



# SRM

UNIVERSITY

(Under section 3 of UGC Act 1956)

**M.Tech. (Full Time) - Food & Nutritional Biotechnology  
Curriculum & Syllabus  
2015 – 2016**

**FACULTY OF ENGINEERING AND TECHNOLOGY  
SRM UNIVERSITY  
SRM NAGAR, KATTANKULATHUR – 603 203**

<b>SEMESTER I</b>					
<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
FP2001	Food Science and Nutrition	3	0	2	4
FP2002	Food Engineering	3	0	2	4
FP2003	Analytical Techniques in Food Processing	4	0	0	4
	Supportive course	3	0	0	3
CAC2001	Career Advancement Course For Engineers - I	1	0	1	1
	Program Elective I	3	0	0	3
	Program Elective II	3	0	0	3
<b>TOTAL</b>		<b>20</b>	<b>0</b>	<b>5</b>	<b>22</b>
<b>Total Contact Hours: 25</b>					
<b>SEMESTER II</b>					
FP2004	Post Harvest Technology of Fruits & Vegetables	3	0	2	4
FP2005	Applied Biotechnology	3	2	0	4
FP2006	Food Safety & Quality Management	3	2	0	4
CAC2002	Career Advancement Course For Engineers - II	1	0	1	1
	Interdisciplinary Elective	3	0	0	3
	Program Elective III	3	0	0	3
	Program Elective IV	3	0	0	3
<b>TOTAL</b>		<b>19</b>	<b>4</b>	<b>3</b>	<b>22</b>
<b>Total Contact Hours: 26</b>					
<b>SEMESTER III</b>					
	Program Elective V	3	0	0	3
	Program Elective VI	3	0	0	3
FP2048	Industrial Training	0	0	1	1
FP2049	Project work Phase I	0	0	12	6
CAC2003	Career Advancement Course For Engineers - III	1	0	1	1
<b>TOTAL</b>		<b>10</b>	<b>0</b>	<b>7</b>	<b>14</b>
<b>Total Contact Hours: 17</b>					
<b>SEMESTER IV</b>					
FP2050	Project work Phase II	0	0	32	16

**Total credits to be earned for the award of M.Tech degree – 74**

## PROGRAM ELECTIVES

Course Code	Name of the Course	L	T	P	C
FP2101	Advanced Techniques in Food Preservation	3	0	0	3
FP2102	Food Microbiology and Fermentation technology	3	0	0	3
FP2103	Biochemistry of Processing & Preservation	3	0	0	3
FP2104	Food Industry Waste and By-product Utilization	3	0	0	3
FP2105	Meat, Poultry and fish processing Technology	3	0	0	3
FP2106	Advanced Dairy Process Biotechnology	3	0	0	3
FP2107	Crop Process Engineering	3	0	0	3
FP2108	Bakery & Confectionery Technology	3	0	0	3
FP2109	Handling, Packaging and Storage of Food Products	3	0	0	3
FP2110	Nutraceuticals and Functional Foods	3	0	0	3
FP2111	Genetically Modified Foods	3	0	0	3
FP2112	Food Processing Plant Design	3	0	0	3

## SUPPORTIVE COURSES

Course Code	Name of the course	L	T	P	C
CH2151	Optimization of Chemical Processes	3	0	0	3
CH2152	Advanced Heat and Mass Transfer	3	0	0	3
MC2133	Statistical Techniques	3	0	0	3

### LEGEND :

- L: Lecture Hours per week
- T: Tutorial Hours per week
- P: Practical Hours per week
- C: Credit

## SEMESTER I

FP2001	<b>FOOD SCIENCE AND NUTRITION</b>	L	T	P	C
	Total Contact Hours - 75	3	0	2	4
<b>PURPOSE</b>					
To emphasize the need for greater and more efficient utilization of the existing food sources and development of entirely new sources; to highlight need for attaining nutritional security.					
<b>INSTRUCTIONAL OBJECTIVES</b>					
1.	At the end of this course, the student will have an idea of food constituents, importance and their daily dietary allowances; scope and prospects for food industries.				

### **UNIT I - FOOD AS ENERGY (9 hours)**

Food as a source of energy. Food requirement in human body. Planning balanced diets to meet the requirements of different age groups. Recommended dietary allowances for Indians, comparison of Indian dietary allowances with that of FAO/WHO standards.

### **UNIT II - FOOD COMPOSITION (9 hours)**

Chemical composition of cereals, pulses (grams and dhal) and oil seeds – effect of processing on the nutritional value of food grains (cereals and pulses).

### **UNIT III - FOOD AND HEALTH (9 hours)**

Therapeutic diets – A brief account. Nutritional significance of carbohydrates, proteins, lipids,-chemistry –dietary source and functional properties. Digestion, metabolism and absorption of protein, fat carbohydrates. Functions of protein, fat and carbohydrates. Dietary requirements

### **UNIT IV - VITAMINS AND MINERALS (9 hours)**

Summary of vitamin stability – toxicity and sources of vitamins – bioavailability of vitamins – reasons for losses of vitamins in foods. Role of these constituents in food industry. Mineral in food and its stability status

### **UNIT V - ANTI NUTRITIONAL FACTORS IN FOOD (9 hours)**

Naturally occurring food toxicants in foods– protease inhibitors, haemagglutinins, goitrogens, lathyrogens, toxic amino acids and naturally occurring carcinogens

## **REFERENCES**

1. Sunetra Roday. *"Food science and nutrition"*. Oxford university Press. 2007.
2. Swaminathan, M. (Latest Edition). *"Hand Book of food and Nutrition"*. The Bangalore Printing and Publishing co. Ltd. Bangalore
3. Shakuntala Manay and Shadasharasamy *"Foods; Facts and principles"*, New Age international Publishers, New Delhi. , 1997.

**PRACTICAL (30 hours)**

**LIST OF EXPERIMENTS**

1. Experiments on Proximate Analysis of Food materials
2. Experiment on Total Phenol Content Of Food Material
3. Experiments on Quality degradation Kinetics.
4. Experiments on Energy Chart Preparation.
5. Experiments on Balanced Meal Designing.

**REFERENCE**

1. Food Science & Nutrition Lab manual, Department of Food Process Engineering, SRM University

FP2002	FOOD ENGINEERING			
	L	T	P	C
Total Contact Hours - 75	3	0	2	4
<b>PURPOSE</b>				
To Emphasis the various properties of the raw material used in food processing, different processing technologies required in transforming them into quality food products and material handling equipment involved in food processing operations.				
<b>INSTRUCTIONAL OBJECTIVES</b>				
1.	Properties of food material			
2.	Drying technology for food products			
3.	Various processing technologies			
4.	Selection and design of handling equipment			
5.	Properties of food material			

**UNIT I – ENGINEERING PROPERTIES**

**(9 hours)**

Physical properties, Thermal properties, frictional properties, Mechanical properties, rheological properties, aero and hydro dynamic properties. Electrical properties, optical properties

## **UNIT II – CONSERVATION OF MASS AND ENERGY (9hours)**

Energy conservation – material and energy balance- problems.

## **UNIT III - NON CONVERSION AND CONVERSION OPERATIONS (9 hours)**

Cleaning of raw materials - cleaning methods, Sorting and grading of foods - weight, size, shape. peeling- methods. Size reduction and screening of solid foods- theory, equipment, size reduction of liquid foods- problems on energy requirement. Filtration and membrane separation - principles, design features and general applications. Centrifugation - principles and applications. Solid-liquid extraction and expression

## **UNIT IV - PRESERVATION OPERATIONS (9 hours)**

Evaporation-principle, methods of operation and equipments, Drying- Moisture content- methods of determination -drying mechanism-constant rate and falling rate period, spray drying- freeze drying-foam mat drying, osmotic dehydration, pasteurization, sterilization, canning

## **UNIT V - LOW TEMPERATURE PRESERVATION (9 hours)**

Refrigeration-chilling-Freezing-theory, equipments, freezing time calculation, freeze drying- freeze concentration.

## **REFERENCES**

1. Sahay, K.M. and K.K. Singh, *"Unit Operations in Agricultural Processing"*. Vikas Publishing House Pvt. Ltd., New Delhi, 2003.
2. McCabe,W.I. and Smith, J.C.*"Unit Operations of Chemical Engineering"*. McGraw - Hill Book Co. New York, 2002.
3. Chakraverty A.and D.S.De.*"Post-harvest technology of cereals and pulses"*. Oxford & IBH Publishing Co., New Delhi, 1988.
4. Mohesenin. N.N, *"Physical properties of Plant and Animal Materials"*. Gordon and Breach Science Publishers, New York, 1985.
5. P.Fellows, *"Food Processing Technology. Principles and practice"*, Ellis Horwood International publishers, Chichester, England, 2005.
6. Earle R.L. *"Unit operations in Food Processing"*, Pergamon Press. 2000.
7. R.Paul singh, *"Introduction to Food Engineering"*. Academic press, California, USA, 2001 .

## **PRACTICAL (30 hours)**

## LIST OF EXPERIMENTS

1. Experiments on Engineering Properties of Food
2. Experiments on Handling of food Material
3. Experiments on Freezing & Thawing of foods.
4. Experiments on Canning
5. Experiments on Sterilization of Foods

## REFERENCE

1. Unit operations and "*Food Process Engineering*" Lab manual, Department of Food Process Engineering, SRM University

FP2003	ANALYTICAL TECHNIQUES IN FOOD PROCESSING	L	T	P	C
	Total Contact Hours - 60		4	0	0
<b>PURPOSE</b>					
To study various food analysis techniques and to get the knowledge of UV-Visible spectrometry, infra red & mass spectra, x-ray, polarimetry, refractometry, conductometry & thermal studies, chromatographic techniques and to understand the quality control methods and systems.					
<b>INSTRUCTIONAL OBJECTIVES</b>					
1.	To be familiar with different methods of investigation used in the analysis of foods				
2.	To gain knowledge about different instruments used in food analysis.				
3.	To know the principles and applications of different techniques used in food and Nutrition research.				

### UNIT I - UV-VISIBLE SPECTROMETRY (11 hours)

Visible spectrometry and Colorimetry – Theory, Deviations from Beer's Law, Instrumentation (Line diagram alone) and application. Ultra violet spectroscopy – Theory, instrumentation and application. NMR spectroscopy – Quantum description, Instrumentation, Chemical shift, applications and limitations.

### UNIT II - INFRA RED AND MASS SPECTRA (11 hours)

Infra red spectroscopy – Theory, Fundamental Vibrations, Overtones, Hook's Law. Instrumentation, Single and Double beam spectrometers, Application and Limitations, Difference between Raman spectra and IR spectra. Mass spectroscopy – Theory, Spectrometers, Interpretation, some examples, applications and limitations

### UNIT III - X-RAY, POLARIMETRY, REFRACTOMETRY (12 hours)

X-ray diffraction – Mosely's law, K and R bands, Principle, instrumentation, various types of detectors and applications in food products. Flame photometer, auto

analyser. Polarimetry and Refractometry – Introduction on specific rotation, optical activity; Principle and instrumentation- Saccharimetry- Analysis of Sugar.

**UNIT IV - CONDUCTOMETRY & THERMAL STUDIES (12 hours)**

Conductometric measurements – Important Laws, Definitions, conductance measurements, applications, Types, advantages and disadvantages of Conductometric titrations. Potential measurements, pH, pO<sub>2</sub>, pCO<sub>2</sub>, pHCO<sub>3</sub>, pH determination, Electrophoresis, Ion selective electrodes, Application of pH measurements. Types of potentiometric titration's and advantages. Thermal methods – Thermogravimetry, Differential Thermal Analysis, Differential Scanning Calorimetry-applications

**UNIT V - CHROMATOGRAPHIC AND OTHER ADVANCED ANALYTICAL TECHNIQUES (14 hours)**

Chromatographic techniques – Introduction and classification. Theory, Instrumentation and Chromatography-different types, their principles and applications. Extraction, separation and identification, water and oil soluble dyes. Detection and estimation of additives in food materials net as, boric acid, benzoates, sulphites, formaldehyde, formic acid, lactic acid, saccharine, etc. Analysis of food stuffs: with reference to the standards of quality. Texture analysis. Colour analysis, SEM. TEM

**REFERENCES**

1. Chatwal, Gurdeep R and Anand, Sham K, *"Instrumentation Methods of Chemical Analysis"*, Himalaya Publications, Bombay, 2003.
2. Willard, H.H., Merritt, L.L., Dean, J.A., and Settle, F.A., *"Instrumental Methods of Analysis, Seventh Edition"*: C B S Publishers & Distributors, Delhi, 1988.
3. Skoog Douglas A., West, Donald M., Holler, F. James., and Crouch Stanley R. *"Analytical Chemistry: An Introduction"*. Seventh Edition,: South-Western, Australia, 2000.
4. Rouessac, F., *"Chemical Analysis: Modern International Method and Techniques"*, Wiley, New Delhi, 1999.

**SEMESTER II**

FP2004	POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES	L	T	P	C
	Total Contact Hours - 75	3	0	2	4
PURPOSE					



This course aims in providing knowledge about the fruit and vegetable structure, post harvest physiology and its spoilage.

#### **INSTRUCTIONAL OBJECTIVES**

1.	To Understand the concepts of physiological characteristics of fruits and vegetables.
2.	To Provide an insight about fruit losses during storage and ways to prevent it.
3.	To Gain knowledge about spoilage of fruit and vegetable.

#### **UNIT I - INTRODUCTION (9 hours)**

Fruit and vegetable production; classification of fruit and vegetables; Structure and cellular components; Importance of post harvest physiology

#### **UNIT II - MATURITY OF FRUITS AND VEGETABLES (9 hours)**

Stages of growth; Maturity criteria; Maturity indices- computational, physical, chemical and physiological methods; Fruit ripening- changes during ripening

#### **UNIT III - POST HARVEST LOSSES (9 hours)**

Post harvest losses-Mechanical injury-types; Technologies to control post harvest losses; Respiration and transpiration loss; methods to measure respiration and transpiration losses; Spoilage of fruit and vegetable; Enzymatic browning and its control

#### **UNIT IV - EQUIPMENTS FOR POST HARVEST HANDLING (9 hours)**

Post harvest handling and transportation; grading and sorting methods and equipment; washing, blanching, peeling and other preparatory operations; storage of fruit and vegetable-methods of storage; Ethylene evolution during storage.

#### **UNIT V - PROCESSING CONCEPTS FOR FRUITS AND VEGETABLES (9 hours)**

Minimal processing concept; Processing methods and equipment for fruit and vegetable products.

## REFERENCES

1. L.R. Verma and V.K. Joshi, "Post Harvest Technology of Fruits and vegetables". Volume 1 and 2. Indus Publishing Company, New Delhi. 2006.
2. R. B. H. Wills, W.B. McGlasson, D. Graham, T. H. Lee and E.G. Hall. "Post Harvest . An Introduction to physiology and Handling of Fruits and Vegetables". CBS Publishers and distributors, New Delhi. 1996.
3. Mircea Enachescu Dauthy, 1995. "Fruit and Vegetable Processing" FAO Agricultural Services Bulletin No.119.
4. Pantastico, E.C.B. "Postharvest physiology, handling and utilization of tropical and subtropical fruits and vegetables". AVI Pub. Co, New Delhi. 1975.
5. "Hand book of Food dehydration and drying" by NIIR board
6. Dr. P.H. Pandey, "Post Harvest Technology of Fruits and Vegetables (Principles and practices)". CBS Publishers, New Delhi. 2006.

## PRACTICAL (30 hours)

### LIST OF EXPERIMENTS

1. Experiments on Pretreatments & Quality Evaluation of fruits and vegetables
2. Experiment on drying kinetics of fruits and vegetables
3. Experiment on Fruit Preservation Technology & Its Quality evaluation
4. Study the osmotic dehydration process for fruits and vegetables
5. Study on the enzymatic browning and control of fruits and vegetables
6. Experiment on Sensory Analysis of products.

### REFERENCE

1. "Post Harvest Technology of Fruit and Vegetables lab manual", Department of Food Process Engineering, SRM University

FP2005	APPLIED BIOTECHNOLOGY	L	T	P	C
	Total Contact Hours - 75	3	2	0	4
<b>PURPOSE</b>					
This course enables the students to understand application of biotechnology in Food processing industries.					
<b>INSTRUCTIONAL OBJECTIVES</b>					
1.	To List out the commercially important enzyme used in food industries				
2.	To Know the techniques involved in the production of enzymes				
3.	To Concept of bio process engineering				
4.	To Understand downstream processing concepts				

**UNIT I - FUNDAMENTALS OF FOOD BIOTECHNOLOGY (15 hours)**

Introduction -Biotechnology relating to the food industry – role of bio process engineering in biotechnology industry. Regulatory and Social aspects of biotechnology in foods.

**UNIT II - INDUSTRIAL PRODUCTION OF FOOD PRODUCTS (15 hours)**

Technological aspects of industrial production of beer and wine, bakers yeast, vitamins, single cell protein, food flavor – food color – food enzymes

**UNIT III - FERMENTED FOODS (15 hours)**

Scope and development, benefits of fermentation, sauerkrauts, yoghurt, shrikhand, cheese, idli, miso, sausages

**UNIT IV - FOOD BORNE DISEASE (15 hours)**

Introduction- food borne illness, classification-food intoxication-food infection-symptoms-sources-incubation period-outbreaks

**UNIT V - BIOSENSORS (15 hours)**

Food products as analytical samples, general aspects of biosensors and their potential applications- Biosensors for food component analysis, biosensors for food contaminant analysis, commercially available biosensors for food analysis.

**REFERENCES**

1. Board R.B. Jones.D. *"Microbial Fermentation Beverages, Foods and Feeds"*. 1995.
2. Sarah Elderidge. *"Food Biotechnology; Current issues and perspectives"*. Nova science pub. Inc. 2003.
3. Stanbury, P.F., Allan Whitaker and S.J. Hall. *"Principles of Fermentation Technology"* Aditya books private Ltd., New Delhi. 1997.
4. Matz, *"Bakery Technology and Engineering"*, Elsevier, Tokyo. 2002.
5. Manfie, *"Chocolate, Cocoa and Confectionery Science & Technology"*, (3<sup>rd</sup> edition) Advance Books, Jaipur. 2002.
6. Gustavo F. Gutierre. *"Food science and food biotechnology"*. GRC Pub. 2003.
7. Brian J. Ford. *"Future of Food"*. WW Norton and Co. Inc. 2000.
8. Roger A., Gorden B., and John ., *" Food biotechnology"*, 1989

FP2006	<b>FOOD SAFETY &amp; QUALITY MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	Total Contact Hours - 75	<b>3</b>	<b>2</b>	<b>0</b>	<b>4</b>

<b>PURPOSE</b>	
This course aims to impart the knowledge of food safety issues, surveillance and monitoring techniques, Food Labeling as well as sanitation and food allergy.	
<b>INSTRUCTIONAL OBJECTIVES</b>	
1.	To know the principles of Food Safety & Quality
2.	To Apply preventive measures and control methods to minimize the hazards
3.	To know the requirements of FSSAI.
4.	To Learn the principles of HACCP and to develop procedures and approaches to identify food safety hazards in food processing
5.	To gain the knowledge about the Food Labeling and sanitation of food industries.

#### **UNIT I - PRINCIPLES OF FOOD SAFETY & FOOD QUALITY (12 hours)**

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

#### **UNIT II - FOOD ADDITIVES & ADULTERANTS (13 hours)**

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

#### **UNIT III - FOOD SAFETY STANDARDS & FSSAI (17 hours)**

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

#### **UNIT IV - HAZARD ANALYSIS – HACCP (17 hours)**

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

#### **UNIT V FOOD LABELING & SANITATION IN FOOD INDUSTRIES (16 hours)**

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

## REFERENCES

1. Krammer, A. and Twigg, B.A. "*Quality control for the food industry*". Third Ed., AVI.Westport. 1970.
2. Inteaz Alli, "*Food Quality assurance-Principles and Practices*", CRC Press, 2004.
3. Sara Mortimore and Carol Wallace, "*HACCP – A practical Approach*", Chapman & Hall, 2003.
4. Mehta R. and George J., "*Food Safety Regulation Concerns And Trade- The Developing Country Perspective*", Macmillan India Ltd., New Delhi. 2005.
5. Birch, G. and Campbell-Platt, G, "*Food Safety – the Challenge Ahead*", Van Nostrand Reinhold, New York. 1993.

## SEMESTER III

<b>INDUSTRIAL TRAINING</b> (Training to be undergone after II semester)		L	T	P	C
<b>FP2048</b>	3 week practical training in industry	0	0	1	1
	Prerequisite				
	Nil				
<b>PURPOSE</b>					
To provide practical exposure in Civil Engineering related organizations.					
<b>INSTRUCTIONAL OBJECTIVES</b>					
1.	Students have to undergo three – week practical training in Civil Engineering related organizations so that they become aware of the practical applications of theoretical concepts studied in the class rooms.				

Students have to undergo three-week practical training in Civil Engineering related organizations of their choice but with the approval of the department. At the end of the training student will submit a report as per the prescribed format to the department.

### Assessment process

This course is mandatory and a student has to pass the course to become eligible for the award of degree. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made. Marks will be awarded out of 100 and appropriate grades assigned as per the regulations.

		L	T	P	C
<b>FP2049</b> <b>FP2050</b>	<b>PROJECT WORK PHASE I (III semester)</b>	0	0	12	6
	<b>PROJECT WORK PHASE II (IV semester)</b>	0	0	32	16
<b>PURPOSE</b>					
To undertake research in an area related to the program of study					
<b>INSTRUCTIONAL OBJECTIVE</b>					
The student shall be capable of identifying a problem related to the program of study and carry out wholesome research on it leading to findings which will facilitate development of a new/improved product, process for the benefit of the society.					

M.Tech projects should be socially relevant and research oriented ones. Each student is expected to do an individual project. The project work is carried out in two phases – Phase I in III semester and Phase II in IV semester. Phase II of the project work shall be in continuation of Phase I only. At the completion of a project the student will submit a project report, which will be evaluated (end semester assessment) by duly

appointed examiner(s). This evaluation will be based on the project report and a viva voce examination on the project. The method of assessment for both Phase I and Phase II is shown in the following table:

<b>Assessment</b>	<b>Tool</b>	<b>Weightage</b>
In- semester	I review	10%
	II review	15%
	III review	35%
End semester	Final viva voce examination	40%

Student will be allowed to appear in the final viva voce examination only if he / she has submitted his / her project work in the form of paper for presentation / publication in a conference / journal and produced the proof of acknowledgement of receipt of paper from the organizers / publishers.

## PROGRAM ELECTIVES

FP2101	ADVANCED TECHNIQUES IN FOOD PRESERVATION	L	T	P	C
	Total Contact Hours - 45		3	0	0
<b>PURPOSE</b>					
To develop an appreciation of need and different emerging techniques used in food processing and preservation.					
<b>INSTRUCTIONAL OBJECTIVES</b>					
1.	The need of preserving food substances by emerging methods				
2.	Microbial safety of foods by emerging methods				

### **UNIT I - FOOD IRRADIATION (7hours)**

Irradiation- radiation sources - absorbed dose, regulations, advantage and limitations of food irradiation - nutritional and microbiological changes in irradiated foods.

### **UNIT II - HIGH PRESSURE PROCESSING OF FOODS (9 hours)**

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

### **UNIT III - PULSED ELECTRIC FIELD PROCESSING OF FOODS (9 hours)**

Principles – mechanism of action – PEF treatment systems – main processing parameters – PEF Technology – equipments – mechanism of microbial and enzyme inactivation- safety aspects– processing of liquid foods using PEF – process models – comparison of high pressure processing and PEF – enzymatic inactivation by PEF, Examples – microbiological and chemical safety of PEF foods, Oscillating magnetic field.

### **UNIT IV- OHMIC AND ULTRASOUND PROCESSING OF FOODS (10 hours)**

Principle of ultrasound – fundamentals – ultrasound as a processing and preservation aid – Effect on properties of foods- Basics of ohmic heating – electrical conductivity - generic configurations- treatment of products



**UNIT V - MINIMAL PROCESSING AND HURDLE TECHNOLOGY (10 hours)**

Minimal processing – factors affecting, fruits/vegetables/salad. basics of hurdle technology – mechanism application to foods - newer chemical and biochemical hurdles- organic acids – plant derived antimicrobials – antimicrobial enzymes – bacteriocins – chitin / chitosan (only one representative example for each group of chemical and biochemical hurdle)

**REFERENCES**

1. Da-wen Sun, *“Emerging Technologies for Food Processing”*, Elsevier Academic Press/Marcel Dekker Inc. NY,1995.
2. Leistner L. and Gould G. *“Hurdle Technologies – Combination treatments for food stability safety and quality”*, Kluwer Academics / Plenum Publishers, New York, 2002.
3. Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Soledad Tapia, M. Pilar Cano, *“Novel Food Processing Technologies”* (Food Science and Technology Series), Publisher: CRC Press, November, 2004.
4. Barbosa-Cánovas, G V, *“Pulsed electric fields in food processing: Fundamental aspects and applications”*- a volume in the Food Preservation Technology series, Edited by Washington State University and Q H Zhang, Ohio State University, USA, Woodhead Publishing Limited, Abington Hall, Abington, Cambridge, CB1 6AH, England, 2001.

FP2102	FOOD MICROBIOLOGY AND FERMENTATION TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45		3	0	0
<b>PURPOSE</b>					
To make the student to understand the causes of food spoilage, control and preventive measures for harmful micro organism. To study about the different value added products by fermentation technique and also study about food safety regulations.					
<b>INSTRUCTIONAL OBJECTIVES</b>					
1.	To list the major food spoilage microorganisms				
2.	To analyze methods used to control or destroy micro organism commonly found in food.				
3.	To understand the role of beneficial micro organisms in food processing and preservation				

**UNIT I -INTRODUCTION ABOUT FOOD MICROBIOLOGY (9 hours)**

History and development of food microorganisms, classification and Identification of Microorganisms - sources of microorganism in foods. Methods of isolation and purification – preparation of media – types of nutritional media – staining techniques – Simple, differential and structural staining – preservation of the microbial culture- primary sources of micro organisms in food.

**UNIT II - FACTORS AFFECTING MICROBIAL GROWTH IN FOOD (9 hours)**

Microbial growth characteristics, factor influencing microbial growth in food, microbial metabolism of food components, microbial sporulation and germination, microbial stress response in the food environment.

**UNIT III - FERMENTED FOOD AND FOOD BORNE DISEASE (9 hours)**

Food borne diseases – food infection and food intoxication – symptoms, causes and control- Micro organisms as food- single cell protein - Fermented food- pickles, sauerkraut- vinegar and lactic acid.

**UNIT IV - MEASURES TO CONTROL OF MICROBIAL GROWTH (9 hours)**

Control of microbial growth – physical, heat, low temperature, reduced water activity, low pH, organic acid, CAS, antimicrobial preservation, irradiation, combination methods. Homeostasis of microorganism, multi target preservation of foods, stress reactions and metabolic exhaustion.

**UNIT V - PRINCIPLES OF FOOD PLANT SANITATION (9 hours)**

Natural antimicrobials from microorganisms- Bacteriocin structure and function Application of bacteriocins in food systems. Basic principles of food plant sanitation- Hazard Analysis and Critical Control Point (HACCP) Program – Good manufacturing Practices(GMP's) and microbiological standards.

**REFERENCES**

1. James M. J., *“Modern Food Microbiology”*, CBS Publishers & Publishers, 1987.
2. George J. B., *“Basic Food Microbiology”*, CBS Publishers & Distributors, 1987.
3. Lidsay, willis, *“Biotechnology, Challenges for the flavour and food industries,”*, Elsevier
4. Applied Science, 1988.
5. Roger A., Gordan B., and John T., *“Food Biotechnology”*, 1989.

FP2103	BIOCHEMISTRY OF PROCESSING AND PRESERVATION	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
<b>PURPOSE</b>					

This course helps the students to apply basic food science knowledge and get to know biochemical changes occurring during various processing and preservation techniques

#### **INSTRUCTIONAL OBJECTIVES**

Upon completion of this course students should be able to understand

- |    |                                                                 |
|----|-----------------------------------------------------------------|
| 1. | The changes occurring during various food processing techniques |
| 2. | The changes during storage and preservation                     |
| 3. | The effect of enzymes on spoilage reactions of foods            |

#### **UNIT I – BIOCHEMICAL CHANGES DURING COOKING (9 hours)**

Cooking – methods, biochemical changes in carbohydrates, proteins and lipids during cooking; parboiling of rice; caramelization of sugars, enzymatic and non enzymatic browning reactions. Loss of nutrients and prevention of loss during cooking.

#### **UNIT II - ISOLATION AND PURIFICATION OF STARCH & PROTEIN (9 hours)**

Isolation and purification of starch; starch in food industry, pectins, gums as stabilizers in food industry. Modifications of starch. Sweeteners and sugars in foods-structure activity relationship. Isolation of proteins from soybean, milk and egg; protein hydrolysates, modification of proteins; storage and stability of proteins.

#### **UNIT III - CHEMISTRY OF PLANTATION CROPS (9 hours)**

Chemistry of Spices and Condiments, tea, coffee, cocoa, Aroma Compounds, essential oils, organic acids, oleoresin, alkaloids, tannins, flavanoids, anthocyanins, and enzyme inhibitors

#### **UNIT IV - CHANGES DURING PRESERVATION AND PROCESSING (9 hours)**

Food preservation – methods – Low and High temperature, Controlled and Modified atmospheric storage, Radiation. Biochemical changes during preservation. Biochemical changes during processing of foods-pickling, malting, drying, baking

## UNIT V BIOCHEMISTRY OF ANIMAL FOOD

(9 hours)

Biochemistry of processing meat and poultry. Chemistry and biochemistry of color in muscle foods. Biochemistry of sea food processing. Sea food enzymes. Biochemistry of fermented meat. Post-mortem changes in animal foods.

### REFERENCES

1. Krammer, A. and Twigg, B.A. *"Quality control for the food industry"*. Third Ed., AVI.Westport. 1970.
2. Inteaz Alli, *"Food Quality assurance-Principles and Practices"*, CRC Press, 2004.
3. Sara Mortimore and Carol Wallace, *"HACCP – A practical Approach"*, Chapman & Hall, 2003.
4. Mehta R. and George J., *"Food Safety Regulation Concerns And Trade-TheDeveloping Country Perspective"*, Macmillan India Ltd., New Delhi. 2005.
5. Birch, G. and Campbell-Platt, G, *"Food Safety — the Challenge Ahead"*, Van Nostrand Reinhold, New York. 1993.
6. David, S Robinson. *"Food Chemistry and nutritive value"*. Longman group, UK. 1997.
7. Desrosier, N.W. *"The Technology of Food Preservation"*, CBS Publishers and Distributors, New Delhi. 1996.
8. Y. H. Hui. *"Food Biochemistry and Food Processing"* Blackwell Publishing, 2006.
9. J. Scott Smith and Y.H. Hui, *"Food Processing: Principles and Applications"*, Blackwell Publishing, 2004.

FP2104	FOOD INDUSTRY WASTE AND BY-PRODUCT UTILIZATION	L	T	P	C
		Total Contact Hours - 45	3	0	0
<b>PURPOSE</b>					
To make the students in understanding about the sources and nature of wastes obtained from various food industries and the ways to convert it into valuable products.					
<b>INSTRUCTIONAL OBJECTIVES</b>					
1.	To be able to list the nature of the wastes obtained from different food processing industries				
2.	To Understand the properties of different food industry wastes				
3.	To able to recognize and communicate common processes which allow the different food processing waste to be converted into valuable products.				

## UNIT I - INTRODUCTION ABOUT FOOD INDUSTRY WASTE UTILIZATION

(9 hours)

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

**UNIT II - FRUIT INDUSTRY WASTE UTILIZATION (9 hours)**

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

**UNIT II - TUBER CROPS WASTE UTILIZATION (9 hours)**

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

**UNIT IV - FISH AND POULTRY WATER UTILIZATION (9 hours)**

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

**UNIT V - BY-PRODUCT UTILIZATION OF COCONUT WASTE (9 hours)**

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

**REFERENCES**

1. P. N. Chereminnoff & A.C Morresi, "Energy from Solid Wastes"1976,
2. Chakravarthy & De, "Agricultural Waste and By Product Utilisation".
3. Bor S. Luli (ed), "Rice Production and Utilisation"
4. E. Beagle, "Rice Husk Conversion to Energy".

FP2105	<b>MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY</b>	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
<b>PURPOSE</b>					
This course prepares the students for a position in the meat, poultry and fish					

processing industry	
<b>INSTRUCTIONAL OBJECTIVES</b>	
1.	To familiarize with the Advanced treatment of the concepts involved in the production, processing and acceptance of meat, poultry and fish
2.	To familiarize with the Products derived from meat, poultry and fish

### **UNIT I - SLAUGHTERING AND CUTTING (9 hours)**

Meat and poultry industries in India - kinds of meat animals and poultry birds – nutritive value of meat, structure of muscles, pre-slaughter care-methods of stunning – slaughtering - classification and quality of meat –meat cuts - beef, pork and lamb.

### **UNIT II - AGING OF MEAT (9 hours)**

Post slaughter care-post mortem and Biochemical changes in meat-Rigor mortis-Aging of meat- meat pigment and colour changes – tenderization-artificial tenderization-muscle stretching-mechanical disruption-artificial enzymes. Quality control and standardization of meat.

### **UNIT III - MEAT PRESERVATION AND PRODUCTS (9 hours)**

Meat preservation-Methods of preservation-low temperature, chilling and freezing-Thermal processing-dehydration-curing and smoking-preservation using antibiotics-preservation by irradiation. Meat products – Ham and Beckon, sausage, quality control and standardization of meat.

### **UNIT III - EGG AND POULTRY PROCESSING (9 hours)**

Formation, structure, chemical composition and nutritive value of eggs - collection, handling, grading and quality parameters of eggs-defect eggs - method of preservation of egg. Dressing –grading-slaughtering-scalding-Mechanical defeathering-eviscerating-preservation-Quality control and standardization of poultry meat. HACCP and quality assure of egg and poultry.

### **UNIT IV FISH PROCESSING (9 hours)**

Composition and nutritional quality of fish - on board handling and preservation - salt ,curing and smoking, drying of fish – effect of drying on quality - freezing preservation. HACCP and quality assure of egg and poultry.

### **REFERENCES**

1. R.A. Lawrie & D.A lawrie *"Lawrie's meat science"*, Woodboard publishing ltd
2. Mead. *"Processing of poultry"*. 1989.
3. Richardson and Mead, *"Poultry meat science"*. 1999.
4. Pearson and Tauber, *"Muscle and meat biochemistry"*. 1989.
5. Andrew L. Winton, Kate Barber Winton, *"Fish and Fish products"*, Agro Botanical Publishers, India. 1993.
6. Barbut. *"Poultry products processing an industry guide"*. 2002.

7. Pearson and Dutson. *"Quality attributes and their measurement in meat poultry and fish"*. 1994.
8. V.P Singh and Neelam Sachan, *"Principle of meat technology"* New India publishing agency.

FP2106	ADVANCED DAIRY PROCESS BIOTECHNOLOGY	L	T	P	C
	Total Contact Hours - 45		3	0	0
<b>PURPOSE</b>					
This course helps the students to gain a good knowledge on the various processes and equipments used in the processing of milk and milk products.					
<b>INSTRUCTIONAL OBJECTIVES</b>					
1.	To understand innovative technologies (LP System and UHT) in dairy industry				
2.	To make awareness about drying methodologies and water activity				
3.	To discover the biotechnological approaches in the field of dairy				

**UNIT I - UNIT OPERATIONS IN DAIRY INDUSTRY (9 hours)**  
 Present status about dairy industry- Per capita availability- demand and supply Indian dairy policy- definition and purpose of pasteurization- test for pasteurization efficiency-sterilization- centrifugation and standardization- Bactofugation- principles-equipment and application

**UNIT II - CHEMICAL PRESERVATION OF MILK AND ULTRA HIGH TEMPERATURE (9 hours)**  
 Development in chemical preservation of milk-LP system- mechanism- H<sub>2</sub>O<sub>2</sub> Vs LP system- defects of LP system- UHT processing of milk-types of UHT plants-effects of milk quality- prospects in India-techno economic considerations

**UNIT III - WATER ACTIVITY AND HURDLE TECHNOLOGY (9 hours)**  
 Application of drying in dairy industry- freeze drying- stages-application-spray drying-innovations- Concept of water activity- humectants-sorption behavior of foods-*a<sub>w</sub>* of different milk products-practical application-hurdle technology-list of hurdles-advantages-microbial growth inhibition-application-future perspectives

**UNIT IV -APPLICATION OF BIOTECHNOLOGY IN DAIRY INDUSTRY (9 hours)**  
 Biotechnological approaches in dairy industries-Bio Preservatives- Bio peptides-productions-functions-Bio detergents-applications- Bio films mechanism effects its control.

**UNIT V ENZYME MODIFIED CHEESE AND PROBIOTIC FOODS (9 hours)**

Acceleration of cheese ripening-merits and demerits- application- Enzyme modified cheese- need- advantage- their utilization in ripening of cheese- Probiotic foods-mode of action- properties- pre requisites

**REFERENCES**

0. Alan Wiseman, *"Principles of biotechnology"*, Survey University press, NewYork, 1988.
1. JackG; Chirikjian Ed., *"Biotechnology-theory and principles"*, Jones and Bartlett publishers London. 1995.
2. Byong H.Lee, *"Fundamentals of food biotechnology"*. VCH Publishers.NY. 1996.
3. Israel Goldberg, *"Functional foods"*, Chapman & Hall, NY. Burton. 1998.
4. De, Sukumar *"Outlines of dairy technology"*, Oxford University Press, Delhi. 1980.
5. Khan, A.Q. and Padmanthan P.N. *"The Technology of Milk Processing"*, Laxmi Publications, New Delhi. 1991.
6. Khan M. E. *"Milk Processing, Dairy Technology Textbook for Class XI"*, NCERT, Delhi. 1998.
7. NDDDB. *"Milk Processing Manual"*, NDDDB, PO Box – 40, Anand, 1980.
8. Burton, H. *"Ultra-high-temperature processing of milk and milk products"*.Elsevier Applied Science, London. 1988.

FP2107	CROP PROCESS ENGINEERING				
	L	T	P	C	
Total Contact Hours - 45		3	0	0	3
<b>PURPOSE</b>					
This course provides knowledge about the different methods of processing and value added products made from cereals and legumes and an ability to know about the effective ways to process and preserve agricultural crops					
<b>INSTRUCTIONAL OBJECTIVES</b>					
1.	To study about the various methods of processing paddy and pulses				
2.	To demonstrate a basic knowledge on process of milling of wheat and corn				
3.	To strength the knowledge about oil seed processing				
4.	To develop an awareness of various processing procedure and processed cereal products				



5.	To learn about processing and product development of plantation crops, spices and tuber crops
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**UNIT I - RICE AND PULSES PROCESSING (9 hours)**

Rice processing – parboiling, drying, dehusking, polishing, modern rice mill machineries – construction details and adjustments, layout of modern rice mill. Pulse milling – pretreatments of pulses, wet and dry method, machinery used for dhal milling.

**UNIT II - PROCESSING OF WHEAT, CORN AND MINOR MILLET (9 hours)**

Wheat milling – methods, corn milling – wet milling, dry milling, oats processing, Soy bean processing, Processing of sorghum, ragi, barley – malting of barley. Breakfast cereals. Processed products. Extruded products.

**UNIT III - OIL SEEDS PROCESSING (9 hours)**

Oil seeds pretreatment, extraction, refining-neutralization, degumming, deodorization, hydrogenation, winterization, palm oil, coconut oil.

**UNIT IV - PLANTATION CROP PROCESSING (9 hours)**

Processing of tea – black tea, Green tea, Oolong tea, flavored tea. Coffee processing – instance coffee. Processing of cocoa, cashew nut processing. Equipments used - processed products.

**UNIT V - SPICES AND PLANTATION CROP PROCESSING (9 hours)**

Processing of pepper, chilli, turmeric, cardamom. Tuber crops- tapioca, potato processing – processed products.

**REFERENCES**

1. Unit operations in Agricultural Processing by Sahay and Singh.
2. Kent Jones, "Cereal Technology"
3. Kent, "Technology of cereals"
4. Sivetz and Foote, "Coffee processing Technology", AVI publishing Co.,
5. Brooker, "Theory of cereal grains"
6. Altschule A.M., "Processed protein food stuffs"
7. Sivetz and Foote, "Coffee processing Technology", AVI publishing Co.,
8. Talburt and Smith, "Potato processing", AVI publishing co

FP2108	BAKERY AND CONFECTIONERY TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45		3	0	0
<b>PURPOSE</b>					
To teach about the baking and production principles of bakery and confectionery					

products.	
<b>INSTRUCTIONAL OBJECTIVES</b>	
1.	To understand the terms in bakery and confectionery
2.	To exhibit the use of sanitation and safety practices in bakery production
3.	To develop an understanding of process technology of bakery products

### **UNIT I – INTRODUCTION**

**(7 hours)**

Bakery and confectionery industries status in India- Essential and optional ingredients.

### **UNIT II - BAKERY PRODUCTS TECHNOLOGY**

**(9 hours)**

Bread, biscuits, cake and other bakery products manufacturing technology - Preservation of bakery products and its equipments.

### **UNIT III - CONFECTIONERY PRODUCTS**

**(10 hours)**

Raw materials- Influence of processing parameters (such as temperature, concentration, pH, interfering agents) on the quality/texture of the confectionery product- chocolate- formulation- processing and storage conditions -unit operations involved in chocolate making- Process flow diagrams- fondant, caramels, fudge and toffee and chocolate

**UNIT IV – EQUIPMENTS****(9 hours)**

Equipments for bakery products and confectionery products- Weighing balance, proofing chamber, baking oven, slicer, packaging machines, conching and tempering equipments

**UNIT V - QUALITY CONTROL****(10 hours)**

Bakery quality assurance- GMP in bakery manufacturing unit- Identification of control points and how to monitor the control points for a range of confectionery products such as caramel, marshmallow, fondant, toffee

**REFERENCES**

1. S.C. Dubey, *"Basic Baking, Science and craft"*, CBS publishers. 1988.
2. Ouaouich and Peter Fellows, *"Cereal Milling and Bakery Products. Production Methods, Equipment and Quality Assurance Practices"*. FAO Publications, Rome. 2004.

FP2109	HANDLING, PACKAGING AND STORAGE OF FOOD PRODUCTS	L	T	P	C
	Total Contact Hours - 45		3	0	0
<b>PURPOSE</b>					
Provides a perspective for understanding about modern food packaging materials and methods used in food industries.					
<b>INSTRUCTIONAL OBJECTIVES</b>					
1.	To understand the various properties of food packaging materials.				
2.	To Select suitable packaging material for different food substances.				
3.	To understand the concept of canning of food products				

**UNIT I - HANDLING****(9 hours)**

Theory and nature of flow, flow through hoppers and ducts, bulk handling equipment - operation, construction and design of belt, chain, screw and pneumatic conveyors and bucket elevators.

**UNIT II - INTRODUCTION TO FOOD PACKAGING****(9 hours)**

Packaging requirements and problems - functions of package- design of packages for various foods. Development of protective packaging- shelf life studies using packaging materials-methods of shelf life estimation.

**UNIT III - FOOD PACKAGING MATERIALS AND TECHNIQUES (9 hours)**

Packaging materials- properties and identification- paper and paper boards. Regenerated cellulose film- plastic films- Aluminium foils and laminations. Edible packaging- Food packages- bags, pouches, carton boxes, metal and plastic tubes, moulded plastic containers, glass containers. Canning and aseptic packaging; Special packaging methods- vacuum and gas packaging, shrink package, retort pouches- Bio degradable packaging.

**UNIT IV - FOOD PACKAGING EQUIPMENTS (9 hours)**

Equipment and method- packaging equipment for solid, liquid semi-liquid food-types of fillers-filler for glass bottle, paper bottle, pouches, plastic cup thermoforming equipments; form -fill - seal equipments, sealing equipment, labeling, capping, canning and cartoning equipments.

**UNIT V - STORAGE OF FOOD GRAINS (9 hours)**

Storage of grains; Storage structures- traditional, modern and improved storage bins. storage entomology. Bag and bulk storage - method of stacking - controlled and modified atmosphere storage- effects of nitrogen, oxygen, and carbon dioxide on storage of durable and perishable commodities.

**REFERANCES**

1. Jacob John. *"A hand book on Food packaging"*. Daya publishing House, Delhi. 2010 .
2. K.M. Sahay and K. K. Singh *"Unit Operations of Agricultural processing"*. Edition II. Vikas Publishing House Pvt. Ltd, Noida. 2010.
3. Crosby, N. T. *"Food packaging Materials"* Applied Science Publishers, London. 1981.
4. Justice, O.I. and I.N. Bass. *"Principles and practices of seed storage"*. Castle House Publication Ltd. 1995.
5. Multon, J.L. *"Preservation and storage of grains, seeds and their by – products"*. CBS Publishers and Distributors, Delhi. 2001.

FP2110	NUTRACEUTICALS AND FUNCTIONAL FOODS				
	L	T	P	C	
Total Contact Hours - 45		3	0	0	3
<b>PURPOSE</b>					
To study the basic nutraceuticals constituents in different foods and its role in health benefits.					
<b>INSTRUCTIONAL OBJECTIVES</b>					
To learn about					
1.	The nutraceuticals constituents present in various food products.				
2.	Health benefits of functional foods				

**UNIT I – INTRODUCTION (9 hours)**

Introduction of nutraceuticals – The link between nutrition and medicine. Classification of nutraceuticals. Prevalence of human diseases (morbidity, mortality), etiology, epidemiology, diagnosis, therapy – historical basis, current status and prognosis.

**UNIT II – NUTRACEUTICALS FROM PLANT ORIGIN (9 hours)**

Nutraceuticals in fruits, vegetables and grains with health benefits. Specific nutraceuticals, drugs of promise in certain diseases and bioavailability of nutraceuticals. Isoflavones: Source and metabolism. Olive oil and plant sterols, Omega 3 fatty acids and eicosanoids. Omega 3 fatty acids and lipoprotein metabolism. Omega 3 fatty acids, insulin resistance and rheumatoid arthritis.

**UNIT III – FLAVONOIDS & THEIR HEALTH BENEFITS (9 hours)**

Soy protein, soy isoflavones, cardiovascular and bone health. Phytoestrogens: Mechanism of action, menopause, breast and prostate cancer. Citrus flavanoids and other natural cholesterol lowering agents. Carotenoids: metabolism and disease.

**UNIT IV – LYCOPENE & RESVERATROL & THEIR HEALTH BENEFITS (9 hours)**

Lycopene: source, properties and nutraceuticals potential. Garlic: the mystical food in health promotion. Phytochemicals in *Capsicum annum*. Grape, wine and tea polyphenols-disease prevention.

**UNIT V – FREE RADICAL BIOLOGY & ANTI-OXIDATIVE DEFENSE MECHANISM (9 hours)**

Free radicals and oxidative stress - Antioxidant mechanisms. The biochemical basis for nutraceuticals for the chemoprevention of disease. Application of herbs to functional foods.

**REFERENCES**

1. Wildman *"Nutraceuticals and Functional Foods"*, CRC Press, 2001.
2. Kramer, Hoppe and Packer, *"Nutraceuticals in Health and Disease Prevention"* Marcel Dekker. Inc., NY, NY.2001.
3. Bao and Fenwick, *"Phytochemicals in Health and Diseases"*. Marcel Decker, Inc. NY, NY. 2004.

FP2111	<b>GENETICALLY MODIFIED FOODS</b>	L	T	P	C
	Total Contact Hours -45	3	0	0	3
<b>PURPOSE</b>					
To study the developments in the field of Genetically modified foods					
<b>INSTRUCTIONAL OBJECTIVES</b>					
To give the students a detailed insight on the following aspects.					
1.	Introduction to GM foods and their methods of production, advantages				
2.	Genetically modified plants which are commercially available				

3.	Transgenic animals and their engineering method
4.	Genetically modified microorganisms and their applications in foods
5.	Pharmaceutical applications of genetically engineered plants
6.	Risk and safety assessment of the GM foods and their labeling

#### **UNIT I – INTRODUCTION AND METHODS OF PRODUCTION (9 hours)**

Introduction to GM foods – Advantages of GM foods – Herbicide tolerant crops – Frost resistance – Drought and salinity resistance – Insect resistance – Virus resistance – Nutritional fortification Methods of establishing Genetically Modified Plants – Transformation methods –*Agrobacterium* transformation and Direct gene transfer

#### **UNIT II – GENETICALLY MODIFIED PLANTS (9 hours)**

Transgenic plants - Commercially available GM crops – *Bacillus thuringiensis* corn (StarLink corn) – Golden Rice – Fungal resistant Bintje potatoes – Lectin potato - Methionine enriched oil – Calgene FLAVR SAVR tomato - Chymosin Bovine Somatotrophin Lite Beer L-tryptophan – Indian Bt eggplant

#### **UNIT III – TRANSGENIC ANIMALS AND GMOs (9 hours)**

Creation of Transgenic animals – Gene transfer in poultry – Gene transfer in fish – Transgenes –gene constructs - Improved growth rate, carcass composition and feed efficiency – Transgenic mammalian farm animals - Transgenic fish -Atlantic Salmon - Bovine Somatotropin un Milk – *alpha* lactalbumin and lactoferrin in milk - Growth hormone genes in pigs - Genetically engineered bacteria – Genetically modified *Sachharomyces* strains – applications in Beer, wine, sake and bread

#### **UNIT I V– PLANT PHARMACEUTICALS (9 hours)**

Beta-carotene in rice - Transgenic “heart-healthy” Canola oil edible vaccines – Hepatitis B vaccine in maize – Cholera vaccine in potatoes

#### **UNIT V- FOOD SAFETY AND ETHICAL ISSUES (9 hours)**

Risk associated with GM foods – Allergens, toxins, antibiotic resistance, soil contamination - Creation of superbugs and superweeds - Increased risk of immune-suppression and cancer risks – Labeling GM foods – Ethics related to cloning – Biosafety and risk assessment

#### **REFERENCES**

1. Knutt J.Heller, “*Genetically engineered food – Method and detection*”Wiley – VCH, 2<sup>nd</sup> edition, 2006.
2. Colin Andre Carter et al., “*Genetically modified food and Global welfare*” Frontiers of Economics and Globalization, Emerald Group Publishing Limited, 1<sup>st</sup> edition, 2011.

3. Stephen Nottingham *"Eat your genes: How genetically modified food is entering your diet"* Zed Books Ltd, 2<sup>nd</sup> edition, 2003.
4. Kung, Shain-Dow *"Biotechnology and Food Quality"* – Butterworth, 1989.
5. Jerry Freedman, *"Genetically modified food – How Biotechnology is changing what we eat"* – The Rosen Publishing Group, Inc. , 1<sup>st</sup> edition, 2009.

FP2112	FOOD PROCESSING PLANT DESIGN	L	T	P	C
	Total Contact Hours -45		3	0	0
<b>PURPOSE</b>					
To understand the complete design aspects of Food processing industry					
<b>INSTRUCTIONAL OBJECTIVES</b>					
1.	To study about construction requirements, process design of Food Processing Industry.				
2.	To gain the knowledge of fabrication and installation of equipments & layout characteristics				
3.	To enhance the knowledge in the design of food processing equipments and food processing plant layout.				

**UNIT I – INTRODUCTION OF FOOD PLANT LAYOUT (9 hours)**  
 Introduction and classification of food plants, selection of site and Location of plant, General points of considerations for designing food plant, floor plant types of layouts Food building planning, Process schedule, principles of food layout.

**UNIT II – CONSTRUCTION REQUIREMENTS (9 hours)**  
 General requirements and considerations for construction, materials and floors for different section of food. Drains and drain layout for small and large dairies. Ventilation, fly control, mold prevention, illumination in food plants.

**UNIT III – PROCESS DESIGN (9 hours)**  
 Process Flowchart, Types of Process Design, Material & Energy balances-design of equipments, Materials for the food equipments. Sanitary pipes and fittings, standard glass piping, plastic tubing, fittings and gaskets, installation, care and maintenance of pipes & fittings.

**UNIT IV - FABRICATION AND INSTALLATION OF EQUIPMENTS (9 hours)**  
 Arrangement of equipment-fabrication of equipment, installation of process equipments, material handling in dairies, Common problems, office layouts-flexibility.

## UNIT V – LAYOUT CHARACTERISTICS

(9 hours)

Plant location factors plant lay out advantages types of layout-characteristics of an efficient layout. Techniques of plant layout. Product selection and development-introduction of new product-stages of product development considerations in product development

### REFERENCES

1. Tufail Ahmed. *"Dairy Plant Engineering and Management"*, CBS Publishers and Distributors, New Delhi, 2001.
2. Ananthkrishnan.C.P. and M.N.Sinha. *"Technology and Engineering of Dairy Plant Operations"*, Laxmi Publications, New Delhi, 1997.
3. Groff, Gane K. and Muthu, John F., *"Operations Management Selected Readings"*, D.B.Taraporevala Sons and Co, Bombay, 1975.
4. Thuesen, H.G., Febrycky, W.J. and Thuesen, G.J., *"Engineering Economy"*, Prentice –Hall Inc, New Jersey, 1978.



## SUPPORTIVE COURSES

CH2151	OPTIMIZATION OF CHEMICAL PROCESSES (Same as CH2108)	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
<b>PURPOSE</b>					
This course makes the students knowledgeable in different optimization methods employed, while solving chemical engineering problems.					
<b>INSTRUCTIONAL OBJECTIVES</b>					
To Familiarize:					
1.	Engineering application of optimization				
2.	Basic concepts of optimization				
3.	Optimization of unconstrained functions				
4.	Unconstrained multivariable optimization				
5.	Applications of optimization in chemical processes.				

### UNIT - I (9 hours)

Engineering application of Optimization-Design variables, Constraints, Objective function, variable bounds. Statement and formulation of an optimization problem. Examples of chemical engineering optimization problems. General procedure for solving Optimization problems. Obstacles of Optimization.

### UNIT – II (9 hours)

Continuity of functions-Unimodal and Multimodal functions. Convex and concave functions, Convex region. Conditions for an extremum of an unconstrained function. Interpretation of the objective function in terms of its quadratic approximation.

### UNIT – III (9 hours)

One dimensional search- Methods for optimizing a function of one variable, Scanning and Bracketing, Newton's method, Quasi-Newton's method, Secant method of unidimensional search- region elimination methods- polynomial approximation methods.

### UNIT - IV (9 hours)

Direct methods- Random search, Grid search, Univariate search, Simplex method, Powell's method. Indirect methods- First order- Gradient method, Conjugate gradient. Second order- Newton's method, secant method.

### UNIT- V (9 hours)

Heat transfer and Energy conservation , optimizing recovery of waste heat, Optimum shell and tube heat exchanger design. Optimization of heat exchanger networks-Optimal allocation of temperatures in a sequence of heat exchangers. Optimization of evaporator design-Multi stage evaporator.

## REFERENCES

1. Edger T.F. and Himmelblau D.M, "*Optimization of Chemical Processes*", McGraw Hill Book Co., New York, 1989.
2. Deb K., "*Optimization for Engineering design: Algorithms and Examples*", Prentice hall, New Delhi, 1996.
3. Ray W.H. and Szekeley J., "*Process Optimization with Application in Metallurgy and Chemical Engineering*", Wiley, New york, 1973.
4. Rao S.S., "*Optimization: Theory and Applications*", 2<sup>nd</sup> Edn., Wiley Eastern, New Delhi, 1984.
5. Beveridge G.S. and Schechter R.S., "*Optimization: Theory and Practice*", McGraw Hill, New York, 1969.

CH2152	ADVANCED HEAT AND MASS TRANSFER	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
<b>PURPOSE</b>					
To provide an adequate knowledge on unsteady state heat transfer and mass operations and the methods & equipments currently used in chemical industries. To provide the student with general techniques to formulate, model and mathematically solve advanced heat and mass transfer problems					
<b>INSTRUCTIONAL OBJECTIVES</b>					
1.	To impart knowledge on steady and unsteady state heat transfer operations				
2.	To impart knowledge on various aspects of convective heat transfer operations and mass transfer equipments				
3.	To impart knowledge on special topics in heat and mass transfer operation that are representative of "real world" engineering problems				

## UNIT I – STEADY AND UNSTEADY STATE HEAT CONDUCTION (9 hours)

Steady and unsteady state heat conduction - Unsteady state heating and cooling of solid objects - Transient heat conduction - Extended surfaces and fins.

**UNIT II – CONVECTIVE HEAT TRANSFER (9 hours)**

Convection heat transfer coefficient - Dimensional analysis in convection heat transfer - Heat transfer during laminar and turbulent flow in closed conduits - Empirical correlations.

**UNIT III – SPECIAL TOPICS IN HEAT TRANSFER (9 hours)**

Heat transfer in magneto fluid dynamic systems - Transpiration cooling - Ablation heat transfer in liquid metals - Heat transfer in fluidized beds - Heat transfer processes in nuclear reactors

**UNIT IV: MASS TRANSFER (9 hours)**

Molecular diffusion - steady state diffusion and transient diffusion - turbulent diffusion - interaction of molecular and turbulent diffusion - mixing and dispersion.

**UNIT V – MASS TRANSFER EQUIPMENTS (9 hours)**

Mass transfer at phase boundary - two film theory - mass transfer from flat plates, cylinders and disc - design of mass transfer equipment

**REFERENCES**

1. Warren L. McCabe, Julian C. Smith and Peter Harriott, "*Unit Operations of Chemical Engineering*", 7<sup>th</sup> ed., McGraw Hill International Edition, New York 2005.
2. Holman J.P., "*Heat Transfer*", 9<sup>th</sup> ed., Tata McGraw Hill Book Co., New Delhi, 2008.
3. Coulson J.M., Richardson J.F., Backhurst J.R. and Harker J.H., "*Coulson & Richardson's Chemical Engineering*", Vol. I, 6<sup>th</sup> ed., Butterworth Heinemann, Oxford, 2009
4. Donald Q. Kern, "*Process Heat Transfer*", Tata McGraw Hill Book Co., New Delhi, 2008.
5. Robert Treybal, Mass "*Transfer Operations*"

MC2133	STATISTICAL TECHNIQUES	L	T	P	C
	Total Contact Hours - 45		3	0	0
<b>PURPOSE</b>					
The course is designed to offer knowledge about the application of Statistical techniques for the analysis of biological data. It provides fundamental ideas on the useful of data analysis, interpretation and inference based on experimental data collected from the conduct of biological experiments. The relevance more on the analysis of biological data.					
<b>INSTRUCTIONAL OBJECTIVES</b>					

1.	Data characteristics and form of distribution of Data Structure
2.	To understand the exact method of data analysis for the problem under investigation.
3.	For drawing valid inferences and to plan for future investigations.

**UNIT I – MEASURES OF AVERAGES AND DISPERSION (9 hours)**

Measures Central Tendency, Dispersion, Skewness and Kurtosis.

**UNIT II – BASIC OF PROBABILITY AND STATISTICAL DISTRIBUTIONS (9 hours)**

Basic Probability Theory – Probability density function – Mathematical Expectation – Basic Statistical Distributions (Binomial, Poisson and Normal Distributions).

**UNIT III – CORRELATION AND REGRESSION ANALYSIS (9 hours)**

Correlation – Simple, Partial and Multiple correlation: Regression – Simple Regression Models and Multiple regression models.

**UNIT IV – SAMPLING THEORY AND HYPOTHESIS TESTING (9hours)**

Basic Sampling Techniques – Sampling Distribution – Large Sample Tests – Chi-square Distribution – Small Sample Tests.

**UNIT V – NON-PARAMETRIC METHODS AND ANALYSIS OF VARIANCE (9 hours)**

Non-Parametric Methods – One sample and two sample tests – Analysis of variance – Principles of experimentation and Basic Experimental designs.

**REFERENCES**

1. S. C. Gupta and V. K. Kapoor, *“Fundamentals of Mathematical Statistics”*, 8<sup>th</sup> Edition, Sultan Chand & Sons, Delhi, 2003.
2. S. C. Gupta and V. K. Kapoor, *“Applied Statistics”*, 8<sup>th</sup> Edition, Sultan Chand & Sons, Delhi, 2003.
3. Marcello Pagano and Kimberley Gauvreau, *“Principles of Bio-Statistics”*, 1<sup>st</sup> Edition, Duxbury: Thomson Learning, USA, 2000.
4. B. L. Agrawal, *“Programmed Statistics”*, 2<sup>nd</sup> Edition, New Age International (P) Ltd., New Delhi, 1996.

## SEMESTER I

<b>CAC2001</b>	<b>Career Advancement Course For Engineers - I</b>	L	T	P	C
	<b>Total Contact Hours - 30</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>
	<b>Prerequisite</b>				
	<b>Nil</b>				
<b>PURPOSE</b>					
To enhance holistic development of students and improve their employability skills					

### INSTRUCTIONAL OBJECTIVES

1. To improve aptitude, problem solving skills and reasoning ability of the student.
2. To collectively solve problems in teams & group.
3. Understand the importance of verbal and written communication in the workplace
4. Understand the significance of oral presentations, and when they may be used.
5. Practice verbal communication by making a technical presentation to the class
6. Develop time management Skills

### UNIT I-BASIC NUMERACY

- Types and Properties of Numbers, LCM, GCD, Fractions and decimals, Surds

### UNIT II-ARITHMETIC – I

- Percentages, Profit & Loss, Equations

### UNIT III-REASONING - I

- Logical Reasoning

### UNIT IV-SOFT SKILLS - I

- Presentation skills, E-mail Etiquette

### UNIT V-SOFT SKILLS - II

- Goal Setting and Prioritizing

## ASSESSMENT

### Soft Skills (Internal)

Assessment of presentation and writing skills.

### Quantitative Aptitude (External)

Objective Questions- 60 marks

Descriptive case lets- 40 marks\*

Duration: 3 hours

\*Engineering problems will be given as descriptive case lets.

### REFERENCE:

1. Quantitative Aptitude by Dinesh Khattar – Pearsons Publicaitons
2. Quantitative Aptitude and Reasoning by RV Praveen – EEE Publications
3. Quantitative Aptitude by Abijith Guha – TATA Mc GRAW Hill Publications
4. Soft Skills for Everyone by Jeff Butterfield – Cengage Learning India Private Limited
5. Six Thinking Hats is a book by [Edward de Bono](#) - Little Brown and Company
6. IBPS PO - CWE Success Master by Arihant - Arihant Publications(I) Pvt.Ltd – Meerut

## SEMESTER II

CAC2002	Career Advancement Course For Engineers - II	L	T	P	C
	Total Contact Hours - 30	1	0	1	1
	Prerequisite				
	Nil				
PURPOSE					
To enhance holistic development of students and improve their employability skills					

### INSTRUCTIONAL OBJECTIVES

1. To improve aptitude, problem solving skills and reasoning ability of the student.
2. To collectively solve problems in teams & group.

3. Understand the importance of verbal communication in the workplace
4. Understand the significance of oral presentations, and when they may be used.
5. Understand the fundamentals of listening and how one can present in a group discussion
6. Prepare or update resume according to the tips presented in class.

### **UNIT I-ARITHMETIC – II**

- Ratios & Proportions, Mixtures & Solutions

### **UNIT II - MODERN MATHEMATICS**

- Sets & Functions, Data Interpretation, Data Sufficiency

### **UNIT III – REASONING - II**

- Analytical Reasoning

### **UNIT IV – COMMUNICATION - I**

- Group discussion, Personal interview

### **UNIT V - COMMUNICATION - II**

- Verbal Reasoning test papers

### **ASSESSMENT**

#### **Communication (Internal)**

- Individuals are put through formal GD and personal interviews.
- Comprehensive assessment of individuals' performance in GD & PI will be carried out.

#### **Quantitative Aptitude (External)**

Objective Questions- 60 marks (30 Verbal +30 Quants)

Descriptive case lets- 40 marks\*

Duration: 3 hours

\*Engineering problems will be given as descriptive case lets.

### **REFERENCES**

1. Quantitative Aptitude by Dinesh Khattar – Pearsons Publicaitons
2. Quantitative Aptitude and Reasoning by RV Praveen – EEE Publications

3. Quantitative Aptitude by Abijith Guha – TATA Mc GRAW Hill Publications
4. General English for Competitive Examination by A.P. Bharadwaj – Pearson Educaiton
5. English for Competitive Examination by Showick Thorpe - Pearson Educaiton
6. IBPS PO - CWE Success Master by Arihant - Arihant Publications(I) Pvt.Ltd - Meerut
7. Verbal Ability for CAT by Sujith Kumar - Pearson India
8. Verbal Ability & Reading Comprehension by Arun Sharma - Tata McGraw - Hill Education

### SEMESTER III

<b>CAC2003</b>	<b>Career Advancement Course For Engineers - III</b>	L	T	P	C
	<b>Total Contact Hours - 30</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>
	<b>Prerequisite</b>				
	<b>Nil</b>				
<b>PURPOSE</b>					
<b>To develop professional skills abreast with contemporary teaching learning methodologies</b>					
<b>INSTRUCTIONAL OBJECTIVES</b>					
<b>At the end of the course the student will be able to</b>					
1	acquire knowledge on planning, preparing and designing a learning program				
2	prepare effective learning resources for active practice sessions				
3	facilitate active learning with new methodologies and approaches				
4	create balanced assessment tools				
5	hone teaching skills for further enrichment				

#### **UNIT I- DESIGN**

**(2 hrs)**

- Planning & Preparing a learning program.
- Planning & Preparing a learning session

#### **UNIT II – PRACTICE**

**(2 hrs)**

- Facilitating active learning
- Engaging learners



### **UNIT III – ASSESSMENT**

**(2 hrs)**

- Assessing learner's progress
- Assessing learner's achievement

### **UNIT IV – HANDS ON TRAINING**

**(10 hrs)**

- Group activities – designing learning session
- Designing teaching learning resources
- Designing assessment tools
- Mock teaching session

### **UNIT V – TEACHING IN ACTION**

**(14 hrs)**

- Live teaching sessions
- Assessments

### **ASSESSMENT (Internal)**

#### **Weightage:**

Design - 40%

Practice – 40%

Quiz – 10%

Assessment – 10%

### **REFERENCES**

Cambridge International Diploma for Teachers and Trainers Text book by Ian Barker - Foundation books

Whitehead, Creating a Living Educational Theory from Questions of the kind: How do I improve my Practice? Cambridge J. of Education

## AMENDMENTS

S.No.	Details of Amendment	Effective from	Approval with date