Revised Course Curriculum and Syllabus
of
B. Tech (Food Technology) Degree Programme

As per Recoomendations of VthDeans
Committee ICAR, New Delhi

for

State Agricultural Universities of Maharashtra
From
Academic Year 2017-18

- **Mahatma Phule Krishi Vidyapeeth, Rahuri**
- **Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola**
- **Dr. Balasaheb Sawant Kokan Krishi Vidyapeeth, Dapoli**
- **Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani**

Department wise distribution of credit load

Department	Existing	As per Vth Dean	Proposed
Food Process Technology	46	40	39
Food Engineering	29	27	39
Food Chemistry and Nutrition	21	28 (merged both dept. in one "Food Safety and Quality)	19
Food Microbiology and Safety	18		21
Food Business Management	11	14	22
Food Processing Operations	---	40	40
Basic Engineering	---	18	---
Basic Sciences and Humanities	---	13	03*
Total	**180 (125+55)**	**180(140+40)**	**183((141+42)**

* Non credit/ Non-Gradial courses

Even and odd semester credit distribution amongst departments

Department	Odd semester credits	Even semester credits	Total credits
	I, III, V, VII	II, IV, VI, VII	
FPT	22	17	39
FE	20	19	39
FCN	09	10	19
FMS	09	12	21
FBM	11	11	22
FPO	20	20	40
Non Credit / Non-Gradial courses	--	03	03+2
Total	**91**	**92**	**183+2**

DEPARTMENTWISE LAYOUT OF COURSES

I. DEPARTMENT OF FOOD PROCESS TECHNOLOGY

Sr. No.	Course No.	Course title	Credits	Semester
1	FPT-111	Principles of Food Processing	3 (2+1)	I
2	FPT-112	Postharvest Management of Fruits and Vegetables	3 (2+1)	I
3	FPT-123	Cereal Processing	3 (2+1)	II
4	FPT-124	Food Packaging Technology	2 (1+1)	II
5	FPT-235	Legumes and Oilseeds Technology	3 (2+1)	III
6	FPT-236	Meat, Poultry and Fish Technology	3 (2+1)	III
7	FPT-237	Processing Technology of Beverages	2 (1+1)	III
8	FPT-238	Processing of Milk and Milk Products	3 (2+1)	III
9	FPT-249	Wheat Milling and Baking Technology	3 (2+1)	IV
10	FPT-2410	Fruits and Vegetables Processing	3 (2+1)	IV
11	FPT-2411	Processing of Spices and Plantation Crops	3 (2+1)	IV
12	FPT-3512	Confectionary and Snacks Technology	3 (2+1)	V
13	FPT-3513	Food Extrusion Technology	2 (1+1)	V
14	FPT-3614	Food Quality and Sensory Evaluation	3 (2+1)	VI
		Total Credits	**39 (25+14)**	

II. DEPARTMENT OF FOOD ENGINEERING

Sr. No.	Course No.	Course title	Credits	Semester
1	FE-111	Engineering Drawing and Graphics	3 (1+2)	I
2	FE-112	Fluid Mechanics	3 (2+1)	I
3	FE-113	Mathematics	2 (2+0)	I
4	FE-124	Heat and Mass Transfer	3 (2+1)	II
5	FE-125	Statistical Methods and Numerical Analysis	2 (1+1)	II
6	FE-236	Energy Generation and Conservation	3 (2+1)	III
7	FE-237	Unit Operations in Food Processing – I	3 (2+1)	III
8	FE-248	Unit Operations in Food Processing – II	3 (2+1)	IV
9	FE-249	Post Harvest and Storage Engineering	3 (2+1)	IV
10	FE-3510	Biochemical Engineering	3 (2+1)	V
11	FE-3511	Food Refrigeration and Cold Storage	3 (2+1)	V
12	FE-3612	Food Processing Equipment Design	2 (1+1)	VI
13	FE-3613	Food Plant Design and Layout	3 (2+1)	VI
14	FE-3614	Instrumentation and Process Control	3 (2+1)	VI
		Total Credits	**39 (25+14)**	

III. DEPARTMENT OF FOOD CHEMISTRY AND NUTRITION

Sr. No.	Course No.	Course title	Credits	Semester
1	FCN-111	Environmental Science and Disaster Management	2 (1+1)	I
2	FCN-112	Biochemistry	2 (1+1)	I
3	FCN-123	Human Nutrition	3 (2+1)	II
4	FCN-124	Food Chemistry of Macronutrients	3 (2+1)	II
5	FCN-235	Food Chemistry and Micronutrients	3 (2+1)	III
6	FCN-246	Food Additives and Preservatives	2 (1+1)	IV
7	FCN-357	Instrumental Techniques in Food Analysis	2 (0+2)	V
8	FCN-368	Enzymes in Food Industry	2 (1+1)	VI
		Total Credits	**19 (10+9)**	

IV. DEPARTMENT OF FOOD MICROBIOLOGY AND SAFETY

Sr. No.	Course No.	Course title	Credits	Semester
1	FMS-111	General Microbiology	3 (2+1)	I
2	FMS-122	Food Microbiology	3 (2+1)	II
3	FMS-233	Industrial Microbiology	3 (2+1)	III
4	FMS-244	Food Safety and Microbial Standards	3 (2+1)	IV
5	FMS-355	Food Biotechnology	3 (2+1)	V
6	FMS-366	Food Plant Sanitation	3 (2+1)	VI
7	FMS-367	Quality Assurance and Certification	3 (2+1)	VI
		Total Credits	**21 (14+7)**	

V. DEPARTMENT OF FOOD BUSINESS MANAGEMENT

Sr. No.	Course No.	Course title	Credits	Semester
1	FBM-111	Computer Programming and Data Structure	3 (1+2)	I
2	FBM-122	Information and Communication Technology	2 (1+1)	II
3	FBM-243	ICT Application in Food Industry	3 (1+2)	IV
4	FBM-354	Entrepreneurship Development	3 (2+1)	V
5	FBM-355	Business Management and Economics	2 (2+0)	V
6	FBM-356	Food Laws and Regulations	3 (2+1)	V
7	FBM-367	Project Preparation and Management	2 (1+1)	VI
8	FBM-368	Marketing Management and International Trade	2 (2+0)	VI
9	FBM-369	Communication Skills and Personality Development	2 (1+1)	VI
		Total Credits	**22 (13+9)**	

VI. DEPARTMENT OF FOOD PLANT OPERATIONS

Sr. No.	Course No.	Course title	Credits	Semester
1	FPO-231	Student READY – Industrial Tour (I)	1 (0+1)	III
2	FPO-232	Student READY – Industrial Tour (II)	1 (0+1)	V
3	FPO-473	Student READY – Experiential Learning Programme – I	7 (0+7)	VII
4	FPO-474	Student READY – Experiential Learning Programme – II	7 (0+7)	VII
5	FPO-475	Student READY – Research Project	3 (0+3)	VII
6	FPO-476	Student READY – Seminar	1 (0+1)	VII
7	FPO-487	Student READY – Inplant Training	20 (0+20)	VIII
		Total Credits	**40 (0+40)**	

SEMESTER WISE COURSE LAYOUT

Semester -I

Sr. No.	Course No.	Course title	Credits
A)	**Core Courses**		
1	FPT-111	Principles of Food Processing	3 (2+1)
2	FPT-112	Postharvest Management of Fruits and Vegetables	3 (2+1)
3	FE-111	Engineering Drawing and Graphics	3 (1+2)
4	FE-112	Fluid Mechanics	3 (2+1)
5	FE-113	Mathematics	2 (2+0)
6	FCN-111	Environmental Science and Disaster Management	2 (1+1)
7	FCN-112	Biochemistry	2 (1+1)
8	FMS-111	General Microbiology	3 (2+1)
9	FBM-111	Computer Programming and Data Structure	3 (1+2)
10	BIO-111	Introductory Biology (NC)	2 (1+1)
		Total Credits	**26 (15+11)**

Semester-II

Sr. No.	Course No.	Course title	Credits
A)	**Core Courses**		
1	FPT-123	Cereal Processing	3 (2+1)
2	FPT-124	Food Packaging Technology	2 (1+1)
3	FE-124	Heat and Mass Transfer	3 (2+1)
4	FE-125	Statistical Methods and Numerical Analysis	2 (1+1)
5	FMS-122	Food Microbiology	3 (2+1)
6	FCN-123	Human Nutrition	3 (2+1)
7	FCN-124	Food Chemistry of Macronutrients	3 (2+1)
8	FBM-122	Information and Communication Technology	2 (1+1)
B)	**Non-Gradial / Non-Credit Courses**		
9	PHEY-122	Physical Education and Yoga	1(0+1)
10	DEG 123	Democracy, Election and Good Governance	1(1+0)
11	NCC/NSS	NCC/ NSS	1(0+1)
		Total Credits	**24 (14+10)**

Semester-III

Sr. No.	Course No.	Course title	Credits
A)	**Core Courses**		
1	FPT-235	Legumes and Oilseeds Technology	3 (2+1)
2	FPT-236	Meat, Poultry and Fish Technology	3 (2+1)
3	FPT-237	Processing Technology of Beverages	2 (1+1)
4	FPT-238	Processing of Milk and Milk Products	3 (2+1)
5	FE-236	Energy Generation and Conservation	3 (2+1)
6	FE-237	Unit Operations in Food Processing – I	3 (2+1)
7	FCN-235	Food Chemistry and Micronutrients	3 (2+1)
8	FMS-233	Industrial Microbiology	3 (2+1)
9	FPO-231	Student READY – Industrial Tour (I)	1 (0+1)
		Total Credits	**24 (15+9)**

Semester-IV

Sr. No.	Course No.	Course title	Credits
A)	**Core Courses**		
1	FPT-249	Wheat Milling and Baking Technology	3 (2+1)
2	FPT-2410	Fruits and Vegetables Processing	3 (2+1)
3	FPT-2411	Processing of Spices and Plantation Crops	3 (2+1)
4	FE-248	Unit Operations in Food Processing – II	3 (2+1)
5	FE-249	Post Harvest and Storage Engineering	3 (2+1)
6	FCN-246	Food Additives and Preservatives	2 (1+1)
7	FMS-244	Food Safety and Microbial Standards	3 (2+1)
8	FBM-243	ICT Application in Food Industry	3 (1+2)
		Total Credits	**23 (14+9)**

Semester-V

Sr. No.	Course No.	Course title	Credits
A)	**Core Courses**		
1	FPT-3512	Confectionary and Snacks Technology	3 (2+1)
2	FPT-3513	Food Extrusion Technology	2 (1+1)
3	FE-3510	Biochemical Engineering	3 (2+1)
4	FE-3511	Food Refrigeration and Cold Storage	3 (2+1)
5	FCN-357	Instrumental Techniques in Food Analysis	2 (0+2)
6	FMS-355	Food Biotechnology	3 (2+1)
7	FBM-354	Entrepreneurship Development	3 (2+1)
8	FBM-355	Business management and Economics	2 (2+0)
9	FBM-356	Food Laws and Regulations	3 (2+1)
10	FPO-352	Student READY – Industrial Tour (II)	1 (0+1)
		Total Credits	**25 (15+10)**

Semester-VI

Sr. No.	Course No.	Course title	Credits
A)	**Core Courses**		
1	FPT-3614	Food Quality and Sensory Evaluation	3 (2+1)
2	FE-3612	Food Processing Equipment Design	2 (1+1)
3	FE-3613	Food Plant Design and Layout	3 (2+1)
4	FE-3614	Instrumentation and Process Control	3 (2+1)
5	FCN-368	Enzymes in Food Industry	2 (1+1)
6	FMS-366	Food Plant Sanitation	3 (2+1)
7	FMS-367	Quality Assurance and Certification	3 (2+1)
8	FBM-367	Project Preparation and Management	2 (1+1)
9	FBM-368	Marketing Management and International Trade	2 (2+0)
10	FBM-369	Communication Skills and Personality Development	2 (1+1)
		Total Credits	**25 (16+9)**

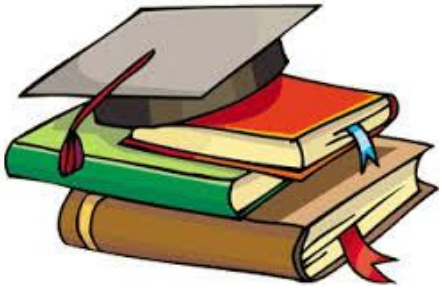
Semester-VII

Sr. No.	Course No.	Course title	Credits
A)	**Core Courses**		
1	FPO-473	Student READY – Experiential Learning Programme – I	7 (0+7)
2	FPO-474	Student READY – Experiential Learning Programme – II	7 (0+7)
3	FPO-475	Student READY – Research Project	3 (0+3)
4	FPO-476	Student READY – Seminar	1 (0+1)
		Total Credits	**18 (0+18)**

Semester-VIII

Sr. No.	Course No.	Course title	Credits
A)	**Core Courses**		
1	FPO-487	Student READY – Inplant Training	20 (0+20)
		Total Credits	**20 (0+20)**

***



DEPARTMENT WISE SYLLBUS AND COURSE CURRICULUM

I. DEPARTMENT OF FOOD PROCESS TECHNOLOGY

Sr. No.	Course No.	Course title	Credits	Semester
1	FPT-111	Principles of Food Processing	3 (2+1)	I
2	FPT-112	Postharvest Management of Fruits and Vegetables	3 (2+1)	I
3	FPT-123	Cereal Processing	3 (2+1)	II
4	FPT-124	Food Packaging Technology	2 (1+1)	II
5	FPT-235	Legumes and Oilseeds Technology	3 (2+1)	III
6	FPT-236	Meat, Poultry and Fish Technology	3 (2+1)	III
7	FPT-237	Processing Technology of Beverages	2 (1+1)	III
8	FPT-238	Processing of Milk and Milk Products	3 (2+1)	III
9	FPT-249	Wheat Milling and Baking Technology	3 (2+1)	IV
10	FPT-2410	Fruits and Vegetables Processing	3 (2+1)	IV
11	FPT-2411	Processing of Spices and Plantation Crops	3 (2+1)	IV
12	FPT-3512	Confectionary and Snacks Technology	3 (2+1)	V
13	FPT-3513	Food Extrusion Technology	2 (1+1)	V
14	FPT-3614	Food Quality and Sensory Evaluation	3 (2+1)	VI
		Total Credits	**39 (25+14)**	

FPT-111 PRINCIPLES OF FOOD PROCESSING 3(2+1)

Theory

Introduction: Defining food; Classification of food; Constituents of foods; Food processing; Food preservation; Food Spoilage – Introduction, Causes of food spoilage, Food poisoning, Food-borne intoxication, Food-borne infection, Food Preservation and Processing: Introduction; necessary; Methodology; Principles and Methods of food preservation, High Temperature Preservation: Introduction; Blanching; Pasteurization; Sterilization; Canning, Drying, Dehydration and Concentration: Introduction; Purpose; Water activity and relative humidity; Factors affecting rate of drying and dehydration; Drying methods; Changes during drying and dehydration; different Driers; Concentration- Methods of concentration, Changes; Effect of drying, dehydration and concentration on quality of foods, Food Irradiation: Introduction; Radiation sources; Measurement of radiation dose; Mechanism of Action; Type of irradiation; Factors affecting food irradiation; Effect of irradiation, Preservation using Sugar, Salt and Acids: Sugar – Introduction, Factors affecting osmotic pressure of sugar solution, Foods preserved using sugar; Salt: Introduction, Antimicrobial activity of salt, Estimation of salt, Food products preserved using salt; Acid – Introduction, Mechanism, Common foods preserved using acids, Preservation by Use of Chemical preservatives: Introduction; Objectives; Factors affecting antimicrobial activity of preservatives; Type of chemical preservatives; Sulphur dioxide, Benzoic acid, etc; Use of other chemicals like acidulants, antioxidants, mold inhibitors, antibodies, etc. Food Fermentation: Introduction, methods, common fermented foods Recent methods in Processing: Introduction; PEF, HPP, Ultrasound, Dielectric heating; Microwave heating, Ohmic heating; Infrared heating; UV light, X-rays, Membrane processing, Ozonization; High intensity electric field in pulses; New hybrid drying technologies; Monitoring by NMR and MRI Technology, etc Effect of processing on nutritional value of food: Introduction; Consuming raw foods; Changes during meat grilling; Effect of processing on vitamins; Effect of processing on minerals; Effect of processing on carbohydrates; Effect of processing on lipids.

Practicals

Demonstration of various machineries used in processing; Demonstration of effect of blanching on quality of foods; Preservation using heat; Preservation by low temperature; Preservation by high concentration of sugar; Preservation by using salt; Preservation by using chemicals.; Drying and dehydration of fruits; Drying and dehydration of vegetables; Fermentation of food.

Teaching Schedule-Theory With Weightages(%)

Lecture No.	Topics	% Syllabus Covered
1 – 3	Introduction: Defining food; classification of food; constituents of foods; food processing; food preservation; food spoilage – introduction, causes of food spoilage, food poisoning, food-borne intoxication, food-borne infection	9
4 – 5	Food preservation and processing: Introduction; necessary; methodology; principles and methods of food preservation	6
6 – 8	High Temperature Preservation: Introduction; blanching; pasteurization; sterilization; canning	9
9 – 11	Low temperature preservation: Introduction; methods of low temperature preservation; chilling; refrigeration and cold storage; factors affecting refrigerated & frozen storage of foods; effect of freezing on constituents of foods	9
12 – 16	Drying, dehydration and concentration: Introduction; purpose; water activity and relative humidity; factors affecting rate of drying and dehydration; drying methods; changes during drying and dehydration; different driers; concentration-methods of concentration, changes; effect of drying, dehydration and concentration on quality of foods	16
17 – 18	Food irradiation: Introduction; radiation sources; measurement of radiation dose; mechanism of action; type of irradiation; factors affecting food irradiation; effect of irradiation	7
19 – 21	Preservation using sugar, salt and acids: Sugar – Introduction, factors affecting osmotic pressure of sugar solution, foods preserved using sugar; salt: introduction, antimicrobial activity of salt, estimation of salt, food products preserved using salt; acid – Introduction, mechanism, common foods preserved using acids	9
22 – 24	Preservation by use of chemicals: Introduction; objectives; factors affecting antimicrobial activity of preservatives; type of chemical preservatives; sulphur dioxide, benzoic acid, etc; use of other chemicals like acidulants, antioxidants, mold inhibitors, antibodies, etc.	9
25	Food fermentation: Introduction, methods, common fermented foods.	3
26 – 30	Recent methods in processing: Introduction; PEF, HPP, ultrasound, dielectric heating; microwave heating, ohmic heating; infrared heating; UV light, X-rays, membrane processing, ozonization; high intensity electric field in pulses; new hybrid drying technologies; monitoring by NMR and MRI Technology, etc	16
31 – 32	Effect of processing on nutritional value of food: Introduction; consuming raw foods; changes during meat grilling; effect of processing on vitamins; effect of processing on minerals; effect of processing on carbohydrates; effect of processing on lipids	7
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of experiments
1	Demonstration of various machineries used in processing	1
2	Demonstration of effect of blanching on food quality characteristics	1
3	Preservation using heat	1
4	Preservation by low temperature	1
5	Preservation by high concentration of sugar(Jam/Jelly/Marmalade /syrup /squash)	3
6	Preservation by using salt (pickling)	1
7	Preservation by using chemical preservatives (sodium benzoate, calcium propionate)	2
8	Drying and dehydration of fruit	1
9	Drying and dehydration of vegetables	1
10	Reconstitution test for fruits and vegetables	1
11	Preservation of coconut shreds using humectants	1
12	Spray drying of milk	1
13	Preparation of fermented product	1
	Total	**16**

TEXTBOOKS

Sr. No.	Name of Book	Author	Publisher
1	Preservation of Fruits & Vegetables	Girdhari Lal, G. S. Siddappa, G. L. Tandon,	Indian Council of Agricultural Research, Publications 1986
2	Food Processing Technology: Principles and Practice	P. Fellows	CRC Press, 2000 ISBN: 9780849308871
3	Handbook of Food Preservation	Shafiur Rahman M.	CRC Press, 2007 ISBN: 9781420017373
4	Emerging Technologies for Food Processing	Da-Wen Sun	Academic Press, 2005 ISBN: 9780080455648
5	Introduction to Food Processing	Jelen P.	Prentice Hall , 1985
6	Handbook of Analysis and Quality Control for Fruit and Vegetable Products.	Ranganna S.	2nd Ed. Tata-McGraw-Hill. 2001.

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Technology of Food Preservation	Desroiser N.W.	AVI Pub. Co., 1997
2	Introduction to Food Science and Technology	Stewart GP and Amerine MA	Elsevier, 2012 ISBN: 0323156649,
3	Food Processing Handbook	Brennan JG	John Wiley & Sons, 2012 ISBN: 9783527634378
	Food Science	Potter NN and Hotchkiss JH	Springer Science & Business Media, 2013ISBN: 9401572623
4	Essentials of Food Science	Vickie AV	Springer Science & Business Media, 2013ISBN: 9781461491385
5	Food Processing and Preservation	B. Sivasankar	PHI Learning Pvt. Ltd., 2002 ISBN: 9788120320864

FPT-112 POSTHARVEST MANAGEMENT OF FRUITS AND VEGETABLES 3(2+1)

Theory

Introduction: Importance; Present status; export potential; employment generation Introduction to Post Harvest Management: Definition of PHM, PHT, Scope, Responsibilities, Post-harvest losses, Possible measures, Morphology of Fruits and Vegetables: Introduction; Parts of fruit; Botanical classification of fruit; Consumer classification of fruit; Classification of fruits on the basis of origin; Vegetables; Fruits vs. vegetables Nutritional value: Introduction; Water; Carbohydrates; Protein; Lipid; Organic acids; Vitamin and minerals, Volatiles; Physiology and Biochemistry: Introduction; Physiological development stages; Respiration; Respiration drift; Climacteric fruit; Non-climacteric fruit; Biochemistry of respiration; Aerobic and Anaerobic respiration; RQ; Factors affecting rate of respiration; Transpiration; Maturity of Fruits and Vegetables: Introduction; Methods of identification of maturity, Fruit Ripening: Introduction; Changes during Ripening; Deterioration of Fruits & Vegetables: Introduction; Primary and Secondary causes of losses; Pre-harvest Factors affecting Quality: Introduction; Preharvest factors related to plant; Preharvest factors related to Environment; Preharvest factors related to chemicals; Harvesting of Fruits & Vegetables: Introduction,definition, methods of harvesting,factors during harvest affecting harvesting of fruits &vegetables: Introduction; Post-harvest handling; Post-harvest Commodity Treatments: Precooling; Waxing; Sprout inhibition; Disinfestation; Fungicide application; Hot water treatment; Vapour heat treatment; Irradiation; Ripening and Degreening; Delaying ripening; Curing of roots and tubers; Dryings of root crops; Commodity treatments for apple Pre-cooling: Introduction; Effect of precooling on product quality; Factors affecting precooling; Cooling methods; Packinghouse operations: Introduction; Dumping (loading and unloading); Washing; Drying; Sorting & Grading; Commodity treatments; Packaging; Transportation Storage Structures: Introduction; Goal of Storage systems; Storage considerations; Storage Systems; Low cost and High Cost Technology, MA, CA and Hypobaric storage Chemical Preservation of Fruits and Vegetables: General rules for chemical preservation; Factors affecting action of chemical preservatives, Hurdle technologies for preservation; Biotechnology of fruits and vegetables

Practicals

Morphological features of some selected fruits and vegetables; Studies on maturity indices;Wax coating of selected fruits; Use of chemicals for ripening of fruits; Effect of maturity on acidity of lemon; Effect of storage of respiration and transpiration of fruit; Packaging of fruits and vegetables with scavengers; Determination of firmness of fruits and vegetables ; Degreening of fruits

Teaching Schedule-Theory With Weightages(%)

Lecture No.	Topics	% Syllabus Covered
1	Introduction: Importance; present status; export potential; employment generation	3
2 – 3	Introduction to post harvest management: Definition of PHM, PHT, scope, responsibilities, post-harvest losses, possible measures, to reduce the PHL	6
4 – 6	Morphology of fruits and vegetables: Introduction; parts of fruit; botanical classification of fruit; consumer classification of fruit; classification of fruits on the basis of origin; vegetables; fruits vs. vegetables	10
7 – 8	Nutritional value: Introduction; water; carbohydrates; protein; lipid; organic acids; vitamin and minerals; volatiles	6
9 – 11	Physiology and biochemistry: Introduction; physiological development stages; respiration; respiration drift; climacteric fruit; non-climacteric fruit; biochemistry of respiration; aerobic and anaerobic respiration; RQ; factors affecting rate of respiration; transpiration	10
12 – 13	Maturity of fruits and vegetables: Introduction; methods of identification of maturity, fruit ripening: introduction; changes during ripening	6
14	Deterioration of fruits & vegetables: Introduction; primary and secondary causes of losses	3
15	Pre-harvest factors affecting quality: Introduction; preharvest factors related to plant; preharvest factors related to environment; preharvest factors related to chemicals;	3
16 – 18	Harvesting of fruits & vegetables: Introduction; definition; different methods of harvesting; factors during harvest affecting quality of produce; post-harvest handling: Iintroduction; postharvest handling	10
19 – 21	Post-harvest commodity treatments: Introduction; precooling; waxing; sprout inhibition; disinfestation; fungicide application; hot water treatment; vapour heat treatment; irradiation; ripening and degreening; delaying ripening; curing of roots and tubers; dryings of root crops; commodity treatments for apple	10
22	Pre-cooling: Introduction; effect of precooling on product quality; factors affecting precooling; cooling methods	3
23 – 24	Packinghouse operations: Introduction; dumping (loading and unloading); washing; drying; sorting & grading; commodity treatments; packaging; transportation	6
25 – 28	Storage structures: Introduction; goal of storage systems; storage considerations; storage systems; low cost and high cost technology, MA, CA and hypobaric storage	12
29 – 31	Chemical preservation of fruits and vegetables: General rules for chemical preservation; factors affecting action of chemical preservatives	9
32	Hurdle technologies for Preservation and biotechnology of fruits and vegetables	3
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of experiments
1	Morphological features of some selected fruits and vegetables	1
2	Determination of angularity of banana and its correlation with maturity	1
3	Study on inactivation of enzyme by blanching	1
4	Determination of total soluble solids of fruits	1
5	Determination of juice content of fruits	1
6	Determination of titrable acidity of fruit and its correlation with ripening	1
7	Studies on starch content and its correlation ripening of fruit	1
8	Determination of fruit firmness and its correlation with ripening	1
9	Wax coating of selected fruits	2
10	Ripening of banana using ethrel	1
11	Studies on effect of different storage temperatures on quality of fruits	1
12	Effect of storage transpiration rate of fruit	1
13	Packaging of fruits and vegetables	2
14	Effect of blanching of polyphenol oxidase activity	1
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	A Handbook on Post harvest Management of Fruits and Vegetables	P. Jacob John	Daya Publishing House, Delhi ISBN: 9788170355328
2	Postharvest: An introduction to the physiology and handling of fruit and vegetables, 6th edition	Wills R. and Golding J.	UNSW Press ISBN: 9781742247854
3	Post harvest Technology of Fruits and Vegetables – Vol. 1	Verma L. R. and Joshi V. K.	Indus Publishing Company, Delhi ISBN: 8173871086
4	Handbook of Analysis and Quality Control for Fruits and Vegetable Products	Ranganna S.	2nd Edition, Tata-McGraw Hill, 2001

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Handbook of Postharvest Technology	Chakraverty A. Mujumdar A. S. Ramaswamy H.	Marcel Dekker Inc. , New York ISBN: 0824705149
2	Handbook of Vegetable Science and Technology:	Salunke D. K. Kadam S. S.	Marcel Dekker Inc. , New York ISBN: 0824705149
3	Handling and Preservation of Fruits and Vegetables by Combined Methods for Rural Areas- Technical Manual	FAO	FAO Agr. Ser. Bull., 149. 2007

FPT-123 CEREAL PROCESSING 3(2+1)

Theory

Present status and future prospects of cereals and millets; Morphology: physico-chemical properties; chemical composition and nutritive value Rice: Paddy processing and rice milling: conventional milling, modern milling, milling operations, milling machines, milling efficiency, byproducts of rice milling. Quality characteristics influencing final milled products. Parboiling: rice bran stabilization and its methods; Aging of rice; Enrichment – need, methods; processed foods from rice – breakfast cereals, flakes, puffing, canning and instant rice. Wheat: break system, purification system and reduction system; extraction rate and its effect on flour composition; Quality characteristics of flour and their suitability for baking. Corn: Corn milling – dry and wet milling, starch and gluten separation, milling fractions and modified starches. Barley: Malting and milling Sorghum: milling, Malting, Pearling and industrial utilization Millets: Importance of Millet, composition, processing of millets for food uses, major and minor millets Products and Byproduct of cereal and millets: infant foods from cereals and millets, breakfast cereal foods – flaked, puffed, expanded, extruded and shredded products, etc.

Practicals

Determination of physical properties of cereal grains;Determination of chemical properties of cereal grains Studies on cooking quality of cereals; Preparation of malt; Value added products from cereals and millets; Production of modified starch; Visit to milling industry

Teaching Schedule - Theory with Weightages (%)

No. Units	Topics	% Syllabus Covered
1-4	Present status and future prospects of cereals and millets; Morphology: physico-chemical properties; chemical composition and nutritive value	13
5-11	Rice: Paddy processing and rice milling: conventional milling, modern milling operations, milling machines, milling efficiency, byproducts of rice milling. Quality characteristics influencing final milled products. Parboiling: rice bran stabilization and its methods; Aging of rice; Enrichment – need, methods; processed foods from rice – breakfast cereals, flakes, puffing, canning and instant rice.	21
12-15	Wheat: break system, purification system and reduction system; extraction rate and its effect on flour composition; Quality characteristics of flour and their suitability for baking.	13
16-20	Corn: Corn milling – dry and wet milling, starch and gluten separation, milling fractions ad modified starches.	15
21	Barley: Malting and milling	3
22-24	Sorghum: Milling, Malting, Pearling and industrial utilization.	9
25-28	Millets: Importance of Millet, composition, processing of millets for food uses, major and minor millets	13
29-32	Products and Byproduct of cereal and millets: infant foods from cereals and millets, cereal based fermented products, breakfast cereal foods – flaked, puffed, expanded, extruded and shredded products, etc.	13
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of experiments
1	Determination of physical properties of cereal grains	2
2	Determination of chemical properties of cereal grains	2

3	Germination of grains	1
4	Studies on cooking quality of cereals (cooking time, grain elongation, etc)	1
5	Functional properties of different cereal flour	1
6	Determination of starch content of cereal	1
7	Study on gelatinization of starch	1
8	Determination of amylase content of rice	1
9	Determination of fat acidity of cereals	1
10	Phenol test for cereals	1
11	Determination of sedimentation value	1
12	Milling of cereal grains	2
13	Visit to milling industry	1
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Technology of Cereals	Kent NL	Woodhead Publishing1983 ISBN: 9780080408347
2	Post Harvest Technology of Cereals, Pulses and Oil seeds	A. Chakravarthy	Oxford and IBH Publishing Company, 2014
3	Modern Cereal Science & Technology	Y. Pomeranz	VCH Publishing, 1987 ISBN: 9780895733269
4	Hand Book of Cereal Science and Technology	Keral Kulp	CRC Press, ISBN: 9780824782948
5	Principles of Cereal Science and Technology	Hoseney RS	2nd Ed. AACC., 1994

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Rice – Utilization	Luh b.s.	Springer, 1991 ISBN: 9780442004859
2	Post Harvest Biotechnology of Cereals	Salunkhe D.K.	CRC Press, 1985 ISBN: 9780849362880
3	Handbook of Post Harvest and Technology; Cereals, Fruit and Vegetables tea and spices.	Chakraverty A., Mujumdar A.S. Hosahalli S.R.	CRC Press 1990 ISBN: 9780203911310
4	Rice – Chemistry and Technology	Champagne E.T.	American Association of Cereal Chemists, 2004 ISBN: 97818911273425
5	Cereal and Cereal Products	Dendy DAV & Dobraszczyk BJ	Aspen Publication, 2001
6	Cereal Science	Matz SA	AVI Publication, 1969

FPT-124 FOOD PACKAGING TECHNOLOGY 3(2+1)

Theory

Introduction to subject, Packaging situations in World and India Need of packaging, plastic consumption/use in World, India etc. Package requirements, package functions Hazards acting on package during transportation, Storage and atmospheric package, labeling laws Package Materials: classification packages, paper as package material its manufacture, types, advantages

corrugated and paper board boxes etc. Glass as package material, Manufacture, Advantages, disadvantages. Metal as package material-manufacture, Advantages, disadvantages Aluminum as package material, its advantages and disadvantages, plastic as package material classification of polymers, Properties of each plastics, uses of each plastics, chemistry of each plastic such as polyethylene, Polypropylene, polystyrene, polycarbonate, PVC, PVDC, Cellulose acetate, Nylon etc. Lamination, Coating and Aseptic packaging, Lamination, need of lamination, types, properties, advantages & disadvantages of each type. Coating on paper & films, types of coatings. Need of coating, methods of coatings. Biodegradable and edible packaging, Aseptic packaging-Need, Advantages, process, comparison of conventional & aseptic packaging. System of aseptic packaging and materials used in aseptic packaging, Machineries used in Packing foods. Permeability – theoretical consideration, permeability of gases and vapours. Permeability of multilayer packages, permeability in relation to products. Packaging of Specific Foods with its properties like bread, biscuits coffee, milk powder, egg powder, carbonated beverages Snack foods etc, Mechanical and functional tests on package, Various mechanical functional testes perform in laboratories on package boxes and package materials.

Practicals

Identification of Packaging Materials; Measurement of Thickness of Packaging Films, papers and boards; Measurement of water absorption of paper, paper boards; Measurement of bursting strength of paper and paperboard; Measurement Tear resistance of papers; Measurement of puncture resistance ofpaper and paperboard; Measurement of tensile strength of paper of paper boards;Determination of gas transmission rate of package films; Determination of WVTR of films; Determination of coating on package materials; Identification of plastic films; Prepackaging practices followed for packing fruits and vegetables.

Teaching Schedule - Theory with Weightages (%)

No. Units	Topics	% Syllabus Covered
1-5	Introduction to subject, Packaging situations in world and India, need of packaging, plastic consumption/use in world, India etc. package requirements, package functions, hazards acting on package during transportation, storage and atmospheric package, labeling laws	16
6-15	Package materials: classification packages, paper as package material its manufacture, types, advantages, corrugated and paper board boxes etc. Glass as package material, manufacture, advantages, disadvantages, metal as package material-manufacture, advantages, disadvantages, aluminum as package material,. Its advantages and disadvantages, plastic as package material, classification of polymers, properties, uses and chemistry of each plastic such as polyethylene, polypropylene, polystyrene, polycarbonate, PVC, PVDC, cellulose acetate, nylon etc.	30
16-21	Lamination, Coating and Aseptic packaging: Lamination, need of lamination, types, properties, advantages & disadvantages of each type. coating on paper & films, types of coatings, need of coating, methods of coatings, Biodegradable and edible packaging, aseptic packaging-need, advantages, process, comparison of conventional & aseptic packaging. system of aseptic packaging and materials used in aseptic packaging machineries used in packing foods. Permeability – theoretical consideration permeability of gases and vapours, permeability of multilayer packages, permeability in relation to products.	19
22-27	Packaging of specific foods with its propertieslike bread, biscuits coffee, milk powder, carbonated beverages snack foods etc	19
28-32	Mechanical and functional tests on package Various mechanical functional testes perform in laboratories on package boxes and package materials	16
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of experiments
1	Identification of packaging materials	1
2	Measurement of thickness of packaging films, papers and boards	1
3	Measurement of water absorption of paper, paper boards	1
4	Measurement of bursting strength of paper of paper boards	1
5	Measurement tear resistance of papers	2
6	Measurement of puncture resistance of paper and paperboard	1
7	Measurement of tensile strength of paper of paper boards	1
8	Determination of gas transmission rate of package films	1
9	Determination of WVTR of films	2
10	Determination of coating on package materials	1
11	Tests for identification of plastic films	2
12	Prepackaging practices followed for packing of fruits and vegetables	1
13	Visit to packaging industry	1
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Handbook of Package	Joseph F. Hanlon	CRC Press

	Engineering		ISBN: 9781566763066
2	Food Packaging: Principles and Practice, Third Edition	Robertson G.L.	CRC Press, 2012 ISBN: 9781439862414
3	Food Packaging	Sacharow and Griffin	AVI Publishing Company, 1980 ISBN: 9780870553479
4	Principles of Food Packaging	R. Heiss	Keppler, 1970
5	Food Packaging	Kadoya T.	Academic Press, 1990

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Fundamentals of Packaging	F.A. Paine	Institute of Packaging, 1981 ISBN: 9780950756707
2	Plastic Packaging: Properties, Processing and Applciations	Culter JD and Hernandez RJ	Hanser, 2004 ISBN: 9783446229082
3	Food Packaging Technology	Richard C, Derek M, Mark J.K.	CRC Press, 2003 ISBN: 9780849397882
4	Principles of Food Packaging	Sacharwo S and Griffin RC	AVI Publication, 1980
5	A Handbook of Food Packaging	Painy FA	Blackie Academics, 1992

FPT-235 LEGUMES AND OILSEEDS TECHNOLOGY 3(2+1)

Theory

Present status and future prospects of legumes and oilseeds; Morphology of legumes and oilseeds; Classification and types of legumes and oilseeds, Anti-nutritional compounds in legumes and oilseeds; Methods of removal of anti-nutritional compounds, Milling of legumes: home scale, cottage scale and modern milling methods, milling quality, efficiency and factors affecting milling; problems in dhal milling industry, Soaking and germination of pulses, Cooking quality of legumes – factors affecting cooking quality, Oilseeds: composition, methods of extraction, Desolventization and refining of oils: degumming, neutralization bleaching, filtration, deodorization, etc. New technologies in oilseed processing, Utilization of oil seed meals for food uses i.e. high protein products like concentrate, isolates Byproduct of pulses and oil milling and their value addition.

Practicals

Determination of physical properties of legumes and oil seeds; Determination of proximate composition of selected pulses and oilseeds; Determination of nutritional quality of selected pulses and oilseeds; Study of mini dhal mill; Study of mini oil mill; Preconditioning of pulses before milling Preconditioning of oilseeds before milling; Removal of anti-nutritional compounds from selected pulses and oilseeds; Laboratory milling of selected pulses and its quality evaluation; Laboratory milling of selected oilseeds and its quality evaluation; Laboratory refining of selected oils; Laboratory hydrogenation of selected oils; Study of cooking quality of dhal; Processing of composite legume mix and preparation of value added products; Visit to commercial dhal mills and oil mills.

Teaching Schedule - Theory with Weightages (%)

No. Units	Topics	% Syllabus Covered
1-4	Present status and future prospects of legumes and oilseeds; Morphology of legumes and oilseeds; Classification and types of legumes and oilseeds	13
5-7	Anti-nutritional compounds in legumes and oilseeds; Methods of removal of anti-nutritional compounds	9
8-12	Milling of legumes: home scale, cottage scale and modern milling methods, milling quality, efficiency and factors affecting milling; problems in dhal milling industry	13
13-15	Soaking and germination of pulses	10
16-18	Cooking quality of legumes – factors affecting cooking quality	9
19-21	Oilseeds: composition, methods of extraction	9
22-24	Desolventization and refining of oils: degumming, neutralization bleaching, filtration, deodorization, etc.	9
25-26	New technologies in oilseed processing	10
27-30	Utilization of oil seed meals for food uses i.e. high protein products like concentrate, isolates	12
31-32	Byproduct of pulses and oil milling and their value addition.	6
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of experiments
1.	Determination of physical properties of legumes/oilseeds	2
2.	Determination of antinutritional factors in legumes	2
3.	Cooking quality of dhal	1
4.	Puffing of legumes	1
5.	Milling of legumes	1
6.	Preparation of composite legume flour	1
7.	Preparation of soy milk and soy paneer	1
8.	Preparation of protein isolate	1
9.	Preparation of quick cooking dhal	1
10.	Measurement of physico-chemical properties of oils	1
11.	Hydrogenation of oil	1
12.	Measurement of melting point of fats	1
13.	Preparation of peanut butter	1
14.	Visit to dhal mill and oil mill	1
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Pulses	Harbhajan Singh	Agrotech Pub. Academy, 2005 ISBN: 9788183210140
2	Legumes Chemistry, Technology and Human Nutrition	Mathews RH	Marcel Dekker, 1989
3	Post harvest technology of cereals: pulses and oilseeds	Chakraverty A.	Oxford & ibh publishing company, 1988 isbn: 9788120402898
4	Bailey's Industrial Oil & Fat Products	Bailey A.E. and Shahidi F.	Wiley Publciation, 2005 ISBN: 9780471385462
5	Food Legumes	Kay DE	Tropical Products Institute, 1979

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Food and Feed from Legumes and Oilseeds	Smartt J and Nwokolo E.	Springer, 2012 ISBN: 9781461304333
2	Legumes and Oilseed Crops	Bajaj YPS	Springer, 2012 ISBN: 9783642744488
3	Handbook of Seed Science and Technology	Basra A.	CRC Press, 2006 ISBN: 9781560223153

FPT-236 MEAT, POULRY AND FISH TECHNOLOGY 3(2+1)

Theory

Sources and developments of meat and poultry industries in India and importance in national economy, Muscle structure, chemical composition and physico-chemical properties of meat muscle, Abattoir design and layout, Pre-slaughter transport and care and antemortem inspection. Slaughtering of animals and poultry, post-mortem inspection and grading of meat, Factors affecting post-mortem changes, properties and shelf life of meat. Egg structure: Composition, quality characteristics, processing and preservation of eggs, Processing and preservation of meat- mechanical deboning, aging or chilling, freezing, pickling, curing, cooking and smoking of meat, Meat tenderization. – principles and methods, Meat emulsions, Technology of manufacture of meat and poultry products Meat plant sanitation and safety By-products utilization of abattoir.

Practicals

Pre-slaughter operations of meat animals and poultry birds;Slaughtering and dressing of meat animals;Study of post-mortem changes;Meat cutting and handling;Evaluation of meat quality;Preservation of meat by different methods and preparation of meat and poultry products;Evaluation of quality and grading of eggs;Preservation of shell eggs;Experiments in by-products utilization.Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish. Fish products: surimi; Fish protein concentrates (FPC); Fish protein extracts (FPE), fish protein hydrolysates (FPH);

Teaching Schedule - Theory with Weightages (%)

Unit No.	**Topics**	**% Syllabus Covered**
1-2	Sources and developments of meat and poultry industries in India and importance in national economy	6
3-5	Muscle structure, chemical composition and physico-chemical properties of meat muscle. Abattoir design and layout	10
6-8	Pre-slaughter transport and care and antimortem inspection	9
9-11	Slaughtering of animals and poultry, post-mortem inspection and grading of meat	9
12-14	Factors affecting post-mortem changes, properties and shelf life of meat	9
15-17	Egg structure: Composition, quality characteristics, processing and preservation of eggs	10
18-20	Processing and preservation of meat- mechanical deboning, aging or chilling, freezing, pickling, curing, cooking and smoking of meat	10
21-23	Meat tenderization. – principles an methods	10
24-25	Meat emulsions	6
26-28	Technology of manufacture of meat and poultry products	9
29-30	Meat plant sanitation and safety; By-products utilization of abattoir	6
31-32	Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish. Fish products: surimi; Fish protein concentrates (FPC); Fish protein extracts (FPE), fish protein hydrolysates (FPH)	6
	Total	**100**

Practical Exercises

Unit No.	Topics	Number of Experiments
1	Slaughtering and dressing of poultry bird	1
2	Slaughtering and dressing of goat	1
3	Determination of water holding capacity of meat	1
4	Determination of extract release volume	1
5	Determination of meat pH	1
6	Estimation of total meat pigments	1
7	Determination of metmyoglobin content of meat	1
8	Preparation of meat products	1
9	Preparation of blood meal	1
10	Tenderization of meat	1
11	Composition and structure of egg	1
12	Determination of egg quality by Haugh unit	1
13	Preservation of shell egg	1
14	Study of anatomy and dressing of fish	1
15	Preparation of fish protein concentrate (FPC)	1
16	Visit to slaughter house	1
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Principles of Meat Science	Aberle E.D.	Kendall Hunt Publication ISBN: 9780787247201
2	Principles of Meat Technology	Singh V. P.	New India Publishing Agency, Delhi ISBN: 9789380235554
3	Handbook of Heat and Meat Processing	Hue Y.H.	CRC Press, New York ISBN: 9781439836835
4	Poultry Production	Singh R. A.	Khyani Publishers, Delhi
5	Fish Processing Technology	Hall G.M.	Springer Publication ISBN: 9781461311133
6	Handbook of Meat, Poultry and Seafood Quality	Kerth	Wiley Backwell, 2012 SBN: 9780470958322

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Meat Science	Lawrie R. A.	Pergamon Press, New York ISBN: 080307906
2	Handbook of Meat Processing	Fidel Toldra	Wiley-Blackwell, Iowa, USA ISBN: 9780813821825
3	Meat Products Handbook – Practical Science and Technology	Gerhard Feiner	CRC Press, Boca Raton ISBN: 9780849380105
4	Outlines of Meat Science and Technology	Sharma B.D.	Jaypee Brother Medical Publishers, ISBN: 9789350254813

FPT-237 PROCESSING TECHNOLOGY OF BEVERAGES 2(1+1)

Theory

History, importance of beverages and status of beverage industry, Processing of beverages, Packaged drinking water, juice based beverages, Synthetic, still, carbonated, low-calorie and dry beverages, isotonic and sports drinks, dairy based , alcoholic beverages fruit beverages, speciality beverages, tea, coffee, cocoa, spices, plant extracts, etc.; FSSAI specifications for beverages, Ingredients, manufacturing and packaging processes and equipment for different beverages; Water treatment and quality of process water Sweeteners, colorants, acidulants, clouding and clarifying and flavouring agents for beverages Carbon dioxide and carbonation Quality tests and control in beverages; Miscellaneous beverages Coconut water, sweet toddy, sugar cane juice, coconut milk, flavoured syrups

Practicals

Quality analysis of raw water; Determination of density and viscosity of caramel; Determination of colours in soft drinks by wool technique; Preparation of iced and flavoured tea; Preparation of carbonated and non-carbonated beverages; Determination of caffeine in beverages; Determination of brix value, gas content, pH and acidity of beverages; Quality analysis of tea and coffee, Preparation of miscellaneous beverages; Visit to carbonation unit; Visit to mineral water plant.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	No. of Lectures	% Syllabus Covered
1	History, importance of beverages and status of beverage industry	**1**	**6**
2	Processing of beverages	**1**	**6**
3	Packaged drinking water, juice based beverages	**1**	**6**
4-5	Synthetic, still, carbonated, low-calorie and dry beverages, isotonic and sports drinks, dairy based and alcoholic beverages,	**2**	**13**
6-7	Fruit beverages, speciality beverages, tea, coffee, cocoa, spices, plant extracts, etc.;	**2**	**13**
8-9	FSSAI specifications for beverages	**2**	**13**
10	Ingredients, manufacturing and packaging processes and equipment for different beverages;	**1**	**6**
11	Water treatment and quality of water	**1**	**6**
12	Sweeteners, colorants, acidulants, clouding, clarifying and flavouring agents for beverages	**1**	**6**
13-14	Carbon dioxide and carbonation	**2**	**13**
15	Quality tests and control in beverages;	**1**	**6**
16	Miscellaneous beverages: coconut water, sweet toddy, sugar cane juice, coconut milk, flavoured syrups	**1**	**6**
	Total	**16**	**100**

Practical Exercises

No. of Unit	Topics	Number of Experiments
1.	Quality analysis of water from different sources and treatments	1
2.	Determination of aqueous extraction of tea/coffee	1
3.	Test for chicory in coffee	1
4.	Detection of sodium benzoate in beverage	1
5.	Measurement of pH and acidity of beverage	1
6.	Detection of *E. coli* in beverage	1
7.	Measurement of CO_2 content of carbonated beverage	1
8.	Determination of caffeine in beverages	1
9.	Determination of tannins in wine	1
10.	Preparation of Instant Tea/coffee	1
11.	Preparation of RTS beverage	1
12.	Preparation of carbonated beverage	1
13.	Specifications for different fruit beverages and preparation of fruits squash	1
14.	Preparation of artificial lemon juice	1
15.	Preparation of beverage using artificial sweetener	1
16.	Visit to carbonation unit	1
17.	Visit to mineral water plant	1
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Fruit and Vegetable Juices	Tressler D.K., Joslyn M.A. and Marsh G.C.	AVI publishing company New York 1971
2	Food and Beverage Technology International USA	Bernard and Alan	Sterling Publication, 1989
3	Beverages: Technology, Chemistry and Mcirobiology	Varnam and Sutherland	Springer, 1994
4	Manufacturing of Food and Beverages	NIIR Board	NIIR Publication, New Delhi

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Food Flavourings	P.R. Ashust	Springer, 2012
2	Handbook of Alcoholic Beverages	Alan Buglass	John Wiley and Sons, 2011
3	Beverages	Pare Jean	Company's Coming Publishing Limited, 1997
4	Preservation of Fruit and Vegetable Products	Girdharilal, Siddappa, Tondon	Indian Council of Agricultural Research, Publications 1986

FPT-238 PROCESSING OF MILK AND MILK PRODUCTS 3(2+1)

Theory

Milk and milk products in India. Importance of milk processing plant in the country Handling and maintenance of dairy plant equipment. Dairy plant operations viz. receiving, separation, clarification, pasteurization, standardization, homogenization, sterilization, storage, transport and distribution of milk. Problems of milk supply in India, UHT, toned, humanized, fortified, reconstituted and flavoured milks. Technology of fermented milks (starter culture, dahi, yoghurt, shrikhand). Milk products processing viz. cream, butter, *ghee*, cheese, condensed milk, evaporated milk, whole and skimmed milk powder ice-cream, butter oil, *khoa, channa, paneer* and similar products. Judging and grading of milk products Cheese spreads by spray and roller drying techniques, EMC (Enzyme modified cheese), Enzymes in dairy processing Insanitization *viz*. selection and use of dairy cleaner and sanitizer. Inplant cleaning system Scope and functioning of milk supply schemes and various national and international organizations, Specifications and standards in milk processing industry, Dairy plant sanitation and waste disposal.

Practicals

Sampling and analysis of milk – Sp.gravity physico chemical properties and composition, DMC and DYC reduction tests, presence of adulterants and preservatives;Standardization of milk for markets;Clarification and separation of milk;Heat processing of milk – Pasteurization;Preparation of ;utter and Ghee;Ice-cream preparation;Preparation of dahi, shrikhand, lassi etc;Preparation of khoa;khoa based sweets;Preparation of channa, paneer and chana based sweets;Visit to Dairy plant;

Teaching Schedule - Theory with Weightages (%)

No. unit	**Topics**	**% Syllabus Covered**
1-2	Milk and milk products in India; Importance of milk processing plant in the country	7
3-6	Handling and maintenance of dairy plant equipment. Dairy plant operations viz. receiving, separation, clarification, pasteurization, standardization, homogenization, sterilization, storage, transport and distribution of milk	12
7-8	Problems of milk supply in India. UHT, toned, humanized,fortified, reconstituted and flavoured milks	7
9-11	Technology of fermented milks (starter culture, dahi, yoghurt, shrikhand); Milk products processing viz. cream, butter, *ghee*, cheese, condensed milk, evaporated milk, whole and skimmed milk powder	9
12-13	Ice-cream, butter oil, *khoa, channa, paneer* and similar products	6
14-15	Judging and grading of milk products	6
16-17	Cheese spreads by spray and roller drying techniques	6
18-19	EMC (Enzyme modified cheese); Enzymes in dairy processing	6
20-21	Insanitization *viz*. selection and use of dairy cleaner and sanitizer	6
22-23	Inplant cleaning system	7
24-26	Scope and functioning of milk supply schemes and various national and international organizations	10
27-29	Specifications and standards in milk processing industry	9
30-32	Dairy plant sanitation and waste disposal	9
	Total	**100**

Practical Exercises

No. of units	**Topics**	Number of experiments
1.	Sampling of milk and milk production	1
2.	Milk testing	1

3.	Determination of fat content of milk	1
4.	Detection of adulterants in milk and milk products	1
5.	Standardization of milk	1
6.	Heat processing of milk – Pasteurization	1
7.	Preparation of butter	1
8.	Preparation of ghee	1
9.	Preparation of ice-cream	1
10.	Preparation of coagulated milk product (paneer)	1
11.	Preparation of indigenous fermented milk products (dahi, Shrikhand, etc)	1
12.	Preparation of khoa	1
13.	Preparation of khoa based sweet	1
14.	Prepaartion of channa	1
15.	Preparation of channa based sweet (*Rasogulla*)	1
16.	Visit to dairy plant	1
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Outline of Dairy Technology	Sukumar De	Oxford University Press, 2008
2	The Fluid Milk Industry	Henderson JL	AVI Publishing Co, USA
3	Indian Dairy Industry	K.S.Rangappa and K L Acharya	Asia publishing house, Mumbai
4	Technology of Milk Processing	Khan QA and Padmanabhan	ICAR, New Delhi

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Principles of Dairy Processing	J.N.Warner,	Wiley Eastern Ltd, New Delhi
2	Judging of Dairy Products	J.A.Nelson and Trout	The Olsen publishing Co. Milwankee, Wisconsin, USA
3	Dairy Technology: Principles of milk properties and processes	Walstra P.	CRC Press, 1999
4	Technology of Dairy Products	Early R.	Springer, 1998

FPT-249 WHEAT MILLING AND BAKING TECHNOLOGY 3(2+1)

Theory

Wheat – importance, production verities used for cultivation, Types of wheat, grading and quality of wheat Structure of wheat chemical constituents, their distribution, Physico-chemical and Rheological properties, Enzymes in wheat, damage wheat, Conditioning of wheat – principles and methods of conditioning, Milling of wheat – Roller flour milling process Break rolls, reduction rolls, The design and operation, Wheat milling process, Products of wheat milling industry,flour, atta, etc. flour grades, supplementation, Fortification, Flour additives, flour improvers, Bleaching, Oxidizing agents Bakery products, role of bakery ingredients (major and minor), from hard wheat: bread processes of bread making using straight and sponge, dough methods role of each ingredient, quality control Testing of raw material testing of final product Bread faults, staleness, roppiness, Baked Products from soft wheat:cookies, crackers, biscuits, cakes: types, ingredients, process, fault causes and remedy Other bakery products: using very hard wheat. pizza, pastry and its types. Macaroni products: Including spaghetti, noodles, vermicelli-process. Nutritional improvement of bakery products Setting of bakery unit, bakery norms, specifications for raw materials, Packaging, marketing of products, project report preparation

Practicals

Classification of wheat based on physico-chemical properties;Conditioning of wheat; Milling of wheat;Quality Testing of flour: Falling number and α- amylase activity; Sedimentation value, Pelshenke value, Rheological Tests (Farinograph, Mixograph, Extensiograph, Alveograph);Manufacture loaf bread, types, faults, remedies, shelf life bread, quality of bread;Test Baking: biscuits, cookies;rackers, buns: ;Types and quality;Other baked products- pastry, pizza;Visit to wheat milling industry, visit to bakery.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1	Wheat – importance, production verities used for cultivation	6
2	Types of wheat, grading and quality of wheat	4
3-4	Structure of wheat, chemical constituents and their distribution	6
5-6	Physico-chemical and Rheological properties	6
7	Enzymes in wheat, damage of wheat	3
8-9	Conditioning of wheat – principles and methods of conditioning	6
10-12	Milling of wheat: Rolling flour milling process; break rolls; reduction rolls; Design and operation, wheat milling process	10
13-14	Products of wheat milling industry: Flour, atta, etc. flour grades, supplementation, Fortification	7
15	Flour additives, flour improvers, Bleaching, Oxidizing agents	3
16-21	Bakery products, role of bakery ingredients (major and minor),from hard wheat: bread processes of bread making using straightand sponge, dough methods role of each ingredient, quality controlTesting of raw material testing of final productDefects in bread; staleness, roppines.	16
22-25	Baked product from soft wheat; cookies, crackers, biscuits, cakes – ingredients, process, fault causes and remedy	12
26-28	Other bakery products: using very hard wheat. pizza, pastry and its types. Macaroni products: Including spaghetti, noodles, vermicelli-process. Nutritional improvement of bakery products	9
29-32	Setting of bakery unit, bakery norms, specifications for raw materials Packaging,	12

	marketing of products, preparation of project report.	
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Classification of wheat based on physico-chemical properties	1
2.	Determination of gluten content of wheat	1
3.	Determination of dough rising capacity	1
4.	Determination of Pelshanke Value	1
5.	Determination of sedimentation value	1
6.	Determination of falling number	1
7.	Determination of alcoholic acidity of flour	1
8.	Preparation of bread	1
9.	Evaluation of quality parameters of bread	1
10.	Preparation of biscuit	1
11.	Evaluation of physical properties of cookies	1
12.	Preparation of sponge cake	1
13.	Rheological Testing (farinograph, mixograph, extensiograph, alveograph, amylograph)	2
14.	Visit to wheat milling industry, visit to bakery unit	1
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Bakery Science and Cereal Technology	Khetarpaul. And	Daya Books, New Delhi 2005
2	Technology of Cereals	Kent.	Woodhead Publishing, 1994
3	Flour Milling Process	Scott JH	Chapman & Hall, 1951
4	Bakery Products Science and Technology	Zhou and Hui	John Wiley and Sons, 2014

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Modern Bakery Products	EIRI	EIRI Publication, New Delhi
2	Dough Wheat and Baked Products	Faridi and Faubin	Springer, 2012
3	Baked Products	Stanley PC and Linda SY	Asia publishing house, Mumbai

FPT-2410 FRUITS AND VEGETABLES PROCESSING 3(2+1)

Theory

Production and processing scenario of fruits and vegetables in India and World, Scope of fruit and vegetable preservation industry in India. present status, constraints and prospects, Overview of principles and preservation methods of fruits and vegetables, Commercial processing technology of fruits and vegetables, Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables, Minimal processing of fruits and vegetables Blanching operations and equipment, Canning: Definition, processing steps, and equipment, cans and containers, quality assurance and defects in canned products, Preparation and preservation of juices, squashes, syrups, sherbets, nectars, cordials, etc; Problems on squash and RTS; Processing and equipment for above products and FSSAI specification Preparation, preservation and machines for manufacture of crystallized fruits and preserves, jam, jelly and marmalades, problems, candies, Preparation, preservation and machines for manufacture of preserve, concentrate, fruit wine, sauerkraut, chutney, pickles, sauce, puree, paste, ketchup; toffee, cheese, lather, dehydrated, wafers and papads, soup powders; FSSAI specification, Production of pectin and vinegar; Commercial processing technology of selected fruits and vegetables for production of various value added processed products.

Practicals

Primary processing of selected fruits and vegetables;Canning of Mango/Guava/ Papaya;Preparation of Jam from selected fruit;Preparation of jelly from selected fruits;Preparation of fruit marmalade;Preparation of RTS;Preparation of squash;Preparation of syrup;Preparation of raisins; dried fig and dried banana; Preparation of anardana;Preparation of papain;Preparation of Pickles;Preparation of dried onion and garlic and ginger;Preparation of banana and potato wafers;Preparation of dehydrated leafy vegetables and Visit to fruits and vegetables pack house; Canning plant, vegetable dehydration plant.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1-2	Production and processing scenario of fruits and vegetables in India and World	6
3-5	Scope of fruit and vegetable preservation industry in India. present status, constraints and prospects	9
6-8	Overview of principles and preservation methods of fruits and vegetables	9
9-12	Commercial processing technology of fruits and vegetables	12
13-15	Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables	10
16-17	Minimal processing of fruits and vegetables	6
18-19	Blanching operations and equipment	6
20-22	Canning: Definition, processing steps, and equipment, cans and containers, quality assurance and defects in canned products	9
23-25	Preparation and preservation of juices, squashes, syrups, sherbets, nectars, cordials, etc; problems in squash and RTS; processing and equipment for above products and FSSAI specification	9
26-29	Preparation, preservation and machines for manufacture of crystallized fruits and preserves, jam, jelly and marmalades, problems, candies; Preparation, preservation and machines for manufacture of preserve, concentrate, fruit wine, sauerkraut, chutney, pickles, sauce, puree, paste, ketchup; toffee, cheese, lather, dehydrated, wafers and papads, soup powders; FSSAI specification	12
30-32	Production of pectin and vinegar; Commercial processing technology of selected fruits and vegetables for production of various value added processed products.	12
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1	Primary processing of selected fruits and vegetables	1
2	Canning of mango/guava/ papaya	1
3	Preparation of jam/ jelly/ marmalade from selected fruit	1

4	Preparation of RTS beverage	1
5	Preparation of squash	1
6	Preparation of grape raisins	1
7	Preparation of dried fig / banana fig	1
8	Preparation of fruit candy	1
9	Osmotic dehydration of fruit slices	1
10	Preparation of fruit leather	1
11	Preparation of fruit toffee	1
12	Preparation of pickle	1
13	Preparation of dried onion/garlic/ginger	1
14	Preparation of banana/ potato wafers	1
15	Preparation of dehydrated tomato powder	1
16	Visit to fruits and vegetables processing unit	1
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Fruit and Vegetable Preservation Principles and Practices	Srivastava R.P. and Sanjeev Kumar	International Book Distributing Company, New Delhi 2005
2	Post Harvest Technology of Fruits and Vegetables : Handling, Processing, Fermentation and Waste Management vol. I & II	Varma L. R. and Joshi V.K.	Indus Publishing, 2000
3	Preservation of Fruits and Vegetables	Khader	ICAR, New Delhi 2010
4	Preservation of Fruits and Vegetable	G. Lal, G.S. Siddappa, G.L. Tandan	ICAR Publication, New Delhi 1996

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Fruit and Vegetable Processing	M.G. Danthy	FAO, Rome
2	Post harvest Handling and Processing of Fruit and Vegetable	I.S. Singh	Text book
3	Fruit Processing	David Arthey,	Reference book
4	Handbook of Fruit and Vegetable Processing	Sinha and Hui	John Wiley and Sons, 2010
5	Fruit and Vegetable Preservation -Principles and Practices	Srivastava RP & Kumar S	International Book Distributors, 2003
6	Handbook of Fruit Science &Technology: Production, Composition and Processing.	Salunkhe DK & Kadam SS.	Marcel Dekker 1995

FPT-2411 PROCESSING OF SPICES AND PLANTATION CROPS 3(2+1)

Theory

Production and processing scenario of spice, flavour & plantation crops and its scope, Major Spices:(1) Post Harvest Technology composition, processed products of following spices – ginger, chilli, turmeric, onion, garlic, pepper, cardamom, cashew nut and coconut, Minor spices - herbs and leafy vegetables: processing and utilization, all spice, annie seed, sweet Basil, caraway seed, cassia, cinnamon, clove,

coriander, cumin, dill seed,fern seed, nutmeg, mint, marjoram, rose merry, saffron, sage,savory, thyme, ajowan, curry leaves, asafoctida,Tea, coffee, cocoa: Processing and quality control, Vanilla and annatto; Processing spice oil and oleoresins; Chemistry and physiology of taste, flavouring compounds in foods separation, purification and identification of natural flavouringmaterials; Synthetic flavouring agents and their stability;flavours of soft drinks, baking and confectionery industry; Standards specification of spices and flavours; Packaging of spices and spice products; Processing of arecanut and its quality control; Processing of cashewnut and its quality control; Flavours of major and minor spices; By products from plantation crops and spices

Practicals

Identification and characterization of flavouring compounds of spices; Estimation of oil contents indifferent spices; Extraction of oil from clove, pepper, cardamom-chili; Extraction of oleoresins:Turmeric, ginger, pepper, clove; Piperine estimation in pepper oleoresin; Steam distillation of spices; Determination of curcumin content in turmeric; Chemical analysis of spices moisture, Volatile oil; Specific; gravity, refractive index, acid value; Study of standard specification of spices; Packaging study of spices;Preparation of curry powder; Preparation of Indian Masala for different foods; Visit to spice industry

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1-2	Production and processing scenario of spice, flavour & plantation crops and its scope	7
3-5	Major spices: Post harvest technology, composition, processed products of spices – ginger, chilli, turmeric, onion, garlic, pepper, cardamom, cashew nut and coconut	9
6-8	Minor spices, herbs and leafy vegetables: processing and utilization, All spice, annie seed, sweet basil, caraway seed, cassia, cinnamon, clove, coriander, cumin, dill seed, Fern seed nutmeg, mint, marjoram, Rose merry, saffron, sage, etc	9
9-11	savory, thyme, ajowan, curry leaves, asafetida	10
12-14	Tea, Coffee, Cocoa: Processing quality control	9
15-16	Vanilla and annatto-processing	7
17	Spice oil and oleoresins	4
18-19	Chemistry and physiological of taste, flavouring compounds in foods	6
20-21	Separation, purification and identification of natural flavouring materials	6
22-23	Synthetic flavouring agents and their stability	6
24-25	Flavours of soft drinks, Baking and confectionery industry	6
26-27	Standards specification of spices and flavours	6
28	Packaging of spices and spice products	3
29	Processing of arecanut and its quality control	3
30	Processing of cashewnut and its quality control	3
31	Flavours of major and minor spices	3
32	By products from plantation crops and spices	3
	Total	**100**

Practical Exercises

Number of units	Topics	Number of experiments
1.	Physicochemical properties of different spices	2

2.	Study of standard specification of spices	1
3.	Study on Curing of ginger	1
4.	Detection of adulteration in spices	2
5.	Determination of piperine content of black pepper	1
6.	Picrocrocine, safranal and crocine content	1
7.	Test for presence of chromate	1
8.	Extraction of oil/ oleoresins from spices	1
9.	Steam distillation of spices for essential oil	1
10.	Determination of curcumin content in turmeric	1
11.	Preparation of curry powder	1
12.	Preparation of Indian *Masala* for different foods	2
13.	Visit to spice industry	1
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Spices and Plantation Crops	K.G. Shanmugavelu	Agrotech Publication, Delhi
2	Spice and Condiments	Pruthi J.S.	National Book Trus, 1996
3	Handbook on Spices and Condiments (cultivation, processing and extraction)	Panda H.	Asia Pacific Business Press Inc. 2010
4	The Complete Book on Spices &Condiments (with cultivation, processing & uses)	NIIR BOARD	Asia Pacific Business Press Inc. 2010
5	Spices and Seasonings: A Food Technology Handbook	Tainter DR and Grenis AT	John Wiley and Sons, 2001

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Handbook of Herbs and spices	Peter VK	Woodhead Publishing 2012
2	The Book of Spices	Rosengarten F.	Pyramid Books, 1973
3	Spices and Herbs for the Food Industry	Lewis YS	Food Trade Press, 1984
5	Food Flavourings	P.R. Ashust	Springer, 2012

FPT-3512 CONFECTIONARY AND SNACKS TECHNOLOGY 3(2+1)

Theory

History, Traditional confectionary goods, Types of confectionary, classification of confectionery products Raw Materials/ ingredients-Sugar, Sugar qualities, Physical, Chemical, Optical properties. Sugar grinding, Dextrose, Fructose, Lactose, caramel, maltose, Honey, sorbitol, xylitol, Iso malt, soy maltose, Polydextrose, Mannitol. Whipping, Release agent, thickeners, Acidulents, Milk and Milk Products, Flavours for confectionery, emulsifiers and other additives, Starch derivatives, colours used in confectionary. Production of glucose syrup, Acid hydrolysis, enzyme hydrolysis, Cocoa Processing: Cocoa bean, processing, roasting, Fermentation, Production of Cocoa butter Cocoa powder, its quality. Chocolate Processing : Ingredients, Mixing, Refining, Conching, Tempering, Molding, Cooling, Coating, Fat bloom. High Boiled Sweets: Introduction, Composition, Properties of high boiled sweets, preparation of high

boiled sweets, Traditional, batch and continuous Method of preparation, Different types of higher boiled sweets, Recipes. Caramel: Definition, Composition, Factors affecting quality of caramel, caramel Manufacture process, batch type, continuous types, checking of faults in caramel, Toffee: Definition, Composition, types of toffee Ingredient and their role. Batch and Continuous method of toffee Fondant: Fudge/Creamy: ingredients, Methods, Productivity Lozenges: Definition recipe, Method of Manufacture, Compositions, factors affecting quality, Industrial production, checklist of faults and remedy Tablets: Definitions, recipe, composition, wet granulation, Slugging, Manufacture of Tablet, and Checklist of tablet faults. Marshmallow and. Nougat: Definition, composition, recipe, and method of manufacture. Nougat Panning: Process, types of Panning, soft and hard panning. Quality of confectionery, Standards and regulations, Packaging requirements of confectionary, economics and marketing of confectionary goods.

Practicals

Production of invert sugar ;Preparation of High boiled sweets; Preparation of Toffee; Preparation of ; Groundnut Chikki; Preparation of decorative cake; Preparation of Chocolate; Preparation of Traditional ; Indian Confection; Preparation of shrikhand wadi; Preparation of milk chocolate ;Preparation ;f fruit toffee ;Preparation of flour based confectionery ;Preparation of milk cake; Preparation of petha ;Preparation of fruit candy ;Preparation of rasgulla ;Visit to Confectionary Industry

Sr. No.	Topics	No. of Lectures	% Syllabus Covered
1-2	History; Traditional confectionary goods; Types of confectionary; Classification of confectionery products.	2	6
3-6	Raw Materials/ ingredients- sugar, sugar qualities, physical, chemical, optical properties,sugar grinding, dextrose, fructose, lactose, caramel, maltose, honey, sorbitol, xylitol, iso-malt, soy maltose, polydextrose, mannitol	4	13
7-8	Whipping, release agent, thickeners, acidulents, milk and milk products, flavours, for confectionery, emulsifiers and other additives,	2	6
9-10	Starch derivatives, colours used in confectionary. Production of glucose syrup, Acid hydrolysis, enzyme hydrolysis	2	6
11-14	Cocoa processing: cocoa bean, processing, roasting, fermentation, Production of cocoa butter,cocoa powder, its quality.	4	14
15-18	Chocolate processing: ingredients, mixing, refining, conching, tempering, molding, cooling, coating, fat bloom.	4	13
19-22	High Boiled Sweets: introduction, composition, properties of high boiled sweets, preparation of high boiled sweets, traditional, batch and continuous method of preparation. different types of higher boiled sweets, recipes.	4	12
23-24	Caramel: definition, composition, factors affecting quality of caramel, caramel manufacture process, batch type, continuous types, checking of faults in caramel.	2	6
25-26	Toffee: definition, composition, types of toffee ingredient and their role. Batch and continuous method of toffee.	2	6
27-28	Fondant: fudge/creamy: ingredients, methods, Productivity lozenges: Definition recipe, Method of Manufacture, Compositions, factors affecting quality, Industrial production, checklist of faults and remedy	2	6
29-30	Tablets: Definitions, recipe, composition, wet granulation, Slugging, Manufacture of Tablet, and Checklist of tablet faults. Marshmallow and. Nougat: Definition, composition, recipe, and method of manufacture. Nougat	2	6
31-32	Panning: Process, types of Panning, soft and hard panning. Quality of confectionery, Standards and regulations, Packaging requirements of confectionary, economics and marketing of confectionary goods.	2	6
	Total	**32**	**100**

Practical Exercises

No. of Unit	Topics	No. of experiments
1	Production of invert sugar	1
2	Preparation of high boiled sweets	1
3	Preparation of toffee	1
4	Preparation of groundnut *chikki*	1
5	Preparation of caramel	1
6	Preparation of chocolate	1
7	Preparation of traditional Indian confection	1
8	Preparation of *shrikhand wadi*	1
9.	Preparation of milk chocolate	1
10.	Preparation of fruit toffee	1
11	Preparation of flour based confectionery	1
12	Preparation of milk cake	1
13	Preparation of *petha*	1
14	Preparation of fruit candy	1
15	Preparation of *rasgulla*	1
16	Visit to confectionary industry	1
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Industrial Chocolate Manufactory and Use	S. T. Beckett	Springer, 2012 ISBN: 9781461521112
2	Sugar Confectionery and Chocolate Manufacture	R. Less and E.B. Jackson	Springer, 2012 ISBN: 9781468414950
3	The Complete Technology Book on Snack Foods	Panda H.	NIIR Project Consultancy Services, 2013 ISBN: 9789381039243
4	Sugar Confectionary Manufacture	Jackson EB	Aspen Publication, 1999

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Snack Food Processing	Lusas EW and Rooney LW	CRC Press, 2001 ISBN: 9781420012545
2	Snack Food	Booth RG	Springer, 2012 ISBN: 9781461314776
3	Chocolate, Cocoa and Confectionery: Science and Technology	Bernard W. Minifie	Springer, 1999 ISBN: 9780834213012
4	Snack Food Technology	Matz S.A.	Springer, 1985 ISBN: 9780870554605

FPT-3513 FOOD EXTRUSION TECHNOLOGY 2(1+1)

Theory

Extrusion: definition, introduction to extruders, principles and types, Uses of extruders in the food industry, Single screw extruder: principle of working, net flow, factors affecting extrusion process, Twin screw extruder: counter rotating and co-rotating twin screw extruder, Process characteristics of the twin screw extruder Pre-conditioning of raw materials used in extrusion process Use of dry extruders in extrusion Chemical and nutritional changes in food during extrusion, Classification of Break fast cereals: Raw materials, process and quality testing of vermicelli, spaghetti: Raw materials, process and quality testing of pasta and macronic products Texturized vegetable protein: Definition, processing techniques, and foods Ready to eat break fast cereals by extrusion cooking.

Practicals

Physicochemical properties of proteins, protein rich products, weaning foods, beverages;Texturized products, protein rich bakery products;Type of food extruders, preparation of extruded products; Factors affecting extrusion cooking, moisture content,; diameter, temperature, pressure, screw speed, time, quality evaluation of these products

Teaching Schedule - Theory with Weightages (%)

Sr. No.	Topics	% Syllabus Covered
1	Extrusion: definition, introduction to extruders, principles and types	6
2	Uses of extruders in the food industry	6
3-4	Single screw extruder: principle of working, net flow, factors affecting extrusion process	13
5-6	Twin screw extruder: counter rotating and co-rotating twin screw extruder	13
7	Process characteristics of the twin screw extruder	6
8	Pre-conditioning of raw materials used in extrusion process	6
9	Use of extruders in extrusion.	6
10	Chemical and nutritional changes in food during extrusion	6
11	Classification of breakfast cereals	6
12	Raw materials, process and quality testing of vermicelli and spaghetti	6
13	Raw materials, process and quality testing of pasta and macronic products	6
14	Texturized vegetable protein: Definition, processing techniques	6
15-16	Ready to eat breakfast cereals by extrusion cooking	14
	Total	**100**

Practical Exercises

Unit No.	Topics	Number of experiments
1	Physical properties of extruded foods (expansion, density, water absorption index, etc)	1
2	Physicochemical properties of proteins	1
3	Preparation of protein isolate and concentrate	2
4	Preparation of noodles/ vermicelli	1
5	Preparation of spaghetti	1
6	Preparation of weaning foods	1
7	Studies on properties of texturized vegetable protein	2
8	Determination of oil absorption capacity of extruded products	1
9	Determination of water absorption capacity of noodles	1
10	Cooking quality of TVP	2
11	Studies on Textural Profile Analysis of extruded products	1
12	Effect of extrusion cooking on antinutritional factor	1
13	Visit to extrusion industry	1
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Extruded foods	Matza S.	Springer, 2000
2	Technology of Extrusion Cooking	N.D. Frame	Springer, 2012
3	Extruders in Food Application	Riaz M.N.	CRC Press, 2000

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Advances in Food Extrusion Technology	Maskan and Altan	CRC Press, 2000
2	Extrusion of Foods	Harper JM	CRC Press, 1981
3	Food Process Engineering and Technology	Berk Z.	Academic Press, 2013
	New Protein Foods, vol. I, and II	A.L. Altschul.	Academic Press, 1985

FPT-3614 FOOD QUALITY AND SENSORY EVALUATION 3(2+1)

Theory

Food quality and its role in food industry, need of quality control, factors affecting quality control, Quality attributes, dominant and hidden attributes, Color: Role of colors in quality spectra, different types of colour, measuring instruments; Viscosity – types of fluids, different viscometers to measure viscosity; Consistency – methods used to measure consistency or product difference between viscosity and consistency; Size and shape - Method to find shape and size of food and food products,Defects: Classification, genetic-physiological defects- Structural, off color, character, entomological Defects- holes, Scars, lesions, off coloring, curled leaves, pathological defects, Mechanical defects, Extraneous or foreign material defects; Measurement of defects: Improving visibility by dilution, white background, color differences, standardization of conditions, reference standards, counts and measures, isolation of defects by floatation, elution, electronic sorting, Internal defects. Texture: Classification, role of firmness, yielding quality, juiciness, chewiness, fibrousness, grittiness, mealiness, stickiness, measurement of texture/ kinesthetic characteristicsby compression, mechanical thumb, puncture tester, succulometer, shearing by tenderometer, texturometer, maturometer, fibro meter, moisture content, by barbender moisture tester, alcohol insoluble solids, color, consistency & sound measurement for kinesthetics. Flavour: Definition and its role in food quality; Taste: Classification, taste qualities, relative intensity, reaction time, effect of disease, temperature, and taste medium on taste, basic tastes and interaction of tastes; Odour: Definition, classification, mechanisms, olfactory abnormalities, odor testing, techniques, thresholds, odor intensities; Factors influencing the Food qualities: Soil, field practices, harvesting practices, procedures, packaging, transportation, storage, conditions, processing conditions, packaging and storage conditions of finished products. Recording and reporting of quality. Sensory evaluation: Definition, classification and methods, sensory evaluation of different products.

Practicals

Quality attributes measurement of various food products;Quality evaluation of product for colours Quality evaluation of product for size, shape;Determination of viscosity of Food roducts;Determination of exture;Sensory evaluation of product for taste and flavor;Market testing of products.; Evaluation of food standards;Determination of color by using lovibond tintometerl; Measurement of texture using pressure tester; Consumer study for food quality; Visit to fruit & Vegetable market for quality assessment.

Teaching Schedule - Theory with Weightages (%)

Unit No.	Topics	% Syllabus Covered
1-2	Food quality and its role in food industry need of quality control, factors affecting quality control	6
3-4	Quality attributes: dominant and hidden attributes	6
5-6	Color-role of colors in quality spectra, different types of colour measuring instruments	6
7-8	Viscosity:- types of fluids, different viscometers to measure viscosity.	6
9-12	Consistency:- methods used to measure consistency or product difference between viscosity and consistency	12
13-14	Size and shape: - Method to find shape and size of food and food products	6
15-18	Defects: Classification, Genetic, physiological defects, structural, off-color, Entomological Defects: holes, Scars, lesions, offcoloring, curled leaves, pathological defects. Mechanical defects, Extraneous or foreign material defects. Measurement of defects: Improving visibility by dilution, white background, color differences, standardization of conditions, reference standards, counts and	9

	measures, isolation of defects by floatation, elution, electronic sorting, Internal defects.	
19-22	Texture: classification, role of firmness, yielding quality, juiciness, chewiness, fibrousness, grittiness, mealiness, stickiness,, measurement of texture/ kinesthetic characteristics.- by compression, mechanical thumb, puncture tester, succulometer, shearing by tenderometer, texturometer, maturometer, fibro meter, moisture content, by barbender moisture tester, alcohol insoluble solids, color, consistency & sound measurement for kinesthetics.	11
23-26	Flavour: Definition and its role in food quality, Taste, classification, taste qualities, relative intensity, reaction time, effect of disease, temperature, and taste medium on taste, basic tastes and interaction of tastes. Odour : definition, Classification, neutral - mechanisms, Olfactory abnormalities, odor testing, techniques, thresholds, odor intensities	9
27-30	Factors influencing the food qualities: Soil, field practices, harvesting practices, procedures, packaging, transportation, storage, conditions, processing conditions, packaging and storage conditions of finished products.	13
31-32	Recording and reporting of quality.	16
	Total	**100**

Practical Exercises

Unit No.	**Topics**	**Number of experiments**
1	Quality attributes of various food products	1
2	Quality evaluation of product for colours	1
3	Quality evaluation of product for size, shape	1
4	Determination of viscosity of food products	1
5	Determination of textural quality profile	2
6	Determination of color by using lovibond tintometer	1
7	Testing of supertaster for sensory evaluation	1
8	Simple difference tests for sensorial evaluation	2
9	Directional difference tests for sensorial evaluation	1
10	Measurement of insect damage	1
11	Evaluation of food products as per standards	1
12	Descriptive testing for sensory evaluation of food	1
13	Consumer study for food quality	1
14	Visit to fruit &vegetable market for quality assessment	1
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Fundamentals of Quality Control for Food Industry	Krammer and Twigg	Avi Publishing Company, 1966
2	Quality Control in Food Industry	Krammer and Twigg	Avi Publishing Company, 1966
3	Quality Control in Food Industry	Herschdoerfer	Elsevier, 2012
4	Sensory Evaluation Techniques	Civillie and Carr	CRC Press, 2015
5	Handbook of Analysis and Quality Control for Fruit and Vegetable Products.	Ranganna S.	2nd Ed. Tata-McGraw-Hill. 2001.

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Food Industry Quality Control Systesm	Clute M.	CRC Press, 2008
2	Sensory Evaluation Practices	Stone, Bleibaum and Thomas	Academic Press, 2012
3	Sensory Evaluation Practices	Taylor	Academic Press, 2012
4	Measurement and Control in Food Processing	Bhuyan	CRC Press, 2006
5	Principles of Sensory Evaluation of Food	Amerine MA, Pangborn RM & Rosslos EB	Academic Press 1965

II. DEPARTMENT OF FOOD ENGINEERING

Sr. No.	Course No.	Course title	Credits	Semester
1	FE-111	Engineering Drawing and Graphics	3 (1+2)	I
2	FE-112	Fluid Mechanics	3 (2+1)	I
3	FE-113	Mathematics	2 (2+0)	I
4	FE-124	Heat and Mass Transfer	3 (2+1)	II
5	FE-125	Statistical Methods and Numerical Analysis	2 (1+1)	II
6	FE-236	Energy Generation and Conservation	3 (2+1)	III
7	FE-237	Unit Operations in Food Processing – I	3 (2+1)	III
8	FE-248	Unit Operations in Food Processing – II	3 (2+1)	IV
9	FE-249	Post Harvest and Storage Engineering	3 (2+1)	IV
10	FE-3510	Biochemical Engineering	3 (2+1)	V
11	FE-3511	Food Refrigeration and Cold Storage	3 (2+1)	V
12	FE-3612	Food Processing Equipment Design	2 (1+1)	VI
13	FE-3613	Food Plant Design and Layout	3 (2+1)	VI
14	FE-3614	Instrumentation and Process Control	3 (2+1)	VI
		Total Credits	**39 (25+14)**	

FE-111 ENGINEERING DRAWING AND GRAPHICS 3 (1+2)

Theory

First and third angle methods of projection; Preparation of working drawing from models and isometric views; Different methods of dimensioning; Types of rivet heads and riveted joints; Processes for producing leak proof joints; Symbols for different types of welded joints; Nomenclature, thread profiles, multi-start threads, left and right hand thread Square headed and hexagonal nuts and bolts Conventional representation of threads Different types of lock nuts, studs Machine screws, cap screws and wood screws Foundation bolts.

Practicals

Introduction of drawing scales; Principles of orthographic projections; References planes; True length and inclination of lines; Projections of solids: Change of position method, alteration of ground lines; Section of solids and interpenetration of solid-surfaces; Development of surfaces of geometrical solids; Isometric projection of geometrical solids;Preparation of manual drawings with dimensions from models and isometric drawings of objects and machine components; Preparation of sectional drawings of simple machine parts; Drawing of riveted joints and thread fasteners; Demonstration on computer graphics and computer aided drafting use of standard software; Sectional drawings of engineering machines; Computer graphics for food engineering applications; Interpretation of sectional views of food equipment and components; Practice in the use of basic and drawing commands on AutoCAD; Generating simple 2-D drawings with dimensioning using AutoCAD; Small Projects using CAD/CAM.

Teaching Schedule - Theory with Weightages (%)

No. of Units	**Topics**	**% Syllabus Covered**
1.	First and third angle methods of projection	7
2-3	Preparation of working drawing from models and isometric views	13
4	Different methods of dimensioning	6
5	Types of rivet heads and riveted joints	6
6	Processes for producing leak proof joints	6
7	Symbols for different types of welded joints	6
8	Nomenclature, thread profiles	6
9-10	multi-start threads, left and right hand thread	13
11-12	Square headed and hexagonal nuts and bolts	13
13	Conventional representation of threads	6
14	Different types of lock nuts, studs	6
15	Machine screws, cap screws and wood screws	6
16	Foundation bolts	6
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Study of drawing scales	1
2.	Study of plane and diagonal scale	1
3.	Study of vernier, comparative and scale of chord	1
4.	Study of principle of orthographic projects, reference plane and different quadrant	1
5.	Drawing of orthographic projection by first angle project method	1
6.	Drawing of orthographic projection by third angle project method	1
7.	Drawing of projection of point	1
8.	Drawing of projection of line	1
9.	Drawing of projection of plane	1
10.	Drawing of projection of solid	1
11.	Drawing of projection of section of solid	1
12.	Study of interpretation of solid	1
13.	Study and drawing of development of surfaces of geometrical solids	1
14.	Study and drawing of isometric projection	1
15.	Preparation of manual drawing with dimension from different model	1
16.	Preparation of manual drawing with dimension from isometric object	1
17.	Preparation of manual drawing with dimension from machine component	1
18.	Drawing of section of machine parts	1
19.	Study and drawing of riveted joints	1
20.	Study and drawing of welded joints	1
21.	Drawing of thread and thread fasteners	1
22.	Study of computer graphics	1
23.	Study of computer aided drafting	1
24.	Study and application of computer graphics in food engineering	1
25.	Interpretation of sectional view of food equipment and components	1
26.	Study and use of AutoCAD	1
27.	Study of two dimensional drawing command in AutoCAD	1
28.	Study of three dimensional drawing command in AutoCAD	1
29.	Two dimensional drawing in AutoCAD	1
30.	Three dimensional drawing in AutoCAD	1
31.	Isometric drawing in AutoCAD	1
32.	Small project using cad / cam	1
	Total	**32**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Machine Drawing	N.D. Bhat and V.M. Panchal	Charotar Publishing House, Anand. 1995
2	Elementary Engineering Drawing	N. D. Bhat	Charotar Publishing House, Anand. 1995
3	Mastering CAD/CAM	Ibrahim Zaid	Mc-Graw Hill Books, USA, 2004

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Principles of CAD/CAM/CAE Systems.	Lee K.	Prentice-Hall, USA.
2	Engineering Drawing and Graphics	Venupogal K.	New Age International, New Delhi 2007
3	Drawing for Engineering	Smith Paul	Juta and Company Ltd., 1999
4	The Workman's Manual of Engineering Drawing	Maxton J.	Lockwood and Company, 1871

FE-112 FLUID MECHANICS 3 (2+1)

Theory

Units and dimensions Properties of fluids; Static pressure of liquids: Hydraulic pressure, absolute and gauge pressure, pressure head of a liquid; Pressure on vertical rectangular surfaces Compressible and non-compressible fluids; Surface tension, capillarity; Pressure measuring devices: Simple, differential, micro-, inclined manometer mechanical gauges, piezometer, Floating bodies: Archimedis principle, stability of floating bodies; Equilibrium of floating bodies, metacentric height, Fluid flow: Classification, steady, uniform and non-uniform, laminar and turbulent, continuity equation; Bernoulli's theorem and its applications; Flow through pipes: Loss of head Flow through orifices, mouthpieces, notches and weirs Vena contracta, hydraulic coefficients, discharge losses; Time for emptying a tank; Loss of head due to contraction, enlargement at entrance and exit of pipe types of notches, rectangular and triangular notches, rectangular weirs; Venturimeters, pitot tube, rotameter Turbines and pumps: classification, centrifugal pumps, reciprocating pumps, positive displacement pump; Centrifugal pumps: operating characteristics of centrifugal pumps Reciprocating pumps: Working of reciprocating pump.

Practicals

Study of different tools and fittings;Study on flow rate versus pressure drop with U-tube manometerVerification of Bernoulli's theorem; Determination of discharge co-efficient for venturi, orifice, V-notchVerification of emptying time formula for a tank; Determination of critical Reynold's number by Reynold apparatus; Study of reciprocating, centrifugal pumps; Study of different types of valves; Study of pumps for viscous fluid; Floating bodies, liquid flow, venturimeter, orifice, weir, flow through pipes

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1	Units and dimensions	3
2-3	Properties of fluids; Static pressure of liquids: Hydraulic pressure, absolute and gauge pressure	7
4-5	Pressure head of a liquid; Pressure on vertical rectangular surfaces	6
6	Compressible and non-compressible fluids; Surface tension, capillarity	3
7-8	Pressure measuring devices: Simple, differential, micro-, inclined manometer	7
9-10	Mechanical gauges, piezometer	6
11-12	Floating bodies: Archimedis principle, stability of floating bodies	6
13-14	Equilibrium of floating bodies, metacentric height	9
15-17	Fluid flow: Classification, steady, uniform and non-uniform, laminar and turbulent, continuity equation	6
18-19	Bernoulli's theorem and its applications	6
20-21	Flow through pipes: Loss of head	6
22-23	Flow through orifices, mouthpieces, notches and weirs	6
24-26	Vena contracta, hydraulic coefficients, discharge losses; Time for emptying a tank; Loss of head due to contraction, enlargement at entrance and exit of pipe	9
27-28	types of notches, rectangular and triangular notches, rectangular weirs; Venturimeters, pitot tube, rotameter	7
29-30	Turbines and pumps: classification, centrifugal pumps, reciprocating pumps, positive displacement pump; Centrifugal pumps: operating characteristics of centrifugal pumps	7
31-32	Reciprocating pumps: Working of reciprocating pump	6
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Study of different tools and fittings	1
2.	Study of different types of manometers (simple and micromanometer)	1
3.	Study of different types of manometers (differential manometer)	1
4.	Study of different mechanical gauges for pressure measurement	1
5.	Numericals for pressure measurement by U tube manometer	1
6.	Verification of Bernoulli's theorem	1
7.	Determination of discharge co-efficient for venturimeter	1
8.	Determination of discharge co-efficient for orifice meter	1
9.	Determination of discharge co-efficient for rectangular and V notch	1
10.	Verification of emptying time formula for a tank and their numerical	1
11.	Study of principle and working of centrifugal pumps	1
12.	Study of principle and working of reciprocating/ positive displacement pump	1
13.	Determination of metacentric height by metacentric height apparatus	1
14.	Study of Reynold's number apparatus to predict type of flow	1
15.	Study of different types of valves	1
16.	Numericals on C.D. for venturimeter and orifice meter	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	A Textbook of Hydraulics	Khurmi RS	S. Chand Publication, 1983
2	A Textbook of Fluid Mechanics and Hydraulics	Bansal RK	Firewell Media, 2005
3	Hydraulics	Jagdish Lal	Metropolitan Publisher, Delhi 1963
4	Fluid Mechanics	Fox, Mcdonanld and Pritchard	8th Edition, Wiley Publishers, 2013

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Fluid Mechanics	Frank M. White.	7th Ed. McGraw-Hill Book Co., Inc., Boston, USA. 2010.
2	Fluid Mechanics: Fundamentals and Applications.	Yunus A. Çengel and John M. Cimbala.	McGraw-Hill, Inc., New York, USA. 2006.
3	Fundamentals of Fluid Mechanics	Bruce R. M., Donald F. Y. and Theodore H. O.	4th Ed. John Wiley & Sons, Inc., New York, USA. 2002
4	Fluid Mechanics with Engineering Applications	E. John Finnemore and Joseph B. Franzini.	10th Ed. McGraw-Hill, Inc., New York, USA. 2002

FE-113 MATHEMATICS 2 (2+0)

Theory

Differential calculus: Taylor's and Maclaurin's expansions, indeterminate form;Function of two or more independent variables, partial differentiation;Homogeneous functions and Euler's theorem, composite functions; Total derivatives, derivative of an implicit function, change of variables, maxima and minima; Ordinary differential equations: Exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors; Equations of first order and higher degree, Clairaut's equation, differential equations of higher orders; Linear differential equations with constant coefficients; Methods of finding complementary functions and particular integrals; Partial differential equations: Formation of partial differential equations, Lagrange's linear equation, higher order linear partial differential equations with constant coefficients; Solution of non-linear partial differential equations, Charpit's method, application of partial differential equations (one-dimensional wave and heat flow equations, two-dimensional steady state heat flow equation (Laplace equation);Matrices: Elementary transformations, rank of a matrix, reduction to normal form, Gauss-Jordon method to find inverse of a matrix; Consistency and solution of linear equations, Eigen values and Eigen vectors, Cayley-Hamilton theorem; Linear transformation, orthogonal transformations, diagonalisation of matrices, bilinear and quadratic forms

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1-2	Differential calculus: Taylor's and Maclaurin's expansions, indeterminate form	7
3-4	Function of two or more independent variables, partial differentiation	6
5-6	Homogeneous functions and Euler's theorem, composite functions	6
7-10	Total derivatives, derivative of an implicit function, change of variables, maxima and minima	12
11-13	Ordinary differential equations: Exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors	9
14-15	Equations of first order and higher degree, Clairaut's equation, differential equations of higher orders	7
16	Linear differential equations with constant coefficients	3
17-18	Methods of finding complementary functions and particular integrals	7
19-22	Partial differential equations: Formation of partial differential equations, Lagrange's linear equation, higher order linear partial differential equations with constant coefficients	12
23-25	Solution of non-linear partial differential equations, Charpit's method, application of partial differential equations (one-dimensional wave and heat flow equations, two-dimensional steady state heat flow equation (Laplace equation)	9
26-27	Matrices: Elementary transformations, rank of a matrix, reduction to normal form, Gauss-Jordon method to find inverse of a matrix	7
28-30	Consistency and solution of linear equations, Eigen values and Eigen vectors, Cayley-Hamilton theorem	9
31-32	Linear transformation, orthogonal transformations, diagonalisation of matrices, bilinear and quadratic forms	6
	Total	**100**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Higher Engineering Mathematics	B.S. Grewal.	Khanna Publishers Delhi. 2004
2	Differential Calculus	Shanti Narayan	S. Chand and Co. Ltd., New Delhi. 2004
3	Integral Calculus	Shanti Narayan	S. Chand and Co. Ltd., New Delhi. 2004
4	A Textbook of Vector Calculus	Shanti Narayan	S. Chand and Co. Ltd., New Delhi. 2004

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Engineering Mathematics	B.V. Ramana	Tata McGraw-Hill Book Co., Delhi. 2008
2	A Textbook of Matrices	Shanti Narayan	S. Chand and Co. Ltd., New Delhi. 2004
3	Engineering Mathematics	Pal and Bhunia	Oxford University Press, UK 2015

FE-124 HEAT AND MASS TRANSFER 3 (2+1)

Theory

Basic heat transfer processes Heat transfer coefficients, properties related to heat transfer; One-dimensional steady state conduction; Theory of heat conduction, Fourier's law and its derivation; Heat transfer through composite walls; One-dimensional steady state heat conduction with heat generation; Heat flow through slab, hollow sphere and cylinder with linear heat transfer; Convection: Forced and free convection; Use of dimensional analysis for correlating variables affecting convection heat transfer; Concept of Nusselt number, Prandtl number, Reynolds number, Grashoff number, some important empirical relations used for determination of heat transfer coefficient; Radiation: Heat radiation, emissivity, absorptivity, transmissivity, radiation through black and grey surfaces; Heat Exchangers: General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, shell and tube and plate heat exchangers, heat exchanger design; Application of different types of heat exchangers in dairy and food industry; Mass transfer: Fick's law of diffusion, steady state diffusion of gases and liquids through solids Mass transfer coefficient, application in dairy and food industry.

Practicals

Heat transfer analysis during conduction and convection; Study on various types of heat exchangers used in food industry;Preparation and calibration of thermocouples; Determination of thermal conductivity of different food products; Study of working principle and constructional details of plate heat exchanger; Study of working principle and constructional details of shell and tube heat exchanger.Determination of overall heat transfer coefficient of shell and tube, plate heat exchangers, jacketed kettle used in food industry.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	No. of Lectures	% Syllabus Covered
1-2	Basic heat transfer processes	2	7
3-4	Heat transfer coefficients, properties related to heat transfer; One-dimensional steady state conduction	2	7
5-7	Theory of heat conduction, Fourier's law and its derivation	3	9
8-10	Heat transfer through composite walls one-dimensional steady state heat conduction with heat generation	3	9
11-13	Heat flow through slab, hollow sphere and cylinder with linear heat transfer	3	9
14-15	Convection: Forced and free convection	2	6
16-18	Use of dimensional analysis for correlating variables affecting convection heat transfer	3	9
19-21	Concept of Nusselt number, Prandtl number, Reynolds number, Grashoff number, some important empirical relations used for determination of heat transfer coefficient	3	9
22-23	Radiation: Heat radiation, emissivity, absorptivity, transmissivity, radiation through black and grey surfaces	2	7
24-26	Heat Exchangers: General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, shell and tube and plate heat exchanger, heat exchanger design	3	9
27-28	Application of different types of heat exchangers in dairy and food industry	2	7
29-31	Mass transfer: Fick's law of diffusion, steady state diffusion of gases and liquids through solids	3	9
32	Mass transfer coefficient, application in dairy and food industry	1	3
	Total	**32**	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Heat transfer analysis during conduction	1
2.	Numericals for rate of heat transfer during conduction in different system (plane wall, composite wall and sphere)	1
3.	Study of heat transfer through composite wall apparatus	1
4.	Heat transfer analysis by convection	1
5.	Study of heat transfer by natural / forced convection apparatus	1
6.	Numericals for rate of heat transfer in convection	1
7.	Preparation and calibration of thermocouples	1
8.	Determination of thermal conductivity of solid food product	1
9.	Determination of thermal conductivity of liquid food	1
10.	Study of principle and working of double pipe heat exchanger	1
11.	Study of principle and working of shell and tube heat exchanger	1
12.	Study of principle and working of plate and mechanical aided heat exchanger	1
13.	Study of heat transfer rate in plate heat exchanger type apparatus	1
14.	Determination of OHTC in shell and tube and plate heat exchanger	1
15.	Numericals on rate of heat transfer in radiation	1
16.	Numericals on rate of mass transfer	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Heat and Mass Transfer	Nag P	McGraw Hill, 2011
2	Heat and Mass Transfer – Fundamentals and Applications	Yunus AC and Afshin JG	McGraw Hill, 2015
3	Heat Transfer	Gupta CP	Prentice Hall of Media, New Delhi 1994
4	Heat Transfer	J.P. Holman	10th Ed. McGraw-Hill Book Co., Boston, USA. 2010

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Heat Transfer in Process Engineering.	Eduardo Cao	The McGraw-Hill Companies, Inc., New York, USA. 2010
2	A Heat Transfer Textbook	John HL and John HL	Phlogiston Press, Cambrige, MA, USA. 2008
3	Unit Operations of Chemical Engineering	Warren LM, Julian S. and Peter H.	7th Ed. McGraw-Hill, Inc., NY, USA. 2004
4	Transport Processes and Separation Process Principles (Includes Unit Operations)	Christie John Geankoplis	4th Ed. Prentice-Hall, NY, USA. 2003

FE-125 STATISTICAL METHODS AND NUMERICAL ANALYSIS 2 (1+1)

Theory

Statistical methods: testing of hypothesis, concepts; Testing of significance based on Z-test, t-test, F-test, Chi-square test, contingency table Correlation, regression, testing of significance of correlation and regression, ANOVA, one-way and two-way classifications; Numerical analysis: Finite differences, various difference operators and their relationships, Factorial notation, interpolation with equal intervals, Newton's forward and backward interpolation formulae, Numerical integration, numerical integration by Trapezoidal, Simpson's and Weddle's rules; Laplace transforms: Definition of Laplace transform, Laplace transforms of elementary functions, Properties of Laplace transforms, inverse Laplace transforms Transforms of derivatives Integrals, Transform of function multiplied by tn, transform of function divided by t, Convolution theorem, application of Laplace transforms to solve ordinary differential equations

Practicals

Problems on one sample, two sample Z-tests when population S.D. is known and unknown; Problems on one sample, two sample and paired t-test; Chi-square test – 2×2 and m×n; Contingency table and F-test;Calculation of correlation coefficient and its testing;ANOVA: One way/two way; Problems on Newton's forward and backward interpolation formula for equal intervals; Problems on trapezoidal rule;Problems on Simpson's 1/3 and 3/8 rules; Problems on Laplace transforms; Problems on inverse transformations.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1	Statistical methods: testing of hypothesis, concepts	6
2-3	Testing of significance based on Z-test, t-test, F-test, Chi-square test, contingency table	13
4	Correlation, regression, testing of significance of correlation and regression	7
5	ANOVA, one-way and two-way classifications	6
6	Numerical analysis: Finite differences, various difference operators and their relationships	6
7	Factorial notation, interpolation with equal intervals, Newton's forward and backward interpolation formulae	6
8-9	Numerical integration, numerical integration by Trapezoidal, Simpson's and Weddle's rules	13
10-11	Laplace transforms: Definition of Laplace transform, Laplace transforms of elementary functions	13
12	Properties of Laplace transforms, inverse Laplace transforms	6
13	Transforms of derivatives	6
14	Integrals, Transform of function multiplied by tn, transform of function divided by t,	6
15	Convolution theorem	6
16	Application of Laplace transforms to solve ordinary differential equations,	6
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Problems on one sample, two sample Z-tests when population S.D. is known and unknown	2
2.	Problems on one sample, two sample and paired t-test	2

3.	Chi-square test – 2×2 and m×n; Contingency table and F-test	2
4.	Calculation of correlation coefficient and its testing	3
5.	ANOVA: One way/two way	2
6.	Problems on Newton's forward and backward interpolation formula for equal intervals; Problems on trapezoidal rule	3
7.	Problems on Simpson's 1/3 and 3/8 rules; Problems on Laplace transforms; Problems on inverse transformations	2
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers Delhi. 2004
2	Higher Engineering Mathematics	B.S. Grewal.	Khanna Publishers Delhi. 2004
3	Differential Calculus	Shanti Narayan	S. Chand and Co. Ltd., New Delhi. 2004
4	Integral Calculus	Shanti Narayan	S. Chand and Co. Ltd., New Delhi. 2004
5	A Textbook of Vector Calculus	Shanti Narayan	S. Chand and Co. Ltd., New Delhi. 2004

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Advanced Engineering Mathematics	Erwin Kreyszig	9th Ed. John Wiley & Sons, New York, USA. 2006
2	Calculus of Finite Differences and Numerical Analysis.	P.P. Gupta and C.C. Malik	Krishna Prakash Mandor, Meerut. 1993
3	Engineering Mathematics	B.V. Ramana	Tata McGraw-Hill Book Co., Delhi. 2008
4	A Textbook of Matrices	Shanti Narayan	S. Chand and Co. Ltd., New Delhi. 2004
5	Engineering Mathematics	Pal and Bhunia	Oxford University Press, UK 2015

FE-236 ENERGY GENERATION AND CONSERVATION 3 (2+1)

Theory

Basic concepts: systems, processes, cycles, energy, The Zeroth Law of Thermodynamics Ideal gases: Equation of state, Compression and expansion of gases, The first Law of Thermodynamics: Internal energy, enthalpy Renewable energy sources like solar, wind and biogas and their utilization in food processing, Related equipment and machineries to renewable energy sources, Fuels : Chemical properties, air for combustion, Calorific value and its determination, Properties of steam: Wet, dry saturated, superheated steam Steam generators: Fire tube boilers, Water tube boilers Boiler mountings and Boiler accessories, Measurement of Height of boiler chimney, Condensers; Layout of pipe-line and expansion joints, Air Compressors: Reciprocating, Single and two stage air compressors

Practicals

Determination of calorific value of fuel;Determination of dryness fraction of steam; To study the boiler installed in Model Plant, Babcock and Wilcox boiler, Electrode boiler; Boiler mounting; Visit to sugar mill or rice mill plant with steam utilization; Study of solar water heater and biogas plants and appliances

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1-3	Basic concepts : systems, processes, cycles, energy, The Zeroth Law of Thermodynamics	9
4-6	Ideal gases : Equation of state, Compression and expansion of gases	9
7-9	The first Law of Thermodynamics: Internal energy, enthalpy	9
10-12	Renewable energy sources like solar, wind and biogas and their utilization in food processing	9
13-15	Related equipment and machineries to renewable energy sources	9
16-18	Fuels : Chemical properties, air for combustion, Calorific value and its determination	9
19-21	Properties of steam: Wet, dry saturated, superheated steam	9
22-23	Steam generators: Fire tube boilers, Water tube boilers	7
24-26	Boiler mountings and boiler accessories	9
27-28	Measurement of height of boiler chimney	7
29-30	Condensers; layout of pipe-line and expansion joints	7
31-32	Air compressors: Reciprocating, single and two stage air compressors	7
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Determination of calorific value of fuel	1
2.	Determination of air requirement for combustion of fuel	1
3.	Numericals on calorific value of air requirement of fuel	1
4.	Determination of dryness fraction of steam by throttling calorimeter	1
5.	Determination of dryness fraction of steam by separating calorimeter	1
6.	To study the principle and working of fire tube boiler	1
7.	To study the principle and working of water tube boiler	1
8.	To study the parts, principle and working of Babcock and Wilcox boiler	1
9.	To study the parts, principle and working of Multi drum boiler	1
10.	To study the function and working of boiler mounting	1
11.	To study the function and working of boiler accessories	1
12.	To study the different renewable energy sources	1
13.	To study the solar operated machineries	1
14.	To study the principle and working of wind mill	1
15.	Visit to sugar or rice mill plant with steam utilization	1
16.	Visit to power plant/ industry using renewable energy sources	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Engineering Thermodynamics	C.P. Gupta and Rajendra Prakash	Nemi Chand and Sons, Roorkee 1991
2	Thermal Engineering	Ballaney P.L.	Khanna Publishers, New Delhi, 1985
3	Electric Energy-Generation, Utilization and Conservation	S. Sivanagaraju, M. Balasubba Reddy, D. Srilatha	Pearson Education, India 2015
4	Energy Management and Conservation	Sharma KV and Venkateseshaiah P.	I K International Publishing, 2011
5	Energy generation	Diwan and Dwivedi	Pentagon Press, 2008

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	N.C. Pandya & C.S. Shah.	Elements of Heat Engines	Charotar Publishing House, Anand 1990
2	Indian Boiler Regulation Codes		Indian Boiler Regulation Codes, 1991
3	Generation of Electrical Energy	Gupta BR	S. Chand Publishing, New Delhi 2010

FE-237 UNIT OPERATIONS IN FOOD PROCESSING – I 3 (2+1)

Theory

Size reduction: Benefits, classification, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger's, Kick's and Bond's equations, work index, energy utilization; Size reduction equipment: Principal types, hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, colloid mill, cutting machines (slicing, dicing, shredding, pulping); Mixing: Theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, Theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), Mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids; Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging machines; Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids; Membrane separation: General considerations, materials for membrane construction, Ultra-filtration, processing variables, membrane fouling, Applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications, Membrane separation methods, gel filtration, ion exchange, per-evaporation and micro filtration.

Practicals

Determination of reduction ratio of different size reduction machinaries;; Determination of mixing index of a feed mixer; Power requirement in size reduction of grain using Rittinger's law, Kick's law and Bond's law.; Performance evaluation of hammer mill; Performance evaluation of attrition mill; Study of centrifugal separator; Study of freeze dryer and freeze drying process; Study on osmosis in fruits; Study of reverse osmosis process;Study of ultra filtration/membrane separation process.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1-2	Size reduction: Benefits, classification, sieve/screen analysis, principle and mechanisms of comminution of food	7
3-5	Rittinger's, Kick's and Bond's equations, work index, energy utilization;	9
6-8	Size reduction equipment: Principal types, hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, colloid mill, cutting machines (slicing, dicing, shredding, pulping);	9
9-11	Mixing: Theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing;	9
12-14	Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers),	9
15-16	Mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids;	7
17-19	Mechanical Separations: theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging machines;	9
20-22	Filtration: theory of filtration, rate of filtration, pressure drop during filtration, applications	9
23-24	Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids;	7
25-26	Membrane separation: General considerations, materials for membrane construction,	7

27-28	Ultra-filtration, processing variables, membrane fouling,	6
29-30	Applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications;	6
31-32	Membrane separation methods, gel filtration, ion exchange, per-evaporation and micro filtration.	6
	Total	100

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Study of Principle, working and demonstration of hammer mill and crushing roll	1
2.	Study of Principle, working and demonstration of attrition mill	1
3.	Study of Principle, working and demonstration of colloidal mill	1
4.	Study of Principle, working and demonstration of modern house mill/ magnum mill	1
5.	Determination of reduction ratio of different size reduction machineries	1
6.	Study of different disintegration operations (slicing, dicing, shredding and pulping)	1
7.	Determination of mixing index of a food mixer	1
8.	Power requirement in size reduction of grain using Rittinger's law, Kick's law and Bond's law	1
9.	Study of centrifugal separation (centrifugal cream separation, centrifugal machine)	1
10.	Study of principle and working of roller dryer, cabinet dryer	1
11.	Study of principle and working of freeze dryer and vacuum dryer	1
12.	Study on osmosis of fruit	1
13.	Study on reverse osmosis	1
14.	Study of filtration operation (ultrafiltration)	1
15.	Study of membrane separation	1
16.	Study of plate and frame filter press	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Food Engineering Operation	Brenan JG, Butters JR,	Elsevier Applied Science London. 1990
2	Unit Operations in Food Processing	Earle RL	Elsevier, 2013
3	Unit Operations in Food Processing	Ibarz A. and Gustavo VBC	CRC Press, 2002

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Unit Operations of Chemical Engineering	Warren LM, Julian Smith, Peter Harriott	7th Ed. McGraw-Hill, Inc., NY, USA. 2004
2	Transport Processes and Separation Process Principles	Christie John Geankoplis	4th Ed. Prentice-Hall, NY, USA. 2003
3	Handbook of Food Processing Equipment	Saravacos GD and Athanasios EK	Springer Science+Business Media, New York, USA. 2002

FE-248 UNIT OPERATIONS IN FOOD PROCESSING – II 3 (2+1)

Theory

Evaporation: Principles of evaporation, mass and energy balance, factors affecting rate of evaporation, thermodynamics of evaporation (phase change, boiling point elevation, Dühring plot Heat and mass transfer in evaporator, factors influencing the overall heat transfer coefficient, influence of feed liquor properties on evaporation; Evaporation equipment: Natural circulation evaporators, horizontal/vertical short tube, natural circulation with external calandria, long tube, forced circulation; Evaporator ancillary plant, design of evaporation systems, single effect, multiple effect evaporators, feeding methods of multiple effect evaporation systems, feed preheating, vapour recompression systems; Fouling of evaporators and heat exchanges; Recompression heat and mass recovery and vacuum creating devices; Food freezing: Introduction, Principles of food freezing, Freezing systems; Direct contact systems, air blast immersion; Changes in foods; Frozen food properties; freezing time, factors influencing freezing time, freezing/thawing time; Frozen food storage: Quality changes in foods during frozen storage Freeze drying: equipment and practice Expression and Extraction: liquid-liquid extraction processes, types of equipment and design for liquid-liquid extraction, continuous multistage counter current extraction; Crystallization and dissolution: Theoryand principles, kinetics, applications in food industry, equipment for crystallization Distillation: Principles, vapour-liquid equilibrium, continuous flow distillation, batch/differential distillation, fractional distillation, steam distillation, distillation of wines and spirits Baking: Principles, baked foods, baking equipment; Roasting: Principles of roasting, roasting equipment Pasteurization: Purpose, microorganisms and their reaction to temperature and other influences, methods of heating, design and mode of operation of heating equipment, plate heat exchanger Sterilization: Principles, design of batch and continuous sterilization, different methods and equipments; UHT sterilization, in the package sterilization, temperature and pressure patterns, equipment for sterilizing goods in the package Aseptic processing: principles, analysis of thermal resilience, duration mathematics of conduction heating; Blanching: principle and equipment; Homogenization, Emulsification

Practicals

Study of working principle open pan and vacuum evaporator;Study of single effect evaporator; Study of sterilizer;Study of freezers; Freezing of foods by different methods; Effect of sample particle size and time on solvent extraction process; Study of blancher, pasteurizers, fryers, Homogenizers, irradiators; Determination of oil uptake by the food product during frying; Study on qualitative changes in the fried food product; Visit sugar processing industry.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1-3	Evaporation: Principles of evaporation, mass and energy balance, factors affecting rate of evaporation, thermodynamics of evaporation (phase change, boiling point elevation, Dühring plot	9
4-5	Heat and mass transfer in evaporator, factors influencing the overall heat transfer coefficient, influence of feed liquor properties on evaporation	7
6-7	Evaporation equipment: Natural circulation evaporators, horizontal/vertical short tube, natural circulation with external calandria, long tube, forced circulation	7
8-10	Evaporator ancillary plant, design of evaporation systems, single effect, multiple effect evaporators, feeding methods of multiple effect evaporation systems, feed preheating, vapour recompression systems; Fouling of evaporators and heat exchanges; Recompression heat and mass recovery and vacuum creating devices	9
11-13	Food freezing: Introduction, Principles of food freezing, Freezing systems; Direct contact systems, air blast immersion; Changes in foods;	9
14-16	Frozen food properties; freezing time, factors influencing freezing time, freezing/thawing time; Frozen food storage: Quality changes in foods during frozen storage	9
17-18	Freeze drying: equipment and practice	7
19-20	Expression and Extraction: liquid-liquid extraction processes, types of equipment and design for liquid-liquid extraction, continuous multistage counter current extraction	7
21-22	Crystallization and dissolution: theory and principles, kinetics, applications in food industry, equipment for crystallization	6
23-24	Distillation: Principles, vapour-liquid equilibrium, continuous flow distillation, batch/differential distillation, fractional distillation, steam distillation, distillation of wines and spirits	6
25-26	Baking: Principles, baked foods, baking equipment; Roasting: Principles of roasting, roasting equipment	6
27-28	Pasteurization: Purpose, microorganisms and their reaction to temperature and other influences, methods of heating, design and mode of operation of heating equipment, plate heat exchanger	6
29-30	Sterilization: Principles, design of batch and continuous sterilization, different methods and equipments; UHT sterilization, in the package sterilization, temperature and pressure patterns, equipment for sterilizing goods in the package	6
31-32	Aseptic processing: principles, analysis of thermal resilience, duration mathematics of conduction heating; Blanching: principle and equipment; Homogenization, Emulsification	6
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Study of cleaners for grains (Screening, aspiration, abrasion and magnetic cleaning)	1
2.	Study of washers for fruits and vegetables (soaking tank, belt washer)	1
3.	Study of crop dryer, hot air dryer and vacuum dryer	1
4.	Study of principle and working of spray dryer	1
5.	Study of principle and working of roller drum dryer and fluidized bed dryer	1
6.	Study of freeze drying process and freeze dryer	1
7.	Study of graders for grains	1

8.	Study of graders for fruits and vegetables	1
9.	Study of different components of flour mill	1
10.	Study of different material handling equipments	1
11.	Layout, design, sizing capacity and drawing of traditional storage structures	1
12.	Visit to traditional storage structure	1
13.	Design of cold storage for particular capacity and commodity	1
14.	Design of CAS and MAP for particular capacity and commodity	1
15.	Visit to CA storage	1
16.	Visit to evaporative cooling system for storage	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Food Engineering Operation	Brenan, Butters, Cowell and Lilly	Elsevier Applied Science London. 1990
2	Unit Operations in Food Engineering.	Albert Ibarz and Gustavo V. Barbosa-Cánovas	CRC Press, Boca Raton, FL, USA. 2003
3	Unit Operations in Food Processing	Earle RL	Elsevier, 2013
4	Introduction to Food Engineering,	R. Paul Singh and Dennis R. Heldman.	2014. 5th Ed. Elsevier, Amsterdam, The Netherlands.
5	Unit Operations of Chemical Engineering	Warren L. McCabe, Julian Smith, Peter Harriott	7th Ed. McGraw-Hill, Inc., NY, USA. 2004

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Transport Processes and Separation Process Principles (Includes Unit Operations),	Christie John Geankoplis	4th Ed. Prentice-Hall, NY, USA. 2003
2	Handbook of Food Processing Equipment	George D. Saravacos and Athanasios E. Kostaropoulos	Springer Science+Business Media, New York, USA. 2002
3	Coulson & Richardson's Chemical Engineering, Vol. 2, Particle Technology and Separation Processes,	J. F. Richardson, J. H. Harker and J. R. Backhurst	5th Ed. Butterworth–Heinemann, Oxford, UK. 2002
4	Handbook of Food Engineering Practice.	Kenneth J. Valentas, Enrique Rotstein and R. Paul Singh	CRC Press, Boca Raton, FL, USA. 1997

FE-249 POST HARVEST AND STORAGE ENGINEERING 3 (2+1)

Theory

Overview of post harvest technology: Concept and science, production and post harvest losses, reasons for losses, importance of loss reduction; Post Harvest Handling operations; Cleaning: Cleaning of grains, washing of fruits and vegetables, types of cleaners, screens, types of screens, rotary screens, vibrating screens, machinery for cleaning of fruits and vegetables (air cleaners, washers), Sorting and grading: Sorting, grading, methods of grading; Grading- Size grading, colour grading, screening, equipment for grading of fruits and vegetables, grading efficiency, Materials handling: Introduction to different conveying equipments used for handling of grains, fruits and vegetables Scope and importance of material handling devices, Study of different material handling systems: Classification, principles of operation, conveyor system selection/design, Belt conveyor: Principle, characteristics, design, capacity, inclined belt conveyors, idler spacing, Chain conveyor: Principle of operation, advantages, disadvantages, capacity, Screw conveyor: Principle of operation, capacity, power, loading and discharge, Bucket elevator: Principle, classification, operation, advantages, disadvantages, capacity Pneumatic conveying system: Capacity and power requirement, types, air/product separators, Storage: Importance of scientific storage systems, post harvest physiology of semi-perishables and perishables Damages: Direct damages, indirect damages, causes of spoilage in storage (moisture, temperature, humidity, respiration loss, heat of respiration, sprouting), destructive agents (rodents, birds, insects, etc.), sources of infestation and control; Storage structures: Traditional storage structures, improved storage structures, modern storage structures; Farm silos: Horizontal silos, tower silos, pit silos, trench silos, size and capacity of silos; Storage of perishables: cold storage, controlled and modified atmospheric storage, hypobaric storage, Evaporative cooling storage, conditions for storage of perishable products, control of temperature and relative humidity inside storage.

Practicals

Study of cleaners for grains; Study of washers for fruits and vegetables;.Study of crop dryers; Study of hot air dryer; Study of vacuum dryer; Study of working principle of spray dryer and spray drying process; Study of graders for grains; Study of graders for fruits and vegetables; Study of drum dryer and liquid food dehydration using drum drying; Study of fluidized bed dryer and drying process; Study of freeze dryer and freeze drying process; Study of different components of flour mill; Study of different materials handling equipment; Visits to traditional storage structures; Layout design, sizing, capacity and drawing of traditional storage structures; Visits to cold storage;. Design of cold storage for particular capacity and commodity; Visits to CA storage; Design of CA storage for particular capacity and commodity; Visits to evaporative cooling system for storage; Storage study in the MAP.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1-2	Overview of post harvest technology: Concept and science, production and post harvest losses, reasons for losses, importance of loss reduction; Post Harvest Handling operations	7
3-5	Cleaning: Cleaning of grains, washing of fruits and vegetables, types of cleaners, screens, types of screens, rotary screens, vibrating screens, machinery for cleaning of fruits and vegetables (air cleaners, washers)	9
6-7	Sorting and grading: Sorting, grading, methods of grading; Grading- Size grading, colour grading, screening, equipment for grading of fruits and vegetables, grading efficiency	7
8-9	Materials handling: Introduction to different conveying equipments used for handling of grains, fruits and vegetables	7
10-12	Scope and importance of material handling devices	9
13-15	Study of different material handling systems: Classification, principles of operation, conveyor system selection/design	9
16-17	Belt conveyor: Principle, characteristics, design, capacity, inclined belt conveyors, idler spacing. Chain conveyor: Principle of operation, advantages, disadvantages, capacity	7
18-19	Screw conveyor: Principle of operation, capacity, power, loading and discharge, Bucket elevator: Principle, classification, operation, advantages, disadvantages, capacity	6
20-21	Pneumatic conveying system: Capacity and power requirement, types, air/product separators	6
22-23	Storage: Importance of scientific storage systems, post harvest physiology of semi-perishables and perishables	6
24-26	Damages: Direct damages, indirect damages, causes of spoilage in storage (moisture, temperature, humidity, respiration loss, heat of respiration, sprouting), destructive agents (rodents, birds, insects, etc.), sources of infestation and control	9
27-28	Storage structures: Traditional storage structures, improved storage structures, modern storage structures; Farm silos: Horizontal silos, tower silos, pit silos, trench silos, size and capacity of silos	6
29-30	Storage of perishables: cold storage, controlled and modified atmospheric storage, hypobaric storage	6
31-32	Evaporative cooling storage, conditions for storage of perishable products, control of temperature and relative humidity inside storage	6
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Study of cleaners for grains	1
2.	Study of graders for grains	1
3.	Study of washers for fruits and vegetables	1
4.	Study of graders for fruits and vegetables	1
5.	Study of hot air dryer; Study of vacuum dryer; Study of working principle of spray dryer and spray drying process;	1
6.	Study of drum dryer and liquid food dehydration using drum drying	1
7.	Study of fluidized bed dryer and drying process	1
8.	Study of freeze dryer and freeze drying process	1
9.	Study of different components of flour mill; Study of different materials handling equipment	1
10.	Visits to traditional storage structures; Layout design, sizing, capacity and drawing of traditional storage structures	1
11.	Design of cold storage for particular capacity and commodity	1
12.	Visits to cold storage	1
13.	Design of CA storage for particular capacity and commodity	1
14.	Visits to CA storage	1
15.	Visits to evaporative cooling system for storage;	1
16.	Storage study in the MAP.	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Handbook of Farm, Dairy, and Food Machinery	Myer Kutz	William Andrew, Inc., Norwich, NY, USA. 2007
2	Principles and Practices of Agricultural Structures and Environmental Control	P.H. Pandey	Kalyani Publishers, Ludhiana 2014
3	Post Harvest Technology of Cereals, Pulses and Oilseeds	A. Chakraverty	3rd Ed. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 2008
4	Perry's Chemical Engineers' Handbook.	Don W. Green and Robert H. Perry	McGraw-Hill Co., Inc., NY, USA. 2008
5	Food Processing Handbook	James G. Brennan	Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany. 2006

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Unit Operations of Agricultural Processing	K.M. Sahay and K.K. singh	Vikas Publishing House Pvt. Ltd., Noida, UP. 2001
2	Grain Handling and Storage	G. Boumans	Elsevier Science Publishers, Amsterdam, The Netherlands. 1985
3	Unit operations in Food Processing	R.L. Earle	Pergamon Press, New York, USA. 1983
4	Drying and Storage of Agricultural Crops	C.W. Hall	The AVI Publishing Company, Inc., Westport, Connecticut, USA. 1980

FE-3510 BIOCHEMICAL ENGINEERING 3 (2+1)

Theory

Biochemical Engineering and their scope: Definition, necessity, value engineering, good manufacturing practices, Standard operating procedures, good laboratory practices, History of Biochemical Engineering:Theory of scientists Pfizer, Alexander Fleming, Salman Waksmen, Instrumentation and their control, physical and chemical parameters Role of biochemical engineering in development of modern fermentor: Scale up, management of cellular process, design, operation and their problems, Basis for biochemical engineering in fermentation industry:Unit operation, unit process, process design, chemical reaction kinetics, process variables, biochemical properties, process control, Kinetics of microbial growth and death: Definition, fermentation kinetics rate of cell synthesis, product formation and effect of environment. Types of kinetics, Batch and continuous type, control measures, Simple enzyme kinetics: Simple kinetics model for enzyme substrate interaction. Derive the equation of Michelin Menton, for reaction rate, product formation, calculation of Km and V max values, Complex enzyme kinetics: Oxidation – reduction form of enzymes, observed apparent rate constant, factors affecting the inhibition, competitive, non competitive inhibition, substrate interaction, Kinetics pattern of various fermentations: Classification of kinetics pattern, as per different scientists, simple, simultaneous, consecutive, stepwise, complex reactions and their examples, Media and air sterilization: Definition, thermal death time, media heat sterilization, advantages of continuous sterilization, Aeration and agitation, Product recovery of different process: Mass transfer resistance, extraction, leaching, drying and evaporation, sorption and storage, permeability law, Product formation for value added products using bioconversions techniques Production of single cell protein, alcohol, raw material for required for product formation, production of antibiotics, economic process, utilization of damaged grain through bioconversion, present mode of utilization and their nutritional value.

Practical

Instrumentation and their control in fermentation industry -physical parameter; Instrumentation and their control in fermentation industry – chemical parameter, metabolic parameters and biosensors in food industry; To study the different parts of 30 lit. laboratory and 1 lakh lit. ; capacity fermentors Comparative study of one lakh liter laboratory fermentor; To study the thermal stability of peroxides enzyme in potato; To assess the amylase activity from given foods sample To measure the microbial growth after; (fermentation thermal death time) To study the mass transfer of solution by dialysis process

To study the time temperature relationship for destruction of microorganisms; To study the ethyl alcohol production through bioconversion; To study the vitamin production through bioconversion; Visit to Distillery Plant.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1-2	Biochemical Engineering and its scope: Definition, necessity, value engineering,	7
4-5	History of Biochemical Engineering: Theory of scientists Pfizer, Alexander Fleming Salman Waksmen. Instrumentation and their control, physical and chemical parameters.	9
6-8	Role of biochemical engineering in development of modern fermentor: Scale up, management of cellular process, design, operation and their problems	9
9-11	Basis for biochemical engineering in fermentation industry: Unit operation, unit process, process design, chemical reaction kinetics, process variables, biochemical properties, process control	9
12-13	Kinetics of microbial growth and death: Definition, fermentation kinetics rate of cell synthesis, product formation and effect of environment. Types of kinetics, Batch and continuous type, control measures	7
14-16	Simple enzyme kinetics: Simple kinetics model for enzyme substrate interaction. Derive the equation of Michelin Menton, for reaction rate, product formation, calculation of Km and V max values	9
17-19	Complex enzyme kinetics: Oxidation – reduction form of enzymes, observed apparent rate constant, factors affecting the inhibition, competitive, non competitive inhibition, substrate interaction	9
20-22	Kinetics pattern of various fermentations: Classification of kinetics pattern, as per different scientists, simple, simultaneous, consecutive, stepwise, complex reactions and their examples	9
23-24	Media and air sterilization: Definition, thermal death time, media heat sterilization, advantages of continuous sterilization.	7
25-27	Aeration and agitation	9
28-29	Product recovery of different process: Mass transfer resistance, extraction, leaching, drying and evaporation, sorption and storage, permeability law	7
30-32	Product formation for value added products using bioconversions techniques Production of single cell protein, alcohol, raw material for required for product formation, production of antibiotics, economic process, utilization of damaged grain through bioconversion, present mode of utilization and their nutritional value	9
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Instrumentation and their control in fermentation industry -physical parameter	1
2.	Instrumentation and their control in fermentation industry – chemical parameter	1
3.	Study of metabolic parameters and biosensors in food industry	1
4.	Study of different parts of laboratory fermentor	1
5.	Study of commercial fermentor	1
6.	Comparative study of laboratory and commercial fermentor	1
7.	Study of thermal stability of peroxides enzyme in potato	1
8.	Assessment of amylase activity of given food sample	1
9.	Measurement of microbial growth after fermentation (TDT)	1
10.	Determination of turbidity (NTU) of fermented materials	1
11.	Study of mass transfer of solution by dialysis process	1
12.	Study of time, temerpature relationship for destruction of organisms (Z and F_o value)	1
13.	Study of alcohol production from high sugar food material	1
14.	Study of alcohol production from molasses	1
15.	Study of vitamin production through bioconversion	1
16.	Visit to distillery plant	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Biochemical Engineering	Alba, Arthur and Millis	CRC Press, 1973
2	Biochemical Engineering: A Textbook for Engineers, Chemists and Biologists	Shigeo, Horiuchi and Yoshida	John Wily and Sons, 2015
3	Biochemical Engineering and Biotechnology	Najafpour GD	Elsevier, 2015
4	Biochemical Engineering	Blanch HW and Clark DS	CRC Press, 1997
5	Fundamentals of Biochemical Engineering	Dutta R.	Springer, 2010

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Biochemical Engineering: A Textbook for Engineers, Chemists and Biologist	Kotah, Horiuchi and Yoshida	Jown Wiley and Sons, 2015
2	Biochemical Engineering	Clark and Blanch	CRC Press, 1997
3	Introduction to Biochemical Engineering	Rao DG	Tata McGraw Hills, 2010
4	Introduction to Biochemical Engineering	Rao DG	Tata McGraw Hill, 2010

FE-3511 FOOD REFRIGERATION AND COLD STORAGE 3 (2+1)

Theory

Principles of refrigeration: Definition, background with second law of thermodynamics, unit of refrigerating capacity, coefficient of performance; Production of low temperatures Common refrigerants and their properties: classification, nomenclature, desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical Azeotropes; Components of vapour compression refrigeration system, evaporator, compressor, condenser and expansion valve Ice manufacture, principles and systems of ice production, Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation, quality of ice Cold storage: Cold store, design of cold storage for different categories of food resources, size and shape, construction and material, insulation, vapour barriers, floors, frost-heave, interior finish and fitting, evaporators, automated cold stores, security of operations Refrigerated transport: Handling and distribution, cold chain, refrigerated product handling, order picking,refrigerated vans, refrigerated display Air-conditioning: Meaning, factors affecting comfort air-conditioning, classification, sensible heat factor, industrial air-conditioning Problems on sensible heat factor; Winter/summer/year round air-conditioning, unitary air-conditioning systems, central air-conditioning Physiological principles in air-conditioning, air distribution and duct design methods Design of complete air-conditioning systems; humidifiers and dehumidifiers Cooling load calculations: Load sources, product cooling, conducted heat, convected heat, internal heat sources, heat of respiration, peak load; etc

Practical

Study of vapour compression refrigeration system; Determination of COP of vapour compression refrigeration system; Study of various types of compressors, condensers, expansion valves and evaporative coils used in refrigeration systems; Study of refrigerants, their properties and charts; Study of direct and indirect contact freezing equipment for foods; Study of spray freezing process for foods; Study of food cold storage; Estimation of refrigeration load for cold storage; Estimation of refrigeration load for meat and poultry products; Study of refrigeration system of dairy plant; Estimation of refrigeration load for ice-cream; Study of cooling system for bakery and estimation of refrigeration loads; Estimation of refrigeration load during chocolate enrobing process; Study of refrigerated van; Study of deep freezing and thawing of foods; Study of refrigerated display of foods and estimation of cooling load

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1-3	Principles of refrigeration: Definition, background with second law of thermodynamics, unit of refrigerating capacity, coefficient of performance; Production of low temperatures, reverse Carnot cycle	10
4-6	Common refrigerants and their properties: classification, nomenclature, desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical	9
7-9	Azeotropes; Components of vapour compression refrigeration system, evaporator, compressor, condenser and expansion valve;	9
10-12	Ice manufacture, principles and systems of ice production, Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation, quality of ice	9
13-16	Cold storage: Cold store, design of cold storage for different categories of food resources, size and shape, construction and material, insulation, vapour barriers, floors, frost-heave, interior finish and fitting, evaporators, automated cold stores, security of operations	13
17-18	Refrigerated transport: Handling and distribution, cold chain, refrigerated product handling, order picking,refrigerated vans, refrigerated display	7
19-21	Air-conditioning: Meaning, factors affecting comfort air-conditioning, classification, sensible heat factor, industrial air-conditioning	9
22-23	Problems on sensible heat factor; Winter/summer/year round air-conditioning, unitary air-conditioning systems, central air-conditioning	7
24-26	Physiological principles in air-conditioning, air distribution and duct design methods	9
27-29	Design of complete air-conditioning systems; humidifiers and dehumidifiers	9
30-32	Cooling load calculations: Load sources, product cooling, conducted heat, convected heat, internal heat sources, heat of respiration, peak load; etc	9
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Study of vapour compression refrigeration system	1
2.	Determination of COP of vapour compression refrigeration system	1
3.	Study of various types of compressors and condensers used in refrigeration system	1
4.	Study of various types of evaporative coils and expansion valves used in refrigeration system	1
5.	Study of refrigerants, their properties and charts	1
6.	Study of direct and indirect contat freezing equipments for foods	1
7.	Study of spray freezing process for food	1
8.	Study of food cold storage	1
9.	Estimation of refrigeration load for cold storage	1
10.	Estimation of refrigeration load for meat and poultry producer	1
11.	Study of refrigeration system for dairy plant	1
12.	Estimation of refrigeration load for ice cream	1
13.	Study of cooling system for bakery and estimation of refrigeration loads	1
14.	Study of refrigeration system of dairy plant; Estimation of refrigeration load for ice-cream	1
15.	Estimation of refrigeration load during chocolate enrobing process	1
16.	Study of refrigerated display of foods and estimation of cooling load	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Refrigeration and Air Conditioning	C.P. Arora	2nd Ed. Tata McGraw-Hill Publishing Co. Ltd., New Delhi. 2000
2	Textbook of Refrigeration and Air Conditioning	R. S. Khurmi & J. K. Gupta	Eurasia Publishing House Pvt. Ltd., New Delhi 1999
3	Basic Refrigeration and Air Conditioning	Ananthanarayan PN	4th Edition, McGraw Hill, Delhi 2013
4	Refrigeration and Air Conditioning	Hundy GF, Trott AR and Welch TC	Elsevier, 2008

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Refrigeration and Air Conditioning	W.F. Stoecker and J.W. Jones	2nd Ed. McGraw-Hill Book Co., New York, USA. 1982
2	Refrigeration & Air Conditioning Technology	William C. Whitman, William	6th Ed. Delmar, Cengage Learning, NY, USA. 2017
3	Refrigeration and Air Conditioning	Arora RC	PHI Learning, New Delhi 2010

FE-3612 FOOD PROCESSING EQUIPMENT DESIGN 2 (1+1)

Theory

Materials and properties: Materials for fabrication, Design of pressure and storage vessels: Operating conditions, design conditions and stress; Design of shell and its component, mountings and accessories, Design of heat exchangers:Design of shell and tube heat exchanger, plate heat exchanger, scraped surface heat exchanger, Sterilizer and retort, Design of evaporators: Design of single effect and multiple effect evaporators and its components, Design of rising film and falling film evaporators and feeding arrangements for evaporators, Design of centrifuge separator, Design of dryers: Design of tray dryer, tunnel dryer, fluidized dryer, spray dryer, vacuum dryer, freeze dryer and microwave dryer, Design of extruders: Cold and hot extruder design, design of screw and barrel, design of twin screw extruder, Safety measures in equipment design, pressure relief devices

Practical

Design of pressure vessel; Design of shell and tube heat exchangers and plate heat exchanger; Design of sterilizers and retort;Design of single and multiple effect evaporators; Design of tray dryer; Design of fluidized bed dryer; Design of spray dryer; Design of vacuum dryer; Design of microwave dryer; Design of belt and chain conveyor; Design of screw conveyor; Design of bucket elevator and pneumatic conveyor; Design of twin screw extruder.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1	Materials and properties: Materials for fabrication	6
2-3	Design of pressure and storage vessels: Operating conditions, design conditions and stress; Design of shell and its component, mountings and accessories	12
4	Design of heat exchangers :Design of shell and tube heat exchanger, plate heat exchanger, scraped surface heat exchanger	6
5-6	Sterilizer and retort	12
7	Design of evaporators: Design of single effect and multiple effect evaporators and its components	6
8-9	Design of rising film and falling film evaporators and feeding arrangements for evaporators	13
10	Design of centrifuge separator	6
11-12	Design of dryers: Design of tray dryer, tunnel dryer, fluidized dryer, spray dryer, vacuum dryer, freeze dryer and microwave dryer	13
13-14	Design of extruders: Cold and hot extruder design, design of screw and barrel, design of twin screw extruder	13
15-16	Safety measures in equipment design, pressure relief devices.	13
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Study of design of pressure vessel	1
2.	Study of different types of pressure vessels used in food industry	1
3.	Design of shell and tube heat exchanger	1
4.	Design of plate heat exchanger	1
5.	Design of sterilizers (Batch type)	1
6.	Design of vertical retort	1
7.	Design of single effect evaporator	1
8.	Design of multiple effect evaporator	1
9.	Design of climbing and falling film evaporator	1
10.	Design of tray and fluidized bed dryer	1
11.	Design of spray, vacuum and microwave dryer	1
12.	Design of belt and chain conveyor	1
13.	Design of screw and roller conveyor	1
14.	Design of bucket elevator	1
15.	Design of pneumatic conveyor	1
16.	Design of single screw and twin screw extruder	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Handbook of Food Processing Equipment	Sarvacos G and Athanacios EK	2nd Edition, Springer 2016
2	Process Equipment Design	Mahajani and Umarji	Macmillan Publisher India Ltd. 1996
3	Peter F. Stanbury, Allan Whitakar and Stephen J. Hall	Principles of Fermentation Technology	2nd Ed. Elsevier Science Ltd., Burlington, MA, USA. 1995
4	Chemical Engineering, Vol. 3, Chemical & Biochemical Reactors & Process Control	J.F. Richarson and D.G. Peacock	3rd Ed. Elsevier Butterworth-Heinemann, Amsterdam, The Netherlands. 1995

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Introduction to Food Engineering	R. Paul Singh and Heldman DR	5th Ed. Elsevier, Amsterdam, The Netherlands. 2014
2	Unit Operations in Food Engineering	Ibarz A. and Barbosa-Cánovas G	CRC Press, Boca Raton, FL, USA. 2010
3	Chemical Engineering, Vol. 6, Chemical Engineering Design	R. K. Sinnott	3rd Ed. Butterworth-Heinemann, Oxford, UK. 1999
4	Handbook of Food Engineering Practice.	Kenneth JV, Enrique R and RP Singh	CRC Press, Boca Raton, FL, USA. 1997

FE-3613 FOOD PLANT DESIGN AND LAYOUT 3 (2+1)

Theory

Overall design of an enterprise: Plant design, sales planning for plant design, Strength of material – engineering materials, material science, use of various metals, including plastic, glass, etc in food industry, selection and specification – material design, concepts and manufacturing of various equipments and machineries for food processing plant, Plant Location, levels of Plant location, Location of layout: location factors, plant site selection, Location Theory and models, industrial buildings and grounds, Classification of Dairy and Food Plants, farm level collection and chilling centre, space requirement, Preparation of a Plant Layout: Plant Layout problem, importance, objectives, classical types of layouts. Evaluation of Plant Layout, Advantages of good layout. Organizing for Plant Layout, Data forms Common Problems in Plant Layout and Process scheduling,Sitting of Process sections, Equipment selection and capacity determination, Arrangement of process, and service equipment, Estimation of Services and Utilities Office layout, line balancing, Flexibility, Practical Layouts, Maintenance of Food Plant Building, Illumination and ventillation, Cleaning and sanitization, painting and colour coding, Fly and insect control.

Practicals

Preparation of project report; Preparation of feasibility report; Layout of Food storage wares and godowns; Layout and design of cold storage; Layout of preprocessing house; Layout of Milk and Milk product plants; Bakery and related product plant; Fruits processing plants; Vegetable processing plants; Layout of multi-product and composite food Plants; Waste treatment and management of food plant; Visit to Fruit and Vegetables processing plant.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1-2	Overall design of an enterprise : Plant design, sales planning for plant design	7
3-7	Strength of material – engineering materials, material science, use of various metals, including plastic, glass, etc in food industry, selection and specification – material design, concepts and manufacturing of various equipments and machineries for food processing plant	16
8-10	Plant Location, levels of Plant location. Location of layout : location factors, plant site selection. Location Theoryand models, industrial buildings and grounds	9
11-13	Classification of Dairy and Food Plants, farm level collection and chilling centre, space requirement	9
14-16	Preparation of a Plant Layout: Plant Layout problem, importance, objectives, classical types of layouts.	9
17-19	Evaluation of Plant Layout. Advantages of good layout. Organizing for Plant Layout, Data forms	9
20-21	Common Problems in Plant Layout and Process scheduling	7
22-23	Sitting of Process sections, Equipment selection and capacity determination	7
24-26	Arrangement of process, and service equipment. Estimation of Services and Utilities	9
27-29	Office layout, line balancing, Flexibility. Practical Layouts	9
30-32	Maintenance of Food Plant Building, Illumination and ventillation, Cleaning	9

	and sanitization, painting and colour coding, Fly and insect control	
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Preparation of project report	1
2.	Preparation of feasibility report	1
3.	Layout of food storage wares and godowns	1
4.	Visit to food storage wares and godowns	1
5.	Layout and design of cold storage	1
6.	Visit to cold storage plant	1
7.	Layout of preprocessing house	1
8.	Layout of milk and milk product plant	1
9.	Visit of milk processing plant	1
10.	Layout and design of bakery and related product plant	1
11.	Visit to bakery unit	1
12.	Layout and design of fruit processing plant	1
13.	Layout and design of vegetable processing plant	1
14.	Visit to fruit and vegetable processing plant	1
15.	Design and layout of multiproduct and composite food plant	1
16.	Waste treatment and management of food plant	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Milk Plant Layout	H.S. Hall	FAO Pub., Rome 1968
2	Plant Layout and Design	James M.Moore	Mac Millan, New York 1971
3	Textbook of Dairy Plant Layout and Design	---	ICAR, New Delhi 2010
4	Applied guide to process and plant design	Sean Moran	Elsevier, 2015

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Facility Planning And Layout Design	Chandrashekar Hiregoudar	Technical Publications, 2017
2	Engineering for Dairy and Food Products	A.W. Faral	Rebert E., Kriger Pub Co., New York 1980
3	Practical Plant Layout	Richard Muther	McGraw Hill, 1955

FE-3614 INSTRUMENTATION AND PROCESS CONTROL 3 (2+1)

Theory

Introduction, definition, recorders and monitors, panel boards; General characteristics of instruments, static and dynamic characteristics; Temperature and temp. scales, various types of thermometers - mercury-in-glass, bimetallic, pressure-spring thermometers, thermo couples, resistance

thermometers and pyrometers; Pressure and pressure scales, manometers, pressure elements differential pressure; Liquid level measurement, different methods of liquid level measurement; Flow measurement, kinds of flow, rate of flow, total flow differential pressure meters, variable area meters; Transmission, pneumatic and electrical; Control elements, control actions, pneumatic and electrical control system.

Practical

To study instrumentation symbols; Measurement of temperature by different thermometers; Measurement of pressure by 'U' tube manometer, ; (inclined tube manometer); Measurement of liquid level in the tank with the help of Bob and tape; Determination of relative humidity by wet and dry bulb thermometer; Measurement of velocity of fluid by using venturimeter/orifice meter/pilot tube; Measurement of RPM of an electric motor by Tachometer; Measurement of wind velocity by anemometer
Measurement of intensity of sun shine by sunshine recorders

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	% Syllabus Covered
1-3	Introduction, definition, recorders and monitors, panel boards	10
4-8	General characteristics of instruments, static and dynamic characteristics	16
9-13	Temperature and temp. scales, various types of thermometers - mercury-in-glass, bimetallic, pressure-spring thermometers, thermo couples, resistance thermometers and pyrometers	16
14-18	Pressure and pressure scales, manometers, pressure elements differential pressure	16
19-22	Liquid level measurement, different methods of liquid level measurement	13
23-26	Flow measurement, kinds of flow, rate of flow, total flow differential pressure meters, variable area meters	13
27-29	pneumatic and electrical Transmission	9
30-32	Control elements, control actions, pneumatic and electrical control systems	10
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1	To study instrumentation symbols	1
2	Measurement of temperature by different thermometers.	1
3	Measurement of pressure by 'U' tube manometer, (inclined tube manometer)	3
4	Measurement of liquid level in the tank with the help of Bob and tape	2
5	Determination of relative humidity by wet and dry bulb thermometer	2
6	Measurement of velocity of fluid by using venturimeter/orifice meter/pilot tube	2
7.	Measurement of RPM of an electric motor by Tachometer	2
8	Measurement of wind velocity by anemometer	1
9	Measurement of intensity of sun shine by sunshine recorders	2
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Process Control Instrumentation Technology	Curtis D. Johnson	7th Ed. Prentice Hall of India Pvt. Ltd., New Delhi. 2003
2	Perry's Chemical Engineers' Handbook	Don W. Green and Robert H. Perry	McGraw-Hill Co., Inc., NY, USA. 2008

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Transducers and Instrumentation	D.V.S. Murty	Prentice-Hall of India Pvt. Ltd. New Delhi. 2004
2	Instrument Engineer's Handbook	Bela G. Liptak	Vol. I and II, 4th Ed. CRC Press, Boca Raton, FL, USA. 2003

DETAILED SYLLABUS

III. DEPARTMENT OF FOOD CHEMISTRY AND NUTRITION

Sr. No.	Course No.	Course title	Credits	Semester
1	FCN-111	Environmental Science and Disaster Management	2 (1+1)	I
2	FCN-112	Biochemistry	2 (1+1)	I
3	FCN-123	Human Nutrition	3 (2+1)	II
4	FCN-124	Food Chemistry of Macronutrients	3 (2+1)	II
5	FCN-235	Food Chemistry and Micronutrients	3 (2+1)	III
6	FCN-246	Food Additives and Preservatives	2 (1+1)	IV
7	FCN-357	Instrumental Techniques in Food Analysis	2 (0+2)	V
8	FCN-368	Enzymes in Food Industry	2 (1+1)	VI
		Total Credits	**19 (10+9)**	

FCN-111 ENVIRONMENTAL SCIENCE AND DISASTER MANAGEMENT 2 (1+1)

Theory

Environment, Ecology and Ecosystems: Introduction, Definition, Inter-relationship amongst and between them, components of environment, relationship between different environment components, Man-environment relationship, Impact of Technology of the Environment, Environmental Degradation. Ecology and Ecosystems: Introduction, ecology, objectives and classification of iconology, concepts of an ecosystem structure and functions of ecosystem, components of ecosystem. Energy Flow: Introduction, Food Chain – grazing, detritus, Food Web, Ecological Pyramids – Pyramid of numbers, pyramids of biomass, pyramid of energy or productivity Bio-geo-chemical cycles: Introduction, Hydrological cycle, Carbon Cycle, Oxygen cycle, Nitrogen Cycle, Sulfur cycle Energy Flow in Ecosystem: Introduction, Renewable resources, Non-renewable resources, Destruction versus conservation. Major Ecosystems: Introduction, Forest ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic Ecosystem, Estuarine ecosystem. Population and Natural Resources: Introduction, development of habitation pattern, environmental factors governing human settlement, population and pollution, reasons for overpopulation, aquatic population growth, demographic projections and population structures, production of food Forest Resource: Introduction, Indian scenario, Importance of Forests – Ecology and economically, uses of forest products, forest types, deforestation – causes, effects, forest degradation in India Energy Resources: Introduction; Indian Scenario; Conventional energy sources and its problems; Non-conventional energy sources – advantages and limitations; Problems due to extraexploitation of energy resources. Environmental pollution: Water pollution – Introduction, water quality standards, sources of water pollution, classification of water pollutants, effect of water pollutants; Air Pollution – Introduction, composition of air, structure of atmosphere, ambient air quality standards, classifications of air pollutants, sources of common air pollutants, effects of common air pollutants; Land Pollution – Introduction, lithosphere, land uses, causes of land degradation; Noise pollution – introduction, sources of noise pollution, effect of noise pollution; Radioactive pollution, Eutrophication; Control of environmental pollution through Law Food Processing Waste and its management: Introduction, management of urban waste water, recycling of organic waste, recycling of factory effluent. Current Environmental Global Issues: Introduction, global warming, green house effect, acid rain, depletion of ozone layer, etc.

Practical

Environment and its Analysis; Water quality parameters; Determination of pH, Acidity and Alkalinity of water; Estimation of dissolved oxygen; Estimation of Biological Oxygen Demand; Estimation of Chemical Oxygen Demand; Estimation of Nitrates; Estimation of Phosphates; Estimation of pollutant Elements; Estimation of Heady Toxic elements; Estimation of Lead/Mercury; Visit to Industrial Sewage Disposal Unit

Teaching Schedule - Theory with Weightages (%)

No. of Units	TOPICS	Weightage (%)
1 – 2	**Environment, Ecology and Ecosystems**: Introduction, Definition, Inter-relationship amongst and between them, components of environment, relationship between different environment components, Man-environment relationship, Impact of Technology of the Environment, Environmental Degradation.	12
3	**Ecology and Ecosystems:** Introduction, ecology, objectives and classification of iconology, concepts of an ecosystem structure and functions of ecosystem, components of ecosystem.	7
4	**Energy Flow:** Introduction, Food Chain – grazing, detritus, Food Web, Ecological Pyramids – Pyramid of numbers, pyramids of biomass, pyramid of energy or productivity.	6
5	**Bio-geo-chemical cycles:** Introduction, Hydrological cycle, Carbon Cycle, Oxygen cycle, Nitrogen Cycle, Sulfur cycle	7
6	**Energy Flow in Ecosystem:** Introduction, Renewable resources, Non-renewable resources, Destruction versus conservation.	6
7	**Major Ecosystems:** Introduction, Forest ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic Ecosystem, Estuarine ecosystem.	7
8	**Population and Natural Resources:** Introduction, development of habitation pattern, environmental factors governing human settlement, population and pollution, reasons for overpopulation, aquatic population growth, demographic projections and population structures, production of food	6
9	**Forest Resource:** Introduction, Indian scenario, Importance of Forests – Ecology and economically, uses of forest products, forest types, deforestation – causes, effects, forest degradation in India	6
10	**Energy Resources:** Introduction; Indian Scenario; Conventional energy sources and its problems; Non-conventional energy sources – advantages and limitations; Problems due to extraexploitation of energy resources.	7
11 – 14	**Environmental pollution**: Water pollution – Introduction, water quality standards, sources of water pollution, classification of water pollutants, effect of water pollutants; Air Pollution – Introduction, composition of air, structure of atmosphere, ambient air quality standards, classifications of air pollutants, sources of common air pollutants, effects of common air pollutants; Land Pollution – Introduction, lithosphere, land uses, causes of land degradation; Noise pollution – introduction, sources of noise pollution, effect of noise pollution; Radioactive pollution, Eutrophication; Control of environmental pollution through Law	24
15	**Food Processing Waste and its management:** Introduction, management of urban waste water, recycling of organic waste, recycling of factory effluent.	6
16	**Current Environmental Global Issues:** Introduction, global warming, green house effect, acid rain, depletion of ozone layer, etc.	6
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1	Environment and its analysis	**1**
2	Water quality parameters	**1**
3	Determination of pH of water samples	**1**
4	Determination of acidity of water	**1**
5	Determination of Alkalinity of water sample	**1**
6	Measurement of turbidity of water samples	**1**
7	Determination of conductivity of water sample	**1**
8	Estimation of dissolved Oxygen (DO) in water sample	**1**
9	Estimation of Biological Oxygen Demand (BOD) of water	**1**
10	Estimation of Chemical Oxygen Demand (COD) of water	**1**
11	Determination of chloride in water	**1**
12	Determination of calcium hardness of water	**1**
13	Determination of total hardness of water	**1**
14	Determination of minerals in water	**2**
15	Visit to Industrial Sewage Disposal Unit	**1**
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Principles of Environmental Studies	Chary Manohar and Jaya Ram Reddy	BS Publishers, Hyderabad. 2004
2	Water and Waste Water Analysis	Kaul S N, Ashuthosh Gautam	Days Publishing House, Delhi. 2002
3	Fundamentals of Environmental Biology	Agrawal KC	Nidhi Publishers (India), Bikaner. 2001

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Text Book of Environmental Studies for Undergraduate Courses	Bharucha Erach	University Grants Commission, University Press, Hyderabad. 2005
2	Introduction to Environment Science	Sharma J P	Lakshmi Publications. 2003
3	Methods in Environmental Analysis – Water	Gupta P K	Soil and Air. Agro bios, Jodhpur. 2004
4	Natural Disaster	Sharma, R.K. & Sharma, G	APH Publishing Corporation, New Delhi. 2005
5	Environment and Ecology: Biodiversity, Climate Change and Disaster Management	Husain Majid	Online book. 2013

FCN-112 BIOCHEMISTRY 2 (1+1)

Theory

Introduction: Biochemistry & it's scope; Cellular Biochemistry - Cell-structure – plant and animal, composition and function of cell organelle Carbohydrates: Occurrence, Classification & Structures;

Physicochemical and Metabolic functions; Biological role of carbohydrates; Metabolism of carbohydrates - glycolysis and respiration, production of ATP, brief description of electron transport chain, oxidative and substrate phosphorylation Proteins: Occurrence, Classification & Structures; Physicochemical & Metabolic functions; Metabolism of proteins - Breakdown of proteins, transamination, deamination, decarboxylation, nitrogen fixation, urea cycle; Lipids: Occurrence, Classification & Structure; Physicochemical and metabolic functions; Biological role of lipids; classification and biosynthesis; Biological role of lipids; breakdown of triglycerides and phospholipids; β-oxidation of long chain fatty acids, ketosis, biosynthesis of fatty acids, triglycerides and phospholipids; Nucleic Acids: Classification, structure & biosynthesis of nucleic acid; Metabolism RNA and DNA metabolism. Vitamins; Sources and classification, Chemistry and Metabolic functions, deficiency syndromes, Minerals; Sources and classification, Chemistry and Metabolic functions, deficiency syndromes.

Practical

Safety measures in the Laboratory; Preparation of various solutions and buffers; Qualitative and quantitative determination of carbohydrates; Qualitative and quantitative determination of amino acids; Qualitative and quantitative determination of proteins; Qualitative and quantitative determination of Lipids; Qualitative and quantitative determination of Vitamins and minerals

Teaching Schedule - Theory with Weightages (%)

No. of Units	TOPICS	Weightage (%)
1 – 2	Introduction: Biochemistry & it's scope; Cellular Biochemistry - Cell-structure – plant and animal, composition and function of cell organelle	14
3 – 6	Carbohydrates: Occurrence, Classification & Structures; Physicochemical and Metabolic functions; Biological role of carbohydrates; Metabolism of carbohydrates - glycolysis and respiration, production of ATP, brief description of electron transport chain, oxidative and substrate phosphorylation	20
7 – 10	Proteins: Occurrence, Classification & Structures; Physicochemical & Metabolic functions; Metabolism of proteins - Breakdown of proteins, transamination, deamination, decarboxylation, nitrogen fixation, urea cycle	20
11 – 13	Lipids: Occurrence, Classification & Structure; Physicochemical and metabolic functions; Biological role of lipids; classification and biosynthesis; Biological role of lipids; breakdown of triglycerides and phospholipids; β-oxidation of long chain fatty acids, ketosis, biosynthesis of fatty acids, triglycerides and phospholipids	16
14	Nucleic Acids: Classification, structure & biosynthesis of nucleic acid; Metabolism RNA and DNA metabolism	10
15	Vitamins; Sources and classification, Chemistry and Metabolic functions, deficiency syndromes	10
16	Minerals; Sources and classification, Chemistry and Metabolic functions, deficiency syndromes	10
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Safety measures in the Laboratory	1
2.	Use of different equipments/ glasswares/ utensils in laboratory	1
3.	Preparation of different solutions based on molarity, concentration and normality, etc	1

4.	Preparation of buffer solutions	1
5.	Qualitative Tests of Carbohydrate (Molisch's Test, Fehling's Test, Benedict Test, Iodine Test, etc.)	1
6.	Quantitative Determination of Carbohydrate by Phenol Sulphuric acid method	1
7.	Determination of reducing sugar by Nelson-Somogyi method	1
8.	Qualitative test for Amino acids and proteins (Biuret Test, Xanthoproteic Test, Ninhydrin Test, Millon's Test, Nitroprusside Test, etc)	1
9.	Estimation of protein content by Micro-Kjeldahl Method	1
10.	Determination of protein by Lowry Method	1
11.	Determination of protein content by beuret method	1
12.	Qualitative tests for lipids (saponification test, unsaturated fatty acid test, etc)	1
13.	Determination of total fat by acid hydrolysis method	1
14.	Determination of crude fat by Soxhlet Method	1
15.	Determination of ash content of given sample	1
16.	Determination of crude fibre content of given sample	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Fundamentals of Biochemistry	Jain JL, Jain S and Jain N	S. Chand Publication, India 2016
2	Biochemistry	Satyanarayana	Elsevier, 2013
3	Lehninger Principles of Biochemistry	David L. Nelson and Michael M. Cox	6th Ed. Macmillan Learning, NY, USA. 2012
4	Outlines of Biochemistry	Conn EE and Stumpf PK	4th Edition Wiley Eastern Ltd, Pune (India)

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Wardlaw's Perspectives in Nutrition: A Functional Approach	Gaile Moe, Danita Kelley, Jacqueline Berning and Carol Byrd-Bredbenner	McGraw-Hill, Inc., NY, USA. 2013
2	Biochemistry	Donald Voet and Judith G. Voet	4th Ed. John Wiley and Sons, Inc., NY, USA. 2011
3	Handbook of Nutrition and Food	Carolyn D. Berdanier, Elaine B. Feldman and Johanna Dwyer	2nd Ed. CRC Press, Boca Raton, FL, USA. 2008
4	Biochemistry & Molecular Biology of Plants	Bob B. Buchanan, Wilhelm Gruissem and Russell L. Jones	John Wiley and Sons, Inc., NY, USA. 2002

FCN-123 HUMAN NUTRITION 3 (2+1)

Theory

Concepts and content of nutrition: Nutrition agencies; Nutrition of community; Nutritional policies and their implementation; Metabolic function of nutrients Nutrients: Sources, functions, digestion, bsorption, assimilation and transport of carbohydrates, proteins and fats in human beings; Water and energy balance: Water intake and losses; Basal metabolism- BMR; Body surface area and factors affecting BMR Formulation of diets: Classification of balanced diet; Preparation of balanced diet for various groups; Diets and disorders Recommended dietary allowances; For various age group; According physiological status; Athletic and sports man; Geriatric persons Malnutrition: Type of Malnutrition; Multi-factorial causes; Epidemiology of under nutrition and over nutrition; Nutrition infection and immunity; Nutrition education Assessment of nutritional status: Diet surveys; Anthropometry; Clinical examination; Biochemical assessment; Additional medical information In-born error of metabolism: Blood constituents; Nutrients; Hormones and enzymes; Miscellaneous disorders Food fad and faddism Potentially toxic substance in human food.

Practical

Role of various national and international agencies in field of human nutrition; Calculation of BMR and body surface area; Preparation of balance diets, evaluation of energy value and techno economical feasibility; Anthropometric measurements; Techniques in animal feeding experiments; Biochemical analysis of urine and blood; Nutritional survey; Determination of energy value; Bomb CalorimeterOn basis of composition; Computation of Energy requirements; On the basis of Physical activity ACU unit

Teaching Schedule - Theory with Weightages (%)

No. of Units	TOPICS	Weightage (%)
1 – 4	**Concepts and content of nutrition:** Nutrition agencies; Nutrition of community; Nutritional policies and their implementation; Metabolic function of nutrients	12
5 – 8	**Nutrients**: Sources, functions, digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings;	12
9 – 12	**Water and energy balance**: Water intake and losses; Basal metabolism-BMR; Body surface area and factors affecting BMR	12
13 – 16	**Formulation of diets**: Classification of balanced diet; Preparation of balanced diet for various groups; Diets and disorders	12
17 – 20	**Recommended dietary allowances**; For various age group; According physiological status; Athletic and sports man; Geriatric persons	12
21 – 24	**Malnutrition**: Type of Malnutrition; Multi-factorial causes; Epidemiology of under nutrition and over nutrition; Nutrition infection and immunity; Nutrition education	12
25 – 26	**Assessment of nutritional status**: Diet surveys; Anthropometry; Clinical examination; Biochemical assessment; Additional medical information	7

27 – 28	**In-born error of metabolism**: Blood constituents; Nutrients; Hormones and enzymes; Miscellaneous disorders	7
29 – 30	Food fad and faddism	7
31 – 32	Potentially toxic substance in human food	7
	Total	

Practical Exercises

No. of Units	Topics	No. of Experiments
1	Role of various national and international agencies in field of human nutrition	1
2	Nutritive value of different food groups	1
3	Nutritional labeling of food products	1
	Calculation of BMR	1
5	Calculation of BMI	1
6	Anthropometric measurements	1
7	Preparation of balance diet and RDA of nutrients	1
8	Techniques in animal feeding experiments	1
9	Computation of energy requirements	1
10	Determination of energy value of food by bomb calorimeter	1
11	Clinical methods of assessing nutritional status (for calorific requirement)	1
12	Clinical methods of assessing nutritional status (for vitamin deficiency)	1
13	Clinical methods of assessing nutritional status (for mineral deficiency)	1
14	Diet for specific health condition (diabetic patient)	1
15	Diet for specific health condition (Obesity)	1
16	Visit to Pathological laboratory	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Advanced Text Book on Food & Nutrition (Volume I and II)	Swaminathan M	The Bangalore Printing and Publishing Co.Ltd, Bangalore. 2006
2	ABC of Nutrition (4th edition)	Stewart Truswell	BMJ Publishing Group 2003 ISBN 0727916645
3	Encyclopedia of Human Nutrition	Benjamin C., Lindsay A., Andrew P.	Elsevier Academic Press, 2005 ISBN 0121501108
4	Barasi's Human Nutrition – A Health Perspective	Mike Lean and E. Combet	Second Edition CRC Press, London
5	Principles of Human Nutrition	Martin Eastwood	Blackwell Publishing, Boca Rotan
6	Encyclopedia of Foods – A Guide to Healthy Nutrition	Mayo Clinic and Dole Food Company Inc.	Academic Press – An Imprint of Elsevier, San Diego, California

REFERENCE BOOK

Sr. No.	Name of Book	Author	Publisher
1	Essentials of Human Nutrition	Jim M. and Stewart T.	Oxford University Press, 2002 ISBN 019850861

2	Introduction to Human Nutrition	Micheal J. G., Susan A.L. Aedin C. and Hester H.V.	Wiley-Blackwell Publication, UK 2009 ISBN 9781405168076
3	Nutrition and Health	Gerald W.	Taylor and Francis, London 2002 ISBN 0415278740
4	Handbook of Nutrition and Food	Carolyn D. Berdanier, Elaine B. Feldman and Johanna Dwyer	2nd Ed. CRC Press, Boca Raton, FL, USA. 2008
5	Nutrition and Physical Fitness	Bogert L.J., Goerge M.B, Doris H.C.	W.B. Saunders Company, Toronto, Canada

FCN-124 FOOD CHEMISTRY OF MACRONUTRIENTS 3 (2+1)

Theory

Introduction: Nature Scope and development of food chemistry, role of food chemist. **Moisture in foods**: Role and type of water in foods; Functional properties of water; role of water in food spoilage; Water activity and sorption isotherm; Molecular mobility and foods stability.**Dispersed systems of foods**: Physicochemical aspects of food dispersion system (sol, gel, foam, emulsions, etc); Rheology of diphase systems Carbohydrates: Changes of carbohydrates on cooking, modification of carbohydrates, dietary fibres and carbohydrates digestibility; Enzymatic and chemical reactions of carbohydrates; Proteins in foods: Processing induced, physical, chemical and nutritional changes in protein, chemical and enzymatic modification of protein Lipids in foods: Role and use of lipids/fat, crystallization and consistency, chemical aspects of lipids, lipolysis, auto-oxidation, thermal decomposition, chemistry of frying technology of fat and oil; Oil processing: Refining, hydrogenations, inter esterification, safety use of oils and fats in food formulation; Enzymatic and chemical reactions of fats; Rancidity and its types, detection techniques chemical aspects of lipids, antioxidants

Practical

Determination of moisture content of foods using different methods; Studies of absorption isotherms; Swelling and solubility characteristics of starches; Rheological properties of diphase systems; Determination of crude proteins by microkjaldhal method; Determination of essential amino acids methionine etc.; Isolation of protein from different sources and preparation of protein isolates and concentrates; Determination of acid value, saponification value and iodine number of fat/ oil

Teaching Schedule - Theory with Weightages (%)

No. of Units	TOPICS	Weightage (%)
1 – 3	**Introduction**: Nature Scope and development of food chemistry, role of food chemist.	12
4 – 8	**Moisture in foods**: Role and type of water in foods; Functional properties of water; role of water in food spoilage; Water activity and sorption isotherm; Molecular mobility and foods stability	16
9 – 13	**Dispersed systems of foods**: Physicochemical aspects of food dispersion system (sol, gel, foam, emulsions, etc); Rheology of diphase systems	16
14 – 19	Carbohydrates: Changes of carbohydrates on cooking, modification of carbohydrates, dietary fibres and carbohydrates digestibility; Enzymatic and chemical reactions of carbohydrates;	18
20 – 25	Proteins in foods: Processing induced, physical, chemical and nutritional changes in protein, chemical and enzymatic modification of protein	18
26 – 32	Lipids in foods: Role and use of lipids/fat, crystallization and consistency, chemical aspects of lipids, lipolysis, auto-oxidation, thermal decomposition, chemistry of frying technology of fat and oil; Oil processing: Refining, hydrogenations, inter esterification, safety use of oils and fats in food formulation; Enzymatic and chemical reactions of fats; Rancidity and its types, detection techniques chemical aspects of lipids, antioxidants;.	20
	Total	**100**

Practical Exercises

No. of	Topics	No. of

Units		Experiments
1	Determination of moisture content by hot air oven method	1
2	Determination of moisture content of liquid foods by Karl Fischer method	1
3	Studies on sorption isotherm	1
4	Preparation of different gel system	1
5	Preparation of emulsion and determination of emulsion stability	1
6	Isolation of protein from different food sources	1
7	Preparation of protein isolate/concentrate	1
8	Isolation of starch of given sample	1
9	Studies on different properties of starches	1
10	Determination of total sugar in food	1
11	Estimation of reducing sugar in food	1
12	Determination of Physical properties of fat	1
13	Determination of acid value of oil	1
14	Determination of iodine value of oil	1
15	Determination of saponification value	1
16	Test for detection of different oils (Baudouin test, Halphens test, hexabromide test)	1
	Total	16

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Food Chemistry	Owen R, Fennema	3rd Ed. Marcel Dekker, Inc., New York, USA. 1996
2	Food Chemistry	Lillian Hoagland Meyer	The AVI Publishing Co Inc., Connecticut, MA, USA. 1974
3	Principles of Food Chemistry	DeMan JM	AVI Publishing Co Inc., 1976
4	Essentials of Food and Nutrition	Swaminathan M.	Vol. II, Ganesh & Co., 1974

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Introductory Food Chemistry. Comstock Publishing Associates	John W. Brady	Cornell University Press, Ithaca, USA. 2013
2	Food Chemistry	H.-D. Belitz, W. Grosch and P. Schieberle	4th Ed. Springer-Verlag Berlin Heidelberg. 2009
3	Biochemistry of Foods	Eskin NAM, Henderson HM and Townsed RJ	Academic Press, New York 1971
4	Food Biochemistry and Food Processing	Benjamin K. S.	Wiley-Blackwell, London ISBN: 978081380874
5	Food Chemistry	David Newton	Facts on File, Inc. New York ISBN: 0816052778

FCN-235 FOOD CHEMISTRY OF MICRONUTRIENTS 3 (2+1)

Theory

Chemistry of food flavour; Philosophy and definitions of flavour, flavourmatics/flavouring compounds, sensory assessment of flavour, technology for flavour retention; Pigments in animal and plants kingdoms: Heme pigments, chlorophyll, carotenoids, phenolic and flavonoids, betalins, effect of processing on pigment behaviour; Technology for retention of natural colours of food stuffs Food colorants; Regulatory use of regulatory dyes; Colour losses during thermal processing; Vitamins and minerals: Requirements, allowances, enrichment, restorations, fortifications, losses of vitamins and minerals, optimization and retention of vitamins and minerals; Chemistry of anti-nutritional factors. Food toxicology: Inherent toxicants – antinutritional factors their occurrence, effects and methods of elimination or inactivation- protease inhibitions, lectins, lathyrogens, phytates and flatulence factors; Terms in toxicology; Safety evaluation using traditional and modern approach; Food Contaminants; Pesticidal residues – permitted limits; Toxicology and public health

Practical

Preparation of mineral solution by using ash and tri acid method (dry and wet oxidations); Estimation of calcium; Determination of phosphorus; Determination of iron; Estimation of magnesium; Estimation of tannins and phytic acid from food; Determination of vit. A (Total carotenoids); Determination of ascorbic acid by dye method; Determination of niacine and pyridoxine; Determination of food colors; Assessment of hydrocolloids as food additives

Teaching Schedule - Theory with Weightages (%)

No. of Units	TOPICS	Weightage (%)
1 – 6	**Chemistry of food flavour**; Philosophy and definitions of flavour, flavourmatics/flavouring compounds, sensory assessment of flavour, technology for flavour retention;	22
7 – 11	**Pigments in animal and plants kingdoms**: Heme pigments, chlorophyll, carotenoids, phenolic and flavonoids, betalins, effect of processing on pigment behaviour; Technology for retention of natural colours of food stuffs;	18
12 – 15	**Food colorants**; Regulatory use of regulatory dyes; Colour losses during thermal processing;	16
16 – 20	**Vitamins and minerals**: Requirements, allowances, enrichment, restorations, fortifications, losses of vitamins and minerals, optimization and retention of vitamins and minerals; Chemistry of anti-nutritional factors.	18
21	**Nutracueticals in food:** major nutraceuticals viz. antioxidants, phenols, tannins, etc	3
22 – 32	**Food toxicology**: Inherent toxicants – antinutritional factors their occurrence, effects and methods of elimination or inactivation- protease inhibitions, lectins, lathyrogens, phytates and flatulence factors; Terms in toxicology; Safety evaluation using traditional and modern approach; Food Contaminants; Pesticidal residues – permitted limits; Toxicology and public health	23
	Total	**100**

Practical Exercises

No.of Units	Topics	No. of Lectures
1.	Preparation of mineral solution by using ash and tri acid method (dry and wet oxidations)	1
2.	Estimation of calcium	1
3.	Determination of phosphorus	1
4.	Determination of iron	1

5.	Estimation of magnesium	1
6.	Estimation of tannins from food	1
7.	Estimation of oxalic acid in tomatoes	1
8.	Estimation of phytic acid from food	1
9.	Determination of total carotenoids	1
10.	Determination of ascorbic acid by dye method	1
11.	Determination of niacin/ pyridoxine	1
12.	Estimation of lysine content	1
13.	Determination of food colors	1
14.	Qualitative tests for identification of phytochemical in food	1
15.	Determination of chlorophyll content of given sample	1
16.	Determination of in-vitro digestibility of protein	1
17.	Estimation of total phenol content	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Food Chemistry	Owen R, Fennema	3rd Ed. Marcel Dekker, Inc., New York, USA. 1996
2	Food Chemistry	Meyer L.H.	CBS Publishers & Distributors, New Delhi (India) 2004
3	Food Chemistry	Lillian Hoagland Meyer	The AVI Publishing Co Inc., Connecticut, MA, USA. 1974
4	Introductory Food Chemistry.	John W. Brady	Cornell University Press, Ithaca, USA. 2013
5	Food Chemistry	H.-D. Belitz, W. Grosch and P. Schieberle	4th Ed. Springer-Verlag Berlin Heidelberg. 2009
6	Biochemistry of Foods	Eskin NAM, Henderson HM and Townsed RJ	Academic Press, New York 1971

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Food Biochemistry and Food Processing	Benjamin K. S.	Wiley-Blackwell, London, 1983
2	Food Chemistry	David Newton	Facts on File, Inc. New York 2004
3	Principles of Food Chemistry	DeMan JM	AVI Publishing Co Inc., 1976
4	Essentials of Food and Nutrition	Swaminathan M.	Vol. II, Ganesh & Co., 1974

FCN-246 FOOD ADDITIVES AND PRESERVATIVES 2 (1+1)

Theory

Introduction: Introduction to Food Additives; Scope of food additives; Functions and uses of Food Additives; Classification- Intentional & Unintentional Food additives; Types of food additives Toxicology and Safety Evaluation of Food Additives: Effects of Food Additives; Food Additives generally recognized as safe (GRAS); Tolerance levels & Toxic levels in Foods; Legal safeguard; Risks of food additives

Naturally occurring food additives: Classification; Health Implications; Role in Foods Acidulants: Introduction; Different acidulants; Role in food processing Food colorants: Introduction; Natural & Synthetic food colorants; Classification of Food colorants; Chemical nature; Impact on health. Pigments: Importance; Classification: Utilization as food colour Food Preservatives : Introduction; Classification- Natural & chemical preservatives; Mode of action; Role in Food processing

Antioxidants & chelating agents: Introduction; Role in foods; Types of antioxidants -natural & synthetic; Mode of action of antioxidants in foods; Chelating agents- Naturally & synthetic; Mode of action of chelating agents; Applications of antioxidants and chelating agents Stabilizers, thickeners and Emulsifiers: Introduction; Types; Applications in food processing; Sweeteners: Introduction; Classification- Artificial sweeteners & Non-nutritive sweeteners; Health implications; Role in food processing. Bleaching & maturing agents: Introduction; Different bleaching & maturing agents; Role in food processing Taste and Flavoring agents: Introduction; Classification of flavors- natural & synthetic; Flavor enhancer/ Potentatior; Importance of taste and flavours; Role of flavoring agents in food processing. Anti-caking agents and Humectants: Introduction; Different Anti-caking agents and Humectants; Role in food processing Starch modifiers: Introduction; Chemical nature; Role in food processing. Antimicrobial agents, Clarifying agents, antifoaming agents, Fat mimetics and replacers: Introductions; Role in food processing;

Practical

Evaluation of GRAS aspects of Food Additives; Qualitative Tests for Presence of Benzoic acid in foods; Quantitative Determination of Benzoic acid; Determination of Nitrates and Nitrites in Foods; Qualitative and Quantitative Test for presence of non-nutritive sweeteners; Identification of Natural Colors; Determination of Synthetic colorants in food; Extraction and identification of food pigments; Determination of total chlorophyll by Spectrophotometric method; Detection of chemical preservatives in foods; Study of effect of acidulants in fruit juices; Study of effect of stabilizers/thickeners on quality of foods; Study of effect of clarifying agents on the fruit juices; Role of emulsifiers in foods; Role of leaving agent in baked food product; Role and mode of action of antioxidant in food products

Teaching Schedule - Theory with Weightages (%)

No. of Units	TOPICS	Weightage (%)
1 – 3	**Introduction:** Introduction to Food Additives; Scope of food additives; Functions and uses of Food Additives; Classification- Intentional & Unintentional Food additives; Types of food additives **Toxicology and Safety Evaluation of Food Additives:** Effects of Food Additives; Food Additives generally recognized as safe (GRAS); Tolerance levels & Toxic levels in Foods; Legal safeguard; Risks of food additives	19

4 – 6	**Naturally occurring food additives**: Classification; Health Implications; Role in Foods **Acidulants:** Introduction; Different acidulants; Role in food processing **Food colorants:** Introduction; Natural & Synthetic food colorants; Classification of Food colorants; Chemical nature; Impact on health.	19
7	**Pigments:** Importance; Classification: Utilization as food colour	6
8 – 10	**Food Preservatives :** Introduction; Classification- Natural & chemical preservatives; Mode of action; Role in Food processing **Antioxidants & chelating agents:** Introduction; Role in foods; Types of antioxidants -natural & synthetic; Mode of action of antioxidants in foods; Chelating agents- Naturally & synthetic; Mode of action of chelating agents; Applications of antioxidants and chelating agents	19
11	**Stabilizers, thickeners and Emulsifiers:** Introduction; Types; Applications in food processing;	6
12	**Sweeteners:** Introduction; Classification- Artificial sweeteners & Non-nutritive sweeteners; Health implications; Role in food processing.	6
13	**Bleaching & maturing agents:** Introduction; Different bleaching & maturing agents; Role in food processing.	6
14	**Taste and Flavoring agents:** Introduction; Classification of flavors- natural & synthetic; Flavor enhancer/ Potentatior; Importance of taste and flavours; Role of flavoring agents in food processing.	6
15 – 16	**Anti-caking agents and Humectants:** Introduction; Different Anti-caking agents and Humectants; Role in food processing **Starch modifiers:** Introduction; Chemical nature; Role in food processing. **Antimicrobial agents, Clarifying agents, antifoaming agents, Fat mimetics and replacers:** Introductions; Role in food processing;	13
	Total	**100**

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Evaluation of GRAS aspects of Food Additives	1
2.	E numbers for different food additives	1
3.	Qualitative Tests for presence of benzoic acid in foods	1
4.	Qualitative Tests for presence of sulphurous acid in foods	1
5.	Quantitative determination of benzoic acid	1
6.	Determination of nitrates and nitrites in Foods	1
7.	Qualitative for presence of non-nutritive sweeteners	1
8.	Identification of colorsin food by TLC	1
9.	Determination of diacetyl content in dairy products	1
10.	Determination of total chlorophyll by Spectrophotometric method	1
11.	Detection of chemical preservatives in foods	1
12.	Study of effect of acidulants in fruit juices	1
13.	Study of effect of stabilizers/thickeners on quality of foods	1
14.	Study of effect of clarifying agents on the fruit juices	1
15.	Role of emulsifiers in foods	1
16.	Role of leaving agent in baked food product	1
17.	Role and mode of action of antioxidant in food products	1
18.		
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Food Additives	A Larry Branen, P Michael Davidson and Seppo Salminen	CRC Book Press. USA.
2	Food Additives	S.N. Mahindru	APH Publishing Corporation, Drya Ganj, New Delhi.
3	Food colours, Flavours and Additives Technology Handbook	NIIR Board of Consultants and Engineers	Natonal Institute of Industrial Research, Kamla Nagar, Delhi

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Food chemistry	H.D. Belitz, W. Grosh and P. Schieberle	4th Revised & Extemded Edition, Springer. 2009
2	Food chemistry	Owen R Fennema	Marcel Dekker, Inc. New York. 1996
3	Food chemistry	Lillian Hogland Meyer	Avi Pub Co .1974
4	Handbook of Food Toxicology	S.S Deshpande	Marcel Dekker 2002

FCN-357 INSTRUMENTAL TECHNIQUES IN FOOD 2 (0+2)

ANALYSIS

Practical

Sampling plan; Sample collection and preparation for analysis; Sensory evaluation of products; Quality evaluation of raw materials: Fruits, vegetables, cereals, dairy products, meat, poultry products; Quality evaluation of food products for color and taste of marketed products; Analysis of heavy metals using atomic absorption spectrophotometer; Estimation of physic acid using spectrophotometer; Separation of amino acids by two-dimensional paper chromatography; Identification of sugars in fruit juice using TLC; Separation of pralines by ion-exchange chromatography; Molecular weight determination using sephadox-gel; Identification of organic acids by paper electrophoresis; Gel-electrophoresis for analytic techniques; Quantitative determination of sugars and fatty acid profile by GLE; Quantitative make-up of water and fat soluble vitamins using HPLC; Separation of sugars by paper chromatography; Analysis of wheat flour; Analysis of foods for pesticide and drug residues; Study of colorimetry and spectrophotometry; Spectrophotometric method of total chlorophyll (A & B).

Practical Exercises

No. of Units	Topics	No. of Experiments
1.	Sampling plan; Sample collection and preparation for analysis	2
2.	Study of different chromatographic techniques	1
3.	Identification of sugars in fruit juice using TLC	1
4.	Separation of amino acids by two-dimensional paper chromatography	1
5.	Determination of carotenoids by HPLC	2
6.	Analysis of heavy metals	2
7.	Quantitative determination of sugars and fatty acid profile by GLC	2
8.	Identification of organic acids by paper electrophoresis	1
9.	Gel-electrophoresis for analytic techniques	1
10.	Near-Infrared Spectroscopy	1
11.	Estimation of phytic acid using spectrophotometer	1
12.	Quantitative make-up of water soluble vitamins	2
13.	Quantitative make-up of fat soluble vitamins	2
14.	Estimation of chlorophyll content by different methods	1
15.	Analysis of minor constituents of foods	2
16.	Determination of molecular weight of pectin	1
17.	Quality evaluation of raw materials: Fruits, vegetables, cereals, dairy products, meat, poultry products	6
18.	Quality evaluation of food products for color and taste of marketed products	4
	Total	**32**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Handbook of Food Analysis Instruments	Semih Ötles	CRC Press, Boca Raton, FL, USA. 2009
2	Food Analysis	S. Suzanne Nielsen	3rd Ed. Kluwer Academic, New York, USA. 2003
3	Official methods of analysis of AOAC International	AOAC	17th Ed. Gaithersburg, MD, USA, Association of Analytical Communities, 2003
4	Instrumental Methods of Food Analysis	Macleod AJ	Elek Sci. Marcel Dekker. 1973
5	Food Analysis - Theory and Practice	Pomrenz Y & Meloan CE	3rd Ed. CBS. 1996
6	Handbook of Analysis and Quality Control for Fruit and Vegetable Products	Ranganna S.	2nd Ed. Tata-McGraw-Hill. 2001

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Food Analysis Laboratory Manual	S. Suzanne Nielsen	2nd Ed. Springer, NY, USA. 2010
2	Modern Techniques for Food Authentication	Da-Wen Sun	Elsevier Inc., Burlington, MA, USA. 2008
3	Pearson's Chemical Analysis of Foods	Kirk RS & Sawyer R	9th Ed. Longman Scientific & Technical. 1991

FCN-368 ENZYMES IN FOOD INDUSTRY 2 (1+1)

Theory

Introduction: classification and nomenclature, mechanism of enzyme action, enzyme kinetics, factors affecting the rate of enzymic reactions, sources of enzymes Enzyme Kinetics: enzyme concentration, substrate concentration, environmental conditions, inhibitors, activators and cofactors Undesirable and desirable enzymic reactions in foods Sources of enzymes: different sources, extraction of enzymes and purification, enzyme technology and application Enzymes in milk and cheese industries: enzymes in milk processing and cheese production Enzymes in Meat industry: enzymes in tenderization of meat Enzymes in baking industry Enzymes in production of beverages and fruit juices: enzymes in tea, cocoa, wine, beer, whiskey, cider, etc Enzymes in sugar industries: Types of enzymes in sugar industry; isolation, purification and assay of enzymes, Enzymes in fats, oil, flavour and fragrances Immobilized enzymes in food processing

Practical

Effects of different enzymatic reactions on foods; Effect of enzymes on meat; Effects of enzymes on bakery products; Effect of enzymes on fruit juices and beverages; Improving different properties of foods by application of enzymes; Enzymes

Teaching Schedule - Theory with Weightages (%)

No. of Units	TOPICS	Weightage (%)
1 – 3	Introduction: classification and nomenclature, mechanism of enzyme action, enzyme kinetics, factors affecting the rate of enzymic reactions, sources of enzymes	19
4 – 5	Enzyme Kinetics: enzyme concentration, substrate concentration, environmental conditions, inhibitors, activators and cofactors	13
6 – 7	Undesirable and desirable enzymic reactions in foods	13
8 – 9	Sources of enzymes: different sources, extraction of enzymes and purification, enzyme technology and application	13
10	Enzymes in milk and cheese industries: enzymes in milk processing and cheese production	6
11	Enzymes in Meat industry: enzymes in tenderization of meat	6
12	Enzymes in baking industry	6
13	Enzymes in production of beverages and fruit juices: enzymes in tea, cocoa, wine, beer, whiskey, cider, etc	6
14	Enzymes in sugar industries: Types of enzymes in sugar industry; isolation, purification and assay of enzymes,	6
15	Enzymes in fats, oil, flavour and fragrances	6
16	Immobilized enzymes in food processing	6
	Total	

Practical Exercises

No. of Units	TOPICS	No. of Lectures
1	Classification of enzymes	1
2	Isolation and purification of enzymes	1
3	Activation of polyphenol oxidase from food sample	1
4	Separation of casein from milk using rennin	1
5	Effect of xylanase enzyme on water absorption capacity of bread	1
6	Measurement of amylase content of wheat flour	1
7	Application of pectinase in fruit juices	1
8	Inactivation of phosphatase enzyme	1
9	Effect of papain on meat tenderness	1
10	Application of lipase in enhancing emulsifying capacity	1
11	Application of lipase in noodles	1
12	Detection of phosphatise enzyme in milk	1
13	Use of glucose oxidase in egg powder manufacture	1
14	Use of invertase enzyme in confectionary	1
15	Use of lactase enzyme in dairy industry	1
16	Effect of cellulose on fruit juice yield	1
	Total	16

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Enzymes in Food Processing	G.A. Tucker and L.F.J. Woods	Springer 2009
2	Enzymes in Food and Beverage Processing	Muthuswamy C.	CRC Press, London 2015
3	Enzymes in Food Processing – Fundamentals and potential application	Panesar P.S., Marwaha S.S. and Kumar H.	IK International Publishing House, 2010 ISBN: 9380026331

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Enzymes in Industry: production and applications	Aehle W	Wiley- VCH Verlag GmbH & Co.
2	Principles of Enzyme Technology	Khan M.Y. and Khan F.	PHI Publication, New Delhi 2015 ISBN 8120350413
3	Microbial Enzyme Technology in Food Applications	Ray R.C. and Rosell C.M.	CRC Press, London 2017 ISBN: 1498749844

DETAILED SYLLABUS

IV. DEPARTMENT OF FOOD MICROBIOLOGY AND SAFETY

Sr. No.	Course No.	Course title	Credits	Semester
1	FMS-111	General Microbiology	3 (2+1)	I
2	FMS-122	Food Microbiology	3 (2+1)	II
3	FMS-233	Industrial Microbiology	3 (2+1)	III
4	FMS-244	Food Safety and Microbial Standards	3 (2+1)	IV
5	FMS-355	Food Biotechnology	3 (2+1)	V
6	FMS-366	Food Plant Sanitation	3 (2+1)	VI
7	FMS-367	Quality Assurance and Certification	3 (2+1)	VI
		Total Credits	**21 (14+7)**	

FMS-111 GENERAL MICROBIOLOGY 3 (2+1)

Theory

Evolution and scope of microbiology Microbial classification, nomenclature and identification, Taxonomic groups and General methods of classifying bacteria Microscopy and microscopes: Smears and

staining Morphology and fine structure of bacteria, Cultivation of bacteria, nutritional requirements, Nutritional classification of bacteria, Phototrophs, chemotrophs, autotrophs and heterotrophs, Obligate parasites Bacteriological media, Growth of bacteria, Reproduction of bacteria, Introduction to fungi, algae and protozoa and virus Nutrient transport phenomenon: Passive diffusion, facilitated diffusion, Group translocation and active transport Mutations: Types of mutations, mutagenesis, Mutation rate, repair of mutations, Phenotypes of bacterial mutants and Designation of bacterial mutants Destruction of microorganisms: Physical agents and chemical agents, Chemotherapeutic agents and chemotherapy, Characteristics of antibiotics and Mode of action of antibiotics Pure culture: Methods of isolation of pure cultures, Maintenance and preservation of pure cultures and culture collections

Practical

Microscopy; Micrometry; Cleaning and sterilization of glassware and acquainting with equipment used in microbiology; Preparation of nutrient agar media and techniques of inoculation; Staining methods (monochrome staining, gram staining, negative staining, capsule-staining, flagella staining and endospore staining); Pure culture techniques (streak plate/pour plate/spread plate); Identification procedures (morphology and cultural characteristics); Growth characteristics of fungi: Determination of microbial numbers, direct plate count, generation time; Factors influencing growth: pH, temperature, growth curves for bacteria

Teaching Schedule - Theory with Weightages (%)

Number of Units	Topic	Per cent Covered
1 – 2	Evolution and scope of microbiology	7
3 – 6	Microbial classification, nomenclature and identification, Taxonomic groups and general methods of classifying bacteria	12
7 – 9	Microscopy and microscopes: Smears and staining	9
10 – 14	Morphology and fine structure of bacteria, cultivation of bacteria, nutritional requirements, nutritional classification of bacteria, phototrophs, chemotrophs, autotrophs and heterotrophs, obligate parasites	16
15 – 17	Bacteriological media, growth of bacteria, reproduction of bacteria, introduction to fungi, algae and protozoa and virus	9
18 – 20	Nutrient transport phenomenon: passive diffusion, facilitated diffusion, group translocation and active transport	9
21 – 25	Mutations: types of mutations, mutagenesis, mutation rate, repair of mutations, phenotypes of bacterial mutants and designation of bacterial mutants	16
26 – 29	Destruction of microorganisms: physical agents and chemical agents, chemotherapeutic agents and chemotherapy, characteristics of antibiotics and mode of action of antibiotics	13
30 – 32	Pure culture: methods of isolation of pure cultures, maintenance and preservation of pure cultures and culture collections	9
	Total	**100**

Practical Exercises

Number of Units	Topic	Number of Experiment
1.	Guidelines for safety in food microbiology laboratory work	1
2.	Introduction to equipments commonly used in microbiology laboratory	1
3.	Sterilization of glasswares used in microbiology laboratory	1
4.	Simple staining: monochrome straining and negative staining	1
5.	Differential staining: Gram's staining and spore staining	1
6.	Microscopy	1
7.	Measuring size of microorganisms by micrometry	1
8.	Preparation of culture media	2
9.	Dye reduction tests for microorganisms	1
10.	Isolation of microorganisms using streak plate method	1
11.	Isolation and enumeration of microorganisms using spread plate method	1
12.	Isolation and enumeration of microorganisms using pout plate method	1
13.	Effect of different factors on growth of microorganisms	1
14.	Microorganisms examination of water	2
	Total	16

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Microbiology	Pelczar, Chan and Krieg	5th Ed. Tata McGraw-Hill Education, New Delhi.
2	Fundamentals of Microbiology	Jeffrey C.P.	Elsevier Publication, London 2017 ISBN-13: 978-1449688615
3	Basic Microbiology	Khuntia B.K.	Daya Publication, New Delhi 2001

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Microbiology: An Introduction	Gerard J. Tortora, Berdell R. Funke, Christine L. Case	12th Ed. Prentice-Hall, NY, USA. 2014
2	Prescott's Microbiology	Willey, Sherwood and Christopher	9th Ed. McGraw-Hill Higher Education, NY, USA. 1998

FMS-122 FOOD MICROBIOLOGY 3 (2+1)

Theory

Importance and significance of microbes in food science Microbial spoilage of foods Factors affecting kinds, numbers, growth and survival of microorganisms in foods, Intrinsic factors; pH, water activity, nutrients etc and Extrinsic factors: Relative humidity, temperature and gaseous atmosphere Chemical changes caused by microorganisms: Changes in nitrogenous organic compounds, non-nitrogenous organic compounds, organic acids, other compounds, lipids, pectic substances, Contamination of foods; Sources of contamination, Genera of bacteria, Maintenance of anaerobic conditions; Asepsis,

removal of microorganisms; Intermediate moisture foods; Microbiology of cereal and cereal products Microbiology of milk and milk products, meat and meat products, poultry and eggs, fish and other sea foods Microbiology of fruits and vegetables and canned foods Microbiology of sugar and sugar products and salts and spices Shelf life: Calculation of shelf life, Shelf life requirements, deteriorative reactions, accelerated testing Simulations of product: Package environment interaction, shelf life simulation for moisture, oxygen, and light sensitive products Food borne intoxications and infections, types of food involved, toxicity and symptoms, chemical properties, environmental conditions Food borne viruses: Polio, hepatitis A and E, noroviruses, rota viruses, prion diseases, types of food involved, toxicity and symptoms

Practical

Isolation of bacteria and molds from foods; Microbial examination of cereal and cereal products: Identification, isolation and confirmation; Microbial examination of vegetable and fruits: Identification, isolation and confirmation; Microbial examination of meat and meat products: Identification, isolation and confirmation; Microbial examination of fish and other sea foods: Identification, isolation and confirmation; Microbial examination of eggs and poultry: Identification, isolation and confirmation

Microbial examination of milk and milk products: Identification, isolation and confirmation; Microbial examination of sugar, salts and spices; Microbial examination of canned products: Identification, isolation and confirmation; Determination and enumeration of pathogenic and indicator organisms in foods (Coliform/Enterococcus); Thermal death time determination; Detection of Salmonella from food sample

Detection of coliforms from water by MPN method; Detection of Staphylococcus aureus from food sample

Teaching Schedule - Theory with Weightages (%)

Number of Units	Topic	Per cent Covered
1 – 2	Importance and significance of microbes in food science	7
3 – 7	Microbial spoilage of foods Factors affecting kinds, numbers, growth and survival of microorganisms in foods, Intrinsic factors; pH, water activity, nutrients etc and Extrinsic factors: Relative humidity, temperature and gaseous atmosphere	13
8 – 12	Chemical changes caused by microorganisms: Changes in nitrogenous organic compounds, non-nitrogenous organic compounds, organic acids, other compounds, lipids, pectic substances, Contamination of foods; Sources of contamination, Genera of bacteria, Maintenance of anaerobic conditions; Asepsis, removal of microorganisms; Intermediate moisture foods;	16
13 – 14	Microbiology of cereal and cereal products	7
15 – 17	Microbiology of milk and milk products, meat and meat products, poultry	9

	and eggs, fish and other sea foods	
18 – 19	Microbiology of fruits and vegetables and canned foods	7
20 – 21	Microbiology of sugar and sugar products and salts and spices	7
22 – 23	Shelf life: Calculation of shelf life, Shelf life requirements, deteriorative reactions, accelerated testing	7
24 – 26	Simulations of product: Package environment interaction, shelf life simulation for moisture, oxygen, and light sensitive products	9
27 – 29	Food borne intoxications and infections, types of food involved, toxicity and symptoms, chemical properties, environmental conditions	9
30 – 32	Food borne viruses: Polio, hepatitis A and E, noroviruses, rota viruses, prion diseases, types of food involved, toxicity and symptoms	9
	Total	**100**

Practical Exercises

Number of Units	**Topic**	**Number of Experiment**
1	Isolation of bacteria and molds from foods	1
2	Microbial examination of cereal and cereal products: Identification, isolation and confirmation	2
3	Microbial examination of vegetable and fruits: Identification, isolation and confirmation	1
4	Microbial examination of meat and meat products: Identification, isolation and confirmation	1
5	Microbial examination of fish and other sea foods: Identification, isolation and confirmation	1
6	Microbial examination of eggs and poultry: Identification, isolation and confirmation	1
7	Microbial examination of milk and milk products: Identification, isolation and confirmation	1
8	Microbial examination of sugar, salts and spices	1
9	Microbial examination of canned products: Identification, isolation and confirmation	2
10	Determination and enumeration of pathogenic and indicator organisms in foods (*Coliform*/*Enterococcus*)	1
11	Thermal death time determination	1
12	Detection of *Salmonella* from food sample	1
13	Detection of *coliforms* from water by MPN method	1
14	Detection of *Staphylococcus* aureus from food sample	1
	Total	16

TEXT BOOK

Sr. No.	**Name of Book**	**Author**	**Publisher**
1	Food Microbiology	Frazier and Dennis	4th Ed. Tata McGraw-Hill Education, New Delhi. 1987
2	Modern Food Microbiology	James M. Jay	6th Ed. Aspen Publishers, Inc., Gaithersburg, Maryland, USA. 2002
3	Basic Food Microbiology	Banawart GJ	2nd Ed. AVI Publ. 1989

4	Essentials of Food Microbiology	Garbutt J	Arnold Heinemann, 1997
5	Fundamentals of Food Microbiology	Ray B	3rd Edition, CRC Press, 2004

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Martin R. Adams and Maurice O. Moss	Food Microbiology	3rd Ed., The Royal Society of Chemistry, Cambridge, UK. 2008
2	Basic Food Microbiology	George J. Banwart	2nd Ed. Chapman & Hall, New York, USA. 1989

FMS-233 INDUSTRIAL MICROBIOLOGY 3 (2+1)

Theory

History of industrial microbiology; Primary and secondary metabolites produced by the microorganisms Screening of microorganisms; Preservation of microorganisms; Organizations involved in microbiological work Fermentation media, Industrial sterilization; Fermentor: Components of a fermentor, parts of fermentors, peripheral parts and accessories, additional accessories and peripherals. Types of fermentors Types of fermentations; Alcoholic beverages: types, production and quality; Industrially important secondary metabolites; and microorganisms involved Probiotics: Industrially important secondary metabolites, their production and downstream processing, biopesticides, antibiotics, enzymes, exopolysaccharides, biopolymers, steroids, biomers; Importance, role in fermented foods, organisms involved, beneficial effects Bacteriocins and Nisin Production of microbial enzymes; Downstream processing Cell disruption methods: Mechanical disruption methods and non-mechanical disruption methods; Extraction; Purification; Concentration; Product recovery. Microbial cell products i.e. Mushroom, SCP, Baker's yeast, blue green algae and sprulina Measures to improve yield of fermented products

Practical

Isolation and screening of citric acid/ amylase/protease/antibiotic producing microbes, Production of citric acid/Lactic acid/ Acetic acid; Purification of citric acid/Lactic acid/ Acetic acid and Estimation of citric acid/Lactic acid/ Acetic acid; Standardization of physical factors for higher yields of citric acid; Isolation, identification of cultures producing bio-colours; Production, purification and estimation of beer/ ethanol Production, purification and assay of fungal amylases/proteases/Lipase; Production and assay of nisin from lactic acid bacteria.

Teaching Schedule - Theory with Weightages (%)

Number of Units	Topic	% Syllabus Covered
1 – 2	History of industrial microbiology	7
3 – 4	Primary and secondary metabolites produced by the microorganisms	7
5 – 7	Screening of microorganisms; Preservation of microorganisms; Organizations involved in microbiological work	9
8 – 12	Fermentation media, Industrial sterilization; Fermentor: Components of a fermentor, parts of fermentors, peripheral parts and accessories, additional accessories and peripherals. Types of fermentors	16
13 – 15	Alcoholic beverages: types, production and quality; Types of fermentations; Industrially important secondary metabolites; and microorganisms involved	9
16 – 18	Probiotics: Importance, role in fermented foods, organisms involved, beneficial effects	9
19 – 20	Industrially important secondary metabolites, their production and downstream processing, biopesticides, antibiotics, enzymes, exopolysaccharides, biopolymers, steroids, biomers	7
21 – 22	Production of microbial enzymes; Downstream processing	7
23 – 27	Cell disruption methods: Mechanical disruption methods and non-mechanical disruption methods; Extraction; Purification; Concentration; Product recovery.	16

28 – 30	Microbial cell products i.e. Mushroom, SCP, Baker's yeast, blue green algae and sprulina	9
31 – 32	Oriental and traditional fermented foods; Measures to improve yield of fermented products	7
	Total	**100**

Practical Exercises

Number of Units	Topic	Number of Experiment
1.	Study of fermentor accessories	1
2.	Study of bacterial growth curve	1
3.	Isolation and screening of citric acid/ amylase/protease/antibiotic producing microbes, Production of citric acid/Lactic acid/ Acetic acid	3
4.	Purification of citric acid/Lactic acid/ Acetic acid and Estimation of citric acid/Lactic acid/ Acetic acid	2
5.	Standardization of physical factors for higher yields of citric acid	2
6.	Isolation, identification of cultures producing bio-colours	1
7.	Production of alcoholic beverage by fermentation	2
8.	Production, purification and estimation of beer/ ethanol	1
9.	Production, purification and assay of fungal amylases/proteases/Lipase	1
10.	Production and assay of nisin from lactic acid bacteria	1
11.	Production of polysaccharides	1
12.	Production of traditional fermented food	2
	Total	16

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Industrial Microbiology	Casida LE	Wiley, 1968
2	Industrial Applications of Microbiology	Rajvaidya N.	APH Publishing, 2006
3	Prescott & Dunn's Industrial Microbiology	G. Reed	4th Ed. AVI Publishers, Connecticut, USA. 2004
4	Brewing Science and Practice.	Dennis EB,	Woodhead Publishing Ltd. Cambridge, England. 2004

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Modern Industrial Microbiology and Biotechnology	Nduka Okafor	Science Publishers, Enfield, New Hampshire, USA. 2004
2	Handbook of Indigenous Fermented Foods	Steinkraus KS	Marcel Dekker, 1996

FMS-244 FOOD SAFETY AND MICROBIAL STANDARDS 3 (2+1)

Theory

Hazards in food chain: physical, chemical and biological biological; Toxins in food: naturally occurring, bacterial and fungal Intrinsic toxins produced during processing and storage Metals as toxins: Sources, contamination, toxicity and elimination Pesticide residues as toxin: Chlorinated and non-chlorinated Permitted and non-permitted food additives as an amended Microbial standards of fresh and processed foods Risk assessment and management during food preparation

Practical

Estimation of Salmonella / Shigella / Staphylococcus from food samples; Estimation of Fungal toxins form food Samples.; (Different types of foods); Heavy metal detection (Lead); Isolation and identification of Listeria and E. coli; HACCP for food industries by taking few models; Study of National and International microbial quality standards; Visit to export oriented food processing industry; Microbial and chemical analysis of water

Teaching Schedule - Theory with Weightages (%)

Number of Units	Topic	Per cent Covered
1 – 5	Hazards in food chain: physical, chemical and biological	16
6 – 9	Toxins in food: naturally occurring, bacterial and fungal	13
10 – 12	Intrinsic toxins produced during processing and storage of food	9
13 – 16	Metals as toxins: Sources, contamination, toxicity and elimination	13
17 – 21	Pesticide residues as toxin: Chlorinated and non-chlorinated	16
22 – 25	Permitted and non-permitted food additives	13
26 – 28	Microbial standards of fresh and processed foods	9
29 – 32	Risk assessment and management during food preparation	13
	Total	**100**

Practical Exercises

Number of Unit	Topics	No. of Experiments
1.	Estimation of Salmonella / Shigella / Staphylococcus from food samples	3
2.	Estimation of fungal toxins from different foods (Different types of foods)	2
3.	Detection of Lead	1
4.	Detection of *Bacillus cereus*	1
5.	Detection of *Campylabacter*	1
6.	Detection of *Escherichia coli* and *coliforms*	1
7.	Detection of *Listeria*	1
8.	Detection of *Salmonella*	1
9.	Detection of *Staphylococcus aureus*	1
10.	Detection of *Clostridium perfringens*	1
11.	HACCP for food industries by taking few models	1
12.	Study of National and International microbial quality standards	1
13.	Visit to food industry to study microbial safety	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Handbook of Food Toxicology	Deshpande SS	CRC Press
2	Food Hygiene and Sanitation	Roday	Tata McGraw Hill Education, 2011
3	Principles of Food Sanitation	Marriot and Gravi	Springer, 2006
4	Food Safety and Toxicology	Vries JD	CRC Press, 1996
5	Food Safety: Theory and Practice	Knechtges PL	Jones and Bartlett Publishers, 2011

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Food Microbiology	Adams and Moss	Royal Society of Chemistry, 2015
2	The Safety of Foods	Graham HD	AVI Publishing 1968
3	Food Additive Toxicology	Maga	CRC Press, 1994
4	Food Safety Management: A Practical Guide for the Food Industry	Yasmine and Huub	Academic Press, 2013

FMS-355 FOOD BIOTECHNOLOGY 3 (2+1)

Theory

Chemical nature of the genetic material, properties and functions of the genetic material, organization of the genetic material in bacteria, eukaryotes and viruses Chemical nature of the genetic material, properties and functions of the genetic material, organization of the genetic material in bacteria, eukaryotes and viruses Transcription and translation: RNA synthesis, types of RNA, genetic code; Mutation and DNA repair, mechanisms of repair of damaged DNA (photo reactivation, excision repair, recombination repair, SOS repair, mismatch repair), transposable elements, plasmids, types of plasmids, genetic recombination in bacteria, transformation, transduction, conjugation, regulation of gene expression in prokaryotes; Expression of foreign genes, Promoter enzymes Recombinant DNA technology: Restriction enzymes, cloning vectors, cloning procedure, cloning of specific gene and their identification (colony hybridization, C-DNA, southern blotting, polymerase chain reaction) Gene cloning: Production of identical cells, isolation and purification of insert DNA, isolation of vector DNA, construction of recombined DNA, introduction of recombined DNA into host cell, identification and selection of cells containing cloned genes Biosensors: Classification and application in food industry Application of biotechnology in food, Immobilization of enzymes: Arresting of cell in insoluble matrix, immobilized cell systems, cell attachment in a surface, aggregation, entrapment, containment, physical adsorption, covalent bonding, cross linking, entrapment into polymeric films, microencapsulation, large scale cell immobilization, uses and applications in industries Ethical issues concerning GM foods: Testing for GMOs, current guidelines for production, release and movement of GMOs, labelling and traceability, trade related aspects, bio-safety, risk assessment, risk management, public perception of GM foods, IPR, GMO Act 2004

Practical

Chemical mutagenesis using chemical mutagens (Ethidium bromide); Determination of survival curves using physical and chemical mutagens; Isolation and analysis of chromosomal/genomic DNA from E. coli and Bacillus cereus; Separation of protoplast using cellulytic enzymes; Production of biomass from fruit and vegetable waste; Introduction of ELISA/Southern blot/DNA finger printing, etc; Agarose gel electrophoresis of plasmid DNA; Pesticide degradation by pseudomonas species

Teaching Schedule - Theory with Weightages (%)

Number of Units	Topic	Per cent Covered
1 – 4	Chemical nature of the genetic material, properties and functions of the genetic material, organization of the genetic material in bacteria, eukaryotes and viruses	12
5 – 8	Chemical nature of the genetic material, properties and functions of the genetic material, organization of the genetic material in bacteria, eukaryotes and viruses	13
9 – 13	Transcription and translation: RNA synthesis, types of RNA, genetic code; Mutation and DNA repair, mechanisms of repair of damaged DNA (photo reactivation, excision repair, recombination repair, SOS repair, mismatch repair), transposable elements, plasmids, types of plasmids, genetic recombination in bacteria, transformation, transduction, conjugation, regulation of gene expression in prokaryotes; Expression of foreign genes, Promoter enzymes	16
14 – 16	Recombinant DNA technology: Restriction enzymes, cloning vectors, cloning procedure, cloning of specific gene and their identification (colony hybridization, C-DNA, southern blotting, polymerase chain reaction)	9
17 – 20	Gene cloning: Production of identical cells, isolation and purification of insert DNA, isolation of vector DNA, construction of recombined DNA, introduction of recombined DNA into host cell, identification and selection of cells containing cloned genes	12
21 – 23	Biosensors: Classification and application in food industry	9
24 – 27	Application of biotechnology in food, Immobilization of enzymes: Arresting of cell in insoluble matrix, immobilized cell systems, cell attachment in a surface, aggregation, entrapment, containment, physical adsorption, covalent bonding, cross linking, entrapment into polymeric films, microencapsulation, large scale cell immobilization, uses and applications in industries	13
28 – 32	Ethical issues concerning GM foods: Testing for GMOs, current guidelines for production, release and movement of GMOs, labelling and traceability, trade related aspects, bio-safety, risk assessment, risk management, public perception of GM foods, IPR, GMO Act 2004	16
Total		**100**

Practical Exercises

Number of Units	Topic	Number of Lectures
1	Chemical mutagenesis using chemical mutagens (Ethidium bromide)	1
2	Determination of survival curves using physical and chemical mutagens	2
3	Production of biomass and enzymes from fruits and vegetable waste	2
4	Isolation and analysis of chromosomal/genomic DNA from *E. coli* and *Bacillus cereus*	2
5	Separation of protoplast using cellulytic enzymes	2
6	Production of biomass from fruit and vegetable waste	2
7	Introduction of ELISA/Southern blot/DNA finger printing, etc	2
8	Agarose gel electrophoresis of plasmid DNA	2
9	Pesticide degradation by pseudomonas species	2
	Total	16

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Biotechnology - Expanding Horizons	B.D. Singh	Kalyani Publishers, New Delhi. 2014
2	Introduction to Molecular Biology and Genetic Engineering	Brandenberg, Dhlamini, Sensi, Ghosh and Sonnino	FAO, Rome Italy 2011
3	Industrial Microbiology: Fundamentals and Applications	Ashok Agarwal and Pradeep Parihar	Agrobios India, Jodhpur. 2005

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Biotechnology and Food Processing Mechanics	Meenakshi Paul	Gene-Tech Books, New Delhi 2007
2	Molecular Biology of the Gene	James D. Watson	7th Ed. Benjamin Cummings, San Francisco, USA. 2013
3	Principles of Gene Manipulation and Genomics	S.B. Primrose and R.M. Twyman	7th Ed. Blackwell Publishing, Victoria, Australia 2006

FMS-366 FOOD PLANT SANITATION 3 (2+1)

Theory

Good manufacturing practices and current good manufacturing practices Sanitation and the food industry: Sanitation, sanitation laws and regulations and guidelines, establishment of sanitary, potential risks of food borne bioterrorism, bioterrorism protection measures and role of pest management in bio-security Relationship of microorganisms to sanitation, Food contamination and protection against contamination Personal hygiene and sanitary food handling: Role of HACCP in sanitation, quality assurance for sanitation cleaning compounds, handling and storage precautions Sanitizers, sanitizing methods, sanitation equipment, waste product handling, solid waste disposal and liquid waste disposal Pest control: Insect infestation, cockroaches, insect destruction, rodents, birds, use of pesticides and integrated pest management Sanitary design and construction for food processing: Site selection, site preparation, building construction considerations, processing and design considerations and pest control design Low-moisture food manufacturing and storage sanitation: Sanitary construction considerations, receipt and storage of raw materials and cleaning of low-moisture food manufacturing plants Fruit and vegetable processing plant sanitation: Contamination sources, sanitary construction considerations, cleaning considerations, cleaning of processing plants, cleaners and sanitizers, cleaning procedures and evaluation of sanitation effectiveness

Practical

Estimation of BOD (Biological Oxygen Demand); Estimation of COD (Chemical Oxygen Demand); Determination of hardness of water; Good Manufacturing Practices (GMPs) and personal hygiene; Sewage treatment: Primary, secondary, tertiary and quaternary and Aerobic and anaerobic sludge treatment; Lab demonstration on state of water; Study of CIP plant; Isolation and identification of Actinomycetes; Enrichment and isolation of cellulose degrading bacteria; Biodegradation of phenol compounds; Bacteriological examination of water: Coliform MPN test; Sampling of airborne microorganisms, Sampling of surfaces - equipment and physical plant; Aerosol sampling and measurement guidelines

Teaching Schedule - Theory with Weightages (%)

Number of Units	Topic	Per cent Covered
1	Good manufacturing practices and current good manufacturing practices	2
2 – 6	Sanitation and the food industry: Sanitation, sanitation laws and regulations and guidelines, establishment of sanitary, potential risks of food borne bioterrorism, bioterrorism protection measures and role of pest management in bio-security	16
7 – 9	Relationship of microorganisms to sanitation, Food contamination and protection against contamination	9
10 – 13	Personal hygiene and sanitary food handling: Role of HACCP in sanitation, quality assurance for sanitation cleaning compounds, handling and storage precautions	13
14 – 16	Sanitizers, sanitizing methods, sanitation equipment, waste product handling, solid waste disposal and liquid waste disposal; Soil types and properties of cleaning agents.	9
17 – 19	Pest control: Insect infestation, cockroaches, insect destruction, rodents, birds, use of pesticides and integrated pest management	9

20 – 23	Sanitary design and construction for food processing: Site selection, site preparation, building construction considerations, processing and design considerations and pest control design	13
24 – 28	Low-moisture food manufacturing and storage sanitation: Sanitary construction considerations, receipt and storage of raw materials and cleaning of low-moisture food manufacturing plants	16
29 – 32	Fruit and vegetable processing plant sanitation: Contamination sources, sanitary construction considerations, cleaning considerations, cleaning of processing plants, cleaners and sanitizers, cleaning procedures and evaluation of sanitation effectiveness	13
	Total	**100**

Practical Exercises

Number of Units	Topic	Number of Lectures
1	Estimation of BOD (Biological Oxygen Demand)	1
2	Estimation of COD (Chemical Oxygen Demand)	1
3	Determination of hardness of water	1
4 – 5	Good Manufacturing Practices (GMPs) and personal hygiene	2
6 – 8	Sewage treatment: Primary, secondary, tertiary and quaternary and Aerobic and anaerobic sludge treatment	3
9	Microbial quality of water	1
10	Study of CIP plant	1
11	Isolation and identification of Actinomycetes	1
12	Enrichment and isolation of cellulose degrading bacteria	1
13	Biodegradation of phenol compounds	1
14	Bacteriological examination of water: Coliform MPN test	1
15	Sampling of airborne microorganisms, Sampling of surfaces - equipment and physical plant	1
16	Aerosol sampling and measurement guidelines	1
	Total	16

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Principles of Food Sanitation	Marriot and Gravi	Springer, 2006
2	Food Hygiene and Sanitation	Roday S.	McGraw Hill Education, 2011
3	Essentials of Food Sanitation	Marriot N.	Springer 1997

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Biotechnology - Expanding Horizons	B.D. Singh	Kalyani Publishers, New Delhi. 2014
2	Biotechnology and Food Processing Mechanics	Meenakshi Paul	Gene-Tech Books, New Delhi 2007
3	Molecular Biology of the Gene	James D. Watson	7th Ed. Benjamin Cummings, San Francisco, USA. 2013
4	Principles of Gene Manipulation and Genomics	S.B. Primrose and R.M. Twyman	7th Ed. Blackwell Publishing, Victoria, Australia 2006

FMS-367 QUALITY ASSURANCE AND CERTIFICAITON 3(2+1)

Theory

Introduction to Quality: Defining quality, Dimensions of quality, Quality control & quality assurance, Quality Gurus' Contribution Total Quality Management: Objectives, principles, implementation; Deming's 14 points on TQM, Benefits of TQM, Quality Tools, Quality Circle Other Management Philosophies: 5S, Six sigma, Lean manufacturing, Just-In-Time (JIT), Kanban International Organization for standardization (ISO): Introduction, ISO standards, benefits, procedure, generic management systems. ISO 9000, PRP for Food Safety: GAP – objectives, principles, benefits; GLP – need, history, objectives, principles, bodies; GHP – objectives, principles; GMP – objectives, GMP in food industry HACCP: Introduction, History of HACCP, Definitions related to HACCP system, Principles of HACCP, application of HACCP system, implementation steps for HAACP system, Benefits of HACCP ISO 22000: Introduction, History, benefits, Objectives, ISO 22000 family of standards series, ISO standard document, Role of BIS in ISO 22000 GFSI, FSSC 22000, IFS, SQF, AIB, GRMS, PAS 96 Accreditation and Certification: Introduction, Benefits, accreditation organizations, Certification, Types of certifications, Certification Bodies in India, BIS, AGMARK Documentation Auditing and Surveillance: Introduction, Definition, Objectives of auditing, Types of Audit, Principles of Auditing, Audit Program Procedures, Audit Activities, Audit Competencies, Lead Auditor, Surveillance. Recent Update on the subject (if any).

Practicals

Activities of Quality Department; Writing Standard Operating Procedures; Preparation of quality policy & documentation (quality Manuals); Application of HACCP to products.; Implementation procedure of ISO 22000; Preparation of documentation and records; Auditing- surveillance, mock audit.; Visit to units with GMP, ISO, HACCP certified plants

Teaching Schedule - Theory with Weightages (%)

Number of Units	Topic	Per cent Covered
1-2	Introduction to Quality: Defining quality, Dimensions of quality, Quality control &quality assurance, Quality Gurus' Contribution	6
3-5	Total Quality Management: Objectives, principles, implementation; Deming's 14 points on TQM, Benefits of TQM, Quality Tools, Quality Circle	10
6-7	Other Management Philosophies: 5S, Six sigma, Lean manufacturing, Just-In-Time (JIT), Kanban	6
8-10	International Organization for Standardization (ISO): Introduction, ISO standards, benefits, procedure, generic management systems. ISO 9000,	10
11-14	PRP for Food Safety: GAP – objectives, principles, benefits; GLP – need, history, objectives, principles, bodies; GHP – objectives, principles; GMP – objectives, GMP in food industry	12
15-18	HACCP: Introduction, History of HACCP, Definitions related to HACCP system, Principles of HACCP, Application of HACCP system,	12

	Implementation steps for HAACP system, Benefits of HACCP	
19-21	ISO 22000: Introduction, History, Benefits, Objectives, ISO 22000 family of standards series, ISO standard document, Role of BIS in ISO 22000	10
22-26	GFSI, FSSC 22000, IFS, SQF, AIB, GRMS, PAS 96	16
27-28	Accreditation and Certification: Introduction, Benefits, accreditation organizations, Certification, Types of certifications, Certification Bodies in India, BIS, AGMARK	6
29	Documentation	3
30-32	Auditing and Surveillance: Introduction, Definition, Objectives of auditing, Types of Audit, Principles of Auditing, Audit Program Procedures, Audit Activities, Audit Competencies, Lead Auditor, Surveillance. Recent Update on the subject (if any)	9
	Total	**100**

Practical Exercises

Number of Units	Topic	Number of Experiment
1	Activities of Quality Department	1
2	Studies on bar codes	1
3	Writing Standard Operating Procedures	2
4	Preparation of quality policy & documentation (quality Manuals)	1
5	Application of HACCP to products	2
6	HACCP Plan for Fruits and Vegetables	1
7	Implementation procedure of ISO 22000	1
8	Preparation of documentation and records	2
9	Auditing- surveillance, mock audit	2
10	Visit to units with GMP, ISO, HACCP certified plants	3
	Total	**16**

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Quality Assurance for Food Industry – A Practical Approach	J. Andres Vasconcellos	CRC Press Boca Raton [ISBN: 9780849319129]
2	Food Quality Assurance – Principles and Practices	Inteaz Alli	CRC Press Boca Raton [ISBN: 9780203484883]
3	HACCP User's Manual	Corlett D.A.	An Aspen Publication, Maryland
4	Total Quality Assurance for the Food Industry	Gould W.A. and Gould W.B.	CTI Publication – Technology and Engineering
5	Food Industry Quality Control Systems	Mark Clute	CRC Press, Boca Raton [ISBN: 978-0-8493-8028-0]
6	Guide to Quality Management Systems for Food Industries	Early R.	Blackie Academic. 1995

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Manual of Food Quality Control: Quality assurance in the food control microbiological laboratory	FAO	FAO Publication
2	HACCP and ISO 22000 – Application to Foods of Animal Origin	Arvanitoyannis I.S.	Wiley-Blackwell Publication Oxford [ISBN: 978-1-4051-5366-9]
3	Food Safety Management and ISO 22000 – Food Industry Briefing	Early Ralph	Food Industry Briefing Publication [ISBN: 9781405193245]
4	ISO 22000: Food Safety Management Systems Requirements for Any Organization in the Food...	ISO	International Organization for Standardization
5	HACCP, GMP and ISO 22000 – Overview	---	Institute of Workforce Education Saint Augustine College Publication [ISBN: 9781633051485]
6	HACCP – A Food Industry briefing	Mortimore S.E. and Wallace C.A.	Wiley Blackwell New York ISBN: 978-1-118-42723-1
7	Quality Management Essentials	Hoyle David	Elsevier Publication Oxford, UK [ISBN: 9780750667869
8	Sensory Evaluation of Foods	Piggot JR	Elbview applied Science, 1984

DETAILED SYLLABUS

V. DEPARTMENT OF FOOD BUSINESS MANAGEMENT

V. DEPARTMENT OF FOOD BUSINESS MANAGEMENT

Sr. No.	Course No.	Course title	Credits	Semester
1	FBM-111	Computer Programming and Data Structure	3 (1+2)	I
2	FBM-122	Information and Communication Technology	2 (1+1)	II
3	FBM-243	ICT Application in Food Industry	3 (1+2)	IV
4	FBM-354	Entrepreneurship Development	3 (2+1)	V
5	FBM-355	Business Management and Economics	2 (2+0)	V
6	FBM-356	Food Laws and Regulations	3 (2+1)	V
7	FBM-367	Project Preparation and Management	2 (1+1)	VI
8	FBM-368	Marketing Management and International Trade	2 (2+0)	VI
9	FBM-369	Communication Skills and Personality Development	2 (1+1)	VI
		Total Credits	**22 (13+9)**	

FBM-111 COMPUTER PROGRAMMING AND DATA STRUCTURES 3 (1+2)

THEORY

Introduction: introduction to high level languages i.e. "C" language. Basic structure of C program, character set, variables, constants Data type: Primary data types and user defined data types, typecasting Operators: Arithmatic, logic, relational, building and evaluating expressions, standard library functions Managing Input and Output: input/output statement, scanf(), getchar (), getch(), putchar() Decision making, branching, looping: conditional statements (if, if-else, nesting of if, if-ladder); Looping statement (while(), do,, while() and for() – looping statements) Array: one dimensional, two dimensional and multi dimensional arrays Functions: library functions, user defined functions, passing arguments and returning values, recursion String functions: strcat(), strlen(), strcpy(), stremp (), etc. Data structure: structures, Union and Pointers (Syntax and definition) Stacks, push/pop operations, Queues, Insertion and deletion operations, linked lists

Practical

Write a first programme to print "Welcome to C-programming".; Write a program for addition, subtraction, multiplication and division of given two numbers A,B.; Write a program to check odd or even number.; Write a program to convert number of days in to months and days.
Write a program to find the Area of Circle, by giving radius as input.; Write a program to find the right most digit of a given number.; Program to calculate the simple interest by giving, principle amount, rate of interest and period in months.; Write a program to find the square root of a given number.; Write a program to find the largest among two numbers;
Write a program to find the largest of three given numbers A, B, C.; Write a program to find the roots of quadratic equation AX2+BX+C= 0; Write a program to find the average/mean of given 10 numbers.; Write a program to print the given number in reverse order.; Write a program to fin d the sum of first fifty even numbers.; Write a program to generate Fibonacci series up to given numbers N.; Write a program to print the following triangle. ;

1
12
123
1234

Write a program to determine if the given number is prime or not prime; Write a program to find the factorial of a given number using function.; Write a program to find the factorial of a given numbers using Recursion.; Write a program to find Xy using user defined function.; Write a program to check the given integer number is Palidrome or not; Write a program to print the following triangle.

12345
1234
123
12
1

Write a program to find the average of 10 given numbers using arrays; print the numbers as well as average.Write a program to determine the grade of a student using nested if statement. Write a program to select the desired branch of Engineering b using switch-case statement.; Write a program to check the given character is VOVEL or NOT; Write a program to read the string in the form of first name, middle name and last name and print the complete name.; Write a program to determine whether the given string is palindrome or not.; Write a program to determine whether the given character is in lowercase, uppercase, punctuation or space. ; Write a program to arrange the given 10 numbers using bubble sort method.; Write a program to arrange the given 10 numbers

using selection sort method.; Write a program for addition of 3 x 3 matrix: Write a program of substraction fo 3 x 3 matrix: Write a program for multiplication of 3 x 3 matrix

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	Per cent Covered
1 – 2	Introduction: introduction to high level languages i.e. "C" language. Basic structure of C program, character set, variables, constants	13
3 – 4	Data type: Primary data types and user defined data types, typecasting	13
5 – 6	Operators: Arithmatic, logic, relational, building and evaluating expressions, standard library functions	13
7	Managing Input and Output: input/output statement, scanf(), getchar (), getch(), putchar()	6
8	Decision making, branching, looping: conditional statements (if, if-else, nesting of if, if-ladder); Looping statement (while(), do,, while() and for() – looping statements)	6
9	Array: one dimensional, two dimensional and multi dimensional arrays	6
10 – 11	Functions: library functions, user defined functions, passing arguments and returning values, recursion	13
12	String functions: strcat(), strlen(), strcpy(), stremp (), etc.	6
13 – 14	Data structure: structures, Union and Pointers (Syntax and definition)	12
15 – 16	Stacks, push/pop operations, Queues, Insertion and deletion operations, linked lists.	12
	Total	**100**

Practical Exercises

No. of Units	Topics	Number of practicals
1	Write a first programme to print "Welcome to C-programming".	1
2	Write a program for addition, subtraction, multiplication and division of given two numbers A,B.	1
3	Write a program to check odd or even number.	1
4	Write a program to convert number of days in to months and days.	1
5	Write a program to find the Area of Circle, by giving radius as input.	1
6	Write a program to find the right most digit of a given number.	1
7	Program to calculate the simple interest by giving, principle amount, rate of interest and period in months.	1
8	Write a program to find the square root of a given number.	1
9	Write a program to find the largest among two numbers.	1
10	Write a program to find the largest of three given numbers A, B, C.	1
11	Write a program to find the roots of quadratic equation $AX^2+BX+C= 0$	1
12	Write a program to find the average/mean of given 10 numbers.	1
13	Write a program to print the given number in reverse order.	1
14	Write a program to fin d the sum of first fifty even numbers.	1
15	Write a program to generate Fibonacci series up to given numbers N.	1
16	Write a program to print the following triangle. 1 12 123 1234	1
17	Write a program to determine if the given number is prime or not prime	1
18	Write a program to find the factorial of a given number using function.	1
19	Write a program to find the factorial of a given numbers using Recursion.	1
20	Write a program to find X^y using user defined function.	1
21	Write a program to check the given integer number is Palidrome or not	1
22	Write a program to print the following triangle. 12345 1234 123 12	1

	1	
23	Write a program to find the average of 10 given numbers using arrays; print the numbers as well as average.	1
24	Write a program to determine the grade of a student using nested if statement.	1
25	Write a program to select the desired branch of Engineering b using switch-case statement.	1
26	Write a program to check the given character is VOVEL or NOT	1
27	Write a program to read the string in the form of first name, middle name and last name and print the complete name.	1
28	Write a program to determine whether the given string is palindrome or not.	1
29	Write a program to determine whether the given character is in lowercase, uppercase, punctuation or space.	1
30	Write a program to arrange the given 10 numbers using bubble sort method.	1
31	Write a program to arrange the given 10 numbers using selection sort method.	1
32	Write a program for addition of 3 x 3 matrix: Write a program of substraction fo 3 x 3 matrix: Write a program for multiplication of 3 x 3 matrix	1
	Total	32

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Data Structures and Algorithm Analysis in C++,	Mark Allen Weiss	4th Ed. Pearson Education, Boston, USA. 2014
2	Computer programming in C	Rajaraman V.	Prentice Hall of India, 2006
3	Computer Concept and Programming in C	Godse AP and Godse DA	Technical Publication, Pune 2008
4			

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Fundamentals of Computer Programming with C#	Sofia, Bulgaria	Svetlin Nakov & Co, 2013
2	Object Oriented Programming with C++	Balagurusamy	4th Ed. Tata McGraw-Hill Publishing Company Limited, New Delhi. 2008

FBM-122 INFORMATION AND COMMUNICATION TECHNOLOGY 2 (1+1)

THEORY

Introduction to Computers, Definition: Hardware, Software & firmware. Types of software. Data Representation, Number systems (Binary, Hexadecimal). Difference between ASCII & UNICODE (Different Encoding Schemes) Primary , Secondary Memory , Units used for measurement of memory , Input Output devices Operating Systems, definition and types File Management. Applications used for document creation & Editing, Data presentation using slides. Use of Spreadsheets for statistical analysis, evaluating mathematical & logical expressions Use of Spreadsheets for Interpretation and graph creation Database, concepts and types, uses of DBMS/RDBMS in Agriculture Database design, creation, Preparation of presentation. Import export operations, using numerical tabular data/text/graph /slides within different applications using cut-paste. Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc; Geospatial technology for generating valuable agri-information Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc for supporting Farm decisions Communication process, Berlo' s model, feedback and barriers to communication.

Practical

Study of Computer Components, accessories; practice of important DOS Commands; Introduction of different operating systems such as MS-Windows, Unix/ Linux, Creating, Files & Folders, File Management.; Word-Processing – 1; Word Processing – 2; Presentation

Spreadsheet -1 ; Spreadsheet -2; Spreadsheet -3; DBMS/RDBMS Creating, Updating database

Querying/Retrieving data , relation ; Introduction to World Wide Web (WWW).; Demonstration of Agri-information system.; Hands on Crop Simulation Models (CSM) such as DSSAT/Crop-Info/CropSyst/Wofost; Computation of water and nutrient requirements of crop using CSM and IT tools; Introduction of Geospatial Technology for generating valuable information for Agriculture.; Hands on Decision Support System; Introduction of programming languages. Preparation of contingent crop planning.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	Per cent Covered
1	Introduction to Computers, Definition: Hardware, Software & firmware. Types of software.	7
2	Data Representation, Number systems (Binary, Hexadecimal). Difference between ASCII & UNICODE (Different Encoding Schemes)	7
3	Primary , Secondary Memory , Units used for measurement of memory , Input Output devices	7
4	Operating Systems, definition and types	7
5	File Management.	6
6	Applications used for document creation & Editing, Data presentation using slides.	6
7	Use of Spreadsheets for statistical analysis, evaluating mathematical & logical expressions.	6
8	Use of Spreadsheets for Interpretation and graph creation.	6
9	Database, concepts and types, uses of DBMS/RDBMS in Agriculture	6
10	Database design, creation,	6
11	Database, concepts and types, uses of DBMS/RDBMS in Agriculture	6
12	Database design, creation,	6
13	Preparation of presentation. Import export operations, using numerical tabular data/text/graph /slides within different applications using cut-paste.	6
14	Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc; Geospatial technology for generating valuable agri-information	6
15	Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc for supporting Farm decisions.	6
16	Communication process, Berlo' s model, feedback and barriers to communication.	6
	Total	**100**

Practical Exercises

No. of Units	Topics	Number of practicals
1	Study of computer components, accessories	1
2	practice of important DOS Commands	1
3	Introduction of different operating systems such as MS-Windows, Unix/ Linux, Creating, Files & Folders, File Management.	1
4	Word-Processing – 1	1
5	Word Processing – 2	1
6	Presentation	1
7	Spreadsheet -1	1
8	Spreadsheet -2	1
9	Spreadsheet -3	1
10	DBMS/RDBMS Creating, Updating database	1
11	Querying/Retrieving data , relation	1
12	Introduction to World Wide Web (WWW). Demonstration of Agri-information system.	1
13	Hands on Crop Simulation Models (CSM) such as DSSAT/Crop-Info/CropSyst/Wofost; Computation of water and nutrient requirements of crop using CSM and IT tools	1
14	Introduction of Geospatial Technology for generating valuable information for Agriculture.	1
15	Hands on Decision Support System	1
16	Introduction of programming languages. Preparation of contingent crop planning.	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Computer Fundamentals	Pradeep K. Sinha and Priti Sinha	III edition, BPB Publications, B-14, Connaught Place, New Delhi – 110 001.
2	Computer Fundamentals	P.K. Sinha	BPB Publications, B-14, Connaught Place, New Delhi – 110 001.

REFERENCE BOOKS AND LINKS

- Mastering Office Professional for window 95, BPB Publications, B-14, Connaught Place, New Delhi – 110 001.
- Statistical Methods for Agricultural workers by V.G. Panse and P.V. Sukhatma, ICAR, New Delhi.
- http://www.tutorialsforopenoffice.org/category_index/base.html
- http://mkisan.gov.in/downloadmobileapps.aspx
- http://www.nrsc.gov.in/Agriculture
- http://iasri.res.in/
- http://communicationtheory.org/berlos-smcr-model-of-communication/

FBM-243 ICT APPLICATION IN FOOD INDUSTRY 3 (1+2)

Theory

Importance of computerization in food industry, operating environments and information systems for various types of food industries, Supervisory control and data acquisition (SCADA); SCADA systems hardware, firmware, software and protocols, landlines, local area network systems, modems; Spreadsheet applications: Data interpretation and solving problems, preparation of charts, use of macros to solve engineering problems, use of add-ins, use of solver; Web hosting and webpage design; file transfer protocol (FTP), on-line food process control from centralized server system in processing plant; Use of MATLAB in food industry; computing with MATLAB, script files and editor/debugger, MATLAB help system, problem solving methodologies, numeric, cell, arrays, matrix operations, user defined functions, programming using MATLAB; debugging MATLAB programs, applications to simulations; Plotting and model building in MATLAB, X-Y plotting functions, subplots and overlay plots, special plot types, interactive plotting in MATLAB, function discovery, regression, the basic fitting interface, three dimensional plots; Introduction to toolboxes useful to food industry, curve fitting toolbox, fuzzy logic toolbox, neural network toolbox, image processing toolbox, statistical toolbox; Introduction to computational fluid dynamics (CFD), governing equations of fluid dynamics; Models of flow, substantial derivative, divergence of velocity, continuity, momentum and energy equations; Physical boundary conditions, discretization; Applications of CFD in food and beverage industry; Introduction to CFD software, GAMBIT and FLUENT software; LabVIEW – LabVIEW environment: Getting data into computer, data acquisition devices, NI-DAQ, simulated data acquisition, sound card, front panel/block diagram, toolbar/tools palette Components of a LabVIEW application: Creating a VI, data Flow execution, debugging techniques, additional help, context help, tips for working in LabVIEW; LabVIEW typical programs: Loops, while loop, for loop, functions and sub Vis, types of functions, searching the functions palette, creating custom sub Vis, decision making and file I/O, case structure, select (if statement), file I/O; LabVIEW results: Displaying data on front panel, controls and indicators, graphs and charts, arrays, loop timing, signal processing, textual math, math script.

Practical

Introduction to various features in spreadsheet; Solving problems using functions in spreadsheets; Use of Add-Ins in spread sheet and statistical data analysis using Analysis Tool pack; Solution of problems on regression analysis using Analysis Tool pack in spreadsheet; Solution of problems on optimization using solver package in spreadsheet; Introduction to MATLAB; Writing code using MATLAB programming; Solution of problems using Curve Fitting Toolbox in MATLAB; Solution of problems using Fuzzy Logic Toolbox in MATLAB; Solution of problems using Neural Network Toolbox in MATLAB; Solution of problems using Image Processing Toolbox in MATLAB; Introduction to GAMBIT software; Creation of geometry for laminar flow through pipe using GAMBIT; Introduction to FLUENT software; Import of geometry and application of boundary conditions; Solution of problems on laminar flow using FLUENT; Introduction to LabVIEW and NI-DAQ.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topic	Per cent Covered
1	Importance of computerization in food industry, operating environments and information systems for various types of food industries,	7
2 – 3	Supervisory control and data acquisition (SCADA); SCADA systems hardware, firmware, software and protocols, landlines, local area network systems, modems; Spreadsheet applications: Data interpretation and solving problems, preparation of charts, use of macros to solve engineering problems, use of add-ins, use of solver;	12
4 – 5	Web hosting and webpage design; file transfer protocol (FTP), on-line food process control from centralized server system in processing plant;	12
6 – 7	Use of MATLAB in food industry; computing with MATLAB, script files and editor/debugger, MATLAB help system, problem solving methodologies, numeric, cell, arrays, matrix operations, user defined functions, programming using MATLAB; debugging MATLAB programs, applications to simulations; Plotting and model building in MATLAB, X-Y plotting functions, subplots and overlay plots, special plot types, interactive plotting in MATLAB, function discovery, regression, the basic fitting interface, three dimensional plots;	12
8	Introduction to toolboxes useful to food industry, curve fitting toolbox, fuzzy logic toolbox, neural network toolbox, image processing toolbox, statistical toolbox;	7
9 – 11	Introduction to computational fluid dynamics (CFD), governing equations of fluid dynamics; Models of flow, substantial derivative, divergence of velocity, continuity, momentum and energy equations; Physical boundary conditions, discretization; Applications of CFD in food and beverage industry;	19
12 – 13	Introduction to CFD software, GAMBIT and FLUENT software; LabVIEW – LabVIEW environment: Getting data into computer, data acquisition devices, NI-DAQ, simulated data acquisition, sound card, front panel/block diagram, toolbar/tools palette;	12
14 – 16	Components of a LabVIEW application: Creating a VI, data Flow execution, debugging techniques, additional help, context help, tips for working in LabVIEW; LabVIEW typical programs: Loops, while loop, for loop, functions and sub Vis, types of functions, searching the functions palette, creating custom sub Vis, decision making and file I/O, case structure, select (if statement), file I/O; LabVIEW results: Displaying data on front panel, controls and indicators, graphs and charts, arrays, loop timing, signal processing, textual math, math script.	19
	Total	**100**

Practical Exercises

No. of Units	Topic	Number of Experiments
1	Introduction to various features in spreadsheet; Solving problems using functions in spreadsheets; Use of Add-Ins in spread sheet and statistical data analysis using Analysis Tool pack; Solution of problems on regression analysis using Analysis Tool pack in spreadsheet; Solution of problems on optimization using solver package in spreadsheet;	10
2	Introduction to MATLAB; Writing code using MATLAB programming; Solution of problems using Curve Fitting Toolbox in MATLAB; Solution of problems using Fuzzy Logic Toolbox in MATLAB; Solution of problems using Neural Network Toolbox in MATLAB; Solution of problems using Image Processing Toolbox in MATLAB;	7
3	Introduction to GAMBIT software; Creation of geometry for laminar flow through pipe using GAMBIT;	7
4	Introduction to FLUENT software; Import of geometry and application of boundary conditions; Solution of problems on laminar flow using FLUENT;	6
5	Introduction to LabVIEW and NI-DAQ.	2
	Total	**32**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Computer Applications in Food Technology: Use of Spreadsheets in Graphical, Statistical and Process Analysis	R. Paul Singh	Academic Press, London. 2014
2	Introduction to LabVIEW: 3-Hour Hands-On	National Instruments Corporation	NI, Austin, Texas. 2005
3	Practical SCADA for Industry	David Bailey and Edwin Wright	Elsevier, Burlington, MA 2003

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Introduction to MATLAB for Engineers	William J. Palm	3rd Ed. McGraw-Hill Companies, Inc., NY, USA. 2011
2	Computational Fluid Dynamics in Food Processing	Da-Wen Sun	CRC Press, Boca Raton, FL, USA. 2007
3	Web Design: A Complete Introduction	Nigel Chapman and Jenny Chapman	John Wiley & Sons, USA. 2006

FBM-479 ENTREPRENEURSHIP DEVELOPMENT 3 (2+1)

Theory

Entrepreneurship: Importance and growth, characteristics and qualities of entrepreneur, role of entrepreneurship, ethics and social responsibilities; Entrepreneurship development Assessing overall business environment in the Indian economy; Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs; Globalization and the emerging business/entrepreneurial environment; Concept of entrepreneurship, entrepreneurial and managerial characteristics, managing an enterprise, motivation and entrepreneurship development, importance of planning, monitoring, evaluation and follow up, managing competition, entrepreneurship development programs, SWOT analysis, generation, incubation and commercialization of ideas and innovations; Women entrepreneurship: Role and importance, problems; Corporate entrepreneurship: Role, mobility of entrepreneur; Entrepreneurial motivation; Planning and evaluation of projects: Growth of firm, project identification and selection, factors inducing growth; Project feasibility study: Post planning of project, project planning and control; New venture management; Creativity Government schemes and incentives for promotion of entrepreneurship; Government policy on small and medium enterprises (SMEs)/SSIs; Export and import policies relevant to food processing sector; Venture capital; Contract farming and joint ventures, public-private partnerships; Overview of food industry inputs; Characteristics of Indian food processing industries and export; Social responsibility of business.

Practical

Visit to public enterprise; Visit to private enterprise; Visit to agro-processing/food business centres; SWOT analysis of public enterprises; SWOT analysis of private enterprises; Project proposals as ntrepreneur – individual and group; Presentation of project proposals in the class.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	Number of Lectures	Per cent Covered
1 – 4	Entrepreneurship: Importance and growth, characteristics and qualities of entrepreneur, role of entrepreneurship, ethics and social responsibilities; Entrepreneurship development:	4	13
5 – 8	Assessing overall business environment in the Indian economy; Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs;	4	13
9 – 14	Globalization and the emerging business/entrepreneurial environment; Concept of entrepreneurship, entrepreneurial and managerial characteristics, managing an enterprise, motivation and entrepreneurship development, importance of planning, monitoring, evaluation and follow up, managing competition,	6	19
15 – 18	entrepreneurship development programs, SWOT analysis, generation, incubation and commercialization of ideas and	4	12

	innovations;		
19 – 22	Women entrepreneurship: Role and importance, problems; Corporate entrepreneurship: Role, mobility of entrepreneur;	4	12
23 – 26	Entrepreneurial motivation; Planning and evaluation of projects: Growth of firm, project identification and selection, factors inducing growth; Project feasibility study: Post planning of project, project planning and control; New venture management; Creativity.	4	12
27 – 32	Government schemes and incentives for promotion of entrepreneurship; Government policy on small and medium enterprises (SMEs)/SSIs; Export and import policies relevant to food processing sector; Venture capital; Contract farming and joint ventures, public-private partnerships; Overview of food industry inputs; Characteristics of Indian food processing industries and export; Social responsibility of business.	6	19
	Total	**32**	**100**

Practical Exercises

No. of Units	**Topics**	**Number of Lectures**
1.	Data collection from market on various projects on food processing and analysis	2
2.	Project proposals as entrepreneur – individual and group	3
3.	Calculation of project cost and break even analysis of specific project	3
4.	Different schemes for food entrepreneurs	3
5.	Visit to public enterprise	1
6.	Visit to private enterprise	1
7.	Visit to agro-processing/food business centres	1
8.	SWOT analysis of public enterprises	1
9.	SWOT analysis of private enterprise	1
10.	Presentation of project proposals in the class	2
	Total	16

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Impact Making Entrepreneurs	EDI, Ahmedabad	Entrepreneurship Development Institute, Ahmedabad
2	Developing New Entrepreneurs	EDI, Ahmedabad	Entrepreneurship Development Institute, Ahmedabad
3	New Initiative in Entrepreneurship	Jain GR and Gupta D.	Entrepreneurship Development Institute, Ahmedabad

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Entrepreneurship Development	C.B. Gupta and N.P. Srinivasan	S. Chand & Sons, New Delhi. 2012
2	Entrepreneurship Development	Anil Kumar, S., Poornima, S.C., Mini, K., Abraham and Jayashree, K	New Age International Publishers, New Delhi. 2003
3	Management: Theory and Practice	Gupta, C.B.	Sultan Chand & Sons, New Delhi. 2001
4	Dynamics of Entrepreneurial Development and Management	Vasant Desai	Himalaya Publishing House, New Delhi. 2000

FBM-355 BUSINESS MANAGEMENT AND ECONOMICS 2 (2+0)

Theory

Definitions, management principles, scientific principles, administrative principles; Maslow's Hierarchy of needs theory; Functions of management: Planning, organizing, staffing, directing, controlling Organizational structures, principles of organization; Types of organization: Formal and informal, line, line and staff, matrix, hybrid Introduction to economics: Definitions, nature, scope, difference between microeconomics and macroeconomics; Theory of demand and supply, elasticity of demand, price and income elasticity; Markets: Types of markets and their characteristics; National income: GDP, GNP, NNP, disposable personal income, per capita income, inflation; Theory of production: Production function, factors of production. Law of variable proportions and law of returns to scale; Cost: Short run and long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost; Break even analysis; Finance management: Definition, scope, objective; Different systems of accounting: Financial accounting, cost accounting, management accounting; Human resource management: Definitions, objectives of manpower planning, process, sources of recruitment, process of selection; Corporate social responsibility: Importance, business ethics.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	Per cent Covered
1 – 5	Definitions, management principles, scientific principles, administrative principles; Maslow's Hierarchy of needs theory; Functions of management: Planning, organizing, staffing, directing, controlling;	16
6 – 9	Organizational structures, principles of organization; Types of organization: Formal and informal, line, line and staff, matrix, hybrid;	12
10 – 13	Introduction to economics: Definitions, nature, scope, difference between microeconomics and macroeconomics; Theory of demand and supply, elasticity of demand, price and income elasticity;	12
14 – 17	Markets: Types of markets and their characteristics; National income: GDP, GNP, NNP, disposable personal income, per capita income, inflation;	12
18 – 22	Theory of production: Production function, factors of production. Law of variable proportions and law of returns to scale; Cost: Short run and long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost; Break even analysis;	16
23 – 27	Finance management: Definition, scope, objective; Different systems of accounting: Financial accounting, cost accounting, management accounting;	16
28 – 32	Human resource management: Definitions, objectives of manpower planning, process, sources of recruitment, process of selection; Corporate social responsibility: Importance, business ethics.	16
	Total	**100**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Agriculture, Finance and Management	Reddy and Raghuram	Oxford & IBH Pub Co, 1996
2	Marketing Management	Kotler and Keller, Burton	Pearson Education Australia, 2008
3	Management: Principles and Guidelines	Duening and Ivacevinch	Dreamtech Press, 2003

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	L.M. Prasad	Principles and Practices of Management	9th Ed. S. Chand & Sons, New Delhi 2001
2	Principles of Management	Koontz Harold	Tata McGraw-Hill Education Private Limited, New Delhi.
3	Managerial Economics	P.C. Thomas	9th Ed. Kalyani Publishers
4	Modern Economic Theory	K.K. Dewett and M.H. Navalur	S. Chand & Sons, New Delhi.
5	Human Resource Management	P. Subba Rao	Himalaya Publications. New Delhi
6	Financial Accounting	S.P. Jain	Kalyani Publications, Ludhiana

FBM-356 FOOD LAWS AND REGULATIONS 3 (2+1)

Theory

Introduction to Food Laws and Regulations: Need for food standards and their enforcement, various types of laws (Mandatory/Regulatory and Voluntary/Optional); Food Safety and Standards Authority of India (FSSAI); Food Safety and Standards Act, 2006 (FSSA) – inception, importance and significance, discussion on important sections; FSS Regulations: Regulations on Licensing and Registration, Regulations on Contaminants, toxins and residues, FSS Regulations on Food product standards and food additives, FSS Regulations on Laboratory and sampling analysis; FSS Regulations on Packaging and Labelling; FSS Regulations on Prohibition and Restriction on sales.Other Relevant Acts: Environment (Protection) Act, 1986, Standards of Weights and Measures Act, 1976, Essential Commodities Act, 1955, The Export (Quality Control and Inspection) Act, 1963, The Insecticides Act, 1968, Consumer Protection Act, 1986. Introduction to various food laws (Voluntary) - Agmark Standards (AGMARK), Codex Alimentarius Standards, BIS Standards and Specifications.

Practical

Licensing and registration process; Examination of Cereals as per specificationsl; Examination of milk and milk products as per specifications; Examination of Oil and Oil products as per specifications; Examination of fruits and vegetable products as per regulations; Visit to FDA department

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	Per cent Covered
1 – 4	Introduction to Food Laws and Regulations: Need for food standards and their enforcement, various types of laws (Mandatory/Regulatory and Voluntary/Optional);	13
5	Food Safety and Standards Authority of India (FSSAI);	3
6 – 7	Food Safety and Standards Act, 2006 (FSSA) – inception, importance and significance, discussion on important sections;	7
8 – 15	FSS Regulations: Regulations on Licensing and Registration, Regulations on Contaminants, toxins and residues, FSS Regulations on Food product standards and food additives, FSS Regulations on Laboratory and sampling analysis; FSS Regulations on Packaging and Labelling; FSS Regulations on Prohibition and Restriction on sales.	25
16 – 17	Environment (Protection) Act, 1986	6
18 – 19	Standards of Weights and Measures Act, 1976	6
20 – 22	Essential Commodities Act, 1955	9
23 – 24	The Export (Quality Control and Inspection) Act, 1963	6
25 – 26	The Insecticides Act, 1968	6
27 – 28	Consumer Protection Act, 1986	6
29 – 32	Introduction to various food laws (Voluntary) - Agmark Standards (AGMARK), Codex Alimentarius Standards, BIS Standards and Specifications, GMP Regulations	13
	Total	**100**

Practical Exercises

No. of Units	Topic	Number of Experiments
1	Licensing and registration process	1
2	Examination of Cereals as per specifications	3
3	Examination of milk and milk products as per specifications	3
	Examination of Oil and Oil products as per specifications	4
4	Examination of fruits and vegetable products as per regulations	4
5	Visit to FDA department	1
	Total	16

TEXT BOOK

Sr.	Name of Book	Author	Publisher

No.			
1	Food Safety and Standards Act, 2006	---	Commercials Law Publications, New Delhi
2	Food Safety and Standards Act, 2006	---	FSSAI, New Delhi
	The Food Safety and Standards Act, 2006 (Along with Rules & Regulations)	---	Commercials Law Publications, New Delhi

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	TAXMANN's Guide to Food Safety and Standards Act 2006	---	Taxmann's Publication
2	Food Safety and Standards Act, Rules & Regulations.	Vidhi Jain Akalank Kumar Jain	---

FBM-367 PROJECT PREPARATION AND MANAGEMENT 2 (1+1)

Theory

Overview of project management: Functions and viewpoints of management, evolution of project management, forms and environment of project management; Project life cycle; Project selection: Project identification and screening, project appraisal, project charter, project proposal, project scope, statement of work Project planning and scheduling: Work breakdown structure, planning and scheduling of activity networks, network scheduling, precedence diagrams, critical path method, program evaluation and review technique, assumptions in PERT modelling, decision CPM, GERT Project cost estimating: Types of estimates and estimating methods, dynamic project planning and scheduling, time-cost trade-offs, resource considerations in projects, resource profiles and levelling, limited resource allocation Project implementation, monitoring and control: Project management process and role of project manager, team building and leadership in projects, organizational and behavioural issues in project management, project monitoring and control, PERT/cost method, earned value analysis; Project completion and future directions: Project completion and review; Project management: Recent trends and future directions; Computers in project management

Practical

Studies on Market Survey based on enterprise; Preparation of Project Report; Project selection, ; dentification, appraisal and scope;Methods of monitoring and feasibility of projects; Studies on investment and repayment plants; Project monitoring and Control – PERT Modeling

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	Number of Lectures	Per cent Covered
1 – 3	Overview of project management: Functions and viewpoints of management, evolution of project management, forms and environment of project management;	3	19
4 – 6	Project life cycle; Project selection: Project identification and screening, project appraisal, project charter, project proposal, project scope, statement of work	3	19
7 – 9	Project planning and scheduling: Work breakdown structure, planning and scheduling of activity networks, network scheduling, precedence diagrams, critical path method, program evaluation and review technique, assumptions in PERT modelling, decision CPM, GERT	3	19
10 – 11	Project cost estimating: Types of estimates and estimating methods, dynamic project planning and scheduling, time-cost trade-offs, resource considerations in projects, resource profiles and levelling, limited resource allocation	2	12
12 – 14	Project implementation, monitoring and control: Project management process and role of project manager, team building and leadership in projects, organizational and behavioural issues in project management, project monitoring and control, PERT/cost method, earned value analysis;	3	19
15 – 16	Project completion and future directions: Project completion and review; Project management: Recent trends and future directions;	2	12

	Computers in project management.		
	Total	**16**	**100**

Practical Exercises

No. of Units	Topic	Number of Experiments
1	Studies on Market Survey based on enterprise	3
2	Preparation of Project Report	2
3	Project selection, identification, appraisal and scope	3
4	Methods of monitoring and feasibility of projects	2
5	Studies on investment and repayment plants	3
6	Project monitoring and Control – PERT Modeling	2
	Total	16

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	A Manual on How to Prepare a Project Report	J.B.Patel & D.G.Allampally	Entrepreneurship Development Institute of India, Ahmedabad
2	A Manual on Business Opportunity Identification & Selection	J.B.Patel & S.S.Modi	Entrepreneurship Development Institute of India, Ahmedabad
3	Manual for Entrepreneurs	EDI, Ahmedabad	Tata McGraw Hill Education, 2005

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Operations Research	R. Panneerselvam	2nd Ed. International Book House, Mumbai. 2004
2	Projects	Prasanna Chandra	Tata McGraw-Hill Publication, New Delhi.
3	Project Management for Business and Technology – Principles and Practices	John M. Nicholas	Pearson Prentice Hall
4	Project Management – A System Approach to Planning, Scheduling, and Controlling	Harold Kerzner	CBS Publishers & Distributors
5	Projects – Planning, Analysis, Selection, Financing, Implementation, and Review	Prasanna Chandra	Tata McGraw-Hill Publishing Company Ltd
6	Textbook of Project Management.	P. Gopalakrishnan and V.E. Rama Moorthy	Macmillan Publication, New Delhi

FBM-368 MARKETING MANAGEMENT AND INTERNATIONAL TRADE 2 (2+0)

Theory

Marketing: Concept, functions, scope and marketing management; Process: Concepts of marketing-mix, elements of marketing-mix; Market structure and consumer buying behaviour: micro- and macro-environments; Marketing research and marketing information systems; Market measurement, market forecasting, market segmentation, targeting and positioning; Allocation and marketing resources; Marketing planning process; Product policy and planning: Product-mix, product line, product life cycle; New product development process; Product brand, packaging, services decisions; Marketing channel decisions; Retailing, wholesaling and distribution; Pricing decisions; Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry; Promotion-mix decisions; Advertising: Objectives, budget and advertising message, media planning, personal selling, publicity, sales promotion; World consumption of food: Patterns and types of food consumption across the globe; Salient features of international marketing, composition and direction of Indian exports, international marketing environment, deciding which and how to enter international market; Direct exports, indirect exports, licensing, joint ventures, direct investment and internationalization process, distribution channels;

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	Number of Lectures	Per cent Covered
1 – 4	Marketing: Concept, functions, scope and marketing management; Process: Concepts of marketing-mix, elements of marketing-mix; Market structure and consumer buying behaviour: micro- and macro-environments;	4	13
5 – 8	Marketing research and marketing information systems; Market measurement, market forecasting, market segmentation, targeting and positioning; Allocation and marketing resources; Marketing planning process;	4	13
9 – 12	Product policy and planning: Product-mix, product line, product life cycle; New product development process; Product brand, packaging, services decisions;	4	12
13 – 16	Marketing channel decisions; Retailing, wholesaling and distribution; Pricing decisions; Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry; Promotion-mix decisions;	4	12
17 – 22	Advertising: Objectives, budget and advertising message, media planning, personal selling, publicity, sales promotion; World consumption of food: Patterns and types of food consumption across the globe;	6	19
23 – 28	Salient features of international marketing, composition and direction of Indian exports, international marketing environment, deciding which and how to enter international market; Direct exports, indirect exports, licensing, joint ventures, direct investment and internationalization process, distribution channels;	6	19
29 – 32	WTO and world trade agreements related to food business, export trends and prospects of food products in India; Government institutions related to international food trade: APEDA, Tea Board, Spice Board, MOFPI, etc.	4	12

		Total	**32**	**100**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	International Business	Aswathappa	Tata McGraw-Hill Education, New Delhi
2	Marketing Management	C.N. Sontakki	Kalyani Publishers, New Delhi.
3	International Business	Aswathappa	Tata McGraw-Hill Education, New Delhi
4	International Business: Text and Cases	Fransis Cherunilam	5th Ed. PHI Learning, New Delhi.

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Marketing Management: A South Asian Perspective	Philip Kotler, Keller, Koshy and Jha	14th Ed. Pearson Education. 2013
2	Fundamentals of Marketing	Willium J. Stanton	Tata McGraw-Hill Publication, New Delhi. 1984

FBM-369 COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT 2 (1+1)

Theory

Communication Skills: Structural and functional grammar; Meaning and process of communication, Verbal and nonverbal communication; Listening and note taking Writing skills, Oral presentation skills; Field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting Individual and group presentations, impromptu presentation, public speaking; Group discussion Organizing seminars and conferences

Practicals

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations.

Teaching Schedule - Theory with Weightages (%)

No. of Units	Topics	Per cent Covered
1 – 2	Communication Skills	13
3	Structural and functional grammar	6
4	Meaning and process of communication	6
5	Verbal and nonverbal communication	6
6	Listening and note taking	6
7 – 8	Writing skills	13
9 – 10	Oral presentation skills	13
11	Field diary and lab record; indexing, footnote and bibliographic procedures	6
12	Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting	6
13	Individual and group presentations, impromptu presentation, public speaking	6
14 – 15	Group discussion	13
16 – 16	Organizing seminars and conferences	6
	Total	

Practicals

Sr. No.	Topics	Number of Lectures
1.	Activities for personality development	1
2.	Listening and notes taking	1
3.	Writing skills: abstracting, summarizing, technical articles, etc	4
4.	Oral presentation skills	2
5.	Public speaking	1
6.	Group discussion	2
7.	Goal setting	1
8.	Presentation using powerpoint	1
9.	Resume building	1
10.	Time management	1
11.	Interview skills	1
	Total	**16**

TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Effective Communication and Soft Skills	Mamatha Bhatnagar and Nitin Bhatnagar	Person Education. 2013

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Technical Communication Principles and Practice	Meenakshi Raman, Sangeeta Sharma	
2	Personality Development	Harold Wallace and Ann Masters	Cengage Publishers.
3	Basic Communication Skills for Technology	Andrea J. Rutherford	Pearson Education.

NON CREDIT COMPULSORY COURSES

PHEY-122 PHYSICAL EDUCATION AND YOGA 1 (0+1)

Practical

Introduction to physical education: Definition, scientific machine principles, objectives, scope, history, development and importance; Physical training and health; Fartlek training and circuit training; Body mechanism and body type: Kretchmark's and Sheldon's classification; Theories of learning; Exercises for good posture; Exercises to develop physical fitness, growth, flexibility - components, speed, strength, endurance, power, flexibility, agility, coordination and balance Test and measurement in physical education: Physical fitness test, motor fitness test, ability test, cardiovascular efficiency test and physical fitness index; Calisthenics, weight training, aerobic and anaerobic exercises; Circuit training, interval training, far trek training, pressure training and resistance training; Importance of Asanas, free hand exercises and yoga; Recreation: Definition, agencies promoting recreation, camping and re-recreation; Governance of sports in India; Organization of tournaments; National and international events Drawing of fixtures; Rules and regulations; Coaching and fundamentals of skill development of major games, coaching and tactic development of athletic events

Practical Exercises

No. of Units	Topics	Number of Lectures
1	Introduction to physical education: Definition, scientific machine principles, objectives, scope, history, development and importance;	2
2	Physical training and health; Fartlek training and circuit training; Body mechanism and body type: Kretchmark's and Sheldon's classification; Theories of learning;	2
3	Exercises for good posture; Exercises to develop physical fitness, growth, flexibility - components, speed, strength, endurance, power, flexibility, agility, coordination and balance	2
4	Test and measurement in physical education: Physical fitness test, motor fitness test, ability test, cardiovascular efficiency test and physical fitness index; Calisthenics, weight training, aerobic and anaerobic exercises; Circuit training, interval training, far trek training, pressure training and resistance training; Importance of Asanas, free hand exercises and yoga;	4
5	Recreation: Definition, agencies promoting recreation, camping and re-recreation;	2
6	Governance of sports in India; Organization of tournaments; National and international events	2
7	Drawing of fixtures; Rules and regulations; Coaching and fundamentals of skill development of major games, coaching and tactic development of athletic events	2
	Total	**16**

AL -122 NATIONAL SERVICE SCHEME (NSS) 1 (0+1)

Practical

Orientation of students towards national problems; Study of the philosophy of N.S.S., fundamental rights, directive principles of state policy, socio-economic structure of Indian society, population and five year plans; Functional literacy: Non-formal education of rural youth, eradication of social evil, awareness programmes, consumer awareness, highlights of the Consumer Act, environment enrichment and conservation, health, family welfare and nutrition; Right to information act.

Practical Exercises

No. of Units	Topics	Number of Lectures
1 – 2	Orientation of students towards national problems;	13
3 – 6	Study of the philosophy of N.S.S., fundamental rights, directive principles of state policy,	25
7 – 8	socio-economic structure of Indian society, population and five year plans;	13
9 – 14	Functional literacy: Non-formal education of rural youth, eradication of social evil, awareness programmes, consumer awareness, highlights of the Consumer Act, environment enrichment and conservation, health, family welfare and nutrition;	37
15 – 16	Right to information act.	12
	Total	**100**

DEG-123 DEMOCRACY, ELECTION AND GOOD GOVERNANCE 1 (1+0)

Theory

Unit No. 1

Democracy – Introduction meaning, classification, Principles of Democracy, Dimensions of democracy, Democracy and Diversity Decentralization : concept, features, Fundamental Rights in the Indian Constitution, Outcomes of Democracy and Challenges of Democracy

Unit No. 2

Independent Election Commission in India powers of election commission in India, Elections to local self Government Bodies, National level, State level, Institutions at the local level Municipal Cooperation, Municipal Council Nagar Panchayat, Zilla Parishad, Panchayat Samiti, Gram Panchayat : powers duties, Constitutional Provision of 73 & 74 constitutional Amendment Act and Important features of 73 & 74 Constitutional Amendment Act

Unit No. 3

Good Governance : Concept, meaning, Government & Good Governance, , Good Governance and India, Nature of G.G. in India, Attributes of Poor Goverance1 and Steps taken for Good Governance in India.

Teaching Schedule (Theory)

Unit No.	Topic	Weightage %
1	Democracy – Introduction meaning, classification	4
2	Principles of Democracy, Dimensions of democracy	6
3	Democracy and Diversity Decentralization : concept, features,	6
4	Fundamental Rights in the Indian Constitution	10
5	Outcomes of Democracy, Challenges of Democracy	5
6	Independent Election Commission in India powers of election commission in India	8
7	Elections to local self-Government Bodies, National level, State Level	8
8	Institutions at the local level Municipal Cooperation, Municipal Council Nagar Panchayat	8
9 & 10	Zilla Parishad, Panchayat Samiti, Gram Panchayat : powers duties	10
11	Constitutional Provision of 73 & 74 constitutional Amendment Act	5
12	Important features of 73 & 74, Constitutional Amendment Act	5
13	Good Governance : Concept, meaning	5
14	Government & Good Governance, , Good Governance and India, Nature of G.G. in India	5
15	Attributes of Poor Goverance1	5
16	Steps taken for Good Governance in India	10
	Total	**100**

Suggested Readings:

Development and Democrasy in India by Shailendra D Dharma, Publication : Publisher: Lynne

Rienner, Boulder. Year: 2002

The Constitution of India, by P. M. Bakshi. Publication: Universal Law Publishing. Edn.: 14th, Year :2017

DETAILED SYLLABUS

VI. DEPARTMENT OF FOOD PLANT OPERATIONS

Sr. No.	Course No.	Course title	Credits	Semester
1	FPO-231	Student READY – Industrial Tour (I)	1 (0+1)	III
2	FPO-352	Student READY – Industrial Tour (II)	1 (0+1)	V
3	FPO-473	Student READY – Experiential Learning Programme – I	7 (0+7)	VII
4	FPO-474	Student READY – Experiential Learning Programme – II	7 (0+7)	VII
5	FPO-475	Student READY – Research Project	3 (0+3)	VII
6	FPO-476	Student READY – Seminar	1 (0+1)	VII
7	FPO-487	Student READY – Inplant Training	20 (0+20)	VIII
		Total Credits	**40 (0+40)**	

Student READY
(Rural and Entrepreneurship Awareness Development Yojana)

About Student READY

The Student READY (Rural Entrepreneurship Awareness Development Yojana) programme aims to provide rural entrepreneurship awareness, practical experience in real-life situation in rural agriculture and creating awareness to undergraduate students about practical agriculture and allied sciences. The programme will help in building confidence, skill and acquire Indigenous Technical Knowledge (ITK) of the locality and thereby, preparing the pass-out for self-employment. It also aims to provide opportunities to acquire hands-on-experience and entrepreneurial skills. To reorient graduates of agriculture and allied subjects for ensuring and assuring employability and develop entrepreneurs for emerging knowledge intensive agriculture, it was felt necessary to introduce this program in all the AU's as an essential prerequisite for the award of degree to ensure hands on experience and practical training.

In compliance with the student READY programme launched by the Hon'ble Prime Minister of India on 25th July 2015, the following components are proposed for conducting one year programme in all the UG disciplines.

- Experience Learning
- Rural Agriculture Work Experience
- In-plant Training/ Industrial Attachment
- Hands-on Training (HOT) / Skill Development Training
- Students Projects

All the above mentioned components are interactive and are conceptualized for building skills in project development and execution, decision-making, individual and team coordination, approach to problem solving, accounting, quality control, marketing and resolving conflicts, etc. with the end to end approach.

Student READY: Concept

The term READY refers to "Rural and Entrepreneurship Awareness Development Yojana" and the programme was conceptualized to reorient graduates of Agriculture and allied subjects for ensuring and assuring employability and develop entrepreneurs for emerging knowledge intensive agriculture. The proposal envisages the introduction of the programme in

all the Agricultural Universities as an essential prerequisite for the award of degree to ensure hands on experience and practical training by adopting the following components depending on the requirement of respective discipline and local demands.

Student READY for Food Technology

Food Technology is one of the rising stream of agriculture where more emphasis is required to cater the need of entrepreneurs and industries around the nation and abroad. Considering the dynamism of Food Technology, following Student READY programmes are adopted.

- Experiential Learning Programme
- Research Projects
- Inplant Training

The details of Students READY programmes for Food Technology and their credit distribution is as follows:

FPO-231 STUDENT READY – INDUSTRIAL TOUR (I) 1 (0+1)
FPO-352 STUDENT READY – INDUSTRIAL TOUR (II) 1 (0+1)

Student READY – Industrial Tour should be compulsorily carried out by college for 1 to 2 weeks. The Industrial Tour should be planned by the Institute to make students acquaint with different sectors of Food Processing Industries (viz. Bakery, fruits and vegetables, snacks, meat processing, etc). The formal one days training should be arranged by college for students to teach them what to look for during the Industrial Tour. The students should be shared with the details of industries being visited to and given an assignment to collect the basic details of the types of products and technicalities related to it.

Formats for Study Tour or Educational Tour Report and For Its Evaluation

1. Name of the student :
2. Reg. No :
3. Name of the Tour :
4. Tour In-charge Professors:
5. Period of Tour :
6. Industries/ Institutes visited :

Place	Date and Time	Industries/ Institutes/ Organizations	Learning outcome

Evaluation shall be done by 3 members consisting Head and 2 staff members accompanying Tour Programme. Students should be assigned marks for Industrial Tour based on following Criteria:

Sr. No.	Topics	% Marks covered
1	Tour Diary Evaluation	30
2	Technical knowledge related to products	20
3	Questions asked by students during the Tour	10
4	Answers given by students during the Tour	10
5	Manners, Antiquate and Personality of students maintained during Tour	10
6	Presentation of Tour Report with Pictures in PPT	20
	Total	**100**

FPO-473	**Student READY – Experiential Learning Programme - I**	**0 (0+7)**
FPO-474	**Student READY – Experiential Learning Programme - II**	**0 (0+7)**

In this revised syllabus, more emphasis on experiential learning has been laid. This is a major structural change undertaken for bringing professionalism and practical work experience in real life situations to graduates. These programmes will build confidence, facilitate skill development through experiential learning and facilitate in producing job providers rather than job seekers. Modification in course curriculum necessitates change in methodology in teaching and learning and development of facilities like food processing facilities, ELP unit, etc.

It is further suggested that all colleges should have Experiential Learning Units and in case these units are lying useless, outsourcing of these units could be a good option to generate money from them throughout the year.

About Experiential Learning (EL)

The word 'experiential' essentially means that learning and development are achieved through personally determined experience and involvement, rather than on received teaching or training, typically in group, by observation, study of theory or hypothesis, bring in innovation or transfer of skills or knowledge. Experiential learning is a business curriculum-related endeavour which is interactive. EL is for building (or reinforcing) skills in project development and execution, decision-making, individual and team coordination, approach to problem solving, accounting, marketing and resolving conflicts, etc. The programme has end to end approach. Carefully calibrated activities help the participants to explore and discover their own potential and both activities and facilitation play a critical role in enhancing team performance.

Experiential Learning (EL) helps the student to develop competence, capability, capacity building, acquiring skills, expertise, and confidence to start their own enterprise and turn job creators instead of job seekers. This is a step forward for "Earn while Learn" concept. Experiential Learning is an important module for high quality professional competence and practical work experience in real life situation to Graduates. The module with entrepreneurial orientation of production and production to consumption pattern is expected to facilitates producing Job Providers rather than Job Seekers.

The EL provides the students an excellent opportunity to develop analytical and entrepreneurial skills, and knowledge through meaningful hands on experience, confidence in their ability to design and execute project work. The main objectives of EL are:

- To promote professional skills and knowledge through meaningful hands on experience
- To build confidence and to work in project mode
- To acquire enterprise management capabilities
- Objectives
- To promote employment opportunities and entrepreneurship developmental skills in the field of agriculture science through integration of basic knowledge and conceptual aspects with experiential learning in specialized field of use of value added technology, devices & system.
- To generate trained skill man power for self-employment and entrepreneurship development.
- To earn through value addition technologies available locally through integration of integrated farming, food safety, agriculture market and good agriculture practices.
- To explore wider opportunities an integration of different agriculture on farm practices & devices for revenue generation.
- To integrate education with enterprenenship for employment generation so that Agriculture students may become job providers rather than job seekers.

Activities Envisaged

- To conduct hands-on training and entrepreneurship skills among outgoing UG students interested in the field of Agriculture & allied branches.
- To conduct special training in frontier areas of Agriculture for undergraduate degree students for establishing an enterprise and its management.
- To explore possibility of expanding scope/ federating students into business group and for industrial sectors.

This would impart skills among students in preparation of project feasibility and implementation reports for establishment of production units, procurement of raw materials, production of value added product enriched manure, production of briquettes from loose

biomass, production of agricultural products under greenhouse, packaging and storage of value added products, conduct manufacturing and production techniques, organize resources and utilities, sale of product, quality control, instrumentation for taking care of practical exercise, proper methods and procedures for maintenance of records including inventory of materials, maintenance of accounts, management of the enterprise and learning distribution techniques and marketing. Students will trained in:

- Pre-investment and pre-feasibility study
- New project identification
- Project feasibility and market study
- Identification of profitable industrial project opportunities
- Preparation of project profiles
- Preparation of techno-economics feasibility reports
- Identification and selection of plant and machinery
- Manufacturing process and equipments required
- General guidance for establishment, repair and maintenance of renewable energy gudgets
- Technical and commercial counselling
- Investment decision making
- Corporate diversification planning
- Forecasting financial aspects by estimating the cost of raw material, formulating the cash flow statement, projecting the balance sheet etc.
- Marketing and distribution of processed products.
- Federating into business group

ELP OF FOOD TECHNOLOGY

There should be cross-listed common ELP module as detailed below, out of which the student should choose one module each for EPL – I (FPO – 473) and ELP – II (FPO – 474).

ELP Modules

1. Drying and Dehydrations of fruits and vegetables
2. Fruits and Vegetable Products
3. Beverages and other Innovative Products
4. Spice Products
5. Postharvest management and marketing of Fresh Fruits and Vegetables
6. Egg, Poultry and Meat Processing
7. Bakery Products
8. Grain based Products (Cereal, Legumes/pulses and oilseeds)
9. Chocolate, Confectionary and Snack Products
10. Traditional, Heritage Food Products
11. Milk and Milk products
12. Processing of Fish and Fish Products
13. Functional Foods and Nutraceuticals

Distribution of credits and Activities for Experiential Learning Programme (I & II)

Sr. No.	Topics	Credits
1	**Capacity Building** *Preparation of Business Plan* i) Market Survey of food products ii) Product Planning iii) Innovativeness & Creativity v) Presentation of project concept note/ product plan	1
2	**Skill Development** *Production Management* i) Organization of resource and utilities ii) Regularity in production & Adhering to Plan iii) Positioning of product in market	1
3	**Skill Development** *Product Quality Control and Evaluation* i) Food Safety Plan for product (HACCP) ii) Parameters for Quality Control iii) Evaluation of Product Uniformity and Quality	1
4	**Skill Development** *Sales and Marketing* i) Marketing Strategy (type of consumer, product costing, etc) ii) Preparation of Marketing Material (Brochure containing product information, etc) iii) Sales volumes iii) Profit generated including C/B ratio andPay back period, etc.	0.5
5	**Documentation and reports** i) Record keeping (for Raw material) ii) Financial records related to product iii) Preparation of product manual	0.5
6	**Techno-economic Feasibility Report:** ProjectReport should be prepared based on ELP experience of students formicro/small/medium scale industry level.	2
7	**Evaluation** i) presentation of report ii) oral performance	1
	Total credits	**07**

Evaluation of ELP I & II projects should be carried out by Committee consisting at least three Academic members nominated by university.

Sharing of Total Profit Generated

- 50% of the profit will be distributed among concerned students
- Faculty share will be 10% of the profit; faculty includes teaching and non-teaching staff responsible for conducting of ELP
- University will get 20% of the profit and which will be included in the central training fund of the university.
- Associate staff including ministerial staff and Class IV will share the 10% of the profit
- Remaining 10% of the profit will be utilized for the development of facilities by head of the institution.

FPO-475 STUDENT READY – RESEARCH PROJECT 3 (0+3)

General Information

Student Project aims to motivate/encourage and to provide opportunity to the Under-Graduate Students of Agricultural Universities to take up challenges in identification and/or in solution of the problem of the surrounding society related to Agricultural and Allied Sciences and work for better utilization of resources. The participant students shall be able to carry out a project on a topic in relation to a problem of the region. The project should be innovative and activity based, so that the students may develop their ability to solve a societal problem experienced locally using their skill and knowledge. The project will help in creative thinking, observation, ability to raise pertinent questions and predicting solution. This also helps the students how to make field work, to write a scientific report and to present the work.

A Good Project should have:

i) Originality, Innovation and creativity and should commensurate with understanding the problem and finding solution.
ii) Relevance of the project to the community and impact of the project on society.
iii) Proper understanding of the subject, quality and quantity of the work and efforts to validate the data collected.

Food Technology is a dynamic field which require continuous research and innovation in product. With this intention Research Project is included is course curriculum to promote the students towards research and innovation in the field. Research Project should be allotted to students based on their/Guide's interest towards the ELP project. The Research Project is not supposed to be a formal dissertation, rather it should be objective based to make minor changes in existing products or product innovation based on consumer demand and market needs. Formal Training should be given to students to make them acquaint with basic research skills and writing skills.

During Research Project, student shall learn to collect the necessary research data and facts related to product and process and plan the product trials accordingly.

Research Project should be correlated with the ELP products which students are supposed to make during the student READY – Experiential learning Programme (I & II).

Project Report

The structure of the project report shall be in the format is as follows:

i) The Cover Page - It should have

- Title of the project
- Name and address of Group Leader and team members
- Name and address of Supervisor/Guide teacher

ii) Abstract - 500 words

iii) Contents

iv) Introduction- Description on background of the study

v) Aims and Objectives

vi) Relevance of the project work

vii) Methodology

viii) Observations: This shall include the observations during the experiment. Observation can be both qualitative as well as quantitative.

ix) Data analysis and interpretation: The data generated/ obtained from the experiments/observations should be processed for better understanding in a more structured manner. Tools and methods (e.g. statistical methods) may be used for analysing data to understand the patterns that emerges from it to form results and conclusions.

x) Results: Results are the output of compilation of the data into meaningful outcomes/ interpretations and sometimes, there is a need to redo the experiments to get consistent results. In case it is not possible to "repeat the experiments", there should be adequate replicates so that adequate data is available for interpretation, and arriving at results.

xi) Conclusions: This is the logical end of the project to arrive at specific conclusions from the observed phenomena. In a way, the whole objective of the project is to arrive at some conclusion, either positive or negative which would lead to a better understanding of the problem.

xii) Acknowledgement

xiii) References

Evaluation Criteria

The evaluation of Research Project should be done by Guide and Team nominated by Associate Dean & Principal/University. The mark distribution in Research Project should be as follows:

Sr. No.	Particulars	Marks
1	Originality of Idea and Concept	10
2	Relevance of the project to the theme/problem	10
3	Data collection and analysis	10
4	Research Plan and Methodology	30
5	Experimentation/ execution of research work	50
6	Research Report Writing	20
7	Oral Presentation	20
	Total	**150**

FPO-476 STUDENT READY – SEMINAR 1(0+1)

Seminar on Technical Topic of Food Technology shall be delivered by individual student. The Seminar topic shall be decided by respective Guide/Advisor. Students will be responsible for collection of necessary information, preparation of synopsis and Power Point Presentation and discussion by each student allotted topic. The evaluation of Seminar shall be done by Team of Academic members (at least 3) nominated by Associate Dean & Principal/University.

Evaluation Criteria

Sr. No.	Particulars	Marks
1	Understanding of Topic and Preparation of Script	10
2	Data and Facts collection	10
3	Presentation (Use of Audio Visual Aid)	10
4	Presentation Skills	10
5	Response of student towards questions raised by Audience/Team	10
	Total	**50**

FPO-487 Student READY –INPLANT TRAINING 20 (0+20)

Technology and globalization are ushering an era of unprecedented change. To augment this, the need and pressure for change and innovation is inevitable. In this training, students will exposure to different departments and activities of the industry and submit the reports to the university. Such in-plant trainings will provide an industrial exposure to the students as well as to develop their career in the high tech industrial requirements. In-Plant training is meant to correlate theory and actual practices in the industries. It is expected that sense of running an industry may be articulated in a right way through this type of industrial attachment mode. To enrich the practical knowledge of the students, In-plant Training shall be mandatory in the last semester for a period of up to 14 weeks. In-plant trainings will provide an industrial exposure to the students as well as to develop their career in the high tech industrial requirements. In-plant training is meant to correlate theory and actual practices in the industries with the following objectives:

- To expose the students to Industrial environment, which cannot be simulated in the university
- To familiarize the students with various Materials, Machines, Processes, Products and their applications along with relevant aspects of shop management
- To make the students understand the psychology of the workers, and approach to problems along with the practices following at factory
- To make the students understand the scope, functions and job responsibility-ties in various department of an organization
- Exposure to various aspects of entrepreneurship during the programme period

Inplant Training Procedure

Inplant Training should be arranged in VIII Semester of Degree programme. Inplant Training Cell of the College should be established to coordinate and monitor the Inplant Training Programme. Inplant Training Cell should be collaborated with Training and Placement Cell of the College. A student shall be sent to various Food Industries approved by Academic Council of University.

Generalized lay-out

Sr. No.	Activities	Number of weeks
1	General orientation and on-campus training by faculty. Finalisation of industry for attachment	02
2	In-plant training : Industry attachment	14
3	Project Report Preparation, Presentation and Evaluation	04
	Total credits	20

Activities and Tasks during 'Student READY In-plant training programme'

1	Acquaintance with industry and staff
2	Study of structure, functioning, objective and mandates of the industry
3	Ethics of industry
4	Activities in different departments of industries
5	Skill development in all crucial tasks of the industry
6	Documentation of the activities and task performed by the students
7	Performance evaluation
8	Learning outcome from the Inplant Training

Evaluation Criteria

The evaluation of students should be done both at Industry Level (10 Credits) and at College/ University level (10 Credits), as follows:

Sr. No.	Particulars	Credits
1	At Industry Level	10
2	At College Level	10

***