



Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University under Category 'A' by MHRD, Estd. u/s 3 of UGC Act 1956)
Re-accredited with 'A+' Grade by NAAC. Recognised by UGC under Section 12 B
Coimbatore - 641 043, Tamil Nadu, India
School of Engineering

M.E.FOOD TECHNOLOGY
Scheme of Instruction & Examination
(For students admitted during 2021 - 22 and onwards)

PSO1: The Postgraduates will attain the skills of using knowledge in food processing for developing of innovative processes & products and designing of equipment using novel technologies.

Part	Course Code	Name of Course /Component	Hours of Instruction/week		Scheme of Examination						
			T	P	Duration of exam	CIA		CE		Total	Credit
						T	P	T	P		
First Semester											
I	Core Courses (CC)										
	21MEFC01	Operations Research	4	-	3	40	-	60	-	100	4
	21MEFC02	Unit Operations for Food Industries	3	-	3	40	-	60	-	100	3
	21MEFC03	Food Engineering Practicals	-	3	3	-	40	-	60	100	1.5
	21MEFC04	Food Packaging Practicals	-	3	3	-	40	-	60	100	1.5
	21MEFC05	Research Methodology and IPR	3	-	3	40	-	60	-	100	3
	Program Electives (PE)										
	21MEFE11/ 21MEFE12/ 21MEFE13	Program Elective-I	3	-	3	40	-	60	-	100	3
	21MEFE21/ 21MEFE22/ 21MEFE23	Program Elective-II	3	-	3	40	-	60	-	100	3
II	Non Credit Mandatory Courses (NCMC)										
	Audit Course (AC)										
	21MEMA11/ 21MEMA12/ 21MEMA13	Audit Course-I	3	-	2	100	-	-	-	100	Remark
	Extracurricular Course (ECC)										
		CSS	2		-						-
Program Elective I:	21MEFE11 Drying Technology/ 21MEFE12 Food Preservation Technology/ 21MEFE13 Storage Engineering										
Program Elective II:	21MEFE21 Advances in Food Packaging / 21MEFE22 Non Thermal Processing Techniques in Foods/ 21MEFE23 Advanced Food Chemistry and Microbiology										

Second Semester											
Part	Course Code	Name of Course /Component	Hours of Instruction/week		Scheme of Examination						
			T	P	Duration of exam	CIA		CE		Total	Credit
						T	P	T	P		
I	Core Courses (CC)										
	21MEFC06	Fruits and Vegetables Processing Technology	3	-	3	40	-	60	-	100	3
	21MEFC07	Milling, Baking and Confectionery Technology	3	-	3	40	-	60	-	100	3
	21MEFC08	Food Processing and Preservation Practicals	-	3	3	-	40	-	60	100	1.5
	21MEFC09	Food Analysis Practicals	-	3	3	-	40	-	60	100	1.5
	21MEFC10	Mini Project with Seminar	-	0/2	-	-	100	-	-	100	1
	Professional Certification Course (PCC)										
	21MEFP01	Professional Certification Course	-	-	-	100	-	-	-	100	2
	Program Electives (PE)										
	21MEFE31/ 21MEFE32/ 21MEFE33	Program Elective-III	3	-	3	40	-	60	-	100	3
	21MEFE41/ 21MEFE42/ 21MEFE43	Program Elective-IV	3	-	3	40	-	60	-	100	3
II	Non Credit Mandatory Courses (NCMC)										
	Audit Course (AC)										
	21MEMA21/ 21MEMA22	Audit Course-II	3	-	2	100	-	-	-	100	Remark
	Extracurricular Course (ECC)										
	21MECS01	CSS	2	-	2	50	50	-	-	100	Remark
	Internship during summer vacation for one month										
	Program Elective III:	21MEFE31 Milk and Milk Products Technology / 21MEFE32 Flavours, spices and plantation products 21MEFE33 Technology of Frozen Foods									
	Program Elective IV:	21MEFE41 Instrumental Techniques in Food Analysis/ 21MEFE42 Food Waste Management and By-Products Utilization/21MEFE43 IoT and Sensors for Food Technology									
Third Semester											
Part	Course Code	Name of Course /Component	Hours of Instruction/week		Scheme of Examination						
			T	P	Duration of exam	CIA		CE		Total	Credit
						T	P	T	P		
I	Core Courses (CC)										
	21MEFC11	Research Project Phase-I	-	20	-	-	100	-	-	100	10
	21MEFC12	Internship	-	-	-	100	-	-	-	100	1
I	Program Electives (PE)										
	21MEFE51/ 21MEFE52/ 21MEFE53	Program Elective-V	3	-	3	40	-	60	-	100	3
I	Open Electives (OE)										
	21MEMO01/ 21MEMO02/ 21MEMO03	Open Elective	3	-	3	40	-	60	-	100	3
	Program Elective V:	21MEFE51 Safety Standards and Quality Auditing /21MEFE52 Food Process Design and Layout/ 21MEFE53 Advances in Meat, Fish and Poultry Technology									
	Open Electives :	21MEBO01 Quality Assurance and Safety in Hospitals/21MEEO01 Web Mining/21MELO01 Waste to Energy									

Fourth Semester											
Part	Course Code	Name of Course /Component	Hours of Instruction/week		Scheme of Examination						
			T	P	Duration of exam	CIA		CE		Total	Credit
I											
Core Courses (CC)											
	21MEFC13	Research Project Phase-II	-	32	-	-	200	-	200	400	16
										Total	70
MOOC											
			-	-	-	-	-	-	-	-	2 to 4

Requirements to earn the Degree:

- Total credits required to earned in Part I Component: 70**
- Minimum of 2 credits to be earned in MOOC courses during 1st to 3rd semester from SWAYAM-NPTEL.**
- Successful completion of Part II Non-Credit Mandatory Courses (NMC).**

List of Program Electives (PE)

S.No	Course Code	Course Title
1.	21MEFE11	Drying Technology
2.	21MEFE12	Food Preservation Technology
3.	21MEFE13	Storage Engineering
4.	21MEFE21	Advances in Food Packaging
5.	21MEFE22	Non Thermal Processing Techniques in Foods
6.	21MEFE23	Advanced Food Chemistry and Microbiology
7.	21MEFE31	Milk and Milk Products Technology
8.	21MEFE32	Flavour, Spices and Plantation Products
9.	21MEFE33	Technology of Frozen Foods
10.	21MEFE41	Instrumental Techniques in Food Analysis
11.	21MEFE42	Food Waste Management and By-Products Utilization
12.	21MEFE43	IoT and Sensors for Food Technology
13.	21MEFE51	Safety Standards and Quality Auditing
14.	21MEFE52	Food Process Design and Layout
15.	21MEFE53	Advances in Meat, Fish and Poultry Technology

Open Electives (OE)

S.No	Course Code	Course Title
1.	21MEFO01	Industrial safety and GMP in Food Industries

List of Audit Courses (Non-Credit Mandatory Course)

S. No	Course Code	Audit Course - I
1.	21MEMA11	English for Research Paper Writing
2.	21MEMA12	Disaster Management
3.	21MEMA13	Research and Publication Ethics

S. No	Course Code	Audit Course - II
1.	21MEMA21	Pedagogy Studies
2.	21MEMA22	Value Education

Operations Research

Semester I
21MEFC01

Hours of Instruction/week: 4T
No. of credits: 4

Objective:

CLO1: To study the mathematical modelling of real life situations, getting their solutions, transportation, sequencing and replacement models and simulation techniques

Unit I- Linear Programming Problem (LPP)

12

Formulation – graphical solution – simplex Method – duality – Big – M method - two – phase simplex method – transportation problem – North – west corner rule – least cost method – Vogel’s approximation method – MODI method – Assignment problem – Hungarian method.

Unit II- Sequencing problems

12

Problem of two jobs and n machines- problem of three jobs and n machines- problem of n jobs and m machines-graphical solution.

Unit III- Inventory control

12

Economic lot size problems - problem of EOQ with shortage - selective control techniques-inventory control with price breaks.

Unit IV- Replacement problems

12

Introduction-replacement of items that deteriorate with time- replacement of items that completely fails- other replacement problems.

Unit V- Simulation

12

Introduction – Advantages of simulation techniques – Limitations of simulation techniques –Monte-Carlo simulation – General problems – Applications – Queuing problems – Maintenance problems – Inventory problems.

Total: 60 Hours

Reference Books

1. Handy A.Taha, Operations Research (Seventh edition) Prentice Hall of India (P) Ltd., New Delhi, 2005.
2. KantiSwarup, P.K.Gupta, Man Mohan, Operations Research, Sultan Chand and sons Educational Publishers, New Delhi, 2005.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Improve skills in linear transformations and its application and gain knowledge in application of inner product spaces

CO2: Apply various optimization techniques like classical, Linear and simplex algorithm

CO3: Formulate constrained and unconstrained optimization techniques for solving and optimizing problems in real world situations

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	(PSOs)	
CO1	H			M									1	2
CO2		H		H							M		M	
CO3	H													

Unit Operations for Food Industries

Semester I
21MEFC02

Hours of Instruction/week: 3T
No. of credits: 3

Objective:

CLO1: To gain knowledge in various unit operations and machineries involved in the food processing industry.

Unit I-Evaporation and Concentration

9

Unit operations in food processing –conservation of mass and energy –overall view of an engineering process-dimensions and units –dimensional and unit consistency –dimensionless ratios- evaporation –definition –liquid characteristics –single and multiple effect evaporation-performance of evaporators and boiling point elevation –capacity –economy and heat balance-types of evaporators –once through and circulation evaporators –short tube evaporators and long tube evaporators –agitated film evaporator.

Unit II- Mechanical Separation

9

Filtration –definition –filter media–types and requirements-constant rate filtration –constant pressure filtration –filter cake resistance-filtration equipment –rotary vacuum filter –filter press-sedimentation –gravitational sedimentation of particles in a fluid –Stoke’s law, sedimentation of particles in gas-cyclones –settling under sedimentation and gravitational sedimentation-centrifugal separations –rate of separations –liquid –liquid separation –centrifuge Equipment.

Unit III- Contact Equilibrium Separation

9

Contact equilibrium separation processes –concentrations –gas-liquid and solid -liquid equilibrium – equilibrium concentration relationships –operating conditions-calculation of separation in contact – equilibrium processes-gas absorption –rate of gas absorption –stage –equilibrium gas –absorption equipment-properties of tower packing –types –construction –flow through packed towers-extraction –rate of extraction –stage equilibrium extraction - equipment for leaching coarse solids –intermediate solids – basket extractor -extraction of fine material –Dorr agitator –continuous leaching –decantation systems – extraction towers-washing –equipment’s.

Unit IV-Crystallization and Distillation

9

Crystallization –equilibrium -solubility and equilibrium diagram –rate of crystal growth –equilibrium crystallization-crystallization equipment –classification –construction and operation-tank, agitated batch, Swenson-Walker vacuum crystallizers-distillation –binary mixtures –flash and differential distillation steam distillation –theory –consumption –continuous distillation with rectification –vacuum distillation - batch distillation –operation and process –advantages and limitations-distillation equipment’s –construction and operation –factors influencing the operation.

Unit V- Mixing

9

Definitions and principles– Basic equations standards. Evaluation of constants – work, energy and Power – Agitation and Mixing – Purpose of agitation – Agitated vessels – impellers – propellers – turbine –High efficiency impellers – Impellers for high viscosity liquids. Draft tubes – Power number – mixing and blending of miscible liquids, mixing index.

Total: 45 Hours

Reference Books

1. Earle, R.L, “Unit Operations in Food Processing”. Pergamon Press .2nd editionUK, 2009.
2. McCabe W.L., Smith J.C. “Unit Operations in Chemical Engineering”, 7th Edition, McGraw–Hill Int., 2001.
3. C.J. “Transport Processes and Separation Process Principles”, 4th Edition, Prentice Hall, 2003.
4. Geankoplis, C. J. Transport processes and separation process principles: (includes unit operations). Prentice Hall Professional Technical Reference, 2003.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Analyze the various unit operations involved in food processing.

CO2: Demonstrate the unit operation machineries involved in food industry

CO3: Select suitable mixing equipment for product development.

CO, PO MAPPING

Cos/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs	
													1	2
CO1		H												
CO2			M								M		M	
CO3		H												

Food Engineering Practicals

Semester I
21MEFC03

Hours of Instruction/Week: 3P
No. of credits: 1.5

Objective:

CLO1: To acquaint with the engineering properties of food materials.

1. Thermal processing of liquid foods.
2. Determination of physical properties of Foods.
3. Experiments on drying of fruits and Vegetables
4. Experiments on viscosity of the food materials
5. Experiments on milling and particle size analysis.
6. Experiments on ghee boiling for milk cream
7. Determination of Textural properties of foods
8. Experiments on Rheological property of foods
9. Experiment of food freezing time using Planks equation
10. Experiment on osmotic dehydration of food material
11. Performance evaluation of power operated cleaners.
12. Comparative studies of different types of driers.

Total: 30 Hours

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Analyse the engineering properties for foods and food products.

CO2: Apply the working principles of machineries involved in processing of food products.

CO3: Evaluate the performance of various food processing machinery.

CO, PO MAPPING

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs	
													1	2
CO1	H		M		M				M	M			1	2
CO2		H	M	L					M	M				
CO3				L					M	M			H	

Food Packaging Practicals

Semester I
21MEFC04

Hours of Instruction/Week: 3P

No. of credits: 1.5

Objective:

CLO1: To impart knowledge about the properties of packaging materials used for foods.

1. Identification of different types of packaging materials.
2. Determination of tensile strength of given packaging material.
3. Perform different destructive tests for glass containers.
4. Perform non-destructive tests for glass containers.
5. Determination of wax weight.
6. Measurement of thickness of packaging materials.
7. Perform grease-resistance test in plastic pouches.
8. Determination of bursting strength of packaging material.
9. Determination of barrier properties of packaging materials.
10. Demonstration of can-seaming operation.
11. Testing of chemical resistance of packaging materials.
12. Determination of drop test of food package.
13. Visit to relevant industries.

Total: 30 Hours

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Evaluate the properties of food packaging materials.

CO2: Explore new packaging materials with quality standards for food products.

CO3: Identify the suitable packaging material for desired food products.

CO, PO MAPPING

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs	
CO1	H		M		M				M	M			1	2
CO2		H	M	L					M	M				
CO3		H											H	

Research Methodology and IPR

Semester I
21MEFC05

Hours of Instruction/week: 3T
No. of credits: 3

Objective:

CLO1: To introduce the concept of Scientific Research and its processes and intellectual property rights

CLO2: To Explore and identify an appropriate research problem in their interesting domain

Unit 1-Introduction

9

Meaning of research problem- Sources of research problem- Criteria Characteristics of a good research problem- Errors in selecting a research problem- Scope and objectives of research problem. Approaches of investigation of solutions for research problem data collection analysis- interpretation Necessary instrumentations

Unit II-Literature Survey

9

Effective literature studies approaches-Analysis Plagiarism-Research ethics-Effective technical writing-How to write report - Paper Developing a Research Proposal-Format of research proposal - presentation and assessment by a review committee

Unit III- Intellectual Property Rights

9

Nature of Intellectual Property: Patents- Designs-Trade and Copyright. Process of Patenting and Development: technological research- innovation- patenting- development. International Scenario: International co-operation on IntellectualProperty. Procedure for grants of patents- Patenting under PCT.

Unit IV - Patent Rights

9

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit V- New Development In PR

9

Administration of Patent System- IPR of Biological Systems- Computer Software etc- Traditional knowledge Case Studies -IPR and IITs.

Total: 45 Hours

Reference Books

1. Stuart Melville and Wayne Goddard (1996). Research methodology: An introduction for science & engineering students . Juta & Co Ltd.
2. Wayne Goddard and Stuart Melville (2004). Research Methodology: An Introduction Juta and company Ltd.
3. Ranjit Kumar (2014). Research Methodology: A Step by Step Guide for beginners. 3rd Edition. SAGE publications Ltd..
4. Halbert (2007). Resisting Intellectual Property. Taylor & Francis Ltd.
5. Mayall (2002). Industrial Design. McGraw Hill
6. Niebel (2005) . Product Design. McGraw Hill
7. Asimov (2000). Introduction to Design Prentice Hall
8. Robert P. Merges. Peter S. Menell. Mark A. (2016) Lemley Intellectual Property in New Technological Age.
9. T. Ramappa (2008) Intellectual Property Rights Under WTO. S. Chand

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Outline the use of research and analyze the research related problem

CO2: Illustrate about when IPR would take such important place in growth of individuals and nation, emphasis the need of information about Intellectual Property Right to be promoted

CO3: Discuss about the adequate knowledge on patent and rights.

CO, PO MAPPING

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	(PSOs)	
													1	2
CO1	H	H	M	H	-	-	M	-	H	-	-	M	H	H
CO2	M	-	M	-	-	M	M	-	-	M	-	M	M	-
CO3	-	H	M	-	-	-	-	-	H	-	-	M	-	H

Fruits and Vegetables Processing Technology

Semester II
21MEFC06

Hours of Instruction/week: 3T
No. of credits: 3

Objective:

CLO1: To demonstrate the manifold processing techniques in fruits and vegetables.

UNIT I Post Harvest Technology

9

Physiology of development, ripening and senescence of fruits and vegetables, Harvesting and harvesting indices of fruits and vegetables, post-harvest changes of fruits and vegetables, Technological advances in processing of fruit and vegetables

UNIT II Minimal process Technology

9

Minimal process Technology- Fresh-cut Produce - Quality Parameters of Fresh-cut Fruit and Vegetable Products- Safety Aspects of Fresh-cut Fruits and Vegetables. Enzymatic Effects on Flavor and Texture of Fresh-cut Fruits and Vegetables- Preservative Treatments for Fresh-cut Fruits and Vegetables- Application of Packaging and Modified Atmosphere to Fresh-cut Fruits and Vegetables, Storage and handling of fresh produce.

UNIT III Edible coatings for fruits

9

Edible coatings for fruits-Types of edible coatings- Gas permeation properties of edible coatings- Determining diffusivities of fruits- Measuring internal gas composition of fruits-Shelf life characteristics.

UNIT IV Recent techniques in processing of fruits and vegetables

9

Recent techniques in processing of fruits and vegetables: Microwave and radio frequency processing, ohmic and inductive heating, high pressure processing, pulsed electric field, high voltage arc discharge, pulsed light technology, oscillating magnetic fields and ultrasonics.

UNIT V Quality attributes of fresh fruits and vegetables

9

Quality attributes of fresh fruits and vegetables- Quality indices of fruit and vegetable juices- Maturity and ripeness indices of fruits and vegetables Microbiology of fresh and processed fruits and vegetable products- Advances in byproduct utilization.

Total: 45 Hours

Reference Books

1. Hui Y. H., Hand book of fruits and fruit processing. Blackwell publishing, 2006.
2. Jongen W. M. F. 2002. Fruits and vegetable processing improving quality. Wood head Publishing Limited, CRC Press LLC, 2002.
3. Bayindirli, A. Enzymes in fruit and vegetable processing: chemistry and engineering applications. CRC Press, 2010.
4. Sinha, N., Hui, Y. H., Evranuz, E. Ö., Siddiq, M., & Ahmed, J. Handbook of vegetables and vegetable processing. John Wiley & Sons, 2010.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Prioritize the quality attributes of fruits and vegetables.

CO2: Demonstrate the various processing techniques of fruits and vegetables.

CO3: Develop new products from fruits and vegetables using recent processing techniques.

CO, PO MAPPING

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	(PSOs)	
													1	2
CO1			M		H						M			M
CO2	H			M									H	
CO2					H							M	M	

Milling, Baking and Confectionery Technology

Semester II

21MEFC07

Hours of Instruction/week: 3T

No. of credits: 3

Objective:

CLO1: This course aims to provide knowledge on cereal milling techniques, modern baking and confectionery technology employed in the food processing industry.

UNIT I- Introduction to Cereals and Milling Techniques

9

Importance of Cereals; Nutrient composition of cereal grains; Structure of Cereal Grains; Cereals of the World- origin, classification, types. Storage and pre-processing; Dry Milling technology (rice and wheat.) Wet Milling (maize) - flour quality; Types and grades of flour.

UNIT II- Raw Materials & Equipment For Baking

9

Functions of various raw materials used in baking industries. Essential ingredients, other ingredients. Leaveners and yeast foods, shortenings, emulsifiers, antioxidants, sweeteners, water and salt, Ingredients from milk and eggs.

Introduction to equipment used in bakery unit - bulk handling of ingredients, dough mixers, dividing, rounding, sheeting and laminating. Ovens and slicers, packaging material and equipment.

UNIT III- Bread Manufacturing

9

Dough mixing methods for bread making- Straight dough fermentation, sponge and dough, Accelerated processing. Chorely wood bread process, dough retarding and freezing. Processing of bread - characteristic of good bread: Internal characters, external characters. Bread defects and spoilage of bread causes, detection and prevention. .

UNIT IV- Biscuits and Cookies

9

Production of cakes and cookies/ biscuits. Types of biscuits dough- Developed dough, short dough's, semi-sweet, enzyme modified dough's and batters. Cake making: Ingredients and their function - different types of cake, cake defects and remedies.

UNIT V- Confectionery Products

9

Quality characteristics of confectionery ingredients; Technology for manufacture of chocolate and hard boiled candy; caramel, toffee, fudge, marshmallow and fondants. Good Manufacturing Practices (GMP) in baking and confectionery industries.

Total: 45 Hours

Reference Books

1. Hui, Y. H., Corke, H., De Leyn, I., Nip, W. K., & Cross, N. A. (Eds.). Bakery products: science and technology. John Wiley & Sons, 2008.
2. Stanley P Cauvain, Linda S Young, "Technology of Bread Making", Aspen Publication, 2nd Edition, 2007.
3. Yogambal Ashok. "Textbook of Bakery and Confectionary". PHI Learning Pvt. Ltd,2012
4. Matz, Samuel A. "Bakery Technology and Engineering", 3rd Edition. CBS Publishers, 2008.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Adapt the processing and milling techniques of cereals.

CO2: Interpret various bakery and confectionery ingredients and their role in products.

CO3: Evaluate and monitor the quality of bakery and confectionary products.

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	Program Specific Outcomes	
													PSO1	PSO1
CO1	H				H							M	H	
CO2	H	M												M
CO3		H	M		H							M	M	

Food Processing and Preservation Practicals

Semester II
21MEFC08

Hours of Instruction/Week: 3P
No. of credits: 1.5

Objective:

CLO1: To demonstrate various food processing and preservation techniques.

1. Experiment on Preservation of vegetables using hurdle technology
2. Experiment on effect of blanching to prevent browning in vegetables
3. Experiment on canning of food products
4. Experiment on dehydration of food products
5. Experiment on osmotic dehydration of food products
6. Experiment on edible coating of fruits and vegetables
7. Extraction of essential oils using solvent extraction method
8. Experiment on fermentation of food products and its analysis
9. Experiment on different peeling methods
10. Experiments on size reduction of fruits and vegetables
11. Experiment on milling of grains.
12. Experiment on fluidized bed drier

Total: 30 Hours

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Interpret the processing techniques involved in food preservation.

CO2: Identify the working principle of different extraction methods.

CO3: Development of new products using various food processing techniques.

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	PSOs		
													1	2	
CO1			M		H						M				M
CO2					H							M		M	
CO3	H			M										M	

Food Analysis Practicals

Semester II
21MEFC09

Hours of Instruction/Week: 3P

No. of credits: 1.5

Objective:

CLO1: To analyze the biochemical properties of foods.

1. Measuring water activity in any hygroscopic food material (for instance - biscuits/potato chips/coffee powder).
2. Estimation of tannin/ phytic acid by spectrometric method.
3. Separation of amino acids/coal tar dyes by two dimensional paper chromatography.
4. Separation and identification of sugars in fruit juices.
5. Electrophoretic Techniques in food analysis.
6. Separation of proteins by ion-exchange chromatography.
7. Separation and identification of carotenoids by column chromatography.
8. Identification and determination of organic acids by HPLC.
9. Analysis of dietary fibre/glucose by enzymatic method.
10. Microbial analysis in foods

Total: 30 Hours

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Demonstrate the various analytical techniques used to determine the quality of food materials.

CO2: Analyse the basic constituents present in foods.

CO3: Evaluate the biochemical changes involved in formulation of innovative products.

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	PSOs	
													1	2
CO1			M		H						M			M
CO2					H							M	M	
CO3	H		M									M	M	

Mini Project with Seminar

Semester II
21MEFC10

Hours of Instruction/week: 2P
No. of Credits: 1

Objective:

CLO: To make the students realize, design and develop innovative ideas in food processing.

Research Project Phase-I

Semester III
21MEFC11

Hours of Instruction/week: 20
No. of Credits: 10

Objective:

CLO: To make the students identify the area of research in order to satisfy the needs of Food Industries and society / In-House as Research Project Phase-I.

Internship

Semester III
21MEFC12

Hours of Instruction/week: -
No. of Credits: 1

Objective:

CLO: To expose the students to the food industrial environment for enhancing their skill and knowledge.

Research Project Phase-II

Semester IV
21MEFC13

Hours of Instruction/week: 32
No. of Credits: 16

Objective:

CLO: To make the students continue their Project Phase- I and implement new ideas to satisfy the needs of Food Industries and society as Research Project Phase-II.

Program Elective-I
Drying Technology

Semester I
21MEFE11

Hours of Instruction/week: 3T
No. of credits: 3

Objective:

CLO1: To illustrate the principles of drying and its significance in food processing.

Unit I- Theory of Drying

9

Principles of drying – Fundamentals of air-water mixtures – Psychrometric chart – Problems based on psychrometry – Drying curves – constant and falling rate period - Heat and mass transfer in dryers – moisture content in foods – determination of moisture content and its measurement - methods of determination - Equilibrium moisture content – methods of determination – EMC models.

Unit II- Drying Methods

9

Selection of dryers – design of dryers - Conduction drying – convection drying – Pneumatic or fluidized bed drying – natural air drying – heated air drying – re-circulatory dryer (non-mixing type) – LSU dryer (continuous mixing type) – Baffle dryer - Radiation drying – Sun drying and infrared drying – Dielectric drying – chemical drying -Thin layer and deep bed drying - dryer performance

Unit III -Drum Dryer, Foam Mat Dryer and Freeze Dryer

9

Drum driers - Types of Drum Dryers - Principles of Operation of the Drum Dryer – rotary dryers Cabinet drying – vacuum tray dryers - Foam Mat Drying- Principles- Equipment- Factors affecting Foam mat drying – Freeze dryers - Fundamentals of freeze drying – Freezing – Primary drying stage – secondary drying stage -Changes during freeze drying – Condensation, defrosting – Industrial freeze driers.

Unit IV -Fluidized Bed Dryer, Spray Dryer, Osmotic Drying

9

Fluidized bed dryer – Spouted bed dryer - spray drying of foods - Principles of Spray Drying Processes – Atomizers and nozzles - Reconstitution of powders – Foam spray drying - Osmotic dehydration – Principles – Factors affecting osmosis Equipment used.

Unit V -Radiation and Dielectric Dryers

9

Infrared drying – principles - microwave drying of foods – dielectric concepts – construction and working – Radio Frequency drying – principles – working - Flash Dryers - Design of Flash Dryers - Materials Dried in Flash Dryers.

Total: 45 Hours

Reference Books

1. Paul Singh, R and Dennis R. Heldman. Introduction to Food Engineering Academic Press,2001
2. Hui Y. H, “Food Drying Science and Technology, Microbiology, Chemistry, Application”, CHIPS, 2008.
3. Chakraverty. A. “Post -Harvest Technology of Cereals, Pulses and Oil seeds”, Oxford and IBH Publishing Co.Pvt. Ltd. New Delhi, 2014
4. Loesecke, H. W. V, “Drying & Dehydration of Foods”, Published by Agrobios, 2005.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Demonstrate the principles and different methods of drying.

CO2: Selection of particular dryer for desired end product applications.

CO3: Design innovative driers depending on the properties of food and food products.

CO, PO MAPPING

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	(PSOs)		
													1	2	
CO1		H													
CO2	H										M				
CO3			M												M

Food Preservation Technology

Semester I
21MEFE12

Hours of Instruction/week: 3T
No. of credits: 3

Objective:

CLO1: To describe the concepts underlying various food preservation methods.

UNIT I - Food and its Preservation

9

General principles of preservation, classification of methods used for preservation, need and importance of preservation at domestic and large scale, Causes of food spoilage; Nature of harvested crop, plant and animal – moisture, pH and water activity of foods.

UNIT II- Low Temperature Methods

9

Principles of storage using low temperature; Product storage; Effect of cold storage on quality, storage of grains; Principles of refrigerated gas storage of foods, Gas packed refrigerated dough, Sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers. Principles of food freezing: Freezing of raw and processed foods, freeze concentration, freeze drying, IQF.

UNIT III- Canning and chemical preservation

9

Principles of canning and bottling of foods; Types and classification of foods used for canning; spoilage of canned and bottled foods, storage of canned foods; Influence of canning on the quality of food; retort pouch processing. Chemical Preservation: Preservation of foods by use of sugar, salt, chemicals and antibiotics and by smoking.

UNIT IV- Membrane Processing

9

Membrane Processing: General principles and advantages, dead end and cross flow, Classification of membrane system: Reverse Osmosis, Nano Filtration, Ultra Filtration, Micro Filtration, Electrodialysis and Pervaporation; Membrane technology comparison chart, Membrane application in the food industries; Membrane performance, and Limitation of membrane processes.

UNIT V- Food Concentration

9

Food Concentration: Evaporation- Definition, types of evaporator (single effect, double effect and multiple effect evaporator); Freeze concentration- General principles and applications, basic elements, ice crystal nucleation, growth and crystallization, separation techniques (filtration and wash column).

Total: 45 Hours

Reference Books

1. Karnal, Marcus and D.B. Lund “Physical Principles of Food Preservation”. Rutledge, 2003.
2. Gould, G.W. “New Methods in Food Preservation”.Springer, 1995.
3. Hui, Y.H. “Handbook of Vegetable Preservation and Processing”. Marcel Dekker, 2003.
4. Subbulakshmi, G., and Shobha A. Udiipi “Food Processing and Preservation”.New Age Publications, 2006.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Interpret the principles of food preservation techniques.

CO2: Analyse the effect of enzymes on spoilage reactions of foods during storage and preservation.

CO3: Prioritize the methods of food preservation to retain the final quality of foods.

CO, PO MAPPING

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	(PSOs)	
													1	2
CO1			H											
CO2		H									M			M
CO3	M		M											

Storage Engineering

Semester I
21MEFE13

Hours of Instruction/week: 3T
No. of credits: 3

Objective:

CLO1: To illustrate about different grain storage structures and its theory.

Unit I - Physico - Chemical and Thermal Properties of Grains 9

Grain dimensions, bulk density, true density, and porosity, and coefficient of friction, angle of repose, thermal conductivity and aerodynamic properties. Psychrometry: humidity, % relative humidity, humid heat, deterioration index, wet bulb temperature, use of psychrometric charts.

Unit II – Insects and Pests 9

Types, extent of losses during storage, causes and control measures, Insecticides- principles, scope of application in warehouses; requirements, group of active ingredients, choice, toxicity, resistance, application techniques, Fumigants - chemicals, areas of application, choice, toxicity, application rates, exposure time and resistance. Rodenticides - Types and effectiveness and limitations, important moulds and bacteria involved in spoilage of grains; effect on physico- chemical and sensory quality of grains; mycotoxins

Unit III– Grain Storage Theory 9

Principles, moisture movement during bulk storage of grains, methods of aeration, various theories, Physical, chemical, microbiological and sensory changes occurring during storage.

Unit IV – Grain Storage Structures 9

Grain storage structures - location and material selection for storage building, Types - traditional, modern; temporary and permanent storage structures; design considerations - pressure distribution in storage bins.

Unit V – Controlled and modified atmosphere Storage 9

Air tight, controlled atmosphere and modified atmospheric storage; differences, principles, optimization of storage gas composition, rate of supply, control systems for oxygen and carbon dioxide- their effect on microbes and limitations.

Total: 45 Hours

Reference Books

1. Shejbal, J. (ed), Controlled atmosphere storage of grains. Elsevier Scientific Publishing Co. London, 1980.
2. Ripp, B. E., ed. Controlled atmosphere and fumigation in grain storages. Elsevier, 2012.
3. Wang, S. X., & Taratorin, A. M. Magnetic Information Storage Technology: A Volume in the Electromagnetism Series. Elsevier, 1999.
4. Bala, B. K., & Bala, B. K. Drying and storage of cereal grains. Enfield (NH): Science Publishers, 1997.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Identify the safe storage system for food materials.

CO2: Distinguish between traditional storage structures and modern storage structures.

CO3: Demonstrate the controlled and modified storage structures based on the farm requirements.

CO, PO MAPPING

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	(PSOs)	
													1	2
CO1	H	M												
CO2			H								M			M
CO3			M										M	

**Program Elective-II
Advances in Food Packaging**

Semester I
21MEFE21
Objective:

Hours of Instruction/week: 3T
No. of credits: 3

CLO1: To prepare the students to learn the concepts of novel packaging techniques for foods.

UNIT I - Novel packaging techniques **9**

Novel packaging techniques- Active and intelligent packaging, Active packaging techniques. Intelligent packaging techniques, Oxygen scavenging technology. Ethylene scavenging technology. Antimicrobial food packaging: Constructing an antimicrobial packaging system, Factors affecting the effectiveness of antimicrobial packaging.

UNIT II- Bio based packaging **9**

Bio based packaging of foods-Non-migratory bioactive polymers (NMBP) in food packaging, Advantages of NMBP, limitations, inherently bioactive synthetic polymers: Types and applications, Polymers with immobilized bioactive compounds.

UNIT III- Time-temperature indicators **9**

Time-temperature indicators (TTIs) - Requirements for TTIs, Development of TTIs, Current TTI systems, maximizing the effectiveness of TTIs, Using TTIs to monitor shelf-life during distribution, Using TTIs to optimize distribution and stock rotation.

UNIT IV- Modified Atmospheric Packaging **9**

Modified Atmospheric Packaging (MAP) - MAP applications for fresh-prepared produce, Novel MAP gases, Applying high O₂ MAP Testing novel MAP applications.

Packaging-flavour interactions. Factors affecting flavour absorption- role of the food matrix- role of differing packaging materials- Case study: packaging and lipid oxidation, Modelling flavour absorption.

UNIT V- Modern packaging systems **9**

Modern packaging systems: Green plastics for food packaging –biopolymers in food packaging- Developing novel biodegradable materials- Current applications- Integrating intelligent packaging - role of packaging in the supply chain-Creating integrated packaging, storage and distribution.

Traceability: Radio Frequency Identification. Recycling packaging materials: recyclability of packaging plastics- Improving the recyclability of plastics packaging, Testing the safety and quality of recycled material, Using recycled plastics in packaging.

Total: 45 Hours

Reference Books

1. Ahvenainen R, Novel Food Packaging Techniques. CRC, 2001.
2. Painy FA, A Handbook of Food Packaging. Blackie, 1992.
3. Palling SJ., Developments in Food Packaging. App. Sci.Publ., 1980.
4. Rooney ML., Active Food Packaging. Chapman &Hall, 1988.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Select suitable packaging materials for food products.

CO2: Distinguish between different techniques of food packaging.

CO3: Formulate innovative packaging materials for processed food products.

CO, PO MAPPING

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	(PSOs)	
													1	2
CO1	H		M								M			M
CO2			M										M	
CO3			M										M	

Non Thermal Processing Techniques in Foods

Semester I
21MEFE22

Hours of Instruction/week: 3T

No. of credits: 3

Objective:

CLO1: To describe the emerging techniques in food processing.

Unit I - High Pressure Processing of Foods

9

Principles – applications to food systems – effect on quality – textural, nutritional and Microbiological quality – factors affecting the quality – modelling of high pressure processes – High Pressure Freezing, Principles and Applications

Unit II - Radiation Processing of Foods

9

Principle, Types of radiation sources. Biological effects of irradiation, Irradiation of Foods Gamma Irradiation, X-Ray Irradiation, UV Irradiation–Combined treatments. Applications and Limitations.

Unit III - Osmotic Dehydration of Foods

9

Principle – Mechanism of osmotic dehydration – Effect of process parameters on mass. Transfer– Methods to increase the rate of mass transfer – Applications – Limitations of osmotic Dehydration – Management of osmotic solutions

Unit IV - Ohmic and Ultrasound Processing of Food

9

Principle of ultrasound – Fundamentals – Ultrasound as a processing and preservation aid – Effect on properties of foods Basics of ohmic heating – Electrical conductivity - generic configurations- treatment of products.

Unit V - Pulsed Light and Hurdle Technology

9

Basics of hurdle technology – Mechanism Application to foods - Newer Chemical and Biochemical hurdles- organic acids – Plant derived antimicrobials – Antimicrobial enzymes – bacteriocins – chitin / chitosan (only one representative example for each group of chemical and biochemical hurdle) Pulsed Electric Field Processing of Foods: Principles – Mechanism of action – PEF treatment systems – Main processing parameters – PEF Technology – Equipments – Mechanism of microbial and enzyme inactivation- safety aspects– Processing of liquid foods using PEF – Process models – Comparison of High pressure processing and PEF – Enzymatic Inactivation by PEF, Examples – Microbiological and chemical safety of PEF foods.

Total: 45 Hours

Reference Books

1. Leistner L. and Gould G. Hurdle Technologies – Combination treatments for food Stability safety and quality, Kluwer Academics / Plenum Publishers, 2002.
2. Da-wen Sun: Emerging Technologies for Food Processing, Elsevier Academic Press and Marcel DekkerInc, 2014.
3. Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Soledad Tapia, M. Pilar Cano, Novel Food Processing Technologies (Food Science and Technology Series), CRC Press, 2004.
4. Knoerzer, K., Juliano, P., Roupas, P.,&Versteeg, C. (Eds.).Innovative food processing technologies: advances in multiphysics simulation. John Wiley & Sons,2011.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Demonstrate the processing stages of various emerging technologies.

CO2: Distinguish the emerging technologies over existing technologies.

CO3: Ideate innovative technologies for shelf life extension of food products.

CO, PO MAPPING

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	(PSOs)	
													1	2
CO1	H	H	M									M	H	
CO2		H	M											M
CO3		H	M		H							M	H	

Advanced Food Chemistry and Microbiology

Semester I
21MEFE23

Hours of Instruction/week: 3T
No. of credits: 3

Objective:

CLO1: To illustrate the complexities of the chemical components and role of microbes in foods.

UNIT I-Water Relations in Food, Food Lipids and Antioxidants

9

Water relationships in foods: water activity and its relevance to deteriorative processes in foods (chemical, enzymatic, physical and microbial changes); Glass transitions and molecular mobility in foods, their relevance to quality and shelf life of food systems. Chemistry of oils and fats, free radical chemistry, types of oxidative reactions, Antioxidants: chemistry and mechanisms of action, techniques of evaluation of antioxidant activity, uses.

UNIT II- Food Proteins and Enzymes

9

Chemistry, structure and functions of amino acids and proteins. Enzymic reactions, kinetics, Maillard reactions, enzymic browning, Role of enzyme in food processing. Functional properties of proteins: modified proteins, application in product formulation.

UNIT III-Starch, Hydrocolloids and Gums

9

Starch, hydrocolloids and gums: occurrence, functions in food systems, properties, gelatinization, retro gradation and modified starches; Food carbohydrates: structural, analytical, physicochemical, nutritional and functional properties of carbohydrates and polysaccharides of plant and microbial origin.

UNIT IV-Food Fermentation and Spoilage

9

History of microbiology of food; Microbial growth pattern, Microbial growth in food: intrinsic, extrinsic and implicit factors. Microbes of importance in food fermentations: lactic acid bacteria fermentation and starter cultures. Alcoholic fermentations - yeast fermentations, fungal fermentations. Food fermentations-yoghurt, cheese, fermented milks, breads, idli, soy products, fermented vegetables and meats. Types of micro-organism associated with foods spoilage-mold, yeast and bacteria; Biochemical changes caused by microorganisms, microbial contamination and deterioration of vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing.

UNIT V-Food Pathogens

9

Food poisoning and microbial toxins, Food borne intoxicants and mycotoxins; Microbial interactions; Use of antimicrobial chemicals - organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, benzoates, sorbates / propionates naturally occurring antimicrobials – Their mode of action; Microbial standards for different foods.

Total: 45 Hours

Reference Books

1. Chopra, H.K and Panesar, P.S. "Food Chemistry", Narosa, 2010.
2. Damodaran, S., Parkin, K.L. and Fennema, O.R. "Food Chemistry", 4th Edition, CRC /Taylor & Francis, 2008
3. Belitz, H.D., Grosch, W and Schieberle, P. "Food Chemistry", 3rd Edition, Springer,2004
4. Walstra, P. "Physical Chemistry of Foods", Marcel Dekker, 2003.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Elaborate the chemical changes and their impact on the food product.

CO2: Infer the role of microbes in food quality and safety.

CO3: Interpret the structural properties of chemical compounds based on the physical parameters.

CO, PO MAPPING

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	(PSOs)	
													1	2
CO1	H		H									M	M	H
CO2	H		H										M	
CO3	H	M										M		H

Program Elective-III
Milk and Milk Products Technology

Semester II
21MEFE31

Hours of Instruction/week: 3T
No. of credits: 3

Objective:

CLO1: To prepare the students to learn the unit operations involved in processing of milk and milk products.

UNIT I Introduction and Homogenization of milk **9**

Present status of milk & milk products in India and Abroad; market milk- Composition of milk of various species, quality evaluation and testing of milk, procurement, transportation and processing of market milk, cleaning & sanitization of dairy equipment.

Principle of homogenization, Effect of homogenization, single and double stage homogenizers care and maintenance of homogenizers, efficiency of homogenization, design principles of homogenizers, operation and maintenance, application of homogenization in dairy industry.

UNIT II Equipment in milk processing **9**

Designs and equipment of tank, types of tanks, pumps in dairy industry. Agitation and mixing, construction of agitators and patterns of flow. Separation by gravity and centrifugal force, clarifiers and separators, centrifugal separator and efficiency of separation, flow rate and power consumption.

UNIT III Pasteurization and concentration of milk **9**

Pasteurization of milk; Holding methods, HTST pasteurizer and design principle and thermal death kinetics, care and maintenance, Advantages of HTST pasteurization, UHT processing of milk, quality changes during processing of milk.

Concentration of milk, evaporator, food properties in relation to evaporator performance, Construction and types of evaporator, heat and mass balance in single and multiple effect evaporator, performance characteristics of evaporators and their selection criteria steam economy. Recent advances in evaporating techniques.

UNIT IV Drying **9**

Theory of drying, estimation of drying rates and drying time, drying equipment, particle size calculation, design of spray and drum dryer, skim milk and whole milk powders manufacturing methods. Fluidized bed drying, principles of fluidized bed method, types of fluidized bed drier, drying and cooling times in fluidized bed; Freeze drying, agglomeration, methods of agglomeration, recent advances in drying.

UNIT V Types of milk products **9**

Dairy products- butter; ghee; cheese; casein and its derivatives; condensed and evaporated milk, traditional products; whey powder, protein concentrate and isolate; lactose their composition, standards, manufacturing, process control and quality control parameters.

Total: 45 Hours

Reference Books

1. Aneja RP, Mathur BN, Chandan RC & Banerjee AK. Technology of Indian Milk Products. Dairy India Publ, 2002.
2. De S.1980. Outlines of Dairy Technology. Oxford Univ. Press, 1980.
3. Walstra P. (Ed.). Dairy Science and Technology. 2nd Ed. Taylor & Francis, 2006.
4. Rathore NS et al. Fundamentals of Dairy Technology - Theory & Practices. Himanshu Publcn., 2008.
5. Walstra, P., Walstra, P., Wouters, J. T., & Geurts, T. J. Dairy science and technology. CRC press, 2005.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Elaborate various equipment employed in the dairy processing industry.

CO2: Develop value added products from milk.

CO3: Analyse the effluent treatment in dairy industry along with the unit operations.

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	PSO's	
													1	2
CO1	H	M	H									M	H	
CO2			M											H
CO3		H			H							M	H	M

Flavours, Spices and Plantation Products

Semester II
21MEFE32

Hours of Instruction/week: 3T
No. of credits: 3

Objective:

CLO1: To illustrate the processing and biochemical properties of flavouring components and plantation crops.

UNIT I- Flavours Introduction

9

Definition and Description of flavour, flavour profile. Measurement of flavour, particularly for wine, tea, coffee, spices and condiments. Natural and synthetic flavouring substances and their chemical characteristics. Flavour components/constituents of fruit and vegetables, coffee, tea and cocoa bean, spices and condiments

UNITII-Flavours Processing and Stability Studies

9

Effect of storage, cooking condition of various foods, processing, transportation and environmental condition on flavour components. Processing (industrial/commercial)technologies / methods of flavouring compounds of plant foods and their utilization and application ,Recent developments in flavour research, processing and technology

UNIT III- Plantation Crops

9

Tea: Processing of tea, various types of tea, chemistry of constituents, fermentation, and tea concentrates decaffeination process, Evaluation and grading of tea. Coffee: Processing of coffee, type of coffee, drying, fermentation, roasting and browning processes and their importance, chicory chemistry and technology. Analysis of tea and coffee, quality components - standards and specification of tea and coffee products. Processing and analysis of cocoa bean, beverages and study of factors that affect quality and uses for the consumers

UNIT IV- Spices- Classification and Functional Value

9

Scope of spice processing in India, Types, spice qualities and specification, uses and physiological effects, components, antimicrobial and antioxidant properties, Medicinal value of condiments and spice products

UNIT V-Spices Processing

9

Important spices added in food products, Processing and manufacturing of major Indian Spices: Pepper, cinnamon, cardamom, Nutmeg, saffron, turmeric and Ginger, minor spices- cloves, leafy spices, bay oregano, and seed spices. Spice processing machineries packaging and handling of spices. Spice blends and extractives, essential and encapsulated oils, oleoresins – uses in processed foods

Total: 45 Hours

Reference Books

1. Heath, H.B. "Flavor Chemistry and Technology", CBS Publications, 2005
2. Spanier, A.M *et al.*, "Food Flavor and Chemistry: Explorations into the 21st Century", RSC, 2005.
3. Reineccius, G. "Flavor Chemistry and Technology", 2nd Edition, Taylor & Francis, 2006
4. Hirasa, K and Takemasa, M. "Spice Science and Technology", Marcel Dekker, 1998

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Summarize the quality aspects of flavor, spices and plantation products.

CO2: Determine the stability studies on storage, processing, transportation.

CO3: Analyse the quality and functional value of spices.

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	PSO's	
													1	2
CO1	H				H							M	H	
CO2	H	M												M
CO3		H	M		H							M	M	

Technology of Frozen Foods

Semester II

21MEFE33

Hours of Instruction/week: 3T

No. of credits: 3

Objective:

CLO1: To enable the students to gain knowledge on processing methods and quality measurement of frozen foods.

UNIT I Introduction to frozen foods

9

Glass transitions in frozen foods and biomaterials, Microbiology of frozen foods, thermo-physical properties of frozen foods, freezing loads and freezing time calculation, innovations in freezing process

UNITII Equipment for freezing

9

Freezing methods and equipment, Transportation of frozen foods, Retail display equipment and management, Monitoring and control of the cold chain.

UNIT III Quality and safety of frozen foods

9

Quality and safety of frozen fruits and vegetables, Quality and safety of frozen dairy products, Quality and safety of frozen ready meals, Quality and safety of frozen bakery products. Quality and safety of frozen meat and meat, egg and poultry products, Safety and quality of frozen fish, Shellfish, and related products.

UNIT IV Chemical and sensory analysis of frozen foods

9

Chemical Measurements, Sensory analysis of frozen foods, Foodborne illnesses and detection of pathogenic microorganisms, Shelf-life prediction of frozen foods.

UNIT V Frozen food packaging

9

Introduction to frozen food packaging, Plastic packaging of frozen foods, Paper and card packaging of frozen foods, Packaging of frozen foods with other materials, Packaging machinery

Total: 45 Hours

Reference Books

1. Kennedy, C. J. (Ed.). Managing frozen foods. Elsevier, 2000.
2. Hui, Y. H., Legarretta, I. G., Lim, M. H., Murrell, K. D., & Nip, W. K. (Eds.). Handbook of frozen foods (Vol. 133). CRC Press, 2004.
3. Erickson, M. C., & Hung, Y. C. Quality in frozen food. Springer Science & Business Media, 2012.
4. Mallett, C. P. (Ed.). Frozen food technology. Springer Science & Business Media, 1993.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Apply knowledge on the fundamentals of frozen foods.

CO2: Identify the properties and method of frozen foods.

CO3: Perceive the quality, safety and packaging of frozen foods in food technology.

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	(PSOs)	
													1	2
CO1	H				M									M
CO2			M		H						M			M
CO3					H							M	M	

Program Elective-IV
Instrumental Techniques in Food Analysis

Semester II

Hours of Instruction/week: 3T

21MEFE41

No. of credits: 3

Objective:

CLO1: To enable the students to apply the knowledge in real time analytical instruments in food processing.

UNIT I Calibration and standardization of instruments **9**

Sampling techniques; Calibration and standardization of different instruments, water activity- its measurements and significance in food quality.

UNITII Spectroscopic techniques **9**

Spectroscopic techniques using UV/Vis, fluorescence, IR, FTIR, NIR, NMR, atomic absorption, ICP, polarimetry, refractometry, microscopic techniques in food analysis (light microscopy, SEM, TEM, XRD, particle size analysis, image analysis etc.). Color measurements in raw and processed foods.

UNIT III Chromatographic techniques **9**

Chromatographic techniques: Adsorption, column, partition, affinity, ion exchange, size exclusion, GC, GLC, HPLC, HPTLC, GCMS, LCMS.

UNIT IV Separation techniques **9**

Separation techniques: Gel filtration, Dialysis, Electrophoresis, Sedimentation, ultrafiltration and ultracentrifugation, solid phase extraction, supercritical fluid extraction, isoelectric focusing, manometric techniques-membrane separation techniques

UNIT V Special Instrumental techniques **9**

Special techniques: immunoassay techniques; isotopic, non-isotopic and enzyme immunoassays; surface tension and its significance in food analysis - enzymatic methods of food analysis; thermal methods in food analysis -differential scanning calorimetry. Texture analysis of foods- viscosity measurements and its significance in food quality.

Total: 45 Hours

Reference Books

1. Pare, J. R. J., & Bélanger, J. M. (Eds.). Instrumental methods in food analysis. Elsevier, 1997.
2. MacLeod, A. J. Instrumental methods of food analysis. Elek Science, 1973.
3. Pomeranz, Y. (Ed.). Food analysis: theory and practice. Springer Science & Business Media, 2013.
4. Nag, A. Analytical and Instrumental Techniques in Agriculture, Environmental and Food Engineering. PHI Learning Pvt. Ltd, 2015.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Identify the composition and characteristics of various food samples using advanced chromatographic techniques.

CO2: Elaborate the principles of extraction techniques.

CO3: Interpret the instrumental methods of chemical analysis of foods.

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	PSO's	
													1	2
CO1	M		H										H	
CO2	H	H										M		M
CO3	H		M									M	H	

Food Waste Management and By-Products Utilization

Semester II

Hours of Instruction/week: 3T

21MEFE42

No. of credits: 3

Objective:

CLO1: To gain knowledge on food wastes obtained from various industries and the ways to convert it into valuable products.

UNIT I- Introduction about Food Industry Waste Utilization:

9

Waste from rice mill industry – agricultural waste based furnace- types, design. Utilization of rice husk-cement preparation, ceramic materials. Utilization of rice bran - problems in processing of rice bran-stabilization- methods of utilization- rice bran stabilizers-extraction of rice bran-refining-uses of bran, bran oil and defatted bran.

UNIT II-Fruit Industry Waste Utilization

9

Different sources of wastes from fruit and vegetable industries and their availability in India- Status and types of waste available- possible byproducts. Utilization of mango, citrus, apple, guava, grape waste-vinegar production. SCP production, organic acid production from vegetable waste. Utilization of moringa, potato, leafy vegetable waste.

UNIT III-Tuber Crops Waste Utilization

9

Waste from tuber crops - effluent safe disposal- effluent treatment plant- waste recycling plant - feasibility report for food industries using food waste and by products. Alcohol production from cane sugar industry waste.

UNIT IV- Fish and Poultry Waste Utilization

9

Fish industry by products- methods and production of fish meal, fish protein concentrate-fish and body oils. Poultry waste- recycling. Tapioca waste utilization- furfural production methods-paper making from cellulosic waste

UNIT V-By-Product Utilization of Coconut Waste

9

Waste from Coconuts – uses of coir pith-biogas production-particle board, utilization of coconut husk-coir fibre. Coconut shell utilization - methods for production of shell charcoal- fuel briquette-machineries used.

Total: 45 Hours

Reference Books

1. P. N. Cheremisinoff & A.C Morresi, "Energy from Solid Wastes" 1976,
2. Onwueme, I. C. The tropical tuber crops: yams, cassava, sweet potato, and cocoyams. John Wiley and Sons, 1978.
3. Hui, Y. H. Handbook of fruits and fruit processing. John Wiley & Sons, 2008.
4. Borgstrom, G. (Ed.). Fish As Food V2: Nutrition, Sanitation, and Utilization. Elsevier, 2012.

Course Outcomes:

CO1: Distinguish the nature of the wastes obtained from different food processing industries.

CO2: Evaluate the properties of different food industry wastes.

CO3: Recognize and communicate common processes involved in the conversion of processing waste into valuable products.

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	PSO's	
													1	2
CO1			H	M									M	
CO2						M	H							
CO3								M			M	M	H	

IoT and Sensors for Food Technology

Semester II

21MEFE43

Hours of Instruction/week: 3T

No. of credits: 3

Objective:

CLO1: To learn the types of sensors used in food technology applications.

Unit I- IOT

9

Introduction to Internet of Things: Overview of Internet of Things- the Edge, Cloud and the Application Development, Anatomy of the Thing, Industrial Internet of Things (MOT - Industry 4.0), Quality Assurance, Predictive Maintenance, Real Time Diagnostics, Design and Development for IOT, Understanding System Design for IOT, Design Model for IOT.

Unit II- IOT and their challenges

9

Domain specific IOT and their challenges: Illustrated domains-home automation, smart cities, environment, energy, retail, logistics, health and life style.

Unit III- Biosensors

9

Biosensors, Basic construction and measurement principles of Amperometric, Applications of amperometric biosensors. Principles of optical detection, Types of optical biosensors, Optical biosensors for food quality and food safety

Unit IV Biosensors for quality assurance in food industry

9

Base devices and sensing agents, Principles of immune analysis, Detection of microorganisms. Applications and future trends.

Unit V- Novel sensors

9

Novel sensing receptors, Electronic nose, tongue and testers and application in food analysis

Total: 45 Hours

Reference Books

1. Erika Kress-Rogers. Instrumentation and sensors for the food industry, CRC Press Publishers, 2001.
2. I.E. Tothill (Editor).Rapid and On-Line Instrumentation for Food Quality Assurance (Woodhead Publishing in Food Science and Technology).Woodhead Publishing, England, 2000.
3. Mutlu, M. (Ed.).Biosensors in food processing, safety, and quality control. CRC Press, 2016.
4. Turner, A., Karube, I., & Wilson, G. S.Biosensors: fundamentals and applications. Oxford university press, 1987.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Analyze the fundamentals of sensors used in the food industry

CO2: Interpret the different types of biosensors in food engineering.

CO3: Demonstrate the working principle of sensors and their application.

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	PSO's	
													PSO1	PSO2
CO1	H		H									M	M	H
CO2	H	M												H
CO3	H				M								H	

Program Elective-V
Safety Standards and Quality Auditing

Semester III
21MEFE51

Hours of Instruction/week: 3T
No. of credits: 3

Objective:

CLO1: To impart knowledge on food safety standards and food quality monitoring techniques, food Labelling as well as sanitation and food allergy.

UNIT I- Principles of Food Safety & Food Quality **9**

Principles of food safety and food quality- quality management principles – methods of food quality evaluation – risk analysis – Food safety testing. Pesticidal residue analysis.

UNIT II- Food Additives & Adulterants **9**

Food additives and preservatives – antioxidants, sweeteners flavours, colours, vitamins, stabilizers. Types of adulterants – test to detect adulterants in foods – metal contaminants - contaminants of processed foods - contaminants of smoked foods. Types of hazards- physical, chemical and biological - Food toxins.

UNIT III- Food Safety Standards & FSSAI **9**

Quality assurance of food commodities – Raw material supply certification of standards for export – APEDA, MPEDA, BVQS, SGS, BIS, BQS, quality system certification - ISO, HACCP, GMP- Indian and International food laws and regulations. FSSAI - Food safety and Standards Act – organizational chart – role of individual authority –principles to be followed – Responsibilities of the food business operator – Liability of manufacturers, packers, wholesalers, distributors and sellers –Enforcement of the act – Licensing and registration of food business

UNIT IV- Hazard Analysis – HACCP **9**

Codex Alimentarius - HACCP - History definition - preliminary task - principles - hazard analysis - record keeping - HACCP implementation and maintenance. General principle of microbial risk - assessment - hazard determination - HACCP worksheet. Critical Control Point - identification of critical points in the process - Methods by which obstacles can be overcome. HACCP implementation for dairy, bakery, fruit and vegetable and meat processing industries

UNIT V- Food Labelling & Sanitation in Food Industries **9**

Food labeling - Food allergy - Food intolerance - Sanitation - Need for sanitation- safe handling – cross contamination -cleaning and cleaners- CIP cleaning sanitizers, hygiene and safety rules for building and equipments – cleaner production in food industry – fruit and vegetable processing - sea food processing - brewing and wine processing

Total: 45 Hours

Reference Books

1. Krammer, A. and Twigg, B.A. “Quality control for the food industry”. Third Ed., AVI. Westport. 1970.
2. InteazAlli, “Food Quality assurance-Principles and Practices”, CRC Press, 2004.
3. Sara Mortimore and Carol Wallace, “HACCP – A practical Approach”, Chapman & Hall, 2003.
4. Mehta R. and George J., “Food Safety Regulation Concerns And Trade- The Developing Country Perspective”, Macmillan India Ltd., New Delhi. 2005.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Appraise the safety standards & quality testing of different foods.

CO2: Review the principles of HACCP & develop procedures to identify food safety hazards in food processing.

CO3: Compile hygienic standards and sanitation procedures followed in food industries

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	PSO's	
													PSO1	PSO2
CO1			H										M	
CO2				M				H					M	
CO3						M						M	H	

Food Process Design and Layout

Semester III

Hours of Instruction/week: 3T

21MEFE52

No. of credits: 3

Objective:

CLO1: To evaluate the concepts of designing a layout for food processing plant and estimation of cost.

UNIT I- Site Selection

9

Site selection - Factors - Case Study: Site Selection - Product Capacity and quality – Storage of Raw materials and Product - Waste Disposal, Utilities – Requirements for water, electricity, labour, transportation facilities, refrigeration, boiler- laboratory - Plans for Future Expansion Hours of Operation- Completion Date- Safety

UNIT II- Plant Design, Safety, Pollution and its Abatement

9

Manufacturing Plant Design – Building design – Legal aspects – Building bylaws, Expansion – Plant Location – The structure – Facilities Lay-out Office, toilet, laboratory- Problem of pollution - Determining Pollution Standards- Meeting Pollution Standards- Air and Water Pollution Abatement Methods- BOD and COD

UNIT III- Cleaning and Sanitation

9

Goals of cleaning and sanitizing – Types of soil – Cleaning criteria and measurement – The cleaning process – Environmental aspects – Cleaning Kinetics – Hygienic design – Cleanability test methods – Water treatment

UNIT IV- Layout and Cost Estimation

9

New Plant Layout- Product and process layout - Expansion and Improvements of Existing Facilities- Case Study: Layout and Warehouse Requirements – Inventory control - Cost Indexes - Capacity vis-a-vis Costs - Factored Cost Estimate – Break – even point - Improvements– Module Cost Estimation - Unit Operations Estimate- Detailed Cost Estimate- Accuracy of Estimates- Case Study: Capital Cost Estimation.

UNIT V- Economic Evaluation

9

Cost of Producing a Product- Capital - Elementary Profitability Measures- Time Value of Money- Compound Interest- Net Present Value- Rate of Return- Comparison of Net Present Value and Rate of Return Methods- Proper Interest Rates - Expected Return on the Investment Economic Evaluation – Depreciation – Amortization- Depletion Allowance- Investment Credit Special Tax Rules - Problems.

Total: 45 Hours

Reference Books

1. Dennis R. Heldman and Daryl B. Lund. “Hand Book of Food Engineering”, Second edition, CRC Press, Taylor and Francis Group, 2007.
2. R.K. Sinnott. “Coulson and Richardsons Chemical Engineering” Vol. 6., 4th Edition, Elsevier Publication, 2005.
3. Peters, M. S., Timmerhaus, K. D., West, R. E., Timmerhaus, K., & West, R. Plant design and economics for chemical engineers (Vol. 4). New York: McGraw-Hill, 1968.
4. Lynn J. Frewer, WillehmNorde, R. H. Fischer and W. H. Kampers, Nanotechnology in the Agri-food sector, Wiley-VCH Verlag, 2011.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Recognize key concepts of designing a food process layout with the insight of legal aspects & pollution standards.

CO2: Validate the cleaning kinetics & the test methods considering the environmental aspects & sustainability.

CO3: Review the economic evaluation, tax rules through calculations and cost estimations.

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	PSO	
													PSO1	PSO2
CO1			H			H						M	M	
CO2							H	M						
CO3	H			M									H	

Advances in Meat, Fish and Poultry Technology

Semester III

Hours of Instruction/week: 3T

21MEFE53

No. of credits: 3

Objective:

CLO1: To comprehend the knowledge in advanced methods involved in processing of meat, fish and poultry.

UNIT I- Introduction 9

Sources of meat and meat products in India, its importance in national economy; Industrial profile of meat and poultry industry -Meat production and trade practices.

UNIT II- Slaughtering of Animals and Poultry 9

Common and commercially important meats; pre and post slaughter handling, meat inspection and grading; animal welfare and safety in slaughter plant; Structure and composition of meat, carcass chilling, ageing; storage of fresh meat. Mechanical deboning, meat tenderization. Factors affecting post-mortem changes, properties and shelf-life of meat- meat quality evaluation.

UNIT III- Meat Products and Standards 9

Modified atmosphere packaging, packaging of retail cuts; Processing and preservation artificial tenderizing, chilling, freezing, curing, smoking, sausage manufacture, ready-to-eat meats and meat products; Aging, pickling and smoking of meat; Meat plant sanitation and safety, By-product utilization; Recent trends in meat processing; MMPO, MFPO, radiation processing; meat safety. Kosher and Halal certification, safety issues, regulation and quality assurance.

UNIT IV- Poultry, Egg and Egg Products 9

Poultry industry in India- quality characteristics of poultry products, microbiology of poultry meat, spoilage factors; Lay-out and design of poultry processing plants, Plant sanitation. Poultry meat processing operations, equipment, Structure, composition, nutritive value and functional properties of eggs and its preservation by different methods. Factor affecting egg quality and measures of egg quality; egg products-egg powder and frozen liquid eggs.

UNIT V- Fish and Marine Products 9

Types of fish, composition, post-harvest quality changes, post-harvest losses, methods for assessing and preventing losses; structure, post-mortem changes in fish. Processing of fish, crab, prawns, seaweeds, canning, smoking, freezing and dehydration of fish; Freezing techniques and irradiation process, value addition, preparation of fish products (Fish sausage, fermented fish, fish products, fish soups, fish powder, prawn powder and cutlets), seaweed products like pickles, hydrocolloids and fish oil.

Total: 45 Hours

Reference Books

1. Sofos, J.N. "Improving the Safety of Fresh Meat" Wood Head Publishing / CRC, 2005.
2. Toldra, F. "Handbook of Meat Processing", Wiley Blackwell, 2010
3. Kerry, J.P. "Improving the Sensory and Nutritional Quality of Fresh Meat", CRC/Wood Head, 2009
4. Venugopal, V. "Seafood Processing: Adding Value through Quick Freezing, Retort able Packaging and Cook-Chilling & other methods" (Food Science and Technology Vol.13) , CRC press, 2006

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Apply the advanced treatment methods in the production, processing and acceptance of meat, poultry and fish.

CO2: Develop new products from meat, fish and poultry using different processing technologies.

CO3: Assess the regulations and quality standards for meat, poultry and fish products.

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	PSO's	
													PSO1	PSO2
CO1					M							M	H	
CO2					H	M	M						M	
CO3			M				H						M	

Open Elective

Industrial safety and GMP in Food Industries

Semester III

Hours of Instruction/week: 3T

21MEFO01

No. of credits: 3

Objective:

CLO1: To apply knowledge on the concepts and causes of Industrial Safety and Good Manufacturing Practices in Food Industries.

UNIT I- Industrial safety

9

Need for safety, Safety Legislation: Acts and rules, Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety colour codes. Fire prevention and fire fighting, equipment and methods.

UNIT II- Fundamentals of Maintenance Engineering

9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment

UNIT III- Wear and Corrosion and their prevention

9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV- Fault tracing

9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's .Types of faults in machine tools and their general causes.

UNIT V- Periodic and preventive maintenance and GMP

9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance. Good Manufacturing Practices (GMP) in food industries.

Total: 45 Hours

Reference Books

1. Higgins, L. R., Mobley, R. K., & Smith, R. (2002). Maintenance engineering handbook (pp. 1-3). New York: McGraw-Hill, 2002.
2. Morrow, L. C. Maintenance engineering handbook. Meh, 1966.
3. Kececioglu, D. (2003). Maintainability, availability, and operational readiness engineering handbook (Vol. 1) DEStech Publications, Inc., 2003.
4. Dyro, J. (Ed.).Clinical engineering handbook. Elsevier, 2004.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Recognize the need of Industrial safety & analyse the significance of maintenance engineering in a food processing sector.

CO2: Review the types, effects of damages in Food Processing equipment & categorize the Appropriate preventive measures as well as methods.

CO3: Comprehend the importance of fault tracing & Good Manufacturing Practices (GMP) in Food Industries.

CO, PO MAPPING

POs	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	PSO's	
													PSO1	PSO2
CO1						H	M						M	
CO2			H	M		M							H	
CO3		H						M				M	M	

Audit course-I
English for Research Paper Writing
(Non-credit Mandatory course)

Semester I
21MEMA11

Hours of Instruction/week: 3T

Objective:

CLO1: To educate the students to write an effective research paper

Unit I **9**
Scientific Papers- Definition, Key characteristics- Clarity, Understanding the signals, Language of a scientific paper, Research ethics, rights and permissions- originality and authorship, avoiding ambiguity and vagueness

Unit II **9**
Components of a research paper-Importance and requirements while choosing a title. Importance of Syntax in title, Title as a label, matching title to relevance of study

Unit III **9**
Preparation of abstract. Types of abstracts, Economy of words, Introduction, Reasons for rules, Citations and abbreviations; Writing of Materials and Methods- Purpose, Materials, online resources, Methods, Measurements and analysis, Need for -Tabular materials, References and correct form and Grammar, Abbreviations and Jargons

Unit IV **9**
Results and discussion: Results-Contents, Strive for clarity, Handling of numbers, Discussion- components, Factual relationship, significance of the paper, Defining scientific truth. Tables and Illustrations- Graphs, Photographs-when, where and how to use. Importance of Conclusion

Unit V **9**
Citing of references- Rules to follow, reference styles and systems, Titles and inclusive pages, Journal abbreviations. Journal publication- Factors to be considered in choosing the journal, Cover letter to journals for publishing the manuscript. Use and misuse of English in manuscript, Ten commandments of good writing.

Total: 45 Hours

Reference Books

1. Goldbort R, "Writing for Science", Yale University Press (available on Google Books), 2006.
2. Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006.
3. Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM. Highman's book, 1998.
4. Adrian Wallwork, "English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Understand how to improve your writing skills and level of readability

CO2: Learn about the writing method in each section

CO3: Study and develop research papers, learn the key skills for a good quality research paper

Audit course-I
Disaster Management
(Non-credit Mandatory course)

Semester I
21MEMA12

Hours of Instruction/week: 3T

Objective:

CLO1: To provide broad understanding about the basic concepts of disaster management.

Unit I- Introduction **6**

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit II- Repercussions of Disasters and Hazards **6**

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Unit III- Disaster Prone Areas in India **6**

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

Unit IV- Disaster Preparedness and Management **6**

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness

Unit V- Risk Assessment and Disaster Mitigation **6**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co- Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Total: 30 Hours

Reference Books

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal book Company, 2004.
2. Sahni, Pardeepet. al., (Eds.), "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi, 2009.
3. Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2008.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Familiarize between natural and man-made disaster

CO2: Learn about the repercussions of disasters and hazards

CO3: Observe the various disaster prone areas in India

Audit course-I

Research and Publication Ethics (Non-credit Mandatory course)

Semester I
21MEMA13

Hours of Instruction/week: 3T

Objective:

CLO1: To create awareness about the publication ethics and publication misconducts

Unit I Philosophy, Ethics and Scientific Conduct 9

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions
3. Ethics with respect to science and research
4. Intellectual honesty and research integrity
5. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
6. Redundant publications: duplicate and overlapping publications, salami slicing
7. Selective reporting and misrepresentation of data

Unit II Publication Ethics 9

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals Predatory publishers and journals

PRACTICE

Unit III Open Access Publishing & Publication Misconduct 9

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Unit IV: Publication Misconduct 9

A. Group Discussions Subject specific ethical issues, FFP, authorship

1. Conflict of interest
2. Complaints and appeals: examples and fraud from India and abroad

B. Software Tools

1. Use of plagiarism software like Turnitin, Urkund and other open source software tools

Unit V: Databases and Research Metrics 9

A. Databases

1. Indexing databases
2. Citation databases: Web of Science, Scopus etc.,

B. Research Metrics

1. Impact Factor of Journal as per Journal Citation report, SNIP, SJR, IPP, Cite Score
2. Metrics: h-index, g index, HO index, almetrics

Total: 45 Hours

Reference Books

1. **Bird, A.** “*Philosophy of Science*”. Routledge. 2006
2. **MacIntyre, Alasdair** “*A Short History of Ethics*”. London. 1967
3. **P. Chaddah,** “*Ethics in Competitive Research: Do not get scooped; do not get plagiarized*”, ISBN:978-9387480865 2018
4. **National Academy of Sciences, National Academy of Engineering and Institute of Medicine.** *On Being a Scientist: A Guide to Responsible Conduct in Research*: Third Edition. National Academies Press. 2009
5. **Resnik, D. B.** *What is ethics in research & why is it important*. National Institute of Environmental Health Sciences, 1-10. Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
6. **Beall, J.** (2012). Predatory publishers are corrupting open access. *Nature*, 489(7415), 179-179. <https://doi.org/10.1038/489179a> 2011
6. **Indian National Science Academy (INSA),** *Ethics in Science Education, Research and Governance*, ISBN: 978-81-939482-1-7. http://www.insaindia.res.in/pdf/Ethics_Book.pdf 2019.

Audit course-II
Pedagogy Studies
(Non-credit Mandatory course)

Semester II
21MEMA21

Hours of Instruction/week: 3T

Objective:

CLO1: To provide the knowledge about pedagogy studies

Unit I- Introduction and Methodology **9**

Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teaching Learning outcome, Teacher education, Research questions, Overview of methodology and Searching.

Unit II- Thematic overview and Learner Intelligences **9**

Pedagogical practices, formal and informal classroom, multiple intelligences, Curriculum and syllabus, adopting teaching methods that appeal to different intelligences

Unit III -Evidence on the effectiveness of pedagogical practices **9**

Methodology of teaching, Materials for teaching, support system for effective pedagogical practices, online and blended classrooms, developing e content, approaches and strategies, engaging learners in the virtual mode, Brain-based learning, Principles of Brain based learning

Unit IV- Professional development **9**

Follow-up support, Peer, Individual, group learning, Barriers to learning, Special Learning Disabilities, Dyslexia, Dysgraphia, Dyspraxia, Dyscalculia. Use of technological tools to enhance learning, Classroom management, online teaching for rural India

Unit V- Research gaps and future directions **9**

Research design, Context, Pedagogy, online tests and assessment, Formative and Summative Assessment, Methods of Evaluation, Inspiring students to be autonomous learners, Dissemination and research impact.

Total: 45 Hours

Reference Books

1. <http://www.jensenlearning.com/what-is-brain-based-research>
2. Anandan, K.N. (2006) Tuition to Intuition, Transcent, Calicut
3. Harwell, J. M (1989) Complete Learning Disabilities Handbooks, New York. The Centre for Applied Research in Education
4. Raj, F (2010) Breaking Through, A hand book for teachers and parents of children with Specific Learning Disabilities. VIFA Publications, Secunderabad.

Course Outcome:

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

CO1: Understand conceptual framework, pedagogical practices to enhance learning process

CO2: Analyse learning disabilities and address the needs of diverse learners

CO3: Encourage students to be autonomous learners and instill habits of life-long learning

Audit course-II
Value Education
(Non-credit Mandatory course)

Semester II
21MEMA22

Hours of Instruction/week: 3T

Objective:

CLO1: To provide the knowledge about values in life and self-management

Unit I- Value education and Human rights **9**

Value education-Meaning, objectives, importance, Scope and needs. Types-Personal, social, religious, spiritual, universal, cultural and moral values.Values in life and developing a Mission statement. Human rights- meaning, and laws on violation of human rights

Unit II- Values, goals and standards **9**

Values, goals and standards-meaning and importance in life. Goals- short term and long term goals. Personal goals, family goals.Relationship among values, goals and standards in life.Standards- meaning and its importance and criteria in setting standards and practicing.

Unit III- Human values and cultivation of values **9**

Self-assessment and self-awareness.Importance of cultivation of values-sense of duty, devotion, self-reliance, confidence, concentration, truthfulness, Cleanliness, honesty, humanity, Power of faith, National unity, Love for nature, Discipline.Corporate ethics-Ethical values and global values.

Unit IV- Personality and behavior development **9**

Social and scientific attitude, developing responsible attitude- Accepting responsibilities in personal and professional life, developing readiness to accept changes in life and society.Integrity and discipline, Effective personality- 7 habits of effective people.Positive thinking- meaning and importance. Understanding positive thinking and self-talk, How to avoid negative thinking, Putting into practice and practicing positive thinking in everyday life.

Unit V- Importance of character and competence **9**

Achievement motivation, Self-management and good health
Importance of religion in life- Holy books vs. Blind faith, Role of women in inculcating moral values in family to nurture good citizens of the society.Self control-meaning, importance and ways to help improve self-control and build good habits.

Total: 45 Hours

Reference Books

1. R.P.Shukla (2004)-Value Education and Education for Human Rights -Sarup and sons, New Delhi
2. Chakraborty S.K (1998) - Values and ethics for organizations- theory and practice, Oxford University Press, New Delhi
3. Peale Norman Vincent (2016) Edition 1The Power of positive thinking
4. Home management - Values, Goals and Standards – Brain Kart

Course Outcome:

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

CO1: Identify the values and discriminate positive and negative values and practice positive thinking and good moral values

CO2: Give focus on character formation, competence and personality development.

CO3: Develop good habits, discipline and accept the family and professional responsibilities and lead a meaningful life.

Community and Social Service (CSS)

Semester II

Hours of Instruction/week: 2

21MECS01

Objective:

CLO1: To create awareness on needs and problems of the community with social awareness and a caring attitude for needy people

CLO2: To develop skills in organizing women into groups for collective action

Unit I Profile of Women in India

6

Profile of women in terms of literacy, work participation, health, reproductive health and nutrition and social and political participation. Survey to find out the literacy rate in different areas.

Unit II Government Programmes for the upliftment of Women

6

Education, Employment and Health

Unit III Organizational support for Women

6

Self-help Groups, a strategy for Entrepreneurship among women. Role of NGOs for upliftment of women, organizing women into groups.

Unit IV Women and Political Participation

6

Need for political empowerment of women, 73rd amendment, 1/3rd reservation of women in Panchayat and local bodies performances, problems and prospects of elected women. Study the participation of women in local bodies

Unit V Students involvement in community Social Services

6

Data base on women – literacy, employment, issues related to work participation, marital problems and disability. Awareness generation programmes – child labour, violence against women, blood donation and legal provisions safeguarding women. Activities oriented: adult literacy and subject related activities

Total: 30 Hours

Reference Books

1. Department of Home Science Extension, 2006, approaches to women and Development, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore.

Course Outcome:

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

CO1: To possess the attributes of being morally and intellectually responsive with social awareness and a caring attitude for needy people

CO2: To serve the community by applying their professional knowledge and skills and to organize various types of community service activities and awareness programmes.

CO3: To develop a right attitude of life, good interpersonal and communication skills and a sense of social awareness