

Teaching Scheme and Syllabi of B.E. (Food Tech.)

First Year

1st SEMESTER

S. No.	Course code	Courses	Contact hrs per week			Mid Term	End Term	Total Marks	Credits
			L	T	P				
1.	BS 101	Mathematics –I	3	1	-	50	50	100	4
2.	BS105	Chemistry II	3	-	-	50	50	100	3
3.	ESC103	Electrical & Electronics Engineering	3	1	-	50	50	100	4
4.	PCC101	Introduction to Engg and Technology	2	1	-	50	50	100	3
5.	HSMC 101	Communication Skills	2	-	-	50	50	100	2
7.	ESC 154	Electrical & Electronics Engineering Lab.	-	-	3	50	-	50	1.5
8.	BS 153	Chemistry II Lab.	-	-	3	50	-	50	1.5
9.	HSMC 151	Communication Skills Lab.	-	-	2	50	-	50	1
10.	MC 102	Ethics and self awareness	3	-	-	50	50	100	NC*
Total			16	3	8	450	300	750	20

2nd SEMESTER

S. No.	Course code	Courses	Contact hrs per week			Mid Term	End Term	Total Marks	Credits
			L	T	P				
1.	BS104	Mathematics –II	3	1	-	50	50	100	4
2.	BS102	Physics	3	1	-	50	50	100	4
3.	BS103	Chemistry-I	3	-	-	50	50	100	3
4.	ESC 101	Computer Programming for problem solving	2	-	-	50	50	100	2
5.	ESC 102	Engineering Graphics	2	-	-	50	50	100	2
7.	ESC 151	Engineering Graphics	-	-	3	50	-	50	1.5
8.	ESC 152	Engineering Workshop	-	-	2	50	-	50	1
9.	BS 151	Physics Lab.	-	-	3	50	-	50	1.5
10.	BS 152	Chemistry I Lab.	-	-	3	50	-	50	1.5
11.	ESC 153	Computer Lab.	-	-	2	50	-	50	1
12.	MC 101	Introduction to Env. Science	3	-	-	50	50	100	NC*
Total			16	2	13	550	300	850	21.5

* For a non-credit course passing with 40% marks will be compulsory, otherwise student will get reappear and passing this course will be mandatory.

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3rdSEMESTER

S. No.	Course code	Courses	Contact hrs per week			Mid Term	End Term	Total Marks	Credits
			L	T	P				
1.	PCC 102	Material and Energy Balance	3	1	-	50	50	100	4
2.	PCC 103	Fluid Flow	3	1	-	50	50	100	4
3.	PCC 104	Mechanical Operations	3	1	-	50	50	100	4
4.	PCC 201	Element of Bio & Food Science	3	-	-	50	50	100	3
5.	PCC 202	Biochemistry & Nutrition	3	-	-	50	50	100	3
6.	PCC 203	Food Chemistry	3	-	-	50	50	50	3
7.	PCC 151	Mechanical Operation Lab.	-	-	3	50	-	50	1.5
8.	PCC 152	Fluid Flow Lab.	-	-	3	50	-	50	1.5
9.	FT 251	Element of Bio & Food Science Lab	-	-	2	50	-	50	1
10	FT 252	Biochemistry & Nutrition Lab	-	-	2	50	-	50	1
11	PCC 253	Food Chemistry Lab	-	-	2	50	-	50	1
Total			18	3	12	550	300	800	27

4thSEMESTER

S. No.	Course code	Courses	Contact hrs per week			Mid Term	End Term	Total Marks	Credits
			L	T	P				
1.	PCC 105	Heat Transfer	3	1	-	50	50	100	4
2.	PCC 106	Chemical Engineering Thermodynamics	3	1	-	50	50	100	4
3.	PCC 204	Food Microbiology	3	-	-	50	50	100	3
4.	PCC 205	Processing of Milk and Milk products	3	-	-	50	50	100	3
5.	PCC 206	Processing of Cereals & Pulses	3	-	-	50	50	100	3
6.	PCC 154	Heat Transfer Lab.	-	-	3	50	-	50	1.5
7.	ESC 155	Process Equipment Design	-	-	3	50	-	50	1.5
8.	PCC 254	Food Microbiology Lab	-	-	3	50	-	50	1.5
9.	PCC 255	Processing of cereal and Pulses Lab	-	-	2	50	-	50	1
10.	PCC 256	Processing of Milk and Milk products Lab	-	-	2	50	-	50	1
11.	FT 101	Comprehensive viva	-	-	-	50	-	50	1
Total			15	2	13	550	250	800	24.5

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5thSEMESTER

S. No.	Course code	Courses	Contact hrs per week			Mid Term	End Term	Total Marks	Credits
			L	T	P				
1.	PEC 101	Deptt. Elective I (Numerical Methods in Chemical Engineering)	3	1	-	50	50	100	4
2.	PEC 102	Department Elective II (Biochemical Engg)	3	-	-	50	50	100	3
3.	PCC 109	Mass Transfer I	3	1	-	50	50	100	4
4.	PCC 207	Processing of Fruits and Vegetables	3	-	-	50	50	100	3
5.	PCC 208	Processing of Oil Seeds, Oils and Fats	3	-	-	50	50	100	3
6.	PEC 151	Deptt. Elective Lab. I (Chemical Engineering Computation Lab)	-	-	3	50	-	100	1.5
7.	PEC 153	Process Plant Design I	-	-	3	50	-	50	1.5
8.	PCC 257	Processing of Fruits and Vegetable Lab	-	-	2	50	-	50	1
9.	PCC 258	Processing of Oil Seeds, Oils and Fats Lab	-	-	2	50	-	50	1
Total			15	2	10	450	250	750	22

6thSEMESTER

S. No.	Course code	Courses	Contact hrs per week			Mid Term	End Term	Total Marks	Credits
			L	T	P				
1.	PCC 108	Chemical Reaction Engineering-I	3	1	-	50	50	100	4
2.	PCC 112	Mass Transfer II	3	1	-	50	50	100	4
3.	PCC 209	Confectionary Technology	3	-	-	50	50	100	3
4.	PEC 102	Department Elective II (Meat Fish)	3	-	-	50	50	100	3
5.	OEC I01	Open Elective I (Process Instrumentation)	3	-	-	50	50	100	3
6.	PCC 157	Mass Transfer Lab.	-	-	3	50	-	50	1.5
7.	PEC 154	Process Plant Design II	-	-	3	50	-	50	1.5
8.	PCC 155	Chemical Reaction Engineering Lab.	-	-	3	50	-	50	1.5
9.	PEC 155	Department Elective III Lab. (Meat fish poultry lab)	-	-	2	50	-	50	1
10.	FT 102	Industrial Training*				-	-		
Total			15	2	11	450	250	700	22.5

* There will be 6-8 weeks' compulsory industrial training after 6th semester theory examination during summer vacation. Every student will submit the Industrial Training report within one month from the start of teaching of the 7th semester. After that it will be evaluated by the team of Training & Placement Officers. The Credits for the Industrial Training will be awarded in the seventh semester

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7thSEMESTER

S. No.	Course code	Courses	Contact hrs per week			Mid Term	End Term	Total Marks	Credits
			L	T	P				
1.	PCC 113	Process Dynamics & Control	3	1	-	50	50	100	4
2.	PCC 115	Environmental Engineering	3	1	-	50	50	100	4
3.	OEC 102	Open Elective II (Industrial Safety & Hazards)	3	-	-	50	50	100	3
6.	PCC 159	Environmental Engineering Lab.	-	-	3	50	-	50	1.5
7.	PCC 158	Process Dynamics & Control Lab.	-	-	3	50	-	50	1.5
8.	FT 103	Project Work**	-	-	2	-	-	-	-
9.	FT 104	Literature Survey, Report Writing and Seminar	-	-	3	50	-	50	1.5
10.	FT 102	Industrial Training	-	-	-	100	-	100	2
11.	FT 105	NSS/NCC/Sports proficiency/Community services/Professional activities	-	-	-	-	-	-	1
		Total	9	2	11	400	150	550	18.5

8thSEMESTER

S. No.	Course code	Courses	Contact hrs per week			Mid Term	End Term	Total Marks	Credits
			L	T	P				
2.	OEC 103	Open Elective III (Food Regulation and Quality control)	3	-	-	50	50	100	3
3.	OEC 104	Open Elective IV (Beverage Technology)	3	-	-	50	50	100	3
4.	PEC 104	Department Elective IV (Packaging Technology)	3	-	-	50	50	100	3
	HSMC 102	Process Engineering Economics	3	1	-	50	50	100	4
5.	FT 103	Project Work	-	-	2	50	50	100	2
7.	OEC 151	Open Elective III Lab. (Food Regulation and Quality control)	-	-	2	50	-	50	1
8.	FT 106	Comprehensive Viva	-	-	-	-	50	50	1
		Total	12	1	4	300	300	600	17

TOTAL CREDITS OF ALL SEMESTERS (Chemical subjects)= 172.5

** Marks and Credits for Project work will be awarded in 8th Semester

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S. No.	List of Departmental Electives	S. No.	List of Open Electives
1.	Meat Fish & Poultry Technology	1.	Food Regulation and quality control
2.	Packaging Technology	2.	Beverage Technology
3.	Biochemical Engineering	3.	Food Rheology and Texture
4.	Food Biotechnology	4.	Project Management & Entrepreneurship
5.	Functional Food	5.	Process Instrumentation
6.	Numerical Methods in Chemical Engineering	6.	Industrial Safety and Hazards
7.	Petroleum Processing Engineering	7.	Nanotechnology
8.	Transport Phenomena	8.	Polymer Science and Engineering
9.	Plant Utilities	9.	Process Modelling & Simulation
10.	Petrochemical Technology	10.	Supply Chain and Logistic Management
11.	Biochemical Engineering	11.	Environment Impact Assessment
12.	Food Processing	12.	Energy Management and Audit
13.	Corrosion Engineering	13.	Applications of computational fluid dynamics
14.	Heterogeneous Catalysis and Reactor Design	14.	Chemical Process Optimization
15.	Industrial Environmental Management	15.	Fluidization Engineering
16.	Introduction to Multiphase Flow	16.	Crystal physics
17.	Natural Gas Engineering	17.	Advance Physics
18.	Catalysis	18.	Energy Materials
19.	Introduction to Colloids and Interfacial Science and Engineering	19.	Functional Material
20.	Biorefinery and Bioproducts Engineering	20.	Material Characterization
21.	MOOCS COURSES(all chemical engg and allied subjects)	21.	Nano Materials
22.		22.	MOOCS COURSES(all chemical engg subjects)

See MOOCs courses at: www.swayam.gov.in and www.nptel.ac.in

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Title	Elements of bio and food science			Credits	3
Code	PCC 201	Semester:-3rd		L T P	3 - -
Max.Marks	End term- 50	Mid term- 50	Practical --	Elective	N
Pre requisites					
THEORY				Time	3 Hours
Note for the Examiner	The examiner will set seven questions of equal marks. The first question ,which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part.The duration of End Term exam will be 3 hrs.				
Course Objectives	<ol style="list-style-type: none"> 1. <i>Developing an awareness about interactions of biology with food technology.</i> 2. <i>Acquaint students to concepts of biology and various techniques of microbiology.</i> 3. <i>Introducing students to various methods involved in processing and preservation of food.</i> 				
Course Outcomes	<p>CO1 Understand the basic principles of cells and the metabolic processes of cells in terms of cellular organelles, membranes, and biological molecules. Along with that various methods used for the isolation, identification and maintenance of microbial cultures.</p> <p>CO2 Understand the molecular basis of genetic information and the flow of genetic information from DNA to RNA to protein and the concept of mutations.</p> <p>CO3 Knowledge of various food regulatory bodies in food processing and packaging as well as differentiating between different materials used in food packaging like metals, glass, plastics and papers and their methods of production.</p> <p>CO4 Understanding techniques employed by food industries to preserve the raw material and finished products and to increase its shelf life by tackling various physical, chemical and biological constraints</p>				
SECTION A					
<i>Overview of biology:</i> Its branches, historical background, biological classification, nomenclature.					8h
<i>Cell biology:</i> Prokaryotic and Eukaryotic cells, Animal and Plant cell structures, Cell division and cell cycle, Plant and Animal tissues, muscles in animals.					
<i>Introduction to Microbiology:</i> Relevance of Microbiology in preservation of foods, Branches of Microbiology, Microscopes and their application in Microbiology, Morphology and physiology of virus, bacteria, yeast, molds and algae, Growth, nutrition and reproduction, Isolation and identification of microorganisms, Pure cultures and their characteristics, Sterilization techniques, Maintenance and preservation of cultures, Culturing techniques: Batch culturing, Continuous culturing, Fed-batch culturing, Growth and factors affecting growth.					10h
<i>Bacterial Genetics:</i> General principles of bacterial genetics, DNA as genetic material, Mutations and their Chemical basis, Strain improvement by mutations, recombinant DNA technology and its applications, recombinant products available in the market.					5h
SECTION B					
<i>Introduction to Food Science and Food Technology:</i> Professional bodies both in India and abroad dealing with food technology, Characteristics of plant and animal foods.					6h
<i>Food Packaging:</i> Rigid and flexible: glass, metal, plastic, packaging system characteristics and advantages.					
<i>Food Preservation:</i> General introduction of food preservation, Historical developments. Preservation of foods by: pasteurization, sterilization, drying, radiation, refrigeration, freezing, sugar, salt, chemicals, radiation, microorganisms, Intermediate moisture foods, Recent trends in food processing and preservation: Introduction to high pressure processing, hurdle technology, Ohmic heating etc.					13h
<i>Food Hygiene and Sanitation:</i> Causes and types of contamination, routes of contamination, General principles of food hygiene in food handling and food processing plants.					

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	3h
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Recommended books:

1. Norman N. Potter, Joseph H. Hotchkiss : Food Science, – 5 th ed. Springer, 1998 - Technology & Engineering
2. Norman W. Desrosier : Technology of food preservation. New Delhi: CBS Pub., 2004
3. P J Fellows : Food Processing Technology: Principles and Practice.
4. J M Jay : Modern Food Microbiology, CBS Publication, New Delhi
5. P. J. Fellows, Taylor and Francis : Food processing technology: Principles and Practice, 3rd Edition 2009.

Title	BIOCHEMISTRY & NUTRITION			Credits	3	
Code	PCC 202	Semester:-3rd		L T P	3 - -	
Max. Marks	End term-50	End term-50	Practical- -	Elective	N	
Pre requisites						
THEORY				Time	3 Hours	
Note for the Examiner	The examiner will set seven questions of equal marks. The first question ,which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part. The duration of End Term exam will be 3 hrs.					
Course Objectives	<ol style="list-style-type: none"> 1. The students will learn about the biological basis of nutrition and various metabolic pathways by which food influence health. 2. They will understand the mechanisms by which diet can influence health and help them develop laboratory skills required for modern biochemical and molecular studies of nutrition. 					
Course Outcomes	CO1 Introduce students to basis of biological catalysts and their function in metabolic pathways. CO2 Provides information about energy produced from lipids and proteins. CO3 Provides information regarding biotechnological concepts and their applications. CO4 Understanding the knowledge about the role of nutrition in maintaining good health.					
SECTION A						12h
Introduction to biochemical science, Enzymes and coenzymes: definition, nomenclature, classification, numbering structure and functions of water-soluble enzymes, energy-rich compounds, active sites, mechanism of enzymes action, effect of temperature, pH, enzyme concentration and substrate concentration on the rate of enzyme reaction, specificity of enzymes, enzyme inhibition, kinetics of enzymes action, activation of enzymes, nature and functions of enzymes involved in digestion. <i>Metabolism of Carbohydrates:</i> Respiratory quotient, Embden-Meyerhoff pathway, Cori and Cori Cycle, Krebs's Cycle, electron transport chain, oxidative phosphorylation.						
<i>Metabolisms of Lipids:</i> Digestion and absorption of lipids, fatty liver, lipotropic agent, oxidation pathway, methylmalonyl Co- pathway metabolism of ketone bodies, energy balance.						12h
<i>Metabolism of Proteins:</i> Digestion and absorption of proteins, amino acids or nitrogen pool, nitrogen balance, general metabolism of proteins and amino acids. Nitrogen fixation.						
SECTION B						
<i>Nucleic Acids and their Components:</i> Bases, nucleotides and nucleotides (cyclic also). Structures and physiochemical properties of DNA and RNA, Nucleoproteins, Replication, Transcription and Translation. <i>Biotechnological Concepts:</i> Vectors used for recombinant DNA technology. Application of cloned DNA.						10h
<i>Introduction to Human Nutrition:</i> The functions of foods, The need for energy, basal energy metabolism. Energy value of foods, Dietary allowances and standards for different age groups, nutritive value of						11h

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foods, Techniques for assessment of human nutrition. Physiological functions, deficiency, role in metabolism and daily requirements of Vitamin A, D, E, K, C, B1, B2, niacin, pyridoxin, cyanocobalamin, folic acid, choline, p-aminobenzoic acid. Minerals as structural and functional constituents in human metabolism, specific role of iron, calcium, phosphorus, iodine, sodium, chlorine, potassium, copper, and magnesium.	
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Books Recommended:

1. Jeremy M. Berg, John L. Tymoczko, Lubert Stryer and Gregory J. Gatto, Jr. 2002, Biochemistry, 7th Ed. W.H. Freeman and Company, NY, USA.
2. David L. Nelson and Michael M. Cox. 2012: Lehninger Principles of Biochemistry, 6th Ed. Macmillan Learning, NY, USA
3. Carolyn D. Berdanier, Elaine B. Feldman and Johanna Dwyer. 2008. :Handbook of Nutrition and Food, 2nd Ed. CRC Press, Boca Raton, FL, USA
4. M. Swaminathan 2018: Essentials of food and nutrition, Bangalore Press, India
5. Voet & Voet: Fundamentals of Biochemistry, John Wiley & Sons

Title	Food Chemistry			Credits	3	
Code	PCC 203	Semester:-3rd		L T P	3 - -	
Max. Marks	End term- 50	Mid term- 50	Practical- -	Elective	N	
Pre requisites				Contact Hours	45	
THEORY					Time	3 Hours
Note for the Examiner	The examiner will set seven questions of equal marks. The first question, which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part. The duration of End Term exam will be 3 hrs.					
SECTION- A						
Moisture in foods : Hydrogen bonding, bound water, water activity. Carbohydrates: Definition, classification and nomenclature. General properties (physical and chemical) of sugar. Reducing and non-reducing sugars. Common monosaccharides, di-saccharides and poly-saccharides. Chemistry of starch, cellulose, gums and mucilage. Crude fibre. Protein: Classification. Amino acid sequence in proteins, pleated sheet and helix structure of proteins. Molecular weight of proteins and ultra-centrifuge separation and purification of proteins. Physical and chemical properties of amino acids. chromatographic separation of amino acids. Food proteins and their characteristics. Protein denaturation.						
SECTION-B						
Lipids : Classification. Occurrence in foods and composition, identification of natural fats and oils in foods. Physical (melting point, softening point, slipping point, short melting point, specific gravity, refractive index, smoke-flash and fire point, turbidity point) and chemical properties. Flavor changes in fats and oils. Natural pigments and Flavouring Agents, Pigments and polyphenols Chlorophylls, carotenoids, anthocyanins, anthoxanthins, flavonoids, tannins and natural flavour constituents. Saponins, Alkaloids. Pectic substances-Protopectin, pectin gels, Importance of Pectin in food products. Vitamins: Occurrence and chemistry of various vitamins: A, B, C, D, E, K, Losses during processing and storage. Food Additives: Types; Methods for safety level analysis, color additives legislation.						

Course Objectives

- 1:** To describe the major and minor components of foods
- 2:** To identify the chemical changes that take place in food during storage and processing
- 3:** To classify different types of carbohydrates, proteins, lipids, vitamins and their importance, diseases caused due to deficiency.

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Course outcomes

CO1 The students will gain knowledge about various components of foods, their importance and deficiency, effect of processing condition on nutrition value of foods.

CO2 The Students will be able to apply that knowledge during process condition optimization of different food product manufacturing and quality maintenance.

Recommended Books.

1. L.H. Meyer: : Food Chemistry, C.B.S. Publishers, Delhi, 1987
2. Fenamma : : Food chemistry, AVI Publishing, USA
3. de Man: : Food Chemistry, AVI Publishing, USA

Paper Title : Elements of Bio & Food Science Lab.

Paper Code: PCC 251

Max. Marks : 50

Credits : 1

Course Objectives:

1. Understanding the microorganisms associated with foods and isolation methods of microorganisms from foods.
2. Learning the fermentation process and microorganisms involved in the production of fermented foods.
3. Name and describing the beneficial and spoilage microorganisms associated with food.

Course Outcomes:

CO1 Understand working principle of microscopes and sterilization techniques.

CO2 Use aseptic technique to properly handle microorganisms to avoid contamination.

CO3 Identify the microorganisms using staining techniques.

CO4 Understand and apply the knowledge to handle microscopes to observe stained microorganisms.

CO5 Isolate the pure culture from mixed population found in contaminated foods.

List of Experiments:

1. Guidelines for safety and introduction to various equipments commonly used in laboratory.
2. Sterilization of glassware used in microbiology laboratory.
3. Use of microscopic technique for identification of microorganisms on the basis of cell morphology.
4. Specific staining techniques: simple staining, gram staining
5. Preparation of nutrient broth, media with nutrient agar, PDA and special media.
6. Isolation of microorganisms using serial dilution and streak plate method.
7. Isolation and enumeration of microorganisms using spread plate method.
8. Microbiological assay of water.
9. Effect of blanching on quality of food.

Paper Title : BIOCHEMISTRY & NUTRITION Lab.

Paper Code PCC 252

Max. Marks : 50

Credits : 1.5

Course Objectives:

1. To gain knowledge of proper literature reviews and evaluation of appropriate methods for analysis.
2. To understand proper use of methods of analysis.
3. To interpret various methodologies for analysis of components in foods.

Course Outcomes:

CO1 Describe various separation and quantification techniques frequently used for food analysis.

CO2 Demonstrate the presence of protein, lipid, carbohydrate and water in food using chemical methods.

CO3 Apply their knowledge in food biochemistry and nutrition in designing new range of products with improved nutritional characteristics

CO4 Evaluate proper selection and application of appropriate methods of analysis.

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List of Experiments:

- 1 Preparation of various solutions and buffers .
- 2 Determination of pka of acids.
- 3 Determination of pI for casein
- 4 Estimation of sugars in fruits by Anthrone method
- 5 Estimation of protein by Lowry method
- 6 Estimation of amino acid using Biuret reaction
- 7 Separation of amino acids using paper chromatography
- 8 Separation of amino acids using thin layer chromatography
- 9 Separation of nucleic acids using electrophoresis

Paper Title: FOOD CHEMISTRY Lab.

Paper Code PCC 253 Max. Marks: 25 Credits : 1

1. Preparation of samples for analyses.
2. Determination of moisture content (wet basis and dry basis).
3. Ash: total, acid soluble, alkali soluble and water soluble.
4. Lipids, protein, crude fibre, reducing and non-reducing sugar.
5. Estimation of ascorbic acid, vitamin-A, chlorophyll, carotenoids etc.
6. Estimation of iron, copper, lead, tin etc.

Course Objectives

CO1: To acquire knowledge on experimental determination of moisture, ash, fat, protein and carbohydrate in food.

CO2: Understanding experimental techniques for measurement of ascorbic acid, vitamins, minerals etc.

Course outcome

Student will be able to implement the practical knowledge of food analysis in industrial scale analysis of food material and will be able to detect adulterant and will be able to maintain quality of food product fresh and during storage at different atmospheric conditions.

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SECOND YEAR

Title	Food Microbiology			Credits	03
Code	PCC 204	Semester:-4th		L T P	3 - -
Max. Marks	End term- 50	End term- 50	Practical- -	Elective	N
Pre requisites					
THEORY				Time	3 Hours
Note for the Examiner	The examiner will set seven questions of equal marks. The first question ,which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part.The duration of End Term exam will be 3 hrs.				
Course Objectives	<p>1. To make students aware about different concepts involved in food spoilage and its prevention by using different food preservation principles and technologies.</p> <p>To familiarize students with procedures and techniques used to detect and enumerate microorganisms in foods.</p>				
Course Outcomes	<p>CO1 Identify different types of microorganisms present in the environment responsible for spoilage of food and evaluate the measures required to control undesired microorganisms in food.</p> <p>CO2 Interpret the effects and causes of various food borne diseases and steps involved in investigating an outbreak.</p> <p>CO3 Understand the technology and microbiology behind various fermented products along with their health benefits and various microbiological methods used for analysis of micro-organisms in food.</p> <p>CO4 Understand the importance of maintaining safety and hygiene in food industry and various approaches used for sanitation of plants and equipments.</p>				
SECTION A					13h
Contamination of foods by microorganisms from natural sources, General principles of spoilage and growth of microorganisms in foods, Preservation of foods by different preservation methods, contamination, preservation and spoilage of different food products.					10h
Food poisoning and food infections (<i>Staphylococcus, Clostridium, Aspergillus, Salmonella, Bacillus</i>), food borne disease outbreak: methods, goals and steps of investigation, control measures, case studies.					
SECTION B					
Microbiology of individual food products:Dairy products, bread, yoghurt, cheese.Microbialflavour – fragrances, Food Allergies,Antimicrobial agents used in foods. Rapid methods for microbiological analysis of foods.					12h
Food processing plant: Importance of hygiene and sanitation,General aspects of sanitary construction and design of food equipment,Cleaning and disinfection, chemicals and methods used in sanitation of plant and equipments, Monitoring techniques and microbiological criteria.					10h

Books Recommended:

1. Bibek Ray and ArunBhunia. 2008. :Fundamental Food Microbiology, 4th Ed., CRC press, Taylor and Francis Group, USA.
2. Martin R. Adams and Maurice O. Moss. 2008. : Food Microbiology, 3rd Ed., The Royal Society of Chemistry, Cambridge, UK.
3. James M. Jay. 2000. : Modern Food Microbiology, 6th Ed. Aspen Publishers, Inc., Gaithersburg, Maryland, USA.
4. George J. Banwart. 1989. :Basic Food Microbiology, 2nd Ed. Chapman & Hall, New York, USA.
5. William C. Frazier and & Dennis C. Westhoff. 1987 :Food Microbiology, 4th Ed. Tata McGraw-Hill Education, New Delhi.

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Title	Processing of Milk and Milk Products			Credits	3
Code	PCC 205	Semester:-4th		L T P	3
Max. Marks	End term- 50	Mid term- 50	Practical-	Elective	N
Pre requisites					
THEORY				Time	3 Hours
Note for the Examiner	The examiner will set seven questions of equal marks. The first question ,which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part.The duration of End Term exam will be 3 hrs.				
SECTION- A					
Present status of milk & milk products in India and Abroad; market milk Composition of milk of various species, quality evaluation and testing of milk, procurement, transportation and processing of market milk, cleaning & sanitization of dairy equipments. Special milks such as flavoured, sterilized, recombined & reconstituted toned & double toned. Condensed milk- Definition, methods of manufacture, evaluation of condensed & evaporated milk; dried milk					
Definition, methods of manufacture of skim & whole milk powder, instantiation, physiochemical properties, evaluation, defects in dried milk powder. Cream- Definition, classification, composition, cream separation, sampling, neutralization, sterilization, pasteurization & cooling of cream, evaluation, defects in cream; Butter- Definition, composition, classification, methods of manufacture, theories of churning, evaluation, defects in butter.					
SECTION- B					
Ice cream- Definition, composition and standards, nutritive value, classification, methods of manufacture, evaluation, defects in ice cream, and technology aspects of softy manufacture. Cheese: Definition, composition, classification, methods of manufacture, cheddar, Gouda, cottage and processed cheese, evaluation, defects in cheese.					
Indigenous milk products - Present status, method of manufacture of yoghurt, dahi, khoa, burfi, kalakand, gulabjamun, rosogolla, srikhand, chhana, paneer, ghee, lassi etc; probiotic milk products. Practical Study on basics of reception of milk at the plant; platform tests in milk; estimation and fat and SNF in milk; Operation of LTLT & HTST Pasteurization; Preparation of special milks; Cream separation & standardization of milk; Preparation and evaluation of table butter, icecream, cheese and indigenous milk product such as khoa, chhana, paneer, ghee, rosogolla, gulab jamun, shrikhand, lassi, burfi etc.; Visit to dairy plants.					

Books Recommended:

1. Aneja RP, Mathur BN, Chandan RC & Banerjee AK. : Technology of Indian Milk Products. Dairy India Publ. 2002.
2. De S. : Outlines of Dairy Technology. OxfordUniv. Press. 1980.
3. Henderson JL. : 1971. Fluid Milk Industry. AVI Publ.
4. Spreer E. : 1993. Milk and Dairy Products. Marcel Dekker.
5. Walstra P. 1999 : Dairy Technology. Marcel Dekker, 1999

CO1: To acquire knowledge of production, processing, distribution, storage and different quality standards of liquid milk.

CO2: To acquire Knowledge of composition and nutritive value of milk and different milk products.

CO3: To acquire knowledge of technology of different milk product like butter, ghee, cheese, icecream manufacturing.

CO4: To acquire Knowledge of storage and preservation and effect of processing condition on quality of different milk products

CO5: To acquire knowledge about process design of different milk and milk product processing equipments.

Course outcome

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Students will be able to implement their knowledge in milk procurement, processing and packaging. Student will be able to implement their knowledge in optimization of development of milk products and also will be able to detect adulterant present in the milk and milk products.

Title	PROCESSING OF CEREALS & PULSES			Credits	3	
Code	PCC 206		Semester:-4th	L T P	3 - -	
Max. Marks	End term-50	Mid term-50	Practical- -	Elective	N	
Pre requisites				Contact Hours		
THEORY				Time	3 Hours	
Note for the Examiner	The examiner will set seven questions of equal marks. The first question ,which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part.The duration of End Term exam will be 3 hrs.					
Course Objectives	<ol style="list-style-type: none"> 1. To acquaint students with production, structure, composition, quality evaluation of various cereals. 2. Students will get exposure of processing technologies of cereals, pulses and storage of cereals. <p>To learn about technologies for product development and value addition of various cereals and pulses.</p>					
Course Outcomes	<p>CO 1 - The students will be able to gain knowledge about the basic composition and structural parts of food grains. They will become aware about paddy processing and rice milling equipments.</p> <p>CO 2 - They will know about wheat processing and basic rheology of wheat dough which will help them for developing entrepreneurial skills and apply the knowledge to process food grains into value added products.</p> <p>CO 3 – Study the processing and milling of maize which will promote gainful employment. They will also gain knowledge about the various products made from processing of maize.</p> <p>CO 4 - They will develop skills needed in the milling of pulses. Students will also become familiar with hygienic and safe handling of Cereal Products.</p>					
SECTION A						
Composition, structure and quality, characteristics of cereal grains and pulses. <i>Paddy Milling</i> : Principles of milling of paddy. Traditional and modern methods of paddy milling. Parboiling of paddy, Paddy milling machinery. Processed foods from rice, by-products of paddy milling and their uses.						15h
<i>Milling of Wheat</i> : Criteria of wheat and flour quality, flour milling, wheat milling machinery. Rheology and Chemistry of dough, Physical dough testing instruments. Technology of baking bread, biscuit, cookies, cakes. Durum wheat and pasta products like macaroni, noodles and spaghetti. Cereal based infant foods.						18h
<i>Corn Milling</i> : Dry and wet milling of corn, corn based ready to eat breakfast cereals. Corn oil processing and utilization, Corn starch modification and uses, Corn sweeteners such as glucose syrup, high fructose corn syrups, dextrose, maltodextrin.						15h
<i>Milling of Pulses</i> : Different methods of pulse milling. Pulse milling machinery. Application of enzymes in processing of cereals and pulses processing. Sanitation in the processing plant. Plant layout						12h

Books Recommended:

1. Wrigley, C. 2004. :Encyclopedia of Grain Science. Academic Press, London, UK
2. B. Tiwari and N. Singh (RSC) :Pulse Chemistry and Technology.

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3. Kent, N.L. and Evers, A.D. 1994. :Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture, 4th Ed. Elsevier Science Ltd., Oxford, UK.
4. Chakraverty, A., Mujumdar, A.S., VijayaRaghavan G.S. and Ramaswamy, H. S. 2003. :Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.
5. Tanley A Watson and Paul E. Ramstad :Corn chemistry and Technology.
6. Ruth H.Matthews, 1989 : Legumes: Chemistry, Technology and Human Nutrition.

Paper Title : FOOD MICROBIOLOGY Lab.

Paper Code PCC 254 Max. Marks : 50 Credits : 3

Course Objective(s)

Helping students understand various methods of isolation, characterization and screening of bacteria, fungi and other related organisms and apply various preservation techniques relative to food safety and spoilage.

Course outcome(s):

After the completion of the Food Microbiology Lab the students will be able to:

- | | |
|-----|--|
| CO1 | Explain various methods of isolation, characterization and screening of bacteria, fungi and other related organisms. |
| CO2 | Apply different preservation techniques relative to food safety and spoilage. |
| CO3 | Enumerate the microorganisms to check the quality characteristics of food. |
| CO4 | Illustrate the growth requirements of common food borne pathogens and spoilage microorganisms. |
| CO5 | Identify which organisms would be likely to grow in a specific food product. |

List of Experiments:

1. Microbial examination of cereal and cereal products
2. Microbial examination of vegetable and fruits
3. Microbial examination of canned products for anaerobic spores.
4. Microbial examination of canned products for yeasts and molds.
5. Microbial examination of milk and milk products.
6. To access bacteriological quality of milk by methylene blue reduction test and resazurin reduction test
7. Detection of Salmonella from food sample
8. Detection of coliforms from milk by MPN method.
9. Enumeration of important groups of microorganisms in foods i.e., Psychrotrophic, thermoduric, thermophilic bacteria.
10. Preparation of different fermented products.

Paper Title : PROCESSING OF CEREALS & PULSES LAB.

Paper Code PCC 255 Max. Marks : 50 Credits : 1.5

1. Milling of rice, assessment of degree of polishing.
2. Evaluation of Physical, chemical properties of wheat and milled products
3. Baking of bread
4. Baking of biscuit cake
5. Evaluation of baked bread.
6. Evaluation of properties of rice (physical and chemical).
7. Cooking quality of rice.
8. Experiment on parboiling, evaluation of quality.
9. Milling of pulses.
10. Visit to flour mill, rice mill and pulse mill industries.

Course Objectives

CO1: To Demonstration of physical, and chemical properties of wheat and rice

CO2: To Study of product development like bread, cake, biscuit

CO3: To acquire practical knowledge on milling and parboiling of rice

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Course outcome

Student will be able to apply their knowledge in the cereal processing industry. As well as able to optimize new cereal product development or fortification of different additives maintaining its quality and nutritional values.

Paper Title : Processing of Milk and Milk Products (Practical)

No. of Practicals: 08

Paper Code PCC 256 Max. Marks : 50 Credits : 1

1. Physical and chemical analysis of milk
2. Physical and chemical analysis of milk powder,
3. Physical and chemical analysis of butter,
4. Physicochemical Analysis of icecream.
5. Testing the adulteration in milk & milk products.
6. Determination of salt in butter.
7. Preparation of cream,
8. Preparation of butter, ghee,
9. Preparation of ice-cream
10. Determination of overrun in icecream
11. Quality evaluation of milk products.

Course objectives

- 1:** To achieve knowledge processing, and storage and different quality standards of liquid milk.
- 2:** To achieve knowledge of composition and nutritive value of milk and different milk products.
- 3:** To acquire knowledge of technology of different milk product like butter, ghee, cheese, icecream manufacturing.
- 4:** To acquire knowledge of preservation and effect of heating condition on quality of different milk products
- 5:** To acquire knowledge about adulteration of milk.

Course outcome

CO1: Students will be able to implement their knowledge in milk Industry during processing, packaging and optimization of pasteurization conditions,

CO2: Students will be able to implement the knowledge in making milk concentrate, milk powder and icecream.

CO3: Student will be able to implement their knowledge in dairy equipment design and optimization of process variables of milk processing.

CO 4: Students also will be able to apply their knowledge in detecting adulterant present in the milk and milk products.

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THIRD YEAR

5th SEMESTER

Title	PROCESSING OF FRUITS & VEGETABLES			Credits	3
Code	PCC 207	Semester:-5th		L T P	3 - -
Max.Marks	End term- 50	Mid term- 50	Practical –	Elective	N
Pre requisites					
THEORY					
				Time	3 Hours
Note for the Examiner	The examiner will set seven questions of equal marks. The first question ,which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part.The duration of End Term exam will be 3 hrs.				
SECTION- A					
<i>Introduction to post harvest processing of Fruits and vegetables:</i> 15 h. Physiology of ripening. Effect of physical and chemical treatments on post harvest life of fruits and vegetables. Role of plant growth regulators in post harvest storage, Storage and handling of fresh fruits and vegetables.					
<i>Preservation:</i> 10 h. Preservation of fruits and vegetables by heat treatment, Canning Processing and preservation of fruits and vegetable juices. Preparation of jams, jelly, marmalade, preserves, pickles and vegetable products.					
SECTION –B					
<i>Fermentation:</i> 10h Fermented fruit and vegetable products. Fermented foods, pickling and curing of food, by product and their utilization. Application of enzymes in processing of fruit and vegetable juices. Food additives					
<i>Fruit based product development:</i> 10h Freezing and dehydration of fruits and vegetables. Concentration of fruits and vegetable juice. Effects of processing on the nutritive value of fruits and vegetables. Intermediate moisture foods Process design of cleaning, cutting, blanching, and thermal processing equipments. Plant layout.					

Books Recommended:

1. Giridhari Lal : : Preservation of Fruits & Vegetables, ICAR Publication, India.
2. Ranganna : : Analysis of Fruits and Vegetables, Tata MacGraw Hill, India.
3. Luh & Woodroof : : Commercial Vegetable Processing, AVI Publishing, USA
4. Woodroof & Luh : : Commercial Fruit Processing, AVI Publishing, USA Bhatt, V. I.& Vora, S. M.

Course Objectives

- CO1:** To develop knowledge of storage and handling of fresh fruits and vegetables after post harvesting.
- CO2:** To develop knowledge of preservation of fruits and vegetables
- CO3:** To make student understand regarding technology of manufacturing of different fermented fruits and vegetable products.
- CO4:** To develop knowledge about utilization of by products from fruits and vegetable industry.
- CO5:** To provide knowledge of process design of machinery used in fruits and vegetable industry.

Course outcomes

The students will gain knowledge about various techniques employed by food industries to preserve the raw material and finished products and to increase its shelf life by tackling various physical, chemical and biological constraints. Students will get familiar with by-product utilization process of fruits and vegetable industry.

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Title	Processing of Oil Seeds, Oils and Fats			Credits	4
Code	PCC 208	Semester:-5th		L T P	3 1 -
Max. Marks	End term- 50	Mid term- 50	Practical-	Elective	N
Pre requisites					
THEORY				Time	3 Hours
Note for the Examiner	The examiner will set seven questions of equal marks. The first question ,which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part.The duration of End Term exam will be 3 hrs.				
SECTION- A					
<i>Introduction to composition and extraction of oils:</i>				18h	
Status of oils & fats and Indian economy. General chemistry. Analytical methods for characterization. Quality standards of edible oils & fats in diet, nutrition & disease. Detection of adulteration. Oil milling methods: Ghani, mechanical expeller, hydraulic press, solvent extraction. Refining of edible oils & fats.					
Refining:				10h	
Basic processing of fats and oils - oil extraction, degumming, refining, bleaching, hydrogenation, fractional crystalization, interesterification, glycerolysis, molecular distillation, plasticizing and tempering. Chemical adjuncts-lecithins, monoglycerides and derivatives, propylene glycol esters, polyglycoesters.					
SECTION- B					
Modifications:				10 h	
Classification of vegetable oil. Modifications of the properties of oils & fats including chemical and biotechnological processes. Confectionary plastic fats. Preparation of various products including different shortenings, margarine, salad dressing & mayonnaise, imitation of dairy products low calorie spreads					
By products:				7 h	
Animal fat, oil derivatives. Technology of oilseed protein isolate. Utilization of byproducts from the oil milling industry. Process design of oil milling equipments and plant layout.					

Books Recommended:

1. Bailey : Fats and Oil, Wiley, USA.
2. Solomons, T. W. G. : Fundamentals of Organic Chemistry, John Wiley and Sons, Inc., New York, 1994
3. Salunkhe, O.K. Chavan, J.K, Adsule, R.N. and Kadam, S.S. : World Oilseeds: chemistry, Technology and Utilization. VNR, New York, 1992
4. Wolf, I.A. : Handbook of Processing and Utilization in Agriculture. CRC Press, Florida, Ed. 1983 (2 vol set)
5. Hamilton, R.J. and Bharti, A. : Fats and Oils: Chemistry and Technology. Applied Science, London. Ed. 1980.

Course objectives

- CO1:** To describe physical, chemical, thermal properties of oils & fats
- CO2:** To acquire information regarding extraction of different oils from different sources, and different extraction methods.
- CO3:** Study of purification of different oils and fats.
- CO4:** Study of By-product utilization of oil industry.
- CO5:** Information regarding design of different oil processing equipments.
- CO6:** Knowledge on oil based items like salad dressing, mayonnaise, margarine etc.

Course outcome

Teaching Scheme and Syllabi of B.E. (Food Tech.)

Students will be able to implement their knowledge in choosing proper extraction process and optimization of process parameter of oil from diverse oil bearing material. Will also be able to optimize refining and storage conditions of oils and fats without rancidity development. Students will also be able to optimize by product utilization and manufacturing of valuable products out of that.

Paper Title : PROCESSING OF FRUITS & VEGETABLES LAB

Paper Code PCC 257

Max. Marks : 50

Credits : 1

Course Objectives :

1. To enable the students to understand the processing of fruits and vegetables
2. To impart technical knowledge of about how to develop products and preservation
3. The students will be able to learn the methods of processing and preservation of freshly harvested and cut fruits and vegetables.

Course Outcomes :

- CO1.** The students will gain knowledge about the manufacturing technology of Fruits and vegetable products.
- CO2.** Understand the importance of various ingredients required for preparation of products.
- CO3.** Calculate the quantity requirement of each constituent.
- CO4.** Prepare fruit and vegetable products of desired specification.
- CO5.** Enumerate the processing and preservation of fruits and vegetables by heat treatment
- CO6.** Understand the dehydration methods used for drying fruit and vegetables.

1. Blanching of fruits and vegetables: Effect of temperature, time and selected compounds on blanching.
2. Preparation of fruit juices, Squashes, R- T -S, nectar, cordial.
3. Preparation of jam, jelly, marmalade, preserve, candy.
4. Preparation of fruit juice concentrate and powder.
5. Preparation of tomato products.
6. Preparation of pickles, chutneys, sauces.
7. Drying of fruits & vegetables.
8. Freezing of fruits & vegetables.
9. Quality control of processed products.
10. Can seaming operation and canning of fruits and vegetables.
11. Visit to a fruit and vegetable processing plant.

Processing of Oil Seeds, Oils & Fat Lab.

PCC 258

Marks: 50

Credit: 1

1. Determination of oil content of foods by Soxhlet method
2. Determination of specific gravity of oils and fats
3. Determination of refractive index of oils and fats by Abbe's refractometer
4. Determination of free fatty acids and acid values of fats and oils
5. Determination of peroxide value of fats and oils
6. Determination of iodine value of fats and oils
7. Determination of melting points and smoke points of fats and oils
8. Determination of saponification value of fats and oils
9. Determination of adulteration of fats and oils
10. Determination of Reichert missile and Polenski value of fats and oils
11. Determination oils absorption during deep fat frying of foods

Course Objectives:

CO1: To develop knowledge on chemistry and technological known-how of oil and oil based products.

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CO2: To acquire knowledge of the analysis of quality criteria and detection of adulterants in oil and oil based products.

Course outcome:

Students will be able to implement the practical knowledge of extraction, characterization and optimization of using oils and fat content in food products and students will be able to detect adulterants in oils/fats.

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THIRD YEAR

6th SEMESTER

Title	CONFECTIONARY TECHNOLOGY			Credits	3
Code	PCC 209	Semester:-6th		L T P	3 - -
Max.Marks	End term 50	Mid term 50	Practical :	Elective	N
Pre requisites	-				
THEORY				Time	3 Hours
Note for the Examiner	The examiner will set seven questions of equal marks. The first question ,which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part.The duration of End Term exam will be 3 hrs.				
SECTION- I					
Introduction:	Definition of confectionary products. Types of confectionary goods. Characteristics and brief processing and FSSAI specifications of raw sweeteners like refined, khandsary and bura Sugar, Misri, Honey, Gur/Jagery, Dextrose, Golden syrup, Dried Glucose syrup, Sucralose, icing sugar, liquid glucose, artificial sweeteners etc. Processing and FSSAI specification of milk, butter, acidulants, emulsifier, vegetable oils, confectionary fats etc.				15h
Sugar confectionary:	Technology of manufacture of toffee, Technology of manufacture of chocolate, Technology of manufacture of fruit drops, Technology of manufacture of hard-boiled candies, Technology of manufacture of bars, Technology of manufacture of gums Technology of manufacture of special confectionary goods line marshmellow, licorice frappe, fondants etc.				12h
SECTION- B					
Chocolate:	Cocoa bean varieties, cultivation conditions, cocoa powder and cocoa butter manufacturing. Technology of manufacture of Chocolates. Quality determination of chocolate and other confectionary products, packaging and their FSSAI specifications.				10h
Gum based confectionary:	Technology of manufacture of chewing gums, bubble gums and Color, flavor and texture of confectionery. Standards and regulations. Economics and marketing of confectionery goods. Process design of equipments used in confectionary. Plant layout.				8h

Books Recommended:

1. Beckett : : Industrial Chocolate Manufacture: 3rd Edition, CBS Publication, New Delhi, 2000
2. Marie : : Handbook of Sweeteners, CBS Publication, New Delhi, 2000.
3. Minifie, B. : : Chocolate, cocoa and Confectionary: Science and Technology, Springer, 2nd Edition, 2012

Course objectives

CO1: To acquire knowledge on chemistry and technology of toffee, chocolate, chewing gum and its quality standard

CO2: To study the technology of manufacturing of chocolate and knowledge of designing of processing equipment.

CO3:To acquire information regarding use of color, flavor and analysis of texture of different confectionary products.

CO4: To know about the specification, packaging and labeling of different confectionary items.

Course outcome

Students will be able to implement their knowledge in diverse confectionary manufacturing processes in selection of suitable raw material, optimize process conditions and maintain the quality of the product. Students

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also will be able to choose suitable packaging material and also will be able to optimize the storage conditions for confectionary products.

PROJECT WORK

FT 103

Marks: 50

Credit: 2

Each student is required to submit a project report on the design of a chemical plant, selecting the best process with optimum equipment size and operating conditions. The object is to test the ability of the student to apply his entire knowledge of Chemical Engineering principles to conceptualize, analyze and solve the problems. To judge his knowledge and originality and capacity for application of laboratory data in designing chemical plants and to determine the level of his proficiency at the end of the course.

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Paper Title: Open Elective (Theory)

FOOD REGULATION & QUALITY CONTROL(Theory)

THEORY	Time	3 Hours
Note for the Examiner	The question paper should be divided into Section A and Section B Total of 7 questions. The examiner will set seven questions of equal marks. The first question, which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of the paper will be divided into two sections having three questions each and the candidate is required to attempt at least two questions from each section.	
Course Objectives	<ol style="list-style-type: none"> 1. <i>To understand the need and importance of quality in food processing.</i> 2. <i>To impart knowledge of food safety and various laws associated with it.</i> 3. <i>To explain why microbiological quality control methods are necessary in food production.</i> 	
Course Outcomes	<p>CO1 Understand the concept of quality and various quality attributes, their measurement and evaluation as well as the quality assessment of food materials on the basis of sensory evaluation.</p> <p>CO2 Learn various methods and techniques for measuring quality of processed and packaged food and recognizing the importance of microbiological methods in food production.</p> <p>CO3 Recognize the importance of food safety and different regulating authorities and food laws prevalent in India and worldwide for different food industries.</p> <p>CO4 Quality aspects of different food products and the effect of various factors on acceptability of the product along with chemical and physical methods employed for assessing the quality of food product.</p>	

SECTION A		
General Principles of Quality Control, Quality Attributes, Colour, gloss, viscosity and consistency, size, shape and texture, flavour, taste, sensory evaluation techniques.		13h
Physical, chemical and microbiological methods of quality evaluation, Application of biosensors to check the quality of packaged food products.		8h
SECTION B		
Government and trade standards for quality, foreign trade policy Food Laws and Regulations: Mandatory and voluntary food laws, Food Safety and Standards Act, PFA, FPO, BIS, AGMARK, ISO, HACCP.		15h
Study of quality of food products: Cereals, fruits, vegetables, milk, egg, meat, fish etc.		9h

Books Recommended:

1. Krammar and Twigg :Quality Control for Food Industry, AVI Publishing, 1979.
2. Ranganna :Handbook of Analysis of Fruit and Vegetable Products, Tata McGraw Hill, New Delhi, 1986.
3. InteazAlli. 2004. :Food Quality Assurance: Principles and Practices. CRC Press, Boca Raton, FL, USA.
4. Ronald H. Schmidt and Gary E. Rodrick. 2003 :Food Safety Handbook. John Wiley & Sons, Inc., Hoboken. New Jersey, USA.
5. R.E. Hester and R.M. Harrison. 2001: Food Safety and Food Quality. Royal Society of Chemistry, Cambridge, UK

Title	BEVERAGE TECHNOLOGY			
THEORY	Time	3 Hours		

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Note for the Examiner	The question paper should be divided into Section A and Section B Total of 7 questions. The examiner will set seven questions of equal marks. The first question, which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of the paper will be divided into two sections having three questions each and the candidate is required to attempt at least two questions from each section.	
Course Objectives	<ol style="list-style-type: none"> 1. <i>Students will learn about various types of beverages, their role in health, and the fermentation processes involved in making beverage.</i> 2. <i>It will enable students to learn about the procedures and machinery involved in the manufacture of beverages.</i> 	
Course Outcomes	CO1	Recognize the types of beverages in market and understanding the processing techniques and safety aspects of drinking water.
	CO2	Understand the technology of non-alcoholic beverages along with the importance and effect of quality of raw materials on the final products.
	CO3	Understand the principle behind the production of various alcoholic beverages and importance of every step for a safe and effective production.
	CO4	Learn the process and machinery involved in production of beverages that will be help in designing and creating newer processes and products that are better economically, nutritionally or technologically.
SECTION A		
Status of the beverage industry in India and its future prospects, types of beverages, Packaged drinking water: types, manufacturing process, quality standards of bottled water; mineral water, natural spring water, flavored water, carbonated water, water treatment process (screening, aeration, sedimentation, filtration, disinfection etc).		8h
Technology of manufacture of non-alcoholic beverages: fruits & vegetable juices, soft drinks, dairy beverages (flavoured milk, lassi, acidophilus milk, kefir, koumiss), whey based beverages etc.		12h
SECTION B		
Technology of manufacture of alcoholic beverages: Beer, wine, whiskey, rum, brandy, Technology of manufacture of instant tea and coffee.		13h
Study of equipments used in manufacturing of beverages: material handling (screw conveyer, belt conveyer, roller conveyer, pneumatic conveyer), filtration (rotary filter, plate and frame filter), Disintegration (Hammer mills, Grinding mills, disk mills, Stemmer/crushers), Pressing (rack and frame press, Horizontal piston press, Belt press, Screw press, Bladder press), Study of Plant layout: importance, objectives, principles and types of plant layout.		12h

Books Recommended:

1. S.C Prescott and C.G. Dunn :Industrial Microbiology, Agrobios (India), 1st Edition, 2007.
2. Chapman & Hall, Woodroof JG & Phillips GF.1974 :Beverages: Carbonated and Non-Carbonated.
3. Philip R. Ashurst. 2005. :Chemistry and Technology of Soft Drinks and Fruit Juices, 2nd Ed. Blackwell Publishing Ltd., Oxford, UK.
4. AmalenduChakraverty, Arun S. Mujumdar, G.S. VijayaRaghavan and Hosahalli S. Ramaswamy. 2003. :Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.
5. Varnam AH & Sutherland JP :Beverages- Technology, Chemistry and Microbiology
6. Hui YH et al 2004. :Handbook of Food and Beverage Fermentation Technology. Marcel Dekker.

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FOOD RHEOLOGY & TEXTURE (Theory)

THEORY	Time	3 Hours
Note for the Examiner	The examiner will set seven questions of equal marks. The first question ,which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part. The duration of End Term exam will be 3 hrs.	

Course Objectives

- CO1.** To provide knowledge about basic concept of stress and strain, elastic solids, fluid behaviour etc.
- CO2.** To provide knowledge about rheological behaviour of food, dynamic and static rheological property measurement methods of food, viscoelastic fluids.
- CO3.** To provide knowledge about description and measurement of solid food rheology using Farinograph; Mixograph; Cone Penetrometer; Warner-Bratzler Shear; Kramer Shear Cell; Melt Flow Indexer:
- CO4.** To provide knowledge about rheology of food hydrocolloids dispersions, food suspensions, pastes, gels, Dough, cheese, emulsions, method of measurement of texture of food material fruits and vegetables, extrudates etc.

Course Outcome

1 Students will be able to apply the knowledge of rheological properties of different liquid and solid food handling during processing.

2. Student will be able to implement the knowledge of rheological properties of visco-elastic dough material.

3. Student will be equipped with the concept of different textural properties, TPA and will be able to implement the knowledge to measure the textural properties of food materials.

4. Students will be able to apply the knowledge of rheology and texture during design of pipes, tanks,

Section A

Basic Concepts of Stress and Strain, Elastic Solids: Hookean and Non-Hookean Behavior Classification of Fluid Behaviour: Newtonian and Non-Newtonian Fluids - Shear Dependence, Time Dependence, Mechanical Models. Determination of Flow Properties, Laminar Flow of Fluids, Circular Ducts, Between Parallel plates Modeling Rheological Behavior, Yield Stress Phenomena, Concepts of Dynamic and Static Yield Stresses, Viscoelastic Fluids, Measurement Methods: Extensional Flow;

Empirical Measurement Methods and Texture Profile Analysis; Farinograph; Mixograph; Cone Penetrometer; Warner-Bratzler Shear; Kramer Shear Cell; Melt Flow Indexer

Section B

Pipeline Design Calculations for Non-Newtonian Fluids, Fanning Friction Factors: Power Law and Bingham Plastic Fluids, Laminar and Turbulent Friction Losses in Valves and Fittings, Velocity Profiles in Laminar and Turbulent Flows Rheology as structural analysis tool for a) Solid food materials b) Fluid and semi-solid food materials

Description and measurement of solid food rheology: Dough, cheese, fruits and vegetables, extrudates Classification, description and measurement of fluid and semi-solid food rheology.

Rheology of food hydrocolloids dispersions, food suspensions, pastes, gels, emulsions. Method of measurement (objective/instrumental) of texture of food material. Correlation with sensory method. Food products specific textural attributes, TPA etc.

References Books

1. Steffe, J.F., Daubert, J.F. (2006) Bioprocessing Pipelines: Rheology and Analysis, East Lansing, MI, Freeman Press
2. Steffe, J.F. (1996) Rheological Methods in Food Process Engineering, Second Edition, East Lansing, MI, Freeman Press
3. Rao, M.A., Steffe, J.F. (1992) Viscoelastic Properties of Food, New York, Elsevier Applied Science

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Open Elective Lab.

FOOD REGULATION AND QUALITY CONTROL LAB. (Practical)

Course Objectives:

Assisting students use laboratory techniques and methods common to Food processing and packaging and to provide an opportunity to the students to evaluate the effective test methods used in sensory evaluation and analyse the resulting information.

Course Outcomes:

- | | |
|-----|---|
| CO1 | Understand the need and functions of quality control and various methods used for assessing the quality of food products. |
| CO2 | Assessing the importance of packaging as a solution to various factors affecting food. |
| CO3 | Gain knowledge on shelf life of food and various methods of estimating it. |
| CO4 | Explain the different packaging materials and their properties. |

List of experiments:

1. Quality examination of canned food sample
2. Determination of color of food sample using Hunter Colorimeter.
3. Preparation and sensory evaluation of food sample (cookies).
4. Recognition of threshold concentration of primary taste.
5. Physical properties of packaging films.
6. Determination of water absorption of paperboard and CFB.
7. Uniformity and amount of wax determination.
8. WVTR of different packaging material.
9. Grease resistance of packaging material.
10. Determination of tin coating weight & porosity.

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Paper Title: Departmental Elective (Theory)

MEAT, FISH & POULTRY TECHNOLOGY (Theory)

THEORY	Time	3 Hours
Note for the Examiner	The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.	

SECTION-A

Development of meat and poultry industry in India. Ante-mortem examination of animals and poultry birds. Slaughter and dressing, post mortem examination. post-mortem changes, factors affecting them and their effect on shelf life of meat. Nutritive value of meat. Poultry dressing, wholesale and retail cuts. Communicated meat products. Canning of meat and meat products. Curing and smoking of meat. Meat tenderization. Disposal and utilization of meat industry by-products. MFPO. Sanitation of abattoir and meat processing. Modified atmospheric packaging of meats.

SECTION-B

Structure, composition and nutritive value of poultry eggs. Quality of eggs and its preservation. Egg Spoilage. Spray dried and frozen egg products.
Fish structure and composition, cold storage, freezing preservation and canning of fish. Pickling of fish, fish protein concentrates, fish meal and by-products of fish processing industry.
Sanitation in meat, fish, egg and poultry processing plants.

Books Recommended:

1. Henricksons, R.L : Meat, Poultry and Sea Food Technology, Prentice Hall.
2. Levie, Albert : Meat Hand Book, 4th Edition, AVI Publishing, Connecticut, 1984.
3. Mountney, G.J. and Poukhurst, C.R. : Poultry Products Technology, 3rd Edition, Food Products Press, 1995.
4. Borgstrom, George : Fish as Food (Vol. i, ii, iii, iv), Academic Press, New York, 1963.
5. Roberts, R.J. : Fish Technology.

Course Outcome

CO1 Students will be able to know the status of meat in India and about structure of meat, nutritive value and shelf life.
CO2 Provide understanding of the technology for handling, processing, and by product utilization of meat industry.
CO3. Understanding the structure of fish, poultry and egg and various techniques used for preservation of fish and poultry.
CO4 Understanding the concept of utilization of meat by products and importance of hygiene and sanitation of meat industry

Title	Packaging Technology		
Note for the Examiner	The examiner will set seven questions of equal marks. The first question ,which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part.The duration of End Term exam will be 3 hrs.		

SECTION-A

Basic concepts:

Requirement, objective and function of food package.

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Characteristics and suitability of use of packaging materials, cellulosic, glass, metal, polymeric composite, rigid, semi-rigid and flexible package forms, adhesive, band and closure, coatings and labels, packaging, product characteristics and packaging requirements, 12h

Packaging methods:

Selection of material, form, machinery and method of packaging, Aseptic, Vacuum, Retort and Gas packaging, Oxygen scavenging packaging, CA/MA packaging.
FSSAI standards and regulations of package, printing, Active Smart packaging 14h

SECTION-B

Packaging problem and solution: 12h

Special problems in packaging of foodstuffs.

Edible packaging and Biodegradable packaging.

Process design of packaging equipments.

Evaluation of efficiency: 12h

Evaluation of packaging materials for different food products and package performance.
Use of Nan composites in food packaging

Books Recommended:

1. Pines, F.A. : Fundamentals of Packaging, Cornhill Publication, London.
2. David, J.R. & David, D.R.D. : Aseptic Processing and Packaging & Food, CRC Press.
3. Sacharow & Griffin : Food Packaging, AVI Publishing, Westport, Conn.
4. Brody, A.L. : Flexible Packaging of Foods, CRC Cleveland, Ohio Press.
5. Heiss, R. : Principle of Food Packaging, An International Guide United Nations Food & Agricultural Organization, Rome, Italy, 1970.

Course Objectives:

CO1: Technical knowledge of different types of packaging materials and methods of manufacturing of different food packages.

CO2: Understanding of the concept of shelf life of different package foods and design of packaging machinery.

CO3: Standards for labeling, printing of different packaged foods.

CO4: Utilization of packaging waste and knowledge of edible and Biodegradable packaging

Course outcome

Students will be able to implement their knowledge in design of different packaging material, size of pack and combination of different packaging material to make laminated pack. Students will be able to implement their knowledge in labelling, printing of different packaged foods also able to design packaging machines.

BIOCHEMICAL ENGINEERING (Theory)

THEORY	Time	3 Hours
Note for the Examiner	The question paper should be divided into Section A and Section B Total of 7 questions. The examiner will set seven questions of equal marks. The first question, which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each	

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	or five questions of two marks each. Rest of the paper will be divided into two sections having three questions each and the candidate is required to attempt at least two questions from each section.
Course Objectives	<ol style="list-style-type: none"> 1. To describe the major metabolic pathways involved in the metabolism of nutrients in the human body. 2. To help the students understand the basic principles of various biochemical processes and realize the importance of different design parameters in bioreactor operation. 3. To recognize the industrial implication of biochemical engineering.
Course Outcomes	CO1 Gaining knowledge about metabolic pathways and cell growth. CO2 Understanding the concept of enzyme kinetics and their applications. CO3 Designing and creating new processes and fermented products that are better economically and technologically. CO4 Understanding the basic calculations for heat and mass transfer and yield of product.

SECTION A

Metabolic Pathways and Energetics of the Cell: The concept of energy coupling, aerobic and anaerobic metabolism, transport across cell membranes. (10h)

Cellular Genetics and Control: Growth and reproduction of a single cell, alteration of cellular DNA, commercial applications.

Kinetics of Enzyme-Catalyzed Reactions: The substrate, enzyme kinetics, factors affecting enzymatic activity and enzymatic reactions in heterogeneous reactions.

Isolation and Utilization of Enzymes: Purification, immobilization, application of enzyme technology. (10h)

SECTION B

Design and Analysis of Biological Reactors: The ideal continuous-flow stirred-tank reactor (CSTR), residence time distribution, different types of reactors, relationship between batch and continuous biological reactors. Fermentation technology: product manufacture by fermentation, reactors for biomass production.

(15h)

Transport Phenomena in Microbial Systems: Gas-liquid mass transfer, determination of oxygen transfer rates, mass transfer, scaling of mass transfer equipment, particulate mass transfer, heat transfer.

Product Yield and Biomass Production: Growth cycle for batch cultivation and its mathematical modeling, products synthesis kinetics, thermal death kinetics of cells and spores. (10h)

Books Recommended:

1. M.L. Shuler and F. Kargi: Bioprocess Engineering: Basic Concepts, PHI Learning Private Limited, New Delhi.
2. D.G. Rao: Biochemical Engineering, McGraw Hill Publishing Co. Ltd.
3. A.V.N. Swamy: Fundamentals of Biochemical Engineering, BS Publications.
4. H.C. Vogel and C.L. Todaro: Fermentation and Biochemical Engineering Handbook: Principles, Process Design and Equipment, Standard Publishers Distributors, Delhi.
5. Balley & Ollis: Biochemical Engineering Fundamentals, McGraw Hill Book Co., 1986. Principles of Fermentation Technology, Whitaker Stanbury & Whitaker, Hall, Adita Books, New Delhi, 1997.

FOOD BIOTECHNOLOGY (Theory)

THEORY	Time	3 Hours
Note for the Examiner	The examiner will set seven questions of equal marks. The first question, which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part. The duration of End Term exam will be 3 hrs.	
Course	1. Understanding the basic concepts of food biotechnology along with principles of	

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Objectives	<p><i>genetics in food industry.</i></p> <p>2. <i>Providing necessary skills required with application of biotechnology in development and progression of food technology.</i></p>
Course Outcomes	<p>CO1 Learning fundamentals of food biotechnology and application of recombinant DNA technology in food processing industry.</p> <p>CO2 Knowledge of various fermentation techniques for the production of food and medicines.</p> <p>CO3 Learning production methods of organic acids, alcoholic beverages and glycerol and basic knowledge on genetic engineering and genetically modified crop</p> <p>CO4 Developing new products with improved quality and application of biotechnology for treatment of food industry wastes.</p>

Section A

Introduction to food biotechnology, genetic engineering and its importance in food Technology. Advantages and disadvantages of genetically modified foods.

Technological aspects of industrial production fermented foods, beverages, vitamins, antibiotics, baker's yeast, single cell protein. Bio-colors, bio-flavors. Classification of fermentation. Application of fermentation technology in food preservation. Regulatory and social aspects of biotechnology of foods.

Section B

Production of alcohol, lactic acid and acetic acid from various food materials. Bacteriocin production and its use in food preservation. Biotechnological processes of manufacture of functional foods, nutraceuticals and probiotics. Biotechnological process for food fortification, prebiotics & oligosaccharides. Application of biotechnology in waste treatment of food industries. Improvement of quality of food by biotechnological processes. Biosensors.

Reference Books:

1. Adams, M.R. and M.O. Moss, Food Microbiology, Turpin Distribution Service Ltd.,Blackhorse Road, Letchworth, Herts SG6 1HN, UK, 1995, 2nd edition.
3. Gauri Mittal, Food Biotechnology: Techniques and Applications. CRC Press,1992.
4. Banwart, George J., Basic Food Microbiology, 2nd ed. AVI/ Van NostrandReinhold Publishing Co, 1989.
5. Cliver, D.D., Foodborne Diseases. Academic Press, Inc, 1990.
6. Debnath, Tools & Techniques of Biotechnology, Pointer Publishers, Jaipur, 2005.

FUNCTIONAL FOOD (Theory)

THEORY	Time	3 Hours
Note for the Examiner	The examiner will set seven questions of equal marks. The first question ,which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part.The duration of End Term exam will be 3 hrs.	
Course Objectives	<ol style="list-style-type: none"> 1. <i>Understanding the basics of nutraceuticals and functional foods.</i> 2. <i>Study the significance of nutraceuticals and their role in disease prevention.</i> 3. <i>Knowledge of regulatory issues related to nutraceuticals and functional foods.</i> 	
Course Outcomes	<p>CO1 Gaining knowledge about concept of nutraceutical and functional foods,their sources and role in prevention of chronic disorders.</p> <p>CO2 Learning methods for identification nutraceutically significant molecules.</p> <p>CO3 Understand the extraction procedures and formulation of functional food along with their stability and analytical issues.</p> <p>CO4 Knowledge of the adverse effects and toxicity issues of nutraceuticals.</p>	

Section A

Definition of Nutraceuticals/ Functional foods and related terms, rationale to claim a compound as a nutraceutical, regulatory issues of nutraceuticals based on CODEX/FSSAI. Concept of angiogenesis and health foods vs. disease. Role of functional food on age related macular degeneration, endurance performance and mood disorders-compounds and their mechanisms of action, dosage levels, contradictions if any.

Section B

Extraction of selected nuraceuticals. Formulation of functional foods containing nutraceuticals-stability and analytical issues, labelling issues. Identification testing of nutraceuticals and heath foods, interactions of

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prescription drugs and nutraceuticals, adverse effects and toxicity of nutraceuticals, Nutrigenomics-an introduction and its relation to nutraceuticals.

References Books

1. Robert EC., 2006, Handbook of Nutraceuticals and functional foods. Wildman.
2. Shi J, 2006, Functional food Ingredients and Nutraceuticals: Processing Technologies, CRC Press.
3. Webb GP, 2006, Dietary supplement and Functional Foods. Blackwell Publications.

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FOOD PROCESSING (Theory)

THEORY	Time	3 Hours
Note for the Examiner	The examiner will set seven questions of equal marks. The first question, which is compulsory, will cover the entire syllabus, having ten conceptual questions of one mark each or five questions of two marks each. Rest of paper will be divided into two parts (SECTIONS) having three questions each and candidate is required to attempt at least two questions from each part. The duration of End Term exam will be 3 hrs.	

SECTION A

Kinetics of biological reactions, determination of reaction order, changes of quality during processing/ storage of foods. Application of Arrhenius equations to biological reactions. Engineering Properties of foods, and their importance. Food processing equipment and their design. Steady state and unsteady state heat transfer. Numerical, graphical methods during heat transfer and their analysis. Unsteady state equations. Food quality deterioration and their modelling.

Principles of Refrigeration. Calculation of refrigeration load. Natural refrigeration, Vapour compression refrigeration. Mollier Chart, Rating of Systems, Compressors, evaporators, Condensers, Expansion valve. Pump, Absorption refrigeration.

SECTION B

Thermal Processing of foods. Pasteurization and sterilization, D value, F value, Z value. Process time calculation. Cook value and quality retention. Time temperature integrators (TTI). Microbial survival curve. Lethality, Ball method. Process calculation by graphical method. Freezing of foods, optimization of freezing time.

Reference Books

Heldman and Singh. 1995. Introduction to Food Engineering. Academic Press.

McCabe WL, Smith JC and Harriott P. 1993. Unit operations of Chemical Engineering. McGraw Hills.

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PROCESSING OF MEAT, FISH & POULTRY (Practical)

- (a) Fish & Meat: Cutting and handling.
- (b) Dressing of poultry.
- (c) Evaluation of quality of meat, fish & poultry.
- (d) Canning, freezing, dehydration & curing of fish.
- (e) Quality of egg & egg powder, egg preservation.
- (f) Preparation of pettie, emulsion etc.
- (g) Canning, freezing, dehydration & curing of poultry
- (h) Visit to meat, fish & poultry processing industries.

Course Objectives

- 1. Student will acquire knowledge about fish processing and preservations by salting, canning etc.**
- 2. Student will acquire knowledge about slaughtering, dressing and handling**
- 3. Student will acquire knowledge about quality of eggs and egg powder**
- 4. Student will acquire knowledge about preparation, preservation of fish and poultry based products.**

Course Outcome

- CO 1: Students will be able to apply their knowledge in fish processing industry to optimize several fish preservation processes**
- CO2: Students will be able to implement their knowledge poultry processing industry to optimize several poultry preservation processes**
- CO3: Students will be able to apply their knowledge egg processing industry to optimize several egg preservation processes**
- CO4: Students will be able to implement their knowledge to maintain quality of meat, fish, poultry based processed product during storage.**