. Quality standards of confectionery products. Packaging and shelf life of Confectionery products.								
REFERENCES:									
1.	Weibiao Zhou, Y.H.Hui., "Bakery Products Science and Technology", 2 nd Edition, Wiley Blackwell, US, 2014.								
2.	Servet Gulum Sumnu, Serpil Sahin. "Food Engineering Aspects of Baking Sweet Goods", 1 st Edition, CRC Press, USA, 2008.								
3.	Richard W. Hartel, Joachim H. von Elbe, Randy Hofberger., "Confectionery science and technology", 1 st Edition, Springer, 2018.								

*includes Term Work(TW) & Online / Certification course hours



COURSEOUTCOMES: On completion of the course, the students will be able to			BT Mapped (HighestLevel)
CO1	summarize the role of ingredients and working of equipment in production of bakery products		Understanding(K2)
CO2	analyze and interpret rheological properties of bakery products		Analyzing(K4)
CO3	select appropriate techniques in industrial production of bakery products		Applying(K3)
CO4	apply heat and mass transfer phenomena in bakery product processing and outline the role of confectionery ingredients		Applying(K3)
CO5	apply the process technology for development of confectionery products		Applying(K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	1	2
CO2	3	3	1	1	2
CO3	3	3	1	2	2
CO4	3	3	1	1	2
CO5	3	3	1	2	2

1–Slight, 2–Moderate, 3–Substantial, BT-Bloom's Taxonomy

ASSESSMENTPATTERN-THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total%
CAT1		75	5	20			100
CAT2		60	20	20			100
CAT3		65	35				100
ESE		45	35	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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J. Mf





24MFE07- ADVANCED SEPARATION TECHNIQUES IN FOOD PROCESSING																				
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit											
Prerequisites	NIL	2	PE	45	0	0	45	90	3											
Preamble	This subject imparts knowledge on separation techniques required for food process industry.																			
Unit - I	Separation Techniques:																			
Introduction, separation from solids, separation from liquids, separation from gases and vapours, Filtration- centrifugation-equipment and application in food processing.																				
Unit - II	Solid Separation Process:																			
Separation Concept based on particle size and shape. Magnetic separation, Eddy-current separation, Ballistic separation, Color separation, Wet Separation Process, liquid-solid and liquid- liquid separation by hydro cyclones, Surface velocity classifier, Elutriators, Impingement separator, Electrostatic precipitation.																				
Unit - III	Other Separation Processes and Powder Technology:																			
Types and choice of adsorbents, Mechanisms of Affinity chromatography and immuno chromatography. Foam separation, Super critical fluid extraction - Food Application. Classification of powder, separation of powder sieving, air classification and its factors affecting, air separation, particle size distribution.																				
Unit - IV	Membrane Technology:																			
Membrane modules, Mechanism and equipment employed for micro-filtration, ultrafiltration, nanofiltration, reverse osmosis, concentration polarization, pervaporation and application of membrane technology in food industry.																				
Unit - V	Ionic Separation Processes and Permeation Techniques:																			
Electrophoresis, dielectrophoresis, ion exchange chromatography, electro dialysis -Theory and equipment Permeation of liquids and gases.																				
REFERENCES:																				
1.	King, C.J., "Separation Processes", 2nd Edition, Dover Publications, inc.Mineola, New York, 2013.																			
2.	Grandison A.S., Lewis M.J., "Separation process in the food & biotechnology industries", 1st Edition, woodheadpublication, England, 1996.																			
3.	Ronald.W. Rousseau., "Handbook of Separation Process Technology", 1st Edition, Wiley India Pvt Ltd, 2009.																			
4.	Jimmy L. Humphery , George E. Keller., "Separation Process Technology", 1st Edition, McGraw-Hill Publishers,1997.																			

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:					BT Mapped (Highest Level)
On completion of the course, the students will be able to					
CO1	infer the concepts of separation techniques				Understanding (K2)
CO2	choose different solid liquid separation process				Applying (K3)
CO3	outline the adsorption and particle separation process				Understanding (K2)
CO4	categorize separation based on membranes				Analyzing (K4)
CO5	make use of ionic separation and permeation processes				Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1		1
CO2	3	2	1		1
CO3	3	2	1		2
CO4	3	2	1		2
CO5	3	2	1		1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		60	40				100
CAT3		40	40	20			100
ESE		40	40	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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24MFE08- FOOD PACKAGING AND STORAGE ENGINEERING										
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	2	PE	45	0	0	45	90	3	
Preamble	This course will deliver knowledge on recent developments and trends in food packaging and storage methods.									
Unit - I	Packaging Materials and Selection of Package: Functions of packaging, Type of packaging materials, Selection of packaging materials and methods for different foods solid, semi-solid and liquid food. Optimizing packaging. Advances in sealing, seaming and methods to detect defects, improving the performance of retortable pouches, testing consumer responses to new packaging concepts.									
Unit - II	Developments in Active Packaging: Controlled release packaging – process, structure, property and food variables, target release rate, active nanocomposites packaging – free radical scavenging nanocomposites, oxygen scavenging nanocomposites, antimicrobial nanocomposites, edible chitosan coatings – properties of chitosan, application of chitosan-based coatings, flavor-release packaging – mechanism of flavor release, practical applications.									
Unit - III	Trends in Packaging, Labeling and Shelf life Studies: MAP - novel gases, high oxygen MAP, applications, Natural non-toxic insect repellent packaging materials, Interactive packaging using internet, Smart Labeling - Labeling to detect changes in temperature, monitor freshness, detect changes in oxygen and carbon dioxide concentration. Shelf life studies - Shelf life models – constant H ₂ O and O ₂ driving forces, variable H ₂ O driving force, variable O ₂ driving force. Accelerated Shelf Life Study. Advances in freshness and safety indicators in food packaging.									
Unit - IV	Storage Engineering and Handling: Storage of grains–biochemical changes during storage– production, distribution and storage capacity estimate models– ecology, storage factors affecting losses, storage requirements, bag and bulk storage– pressure distribution– method of stacking– preventive method, the behavior of grains as bulk cargo, function structural and thermal design of structures. Parameters of good storage structure. Controlled Atmospheric Storage (CAS). Ceiling and Plinth Storage									
Unit - V	Grain Protection: Grain inspection techniques, Theories of rodent control, Protection against Fungi, Pests and Mites, Insect light traps, biological control of stored product pests. Commodity and space fumigation – movement of gases, dosage and exposure periods, choice of fumigants, fumigation management plan. Dust control.									
REFERENCES:										
1.	Kit L. Yam., Dong Sun Lee., "Emerging Food Packaging Technologies: Principles and practice", 1st Edition, Woodhead Publishing, UK, 2012									
2.	Jerry Heaps., "Insect Management for Food Storage and Processing", 2nd Edition, Elsevier, USA, 2006.									
3.	Raija Ahvenainen., "Novel Food Packaging Techniques", 1st Edition, Wood head Publishing, UK, 2003.									
4.	Bala B. K., "Drying and Storage of Cereal Grains", 2nd Edition, Wiley Blackwell, UK, 2016.									

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:				BT Mapped (Highest Level)
On completion of the course, the students will be able to				
CO1	select appropriate packaging materials based on food products			Applying (K3)
CO2	infer active packaging and other trends in food packaging			Understanding (K2)
CO3	make use of Models to predict shelf life of food products.			Applying (K3)
CO4	outline different types of food storage and handling methods			Understanding (K2)
CO5	choose appropriate grain protection techniques			Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	1	1
CO2	3	3	1	2	3
CO3	3	3	1	2	3
CO4	3	2	1	2	2
CO5	3	2	1	2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		70	30				100
CAT2		60	40				100
CAT3		60	40				100
ESE		70	30				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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Signature of the Chairman
Board of Studies - Technology

J. J. Ramu
Signature





24MFE09- ENZYME ENGINEERING AND TECHNOLOGY										
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	2	PE	45	0	0	45	90	3	
Preamble	This course gives an insight about the properties, kinetics and application of enzymes in food industry									
Unit - I	Introduction to Enzymes: Classification and nomenclature of enzymes according to IUB. Mechanisms of enzyme action, concept of active site and energetic of enzyme substrate complex formation, specificity of enzyme action, Mechanism of enzyme catalysis- electrostatic proximity and orientation effect, role of entropy in catalysis. Co-enzyme, cofactor and prosthetic group – reaction involving TPP, Pyridoxal phosphate, Nicotinamide, Flavin Nucleotides, Co-A, Biotin and Vitamin K dependent carboxylation. Isozymes, abzymes, synzymes.									
Unit - II	Kinetics of Enzyme Action: Order of reaction, Activation energy, Kinetics of single substrate reactions, Estimation of Michelis-Menten parameters, Lineweaver burk plot, multisubstrate reactions-mechanisms and kinetics, turn over number, pH and temperature effect on enzymes and deactivation kinetics.									
Unit - III	Enzyme Kinetics and Inhibition: Reversible inhibition - Kinetics of competitive, non-competitive and uncompetitive inhibition. Irreversible inhibition – suicide inhibition. Allosteric regulation of enzymes, Monod Wyman Changeux model. Enzyme Immobilization - Physical and chemical techniques for enzyme immobilization-adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding - examples, advantages and disadvantages.									
Unit - IV	Application of Enzyme Extracts: Plant, animal and microbial sources, methods of characterization of enzyme extract, development of enzymatic assays. Enzyme application in food processing, meat industry, fruit and vegetable industry, dairy industry, healthcare and environment									
Unit - V	Enzyme Engineering and Biosensor: Enzyme engineering- design and construction of novel enzymes, random mutagenesis, site directed mutagenesis, rational and computational design, artificial enzymes. Design of enzyme electrodes and their application as biosensors in industry									
REFERENCES:										
1.	Young Je Yoo, Yan Feng., Yong Hwan Kim, Camila Flor J. Yagonia., "Fundamentals of Enzyme Engineering", 1st edition, Springer Netherlands, 2017.									
2.	Parmjit S.Panesar, Satwinder S. Marwaha, Harish K. Chopra., "Enzymes in Food Processing: Fundamentals &Potential Applications", 1st edition, I.K. International Publishing House, 2010.									
3.	Whitehurst R. , Law B., "Enzymes in Food Technology", 2nd edition, Blackwell Publishing, 2010.									
4.	Trevor Palmer., "Enzymes: Biochemistry, Biotechnology and Clinical Chemistry", 2nd edition, Horwood Publishing, 2008.									

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:			BT Mapped (Highest Level)
On completion of the course, the students will be able to			
CO1	outline enzyme classification and understand the influence of environmental factors on enzyme activity		Understanding (K2)
CO2	Make use of enzyme kinetics action for applying enzyme kinetics in various application		Applying (K3)
CO3	Apply suitable methods for enzyme inhibition and immobilization		Applying (K3)
CO4	Identify suitable enzymes for processing and development of food products		Applying (K3)
CO5	Make use of concepts of enzyme engineering and biosensors		Applying (K3)

Mapping of COs with POs

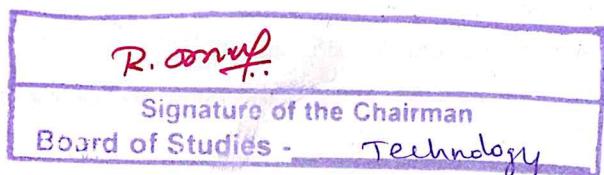
COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1		1
CO2	3	2	1		1
CO3	3	3	1		2
CO4	3	3	1	2	2
CO5	3	3	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		60	40				100
CAT3		60	40				100
ESE		60	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)



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24MFE10- MACHINE VISION FOR FOODTECHNOLOGY										
Programme& Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	2	PE	45	0	0	45	90	3	
Preamble	To give an outline on theories of machine vision and to develop suitable food engineering solutions.									
Unit- I	Image Acquisition Systems:									
Electromagnetic spectrum - Image acquisition system -computer vision system: Ultrasound, Infrared, Tomographic imaging, comparison of human visual system with computer vision, Image Segmentation Techniques: Pre-processing Techniques - Noise Removal - Contrast Enhancing, Segmentation Techniques – Thresholding-based Segmentation - Edge-based Segmentation - Region-Based Segmentation-Gradient-Based Segmentation-Classification Based Segmentation. Image processing Techniques: Data reduction, Windowing, Digital conversion.										9
Unit- II	Object Measurement System:									
Size – shape – size dependent and independent - colour – human and hardware oriented, instrumental – texture – structural, statistical, transform and model-based, Object classification methods: Artificial Neural Network – statistical classification – Fuzzy logic – Decision tree – Support vector machine.										9
Unit- III	Hyper spectral Imaging Technology:									
Fundamentals – multivariate data analysis - spectral pre-processing, development of multivariate calibration, model validation and evaluation, selection of important wavelengths, Multivariate Image Analysis. Application for muscle foods.										9
Unit- IV	Raman Chemical Imaging Technology:									
Principles – Raman spectroscopy techniques – Raman imaging instruments – Raman image analysis techniques – Image pre-processing, target identification, mapping and quantitative analysis. Raman chemical imaging technology application in foods.										9
Unit- V	Quality Evaluation of Foods:									
Meat: noncontact quality evaluation of meat cuts, non-destructive technologies for cooked meat quality judgment, poultry and sea foods - hyper spectral imaging. Fruits and vegetables: surface and internal defects, assessing texture and flavour. Grains: assessing classes and quality. 3D machine vision technology, Decision making considerations for machine vision applications.										9
REFERENCES:										
1.	Alexander Hornberg., "Handbook of Machine and Computer Vision: The Guide for Developers and Users", 3rd Edition, John Wiley & Sons, Germany, 2017.									
2.	Da-Wen Sun., "Computer Vision Technology for Food Quality Evaluation", 2 nd Edition, Academic Press, London, 2011.									
3.	Davis E.R., "Image Processing for the Food Industry", 1 st Edition, World Scientific, Singapore, 2000.									
4.	Bosoon Park, RenfuLu., "Hyper spectral Imaging Technology in Food and Agriculture", 1 st Edition, Springer, 2015.									

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:			BT Mapped (Highest Level)
On completion of the course, the students will be able to			
CO1	select appropriate image acquisition and segmentation techniques for different types food		Applying(K3)
CO2	apply suitable machine vision technology for food material measurement and classification		Applying(K3)
CO3	analyse use of hyperspectral imaging technology in food products		Analyzing (K4)
CO4	examine the role of raman chemical imaging technology in food materials		Analyzing (K4)
CO5	select and use suitable machine vision technology for quality evaluation of various food materials		Applying(K3)

Mapping of COs with POs

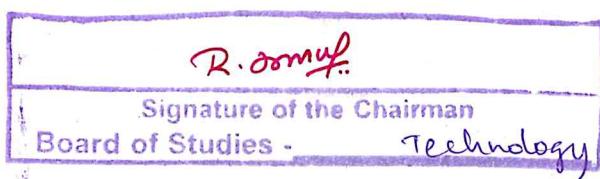
COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1		2
CO2	3	3	1		2
CO3	3	3	1	1	2
CO4	3	3	1	1	2
CO5	3	3	1	2	2

1–Slight, 2–Moderate, 3–Substantial, BT-Bloom's Taxonomy

ASSESSMENT PATTERN-THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total%
CAT1		60	40				100
CAT2		40	40	20			100
CAT3		40	40	20			100
ESE		40	40	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)



N. Sathi



24MFE11- TECHNOLOGY OF FOOD COLOURS AND FLAVOURS										
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	2	PE	45	0	0	45	90	3	
Preamble	This course will help students to understand the chemistry, technology and application of flavours and colours in food products.									
Unit - I	Basics of Food Flavours and Colours:									
Unit - II	Introduction, classification of food flavours, perception of flavour and taste—Theories of olfaction -Molecular structure and activity relationships of taste – sweet, bitter, acid and salt, Chemicals causing pungency, astringency, cooling effect – properties. Regulations regarding additions, toxicology and safety aspects of food flavour. Introduction, classification of food colours, perception of colour, basics of colour – hue, chroma, brightness, saturation. Regulations regarding additions, toxicology and safety aspects of food colours.									
Unit - III	Origin and Technology of Food colours:									
Unit - IV	Plant - Chlorophyll and chlorophyll derivatives, carotenoids, annatto, saffron, turmeric, Caramel colour, anthocyanins and betalains. Animal- Haems and bilins , monascus, cochineal and related pigments. Synthetic -Forms and types, certified F, D and C colourants. Technology for the production of dried colorants, stability - pH, temperature and other processing conditions. Role of micro-organism in synthesis of food colours, encapsulated food colourants.									
Unit - V	Food flavours from plant origin and its processing:									
Unit - VI	Alliaceous flavours, bittering agents, coffee and cocoa, fruit flavours. Enzymatic development, effect of roasting, cooking, frying on flavour developments Essential oils and oleoresins – extraction methods. Liquid and dry flavour production, encapsulated flavours, microbial synthesis of flavours, flavour enhancer and seasonings. factors affecting stability of flavours									
Unit - VII	Flavour and Colour Analysis:									
Unit - VIII	Aroma Compounds - Sample Selection/Preparation, Principles of Aroma Isolation – Solubility, Sorptive Extraction, Volatility. Methods of Aroma Isolation – Static Headspace, Headspace Concentration Methods (Dynamic Headspace) - Distillation Methods – Solvent Extraction, Sorptive Extraction - Concentration for Analysis, Aroma Isolation, Prefractionation - Gas Chromatography, GC/Olfactometry (GC/O) GC- MS/Olfactometry (GC-MS/O), Mass Spectrometry. Preparation and isolation of sample, spectrophotometry, colorimetry, Hunter Colour lab, CIE system, Lovibond Tintometer, Munsell colour system.									
Unit - IX	Flavourants and Colourants applications in food:									
Unit - X	Soups and stocks, sauces, seasonings, and marinades, baked goods and bakery products, snack foods, sugar based confectionery products and chewing gum, dairy Products - flavoured milks, flavoured yogurts, flavoured dairy desserts. Beverages, and other foods.									
REFERENCES:										
1.	Reineccius G., Heath H.B., "Flavor Chemistry and Technology", 2nd Edition, CRC Press, 2006.									
2.	Carmen Socaciu., "Food Colorants: Chemical and Functional Properties",1st Edition, CRC Press, 2008.									
3.	Rowe D.J., "Chemistry and Technology of Flavors and Fragrances", 1st Edition, Blackwell Publishing Ltd., 2005.									
4.	NIIR board., "Food Colours, Flavours and Additives Technology Handbook, 1st Edition, National Institute of Industrial Research,2004.									

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:		BT Mapped (Highest Level)
On completion of the course, the students will be able to		
CO1	summarize the basic concepts related to flavours and colours	Understanding (K2)
CO2	apply the technological aspects of colours in food product development	Applying (K3)
CO3	apply the technological aspects of flavours in food product development	Applying (K3)
CO4	examine the techniques involved in analysis of flavor and color	Analyzing (K4)
CO5	select and apply appropriate flavours and colours for different food products	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	3	1
CO2	3	3	1	2	2
CO3	3	3	1	2	2
CO4	3	3	1	1	2
CO5	3	3	1	1	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		55	45				100
CAT2		50	50				100
CAT3		55	35	10			100
ESE		50	40	10			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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Signature of the Chairman
Board of Studies - Technology



N. Balaji



24MFE12- FOOD PRODUCT DESIGN AND DEVELOPMENT																				
Programme& Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit											
Prerequisites	NIL	2	PE	45	0	0	45	90	3											
Preamble	This course provides an insight for design, development, standardization, regulatory aspects and commercialization of food products.																			
Unit- I	Role of ingredient in new product development:																			
Introduction, Characteristics of food ingredient industry, development process. New ingredients – Fat ingredients, carbohydrate ingredients, fibre ingredients, Protein as ingredients. Ingredients and new nutrition – Biologically active non-nutrient, Functional foods, prebiotics and probiotics, Prebiotics and phytochemicals. Other ingredients–Antioxidants, Antimicrobial agents, Colourants Challenges for new nutrition.																				
Unit- II	Designing new products:																			
New Food Product Development (NPD) process and activities, types of new products, NPD success factors, food innovation - case studies, market-oriented NPD methodologies, organization for successful NPD; Recipe development ;use of traditional recipe and modification; involvement of consumers, chefs and recipe experts; selection of materials/ingredients for specific purposes; modifications for production on large scale, cost effectiveness, nutritional needs or uniqueness Importance of product innovation ;use of novel food ingredients; Gastronomic engineering – principle, Ingredients for structure design.																				
Unit- III	Standardization & Large scale production:																			
Process and equipment design – Principle for equipment selection - establishing process parameters for optimum quality; sensory evaluation: different techniques and tests – sensory cabin/ lab requirements, statistical analysis - application in product development and comparison of market samples - stages of the integration of market and sensory analysis.																				
Unit- IV	Quality, Safety & Regulatory aspects:																			
Product stability; evaluation of shelf life- accelerated shelf life determination - changes in sensory attributes and effects of environmental conditions; Role of packaging in product development – Packaging requirement for specific foods; regulatory aspects; approval for proprietary product.																				
Unit- V	Advertisement and Marketing																			
Customers and consumers, value addition, Marketing characteristics of new products - Product life cycle, profit picture. Corporate avenues for growth and profitability, opportunities in the marketplace for new product development, technological advances driving new product development, government's role in new product development.																				
REFERENCES:																				
1.	Brody,A.L., John B.L., "Developing New Food Products for a Changing Marketplace",2 nd Edition, CRC press, Taylor and Francis Group, UK, 2008.																			
2.	GordonW Fuller., "New Food Product Development: From Concept to Marketplace",3 rd Edition, CRC press, Taylor and Francis Group, UK, 2016.																			
3.	Catherine Side., "Food Product Development: Based on Experience",2 nd Edition, Iowa State Press, Blackwell publications, 2008.																			
4.	Macfie, H., "Consumer-led Food Product Development",1 st Edition CRC press, Wood Head publications,2007.																			

*includes Term Work(TW) & Online / Certification course hours



COURSEOUTCOMES: On completion of the course, the students will be able to				BT Mapped (HighestLevel)
CO1	apply the concept and importance of ingredients in developing new food products			Applying (K3)
CO2	outline the process for developing new food products			Understanding (K2)
CO3	examine the process parameters for standardization and product scaleup			Analyzing (K4)
CO4	analyze the quality, safety and regulatory aspects for new product development			Analyzing (K4)
CO5	utilize the advertisement and marketing strategies for the commercialization of products			Applying(K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	2	2
CO2	3	3	1	2	3
CO3	3	3	1	2	2
CO4	3	3	1	3	3
CO5	3	2	1	2	2

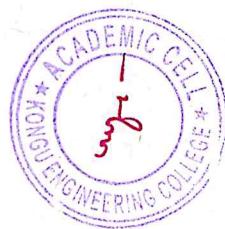
1–Slight,2–Moderate,3–Substantial,BT-Bloom's Taxonomy

ASSESSMENTPATTERN-THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total%
CAT1		60	40				100
CAT2		40	40	20			100
CAT3		40	40	20			100
ESE		40	40	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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Signature of the Chairman
Board of Studies - Technology

*N. Palathai*



24MFE13- TRANSPORT PHENOMENA IN FOOD PROCESSING																		
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit									
Prerequisites	NIL	2	PE	45	0	0	45	90	3									
Preamble	This course deals with the basic principles, laws, relations and similarities among different types of transport (Momentum, Energy, and Mass) that may occur in any system.																	
Unit - I	Momentum Transport																	
Phenomenological laws of transport properties, Newtonian and non-Newtonian fluids, rheological models, theories of transport properties of low density gases and liquids, effect of pressure and temperature. Shell momentum balances – boundary conditions and flow of falling film.																		
Unit - II	Interphase Transport in Isothermal System:																	
Friction factor, Fluid–Fluid systems, Flow patterns in vertical and horizontal pipes, Formulation of bubbles and drops and their size distribution, Solid – fluid systems, Forces acting on stagnant and moving solids, Flow through porous medium, Capillary tube model and its applications.																		
Unit - III	Energy Transport:																	
Fourier's law of heat conduction, theory of thermal conductivity of liquids and solids, shell energy balances- boundary conditions, heat conduction with an electrical heat source, composite walls, viscous heat source.																		
Unit - IV	Interphase Transport in Non-Isothermal System																	
Heat Transfer coefficient, Forced convection in tubes, around submerged objects, Heat Transfer by free convection, film type and drop wise condensation and equations for heat transfer, Heat transfer in boiling liquids.																		
Unit - V	Mass Transport and Interphase Mass Transfer																	
Ficks law of diffusion, Theories of ordinary diffusion in gases and liquids, shell mass balances- boundary conditions, diffusion with heterogeneous and homogeneous reaction – effectiveness factor. Mass transfer co-efficient in single and multiple phases at low and high mass transfer rates. Macroscopic balance to solve steady and Unsteady state problems.																		
REFERENCES:																		
1.	Bird R.B., Stewart W.E., Lightfoot E.N., "Transport Phenomena", 2nd Edition, John Wiley and Sons, 2006.																	
2.	Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt., "Fundamentals of Heat and Mass Transfer", 8th Edition, John Wiley and Sons, 2011.																	
3.	Jorge WeltiChanes, Jorge Vélez-Ruiz, Gustavo VBarbosa-Cánovas., "Transport Phenomena in Food Processing", 1st Edition, CRC Press, 2013.																	
4.	Bodh Raj., "Introduction to Transport Phenomena", 1st Edition, PHI Learning Private Limited, 2012.																	

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:			BT Mapped (Highest Level)
On completion of the course, the students will be able to			
CO1	explain the phenomena behind the transport of momentum, mass and energy		Understanding (K2)
CO2	make use of the shell balance approach to solve momentum, mass and energy transport problems		Applying (K3)
CO3	explain and apply the concept of interphase transport in isothermal systems		Applying (K3)
CO4	identify and apply the concept of interphase transport in non-isothermal systems		Applying (K3)
CO5	analyze the unsteady state problems		Analyzing (K4)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1		1
CO2	3	3	1		1
CO3	3	2	1		1
CO4	3	2	1		1
CO5	3	3	1		1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		50	50				100
CAT3		40	40	20			100
ESE		40	40	20			100

* ±3% may be varied (CAT 1,2 & 3 - 50 marks & ESE – 100 marks)

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24MFE14- OPERATIONAL RESEARCH										
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	2	PE	45	0	0	45	90	3	
Preamble	This course delivers the knowledge of operational research methods to improve operational efficiency and decision making.									
Unit- I	Introduction to Operation Research (OR): History of Operations Research-Stages of Development of Operations Research-Relationship Between Manager and OR Specialist- OR Tools and Techniques- Scope and Applications of Operations Research- Limitations of Operations Research.									
Unit- II	Linear Programming: Introduction to Linear Programming, Graphical Method, Minimization case, Mixed constraint linear programming problem, special cases, Simplex method, Big M method, Two phase method, Types of linear programming solutions, Product Formulation and Process Optimization Using Linear Programming									
Unit- III	Non- Linear Programming: Constrained problems-Equality constraints-Lagrangean method-Inequality Constraints-Karush-Kuhn-Tucker(KKT) Conditions-Quadratic Programming. Applications of non - linear programming in food processing									
Unit- IV	Game Theory and Queuing Theory: Introduction to the theory of games- The definition of a game, Competitive game, Managerial applications of the theory of games, Key concepts in the theory of games, Types of games. Introduction, Mathematical Analysis of Queuing Process, Properties of Queuing System, Notations, Service System, Single Channel Models, Multiple Service Channels, Erlang Family of Distribution of Service Times, Food processing plant applications of queueing equations, Limitations of Queueing Theory.									
Unit- V	Forecasting of operations: Applications of Forecasting, Judgmental Forecasting Methods, Time Series, Forecasting Methods for a Constant- Level Model, Incorporating Seasonal Effects into Forecasting Methods, An Exponential Smoothing Method for a Linear Trend Model, Forecasting Errors, Box-Jenkins method, Causal Forecasting with Linear Regression, forecasting in practice.									
REFERENCES:										
1.	TiwariN.K., ShishirK. Shandilya, "Operations Research", 1 st Edition, Prentice Hall, New Delhi,2006.									
2.	SharmaJ.K., "Operations Research: Theory and Applications", 5 th Edition, Macmillan Publishers, New Delhi ,2012.									
3.	FerruhErdogdu., "Optimization in Food Engineering", 1 st Edition, CRCPress, USA,2008.									
4.	Serafim Bakalis, KaiKnorzer, PeterJ.Fryer., "Modelling Food Processing Operations", 1 st Edition, Woodhead Publishing, UK, 2015.									

*includes Term Work(TW) & Online / Certification course hours



COURSEOUTCOMES: On completion of the course, the students will be able to		BT Mapped (HighestLevel)
CO1	outline the basics of operation research	Understanding(K2)
CO2	solve different kinds of linear programming problems	Applying(K3)
CO3	apply non-linear programming for solving problems	Applying(K3)
CO4	make use of Game and Queuing theory concepts in food processing	Applying(K3)
CO5	apply forecasting methods in food production planning and sales	Applying(K3)

Mapping of Cos with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1		1
CO2	3	2	1		1
CO3	3	2	1		1
CO4	3	2	1		1
CO5	3	3	1		1

1–Slight,2–Moderate,3–Substantial,BT-Bloom's Taxonomy

ASSESSMENTPATTERN-THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total%
CAT1		75	25				100
CAT2		60	40				100
CAT3		60	40				100
ESE		60	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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24MFL21- APPLIED FOOD ANALYSIS LABORATORY

Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites	Nil	2	PC	0	0	30	0	30	1

Preamble To provide practical exposure to different equipment for food analysis.

LIST OF EXPERIMENTS / EXERCISES:

1.	Analysis of turmeric – UV spectroscopy
2.	Analysis of coffee Powder – Caffeine (HPLC), Water activity, Solubility
3.	Evaluation and comparison of cooking quality characteristics of different types of pasta and comply the results with FSSAI standards
4.	Detection of adulterants present in agriculture commodities and food products
5.	Atomic absorption spectroscopic analysis of heavy metals in foods
6.	Discriminative and descriptive sensory analysis of food products with statistical correlation
7.	Estimation of viscosity and consistency of liquid foods using viscometer and consistometer
8.	Estimation of energy value of food products using bomb calorimeter
9.	Color analysis of food products using color spectrophotometer
10.	Determination of textural properties of solid foods-Texture profile analysis of foods
11.	Virtual Laboratory Experiment: a. Flame photometer.

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Manual of methods for the Analysis of Foods", Ministry of Health and Family Welfare, Government of India, New Delhi, 2016.
3.	Sadasivam, S., Manickam, A., "Biochemical Methods", 3 rd Edition, New Age International, Delhi, 2018.
4.	http://www.rpaulsingh.com/learning/virtual/experiments/rheology/index.html

COURSE OUTCOMES:

On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	estimate active components in food products	Evaluating (K5), Precision (K3)
CO2	evaluate quality characteristics and genuinity in agriculture commodities and food products	Evaluating (K5), Precision (K3)
CO3	assess sensory properties and energy value of food products	Evaluating (K5), Precision (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2
CO2	3	3	2	2	2
CO3	3	3	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

*includes Term Work(TW) & Online / Certification course hours

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24MFL22- FOOD PRODUCTS DEVELOPMENT LABORATORY										
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	Nil	2	PC	0	0	30	0	30	1	
Preamble	This course imparts the technical knowledge on development and analysis of different food products.									
LIST OF EXPERIMENTS / EXERCISES:										
1.	Development of protein enriched biscuits/cookies and evaluation.									
2.	Development of deep fat fried snack product and analysis of quality parameters.									
3.	Development of phytochemicals rich beverage and estimation of phytochemicals content in the product.									
4.	Development of blended food flavour-based products and quality evaluation.									
5.	Development of dry health food premix and evaluation of quality and sensory attributes.									
6.	Development of marshmallow and assessment of texture and quality.									
7.	Development of product using dairy replacer specialty fats and quality evaluation.									
8.	Development of eggless cake and quality evaluation.									
9.	Development of Nutritional/Energy bar and product analysis.									
10.	Development of low-fat spread and sensory evaluation.									
11.	Development of symbiotic dairy product and its sensory and microbiological analysis									
12.	Development of sugar free confectionery/ cocoa based confectionery product and evaluation.									
13.	Virtual Lab: Canning of foods – Demo									
REFERENCES/ MANUAL /SOFTWARE:										
1.	Laboratory Manual.									
2.	Wildman, Robert E.C., "Handbook of Nutraceuticals and Functional Foods", 3rd Edition, CRC Press, New York, 2019.									
3.	Richard D. O'Brien., "Fats and oils: Formulating and Processing for Application", 3rd Edition, CRC press, NewYork, 2008.									
4.	http://www.rpaulsingh.com/learning/virtual/experiments/canning/index.html									
COURSE OUTCOMES:										
On completion of the course, the students will be able to										BT Mapped (Highest Level)
CO1	develop and evaluate novel food products in the bakery, confectionery, beverage, dairy and snack foods.									Evaluating (K5), Manipulation (S2)
CO2	make use of functional and specialty ingredients in preparing and evaluating food products									Evaluating (K5), Manipulation (S2)
CO3	develop and evaluate nutrition and conscious food products									Evaluating (K5), Precision (S3)
Mapping of Cos with POs										
COs/POs	PO1	PO2	PO3	PO4	PO5					
CO1	3	3	2	2	3					
CO2	3	3	2	2	3					
CO3	3	3	2	3	3					

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

*includes Term Work(TW) & Online / Certification course hours

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24MFE15- ADVANCED GRAIN SCIENCE AND TECHNOLOGY										
Programme& Branch	M.Tech& Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	3	PE	45	0	0	45	90	3	
Preamble	To learn about the milling of various cereals along with the recent advancements in milling and various cereal based products									
Unit- I	Grains: Introduction, structural components of cereal grains, engineering properties of grains, harvesting, threshing, grain cleaning, grading, drying, storage, aeration and stored grain management, control of insects, microorganisms and rodents during storage.									
Unit- II	Rice Milling: Structure. Principles of size reduction, rice milling - flowsheet. Improving nutritional properties of rice by different methods. Changes in physico-chemical, pasting and milling properties during aging of rice. Water mist polishing, rice moisture conditioning, Instruments for rice quality control – rice analyzer, broken rice analyzer, FWM analyzer, rice taste analyzer.									
Unit- III	Wheat Milling: Morphology of wheat, Classification, Wheat milling - Flow sheet. Turbo milling, air classifiers. Criteria of wheat and flour quality, structure and functional properties of gluten, wheat grain protein, starch, phytochemicals, dough chemistry, rheology, evaluation of flour quality by farinograph, mixograph, extensiograph, alveograph, rapid viscoanalyzer, dynamic rheometry, mixolab.									
Unit- IV	Barley, Corn and Oat Milling: Barley – Processing, finishes products and end uses. Corn – wet and dry milling, Manufacture of value added products such as zein from corn. Oat milling and flaking. Dietary fibre from barley and oats: β glucan structure, extraction, physiological effects and functional properties.									
Unit- V	Cereal Products: Rice snack foods, Rice noodles, quick cooking rice, canned and frozen rice, Baby foods, extruded rice, puffed rice cake, pasta, instant noodles, breakfast cereals, cereal enrichment, malted cereals, special food ingredients from cereals, future trends.									
REFERENCES:										
1.	Karel Kulp, "Handbook of Cereal Science and Technology", 2 nd Edition, CRC Press, 2000.									
2.	Serna-Saldivar, Sergio O., "Cereal grains: Properties, Processing and Nutritional Attributes", 1 st Edition, CRC Press, 2016.									
3.	Amalendu Chakraverty, Arun S. Mujumdar, Hosahalli S. Ramaswamy, "Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices", 1 st Edition, CRC Press, 2003.									
4.	K M Sahay, K K Singh, "Unit operations of agricultural processing", 2 nd Edition, Vikash Publication, 2009.									

*includes Term Work(TW) & Online / Certification course hours



COURSEOUTCOMES: On completion of the course, the students will be able to		BT Mapped (HighestLevel)
CO1	outline the grain properties and pre processing operations of grains	Understanding(K2)
CO2	identify the suitable milling technologies for rice processing	Applying (K3)
CO3	make use of appropriate wheat milling process and flour treatment methods	Applying(K3)
CO4	choose various milling methods suitable for barley, corn and oats	Applying(K3)
CO5	develop different cereal based products	Applying(K3)

Mapping of Cos with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	2	1
CO2	3	3	1	2	2
CO3	3	3	1	2	2
CO4	3	3	1	1	2
CO5	3	3	1	2	3

1–Slight,2–Moderate,3–Substantial,BT-Bloom's Taxonomy

ASSESSMENTPATTERN-THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total%
CAT1		60	40				100
CAT2		40	60				100
CAT3		40	60				100
ESE		50	50				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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24MFE16- FOOD ADDITIVES, NUTRACEUTICALS AND FUNCTIONAL FOODS																		
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit									
Prerequisites	NIL	3	PE	45	0	0	45	90	3									
Preamble	This course provides the knowledge about food additives, nutraceuticals and functional foods																	
Unit - I	Food Additives:																	
Introduction, classification and functions; Role of additives in foods - preservatives, antioxidants, sequestrants, emulsifiers - selection of emulsifier based on Hydrophilic and Lipophilic balance (HLB) and its application, stabilizers and thickeners, bleaching and maturing agents, starch modifiers, food colourants and colour retention agents, sweeteners, humectants, flavorants and flavor enhancers, leavening agents, pH control agents, fat substitutes and replacers, anti- foaming agents. International Product Code.																		
Unit - II	Introduction to Nutraceuticals and therapeutic ingredients:																	
Sources, understanding benefits of nutraceuticals. Scope involved in industry, Indian and global scenario. Eye health ingredients –lutein, zeaxanthin, astaxanthin, beta-carotene, bilberry extracts; Heart health ingredients - omega-3, omega-6, omega-9, beta-glucan, soy protein, phytosterols; Digestive Health Ingredients– prebiotics, probiotics, synbiotics, digestive enzymes, zinc camosine.																		
Unit - III	Health promoting ingredients for women:																	
Women health ingredients - Vitamin D, iron, calcium, soy isoflavones, folic acid, cranberry extract, lycopene,phytoestrogens. Prebiotic fiber, glucosamine, chondroitin, collagen peptide, hyaluronic acid, devils claw, olive polyphenols, boswellia Serrata, horsetail extract.																		
Unit - IV	Dietary Supplements and its Functional sources:																	
Introduction to dietary supplements, Dietary supplements – Need for dietary supplements, supplements forms- tablets,capsules, powders, soft gels, gel caps, liquids.Agnus castus, Aloe vera, Bee products, Chitosan, Echinacea, Garlic, Ginger, Ginkgo biloba, Ginseng, Guarana, Kelp, Milk thistle, Saw palmetto, Spirulina, Chlorella, Hypericum perforatum, Tea extracts.																		
Unit - V	Asian Functional Food:																	
Functional Foods from Meat, Fruit, Fermented Vegetable Products: Kimchi, Sugarcane, Garlic, Onion, Date Fruits, Japanese Green Tea, Miso, Fermented Soybean Products. Cereal based Functional food and their health effects.																		
REFERENCES:																		
1.	Wildman, RobertE.C.,Robert Wildman, Taylor C. Wallace(Eds), "Handbook of Nutraceuticals and Functional Foods", 2nd edition, CRC Press, New York, 2019. .																	
2.	Titus A. M. Msagati., "Chemistry of Food Additives and Preservatives", 1st edition, Wiley-Blackwell, 2013.																	
3.	John Shi, Chi-Tang Ho, Fereidoon Shahidi., "Asian Functional Foods", 1st Edition, CRC Press, 2005.																	

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:		BT Mapped (Highest Level)
On completion of the course, the students will be able to		
CO1	classify and choose food additives for various food applications	Applying (K3)
CO2	Identify the role and importance of Nutraceuticals.	Applying (K3)
CO3	make use of appropriate ingredients for promoting health	Applying (K3)
CO4	summarize various dietary supplements used for promoting health.	Understanding (K2)
CO5	make use of Asian functional foods for promoting health.	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	3	1
CO2	3	2	1	3	2
CO3	3	2	1	3	2
CO4	3	2	1	3	2
CO5	3	2	1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		55	45				100
CAT2		55	45				100
CAT3		60	40				100
ESE		50	50				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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24MFE17- FOOD PROCESS PLANT LAYOUT AND DESIGN										
Programme& Branch	M.Tech&Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	3	PE	45	0	0	45	90	3	
Preamble	To impart knowledge on designing the food process, equipment and plant layout.									
Unit- I	Process design and plant layout: Overview of plant layout and design- Process Flow sheets, Types of process design, Material and energy balances, detailed plant layout aspects, construction materials and plant buildings, Economic analysis in process/plant design, Manufacturing cost and profitability, Computer aided process/plant design and layout.									
Unit- II	Food Plant Design: Elements of Food Plant Design- General aspects, new food plants, plant improvement, plant expansion, mobile food plants, advanced food plants. Good Manufacturing Practices, Food Plant Economics.									
Unit- III	Selection of Food Processing Equipment: Construction characteristics. Operational characteristics- reliability, convenience, safety, instrumentation, ergonomics efficiency, accuracy, environmental impact. Testing of equipments. Equipment specifications.									
Unit- IV	Sizing, construction and costing of Equipment: Sizing and costing of Equipment, materials of construction, Fabrication of equipment-Strength of Construction, Fabrication and Installation of Equipment, Hygienic Design of Food Processing Equipment.									
Unit- V	Design of food process equipment: Heat exchangers- Heat transfer factor. Baking Oven- Load of baking chamber, Load by products, Load by heat loss, Total thermal load, types of heating source. Reactors- process operation, design considerations, location, support and elevation, nozzle location, platform, piping arrangements. Design of equipment for industrial food processing such as evaporation, dehydration, refrigeration, freezing, thermal processing, and dehydration.									
REFERENCES:										
1.	George D. Saravacos, Athanasios E. Kostaropoulos, "Handbook of Food Processing Equipment", 2 nd Edition, Springer Science & Business Media, New York, 2016.									
2.	Ed Bausbacher, Roger Hunt, "Process plant layout and piping design", 1st Edition, P T R Prentice Hall, Englewood Cliffs, New Jersey, 1993.									
3.	Georgina Calderón-Domínguez, Gustavo F. Gutiérrez-López, and Keshavan Nirajan, "Advances in Heat Transfer Unit Operations", 1st Edition, CRC/Taylor & Francis, 2016.									
4.	Teixeira Arthur A., Shoemaker, Charles F, "Computerized Food Processing Operations" 1 st Edition Springer, 1989.									

*includes Term Work(TW) & Online / Certification course hours



COURSEOUTCOMES: On completion of the course, the students will be able to		BT Mapped (HighestLevel)
CO1	explain process design and plant layout	Understanding (K2)
CO2	apply process lay out concepts to construct food plant	Applying(K3)
CO3	select food process equipment based on constructional and operational characteristics	Applying(K3)
CO4	make use of sizing, construction and costing of food process equipment	Applying(K3)
CO5	examining the performance of food process equipment	Analyzing(K4)

Mapping of COs with POs

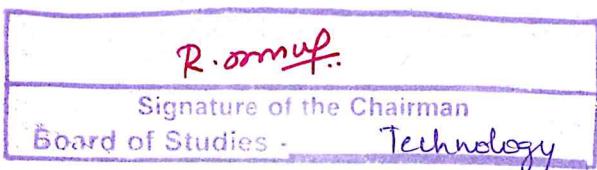
COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1		1
CO2	3	2	1	2	1
CO3	3	3	1	3	1
CO4	3	3	1	2	1
CO5	3	3	1	1	1

1–Slight,2–Moderate,3–Substantial,BT-Bloom's Taxonomy

ASSESSMENTPATTERN-THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total%
CAT1		60	40				100
CAT2		60	40				100
CAT3		40	40	20			100
ESE		50	40	10			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)





24MFE18- FOOD RHEOLOGY									
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites	NIL	3	PE	45	0	0	45	90	3
Preamble	This course provides knowledge on concepts, models, and applications of rheology in food systems.								
Unit - I	Food rheology: Stress and strain tensors, viscometric properties, shear stress-shear rate relationships, units in rheological measurements, types of fluid flow behavior, apparent viscosity, intrinsic viscosity, stress-strain behavior of solid foods, linear viscoelasticity, phase transitions in foods.								
Unit - II	Models for Rheological Properties of Foods: Time-Independent Flow Behaviour - Newtonian Model, Power Law Model, Herschel-Bulkley Model, Quemada Model. Time-Dependent Flow Behaviour - Weltman Model, Tiu-Boger Model. Shear Thinning Foods - Cross and Carreau Models. Effect of Temperature on Viscosity, Peclet Number of Dispersions.								
Unit - III	Rheological Behaviour of Processed Fluid and Semi solid Foods: Fruit Juices and Purees: Role of Soluble and Insoluble Solids, Rheological Properties of Chocolate, Rheology of Milk and Milk Concentrate, Rheology of Mayonnaise, Rheology of sauce and ketchup, Salad Dressing, and Margarine, Rheology of dough, beverages, Structural Analysis of Food Dispersions.								
Unit - IV	Rheological Behaviour of Food Gels: Rheological Tests to Evaluate Properties of Gel Systems, Mechanisms of Gelation, Classification of Gels. Theoretical Treatment of Gels - Rubber Elasticity, Percolation Theory, Cascade Theory. Gel Point and Sol-Gel Transition by Rheological Measurements. Mixed Polymer Gels, Starch Gels.								
Unit - V	Rheology Equipment: Rheometer- Introduction- working principle-calibration procedure- types – parallel plate- cone and plate- concentric cylinder-torsion rectangular. Viscometer- capillary tube viscometer, rotating viscometer, falling ball viscometers, rotational viscometers, and vibration viscometers.								
REFERENCES:									
1.	Rao M.A., "Rheology of Fluid and Semi solid Foods: Principles and Applications", 2nd illustrated Edition, Springer Science & Business Media, 2010.								
2.	Bourne M.C., "Food Texture and Viscosity: Concept and Measurement", Elsevier, 2014.								
3.	Jasim Ahmed, Santanu Basu, "Advances in Food Rheology and Its Applications", 2nd illustrated Edition, Elsevier Science, 2022.								
4.	Borwankar R.P., Shoemaker C.F., "Rheology of Foods", 2nd Edition, Elsevier, USA, 2016.								

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:			BT Mapped (Highest Level)
On completion of the course, the students will be able to			
CO1	explain the fundamentals of food rheology		Understanding (K2)
CO2	identify the different rheological models		Applying (K3)
CO3	identify the rheological behaviour of processed fluids and semi-solid foods		Applying (K3)
CO4	infer the rheological behaviour of food gels		Understanding (K2)
CO5	select the rheometers and explain their working principle based on food applications		Applying (K3)

Mapping of COs with POs

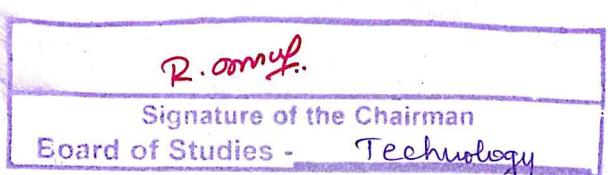
COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1		1
CO2	3	2	1		2
CO3	3	3	1		2
CO4	3	3	1		2
CO5	3	3	1		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		60	40				100
CAT3		70	30				100
ESE		70	30				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)



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24MFE19- INTERNET OF THINGS IN FOOD AND AGRICULTURE																				
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit											
Prerequisites	NIL	3	PE	45	0	0	45	90	3											
Preamble	This course aims to deliver knowledge about concepts of IoT and its applications in food and agriculture.																			
Unit - I	Introduction to Internet of Things (IoT):																			
Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT Communication Models - IoT Communication application programing interfaces – IoT enabled technologies – Wireless Sensor Networks - Cloud Computing – Big data analytics – Communication Protocols, Embedded Systems – IoT Levels and Templates- organizational implementation and management challenges.																				
Unit - II	Python, Physical Devices and Endpoints for IoT:																			
Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, classes, exception handling. Python packages – HTTPLib, URLLib, SMTPLib.: Introduction to Raspberry PI – Interfaces (serial, Serial Peripheral Index (SPI), 12C Programming – Python program with Raspberry PI with focus of interfacing external gadgets – controlling output – reading input from pins – connecting IoT to Cloud – Xively.																				
Unit - III	IoT in Agriculture and IoT in Food:																			
Smart agriculture, type of IoT sensors for agriculture – monitoring of climate conditions, Greenhouse automation, crop management, cattle monitoring and management, End-to-End farm management systems. Benefits and applications of smart farming, Issues and challenges in food and agriculture- efficient routing protocols and ambient energy harvesting for IoT. RFID and sensor network integration in food industry-RFID in food production, food supply chain, retailing and sustainability. RFID in sensor network and food processing-Case studies-Big data analytics in food industries-Food supply chain visibility, Intelligent food supply chain. Block chain-Concepts-Potential Applications in Food Industry.																				
Unit – IV	IoT in Food Spoilage and Safety:																			
Importance of IoT concerning food quality, safety and security. Biosensors for detection of food borne pathogens – prevention & retardation of food spoilage. Microbial detection, GIS, Sensor Networks. Case study on ensuring safety by enhanced IoT. IoT linked wearable devices for managing food safety in the healthcare sector.																				
Unit – V	IoT in Food Traceability and IoT in Food Waste Management:																			
Food Traceability: Need of new technologies in food traceability systems. Architecture of traceability system- ICT & Electronic Product Code (EPC) enabled systems. Real time tracking and remote monitoring – Wireless sensing technologies, remote communications and Intelligent traceability. Food Waste Management: Scope and significance of IoT in food waste management. Smart Garbage System (SGS)- components, design, architecture of SGS, implementation and efficiency, real-time application in food waste minimization.																				
REFERENCES:																				
1.	Qusay F. Hassan, Attaur Rehman Khan, Sajjad A. Madani., "Internet of Things Challenges, Advances and Applications", 2st Edition, CRC Press, Taylor and Francis Group, 2020.																			
2.	Selwyn Piramuthu, Weibiao Zhou., "RFID and Sensor Network Automation in the Food Industry: Ensuring Quality and Safety through Supply Chain Visibility", 1st Edition, John Wiley & Sons, UK, 2016.																			
3.	Montserrat Espíñeira, Francisco J. Santaclara., "Advances in Food Traceability Techniques and Technologies -Improving Quality Throughout the Food Chain", 1st Edition, Wood head Publishing, 2016.																			

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:				BT Mapped (Highest Level)
On completion of the course, the students will be able to				
CO1	outline the basic concepts of IoT			Understanding (K2)
CO2	utilizing python and other physical devices for IoT			Applying (K3)
CO3	apply the concept of IoT for management of agriculture and supply chain			Applying (K3)
CO4	make use of appropriate IoT concepts for rapid detection of food spoilage			Applying (K3)
CO5	utilize IoT methods to solve food traceability and food waste management problems			Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1		2
CO2	3	2	1		2
CO3	3	3	1	2	3
CO4	3	3	1	3	3
CO5	3	3	1	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		60	40				100
CAT3		60	40				100
ESE		60	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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**24MFE20- SENSORY EVALUATION OF FOODS**

Programme&Branch	M.Tech&Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites	NIL	3	PE	45	0	0	45	90	3
Preamble	This course aims to enrich the knowledge of planning and executing sensory evaluation programme.								
Unit- I	Introduction: Sensory evaluation – definition, Role of sensory evaluation in food industry, Sensory perception – vision, gustation, olfaction, touch, audition, multimodal perception. Factors affecting sensory measurements, Factors contributing to successful sensory evaluation. Requirements for sensory testing – Resources, Sample preparation and presentation, Assessors – screening and selection, training, motivation, advantages and disadvantages of internal and external panels.								
Unit- II	Planning a Sensory Project: Product type, Budget, Timings, Selecting the test method, Setting action standards, Experimental design – treatment structure, design structure, Measurement scales, Sensory data analysis – types of data, distribution, data handling, choosing appropriate statistical test.								
Unit- III	Discriminative Test Methods: Overall Difference tests- Triangle test, Duo-trio test, Difference from control test, Same and different test, 'A' 'not A' test. Attribute specific test - Paired comparison, Alternative forced choice, Ranking test. Similarity test - The power of the test, Proportion of true discriminators, Selecting the correct number of assessors.								
Unit- IV	Descriptive Tests and Affective Tests: Consensus profiling, Flavour Profiling, Texture Profiling, Quantitative Descriptive Analysis, Spectrum method, Free choice profiling, Flash profiling, Difference from control profiling, Temporal dominance of sensations. Questionnaire design, Qualitative methods - Focus groups, Preference tests, Acceptance tests, Attribute diagnostics. Linking consumer, sensory and product data. Advantages and disadvantages of test locations.								
Unit- V	Sensory applications in new product development and consumer research: Adoption and use of Flash Profiling in standardizing new product development, improving team tasting in the food industry, Alternative methods of sensory testing -working with chefs, culinary professionals and brew masters, Sensory testing with flavourists: challenges and solutions. Working with children, older people. Empathy and experiment – working with new population groups.								
REFERENCES:									
1.	SarahKemp, Tracey Hollowood, Joanne Hort., "Sensory Evaluation: A Practical Handbook", John Wiley & Sons, 2011.								
2.	Julien Delarue,J., Ben Lawlor, Michel Rogeaux, "Rapid Sensory Profiling Techniques: Applications in New Product Development and Consumer Research", 2 nd Edition, Elsevier Science, 2022.								
3.	Herbert Stone, Rebecca N. Bleibaum, Heather A.Thomas., "Sensory Evaluation Practices", 5th Edition, Academic Press, USA, 2020.								
4.	HarryT.Lawless and Hildegarde Heymann, "Sensory Evaluation of Food: Principle and Practices",2 nd Edition. Springer-Verlag New York, 2016.								

*includes Term Work(TW) & Online / Certification course hours



COURSEOUTCOMES:					BT Mapped (HighestLevel)
On completion of the course, the students will be able to					
CO1	interpret the concepts in sensory evaluation				Understanding (K2)
CO2	organize sensory evaluation session appropriate to the product				Applying(K3)
CO3	choose suitable discriminative test method for sensory evaluation				Applying(K3)
CO4	select suitable descriptive and affective tests for sensory evaluation				Applying(K3)
CO5	analyse the role of sensory evaluation in new product development and consumer research				Analyzing(K4)

Mapping of Cos with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	3	3	1	2	1
CO3	3	3	1		1
CO4	3	3	1		1
CO5	3	3	1	2	2

1–Slight,2–Moderate,3–Substantial,BT-Bloom's Taxonomy

ASSESSMENTPATTERN-THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total%
CAT1		75	25				100
CAT2		60	40				100
CAT3		65	20	15			100
ESE		45	35	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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Signature of the Chairman
Board of Studies - Technology

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24MFE21- ADVANCED MEAT PROCESSING TECHNOLOGY									
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites	NIL	3	PE	45	0	0	45	90	3
Preamble	This course imparts the knowledge about the advances in ensuring originality, processing, preservation and product development from meat and fish.								
Unit - I	Meat and Advances in meat quality assurance:								
Chemical composition and structure of meat. Scientific slaughter: Stunning techniques – mechanical & electrical. Pre-and post-slaughter operations. Factors affecting post-mortem changes. Advances in meat fraud detection. Gene technology for meat traceability and safety. Rapid identification of animal and meat quality. Drug residues in meat.									
Unit - II	Poultry Meat:								
Birds common to the live bird marketing system. Poultry birds - pre-slaughter care and dressing. Strategies for shelf life extension of poultry meat and its products. Co-products and by-products from poultry processing. Low fat, low salt poultry products. Problems and solutions in deboning of poultry meat. Poultry waste management – selecting the right approach.									
Unit - III	Egg:								
Commercially important eggs. Hen egg - structure, composition, chemical contaminants in eggs. Preharvest measures to improve the safety of eggs. Advances in egg defect detection and quality assessment. Traceability of eggs along the supply chain. Effects of processing on the allergenicity of egg proteins. Bioactive egg compounds - applications. Frozen egg products. Designer eggs.									
Unit - IV	Marine products processing:								
Edible products from the sea. Fish – types, on board fish processing and its advantages. Individual quick freezing. Retort pouch processing of fish. Quality chain management in fish processing. Food utilization of by-catch and underutilized species; Advances in fishery by-products technology - Production of fish protein concentrate, fish liver oil, fish sauce and insulin.									
Unit - V	Advances in Meat Products and Processing Operations:								
Accelerated conditioning technologies for meat. New approaches for development of functional meat products. Tailor designing of nitrite free meat products. Latest developments in meat bacterial starters. Probiotic meat products, Spreadable raw fermented sausage. Advances in the manufacture of sausage casings. Advances in bulk packaging for the transport of fresh fish. New sources of animal protein – cultured meat, edible insects.									

REFERENCES:

1. Alaa El-Din A, Bekhit., "Advances in Meat Processing Technology", 1st Edition, CRC Press, USA, 2017.
2. George M. Hall., "Fish Processing: Sustainability and New Opportunities", 1st Edition, Wiley Blackwell Publications, USA, 2010.
3. Enda J. Cummins, James G. Lyng., "Emerging Technologies in Meat Processing: Production, Processing and Technology", 1st Edition, Wiley Blackwell Publications, USA, 2016.
4. Patricia Hester., "Egg Innovations and Strategies for Improvements", 1st Edition, Academic Press, UK, 2016.

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:					BT Mapped (Highest Level)
On completion of the course, the students will be able to					
CO1	select suitable techniques for meat slaughter and meat quality evaluation				Applying (K3)
CO2	apply various methods to preserve poultry products and utilize poultry waste				Applying (K3)
CO3	identify the quality of eggs and develop beneficial egg products				Applying (K3)
CO4	select suitable method for utilization and preservation of marine products				Applying (K3)
CO5	make use of advance technologies in meat and fish processing				Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	3	2
CO2	3	2	1	3	2
CO3	3	2	1	3	2
CO4	3	2	1	3	2
CO5	3	2	1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		60	40				100
CAT3		60	40				100
ESE		60	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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Signature of the Chairman
Board of Studies - Technology

J. Mf





24MFE22- FOOD SUPPLY CHAIN MANAGEMENT										
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	3	PE	45	0	0	45	90	3	
Preamble	This course imparts knowledge in various components, future and challenges involved in food supply chain.									
Unit - I	Introduction to Food Supply Chain: Introduction to Food Supply Chain: Types of food chain, Decision Phases in Supply Chain, Food consumer and supply chain, International Food Supply Chains – factors affecting and challenges, Impact of Globalization on Supply Chain Networks, Food supply chain in India, Entities in the agriculture supply chain and case examples.									
Unit - II	Collaboration within Food Supply Chain: Current relationship models within food sector, Current practices in food supply chain, Perceived risk and product safety in food supply chains, Food packaging and supply chain management, Building blocks of Food Supply Chain Management, Designing food supply chains, Food inventory management, Future of Food Supply Chain Management.									
Unit - III	Operational Challenges: Food retail environment, Food routes to consumer, Impact of expanding consumer choice, Online grocery retailing, Future of food retailing – Challenges and case examples. Food logistics – packaging in logistics, temperature- controlled supply chains, case examples. Supply chain collaboration and relationship. Food Sourcing and Procurement: Sourcing models, Purchasing models, Supplier segmentation, Supplier development, Strategic sourcing, Sustainable procurement.									
Unit - IV	Development in Food Supply Chains and Risk Management: Traceability - legislations and standards, Use of traceability technology in food supply chains, Design of Traceability systems, Product development in food supply chains, Innovations within food supply chains, Risk management and uncertainty, Risks in food supply chain, Managing risks in food supply chains.									
Unit - V	Sustainability Challenges in Food Supply Chains: Sustainable food supply chains, measuring sustainability within food supply chains, Developing sustainability within food supply chains – case examples, Food hubs, Information Technology in food supply chain, Carbon Footprint of food supply chains, Quality Management Schemes in food supply chain.									

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:					BT Mapped (Highest Level)
On completion of the course, the students will be able to					
CO1	explain the various food supply chain models in India and in global perspective				Understanding (K2)
CO2	make use of collaborative approach to balance supply-side inventory to consumer demand				Applying (K3)
CO3	outline the operational challenges in food retailing, logistics, sourcing and procurement				Understanding (K2)
CO4	utilize the concepts of traceability, innovation and risk management in food supply chain				Applying (K3)
CO5	develop sustainability performance in different stages of supply chain				Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	1	2
CO2	3	3	1	3	2
CO3	3	3	1	2	2
CO4	3	3	1	3	2
CO5	3	3	1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		60	40				100
CAT3		60	40				100
ESE		60	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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Signature of the Chairman
1 st year of Studies - <i>Technology</i>





24MFE23- SCALE UP METHODS IN PROCESS ENGINEERING																				
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit											
Prerequisites	NIL	3	PE	45	0	0	45	90	3											
Preamble	This course covers similarity criterion, pilot plant models and dimensional analysis for scaling up of process.																			
Unit - I	Food Product Scale- Up and Principles of Similarity, Pilot Plants and Models:																			
Need and challenges - Scale -up of formulations - Product and package information matrix- Batch versus continuous processing - Product transfers and facility scale- up. Introduction to scale-up methods, pilot and models and principles of similarity																				
Unit - II	Dimensional Analysis and Scale-Up Criterion:																			
Dimensional analysis, regime concept: static, dynamic and mixed regime concepts. Similarity criterion and scale- up methods used in process Engineering.																				
Unit - III	Scale-Up of Mixing and Heat Transfer Equipment:																			
Typical problems in scale-up of mixers, Scaling up of Heat Exchangers and Evaporators.																				
Unit - IV	Scale-Up of Mass Transfer Equipments:																			
Scale-up of distillation columns and packed towers for continuous and batch processes. Scale-up of crystallizers																				
Unit - V	Scale - up of other Selected Processes:																			
Supercritical Fluid Extraction - Screw Extruders - Spray dryers - Ball Mill - Furnaces and Kilns . Limitations of scale- up techniques.																				
REFERENCES:																				
1.	Marko Zlokarnik., "Scale-Up in Chemical Engineering", 2nd Edition, Wiley-VCH-Verlag, Germany, 2006.																			
2.	Kenneth J. Valantash, J. Peter Clark, Leon Levin., "Food Processing Operations and Scale-up", 1st Edition, MarcelDekker Inc, USA, 1990.																			
3.	Donald G. Jordan., "Chemical Process Development" (Part 1 and 2), 1st Edition, R.E.Krieger Pub. Co., USA 1988.																			

*includes Term Work(TW) & Online / Certification course hours





COURSE OUTCOMES:			BT Mapped (Highest Level)
On completion of the course, the students will be able to			
CO1	Illustrate the importance and aspects of food product scale -up		Understanding (K2)
CO2	utilize fundamentals of similarity criterion and dimensional analysis in process engineering		Applying (K3)
CO3	explain scale up methods for Process Engineering		Understanding (K2)
CO4	apply acquired knowledge in scale-up to mixing, heat & mass transfer equipment.		Applying (K3)
CO5	Make use of scaling up of miscellaneous process equipment.		Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1		1
CO2	3	3	1		1
CO3	3	3	1		1
CO4	3	3	1		1
CO5	3	3	1		1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		60	40				100
CAT3		60	40				100
ESE		60	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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Signature of the Chairman
Board of Studies - Technology





24MFE24- DESIGN AND ANALYSIS OF EXPERIMENTS										
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	3	PE	45	0	0	45	90	3	
Preamble	This course highlights different techniques for designing and optimizing experimental data.									
Unit - I	Introduction to Experimental Design: Introduction – Principles and applications of Design of Experiments, Design of a process and product, Guidelines for designing experiments, Using statistical techniques for experimentation, Case studies.									
Unit - II	Statistical Analysis: Sampling and Sampling Distributions, Inferences on Randomized and paired comparison designs, Analysis of Variances, Regression Analysis – Linear, Multiple regressions, Testing for lack of fit.									
Unit - III	Randomized Complete Block Design: Framing RCBD experiments, Latin Square Design, Graeco-Latin Square Design, Central Composite Design, Box Behnken Design, Balanced Incomplete Block Design, Model adequacy checking, Least Square estimation, regression, Contour profile of response surface plot, Case Studies.									
Unit - IV	Factorial Design: Principles and Merits of Factorial design, Analysis of two factorial experiments, Analysis of two level Fractional factorial experiments, Three level Factorial experiments, Introduction to mixed and non regular factorial designs, Case Studies.									
Unit - V	Software Tools and their Applications in data processing: Introduction to RSM, Steepest Ascent method, Analysis of Second order response surface, Designs for Fitting Response surfaces, Mixture experiments. Curve fitting tools -OriginPro, Spread sheet, Matlab. Statistical analysis of data – Design Expert and Minitab.									
REFERENCES:										
1.	Douglas C. Montgomery., "Design and Analysis of Experiments", 8th Edition, Wiley, USA, 2017.									
2.	Hoshmand A.R., "Design of Experiments for Agriculture and the Natural Sciences", 2nd Edition, CRC Press, USA, 2018.									
3.	Castillo E.D., "Process Optimization – A Statistical Approach", 2nd Edition, Springer Science Business Media, USA, 2007.									
4.	Angela Dean , Daniel Voss., "Design and Analysis of Experiments", 1st Edition, Springer, USA, 2013.									

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:			BT Mapped (Highest Level)
On completion of the course, the students will be able to			
CO1	apply the basic principles and strategies of experimental design to real time experimental data		Applying (K3)
CO2	apply fundamental concepts of statistics for testing a hypothesis		Applying (K3)
CO3	analyze randomized complete block experiments		Analyzing (K4)
CO4	analyze factorial experiments for deriving conclusions		Analyzing (K4)
CO5	perform response surface analysis using software tools and interpret the results		Evaluating (K5)

Mapping of COs with POs

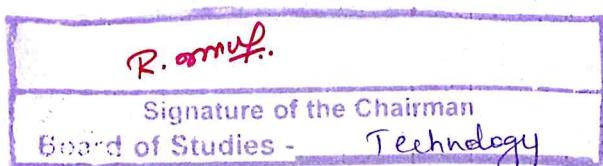
COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1		1
CO2	3	3	1		1
CO3	3	3	1		1
CO4	3	3	1		1
CO5	3	3	1		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		40	40	20			100
CAT3		40	40	20			100
ESE		40	40	10	10		100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)



J. Mavur



24MFE25- PLANTATION CROPS AND SPICES TECHNOLOGY										
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit	
Prerequisites	NIL	3	PE	45	0	0	45	90	3	
Preamble	This course imparts knowledge on processing of plantation crops, spices and herbs.									
Unit - I	Plantation Crops: Types of Plantation crops. Recent trends and innovation in cocoa, coconut, cashew and tuber crops processing. Tea: Manufacturing of diversified tea products – instant tea, functional and herbal tea products. Coffee: Chemistry, Recent Trends in coffee technology, Quality grading of coffee, Chicory chemistry.									
Unit - II	Spices & Condiments: Classification of spices. Functions of spices. Nutritive value of spices and their health benefits. Different forms of spices based on application – fresh, dried, volatile oils, oleoresins, paste, and other extractives. Commercial spice blends and seasonings formulations. Emerging and popular global spice blends. Growing demand for authenticity.									
Unit - III	Advances in spice processing: Spice oil - advances in SCFE, novel solvent free extraction methods using microwave, ultrasound. Cryogenic grinding of spices. Extraction of oleoresins, concepts and technology, desolvantization methods, regulatory and statutory requirements for oleoresin processing. Spice encapsulation. Recent spice research- antioxidants, antimicrobial and health benefits of spice compounds.									
Unit - IV	Herbal spices: Description of various types of herbs - Basil, Cilantro, Dill, Coriander, Mint, Oregano, Borage, Thyme, Parsley, Curry leaves, bilva leaves, Bay leaves, Safflower, Rosemary, Lavender. Processing and post - harvest handling. Functional properties. Quality issues. Recent trends, health benefits and innovations of herbs in food Industry.									
Unit - V	Flavoring Materials Recent advances and trends: Natural flavors, sources of natural flavoring materials – herbs and spices, Genetic engineering in flavour, Flavours generated by enzymes and biological systems, Key aroma and taste components, Flavour stability during food processing and storage, Retention and release of flavours.									
REFERENCES:										
1.	Peter K.V., "Handbook of Herbs and Spices", 2nd Edition, Wood head Publishing, UK, 2012.									
2.	P.S. Ahuja, A. Gulati, R.D. Singh, R.K. Sud, R.C. Boruah., "Science of Tea Technology", 1st Edition, Scientific Publishers, India, 2013.									
3.	AmitBaran Sharangi, Suchand Datta., "Value Addition of Horticultural Crops: Recent Trends and Future Directions", 1st edition, Springer, India, 2015.									

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the recent trends in plantation crops.	Understanding (K2)
CO2	utilize functional properties of spices and condiments in product development	Applying (K3)
CO3	select extraction methods required for spices processing	Applying (K3)
CO4	outline different herbs and their processing	Understanding (K2)
CO5	identify the advances in processing of flavour materials	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	1	2
CO2	3	2	1	1	2
CO3	3	2	1	2	2
CO4	3	2	1	2	2
CO5	3	2	1	1	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		60	40				100
CAT3		60	40				100
ESE		60	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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 Signature of the Chairman	
Board of Studies -	Technology





24MFE26- ADVANCED DAIRY TECHNOLOGY																				
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit											
Prerequisites	NIL	3	PE	45	0	0	45	90	3											
Preamble	This course aims to provide technological advances in processing of milk and milk products.																			
Unit - I	Milk Constituents and Its Properties:																			
Constituents of milk, Factors affecting milk composition, Properties of milk - Thermal, Optical, Electrical and Rheological properties, Refractive Index, Effects of high-pressure treatment on constituents and properties of milk, Bioactive compounds from milk, Advances in Fractionation and Analysis of Milk.																				
Unit - II	Heat-induced Changes and Biotech Approaches in Dairy Products:																			
Chemical and physical changes in Ultra High Temperature treatment, Heat-induced reactions in milk – surface reactions, bulk reactions. Genetically Modified Cheese, Recent Biotechnological Approaches in Dairy and Food Industry, Bio-Functional Whey Based Beverages, Production and enrichment of bioactive peptides derived from milk proteins, Applications of membrane bioreactors and fermenters in dairy industry																				
Unit - III	Advanced Dairy Processing:																			
Microwave processing, High Pressure processing, Pulsed Electric Field processing, Ultrasound processing, Ultraviolet and Pulsed Light Processing, Advanced heating processes - Extended Shelf Life (ESL), Innovative Steam Injection (ISI), Modern approaches to lactose production.																				
Unit - IV	Dairy Products Manufacture:																			
Liquid infant formulae, Anhydrous Milk Fat, Frozen cream, Dried cream, Processed Cheese, Dairy protein products, Blends and blended spreads – production and quality aspects, Glycosylated whey proteins, Milk imitations, Fermented whey, Indirect Biological Acidification process, manufacturing process for cholesterol reduction. Casein and its derivatives.																				
Unit - V	Operational Constraints and Automation in Dairy Industry:																			
Fouling - types, mechanisms, factors affecting fouling, Biofilm - formation, detection, control. Automation at enterprise level - Enterprise Resource Planning - Factors contributing to automation, Stages in automation in dairy.																				
REFERENCES:																				
1.	Spreer E., "Milk and Dairy Product Technology", 1 st Edition, Routledge, UK, 2017.																			
2.	Nurcan Koca., "Technological Approaches for Novel Applications in Dairy Processing", 1 st Edition, In-Tech Open, UK, 2018.																			
3.	Datta N., Tomasula P.M., "Emerging Dairy Processing Technologies: Opportunities for the Dairy Industry", 1 st Edition, John Wiley & Sons, US, 2015.																			
4.	Burton H., "Ultra-High-Temperature Processing of Milk and Milk Products", 1 st Edition, Springer Science & Business Media, New York, 2012.																			

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:				BT Mapped (Highest Level)
On completion of the course, the students will be able to				
CO1	outline milk composition using advanced techniques to optimize product quality.			
CO2	make use of advanced techniques to modify milk properties and enhance product functionality.			
CO3	demonstrate the use of automation and advanced processing to optimize efficiency and ensure product safety.			
CO4	make use of advances in Technology for manufacturing dairy products			
CO5	interpret fouling process and automation in dairy industry			

Mapping of COs with POs

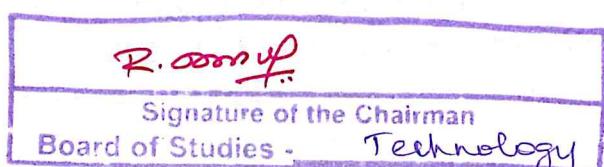
COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	1	1
CO2	3	3	1	2	2
CO3	3	3	1	1	2
CO4	3	3	1	1	2
CO5	3	3	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		60	40				100
CAT3		60	40				100
ESE		60	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)





24MFE27- COMPUTATIONAL FLUID DYNAMICS																				
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit											
Prerequisites	NIL	3	PE	45	0	0	45	90	3											
Preamble	This course deals with the fundamental concepts of CFD applicable for engineering design, simulation and performance analysis.																			
Unit - I	Conservation Laws of Fluid Motion and Boundary Conditions:																			
Introduction to CFD, Governing equations of fluid flow and heat transfer, equations of state, Navier-Stokes equations for Newtonian fluid, conservative form of governing equations of flow, differential and integral forms of general transport equations, classification of physical behaviour, Auxillary conditions for viscous fluid flow equations.																				
Unit - II	Finite Volume Method for Diffusion and Convective- Diffusion Problems:																			
Finite volume method for one-dimensional, two-dimensional and three-dimensional steady state diffusion, steady one-dimensional convection and diffusion, the central differencing scheme. Properties of discretization schemes, assessment of the central differencing scheme for convection-diffusion problems, the upwind differencing scheme, thehybrid differencing scheme, the power-law scheme, higher order differencing schemes for convection-diffusion problems – QUICK scheme.																				
Unit - III	Solution Algorithms for Pressure-Velocity Coupling in Steady Flows:																			
Staggered grid, momentum equations, SIMPLE algorithm, assembly of a complete method, SIMPLER, SIMPLEC, and PISO algorithms; Solution of discretised equations: tri-diagonal matrix algorithm, application of TDMA to two- dimensional and three-dimensional problems.																				
Unit - IV	Finite Volume Method for Unsteady Flows:																			
One-dimensional unsteady state heat conduction, implicit method for two-and three-dimensional problems, discretisation of transient convection-diffusion equation, transient convection-diffusion using QUICK differencing scheme, solution procedures for unsteady flow calculations, steady state calculations using pseudo-transient approach.																				
Unit - V	Turbulence and its Modeling																			
Transition from laminar to turbulent flow, effect of turbulence on properties of the mean flow, Reynolds-averaged Navier-Stokes equations and classical turbulence models, mixing length model, k- ϵ model, Reynolds Stress equation models and Advanced turbulence models, Large eddy simulation.																				
REFERENCES:																				
1. Versteeg H.K., Malalasekara W., "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", 2nd Edition, Pearson Education Ltd., 2007. 2. Anderson John D., "Computational Fluid Dynamics - The Basics with Applications", 1st Edition, Tata-McGraw Hill Publisher, 2012. 3. H. Lomax T. H. Pulliam D. W. Zingg., "Fundamentals of Computational Fluid Dynamics", 1st Edition, Springer,2001.																				

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:		BT Mapped (Highest Level)
On completion of the course, the students will be able to		
CO1	apply the laws governing CFD techniques in developing fluid flow models	Applying (K3)
CO2	make use of finite volume method for developing solution for diffusion problems	Applying (K3)
CO3	analyze the problems using different algorithms	Analyzing (K4)
CO4	apply the finite volume method in solving unsteady processes	Applying (K3)
CO5	analyze and apply turbulence models	Analyzing (K4)

Mapping of COs with POs

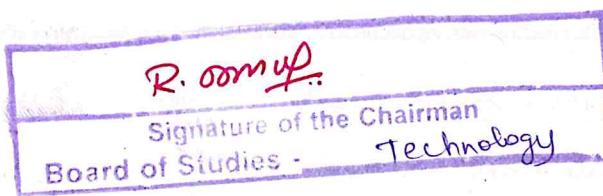
COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1		1
CO2	3	3	1		1
CO3	3	3	1		1
CO4	3	3	1		1
CO5	3	3	1		1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		40	60				100
CAT2		20	50	30			100
CAT3		20	50	30			100
ESE		30	50	20			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)



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24MFE28- INDUSTRIAL PROCESS AUTOMATION																				
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit											
Prerequisites	NIL	3	PE	45	0	0	45	90	3											
Preamble	The subject imparts knowledge on data acquisition, data analysis, modeling and computer based automation in process industries.																			
Unit - I	Introduction																			
Food quality, automated evaluation of food quality, food quality quantization and process control, problems associated in food quality evaluation and need for process automation.																				
Unit - II	Data acquisition:																			
Sampling, concepts and systems for data acquisition: Ultrasonic A mode, electronic nose, data acquisition for food quality process control, Image acquisition: Ultrasonic B mode, Elastography.																				
Unit - III	Data analysis and Modeling :																			
Data pre-processing, Static data analysis, Dynamic data analysis, Image processing: Image segmentation, Image feature extraction. Modeling strategies: Theoretical and empirical modeling, Static and dynamic modeling, Linear statistical modeling, ANN modelling.																				
Unit - IV	Computer based controls																			
Computer based measurement and control system- role, basic components, architecture- Human machine Interface, Hardware for computer based process control system, Interface computer system with process, Industrial Applications.																				
Unit - V	Automation in Food Processing																			
General considerations, Packaging, palletizing, and mixed pallet automation, raw product handling and assembly, Decorative product finishing, integrated automation.																				
REFERENCES:																				
1.	Nof, Y.S., "Handbook of Automation", 1st Edition, Springer Publications, New York, 2009.																			
2.	Huang, Y., Whittaker, A.D., Lacey, R.E., "Automation for food engineering- Food Quality Quantization and Process Control" 1st Edition, CRC press, Florida, 2001.																			
3.	Mittal, G.S., "Computerized control systems in food industry", 1st Edition, Marcel Dekker Inc, New York, USA, 1996.																			

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:			BT Mapped (Highest Level)
On completion of the course, the students will be able to			
CO1	infer the role of automation in quality food processing		Understanding (K2)
CO2	make use of data acquisition in process automation		Applying(K3)
CO3	interpret the data analysis and modeling in automation		Evaluating (K5)
CO4	summarize the concept of computer-based control in automation		Understanding (K2)
CO5	Make use of automation concepts in selected food processing operations.		Applying(K3)

Mapping of COs with POs

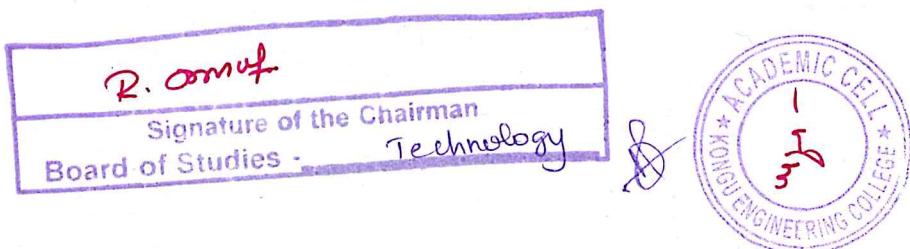
COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	1	1
CO2	3	3	1		2
CO3	3	3	1		2
CO4	3	3	1		2
CO5	3	3	1		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		40	40	10	10		100
CAT3		60	40				100
ESE		40	30	10	10		100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)





24MFE29- PROJECT ENGINEERING AND MANAGEMENT																				
Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit											
Prerequisites	NIL	3	PE	45	0	0	45	90	3											
Preamble	This course will provide knowledge on management principles followed in process industries.																			
Unit - I	Principles of Management and Legal aspects of business enterprise:																			
Management and its function: Planning, organizing, coordination and control, Human relations and performance in organization, Human and cultural variables in global organizations. Industrial relations and disputes. Importance and necessity of industrial legislation, Export – Import regulations. Labour laws, Social welfare legal measurements, Factory Act.																				
Unit - II	Project identification and process planning:																			
Project definition, Project profile and standards, Feedback information (MIS), Evaluation and Modification, Selection, Criteria. Planning the process, Strategic and Managerial Planning, Organizing the process planning.																				
Unit - III	Project Engineering:																			
Economic Balancing, Network Planning, Methods (PERT/CPM), Engineering Flow Diagrams, Cost requirements, Analysis and Estimation of Process Feasibilities (Technical/Economical) Analysis, Application of reliability theory.																				
Unit - IV	Plant Engineering management:																			
Objectives, Programme Control, Plant Location and Site Selection, Layout diagrams, Selection and procurement of equipment and machineries, Installation, Commissioning and Recommissioning, performance appraisal, Strategies choice and Influence, Product planning and development, Provision and maintenance of service facilities.																				
Unit - V	Financial management, Marketing and Sales:																			
Finance: Important, ledger, Journal, Profit and Loss Account, Balance Sheet, Interpretation of Statements, Ration Analysis, Project financing, Project appraisal, return on investments. New Issues in Marketing: Globalization and its impact, Consumerization, Green Marketing and Event Marketing-Sellers and Buyers markets, monopoly, oligopoly, perfect competition, Cost - Elements of Cost, Contribution, Break even analysis, Capital Budgeting, Pricing Policies.																				
REFERENCES:																				
1.	Bangla, T.R., Agarwal, N.K., Sharma, S.C., "Industrial Engineering and Management Science", 5th Edition, Khanna Publishers, New Delhi 2007.																			
2.	Bagad, V.S., "Industrial Management", 1st edition, Technical Publications, Pune, 2014.																			
3.	Clements, J. P., Gido.J., "Effective Project Management", 5th edition, South Western Cengage Learning press, USA, 2012.																			
4.	Peters, M.S. and Timmerhaus, K.D., "Plant design and economics for chemical engineers, 5th edition, McGrawHill Education", USA, 2017.																			

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES: On completion of the course, the students will be able to				BT Mapped (Highest Level)
CO1	summarize the functions of management related to industrial organization and the legal aspects of business enterprises			Understanding (K2)
CO2	identify the projects and meticulously plan the process			Applying (K3)
CO3	explain the significance of various models relevant to project engineering			Understanding (K2)
CO4	outline the importance of project engineering and management			Understanding (K2)
CO5	utilize the knowledge of finance, marketing and sales			Applying (K3)

Mapping of COs with POs

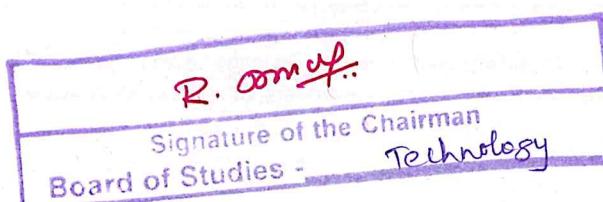
COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	2	1	1	2	1
CO2	3	1	1		1
CO3	2	2	1		1
CO4	3	1	1	1	1
CO5	2	1	1		1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		60	40				100
CAT2		60	40				100
CAT3		60	40				100
ESE		60	40				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)



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24GET13 - INNOVATION, ENTREPRENEURSHIP AND VENTURE DEVELOPMENT																	
(Common to ME/MTech and MCA Programmes)																	
Programme & Branch	All ME/MTech and MCA Programmes	Sem.	Category	L	T	P	SL*	Total	Credit								
Prerequisites	Nil	1/3	PE	45	0	0	45	90	3								
Preamble	This course will direct the students on how to employ their innovations towards a successful entrepreneurial venture development.																
Unit – I	Innovation, Entrepreneurship and Design Thinking:								9								
Creativity and Innovation – Types of innovation – challenges in innovation- steps in innovation management- Meaning and concept of entrepreneurship - Role of Entrepreneurship in Economic Development - Factors affecting Entrepreneurship – Entrepreneurship vs Intrapreneurship. Design Thinking and Entrepreneurship – Design Thinking Stages: Empathize – Define – Ideate – Prototype – Test. Design thinking tools: Analogies – Brainstorming – Mind mapping.																	
Unit – II	Product Design:								9								
Techniques and tools for concept generation, concept evaluation – Product architecture –Minimum Viable Product (MVP)- Product prototyping – tools and techniques– overview of processes and materials – evaluation tools and techniques for user-product interaction.																	
Unit – III	Business Model Canvas (BMC) and Business Plan Preparation:								9								
Lean Canvas and BMC - difference and building blocks- BMC: Patterns – Design – Strategy – Process–Business model failures: Reasons and remedies. Objectives of a Business Plan - Business Planning Process and Preparation.																	
Unit – IV	IPR and Commercialization:								9								
Need for Intellectual Property- Basic concepts - Different Types of IPs: Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design– Patent Licensing - Technology Commercialization – Innovation Marketing.																	
Unit – V	Venture Planning and Means of Finance:								9								
Startup Stages - Forms of Business Ownership - Sources of Finance – Idea Grant – Seed Fund – Angel & Venture Fund – Institutional Support to Entrepreneurs – Bank and Institutional Finance to Entrepreneurs.																	
REFERENCES:																	
1.	E. Gordon & K. Natarajan., "Entrepreneurship Development", 6 th Edition, Himalaya Publishing House, Mumbai, 2017.																
2.	Sangeeta Sharma, "Entrepreneurship Development", 1 st Edition, PHI Learning Pvt. Ltd., New Delhi, 2017.																
3.	Charantimath Poornima M., "Entrepreneurship Development and Small Business Enterprises", 3 rd Edition, Pearson Education, Noida, 2018.																
4.	Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, "Entrepreneurship", 10 th Edition, McGraw Hill, Noida, 2018.																

*includes Term Work(TW) & Online / Certification course hours



COURSE OUTCOMES:											BT Mapped (Highest Level)	
On completion of the course, the students will be able to												
CO1	understand the relationship between innovation and entrepreneurship											Understanding (K2)
CO2	understand and employ design thinking process during product design and development											Analyzing (K4)
CO3	develop suitable business models as per the requirement of the customers											Analyzing (K4)
CO4	practice the procedures for protection of their ideas IPR											Applying (K3)
CO5	understand and plan for suitable type of venture and modes of finances											Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1				3	2	1	3	2	1	1	
CO2	1	2			3	2	1					1	
CO3	3	1	3			1						1	
CO4	1	2				3						1	
CO5	1	2				3						1	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		80	20				100
CAT2		50	50				100
CAT3		80	20				100
ESE		70	30				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

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Signature of the Chairman
Board of Studies - Technology





24MFP31 – PROJECT WORK - I

Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites	NIL	3	PC	0	0	240	0	240	8

COURSE OUTCOMES:

On completion of the course, the students will be able to

BT Mapped
(Highest Level)

CO1	identify and define the problems that need to be solved	Applying (K3)
CO2	select appropriate literature and frame the objectives	Applying (K3)
CO3	develop/ design value added food products and equipments using research tools and methods	Creating (K6)
CO4	analyze the experimental data and derive the valid conclusion	Analyzing (K4)
CO5	elaborate the project in the form of oral presentation, report and technical paper publications	Creating (K6)

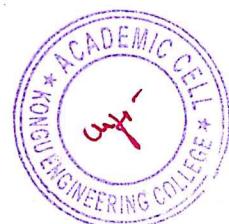
Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	1
CO2	3	1	2	1	3
CO3	3	3	3	3	3
CO4	3	3	1	3	3
CO5	3	2	1	1	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

*includes Term Work(TW) & Online / Certification course hours

<i>R. Omur..</i>
Signature of the Chairman
Board of Studies - Technology





24MFP41 – PROJECT WORK - II

Programme & Branch	M.Tech & Food Technology	Sem.	Category	L	T	P	SL*	Total	Credit
Prerequisites	NIL	4	PC	0	0	360	0	360	12

COURSE OUTCOMES: On completion of the course, the students will be able to			BT Mapped (Highest Level)
CO1	identify and define the problems that need to be solved		Applying (K3)
CO2	select appropriate literature and frame the objectives		Applying (K3)
CO3	develop/ design value added food products and equipments using research tools and methods		Creating (K6)
CO4	analyze the experimental data and derive the valid conclusion		Analyzing (K4)
CO5	elaborate the project in the form of oral presentation, report and technical paper publications		Creating (K6)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	1
CO2	3	1	2	1	3
CO3	3	3	3	3	3
CO4	3	3	1	3	3
CO5	3	2	1	1	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

*includes Term Work(TW) & Online / Certification course hours

