



आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश
IFTM University, Moradabad, Uttar Pradesh
NAAC ACCREDITED

SCHOOL OF AGRICULTURAL SCIENCES & ENGINEERING

DEPARTMENT OF AGRICULTURAL ENGINEERING

**MASTER OF TECHNOLOGY
AGRICULTURAL ENGINEERING**

[w.e.f. ACADEMIC SESSION 2021 – 22]

IFTM UNIVERSITY, MORADABAD

N.H.-24, Lodhipur Rajput, Delhi Road, Moradabad, Uttar Pradesh-244102

Website: www.iftmuniversity.ac.in


Director

School of Agril. Sci. & Engg.
IFTMU, Moradabad.



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IFTM University
Moradabad



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SCHOOL OF AGRICULTURAL SCIENCES & ENGINEERING
DEPARTMENT OF AGRICULTURAL ENGINEERING

CBCS Based Course Structure and Syllabi
of
MASTER OF TECHNOLOGY
Agricultural Engineering
Process and Food Engineering
[w.e.f. Academic Session 2021 – 22]
(As per CBCS guidelines given by UGC)

Summary

Programme	: Master of Technology Agricultural Engineering
Programme Level	: Degree (Post Graduation)
Duration	: Two Years (Four Semesters) Full time
Medium of Instruction	: English
Minimum Required Attendance	: 75%
Maximum Credits	: 66


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ORDINANCE

Eligibility Criteria for Admission:

(a) M. Tech. Agricultural Engineering (Farm Machinery & Power Engineering)

The candidates possess minimum 55% (50% for SC/ST) in B. Tech. Agricultural Engineering / B. Tech. Mechanical Engineering for admission.

(b) M. Tech. Agricultural Engineering (Soil and Water Conservation Engineering)

The candidates possess minimum 55% (50% for SC/ST) in B. Tech. Agricultural Engineering / B. Tech. Civil Engineering for admission.

(c) M. Tech. Agricultural Engineering (Process and Food Engineering)

The candidates possess minimum 55% (50% for SC/ST) in B. Tech. Agricultural Engineering / B. Tech. Biotechnology for admission.

Examination:

Question Paper Structure:

There will be 10 descriptive type questions out of which 5 question have to be attempt. Each question carries 14 marks.

Evaluation and Assessment:

Assessment:						
Evaluation			Internal	External	Total	
Theory			30	70	100	
Practical/ Project Reports/ Viva-Voce			30	70	100	
Class Test-1	Class Test-2	Class Test-3	Assignment(s)	Attendance & Participation	Total	
Best two out of three						
10	10	10	5	5	30	
Duration of Examination			Internal	External		
			1 Hour	3 Hours		

Grade:

- a) The minimum Grade required to pass in each Theory & Practical paper is 'GRADE D'.
i) A candidate, in order to pass have to obtain minimum CGPA of 4.50 is required in a particular academic year inclusive of both semesters of that academic year subject to conditions of carry over system.

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Effective from Session 2021-22

*Grade, Semester Grade Point Average (SGPA), Cumulative Grade Point Average (CGPA) , Final CGPA and Percentage equivalence of CGPA/ Final CGPA will be awarded as per University norms.

Carry Over System: The student will be permitted maximum 04 carry over papers included theory/ practicals/projects for promotion to next academic year.

***All the following will be governed as per university norms and regulations.**

- i) Promotion,
- ii) Change of grade already awarded,
- iii) Award of division,
- iv) Unfair means,
- v) Results,
- vi) Improvement,
- vii) Grade card,
- viii) Ex- studentship,
- ix) Re- admission,
- x) Convocation

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CHOICE BASED CREDIT SYSTEM (CBCS)

Choice Based Credit System (CBCS), It Provides a learning Platform where the student or knowledge seeker has flexibility to choose their course from a list of elective, core & soft skill courses. This is a student centric approach to achieve his target no. of credits as specified by the UGC and adopted by our university.

Group of CBCS:

05 Groups of courses have been identified to provide students comprehensive exposure to a large number of areas, leading to the holistic development of an individual. These groups / clusters are as follows:

1. Engineering Core Courses (ECC)
2. Engineering Laboratory Courses (ELC)
3. Engineering Departmental Elective(EDE)
4. Engineering Supporting Courses (ESC)
5. Project/Dissertation/Seminar/Industrial training/General proficiency (PDT)

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M. Tech. Agricultural Engineering (Process and Food Engineering)			
Basic Structure: Distribution of Courses			
S. No.	Type of Course	Credit	Total Credits
1.	Engineering Core courses (ECC)	06 Courses of 3 Credits each (Total Credit 06X3)	18
2.	Engineering Laboratory Courses (ELC)	05 Courses of 1 Credits each (Total Credit 05X1)	05
3.	Engineering Departmental Elective (EDE)	02 Courses of 3 Credits each (Total Credit 2X3)	06
4.	Engineering Supporting Courses (ESC)	03 Courses of 3 Credits (Total Credit 03X3)	09
5.	Project/Dissertation/ Colloquium (PDT)	02 Course of 4 Credit (Total Credit 04X2) 01 Course of 20 Credits (Total credit 01x20)	28
Total Credits			66

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M.TECH. AGRICULTURAL ENGINEERING (PFE)

CHOICE BASED CREDIT SYSTEM

Effective from Session 2021-22

Course Code		CBCS BASKET	Credits			
Engineering/Discipline/Professional Core Courses(ECC)			L	T	P	C
MAE101		Advanced Food Process Engineering	2	1	0	3
MAE102		Food Plant Design	2	1	0	3
MAE201		Unit Operations in Food Process Engineering	2	1	0	3
MAE202		Engineering Properties of Food Materials	2	1	0	3
MAE301		Food Quality and Safety Engineering	2	1	0	3
MAE302		Food Packaging and Technologies	2	1	0	3
Engineering Supporting Courses (ESC)						
MMAG204		Agricultural Statistics and Experimental Designs	2	1	0	3
MME104		Heat and Mass Transfer	2	1	0	3
MBT101		Food Chemistry	2	1	0	3
Engineering Lab Course(ELC)			L	T	P	C
MAE151		Food Process Engineering Lab	0	0	2	1
MBT151		Food Chemistry Lab	0	0	2	1
MAE251		Unit operations Lab	0	0	2	1
MMAG254		Agricultural Statistics and Experimental Designs Lab	0	0	2	1
MAE351		Food Quality and Safety Engineering Lab	0	0	2	1
Engineering Departmental Elective (EDE)			L	T	P	C
Elective-I	MAE203 I	Fruits and Vegetables Process Engineering	2	1	0	3
	MAE203 II	Processing of Cereals, Pulses and oil Seed				
	MAE203 III	Farm Structures and Environmental Control				
Elective-II	MAE303 I	Storage Engineering and Handling of Agricultural Products	2	1	0	3
	MAE303 II	Food Supply Chain Management				
	MAE303 III	Agricultural Waste and by –Products Utilization				
Project/Dissertation/Seminar/Summer or Industrial Training (PDT)			L	T	P	C
MAE352		Seminar	0	0	2	4
MAE353		Pre-Dissertation	0	0	4	4
MAE451		Dissertation Work			20	20

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STUDY & EVALUATION SCHEME
M. Tech. Agricultural Engineering (Process and Food Engineering)
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CHOICE BASED CREDIT SYSTEM (CBCS)

YEAR I, SEMESTER-I

S.N.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
				L	T	P	Mid Term Exam		External Exam			
							AS +AT	CT		Total		
THEORY												
1.	ECC	MAE101	Advanced Food Process Engineering	3	0	0	20	10	30	70	100	3
2.	ECC	MAE102	Food Plant Design	3	0	0	20	10	30	70	100	3
3.	ESC	MBT101	Food Chemistry	3	0	0	20	10	30	70	100	3
4.	ESC	MME104	Heat and Mass Transfer	3	0	0	20	10	30	70	100	3
PRACTICALS / PROJECT												
							IA	AT				
5.	ELC	MAE151	Food Process Engineering Lab	0	0	2	20	10	30	70	100	1
6.	ELC	MBT151	Food Chemistry Lab	0	0	2	20	10	30	70	100	1
			TOTAL	12	00	04					600	14

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YEAR I, SEMESTER- II

S.N. Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
			L	T	P	Mid Term Exam			External Exam		
						CT	AS +AT	Total			
THEORY											
1.	EEC	MAE201	3	0	0	20	10	30	70	100	3
2.	EEC	MAE202	3	0	0	20	10	30	70	100	3
3.	EDE	MAE203	3	0	0	20	10	30	70	100	3
4.	ESC	MMAG204	3	0	0	20	10	30	70	100	3
PRACTICALS / PROJECT											
						IA	AT				
5.	ELC	MAE251	0	0	2	20	10	30	70	100	1
6.	ELC	MMAG254	0	0	2	20	10	30	70	100	1
		TOTAL	12	00	04					600	14


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YEAR II, SEMESTER- III

S.N. Category	Course Code	Course Name	Periods			EVALUATION SCHEME					Course Total	Credits
			L	T	P	Mid Term Exam			External Exam			
						CT	AS +AT	Total				
THEORY												
1.	ECC	MAE301	3	0	0	20	10	30	70	100	3	
2.	ECC	MAE302	3	0	0	20	10	30	70	100	3	
3.	EDE	MAE303	3	0	0	20	10	30	70	100	3	
PRACTICALS / PROJECT												
						IA	AT					
4.	ELC	MAE351	0	0	2	20	10	30	70	100	1	
5.	PDT	MAE352	0	0	4	-	100	100	-	100	4	
6.	PDT	MAE353	0	0	4	-	50	50	50	100	4	
		Total	09	00	10					600	18	


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Sanjiv Kumar

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YEAR II, SEMESTER- IV

S.N.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
				L	T	P	Mid Term Exam		External Exam			
							CT	AS +AT		Total		
PRACTICALS / PROJECT												
1	PDT	MAE451	Dissertation Work	-	-	20		300	300	300	600	20
			Total	-	-	20					600	20

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M. Tech. Agricultural Engineering (Process and Food Engineering)
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CHOICE BASED CREDIT SYSTEM (CBCS)

Engineering Departmental Elective (EDE)	
Elective-I	MAE203 I Fruits and Vegetables Process Engineering
	MAE203 II Processing of Cereals, Pulses and oil Seed
	MAE203 III Farm Structures and Environmental Control
Elective-II	MAE303 I Storage Engineering and Handling of Agricultural Products
	MAE303 II Food Supply Chain Management
	MAE303 III Agricultural Waste and by –Products Utilization
Project/Dissertation/Seminar/Summer or Industrial Training (PDT)	
MAE352	Seminar
MAE353	Pre-Dissertation
MAE451	Dissertation Work


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Sanjiv Arora

MAE101

Advanced Food Process Engineering

L:T:P 3:0:0

Objectives:

- To enable the students to solve problems in Food Engineering process of value addition and quality improvement.
- To impart knowledge on the Advanced of Food Process Engineering and its importance for the Food Industry.
- To make the student to understand units and dimensions, ability to solve engineering problems related to food processing, and familiarization with some food processing unit operations.

UNIT I

Scope of food processing; historical developments; principles of food processing and preservation **for skill enhancement.**

UNIT II

Processing and preservation by heat – blanching, pasteurization, sterilization and UHT processing, canning, extrusion cooking, dielectric heating, microwave heating, baking, roasting and frying, etc. Milk Processing **for better skilling of entrepreneurship.**

UNIT III

Processing and preservation by low-temperature- refrigeration, freezing, and de-hydro-freezing. Processing and preservation by drying, concentration and evaporation-types of dryers, ultra- filtration, reverse osmosis **for better employability in industry.**


UNIT IV

Processing and preservation by non-thermal methods, irradiation, high pressure Processing (HPP), pulsed electric field, hurdle technology **methods for skilling of rescue management.**

UNIT V

Use and application of enzymes and microorganisms in processing and preservation of foods; food fermentations, pickling, smoking, etc.; Food additives: definition, types and functions, permissible limits and safety aspects **for skill development and employability.**

Course Outcomes:


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CO: 1 The students will be understand the principles in formulating solutions to solve problems in food industry **for skill enhancement.**

CO: 2 The students will be understood the importance of Food Process Engineering as one of the major pillars of Food Science and Technology discipline **for better skilling of entrepreneurship.**

CO: 3 The students will acquired the required skills in dealing with units and dimensions, solving problems of Food Process Engineering **for better employability in industry.**

CO: 4 The students will acquired the knowledge of processing and preservation by non-thermal methods **methods for skilling of rescue management.**

CO: 5 The students will be understand the Uuse and application of enzymes and microorganisms in processing and preservation of foods **for skill development and employability.**

PO-CO Mapping (Please write 3, 2, 1 wherever required)

Note: 3= Highly correlated, 2= moderately correlated, 1= Less correlated

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	1	3	3	2	1	3
CO:2	2	3	1	1	3	3	1	2
CO:3	1	1	3	2	1	3	3	3
CO:4	3	1	3	3	2	3	3	2
CO:5	3	2	3	1	3	3	2	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

Note: 3= Highly correlated, 2= Moderately correlated, 1= Less correlated

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	2	1
CO:2	3	1	3
CO:3	1	3	2
CO:4	3	2	1
CO:5	3	3	2

References:

1. Arsdel W B, Copley MJ & Morgan AI. 1973. Food Dehydration. 2nd Ed. Vols. I, II. AVI Publ.
2. Desrosier N W & James N.1977. Technology of Food Preservation. 3th Ed. AVI. Publ.

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3. **Fellows P J. 2005.** Food Processing Technology: Principle and Practice. 2nd Ed. CRC.
4. **Jelen P. 1985.** Introduction to Food Processing. Prentice Hall.
5. **Potter N N & Hotchkiss 1997.** Food Science. 5th Ed. CBS.
6. **Potty V H & Mulky M J. 1993.** Food Processing. Oxford & IBH.
7. **Ramaswamy H & Marcotte M. 2006.** Food Processing: Principles and Applications. Taylor & Francis.

Website Sources:

- <https://ecourses.icar.gov.in/>
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MAE151

Food Process Engineering Lab


L:T:P 0:0:1

List of Experiments:

Minimum 08 experiments out of the following:

1. Measurement of Moisture Content in Food.
2. Drying and Drying characteristics of food Materials.
3. Post harvest handling of different fruits, vegetable and seed crops.
4. Preparation and evaluation of table butter, ice-cream, cheese and indigenous milk product such pioneer, Dahi, ghee, Lassi, Burfi etc.
5. Preparation of Fermented food products.
6. Evolution of Milk Quality.
7. Preparation of fruit beverage, i.e. Orange squash, grape squash, lime squash.
8. Preparation of fruit juices- orange, pineapple, apple, lemon etc.
9. Studies on of different types of freezers.
10. Studies on Low Temperature Preservation Techniques.
11. Studies on Concentration of Liquid Food.
12. Studies on extrusion cooking of foods.
13. Study on basics of reception of milk at the plant; platform tests on milk.
14. Use of chemicals in preservation of foods.


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MAE102

Food Plant Design

L:T:P 3:0:0

Objectives:

- To enable the students to solve problems in hygienic design aspects and worker's safety, functional design of plant building and selection of building materials, estimation of capital investment,
- To impart knowledge on the design of machinery for drying, milling, separation, grinding, mixing, evaporation, condensation, membrane separation.
- To make the student to understand design considerations of layout and equipment.

UNIT I

Design considerations of layout and equipment **for skill development and employability.**

UNIT II

Plant design concepts and general design considerations: plant location, location factors and their interaction with plant location, location theory models, Computer aided selection of the location. **for better employability in industry.**

UNIT III

Design of machinery for drying, milling, separation, grinding, mixing, evaporation, condensation, membrane separation. Human factors in design, selection of materials of construction and standard component, design standards and testing standards. **methods for skilling of rescue management.**

UNIT IV

Feasibility analysis and preparation of feasibility report: plant size, factors affecting plant size and their interactions, estimation of break-even and economic plant size; Product and process design, process selection, process flow charts, and computer aided development of flow charts. **for skill enhancement.**

UNIT V

Hygienic design aspects and worker's safety, functional design of plant building and selection of building materials, estimation of capital investment, analysis of plant costs and profit abilities, management techniques in plant design including applications of network analysis, preparation of project report and its appraisal **for better skilling of entrepreneurship.**

Course Outcomes:

CO:1 The students will understand the principles in design considerations of layout and equipment **for skill development and employability.**


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CO:2 The students understood the importance on the design of machinery for drying **for better employability in industry.**

CO: 3 Milling, separation, grinding, mixing, evaporation, condensation, membrane separation.

CO: 4The students acquired the required skills in dealing with units and dimensions **for skill enhancement.**

CO: 5 design solving problems of Food Process Engineering. **For better skilling of entrepreneurship.**

PO-CO Mapping (Please write 3, 2, 1 wherever required)

Note: 3= Highly correlated, 2= moderately correlated, 1= Less correlated

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	1	3	2	3	1	3
CO:2	1	3	2	2	1	3	2	1
CO:3	3	2	3	3	1	2	3	3
CO:4	1	2		3	2	1	3	2
CO:5	3	1	3	1	3	3	1	2

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

Note: 3= Highly correlated, 2= Moderately correlated, 1= Less correlated

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	3	1
CO:2	2	3	2
CO:3	1	2	1
CO:4	3	1	2
CO:5	1	2	3

References:

1. Ahmed T. 1997. Dairy Plant Engineering and Management. 3th Ed. Kitab Mahal.
2. Chakraverty A & De DS. 1981. Post-harvest Technology of Cereals.
3. Hall CW & Davis DC. 1979. Processing Equipment for Agricultural Products. AVI Publ.
4. Henderson S & Perry SM. 1976. Agricultural Process Engineering. 5th Ed. AVI Publ.
5. Johnson AJ. 1986. Process Control Instrumentation Technology. 2nd Ed. Wiley International & ELBS.

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6. Richey CB. (Ed.). 1961. Agricultural Engineers' Hand Book. Mc Graw Hill.
7. Romeo T Toledo. 1997. Fundamentals of Food Process Engineering. CBS.

Website Sources:

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MBT-101

Food Chemistry

L:T:P 3:0:0

Objectives:

- To understand the chemistry of food constituents
- To apply food molecules interaction in developing technologies / processes
- To develop skills for experimenting with food systems and to test various approaches for manipulating
- The chemical and/or functional properties of foods.

Unit-I

Food chemistry: definition and importance; Water: functions, physical properties, types of water, water activity and shelf life of food; Carbohydrates: definition, nomenclature, classification, physical and chemical properties of sugar, functional properties of polysaccharides, modified starch, starch hydrolysates, polyols, glycogen, fiber **for skill enhancement.**

for skill development and employability.

Unit-II

Proteins; physical and chemical properties of amino acids, proteins, classification and structure, function and properties of protein, animal and plant proteins, effect of processing; Lipids: classification, estimation of fatty acids, physical properties, Fat constant: saponification number, acid number, iodine value, acetyl value, Reichert Meissel number, effect of freezing, flavoure

Version **for better employability in industry.**

Unit-III

Oxidative and hydrolytic rancidity, hydrogenation, interesterification, different types of fats, uses in food processing, food emulsions, fat replacers **methods for skilling of rescue management.**

Unit-IV

Minerals: classification, minerals in meat, milk, plants and their interaction with other components, losses of minerals during processing, metal uptake in canned foods; Vitamins: fat soluble and water soluble vitamins, their food sources, effect of food processing **methods for skilling of rescue management.**

Unit-V

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Enzymes: nature and functions, enzymes in food processing, immobilized enzymes; Natural pigments and flavoring agents; chlorophyll, carotenoids, anthocyanins, anthoxanthins, flavonoids, tannins, natural flavour constituents; Additives and contaminants: intentional additives, incidental additives, anti-nutritional factors. **for better skilling of entrepreneurship.**

Course Outcomes:

The student will be able to

CO: 1 To name and describe the general chemical structures of the major components of foods (water, proteins), **for skill enhancement.**

CO: 2 acquired the knowledge of Carbohydrates, and lipids) and selected minor components (vitamins and minerals). **for better employability in industry.**

CO: 3 To relate the chemical composition of foods to their functional properties **methods for skilling of rescue management.**

CO: 4 To understand, plan, perform and analyse a range of chemical investigations with an emphasis on food Analysis **methods for skilling of rescue management.**

CO: 5 To give a molecular rationalization for the observed physical properties and reactivity of major food components **for better skilling of entrepreneurship.**

PO-CO Mapping (Please write 3, 2, 1 wherever required)


Note: 3= Highly correlated, 2= moderately correlated, 1= Less correlated

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	2	3	2	2	1	3
CO:2	1	3	1	3	1	3	2	1
CO:3	2	1	3	1	2	3	3	3
CO:4	3	2	1	3	1	3	3	2
CO:5	1	1	3	2	3	3	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

Note: 3= Highly correlated, 2= Moderately correlated, 1= Less correlated


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	Skill Development	Employability	Entrepreneurship Development
CO:1	3	1	2
CO:2	1	3	1
CO:3	3	2	2
CO:4	3	1	1
CO:5	1	2	3

References:

1. **John DeMan**, Principles of Food Chemistry, 3rded, Springer-Verlag, 1999.
2. **C.M.Weaver and J.R.Daniel**, The Food Chemistry Laboratory: A Manual for Experimental
3. foods, Dietetics, Food Scientists. CRC Press, 1996.
4. **S. Damodaran, S., K.L. Parkin, O.R. Fennema**, Fennema's Food Chemistry. CRC, 2007.
5. **O. R. Fennema**, Principles of Food Science Part I: Food Chemistry, Marcel Dekker, 1996.
6. **H.D.Belitz, W.Grosch and P.Schieberle**, Food Chemistry, 3rded, Springer-Verlag, 2003.

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MBT-151

Food Chemistry Lab

L:T:P 0:0:1

List of Experiments:

Minimum 08 experiments out of the following:

1. Deduction of Adulterants in Fat and Oils.
2. Deduction of Adulterants in Milk, Water and Starch.
3. Determination of ash content.
4. Determination of gluten content in Wheat.
5. Determination of minerals: calcium, phosphorous and iron.
6. Determination of proteins.
7. Determination of total sugar (Reducing and Non reducing).
8. Estimation of vitamins: ascorbic acid, carotene and thiamine.
9. Moisture and Total Solids in Fluids.
10. Study of Detection and estimation of amino acids by chromatographic techniques.
11. Study of enzymatic and nonenzymatic browning in food.
12. Study of phosphorus and iron; anti-nutritional factors in foods.


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MME-104

Heat and Mass Transfer

L:T:P 3:0:0

Objectives:

- To enable the student to basic study of the phenomena of heat and mass transfer, to develop methodologies for solving food engineering problems
- To understand the information concerning the performance and design of Heat exchangers
- To develop processes with better heat efficiency and economics

UNIT I

Introduction to heat and mass transfer and their analogous behavior, steady and unsteady state heat conduction, analytical and numerical solution of unsteady state heat conduction equations, use of Gurnie-Lurie and Heisler Charts in solving heat conduction problems. Applications in food processing including freezing and thawing of foods **for skill enhancement.**

for skill enhancement.

UNIT II

Convective heat transfer in food processing systems involving laminar and turbulent flow heat transfer in boiling liquids, heat transfer between fluids and solid foods. Functional design of heat exchangers: Shell and tube, plate and scraped surface heat exchangers, Jacketed vessels **for better skilling of entrepreneurship.**

UNIT III

Radiation heat transfer and its governing laws, its applications in food processing. **for better employability in industry.**

UNIT IV

Molecular diffusion in gases, liquids and solids; molecular diffusion in biological solutions and suspensions molecular diffusion in solids. **methods for skilling of rescue management.**

UNIT V

Unsteady state mass transfer and mass transfer coefficients, molecular diffusion with convection and chemical reaction, diffusion of gases in porous solids and capillaries, mass transfer applications in food processing **for skill development and employability.**


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Course Outcomes:

The student will be able to:

CO: 1 the basic laws of heat transfer and account for the consequence of heat transfer in thermal analyses of engineering systems **for better skilling of entrepreneurship.**

CO: 2 To analyze problems involving steady state heat conduction in simple geometries. **for better skilling of entrepreneurship.**

CO: 3 To evaluate heat transfer coefficients for natural convection **for better employability in industry.**

CO: 4 To analyze heat exchanger performance by using the method of log means temperature difference. **methods for skilling of rescue management.**

CO: 5 To analyze heat exchanger performance by using the method of heat exchanger effectiveness. **for skill development and employability.**

PO-CO Mapping (Please write 3, 2, 1 wherever required)

Note: 3= Highly correlated, 2= moderately correlated, 1= Less correlated

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	1	3	2	2	1	3
CO:2	1	3	2	3	1	3	1	1
CO:3	3	1	3	1	2	1	3	3
CO:4	2	1	2	3	1	2	1	2
CO:5	3	1	3	2	3	3	2	1

CO-Curriculum Enrichment Mapping (Please 3 wherever required)

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	1	3
CO:2	3	2	3
CO:3	1	3	1
CO:4	3	1	2
CO:5	3	3	1

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MAE201

Unit Operations in Food Process Engineering

L:T:P 3:0:0

Objectives:

- To know the various types of equipments used in the food industry.
- To learn the operation and utilization of equipments involved.
- To choose suitable techniques for the food processing operation.

UNIT I

Preservation of foods – physical and chemical methods-microbiological aspects thermo bacteriology. Principles of fluid flow, methods of heat transfer, heat exchangers and their designs. Evaporation and distillation: Blanching, pasteurization-LTLT, HTST and UHT process. Evaporation – definition single and multiple effect evaporator, mass and enthalpy balance, liquid characteristics – single and multiple effect evaporation-performances of evaporators **for skill enhancement**.

UNIT II

Psychrometry, dehydration, EMC, Thermal processing operations; Evaporation, dehydration/drying, types of dryers, blanching, steam requirements in food processing. Homogenization; Mixing- mixers, kneaders and blenders. Extrusion, Extrusion cooking - recent developments, methods, equipment, Membrane technology. Nonthermal processing techniques. Hurdle technology - hydrostatic pressure treatment of food - equipment, processing **for better skilling of entrepreneurship**.

UNIT III

Refrigeration principles and Food freezing. Mechanical separation techniques, size separation equipments; Filtration, sieving, centrifugation, sedimentation. Conveyors and elevators; Size reduction processes; Grinding and milling. Milling of food Materials & Its Equipments **for better employability in industry**.

UNIT IV

Material handling equipments- screw conveyor, bucket elevator, belt conveyor, chain conveyor, pneumatic conveyor-size reduction process- energy and power requirements in commencing- Rittinger's, Bond's and Kick's laws of crushing - principles of milling equipments - hammer mill, ball mill **methods for skilling of rescue management**.

UNIT V


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Application of heat energy and ultrasound - inactivation of microorganisms and enzymes -electrical resistance heating of food - heat generation, ohmic heater, heating models - pulsed electric field preservation- principles and application **for skill development and employability.**

Course Outcomes:

The student will be able to:

CO: 1 To define the various unit operations in food processing **for skill enhancement.**

CO: 2 To compute the moisture content of food materials **for better skilling of entrepreneurship.**

CO: 3 To describe and demonstrate the various process equipments **for better employability in industry.**

CO: 4 To evaluate the different operations in food processing **methods for skilling of rescue management.**

CO: 5 To estimate the energy requirement for the different unit operations **for skill development and employability.**

PO-CO Mapping (Please 3 wherever required)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	1	3	3	1	3	3
CO:2	1	3	2	2	2	3	1	1
CO:3	3	1	3	1	2	3	3	3
CO:4	3	2	1	3	1	3	3	2
CO:5	2	1	3	1	3	3	2	3

CO-Curriculum Enrichment Mapping (Please 3 wherever required)

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	2	1
CO:2	3	1	3
CO:3	1	3	2
CO:4	3	2	1
CO:5	3	3	2

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MAE251

Unit Operations Lab


L:T:P 0:0:1

List of Experiments:

Minimum 08 experiments out of the following:

1. Design and layout of seed processing plant and its economics.
2. Determination of size, shape, density and area-volume-mass relationship of fruits and vegetables.
3. Experiments for the determination of physical properties like, length, breadth, thickness, surface area, bulk density, porosity, true density, coefficient of friction, angle of repose and color for various food grains,
4. Study of different types of dryers.
5. Study of driers, elevating and conveying equipments, size reduction equipments, cleaning and sorting equipments, mixing equipments.
6. Study of Drying Characteristics of food materials.
7. Study of Operation and performance evaluation of various seed processing equipments such as pre cleaner, scalpels, air screen cleaner, indented cylinder, gravity separator, pneumatic separator, conveyors.
8. Study of paddy, wheat, pulses and oilseeds milling equipments; planning and layout of various milling plants.
9. Study of thermal properties like thermal conductivity, thermal diffusivity and specific heat.
10. Study on CAP and MAP.
11. To study the heat exchanger process in double pipe heat exchanger under parallel and counter current flow condition.
12. Visit to a food processing plant.


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MAE202

Engineering Properties of Food Materials

L:T:P 3:0:0

Objectives:

- To study about the different methods of determining the quality and properties of different foods
- To gain knowledge of engineering properties during processing, packing, storage and transport.
- To impart knowledge about electrical properties of food and its applications in food engineering.

UNIT I

Physical characteristics of different food grains, fruits and vegetables; Shape and size, description of shape and size, volume and density, porosity, surface area. Rheology; terms, physical states of materials, classical ideal material, rheological models and equations, visco elasticity, creep-stress relaxation, Non Newtonian fluid and viscometer, rheological properties, force, deformation, stress, strain, elastic, plastic behavior. **for skill enhancement.**

for skill development and employability.

UNIT II

Contact stresses between bodies, Hertz problems, firmness and hardness, friction, effect of load, sliding velocity, water film and surface roughness. Friction in agricultural materials, rolling resistance, angle of internal friction, angle of repose, flow of bulk granular materials, aerodynamics of agricultural products, drag coefficients. **for entrepreneurship.**

UNIT III

Thermal properties: Specific heat, thermal conductivity, thermal diffusivity, methods of determination, steady state and transient heat flow **for better employability in industry.**

UNIT IV

Electrical properties; Dielectric loss factor, loss tangent, A.C. conductivity and dielectric constant, method of determination, energy absorption from high-frequency electric field **methods for skilling of rescue management.**

UNIT V

Application of engineering properties in design and operation of agricultural equipment and structures **for better skilling of entrepreneurship.**


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Course Outcomes:

The student will be able to:

CO: 1 To understand Engineering properties of food materials **for skill enhancement.**

CO: 2 To identify the structure and chemical composition of foods **for entrepreneurship.**
for better skilling of entrepreneurship.

CO: 3 To determine the physical properties of food materials **for better employability in industry.**

CO: 4 To calculate the water activity, food stability sorption and desorption isotherm of food materials.
methods for skilling of rescue management.

CO: 5 To study the difference between Newtonian and non-Newtonian fluids. **for better skilling of entrepreneurship.**

PO-CO Mapping (Please 3 wherever required)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	2	3	3	1	3	3
CO:2	3	3	3	1	2	3	1	1
CO:3	1	3	1	3	1	2	3	3
CO:4	3	2	1	3	2	3	3	2
CO:5	3	1	3	1	3	3	2	3

CO-Curriculum Enrichment Mapping (Please 3 wherever required)

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	1	1
CO:2	1	2	3
CO:3	2	3	2
CO:4	3	1	1
CO:5	1	2	3

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MMAG 204

Agricultural Statistics and Experimental Design

L:T:P : 3:0:0

Objective: The main aims of this course are to provide comprehensive knowledge of the basic information of agriculture statistics and experimental design.

Unit I

Presentation of Data: Frequency distributions; graphical presentation of data by histogram, frequency polygon, frequency curve and cumulative frequency curves Measures of Locations and Dispersion: Mean, median, mode and their simple properties (with-out derivation) and calculations of median by graphs; range, mean deviation, standard deviation, standard error, coefficient of variation. **for better skilling of entrepreneurship.**

Unit II

Probability and Distributions: Random distributions; events exhaustive, mutually exclusive and equally likely; definition of probability (with simple exercises); definitions of binomial, Poisson's and normal distributions; and simple properties of the above distributions (without derivation) **for skill enhancement.**

Unit III

Correlation and Regression: Bivariate data-simple correlation and regression coefficients and their relation; Spearman rank correlation; limits of correlation coefficient; effect of change of origin and scale on correlation coefficient; linear regression and equations of line of regression; association and independence of attributes **for better employability in industry.**

Unit IV

Sampling: Concept of population and sample; random samples; methods of taking a simple random sample. Tests of significance: sampling distribution of mean and standard error; z and t-test (equality of means; paired and unpaired t-test); t-test for comparison of means when variances of two populations differ; Chi- square test for goodness of fit; independence of attributes, and homogeneity of samples; interrelation between t-test and F-Test. **for skill development and employability.**

Unit V

Experimental Designs: Principles of experimental designs; completely randomized, randomized complete block design (missing plot value in RBD); latin square designs; augmented block design;

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simple factorial experiments including split and strip plot design (mathematical derivations not required); analysis of variance (ANOVA) and its use including estimation of LSD (CD) **methods for skilling of rescue management.**

Course Outcomes:

The student is able to

CO: 1 Understand basic theoretical and applied principles of agricultural statistics needed to enter in agriculture **for better skilling of entrepreneurship.**

CO: 2 Demonstrate an understanding of the basic concepts of probability and random variables **for skill enhancement.**

CO: 3 Understand and interpret the concepts of descriptive statistics from the obtained data **for better employability in industry.**

CO: 4 Utilize and apply regression and other statistical methods to analyze commodity markets and economic data. **for skill development and employability.**

CO: 5 Gain proficiency in using statistical software for data analysis **methods for skilling of rescue management.**

PO-CO Mapping (Please 3 wherever required)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	2	3	1	2	1	3
CO:2	2	3	1	1	2	3	2	1
CO:3	1	2	3	2	1	3	3	3
CO:4	2	1	1	3	2	3	3	2
CO:5	1	1	3	2	3	3	1	2

CO-Curriculum Enrichment Mapping (Please 3 wherever required)

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	2	3
CO:2	3	1	2

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CO:3	1	3	1
CO:4	3	3	2
CO:5	3	1	2

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MMAG 254 Agricultural Statistics and Experimental Design Lab L:T:P 0:0:1

List of Experiments:

1. Measurement of central tendency and dispersion
2. Standard deviation and standard error
3. Principle uses of χ^2 , F and T- test.
4. Correlation Coefficient, Regression coefficient and Regression equation.
5. Analysis of data generated from completely randomized design, randomized block design.
6. Analysis of data generated from Latin square design, factorial experiments in 2^2 , 2^3 Split plot designs
7. Missing plot techniques.
8. Analysis of covariance.
9. Sampling in field experiments.
10. Analysis of variance (ANOVA).


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MAE301

Food Quality and Safety Engineering

L:T:P 3:0:0

Objectives:

- Introduce the Food safety, need for quality control and safety
- Explain designing safety in products and processes.
- Describe Personnel hygienic standards, preventative pest control

UNIT I

Food safety, need for quality control and safety, strategy and criteria, microbiological criteria for safety and quality, scope of food toxicology, toxic potential and food toxicants, biological and chemical contaminants **for skill enhancement.**

UNIT II

Food additives and derived substances, factors affecting toxicity, designing safety in products and processes, intrinsic factors, establishing a safe raw material supply, safe and achievable shelf life **for better skilling of entrepreneurship.**

UNIT III

Process equipment and machinery auditing, consideration of risk, environmental consideration, mechanical quality control **for better employability in industry.**

UNIT IV

Personnel hygienic standards, preventative pest control, cleaning and disinfesting system, biological factors underlying food safety **methods for skilling of rescue management.**

UNIT V

Preservation and stability, contaminants of processed foods, adulteration, prevention and control, FPO, PFA, Codex, GMP, BIS and HACCP; Practices, principles, standards, specifications, application establishment and implementation; HACCP and quality management system **for skill development and employability.**

Course Outcomes:

The student is able to


CO: 1 After successful completion of the course, the student will be able to **for skill enhancement.**

CO: 2 Apply the fundamental concepts of Food safety, need for quality control and safety, strategy and criteria, microbiological criteria for safety and quality **for better skilling of entrepreneurship.**

CO: 3 Derive prevention and control, FPO, PFA, Codex, GMP, BIS and HACCP; Practices **for better employability in industry.**

CO: 4 HACCP and quality management system **methods for skilling of rescue management.**

CO: 5 Preservation and stability, contaminants of processed foods, adulteration, prevention and control **for skill development and employability.**


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PO-CO Mapping (Please 3 wherever required)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	1	3	3	2	1	3
CO:2	1	3	2	1	2	3	3	2
CO:3	3	1	3	2	1	1	3	3
CO:4	3	2	1	3	2	3	3	1
CO:5	2	1	3	1	3	3	2	3

CO-Curriculum Enrichment Mapping (Please 3 wherever required)

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	1	1
CO:2	3	2	3
CO:3	2	3	2
CO:4	3	1	1
CO:5	3	3	1

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MAE351

Food Quality and Safety Engineering Lab

L:T:P 0:0:1

List of Experiments:

1. Microbiological examination of food.
2. HACCP case studies.
3. CCP & CCP Decision tree.
4. HACCP control chart.
5. Codex standards and specifications.
6. Visits to food industries to study the various quality and safety aspects adopted.
7. Preparation of quality policy & documentation,
8. Visit to Units with HACCP certification
9. Visit to Units with ISO systems
10. GMP, GAP documentation.


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MAE302

Food Packaging and Technologies

L:T:P 3:0:0

Objectives:

- To impart knowledge of the objectives of food packaging and Technologies its role in food preservation during storage, transportation and distribution
- To provide knowledge to the students about the types of packaging materials their properties and packaging systems.

UNIT I

Introduction of packaging: Package, functions and design. Principle in the development of protective packaging. Deteriorative changes in foodstuff and packaging methods of prevention.

for skill enhancement.

UNIT II

Food containers: Rigid containers, glass, wooden boxes, crates, plywood and wire bound boxes, corrugated and fiber board boxes, textile and paper sacks, corrosion of containers (tin plate); Flexible packaging materials and their properties; Aluminum as packaging material; Evaluation of packaging material and package performance **for better skilling of entrepreneurship.**

UNIT III

Packaging equipments: Food packages, bags, types of pouches, wrappers, carton and other traditional package; Retortablepouches; Shelf life of packaged foodstuff. **for better employability in industry.**

UNIT IV

Methods to extend shelf life; Packaging equipment and machinery: Vacuum, CA and MA packaging machine; gas packaging machine; seal and shrink packaging machine; form and fill sealing machine; aseptic packaging systems; bottling machines; carton making machines **for skill development and employability.**

UNIT V

Package standards and regulation; Shrink packaging; Aseptic packaging, CA and MAP, Active packaging; Biodegradable packaging **methods for skilling of rescue management.**

Course Outcomes:

The student is able to

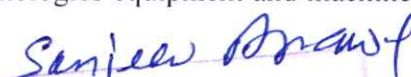
CO: 1 After successful completion of the course, the student will be able to **for skill enhancement.**

CO: 2 Apply the fundamental concepts of Flexible packaging materials and their properties **for better skilling of entrepreneurship.**

CO: 3 Derive prevention and control, gas packaging machine; seal and shrink packaging machine; form and fill sealing machine **for better employability in industry.**

CO: 4 Determine methods to extend shelf life; Packaging and Technologies equipment and machinery **for skill development and employability.**


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CO: 5 Understanding the Package standards and regulation; Shrink packaging; Aseptic packaging methods for skilling of rescue management.

PO-CO Mapping (Please 3 wherever required)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	3	1	2	1	3	3
CO:2	1	3	1	3	1	3	2	1
CO:3	3	1	3	3	3	2	1	2
CO:4	2	2	2	3	1	3	3	1
CO:5	3	1	3	2	3	3	1	3

CO-Curriculum Enrichment Mapping (Please 3 wherever required)

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	2	1
CO:2	3	1	3
CO:3	2	3	2
CO:4	3	3	1
CO:5	3	1	2

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MAE203 I

Fruits and Vegetables Process Engineering

L:T:P 3:0:0

Objectives:

- To enable the students to understand the processing of fruits and vegetables
- To impart technical knowledge of about how to develop products and preservation
- To understand the methods of dehydration

UNIT I

Importance of post harvest technology of fruits and vegetables, structure, cellular components, composition and nutritive value of fruits and vegetables, fruit ripening, spoilage of fruits and vegetables **for skill enhancement.**

UNIT II

Harvesting and washing, pre-cooling, preservation of fruits and vegetables, blanching, commercial canning of fruits and vegetables, minimal processing of fruits and vegetables **for better skilling of entrepreneurship.**

UNIT III

Cold storage of fruits and vegetables, controlled atmosphere packaging of fruits and vegetables, gas composition, quality of storage **for better employability in industry.**

UNIT IV


Dehydration of fruits and vegetables, methods, osmotic dehydration, foam mat drying, freeze drying, microwave heating, applications, radiation preservation of fruits and vegetables, irradiation sources **methods for skilling of rescue management.**


UNIT V

Intermediate moisture foods, ohmic heating principle, high pressure processing of fruits and vegetables, applications, sensory evaluation of fruit and vegetable products, packaging technology for fruits and vegetables, general principles of quality standards and control, FPO, quality attributes **for skill development and employability.**

Course Outcomes:

The student is able to


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CO: 1 To understand the production status and post harvest handling methods of fruits and vegetables **for skill enhancement.**

CO: 2 To learn the methods of processing and preservation of freshly harvested and cut fruits and vegetables **for better skilling of entrepreneurship.**

CO: 3 To enumerate the processing and preservation of fruits and vegetables by heat treatment **for better employability in industry.**

CO: 4 To understand the dehydration methods and design of driers used for drying fruit and vegetables **methods for skilling of rescue management.**

CO: 5 To describe the aseptic technology for product preservation **for skill development and employability.**

PO-CO Mapping (Please 3 wherever required)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	3	3	3	3	2	3
CO:2	1	3	1	3	1	2	3	3
CO:3	3	1	2	1	2	3	3	3
CO:4	2	3	3	3	1	3	1	2
CO:5	3	1	3	2	3	3	1	3

CO-Curriculum Enrichment Mapping (Please 3 wherever required)

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	1	2
CO:2	3	2	3
CO:3	1	3	1
CO:4	3	1	2
CO:5	3	3	1

References:

1. Cruess W V. 2000. Commercial Fruit and Vegetable Products. Agrobios.
2. Mircea Enachesca Danthy. 1997. Fruit and Vegetable Processing. International Book Publ.

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3. Srivastava RP & Sanjeev Kumar. 1993. Fruit and Vegetable Preservation. Principles and Practices. International Book Distr.
4. Sumanbhatti & Uma Varma. 1995. Fruit and Vegetable Processing. CBS.
5. Thompson AK. 1996. Post Harvest Technology of Fruits and Vegetables. Blackwell.
6. Verma L R & Joshi V K. 2000. Post Harvest Technology of Fruits and Vegetables. Vols. I-II. Indus Publ.

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MAE203 II

Processing of Cereals, Pulses and Oil Seeds

L:T:P 3:0:0

Objectives:

- Introduce the properties of Cereals, Pulses and Oil Seeds
- Provide the knowledge on Cereals, Pulses used in food industry
- Introduce the role of Cereals, Pulses additives and phytochemicals

UNIT I

Production and utilization of cereals and pulses, grain structure of major cereals, pulses and oilseeds and their milling fractions; grain quality standards and physico-chemical methods for evaluation of quality of flours. **for skill enhancement.**

UNIT II

Pre-milling treatments and their effects on milling quality; parboiling and drying, conventional, modern and integrated rice milling operations; wheat roller flour milling; processes for milling of corn, oats, barley, gram, pulses, paddy and flour milling equipments. **for better skilling of entrepreneurship.**

UNIT III

Dal mills, handling and storage of by-products and their utilization. Storage of milled products, Expeller and solvent extraction processing, assessment of processed product quality **for better employability in industry.**

UNIT IV

Packaging of processed products, design characteristics of milling equipments; selection, installation and their performance, **methods for skilling of rescue management.**

UNIT V

BIS standards for various processed products **for skill development and employability.**

Course Outcomes:

The student is able to

CO: 1 After completing this unit, the student will be able: **for skill enhancement.**

Co: 2 To understand various physical properties of Cereals, Pulses **for better skilling of entrepreneurship.**

Co: 3 Discuss principles Pre-milling treatments and their effects on milling quality **for better employability in industry.**

Co: 4 Explain the concepts of Storage of milled products, Expeller **methods for skilling of rescue management.**

CO: 5 Understand solvent extraction processing Understand concepts paddy and flour milling equipments. **for skill development and employability.**


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PO-CO Mapping (Please 3 wherever required)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	2	3	3	1	2	3
CO:2	3	3	1	3	2	3	1	1
CO:3	1	1	3	1	1	3	2	3
CO:4	3	2	1	2	1	3	3	3
CO:5	2	1	3	3	3	3	1	3

CO-Curriculum Enrichment Mapping (Please 3 wherever required)

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	2	1
CO:2	3	1	3
CO:3	2	3	2
CO:4	3	1	2
CO:5	3	3	1

References:

1. Asiedu J J.1990. Processing Tropical Crops. ELBS/MacMillan.
2. Chakraverty A. 1995. Post-harvest Technology of Cereals, Pulses and Oilseeds. Oxford & IBH.
3. Morris Lieberman. 1983. Post-harvest Physiology and Crop Preservation. Plenum Press.
4. Pandey P H. 1993. Principles of Agricultural Processing. Kalyani.
5. Pillaiyar P. 1988. Rice - Post Production Manual. Wiley Eastern.
6. Sahay K M & Singh KK. 1993. Unit Operations in Agricultural Processing. Vikas Publ. House.

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MAE203 III

Farm Structures and Environmental Control

L:T:P 3:0:0

Objectives:

- Introduce the different Farm Structures
- Explain thermodynamic properties.
- Describe Instruments and measurements

UNIT I

Thermodynamic properties of moist air, psychrometric chart and computer programmers for thermodynamic properties. **for skill enhancement..**

UNIT II

Farm structures, their design, constructional details and design of low cost structures. Heating, ventilating and exhaust systems, air distribution and air cleaning, **for better skilling of entrepreneurship.**

UNIT III

Drying and dehumidification system, air-water contact operations and evaporation, process and product air conditioning, energy efficient environmental control practices. **for better employability in industry.**

UNIT IV

Instruments and measurements; codes and standards. **Methods for skilling of rescue management.**

UNIT V

Combustion of fuels and equipment **for skill development and employability.**

Course Outcomes:

The student is able to

CO: 1 Apply the fundamental concepts computer programmers for thermodynamic properties **for skill enhancement.**

CO:2 Derive farm structures, their design, constructional details and design of low cost structures **for better skilling of entrepreneurship.**

CO: 3 Determine Instruments and measurements; codes and standards **for better employability in industry.**


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CO: 4 Understand Drying and dehumidification system energy efficient environmental control practices **methods for skilling of rescue management.**

CO: 5 Understand Instruments and measurements; codes and standards **for skill development and employability.**

PO-CO Mapping (Please 3 wherever required)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	3	1	3	1	2	3
CO:2	1	3	2	1	2	3	1	2
CO:3	3	1	3	2	1	2	1	3
CO:4	2	1	1	3	2	3	3	1
CO:5	3	3	3	1	3	3	2	1

CO-Curriculum Enrichment Mapping (Please 3 wherever required)

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	2	1
CO:2	3	1	3
CO:3	2	3	2
CO:4	3	1	2
CO:5	3	3	1

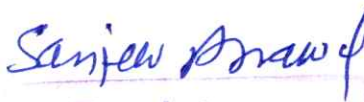
References:

1. Esmay M L & Dixon J E. 1986. Environmental Control for Agricultural Buildings. The AVI Corp.
2. Gaudy A F & Gaudy E T. 1988. Elements of Bioenvironmental Engineering. Engineering Press.
3. Moore F F. 1994. Environmental Control Systems: Heating, Cooling, Lighting. Chapman & Hall.
4. Threlkeld J L. 1970. Thermal Environmental Engineering. Prentice Hall.

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MAE203IV - DAIRY PRODUCTS PROCESSING (2020-21)

Course objective

To acquaint and equip the students with the various dairy products, processing methods and related equipment.

Unit I

Procurement, transportation and processing of market milk, cleaning and sanitization of dairy equipment. Special milks such as flavoured, sterilized, recombined and reconstituted toned and double toned. **for skill enhancement**

Unit II
Condensed milk: Methods of manufacture and related equipment, evaluation of condensed and evaporated milk. Dried milk: Definition, methods of manufacture of skim and whole milk powder, instantiation, physiochemical properties, evaluation, defects in dried milk powder. **for skill enhancement**

Unit III

Cream: Cream separation, neutralization, sterilization, pasteurization and cooling of cream, defects in cream, Butter: methods of manufacture, defects in butter. **better skilling of entrepreneurship**

Unit IV

Ice cream: Methods of manufacture and related equipment, defects in ice cream, technology of softy manufacture. Cheese: Methods of manufacture, cheddar, Gouda, cottage and processed cheese, defects in cheese. **for better employability in industry**

Unit V

Indigenous milk products: Method of manufacture of *yoghurt, dahi, khoa, burfi, kalakand, gulabjamun, rosogolla, srikhand, chhana, paneer, ghee, lassietc.* Probiotic milk product. **better skilling of entrepreneurship**

Outcomes

Students will be able to understand

CO1: mechanize processing operations in dairy industries **for skill enhancement**

CO2: manufacturing of dairy products. **for skill enhancement**

CO3: Cream: Cream separation, neutralization, sterilization, pasteurization **For better skilling of entrepreneurship**

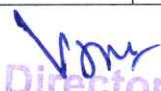
CO4: Ice cream: Methods of manufacture and related equipment **for better employability in industry**

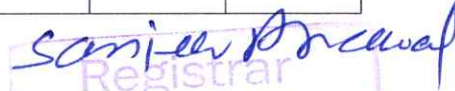
CO5: Indigenous milk products **For better skilling of entrepreneurship**

PO-CO Mapping (Please write 3, 2, 1 wherever required)

Note: 3= Highly correlated, 2= moderately correlated, 1= Less correlated

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
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CO:1	2	3	3	2	3	2	1	3
CO:2	3	2	3	3	3	3	2	3
CO:3	1	2	3	2	3	1	3	3
CO:4	3	3	1	3	2	1	3	2
CO:5	3	2	1	3	2	1	2	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

Note: 3= Highly correlated, 2= Moderately correlated, 1= Less correlated

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	2	1
CO:2	3	1	2
CO:3	2	1	3
CO:4	1	3	2
CO:5	2	1	3

Suggested Books

- Adnan T. 2009. *Dairy Powders and Concentrated Products (Society of Dairy Technology)*. Wiley-Blackwell.
- Adnan T. 2006. *Probiotic Dairy Products (Society of Dairy Technology series)*. Wiley-Blackwell.
- Britz. 2008. *Advanced Dairy Science and Technology*. Blackwell Publisher: BlackwellPublisher Professional.


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Course objective

To acquaint and equip the students with processing of fruits and vegetables and the design features of the equipment used for their processing.

Unit I

Importance of postharvest technology of fruits and vegetables, structure, cellular components, composition and nutritive value of fruits and vegetables, fruit ripening, spoilage of fruits and vegetables **for skill enhancement**

Unit II

Harvesting and washing, pre-cooling, blanching, preservation of fruits and vegetables, commercial canning of fruits and vegetables, minimal processing of fruits and vegetables. **for skill enhancement**

Unit III

Cold storage of fruits and vegetables, controlled atmosphere and modified atmosphere packaging of fruits and vegetables, quality deterioration and storage. **For better skilling of entrepreneurship**

Unit IV

Dehydration of fruits and vegetables, methods, osmotic dehydration, foam mat drying, freeze drying, microwave heating, applications, radiation preservation of fruits and vegetables, irradiation sources.

better employability in industry

Unit V

Intermediate moisture foods, ohmic heating principle, high pressure processing of fruits and vegetables, applications, sensory evaluation of fruit and vegetable products, packaging technology for fruits and vegetables, general principles of quality standards and control, FPO, quality attributes.

For better skilling of entrepreneurship

Outcomes

Student's will be able to understand

CO1: Milling of horticultural crops **for skill enhancement**

CO2: Processing (value added products) all kinds of horticultural crops as per requirement of food industries. **for skill enhancement**

CO3: Cold storage of fruits and vegetables **For better skilling of entrepreneurship**

CO4: Dehydration of fruits and vegetables **better employability in industry**

CO5: Intermediate moisture foods **For better skilling of entrepreneurship**

PO-CO Mapping (Please write 3, 2, 1 wherever required)

Note: 3= Highly correlated, 2= moderately correlated, 1= Less correlated


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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	2	3	3	2	3	2	1	3
CO:2	3	2	3	3	3	3	2	3
CO:3	1	2	3	2	3	1	3	3
CO:4	3	3	1	3	2	1	3	2
CO:5	3	2	1	3	2	1	2	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

Note: 3= Highly correlated, 2= Moderately correlated, 1= Less correlated

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	2	1
CO:2	3	1	2
CO:3	2	1	3
CO:4	1	3	2
CO:5	2	1	3

Suggested Books

- Bhatti S and Varma U. 1995. *Fruit and Vegetable Processing*. CBS.
- Cruesss WV. 2000. *Commercial Fruit and Vegetable Products*. Agrobios Publisher.
- Danthy ME. 1997. *Fruit and Vegetable Processing*. International Book Publisher.
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MAE303 I Storage Engineering and Handling of Agricultural Products L:T:P 3:0:0

Objectives: To impart knowledge of Storage of grains, Grain markets, cold storage, Physical factors influencing flow characteristics, and recent advances in handling of food materials.

UNIT I

Storage of grains, biochemical changes during storage, production, distribution and storage capacity estimate models, storage capacity models, ecology, storage factors affecting losses, storage requirements **for skill enhancement.**

UNIT II

Bag and bulk storage, godowns, bins and silos, rat proof godowns and rodent control, method of stacking, preventive method, bio-engineering properties of stored products, function, structural and thermal design of structures, aeration system **for better skilling of entrepreneurship.**

UNIT III

Grain markets, cold storage, controlled and modified atmosphere storage, effects of nitrogen, oxygen, and carbon dioxide on storage of durable and perishable commodities, irradiation, storage of dehydrated products, food spoilage and preservation, BIS standards **for better employability in industry.**

UNIT IV

Physical factors influencing flow characteristics, mechanics of bulk solids, flow through hoppers, openings and ducts **methods for skilling of rescue management.**

UNIT V

Design of belt, chain, screw, roller, pneumatic conveyors and bucket elevators; principles of fluidization; recent advances in handling of food materials **for better employability in industry.**

Course Outcomes:

The student is able to

CO: 1 Acquire the basic knowledge about Storage of grains, biochemical changes during storage, production, distribution and storage capacity estimate models **for skill enhancement.**

CO: 2 Identify with the different types of method of stacking **for better skilling of entrepreneurship.**

CO: 3 Learn about various Grain markets, cold storage, controlled and modified atmosphere storage


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for better employability in industry.

CO: 4 Understand the different food spoilage and preservation, BIS standards **methods for skilling of rescue management.**

CO: 5 Principles of fluidization; recent advances in handling of food materials. **for better employability in industry.**

PO-CO Mapping (Please 3 wherever required)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	2	3	3	1	2	3
CO:2	3	3	1	2	3	2	1	2
CO:3	1	2	3	1	2	1	2	3
CO:4	3	1	2	3	1	3	3	1
CO:5	1	2	3	1	3	1	2	3

CO-Curriculum Enrichment Mapping (Please 3 wherever required)

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	1	2
CO:2	3	2	3
CO:3	1	3	1
CO:4	3	1	2
CO:5	2	2	1

References:

1. FAO. 1984. Design and Operation of Cold Stores in Developing Countries. FAO.
2. Hall CW. 1970. Handling and Storage of Food Grains in Tropical and Sub-tropical Areas. FAO Publ. Oxford & IBH.
3. Henderson S & Perry SM. 1976. Agricultural Process Engineering. 5thEd. AVI Publ.
4. McFarlane Ian. 1983. Automatic Control of Food Manufacturing Processes. Applied Science Publ.
5. Multon JL. (Ed). 1989. Preservation and Storage of Grains, Seeds and their By-products. CBS.
6. Ripp BE. 1984. Controlled Atmosphere and Fumigation in Grain Storage. Elsevier.
7. Shefelt RL & Prussi SE. 1992. Post Harvest Handling – A System Approach. Academic Press.

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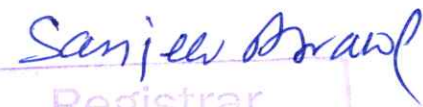
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8. Shejbal J. (Ed). 1980. Controlled Atmosphere Storage of Grains. Elsevier.
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MAE303 II

Food Supply Chain Management

L:T:P 3:0:0

Objectives: To impart knowledge of Food Supply Chain Management, Building blocks of supply chain network, performance measures, decisions in supply world and models.

UNIT I

Building blocks of supply chain network, performance measures, decisions in supply world and models. **for skill enhancement.**

UNIT II

Supply chain inventory management, economic order quantity models, recorder point models, multi echelon inventory systems **for better skilling of entrepreneurship.**

UNIT III

Use of stochastic models and combinatorial optimization in SC planning, layout, capacity planning, inventory optimization, dynamic routing and scheduling **for better employability in industry.**

UNIT IV

Internet technologies and electronic commerce in SCM related to ERP, Q-procurement **methods for skilling of rescue management.**

UNIT V

E-logistics, internet auctions, e-market, electronic, business process optimization **for skill development and employability.**

Course Outcomes:

After the completion of the course the students will be able to:

CO: 1 Acquire the basic knowledge about of Food Supply Chain Management, Building blocks of supply chain network, performance measures, decisions in supply world and models **for skill enhancement.**

CO: 2 Learn about various Supply chain inventory management **for better skilling of entrepreneurship.**

CO: 3 Understand the different Internet technologies and electronic commerce in SCM related to ERP **for better employability in industry.**

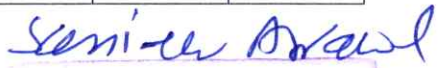
CO: 4 Use of stochastic models and combinatorial optimization in SC planning **methods for skilling of rescue management.**

CO: 5 Understand the Internet technologies and electronic commerce in SCM related to ERP, Q-procurement **for skill development and employability.**

PO-CO Mapping (Please 3 wherever required)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
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CO:2	1	3	2	3	1	3	1	3
CO:3	2	1	2	1	2	3	3	3
CO:4	3	2	1	3	1	3	3	1
CO:5	1	2	1	2	3	3	1	2

CO-Curriculum Enrichment Mapping (Please 3 wherever required)

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	2	1
CO:2	3	1	3
CO:3	2	3	2
CO:4	3	1	1
CO:5	3	3	1

References:

1. Chopra S & Meindel P. 2002. Supply Chain Management: Strategy, Planning and Operation. Prentice Hall.
2. Handfield RB & Nochols EL.1999. Introduction to Supply Chain Management. Prentice Hall.
3. Hopp WJ & Spearman ML. 1996. Factory Physics: Foundations of Manufacturing Management. McGraw Hill.
4. Levi DS, Kaminsky P & Levi ES. 2000. Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies. Mc Graw Hill.
5. Shapiro JF. 2001. Modeling the Supply Chain. Duxbury Thomson Learning.
6. Tayur S, Ganeshan R & Magazine M.1999. Quantitative Models for Supply Chain Management. Kluwer Academic Publ.
7. Viswanadham N. 2000. Analysis of Manufacturing Enterprises. Kluwer.
8. Viswanadham N & Narahari Y. 1998. Performance Modeling of Automated Manufacturing Systems. Prentice Hall.

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MAE303 III Agricultural Waste and by –Products Utilization L:T:P 3:0:0

Objectives:

- Imparting knowledge on recycling and management of different agricultural waste
- Demonstrating integrated agricultural waste management
- Sharing knowledge on methods of conversion of waste into farm inputs

UNIT I

Generation of by-products, agricultural and agro industrial by-products/wastes, properties, on site handling, storage and processing **for skill enhancement.**

UNIT II

Collection of wastes, utilization pattern as fuel, agricultural waste fired furnaces: Mechanism, construction and efficiency, suitability of wastes as fuel, fuel briquettes, briquetting process, equipment, factors affecting briquetting. **for better skilling of entrepreneurship.**

UNIT III

Utilization of wastes for paper production, production of particle board, utilization, by-products from rice mill, rice husk, rice bran, utilization. **for better employability in industry.**

UNIT IV

Thermo-chemical conversions, densification, combustion and gasification, extraction, biological conversions, anaerobic digestion. **Methods for skilling of rescue management.**

UNIT V

Biochemical digestion process, digestion systems, energy from anaerobic digestion, cellulose degradation, fermentation process **for skill development and employability.**

Course Outcomes:


After the completion of the course the students will be able to

CO: 1 Gain knowledge on agricultural wastes and decide on techniques to convert waste to inputs **for skill enhancement.**

CO: 2 Practice varied composting techniques of agricultural waste **for better skilling of entrepreneurship.**

CO: 3 Recommend processes to recycle agricultural wastes **for better employability in industry.**


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CO: 4 Manage and utilize animal waste **methods for skilling of rescue management.**

CO: 5 Comprehend management of waste from food processing industries **for skill development and employability.**

PO-CO Mapping (Please 3 wherever required)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	3	3	1	3	3	1	3	3
CO:2	3	3	2	1	2	3	2	1
CO:3	1	2	3	2	1	3	3	2
CO:4	3	1	3	1	2	1	3	1
CO:5	2	1	3	2	3	3	3	1

CO-Curriculum Enrichment Mapping (Please 3 wherever required)

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	1	2
CO:2	3	2	3
CO:3	2	3	1
CO:4	3	1	2
CO:5	3	3	1

References:

1. ASAE Standards. 1984. Manure Production and Characteristics. Bor S Luh (Ed.). 1980. Rice: Production and Utilization. AVI Publ.
2. Chahal DS.1991. Food, Feed and Fuel from Biomass. Oxford & IBH.
3. Chakraverty A. 1989. Biotechnology and other Alternative Technologies for Utilization of Biomass/ Agricultural Wastes. Oxford & IBH.
4. David C Wilson. 1981. Waste Management - Planning, Evaluation, Technologies. Oxford.
5. Donald L Klass & Emert H George 1981. Fuels from Biomass and Wastes. Ann. Arbor. Science Publ.
6. Srivastava P K, Maheswari RC & Ohja T P. 1995. Biomass Briquetting and Utilization. Jain Bros.
7. USDA 1992. Agricultural Waste Management Field Handbook. USDA.
8. Wilfred A Cote.1983. Biomass Utilization. Plenum Press.

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methods of improving nutritional quality of milk, significance of milk fat in dairy products, chromatographic, spectrometric, ultrasound and other techniques for analysis of milk lipids. **For better skilling of entrepreneurship**

Outcomes

Student's will be able to

CO1: process meat, **for skill enhancement**

CO2: process fish and **for skill enhancement**

CO3: poultry and **For better skilling of entrepreneurship**

CO4: milk processing **for better employability in industry**

CO5: manufacture value added products as per requirement of food industries. **For better skilling of entrepreneurship**

PO-CO Mapping (Please write 3, 2, 1 wherever required)

Note: 3= Highly correlated, 2= moderately correlated, 1= Less correlated

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO:1	2	3	3	2	3	2	1	3
CO:2	3	2	3	3	3	3	2	3
CO:3	1	2	3	2	3	1	3	3
CO:4	3	3	1	3	2	1	3	2
CO:5	3	2	1	3	2	1	2	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

Note: 3= Highly correlated, 2= Moderately correlated, 1= Less correlated

	Skill Development	Employability	Entrepreneurship Development
CO:1	3	2	1
CO:2	3	1	2
CO:3	2	1	3
CO:4	1	3	2
CO:5	2	1	3

Suggested Book

- • Chooksey MK. 2003. *Fish Processing and Product Development*. CIFE, Kochi.
- • Chooksey MK and Basu S. 2003. *Practical Manual on Fish Processing and Quality Contro*
- CIFE, Kochi. Hall GM. 1997. *Fish Processing Technology*. Blabie Academic and Professional.


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MAE303IV - PROCESSING OF MEAT, POULTRY AND FISH

Course objective To acquaint and equip the students with processing of meat, fish and poultry and the design features of the equipment used for their processing.

Unit I

Meat: Genetic engineering of farm animals for better meat quality, automation for the modern slaughterhouse, hot-boning of meat, new spectroscopic techniques for online monitoring of meat quality, real-time PCR for the detection of pathogens in meat, new developments in decontaminating raw meat, automated meat processing, developments in chilling and freezing of meat, high pressure processing of meat, approaches for the development of functional meat products, new techniques for analyzing raw meat, modified atmosphere packaging, perspectives for the active packaging of meat products. **for skill enhancement**

Unit II

Poultry: Breeding and quality of poultry, stunning and slaughter of poultry, processing and packaging of poultry, new techniques of preservation of poultry, production of turkeys, geese, ducks and game birds, microbial hazards in poultry production and processing, latest trends in measuring quality of poultry and poultry products, treatment and disposal of poultry processing waste. **for skill enhancement**

Unit III

Fish and seafood: Fresh fish handling and chill storage, modified atmospheric packaging of seafoods, fish odours and flavours, assessment of freshness of fish and seafoods, traditional dried and salted fish products, proteolysed fish products, minced fish technology, retort pouch processing technology, irradiation and microwave in fish handling and processing, advanced freezing technology for fish storage, high pressure processing of seafoods, value addition of freshwater and aqua cultured fish products, application of enzymes in fish processing and quality control, toxins, pollutants and contaminants in fish and seafoods. **For better skilling of entrepreneurship**

Unit IV

Milk: Physical, chemical and nutritional properties of milk components, improvements in the pasteurization and sterilization of milk. Flavour generation in dairy products, controlling texture of fermented dairy products, functional dairy products, on-line measurement of product quality in dairy processing, high pressure processing of milk products, novel separation technologies to produce dairy ingredients, **for better employability in industry**

Unit V

new technologies to increase shelf-life of dairy products, genetic engineering of milk proteins, production and utilization of functional milk proteins,


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