NEW SYLLABUS UNDER AUTONOMY
DEPARTMENT OF FOOD TECHNOLOGY
HALDIA INSTITUTE OF TECHNOLOGY

Program Educational Objectives (PEOs)

PEO 1: To provide technical knowledge to develop skill and competence to identify, comprehend and solve problems including research and academics in the area of Food Technology and related disciplines

PEO 2: To prepare the students to successfully work in various public and private sector organizations at regional, state, national and international levels, with professional competence, adaptability, and administrative acumen

PEO 3: To develop active interest towards the societal needs, and services through sustainable problem solving and life-long learning in an ethical and responsible manner

Program Specific Outcomes (PSOs)

PSO 1: Ability to understand basic technical concepts and to effectively apply them to identify, comprehend and solve problems in the area of Food Technology and related disciplines.

PSO 2: Ability to integrate the scientific / technical knowledge with personality development traits that provides the society with competent food technology / food engineer / food scientist professionals with adaptability, team work, leadership skills, and administrative acumen

PSO 3: Ability to fulfill societal needs through sustainable problem solving and life-long learning in an ethical and responsible manner.

Programme Outcomes (POs)

B. Tech. Food Technology Graduates will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and that in food engineering and technology to solutions of complex engineering problems.

PO2. Problem analysis: Identify, formulate, and review research literature, and analyze complex engineering problems reaching substantiated conclusions using mathematics, natural science and their applications in food engineering and technology.

PO3. Design / development of solutions: Design and develop solutions for practical engineering problems related to food and allied industries and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research based knowledge, research methods, including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

PO5. Modern tool usage: Ability to create, select, and apply appropriate techniques, resources, and modern engineering and computational tools, including prediction and modeling to different engineering activities, with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning with realistic contextual knowledge to assess economic, environmental, legal, ethical, cultural, and societal issues, and the consequent responsibilities relevant professional engineering practice.

PO7. Environment and sustainability: Understand impact of professional engineering solutions in society in the context of environment, and demonstrate knowledge of and need for sustainability.

PO8. Ethics: Apply ethical principles, and commit to professional ethics, responsibilities, and norms of engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams in multi-disciplinary settings.

PO10. Communication: Communicate effectively on professional activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, give and receive clear instructions, and to enhance awareness in relevant fields.

PO11. Project management and finance: Demonstrate knowledge and understanding of engineering and management principles, and apply these in one's own work taking into consideration the aspects of financial management.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broad context of technological changes.

Semester III [Second year] Curriculum
Branch/ Course: Food Technology

Sl. No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1.	Basic Science Course	BS-FT 301	Chemistry-II	3	0	0	3
2.	Engineering Science Course	ES-FT 301	Engineering Thermodynamics	3	0	0	3
3.	Engineering Science Course	ES-FT 302	Mechanical Operations in Food Processing	3	0	0	3
4.	Professional Core courses	PC-FT 301	Chemistry of Food	3	0	0	3
5.	Professional Core courses	PC-FT 302	Food Microbiology	3	0	0	3
6	Basic Science Course	BS-FT 302	Biology for Engineers	3	0	0	3
	Total Theory			18	0	0	18
Practical & Sessional							
1.	Professional Core courses	PC-FT 391	Chemistry of Food Lab	0	0	3	1.5
2.	Professional Core courses	PC-FT 392	Microbiology of Food Lab	0	0	3	1.5
3.	Basic Science Course	BS-FT 391	Chemistry-II Lab	0	0	3	1.5
4.	Summer Internship	SI-FT 381	Report and Seminar on Internship	0	2	0	2
	Total Practical			0	0	9	6.5
	Total of 3rd Semester			**18**	**2**	**9**	**24.5**

Semester IV [Second year] Curriculum
Branch/ Course: Food Technology

Sl. No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1.	Engineering Science Course	ES-FT 401	Transfer Operations in Food Processing	3	0	0	3
2.	Professional Core courses	PC-FT 401	Biochemistry & Nutrition	3	0	0	3
3.	Professional Core courses	PC-FT 402	Principles of Food Preservation	3	0	0	3
4.	Professional Core courses	PC-FT 403	Engineering Properties of Food Materials	3	0	0	3
5.	Basic Science Courses	BS-FT 401	Numerical Methods & Statistical Techniques	2	0	0	2
6.	Humanities and Social Sciences including Management Courses	HM-FT 401	Professional Ethics & IPR	2	0	0	2
7.	Mandatory non-credit course	MC-FT 401	Slot for MC [Environmental Sciences]	3	0	0	0
	Total Theory			19	0	0	16
Practical							
1.	Engineering Science Course	ES-FT 491	Unit Operation Lab	0	0	3	1.5
2.	Professional Core courses	PC-FT 491	Biochemistry Lab	0	0	3	1.5
3.	Professional Core courses	PC-FT 492	Food Preservation Lab	0	0	2	1
4.	Basic Science Courses	BS-FT 491	Numerical Methods Lab	0	0	2	1
	Total Practical			0	0	10	5
	Total of 4th Semester			**21**	**0**	**10**	**21**

Students undergo Summer Internship for a period of 4-6 weeks	**2 credits**

Semester V [Third year] Curriculum
Branch/ Course: Food Technology

Sl. No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1.	Professional Core courses	PC-FT 501	Technology of Fruits, Vegetables, Spices, Tea, Coffee & Beverages Processing	3	0	0	3
2.	Professional Core courses	PC-FT 502	Fish, Meat & Poultry Processing Technology	3	0	0	3
3.	Professional Core courses	PC-FT 503	Food Process Engineering	3	0	0	3
4.	Professional Elective courses	PE-FT 501 (A/B/C)	Elective – I (Nutraceuticals & Functional Foods/ Instrumental Methods of Food Analysis/ Grain Science & Technology)	3	0	0	3
5.	Open Elective courses	OE-FT 501 (A/B/C)	Open Elective – I (Enzyme Technology/ Renewable Energy Technology/ Flavour Technology)	3	0	0	3
6.	Humanities And Social Sciences Including Management Courses	HM-FT 501	Engineering Economics	3	0	0	3
7.	Mandatory course	MC-FT 501(A/B)	Slot for MC [Constitution of India/ Essence of Indian Knowledge Tradition]	2	0	0	-
	Total Theory			20	0	0	18
Practical & Sessional							
1.	Professional Core courses	PC-FT 591	Food Processing Lab – I	0	0	3	1.5
2.	Professional Core courses	PC-FT 592	Food Analysis & Quality Control Lab-I	0	0	3	1.5
3.	Professional Core courses	PC-FT 593	Food Engineering Lab	0	0	3	1.5
4.	Summer Internship	SI-FT 581	Report and Seminar on Industrial Training	0	2	0	2
	Total Practical			0	0	9	6.5
	Total of 5th Semester			**20**	**2**	**9**	**24.5**

Semester VI [Third year] Curriculum
Branch/ Course: Food Technology

Sl. No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1.	Professional Core courses	PC-FT 601	Milk & Milk Products Processing Technology	3	0	0	3
2.	Professional Core courses	PC-FT 602	Edible Fats and Oils Processing Technology	3	0	0	3
3.	Professional Core courses	PC-FT 603	Technology of Bakery, Confectionary & Extruded Food Processing	3	0	0	3
4.	Professional Elective courses	PE-FT 601 (A/B/C)	Elective – II(Fermentation Technology & Biochemical Engineering/ Management of Food Industry Wastes / Food Additives)	3	0	0	3
5.	Open Elective courses	OE-FT 601 (A/B)	Open Elective – II (Data Structure & Algorithm/ Data Base Management System)	2	0	0	2
6.	Open Elective courses	OE-FT 602 (A/B)	Open Elective – IV (Nanoscience in Food Technology/ Protein Technology/ New Product Development)	3	0	0	3
	Total Theory			17	0	0	17
Practical							
1.	Professional Core courses	PC-FT 691	Food Processing Lab – II	0	0	3	1.5
2.	Professional Core courses	PC-FT 692	Food Analysis & Quality Control Lab-II	0	0	3	1.5
3.	Professional Elective courses	PE-FT 693	Fermentation Technology Lab	0	0	2	1
4.	Open Elective courses	OE-FT 691	Data Base Management System Lab	0	0	2	1
	Total Practical			0	0	10	5
	Total of 6th Semester			**17**	**0**	**10**	**22**

Students undergo Summer Internship for a period of 4 - 6 weeks	**2 credits**

Semester VII [Fourth year] Curriculum
Branch/ Course: Food Technology

Sl. No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1.	Professional Core courses	PC-FT 701	Food Packaging Technology	3	0	0	3
2.	Professional Core courses	PC-FT 702	Food Safety & Quality Management	3	0	0	3
3.	Humanities And Social Sciences Including Management Courses	HM-FT 701	Principles of Management	3	0	0	3
4.	Professional Elective courses	PE-FT 701 (A/B/C)	Elective – III (Food Laws & Standards / Emerging Trends in Food Processing / Food Toxicology)	3	0	0	3
5.	Professional Elective courses	PE-FT 702 (A/B/C)	Elective – IV (Project Engineering & Food Plant Layout/ Modeling & Simulation of Food Processes / Plant Maintenance, Safety & Hygiene)	3	0	0	3
6.	Open Elective courses	OE-FT 701 (A/B/C)	Open Elective – III (Entrepreneurship Development for Food Technologists/ Food Security & Sustainability/ Food Process Equipment Design)	3	0	0	3
	Total Theory			18	0	0	18
Practical & Sessional							
1.	Professional Core courses	PC-FT 791	Food Product Development & Quality Assurance Lab	0	0	4	2
2.	Summer Internship	SI-FT 781	Report and Seminar on Industrial Training	0	2	0	2
3.	Mandatory course	MC-FT 791	Group Discussion & Personality Development	0	0	0	0
	Total Practical			0	0	4	4
	Total of 7th Semester			**18**	**3**	**4**	**22**

Semester VIII [Fourth year] Curriculum
Branch/ Course: Food Technology

Sl. No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1.	Professional Core courses	PC-FT 801	Supply Chain Management & FoodMarketing	2	0	0	2
2.	Professional Core courses	PC-FT 802	Industrial Processing of Food and Beverage	2	0	0	2
Sessional							
1.	Summer Industry Internship	PW-FT 891	Internship Project	-	-	-	8
	Total of 8th Semester			**-**	**-**	**-**	**12**

Detailed Syllabus

B. Tech Food Technology

Second Year: Third Semester

Theory

Name of the Course: Chemistry-II	
Course Code: BS-FT 301	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment.: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points:3	

Objective:	
1	To develop the knowledge of students in the properties of dilute solutions using colligative properties, ionic equilibrium
2	To enable the students to explain the formation, characteristics and application of colloidal solutions
3	To enable the students to explain the shape, properties and bonding of ionic, covalent and coordination compounds
4	To prepare the students to explain kinetics of reactions and mechanism of organic reactions
Pre-Requisite:	
1	Basic physical, inorganic and organic chemistry

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	**Module I: Dilute solutions –** **Colligative properties:** Lowering of vapor pressure of solution, elevation of boiling point, freezing point depression, definition, principles, and laws of osmotic pressure **Ionic equilibrium:** Solubility and solubility product, common ion effect, determination of solubility product by EMF method, ionic product of water, pH, pOH, hydrolysis of salt solutions: Strong acid and weak base, weak acid and strong base, weak acid and weak base, concepts of buffer	8

2	**Module II:** **Coordination chemistry:** Structures of coordination compounds corresponding to coordination number 6; types of ligands; isomerism(geometrical, optical, ionization, linkage and coordination) **Colloid chemistry:** Definition of colloid, principle of colloid formation, types of colloid, colloid preparation, stability of colloid, association of colloid and emulsion	8
3	**Module III:** **General treatment of reaction mechanisms:** Ionic and radical reactions; heterolytic and, homolytic bond cleavage. **Reactive intermediates:** carbocations (carbenium and carbonium ions), carbanions, carbon radicals –structure using orbital picture, electrophilic/ nucleophilic behaviour, stability, generation and fate. Fundamentals of elimination, substitution, addition and rearrangement – Definition and organic reactions.	7
4	**Module IV:** **Structure and bonding:** Ionic and covalent bonding, M.O. and V.B. approaches for diatomic molecules, VSEPR theory and shape of molecules, hybridization, resonance, dipole moment, structure parameters such as bond length, bond angle and bond energy, hydrogen bonding, vander Waals interactions. Ionic solids, ionic radii, lattice energy (Born-Haber Cycle).	7
5	**Module V:** **Kinetics:** Rate of Chemical reactions, Order and Molecularity of chemical reactions, Elementary and Non elementary reactions. First, second and third order reactions. Pseudo-first order reaction. Fractional order reactions. Determination of order and rate constant by integral and half-life method. Effect of rate constant on temperature: Arrhenious equation. Collision theory, Transition state theory.	6

Text and Reference Books:

Text

1. Physical Chemistry by P. C. Rakshit, Sarat Book House
2. Inorganic Chemistry by R. L. Madan, G. D. Tuli, S. Chand & Company Ltd
3. Organic Chemistry by Dr. R.L. Madan, S. Chand & Company Ltd

Reference

1. Physical Chemistry, by P. W. Atkins
2. Inorganic Chemistry 4th Ed: principles of Structure and Reactivity by James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi
3. Mechanism in Organic Chemistry by Peter Sykes, orient Longman Pvt. Ltd.
4. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5thEdition
5. Engineering Chemistry by Jain and Jain

Course Outcome:

After completion of the course the students will be able to

CO1: Understand the fundamentals and application of current chemical and scientific theories and prepare the different solution of definite concentration accurately in the experimental wet lab and industry

CO2: Understand the fundamental properties and reactivity of compound and interactions within the molecules and to explain the reaction involved in chemical and biochemical reaction based on the specific ligands.

CO3: Identify and to know the classes of polymeric compounds and the importance of structure, scope and function of macromolecules

CO4: Understand the importance of different types of solutions use in food engineering and technology

CO5: Be skilled in problems solving, critical thinking, and analytical reasoning.

CO6: Know the various qualitative and quantitative physical methods available for structure determination and apply the analytical skill and design new experimental techniques to be used in food engineering and technology.

Name of the Course: Engineering Thermodynamics	
Course Code: ES-FT 301	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment.: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 3	

Objective:	
1	To develop the fundamental knowledge of students in the area of Engineering Thermodynamics
2	To depict the theory and applications of laws of thermodynamics and thermodynamic properties
Pre-Requisite:	
1	Chemistry
2	Mathematics

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Fundamentals of thermodynamics (System, heat, work, internal energy, entropy, first law), and its practical significance/applied to elementary processes Limitations of the first law of thermodynamics, Second law, concepts of heat engines and heat pumps, refrigeration, Kelvin-Planck and Clausius statements and their equivalence; reversible and irreversible processes; Carnot cycle and Carnot principles/theorems; thermodynamic temperature scale; Clausius inequality and concept of entropy; the principle of increase of entropy, T-s diagrams; second law analysis of control volume; availability and irreversibility; Third law of thermodynamics	12
2	Properties of Pure Substances Thermodynamic properties of pure substances in solid, liquid and vapor phases; P-v- T behaviour of simple compressible substances, phase rule, thermodynamic property tables and charts, ideal and real gases, ideal gas equation of state and van der Waals equation of state; law of corresponding states, compressibility factor. Analysis of non- flow and flow processes for an ideal gas under constant volume (Isochoric), constant pressure (isobaric), constant temperature (isothermal), adiabatic and polytropic conditions.Ideal Gas Mixtures Dalton's and Amagat's laws, properties of ideal gas mixtures, air-water vapour mixtures and simple thermodynamic processes involving them; specific and relative humidities, dew point and wet bulb temperature, adiabatic saturation temperature, psychrometric chart.	12

3	Thermodynamic Relations T-ds relations, Helmholtz and Gibbs functions, Gibbs relations, Maxwell relations, Joule-Thomson coefficient, coefficient of volume expansion, adiabatic and isothermal compressibilities, Clapeyron and Clapeyron-Clausius equations. Thermodynamic and power Cycles Carnot vapor cycle, ideal Rankine cycle, Rankine reheat cycle, vapor-compression refrigeration cycle.	12
4	Thermodynamics of fluid flow; Study of different types of boilers; Brief idea of hydraulic power plants	9

Text and Reference Books:

Text

1. Smith & Vanness, Thermodynamics for Chemical Engineers, MGH

Reference

1. Richardson, J.F., Peacock, D.G. Coulson & Richardson's Chemical Engineering-Volume3ed., First Indian ed. Asian Books Pvt. Ltd. 1998
2. Levenspiel. O., Chemical Reaction Engineering, Wiley Eastern Ltd.
3. Bailey & Olis, Biochemical Engg. Fudamentals, MGH, 1990
4. Physical Chemistry: Castellan, Narosa Publishing.
5. Physical Chemistry ;Moore, PHI

Course Outcome:

After completion of the course the students will be able to

CO1: Understand the basic concept of thermodynamic system.

CO2: Explain the laws of thermodynamics and their applications

CO3: Comprehend the properties of pure substances and real gases.

CO4: Analyze the different thermodynamic relations and their applications.

CO5: Evaluate the fundamentals of Thermodynamics of fluid flow.

CO6: Understand the working of different types of boilers and hydraulic power plants.

Name of the Course: Mechanical Operations in Food Processing	
Course Code: ES-FT 302	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment: 30 marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 3	

Objective:	
1	To know different material balance and energy balance equation to conceptualize the experiments.
2	To assess the different simultaneous mass and energy transfer operation in industrialprocess like drying crystallization etc.
3	To apply their knowledge in membrane separation process.
4	To understand different type of Mechanical operations like crushing and Grinding and Sieve separation technique
5	To understand the Engineering operations in different mixing process solid- solid mixing and liquid liquid mixing etc.
6	To understand different type of pressure filtration process and rate of filtration, constant pressure and Rate filtration
Pre-Requisite:	
1	Physics, Mathematics

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Size Reduction: Principles of comminution, Types of comminuting equipment. Energy and power requirement, Crushers, Grinders, Principles and types of size reduction equipment, disintegration of fibrous materials;	9
2	Mixing: Mixing of liquids and solids (powder), mixing equipment, mixing index and mixing time, Agitation and blending, types of agitators, power consumption in mixing. Mechanical separation, Screening, Types of screen, Filtration, Principle of Constant pressure and constant rate filtration, Settling classifiers, Floatation, Centrifugal separations Centrifugation: Principle of settling, sedimentation, flocculation, devices and types of each operation (free and hinderd settling, hydraulic separation and heavy media separation)	12

3	Material balance: Introductory Concepts, Simplification of the general mass balance equation for steady and unsteady state processes, Procedure for material balance calculations, Material balance without chemical reactions, humidification, continuous filtration, batch mixing, crystallizer, distillation column. Material balance with chemical reaction: Stoichiometry of growth and product formation: growth stoichiometry and elemental balances.	10
4	Material Balance with recycle, bypass and purge streams its application in Food and Biochemical Industries	4
5	Crystallization: material and energy balance calculations and introduction to crystallizer design. Fundamental principles of liquid-liquid extraction, selectivity and choice of solvent; material balances in stage operations and principles of graphical methods in determination of number of equilibrium stages; Fundamental principles of leaching operation and material balance calculations.	7

Text and Reference Books:

1. Unit Operations of Chemical Engineering: McCabe, Smith &Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
3. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
4. Heat Transfer: D.Q. Kern, MGH
5. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, MGH
6. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition, JWS
7. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH
8. Fundamentals of Food Process Engineering R.T. Toledo CBS publication
9. Food Processing Technology P.J. Fellows CRC press

Course Outcome:

After completion of the course the students will be able to

CO1: Understand different disintegration process in Food Industries.

CO2: Realize different Industrial Mixing process and power consumption in Mixing.

CO3: Make use of design of different type of settling tank by applying the principle of setting.

CO4: Comprehend different type of material and Energy balance in different Food Processing Operations.

CO5: Apply of Material Balance principle in case of Microbial growth.

CO6: Understand different types of crystallization process like candy preparation etc.

Name of the Course: Chemistry of Food	
Course Code: PC-FT 301	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 3	

Objective:	
1	To develop the knowledge of students in the basic area of Food Chemistry
2	To enable the students to appreciate the similarities and complexities of the chemical components in foods and understanding of the physicochemical properties of foods.
Pre-Requisite:	
1	Basic physical and organic chemistry
2	Bio-molecules

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	**Introduction:** Development of food chemistry and its importance in food processing, different food groups, function of foods	1
2	**Water:** Importance of water in foods; Structure of water and ice; Crystallization & glass transition; Concept of bound & free water and their implications; Water activity (concepts, sorption phenomenon & isotherms, hysteresis); Role of water in food spoilage & food safety; Moisture determination methods.	5
3	**Carbohydrate:** Nomenclature, classification & physico-chemical properties (oxidation, reduction, hydrolysis etc.); Structure and functionalities of important monosaccharides (glucose, fructose, galactose), disaccharides (sucrose, lactose, maltose) and polysaccharides (starch, cellulose, glycogen, hemi-cellulose, pectic substances, gums, dietary fiber, inulin etc.); Basic idea about Gelatinization, Retrogradation, Crystallization, Caramelization, Mutarotation.	9
4	**Proteins:** Nomenclature, classification & structure of amino acids, peptides & proteins; Physico-chemical and functional properties of protein (hydration, solubility, denaturation, texturization etc.)	9
	Purification, separation & isolation of proteins; Common food proteins; Qualitative and quantitative determination of proteins.	
5	**Browning reactions:** Enzymatic and non-enzymatic browning, advantages and disadvantages, factors affecting their reaction and control	3
6	**Lipids:** Nomenclature, classification & structure of fatty acids and lipids; Importance of PUFA, omega-3 & omega-6 fatty acids, trans fatty acids, phospholipids & sterols in human diet; Physical constants (melting,	10

	solidification, softening, turbidity, smoke, flash & fire points) & chemical constants (saponification number, iodine value, Reichert-Meissl number, Polenske number, acid value, peroxide value); Rancidity and their prevention; Basic idea about polymorphism, hydrogenation, interesterification, winterization, refining; Dietary sources of lipids	
7	**Vitamins:** Types, sources and deficiency diseases of vitamins; Pro-vitamins; Vitamins as antioxidants; Effect of processing and storage.	5
8	**Minerals:** Types, sources and deficiency diseases of important minerals; Effect of processing and storage; Importance of minerals in milk, meatetc.	3

Text and Reference Books:

Text

1. Principles of Food Chemistry by John M. deMan, Third Edition. Aspen Publication, Gaithersburg, Maryland
2. Food Chemistry by L. H. Meyer, CBS Publishers and Distributors
3. Chopra, H.K. and P.S. Panesar. "Food Chemistry". Narosa, 2010.

Reference

1. Hand Book of Analysis and quality control for fruits & vegetables by S. Ranganna, 2ndedn. Tata Mc. Graw Hill Publication, New Delhi, India.
2. Food Chemistry by O. R. Fennema, Third Edition, Marcel Dekker, Inc., New York
3. Food chemistry by Belitz H.D., Grosch W. and Schieberle, Third Edn., Berlin: Springer Verlag
4. Principles of Biochemistry by Lehninger, Nelson & Cox, CBS Publication
5. Principles of Biochemistry by D. J. Voet, J. G. Voet and C.W. Pratt, Third Edn., Wiley.

Course Outcome:

After completion of the course the students will be able to

CO 1: Understand and identify the various food groups; the nutrient components (macro and micro), sources and types of important food constituents.

CO 2: Demonstrate basic structural units, bond formation and estimation process of important food components.

CO 3: Explain the physical, chemical and functional properties of various food constituents.

CO 4: Illustrate the major chemical reactions occurring during handling, processing and storage that limit shelf life of foods.

CO 5: Analyze how the properties of different food components and interactions among these components modulate the specific quality attributes of food systems.

CO 6: Develop solutions to reduce the interference of major chemical reactions during food processing that are likely to impact the overall quality of finished products.

Name of the Course: Food Microbiology		
Course Code: PC-FT 302	**Semester: III**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points: 3		
Objective:		
1	To develop the knowledge of students in the basic area of Food Microbiology	
2	To recognize and describe the characteristics of important pathogens and spoilage Microorganisms, and few beneficial microorganisms in food	
3	To identify the effect of microbial contamination in food and how to examine microbial load	
Pre-Requisite:		
1	Biology	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Introduction – definition, historical development and significance of food microbiology; Bacterial growth; Factors affecting microbial profile of foods; Microbiology of air & water; Techniques of pure culture; Methods for the microbiological examination of water and foods	9
2	Food borne illnesses and diseases- Current Scenario. Basic idea about Microbial Toxin. Antimicrobial agents –physical & chemical – mechanism & action. Disinfection & disinfectants; Control of Microbiological quality and safety	12
3	Concepts of spoilage, pathogenic and beneficial microbes; probiotics and synbiotics, Microbiology of milk & milk products (cheese, butter, ice- cream, milk powder); Microbiology of meat, fish, poultry & egg and their products.	12
4	Microbiology of fruits & vegetable and products like jam, jelly, sauce, juice; Microbiology of cereal and cereal products like bread, biscuits, confectionary.	12

Text and Reference Books:

Text

1. Food Microbiology; WC Frazier; Tata McGraw Hill, Delhi
2. Modern Food Microbiology; James M Jay; CBS Publishers, Delhi

3. Microbiology; Pelczar, Chan and Krieg; Tata McGraw Hill, Delhi
4. Food Microbiology; M. R. Adams

Reference

1. Essentials of Microbiology; K. S. Bilgrami; CBS Publishers, Delhi
2. Hand Book of Microbiology; Bisen
3. Basic Food Microbiology; Bannett, Chapman and Hall
4. Bibek Ray. "Fundamental food microbiology". CRC Press. 3rd Edition. 2005.

Course Outcome:

After completion of the course the students will be able to

CO 1: Identify and note the types of microorganisms inhabiting different categories of food

CO 2: Understand the interactions between microorganisms and the food environment, and factorsinfluencing their growth and survival

CO 3: Describe the characteristics of food-borne, waterborne microorganisms, and methods for their isolation, detection and identification

CO 4: Analyze how beneficial species of microorganisms can be utilized in the food industry.

CO 5: Evaluate how microbial spoilage leads to food-borne illnesses and how they can be controlled.

CO 6: Develop basic microbiological quality control solutions necessary in food production, handling and storage.

Name of the Course: Biology for Engineers	
Course Code: BS-FT 302	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 3	

Objective:	
1	To develop the knowledge of students in the fundamentals of biological sciences and microbiology
2	To enable the students to develop an insight in cellular structure and life processes of microbes
3	To apprise the students about natural products i.e. flavor and pigments (used as food additives) with their synthesis, properties
Pre-Requisite:	
1	Fundamentals of classical biology
2	Organic chemistry

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Introduction to Biology**;** Prokaryotic and Eukaryotic cell; Architecture of plant/animal/microbial cell	2
2	Basics of cell biology – Different cell organelles – cell wall, cell membrane, nucleus, mitochondria, Golgy body, endoplasmic reticulum, vacuoles etc.	4
3	Classification of microbes: Morphology and characteristics of each type; microbial cell metabolism, metabolic enzymes	6
4	Microbial Respiration, Growth and Reproduction	6
5	Basics of microbial genetics – Gene, DNA, RNA, Replication, transcription, transformation, transduction, conjugation, regulation of gene expression	4
6	Natural products from plant/animal/microbial origin – Plant pigments (water-soluble, fat-soluble pigments): sources, properties, chemical identity, changes	6
7	Animal pigments, microbial pigments; sources, properties, chemical identity, changes in processing	6
8	Natural flavouring agent from plant/ animal origin –definition, extraction/ synthesis, purification (if required), flavor enhancers	6

Text Books:

1. Fundamentals of Biology : Sanyal and Chatterjee,
2. Food Chemistry by L. H. Meyer, CBS Publishers and Distributors
3. Biology for Engineers – R. Singhal, Gaurav Agarwal and Ritu bir ; CBS publishers
4. Microbiology – Pelczar, Chan and Krieg; McGraw-Hill Inc., US

Course Outcome:

After completion of the course the students will be able to

CO1: Identify and note the different features of microbial cell and plant/animal cell.

CO2: Understand the characteristic life-processes of microbial cell.

CO3: Identify different types and/or forms of microbes.

CO4: Understand and classify different plant/animal/microbial pigments correlating with structure and properties.

CO5: Evaluate and illustrate synthesis of flavor as natural products from natural source.

CO6: Develop basic biological concept to solve basic problems associated with food production, handling and storage.

Practical

Name of the Course: Chemistry of Food Lab	
Course Code: PC-FT 391	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva -20 Marks

Objective:	
1	To know the physical and chemical properties of food
2	To understand different methods of analysis of food components
3	To utilize food composition tables and databases to solve practical problems

Pre-Requisite:	
1	Handling of glassware, chemicals and equipments
2	Basic knowledge of solution preparation, chemical reactions
3	Spectrophotometric , titrimetric, gravimetric, volumetric principles

Practical:	
	1) Intellectual skills-
	2) Motor skills- Spetrophotometer, pH meter, Hot Air Oven/ Moisture Analyzer, Soxhlet Apparatus, Kjeldhal Unit, Muffle Furnace, Glassware, chemicals & consumables

Laboratory Experiments:	
1	Determination of Moisture in food sample
2	Determination of Acidity and pH in food sample/beverages
3	Determination of total, non-reducing and reducing sugars
4	Determination of Protein in food sample
5	Determination of Crude Fat in food sample
6	Determination of Ash in food sample
7	Estimation of calcium/ zinc/ iron in food sample
8	Determination of Vitamin C in food sample
9	Determination of pigments in food sample

Text and Reference Books:

1. FSSAI Manuals
2. Handbook of analysis & quality control for fruit & vegetable products by S. Rangana, IIed., Tata McGraw Hill Publishing Co., New Delhi

3. ISI Handbook of Food Analysis
4. Official methods of analysis of AOAC

Course Outcome:

After completion of the course the students will be able to

CO1: Understand the safety protocols applicable in laboratory.

CO2: Perform different methods of analysis of food components and know operational techniques of various analytical instruments.

CO 3: Compare different methods available for analysis of particular food component.

CO 4: Understand and effectively use appropriate regulatory specifications for analysis of food components.

CO 5: Analyze effectively the data to reach reasonable and valid conclusion.

CO 6: Design appropriate methods for proximate analysis of different food materials in real situation.

Name of the Course: Microbiology of Food Lab	
Course Code: PC-FT 392	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva -20 Marks

Objective:	
1	Understand the microbiological load of food and beverage samples
2	Understand different microbiological methods of food components
3	Compare different microbiological standards available for analysis of particular food component
4	Understand and use effectively, microbiological techniques to standardize quality to solve practical problems
5	Analyze effectively the data to reach reasonable and valid conclusion
6	Design appropriate SOPs for microbiological analysis of food in real-time situation
Pre-Requisite:	
1	Handling of glasswares, chemicals and equipments
2	Basic knowledge of solution preparation, biology, yeast and mould growth, bacterial growth, pathogen, pasteurization, sterilization
3	Spectrophotometric principles, Laminar air flow cabinet, Microscope, Autoclave

Practical:	
	1) Intellectual skills-
	2) Motor skills- Autoclave, Spetrophotometer, Laminar air flow cabinet, Microscope, , pH meter, Hot Air Oven/ Moisture Analyzer, Petri plate use Glassware, chemicals & consumables

Laboratory Experiments:	
1	Study of a compound microscope.
2	Gram Staining and Study of morphology of bacterial cells
3	Study of autoclave, Preparation and sterilization of nutrient broth and agar
4	Sub-culturing and isolation of a bacterial strain
5	Study of growth of E. coli by a spectrophotometer
6	Study of microbiological quality of milk by MBRT test
7	Preparation of synthetic medium for yeast and mould and inoculation with standard strains of yeasts and moulds
8	Isolation of starch-hydrolyzing organism from soil
9	Dilution and Plating by spread–plate, streak-plate and pour –plate techniques

10	Isolation of pure culture
11	Estimation of microbial count of air, water and soil
12	Growth of Yeast and Mold in synthetic media and their Morphological Identification
13	Preparation of Culture Slants for preservation of Culture

Text and Reference Books:

1. FSSAI Manuals
2. ISI Handbook of Food Analysis
3. Official methods of analysis of AOAC
4. Laboratory Manual of Food Microbiology, Neelima Garg, K L Garg & K.G. Mukerji
5. Handbook of analysis & quality control for fruit & vegetable products by S. Rangana, IIed., Tata McGraw Hill Publishing Co., New Delhi

Course Outcome:

After completion of the course the students will be able to

CO1: Recall and define fundamental principles of biology to recognize and state substantial practical solution of food microbiology problems

CO2: Understand and select appropriate mathematical calculations, review data and express them graphically in relation to the experiment.

CO3: Acquire skills to practice basic lab maintenance protocol, apply appropriate techniques and use theoretical knowledge to handle delicate lab instruments.

CO4: Analyze experiments, examine data, and synthesize information to compare theoretical knowledge with practical experimentation through effective hands on training to reach reasonable and valid conclusions.

CO5: Develop decision making potential, acquire team spirit, manage project, utilize fund, keep good coordination with in realistic constraints such as economic, environmental, ethical, health and microbiological safety, feasibility and sustainability.

CO6: Evaluate effectively all microbial processes which will create lifelong learning by boosting new and original work and thus develop an inquisitive mind and scientific outlook.

Name of the Course: Chemistry - II Lab	
Course Code: BS-FT 391	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva -20 Marks

Objective:	
1	Explain kinetics of reactions and mechanism of organic reactions
2	Analyze effectively the data to reach reasonable and valid conclusion
3	Design appropriate SOPs for analysis of food in real-time situation

Pre-Requisite:	
1	Handling of glassware, chemicals and equipments
2	Basic knowledge of solution preparation, chemical reactions
3	Spectrophotometric , titrimetric, gravimetric, volumetric principles

Practical:	
	1) Intellectual skills-
	2) Motor skills- Spetrophotometer, Glassware, chemicals & consumables

Laboratory Experiments:	
1	Introduction, Student Safety and Emergency Information, Personal Protective Equipment (PPE) and Safe Attire, Behavioral Rules for Safety, Handling Accidents, Proper Waste Disposal
2	Chemical Hygiene Plan (CHP), Material Safety Data Sheet (MSDS), Good Laboratory Practices (GLP)
3	Amino Acid Analysis: pH measurements, Buffer Preparation, Isoelectric Point Determination
4	Temporary and permanent hardness in water sample by complexometric titration using EDTA standard
5	To determine the iron concentration in the given water sample by Spectrophotometer using potassium thiocyanate as colour developing agent
6	Detection of Phenolic/ Carboxylic group in given Food Sample
7	Detection of aldehyde / aliphatic or aromatic alcohol / ester / amino group(s) in given Food Sample

8	Determine the Equivalent weight of Iron by Chemical Displacement method
9	Determine the percentage of available chlorine in the given sample of Bleaching powder by Iodometry
10	Determine the alkalinity of given water sample
11	Study on kinetics of iodine / ester hydrolysis.

Course Outcome:

After completion of the course the students will be able to

CO1: Use molecular understanding in fields that are based upon chemistry, biological chemistry and engineering.

CO2: Know the proper procedures and regulations for safe handling during the use of chemical for safety.

CO3: Be skilled in problem solving, critical thinking and analytical reasoning.

CO4: Design, carryout, record, analyze the results of chemical experiments and communicate results effectively.

CO5: Use a variety of modern instrumentation and to determine different quantitative and qualitative technique and classical technique in course of experimentation.

CO6: Collaborate effectively as part of a team to solve problems, interact productivity with diverse group of team members.

Name of the Course: Report and Seminar on Industrial Training	
Type of Course: Sessional	
Course Code: SI-FT 381	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	
Practical: Nil	
Credit Points: 2	

Details of Syllabus

The Industrial Training will be undertaken by each student during the summer recess after the completion of the 4th semester examination and prior to commencement of the 5th semester. A report on the training which is required to be submitted shall consist of:

1. A general overview of the plant.
2. The products & raw material sources of the plant.
3. Detail description of different processing lines and other equipment.
4. Scheduling of plant operations.
5. Conclusion.

A viva will be conducted after submission of the report and presentation of a seminar

Course Outcomes:

After completion of the course the students will be able to

CO1: Relate different components of food science and technology, skills and scientific techniques followed in various food business/industry.

CO2: Understand hands on expertise in their relevant fields.

CO3: Bridge the gap between academia and ever-changing demand driven industrial business scenario to develop the need of industry with the polarization paradigm.

CO4: Analyze the skills and knowledge required for a particular job function.

CO5: Get exposure to advanced manufacturing and analytical tools to evaluate complex engineering problem.

CO6: Adopt basic industrial practices with ever changing food regulatory standards, ethics, legislation and food safety issues

Second Year: Fourth Semester

Theory

Name of the Course: Transfer Operations in Food Processing		
Course Code: ES-FT 401	**Semester: IV**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points: 3		
Objective:		
1	Understand several unit operations are carried out in Food Processing Industries by applying the knowledge.	
2	Recall several fundamental equations of fluid flow and heat transfer in understanding the subject.	
3	Make use of this knowledge for understanding of operations in industrial distillation in alcohol industries.	
4	Analyze different Industrial scale absorption and stripping operations	
5	Understand basic theory of mass transfer operation and different diffusion related theories	
Pre-Requisite:		
1	Basic operations in food processing	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	**Momentum Transfer and Flow of Fluid**: Raleigh's method and Buckingham's π theorem, dimensional analysis, dimensionless numbers Pressure drop-flow rate, relationship for flow through pipe, rectangular conduit and circular in laminar flow; Turbulent flow and fanning's friction factor; Compressible flow: flow through nozzle and porous media, Apparent viscosity, generalized viscosity coefficient, fundamentals of fluidization, ideal& real fluids, Newton's law of viscosity, Newtonian & Non Newtonian Fluids	9
2	Transport theorem, conservation laws, equation of continuity, Euler's equation of motion, Bernoulli's equation, viscous flow., types ofsimilarities, Friction in flow through packed beds **Measurement of flow rate :** Venturimeter, pitot tube, orificemeter; Rotameter, Pipe Fittings and valves, Pumps – classification, centrifugal and positive displacement type – peristaltic	8

3	**Heat Transfer:** Classification of heat flow processes, conduction, Thermal conductivity. Heat flow in fluids by conduction and convection. Counter current and parallel flow. Enthalpy balance in heat exchange equipment. Individual heat transfer coefficients, overall coefficient, Heating and cooling of fluids, Heat transfer equipment. NTU- Effectiveness relationship; Unsteady state heat transfer in plate, cylinder and spherical bodies; Radiation.	10
4	**Mass Transfer:** Molecular diffusion and Fick's Law; Steady state masstransfer in equimolar counter diffusion and diffusion through stagnant medium Introduction to mass transfer: Molecular diffusion in fluids, diffusivity, mass transfer coefficients, interphase mass transfer, gas absorption	9
5	Counter-current multistage operation, packed tower. Analogy between momentum, heat and mass transfer. Distillation- vapor-liquid equilibrium, relative volatility, batch and equilibrium distillation, steam distillation, molecular distillation, azeotropic and extractive distillation,; theory of rectification; design of distillation column	9

Text & Reference Books:

1. Unit Operations of Chemical Engineering: McCabe, Smith &Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
3. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
4. Heat Transfer: D.Q. Kern, MGH
5. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, MGH
6. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition, JWS
7. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH
8. Mass transfer operations by Robert. E. Treybal Third Edition MGH

Course Outcome:

After completion of the course the students will be able to

CO1: Understand about nature of fluid flow in a pipe line and correlate shear rate of a fluid and pressure drop in a pipe line.

CO2: Design continuous sterilization unit considering the different holding time for different parts of fluid.

CO3: Understand the operational principle of different type of heat exchangers.

CO4: Understand different diffusion control mass transfer operations and vapor liquid mass transfer phenomenon in a distillation Column.

CO5: Realize about importance of reflux ratio and the concept of optimum reflux ratio for minimizing the cost of operation of a distillation column.

CO6: Understand about simultaneous mass and heat transfer phenomenon and different types of analogies between mass and heat transfer.

Name of the Course: Biochemistry & Nutrition	
Course Code: PC-FT 401	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 3	

Objective:	
1	To develop the knowledge of students about biomolecules, relevant biochemical reactions and nutrition.
2	To enable the students to develop an insight on metabolism of different biomolecules and enzymatic pathways leading to end products
3	To make students understand about basic concepts of nutrition, different nutritional demands and dietary requirements
Pre-Requisite:	
1	Basic organic chemistry
2	Bio-molecules

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Introduction to Biochemistry in relation to food, Concept of metabolism with respect to food groups, Proteins and protein structures; Essential amino acids, Metabolism of proteins (digestion and absorption); Nitrogen balance and nitrogen pool; Evaluation of quality of proteins, Protein hydrolysate and their role in nutrition, bioactive peptides	8
2	Enzymes; Definition, function in human nutrition , classification, nomenclature & structure; Co-enzymes and its function; Mechanism of enzyme action, enzyme kinetics & environmental effects; Enzyme inhibition, Common food enzymes, Enzymes for food industries and their role	6
3	Carbohydrates; Definition & classification; Metabolic pathways for breakdown of carbohydrates: glycolytic pathway, citric acid cycle, ATP balance, electron transport chain, gluconeogenesis, glycogenolysis, pentose phosphate pathway; Cori cycle	10
4	Lipids; Essential fatty acids; Digestion & absorption of lipids	6
5	Vitamins & minerals: their common food sources and physiological functions.	4

6	Nutrition: Balanced diet, Nutrition and calorie requirements, Dietary requirements and deficiency diseases of different nutrients, complex carbohydrates and metabolism, special nutrition needs during pregnancy, lactation, infancy, for children, adolescents and aged; nutrition and public health; glycemic index and load, introduction to therapeutic nutrition, sports foods and nutrition Food hypersensitivity: food allergy, food intolerancy, biogenic amines	8

Text and Reference Books:

Text

1. Principles of Biochemistry by Lehninger, Nelson & Cox, CBS Publication
2. Biochemistry and Nutrition by Debajyoti Das,

Reference

3. Food Chemistry by O. R. Fennema, Third Edition, Marcel Dekker, Inc., New York
4. Food chemistry by Belitz H.D., Grosch W. and Schieberle, Third Edn., Berlin: Springer Verlag
5. Food Chemistry by L. H. Meyer, CBS Publishers and Distributors

Course Outcome:

After completion of the course the students will be able to

CO1: Understand requisite background knowledge in the field of Enzyme chemistry, their basic mode of action and regulation to remember, define, and repeat so that they have access in higher education/ Industry.

CO2: Understand how the properties of food components and interactions modulate the specific quality attributes of food systems, and to control the major chemical and biochemical reactions that influence food quality with emphasis on food industry applications.

CO3: Understand roles of biochemical reactions in the regulation of human metabolism and nutrition.

CO4: Comprehend the importance and role of carbohydrates, lipids, protein, vitamins, minerals in development of novel food product in industry.

CO5: Learn the basics of human nutrition and nutritive values of food to exhibit their creative potential in investigating and developing new ideas in food industry based project

CO6: Know the various qualitative and quantitative physical methods available for structure determination and apply the analytical skill and design new experimental techniques to be used in food engineering and technology

Name of the Course: Principles of Food Preservation	
Course Code: PC-FT 402	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 3	

Objective:	
1	To introduce students about the importance of preserving food to prevent wastage and losses
2	To introduce students about the methods of preservation to increase shelf life of food commodities and retain its overall quality
3	To introduce students about the methods of preserving food for value addition
Pre-Requisite:	
1	Knowledge of biology, chemistry
2	Knowledge of basic mathematics
3	Knowledge of food chemistry, food microbiology

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Introduction to food preservation: General principles of preservation; classification of methods used for preservation; need and importance of preservation at domestic and large scale; causes of food spoilage.	4
2	Basic concepts of thermal destruction of microorganisms – lethality, D, Z and F values; assessment of adequacy of thermal processing of food processing operations Pasteurization (definition, time-temperature combination and equipments, application, advantage, disadvantage); sterilization of foods; blanching (definition, time-temperature combination and equipments, adequacy in blanching, application, advantage, disadvantage) Canning (definition, equipments, advantage, disadvantage, influence of canning on the quality of food, spoilage of canned foods); retorting process; commercial sterility	10
3	Principles of food freezing, basic working principle and application of different types of freezers, IQF; frozen storage of foods; freeze concentration, refrigerated storage; cold storage; cold chain; effect of low temperature storage on organoleptic and nutritional characteristics of food.	6

4	Drying and dehydrations, drying phenomenon, factors affecting rate of drying; Sun drying, working principle of batch & continuous driers and their suitability for different foods; Freeze drying, effect of drying on organoleptic and nutritional characteristics of food; osmotic dehydration; intermediate moisture foods	8
5	Preservation by microbial fermentation (principle, types, applications); Chemical preservatives; Biopreservation; lactic acid bacteria, antibiotics; lantibiotics; Hurdle technology, Principles of preservation by use of sugar and salt, curing, pickling; smoking, Overview of minimal processing	6
6	Novel Non-thermal methods: HPP, ultrasonication, ohmic heating, microwave, pulsed electric field, pulsed light, cold plasma, ozone. Preservation by ionizing radiations (Sources of radiations, units and doses, irradiation mechanism, effect on microorganisms and different nutrients; dose requirements for radiation preservation of foods, safe limits)	6

Text and Reference Books:

1. Technology of Food Preservation by Desrosier
2. Handbook of. Food Preservation. Second Edition edited by. M. Shafiur Rahman. CRC Press
3. Food Science by Potter
4. Fruits and vegetable processing by Cruss
5. Preservation of Fruits & Vegetables by IRRI

Course Outcome:

CO1: Relate the basic knowledge of food science to understand the need and importance of food preservation.

CO2: Recognize and understand the causes of spoilage and how they affect the shelf life of food.

CO3: Describe the principles, working mechanism, advantages and disadvantages of different methods and techniques of food preservation

CO4: Apply the knowledge of mathematics and graphical derivation in process time calculations to estimate lethality of sterilization processes and spoilage probability of food products.

CO5: Demonstrate the appropriate application of different preservation processes in specific foods ensuring maximum retention of nutritional and orgnoleptical quality of food products.

CO6: Evaluate preservation principles in product design and value addition of food products

Name of the Course: Engineering Properties of Food Materials	
Course Code: PC-FT 403	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points:3	

Objective:	
1	To impart knowledge and understanding on different types food properties and its relevance to ensure food processing and quality
Pre-Requisite:	
1	Basic understanding of physics, physical chemistry, mechanics, thermodynamics and bioenergetics

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Physical characteristics of different seeds, grain and other food products- shape and size – description of shape and size - volume and density, porosity, surface area	10
2	Rheology: ASTM standard, terms - physical states of materials - classical ideal material – rheological models and equations - visco elasticity - creep stress relaxation - Non Newtonian fluid and viscometry -rheological properties – force - deformation, stress - strain, elastic - plastic behaviour	
3	Contact stresses between bodies: Hertz problems - firmness and hardness - mechanical damage -impact damage and dead load damage - vibration damage - friction - effect of load, sliding velocity, temperature, water film and surface roughness - friction in agricultural materials - rolling resistance -angle of internal friction, angle of repose - flow of bulk granular materials – aero dynamics of agricultural materials and food products - drag coefficients - terminal velocity.	12
4	Thermal properties: specific heat - thermal conductivity thermal diffusivity - methods of determination- steady state and transient heat flow.	12
5	Electrical properties: dielectric loss factor, loss tangent, A.C. Conductivity anddielectric constant -method of determination - energy absorption from high-frequency electric field. Electro-magnetic field effects.	5

Text & Reference Books:

Textbooks:

1. Rao, M. A., Rizvi, S. S. H. and Datta. A. K. Engineering Properties of Foods, (CRC Press, 2005)
2. Sahin S. and Sumnu, S. G. Physical Properties of Foods, (CRC Press, 2006)
3. Mohesenin, N. N. Thermal Properties of Foods and Agricultural Materials, (Gordon and BreachScience Publishers, 1980)
4. Mohesenin, N. N. Physical Properties of Plant and Animal Materials, (Gordon and Breach SciencePublishers, 1980)

References:

1. Peleg, M. and Bagelay, E. B. Physical Properties of Foods, (AVI publishing Co., 1983)
2. Jowitt, R., Escher, F., Hallstrom, B., Meffert, H. F., Walter, T., Spices, E. C. and Vox, G. PhysicalProperties of Foods, (Applied Science Publishers, 1983)
3. Figura L, O. and Teixeira A, A. Food Physics: Physical Properties- Measurement and applications(2007)

Course Outcome:

After completion of the course the students will be able to

CO1: Outline physical properties of food which play indispensable role in development of different food processing equipment for generation of various raw materials as well as finished products.

CO2: Understand rheological behavior of food materials through analysis of the molecular interplay between basic components of foods like water, oil, proteins and carbohydrates.

CO3: Understand the effect of frictional and aerodynamic properties on the perishability and handling properties of food materials.

CO4: Understand the different thermal properties of food materials and their effect on the different modes of heat transfer viz., conduction, convection and radiation.

CO5: Understand the relationship between the composition and dielectric properties of food materials which has wide application in different food processing techniques such as microwave drying.

CO6: Analyze the above-mentioned physical, rheological, frictional, aerodynamic, thermal and electrical properties of various raw materials in order to develop new value-added products or enhance existing products at both industrial and laboratory scale.

Name of the Course: Numerical Methods & Statistical Techniques	
Course Code: BS-FT 401	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 2 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 2	

Objective:	
1	The goal is to provide a basic understanding of the derivation, analysis, and use of thesenumerical and statistical methods, to solve the various problems and methods.
2	Purpose is to provide students with the skills, knowledge and attitudes required to provide solutions to mathematical problems which cannot always be solved by conventional analytical techniques,
3	Realize the importance of selecting the right numerical technique for a particular application, and carefully analyze and interpret the results obtained
Pre-Requisite:	
1	Basic engineering mathematics
2	

Details of Syllabus:

Unit	Content	Hrs/Un
1	**Approximation in numerical computation**: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors.	4
2	**Interpolation:** Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation.	5
3	**Numerical integration**: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms.	3
4	**Design of experiments**: Guidelines for designing experiments and importance of designed experiments in food research, Types of DOE: Full Factorial, fractional factorial, central composite design, rotatable central composite experimental design, box behenken design. Limitations of each.	9
5	**Analysis of variance** of experiments with one or more fixed and random factors, Multiple comparisons. Analysis of residuals, Non-parametric ANOVA,Kruskal–Wallis test.	6
6	Developing empirical equations using experimental data; Basics of RSM (Response surface methodology)	4
7	Application of Fuzzy logic to sensory evaluation and ranking of foods.	5

8	**Applied Statistics:** Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.	4
9	**Test of significance**: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standarddeviations.	4
10	**Testing of fitness**: Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes	5

Text and Reference Books:

Text Books:

1. C.Xavier: C Language and Numerical Methods.
2. Dutta & Jana: Introductory Numerical Analysis.
3. J.B.Scarborough: Numerical Mathematical Analysis.
4. Jain, Iyengar , & Jain: Numerical Methods (Problems and Solution).
5. **Experimental Designs, 2nd Edition,**William G. Cochran, Gertrude M. Cox,ISBN: 978-0-471-54567-5 May 1992
6. Montgomery, D.C. (2009). Design and Analysis of Experiments.

References:

1. Balagurusamy: Numerical Methods, Scitech.
2. Baburam: Numerical Methods, Pearson Education.
3. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
4. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP.
5. Srimanta Pal: Numerical Methods, OUP.

Course Outcome:

After completion of the course the students will be able to

CO1: Construct the interpolating polynomial for both equispaced and unequispaced arguments.

CO2: Apply numerical techniques to solve food engineering problems.

CO3: Construct graphical displays of science/engineering data and interpret the role of such displays indata analysis.

CO4: Apply basic statistical inference techniques, including confidence intervals, hypothesis testing andanalysis of variance, to science/engineering problems.

CO5: Employ appropriate regression models to determine statistical relationships.

CO6: Construct optimal or good designs for a range of practical experiments

Name of the Course: Professional ethics and IPR	
Course Code: HM-FT 401	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 2 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 2	

Objective:	
1	To create awareness amongst students on engineering ethics and Human values
2	To instill Moral and social values, loyalty and to appreciate the rights of others
3	To introduce the fundamental aspects of Intellectual Property Rights so as to make the students competent to play a major role in development and management of innovative projects in Industries
Pre-Requisite:	
1	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	**Morals, values and ethics-integrity-work ethic,** moral dilemmas, Kohlberg's theory-gilligan's theory-consensus and controversy, models of professional roles –theories about right action, Moral leadership-code of conduct, introduction to techniques of professional excellence and stress management. corporate social responsibility, respect for authority, confidentiality-conflicts of interest, occupational crime-professional rights, employee rights	6
2	**Ethical issues in engineering** practice, social and ethical responsibilities of technologists, Conflicts between business demands and professionalideas , fair trade practices, case studies	3
3	**Environmental ethics**, environmental regulations, Safety and risk-Assessment, risk benefit analysis and mitigation of risk,	3
4	**Introduction to IPR**: Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights,. Kinds of Intellectual property rights—Copy Right, Patent, Trade Mark, Trade Secret and trade dress, Design, Layout Design, Geographical Indication, Plant Varieties and Traditional Knowledge	5
5	**Patents and copyrights**—Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties. **Copyright**- Origin, Definition, types of Copy Right; Registration procedure,	10

	Assignment & licence, Terms of Copy Right, Infringement, Remedies, Copy rights with special reference to food excipients, additives and processed products	
6	**Trademarks**—Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing Off, Penalties.	4
7	**Design**-Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention of design- type and functions.	4
8	**International registration systems**, Provision of IPR under TRIPS and WTO, unfair competitions, Legal implications and public concerns in genetic modification in foods, International and National policies of food security	5

Text and Reference Books:

1. Ajit Parulekar and Sarita D Souza, Indian Patents Law-Legal and Business Implications,Macmillan India Ltd,2006
2. B. L. Wadehra, Law Relating to Patents, Trade Marks, Copyrights, Designs and GeographicalIndications, Universal Law Publishing Pvt. Ltd., India 2000
3. P. Narayanan Law of Copyright and Industrial Designs, Eastern Law House, Delhi, 2010
4. Intellectual Property Rights in Agricultural Biotechnology; Edited by Erbish, Maredia, CABI
5. T.M. Murray and M.J. Mehlam, Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley and Sons 2000
6. S.K.Chakraborty: Values and Ethics in Organization, OUP
7. N. Tripathi, Human values, Newage International Economic Reforms and Food Security. TheImpact of trade and technology in South Asia by Suresh Chandra Babu, Haworth Press

Course Outcome:

After completion of the course the students will be able to

CO1: Debate interaction of moral and ethics in profession.

CO2: Relate informed critical reflection on the nature of professionalism and ethical challenges inherent in professionalism

CO3: Explain ethical concepts, challenges and dilemmas confronting members in various aspects of food industry

CO4: Explain the significance of various types of IPR with special reference to food industry

CO5: Apply the strategy of acquiring patent and copyright for own innovative works.

CO6: Identify plagiarized contents in written representations and innovations which can be questioned legally in works

Name of the Course: Environmental Sciences	
Course Code: MC-FT 401	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 0	

Objective:	
1	To understand about different types of pollution of Environment
2	To get idea of Different type of biological Cycles in Nature
3	To understand about different types of pollution and their remedy
4	To understand Air pollution and greenhouse effect
5	To get idea about water pollution and their sources and remedial measure
6	To analyze water for pollution level organic and Inorganic load
7	To understand land pollution and its control
8	To Understand Different type of noise pollution its sources and remedial measure
9	To understand about different types of pollution of Environment
10	To get idea of Different type of biological Cycles in Nature
Pre-Requisite:	
1	Basic knowledge of Chemistry, Biology and Mathematics

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	**Introduction:** Basic ideas of environment, basic concepts, man, society & environment, their interrelationship. Environmental Laws of India Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-a-vis population growth, sustainable development.	3
2	**Materials balance:** Steady state conservation system, steady state system with non conservative pollutants, step function. **Environmental degradation:** Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of environmental science and engineering.	3
3	**Ecology:** Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem-components types and function.	5

	Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundarban); Food chain: definition and one example of each food chain, Food web. Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threat to biodiversity, Conservation of biodiversity.	
4	**Air pollution and control:** Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems. Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on seawater level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth'sheat budget. Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion).	8
5	Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model. Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen,oxides of sulphur, particulate, PAN. Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect ofozone modification. Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP. cyclone separator, bag house, catalytic converter, Ventury scrubber).	8
6	**Water Pollution and Control:** Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic River/Lake/ground water pollution: River: DO, 5 day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) Standard and control: Waste water standard [BOD, COD, Oil, Grease]	9

	Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening]Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds]; Tertiary treatment definition.	
7	**Land Pollution:** Lithosphere; Internal structure of earth, rock and soil. Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. Solid waste management and control (hazardous and biomedical waste).	**3**
8	**Noise Pollution:** Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise] Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L_{10} (18hr Index), Ld_n. Noise pollution control. **Environmental Management:** Environmental impact assessment, Environmental audit, Environmental laws and protection act of India, Different International environmental treaty/ agreement/ protocol.	**6**

Text and Reference Books:

1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
2. De, A. K., "Environmental Chemistry", New Age International.

Course Outcome:

After completion of the course the students will be able to

CO1: Understand about nature of different pollution and their sources.

CO2: Learn about Environmental law of the country.

CO3: Learn about the nature of industrial waste coming out of different Food Industry.

CO4: Have an idea about removal of different water pollutant

CO5: Understand about different type of air pollutant and their method of removal.

CO6: Have some basic idea of solid waste Management and treatment process.

Practical

Name of the Course: Unit Operation Lab	
Course Code: ES-FT 491	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva -20 Marks

Course Objective: After the end of the course students are expected to:

1.	Recall several fundamental equations of fluid flow and heat transfer in understandingthe subject.
2.	Understand several unit operations are carried out in Food Processing Industries by applying knowledge of the lab.
3.	Assess some process line intricacy by applying knowledge of this lab
4.	Enhance their ability to work in a team.
5.	Enhance their oral and written communication skills through published paper review, analysis and presentation.
6	Make use of this knowledge for understanding of operations in industrial distillation in alcohol industries.
7	Analyze different Industrial scale absorption and stripping operations
8	They can understand diffusional phenomenon and mass and heat transferanalogies

Pre-Requisite: Students must have an awareness and understanding of:

1.	Nature of fluid and flow characteristics
2.	Basic principles of heat transfer.
3.	Basic idea about mechanical operation and mass transfer operation.
4.	Application of diffusional mass transfer operation in different separation process.
5.	Basic idea about heat transfer with phase change

Practical:

1.	**Intellectual skills-**Knowledge & Understanding, Critical Thinking, Problem Solving Skills
2.	**Motor skills-**Hand – eye co-ordination, Attention to detail, Manipulative skills.

Laboratory Experiments:	
1	Experiments on Reynolds's Apparatus –Determination of flow regime and construction of friction factor against NRE
2	Experiments on flow measuring device — in closed conduit using (a) Venturimeter, (b) Orificemeter, (c) Rotameter.
3	Determination of Pressure drop for flow through packed bed & verification of Ergun Equation,Kozeny-Karman equation, Blake-Plummer Equation.
4	To study the working characteristics of a Jaw Crusher, calculate the energy consumption asa function of size reduction and compare it with the actual energy requirements.
5	To study the working characteristics of a Ball Mill, calculate the energy consumption as a functionof size reduction and determine the critical speed.
6	To Determine the Overall heat transfer coefficient of a concentric pipe heat exchanger based on theinside diameter of the tube.
7	To study the characteristics of film-wise/drop-wise condensation.
8	Separation: Filtration, centrifugation
9	Mass transfer coefficient / kLa determination
10	Determination of Distillation efficiency in a sieve plate distillation column.
11	Differential distillation and verification of Rayleigh's Equation
12	Differential distillation and verification of Rayleigh's Equation
13	Liquid liquid mixing

Text and Reference Books

1. Unit Operations of Chemical Engineering: McCabe, Smith &Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
3. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
4. Heat Transfer: D.Q. Kern, MGH
5. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, MGH
6. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition, JWS
7. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH

Course Outcome:

After the end of the course students shall be able to:

CO1: Learn the different aspect of fluid flow in a pipe line and through packed bed

CO2: Understand the engineering aspect of heat transfer phenomenon.

CO3: Perform different food processing and mechanical operations in Food Industries.

CO4: Apply the knowledge of mathematics, science, engineering fundamentals and engineering specialization to the solution of complex Engineering problem.

CO5: Analyze operation in distillation plant.

CO6: Understand interphase mass transfer operation in absorption column

Name of the Course: Biochemistry Lab	
Course Code: PC-FT 491	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva -20 Marks

Objective:	
1	Understand the biochemical composition of food
2	Comprehend the different methods of separation and isolation methods of biochemical components of food
3	Comprehend the principle and kinetics of different enzymatic assays
4	Understand and use effectively BOD5 and COD methods to evaluate water pollution
5	Analyze effectively the data to reach reasonable and valid conclusion
6	Design appropriate methods for biochemical assays in real situation

Pre-Requisite:	
1	Handling of glasswares, chemicals and equipments
2	Basic knowledge of solution preparation, chemical reactions
3	Spectrophotometric , titrimetric, gravimetric, volumetric principles

Practical:	
	1) Intellectual skills-
	2) Motor skills- Spectrophotometer, centrifuge, pH meter, Hot AirOven/ Moisture Analyzer, Incubator, Vortex machine, Titration, electrophoresis, Glassware, chemicals & consumables

Laboratory Experiments:	
1	Separation of amino acids/sugars by Ascending Paper Chromatography.
2	Separation of sugars/ lipids by Thin Layer Chromatography.
3	Separation and isolation of proteins/amino acids by Paper Electrophoresis.
4	Determination of BOD5 and COD of a sample of waste water.
5	Preparation of cell-free extract: Bacterial cell by sonication, Chicken liver by homogenization.
6	Assay of enzyme activity – (a) Phosphatase assay [Chicken liver] (b) Protease assay
7	Study of an enzymatic reaction.

Text and Reference Books:

1. Nielsen, S. S. (Ed.). (2010). Food analysis (pp. 139-141). New York: Springer.
2. Jeantet, R., Croguennec, T., Schuck, P., & Brule, G. (Eds.). (2016). Handbook of Food Science and Technology 3: Food Biochemistry and Technology (Vol. 3). John Wiley & Sons.
3. Official methods of analysis of AOAC

Course Outcome:

After completion of the course the students will be able to

CO1: Remember and define the fundamental concept of spectroscopy with practical applications (during enzyme assay, chemical estimation of biomolecules).

CO2: Capable of understanding and explaining the calculation and data analysis and graph preparation during experiments.

CO3: Acquire skills being familiar with general lab maintenance protocol, apply various techniques and implement theoretical knowledge to handle delicate instruments.

CO4: Able to compare theoretical knowledge with lab practical testing biomolecules through effective hands on training.

CO5: Develop decision making potential, team spirit, project management, effective utilization of funds, good coordination keeping in mind various environmental facts, ethics and monetary issues.

CO6: Create lifelong learning boosting new and original work and develop an inquisitive mind.

Name of the Course: Food Preservation Lab	
Course Code: PC-FT 492	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 2 hrs./ week	External Assessment: 60 Marks
Credit Points: 1	Distribution of marks: Experiments - 40 Marks Viva -20 Marks

Objective:	
1	To introduce students about the importance of preserving food to prevent wastage and losses
2	To introduce students about the methods of preservation to increase shelf life of food commodities and retain its overall quality
3	To introduce students about development of value added food products
4	To impart basic knowledge regarding shelf life extension of foods
Pre-Requisite:	
1	Handling of glassware, chemicals and equipments
2	Basic knowledge of handling of fruits and vegetables
3	Understanding of chemical reactions and microbial growth in food

Practical:	
	1) Intellectual skills-
	2) Motor skills- Incubator, Autoclave, Canning unit, UV chamber, Sonicator

Laboratory Experiments:	
1	Estimation of water activity (a_w) for a sample of food/beverage
2	Estimation of chemical preservatives in thermally processed/carbonated beverages
3	Preservation of food by curing/pickling/smoking
4	Preservation by salting
5	Blanching of fruits/vegetables
6	Preservation of food by fermentation
7	Preservation by canning
8	Estimation of shelf life of perishable, semi perishable and low risk food
9	Non thermal methods of food preservation

Course Outcome:

After completion of the course the students will be able to

CO1: Recall the basic principles of microbiology to implement and understand real life constrains to practical problems relating to food preservation.

CO2: Understand the basic nature of different foods and select appropriate techniques, review experimental data and generate a solution specific to each of them.

CO3: Learn the basic chemistry behind food, apply appropriate techniques and use theoretical knowledge to handle sensitive and state of the art lab instruments.

CO4: Analyze different experimental conditions, examine data, and synthesize information to compare theoretical knowledge with practical experimentation through effective hands on training to reach a reasonable and valid conclusion.

CO5: Develop decision making potential, acquire team spirit, manage project, utilize fund, keep good coordination within realistic constraints such as economic, environmental, ethical, health and microbiological safety, feasibility, and sustainability.

CO6: Evaluate effectively all processes in the light of preservation of food which will create lifelong learning by boosting new and original work and thus develop an inquisitive mind and scientific outlook.

Name of the Course: Numerical Method Lab	
Course Code: BS-FT 491	**Semester: IV**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 2 hrs./ week	External Assessment: 60 Marks
Credit Points: 1	Distribution of marks: Experiments - 40 Marks Viva -20 Marks

Objective:	
1	**Demonstrate** the use of a range of standard numerical methods to solve complex engineering problems
2	**Apply** computational techniques as tools in solving engineering problems
3	**Demonstrate** a movement towards ongoing independent development of applying numerical methods to real engineering situations
4	**Interpret** Graphical presentations of data
Pre-Requisite:	
1	Basic computation and mathematics
2	Data collection and representation
Practical:	
	1) Intellectual skills- Critical thinking and reasoning**,** Analyzing, interpreting , summarizing
	2) Motor skills- Use of computer and programming

Laboratory Experiments:	
1	Assignments on Newton forward /backward, Lagrange's interpolation
2	Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule
3	Assignments on numerical solution of a system of linear equations using Gauss elimination and Gauss-Seidel iterations
4	Assignments on numerical solution of Algebraic Equation by Regular-falsi and Newton Raphson methods.
5	Assignments on ordinary differential equation: Euler's and Runga-Kutta methods.
6	Introduction to Software Packages: Matlab / Scilab / Labview / Mathematica
7	**Generate** Various types of DOE using Minitab,/Design Expert,
8	**Perform** regression analysis using Minitab,/Design Expert /SPSS
9	**Construct** graphical displays of science/engineering data and interpret the role of such displays in data analysis.
10.	Assignment on performing ANOVA for a given data
11	Perform sensory evaluation for a food product using fuzzy logic

Course Outcome:

After completion of the course the students will be able to

CO1: Recall the basic programming tools such as, variable declarations, array in one and two dimensions, for-loop, nested for-loop, if-else and repeated summation & multiplication.

CO2: Describe how to write down a program. Explain the logic behind the different numerical tools.

CO3: Use different programming language to write the program for interpolation, integration, algebraic equations, system of linear equations and boundary value differential equations for large number of data and complicated functions.

CO4: Analyze different real time problems and categorize them during the process of solving, by numerical method using programming language.

CO5: Justify and make gradation of above mentioned numerical tools and determine the appropriate program to find the optimal solution for multidisciplinary engineering problems.

CO6: Design a working model and build a path by which a new approach can be generated to create a new problem appreciated by academics, research & emerging direction in industry.

Third Year: Fifth Semester

Theory

Name of the Course: Technology of Fruits, Vegetables, Spices, Tea, Coffee & Beverages Processing	
Course Code: PC - FT 501	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 3	

Objective:	
1	To understand and identify the specific processing technologies used for different foods and the various products derived from these materials.
2	To understand the application of scientific principles in the processing technologies specific to the materials.
Pre-Requisite:	
1	Plant biology
2	Unit operations

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Current status of production and processing of fruits and vegetables; Pre and post harvest structural, compositional and nutritional aspects; Physiology of ripening; Maturity standards for storage, and desirable characteristics of fruits and vegetables for processing; Storage and handling of fresh fruits and vegetables	6
2	Techniques of extension of shelf life of unmodified produce: Role of plants growth regulators in relation to storage; physical and chemical treatment to increase the shelf-life, novel packaging, controlled and modified atmosphere storages, chilling & freezing, sterilization & canning; Minimal processing of fruits and vegetables	10
3	Technology of Products: Juices & pulps, squashes & cordials, nectars, fruit drinks & beverages (carbonated and non carbonated) , concentrates & powders and its quality control	5
	Jam, Jelly & Marmalades; candied fruits, dried fruits and vegetable products (e.g. Aam papads, mango lathers, nuggets, flakes, raisins); soup mixes; sauces &	8

	ketchups; puree & pastes; chutneys & pickles, Specialty fruit and vegetable products	
4	FPO Standards, Standards for processed products, By product utilization.	2
5	Potato processing (potato chips, flakes, powder) and storage	4
6	Proximate composition of tea, coffee & cocoa; different grades of tea and coffee; tea & coffee processing, different tea & coffee products	4
7	Non-alcoholic non carbonated beverages, preparation of health drinks.	2
8	Importance of spices, classification of spices, Technology of spices powder production Different types of condiment and herb products, preservation and packaging of spice powder.	4

Text and Reference Books:

Text

1. Food Science by Potter
2. Fruit and Vegetable Preservation by Srivastava and Sanjeev Kumar
3. Principles of Food Science, Vol-I by Fennma Karrel
4. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference

1. Post Harvest Technology of cereal pulse and oil seeds by Chakraborty, AC
2. Food Science by Mudambi

Course Outcome:

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

CO1: Understand the nutritional and physiological characteristics of fruit and vegetables

CO2: Understand about quality losses of fruit and vegetables during handling and storage and ways to prevent it.

CO3: Develop different value added products from fruits and vegetables.

CO4: Adopt processing of various raw materials used for beverage manufacturing.

CO5: Explain the role of spices in the diet

CO6: Set up new processing flow line for new products with quality standards

Name of the Course: Fish, Meat & Poultry Processing Technology		
Course Code: PC-FT 502	**Semester: V**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points:3		
Objective:		
1	To develop the knowledge of students about the composition of seafood, meat and eggs	
2	To enable the students to understand handling, processing and storage of seafood, meat, eggs and related products	
3	To enable the students to explain the potential of by-products arising from seafood, meat, eggs industry	
Pre-Requisite:		
1	Basic biology, food microbiology, food preservation	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Marine and fresh water fish, shell fish - composition and nutrition; commercially important fish and shell fish; World production status of seafood, effect of method of catching and handling on the quality of fish; handling fish from catching to transportation, storage; post mortem changes, freshness criteria and quality assessment of fish; contaminants and toxicants in fish- both endogenous and exogenous, spoilage of fish; methods of preservation of fish: canning, freezing, drying, salting, smoking, fermentation, marinating and pickling, irradiation; effect of processing and storage on nutritive value; packaging	12
2	Traditional fish based products of India; surimi (meat analogues); fish byproducts - production of fish meal, fish protein concentrate, isolate, hydrolysate, fish liver oil, fish silage; production of non-food items from fish processing wastes and application; food laws governing processing and sale of seafood.	5
3	Common and commercially important animals reared for meat (including poultry), World production status of meat; abattoir design, ante-mortem inspection, pre-slaughter/ante-mortem handling and inspection,	10

	scientific and modern methods of slaughtering of animals: small and large scale; post- slaughter/post-mortem handling and inspection, grading of meat; animal welfare and safety in slaughter plants; meat cuts and portions of meat; post mortem changes: conversion of muscle to meat, ageing; color of meat under different condition	
4	Structure and composition of muscle; comparative nutritional value of different meats; contaminants and toxicants in meat - both endogenous and exogenous; spoilage of meat; storage of fresh meat - modified atmosphere packaging, packaging of retail cuts; Processing and preservation - artificial tenderizing, chilling, freezing, curing, smoking, fermentation, canning, irradiation; meat products (comminuted meat products, meat analogues, sausages- fermented and non-fermented: types, manufacturing process), ready-to-eat products; effect of processing on nutritive value; by-products from meat industries and their utilization; food laws governing processing and sale of meat. Processing of poultry meat	10
5	Eggs - structure, composition; nutritional value; quality factors and grading; storage; egg processing, cleaning, pasteurization, freezing and drying; functional properties and application, utilization of egg-derived products as food ingredients; Effect of processing on nutritive value; additives used in poultry products; by-product utilization; egg substitutes; food laws governing processing and sale of egg and egg based products.	8

Text and Reference Books:

Text books

1. Seafood Processing: Technology, Quality and Safety, Ioannis S. Boziaris (Editor). The Atrium, Chichester, West Sussex, United Kingdom. Wiley-Blackwell, John Wiley and Sons, 2014. ISBN: 978-1-118-34621-1.
2. Advances in Fish Processing Technology, Sen, D.P. (2005), Allied Publishers Pvt. Ltd.
3. Fish Processing Technology , Rogestein & Rogestein
4. Processed Meats; Pearson AM & Gillett TA; 1996, CBS Publishers.
5. Developments in Meat Science – I & II, Lawrie R; Applied Science Pub. Ltd.
6. Egg Science & Technology; Stadelman WJ & Cotterill OJ; 1973, AVI Pub.

Reference

1. Fish as Food; Vol 1 & 2; Bremner HA; 2002, CRC Press.
2. Fish & Fisheries of India; Jhingram VG; 1983, Hindustan Pub Corp
3. Fish as Food, Vol. I-IV; George Borgstrom, Academic Press
4. Meat; Cole DJA & Lawrie RA; 1975, AVI Pub.

5. Egg and poultry meat processing; Stadelman WJ, Olson VM, Shemwell GA & Pasch S; 1988, Elliswood Ltd.

Course Outcome:

After completion of the course the students will be able to

CO1: Recall the basic concepts of biology, define the basic structure and biochemical composition of muscle foods and eggs and how these may undergo changes during ante & post mortem handling, processing and storage.

CO2: Understand the spoilage mechanisms in freshly harvested fish, meat and egg and explain how to estimate their quality using apposite qualitative and quantitative biochemical, physical or organoleptic parameters.

CO3: Explain the principle and applicability of different preservation technologies and apply this knowledge to prescribe suitable preservation methods for freshly harvested fish, animal and eggs.

CO4: Analyze ante mortem handling techniques and stunning methods to minimize pain and struggle of animals and frame a hygienic slaughtering process to yield high quality muscle food.

CO5: Evaluate the possibilities of value addition of fish; meat, poultry to design processing and manufacture of value added products and specialty foods

CO6: Identify potential in the by-products originating from fish, meat and poultry industries and propose the manufacture of various food, feed and non-food products

Name of the Course: Food Process Engineering	
Course Code: PC-FT 503	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 3	

Objective:	
1	To develop the knowledge in the area of food processing and technology
2	To enable students to appreciate the application of scientific principles in the processing of these materials.
Pre-Requisite:	
1	Elementary Physics, Mathematics
2	Knowledge of Unit Operations

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Basic unit operations used in food industry	1
2	Evaporators (basic principle and Single Effect Evaporator). Different types of evaporators: Open pan, Vacuum and boiling-film evaporators.	3
3	Heat Exchanger (HE): counter and co-current flow. Application of LMTD concept in HE. Different types of HE: Tubular, Shell and Tube, Plate HE, Scrapped surface HE	4
4	Freezing: concept of freezing, freezing curve, freezing rate, zone of ice crystallization, freezing vs. thawing. Freezing time: Planck's equation. IIR modification of Planck's equation.	5
5	Different type of freezers: Plate contact freezer, Air blast freezer, cryogenic freezers (use LN_2 and LCO_2; their advantages and disadvantages).Transportation of frozen foods. Cold chain.	3
6	Cold storage: Introduction and importance of cold store. Types of cold store. Construction of cold store. Refrigeration load calculation of cold store. Air flow pattern, evaporators use, duct and damper arrangement. Pre-fabrication in cold store. Idea of vapor barrier. Different problems and faults found in cold storage and solutions.	3
7	Drying: Various type of dryers (basic principle and drying time): Solar dryer, Tray dryer, Drum dryer, Spray dryer, Fluidized bed dryer, Freeze-dryer.	6
8	Engineering aspect of Homogenizer and Pasteurizer (HTST).	3

9	Thermal processing: Introduction. D-value, K- value, Z- value, TDT, Sterilization value. Graphical representation of D-value and Z-value calculation. Lethality. Process time. Retorting: vertical retort-- its different parts and their functions. Process time.	6
10	Kneader: Different types of kneaders used in industry. Oil expeller. Seaming machine: Double seaming, Different parts and their functions. Operational stages of double seaming machine	5
11	Extruder: Introduction. Functions and advantages of extrusion process. Single screw extruder (SSE): different parts present and their functions. Three zones in SSE and their functions. Screw compression ratio (SCR), L/D ratio, Expansion ratio (ER). Screw pitch. Bulk density of product. Double screw extruder (DSE): counter and co-current, intermeshing and non-intermeshing. Advantages of DSE over SSE.	6

Text and Reference Books:

Text

1. Fundamentals of Food Process Engineering; Toledo RT; 2nd edition, 2000, CBS Publishers.
2. Engineering Properties of Foods; Rao MA & Rizvi SSH; 1986, Marcel Dekker Inc.
3. Food process engineering, D. R. Heldman and R.P.Singh
4. Berk, Zeki "Food Process Engineering and Technology" Academic Press, 2009

References

1. Bakery Technology & Engineering; Matz SA; 1960, AVI Pub.
2. The Fundamentals of Food Engineering; Charm SE; 1963, AVI Pub.
3. The Technology of Extrusion Cooking by N.D.Frame, Blackie Academic and Professional, Madras.

Course Outcome:

At the end of this course, the incumbent will be able to:

CO1: Understand the basics of various food processing operations.

CO2: Solve different numerical problems on process Engineering.

CO3: Obtain knowledge in application of scientific principles in the processing technologies specific tothe materials.

CO4: Understand different line or flow diagrams for different food processing operations.

CO5: Better knowing the changes in the composition of foods with respect to the type of processing technology used

CO6: Develop solutions for practical engineering problems related to industries.

Name of the Course: Nutraceuticals & Functional Foods		
Course Code: PE-FT 501A	**Semester: V**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points:3		
Objective:		
1	To develop the understanding of the concept of Nutraceuticals & Functional Foods	
2	To enable the students to learn about the health beneficial properties of Nutraceuticals & Functional Foods	
3	To enable the students to learn about the manufacturing processes, regulatory challenges and market trends of Nutraceuticals & Functional Foods	
Pre-Requisite:		
1	Basic biology, food chemistry, biochemistry, nutrition, food processing, quality control and food regulations	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Definitions of Functional Foods and Nutraceuticals, Types of functional foods and Nutraceuticals, Components like nutrients such as lipids, fibers, amino acids, spices, herbs, polyphenols and bioactive properties, Vitamins and Health, Minerals and Health, Concepts and of Probiotic, prebiotics, synbotics, Supplements like antioxidants and their biochemical functions	10
2	Nutritional significance: Role of nutraceutical / functional foods in cardiovascular health, diabetes, obesity, immunity, neurodegenerative and age related muscular degeneration, stress management; Nutrition and nutraceuticals for targeted population such as children, woman, adults and elderly.	10
3	Enrichment, value addition, fortification, supplementation, Sources, Significance, Fortification and Enrichment in different foods (MSG; Bakery and confectionary products e.g. bread, biscuit and cookies; Breakfast and ready to eat cereals; Infant formulas; Protein mixes; Vegetable Mixes; Dairy product e.g. ice cream; Beverages including diet beverages, Sports drink, Value addition in processed food products	10

4	Functional ingredients: Extraction / purification of lycopene, essential oils, isoflavonoids, prebiotics and probiotics glucosamine, phytosterols, and their stability in processing conditions, Manufacturing of dietary supplements in the form of liquid, rehydration powder, tablet, pill, capsule or mix	10
5	Principles of toxicology and risk assessment of Nutraceuticals, Dosage levels; Adverse effects and toxicity of nutraceuticals, Regulatory and labeling issues, CODEX, FDA, FSSAI, Global nutraceuticals/ Functional food market. Recent research and patents on nutra-ingredients.	5

Text and Reference Books:

1. Handbook of Nutraceuticals and Functional Foods, Robert E.C. Wildman, CRC Pres
2. Nutraceutical and Functional Food Components, Charis Galanakis, Academic Press
3. Functional Foods and Nutraceuticals (Food Science Text Series), Rotimi E. Aluko, Springer; 2012 edition

Course Outcome:

After completion of the course the students will be able to

CO1: Recall the fundamental concept of Nutraceuticals & Functional Foods to understand their origin,presence and functionality.

CO2: Comprehend the disease preventing and health enhancing properties of Nutraceuticals & FunctionalFoods.

CO3: Apply the basic knowledge to comprehend the manufacturing of various fortified, value-addedfunctional foods and nutraceuticals in different forms for consumption

CO4: Analyze the toxicological aspect, related risks in formulating dosage and defining consumptionpatterns of Nutraceuticals & Functional Foods.

CO5: Evaluate regulatory and labeling issues related to manufacture, marketing and sale of Nutraceuticals & Functional Foods

CO6: Design value addition of foods incorporating Nutraceuticals & Functional ingredients.

Name of the Course: Instrumental Methods of Food Analysis	
Course Code: PE-FT 501 B	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points:3	

Objective:	
1	To develop the knowledge of fundamentals of instrument's working principle
2	To enable the students to learn about the instrument's applications in food analysis
Pre-Requisite:	
1	Basic physics, chemistry, biology, mathematics

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	**Chromatographic techniques:** General principles. Partition and adsorption chromatography, Paper, thin layer, Gel filtration, ion exchange and affinity chromatography, Liquid chromatography, High Pressure Liquid Chromatography (HPLC), Gas chromatography (GC)	15
2	**Electrophoretic Techniques:** General principles, Paper and gel electrophoresis. Polyacrylamide gel electrophoresis (Native and SDS)	5
3	**Spectroscopy:** Beers and Lambert's Law; Extinction coefficient; General principles of colorimeters and spectrophotometers; Ultraviolet, Visible, and Fluorescence Spectroscopy; Infrared Spectroscopy; Atomic Absorption Spectroscopy; Atomic Emission Spectroscopy, Nuclear Magnetic Resonance Spectroscopy, IR Spectroscopy, NIR Spectroscopy, FTIR Spectroscopy	12
4	**Spectrometry:**, Principle and applications, Mass Spectrometry, Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), Inductively coupled plasma optical emission spectrometry (ICP-OES), MALDI- TOF, ESI	8
5	**Physical Properties:** Rheological principles of food analysis, Texture Analysis, Thermal Analysis and Color Analysis	5

Text and Reference Books:

1. Skoog, D.A. et al., "Principles of Instrumental Analysis". 6th Edition, Thomson/Brooks/ Cole, 2007.
2. Willard, Hobart H. et al., "Instrumental Methods of Analysis".7th Edition, CBS Publishers, 2008.

3. Braun, R.D. “Introduction to Instrumental Analysis”. McGraw-Hill, 1987.
4. A First Course in Food Analysis, V. Sathe, New Age International Pvt. Ltd., 1st Edition, 1999.
5. Food Analysis, S. S. Nielsen, Kluwer Academic Publishers, 3rd Edition, 2003.
6. Food Analysis Laboratory Manual, S. S. Nielsen, Springer, 2nd Edition, 2010.

Course Outcome:

After completion of the course the students will be able to

CO1: Recall, the structure and working principle of various instruments used in food analysis

CO2: Understand the advantages and shortcomings of the various instruments.

CO3: Apply the various instruments to analyze different components of food matrices.

CO4: Analyze the sensitivity and reproducibility of analytical results produced by the various instruments

CO5: Evaluate the specificity in applications of the various instruments.

CO6: Design and develop methods of food analysis using various instruments.

Name of the Course: Grain Science and Technology	
Course Code: PE - FT 501C	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 3	

Objective:	
1	To understand and identify the specific processing technologies used for different foods and the various products derived from these materials.
2	To understand the application of scientific principles in the processing technologies specific to the materials.
Pre-Requisite:	
1	Plant biology
2	Unit operations

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Importance of cereals pulses and oilseeds, Post-harvest quality and quantity losses, Recommended pre-processing practices for handling of cereals and pulses for their safe storage, Infestation control, National and International quality and grading standards.	8
2	**Wheat:** Structure, types, composition, quality characteristics and physicochemical properties of wheat. Cleaning, tempering and conditioning, and milling processes for different wheat. Turbo grinding & Air Classification. Blending of flours. Milling equipments and milling products (Dalia, Atta, Semolina and flour), By-product utilization.	10
3	**Rice:** Structure, types, composition, quality characteristics and physicochemical properties of rice. Milling and parboiling of paddy, Curing and ageing of paddy and rice. Criteria in and assessment of milling, cooking, nutritional and storage qualities of raw & parboiled rice. Processed rice products (flaked, expanded and puffed rice). By-product (husk and rice bran) utilization.	10
4	**Other Cereals:** Structure, types and composition of corn. Dry and wet milling of corn. Processed corn products (popped corn, corn flakes etc.) Structure and composition of oats, barley, bajra, jowar and other cereal grains and millets. Pearling of millets. Parched and snack products.	6
5	**Cereal Malts**: Basic malting process, malting plant, malt storage, malt characteristics, malt extract, uses	2

6	**Pulses**: Pulses production, types, chemical composition, toxic factors, milling of pulses, milling equipments, factors affecting pulses quality, secondary processing of pulses, processed products, fermented products, traditional products, by products utilization; effect of processing on nutritive value.	7
7	**Oilseeds:** Processing of oilseeds, oil extraction methods- mechanical (ghani and expellers) and chemical methods (solvent extraction)	2

Text and Reference Books:

1. Food Science by Potter

2. Chakraverty A. " Post Harvest Technology of Cereals, Pulses and Oilseeds". Oxford & IBH Publishing Co. Pvt Ltd, 3rd Ed, 2007.

3. Amalendu Chakraverty, R. Paul Singh, "Postharvest Technology and Food Process Engineering, CRC Press, 2014.

4. Food Science by Mudambi

Course Outcome:

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

CO1: Understand the structure, composition and types of cereals and pulses.

CO2: Adopt various processing methods effectively for paddy, wheat and corn processing

CO3: Deliver ideas regarding different unit operations and its equipments involved in grain processing.

CO4: Manufacture different important products from cereal grains

CO5: Develop value added products from minor millets and pulses

CO6: Utilize the by products effectively.

Name of the Course: Enzyme Technology		
Course Code: OE-FT 501A	**Semester: V**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points: 3		
Objective:		
1	To impart knowledge and understandingon basic principles of enzyme functioning and itsrelevance to food processing, biochemical and allied sector	
2	To enable students to overview enzyme production and downstream techniques considering techno-economic feasibility	
Pre-Requisite:		
▪ Elementary knowledge of Enzyme and proteins ▪ Basic understanding of Biochemistry and Food Microbiology ▪ Basic understanding of unit operation (specially separation processes) ▪ Basic understanding of reaction kinetics ▪ Primary knowledge of dairy, bakery, beverage and edible oil industrial process line is preferred		

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Introduction to enzyme technology; Industrial enzymes – present status and opportunities with special reference to food industries; Catalytic properties of enzymes; Intracellular and extra-cellular enzymes.	8
2	Enzyme production technology; Substrate limiting growth: Monod model, Enzyme reactors and process design; Process Scale-up Application ofrecombinant DNA technique for enzyme engineering.	12
3	Cell disintegration by physical, chemical and biological methods; Enzyme purification methods; Insoluble and Soluble product separation processes, Precipitation techniques for enzyme separation: Salting out, Solvent addition, Isoelectric precipitation	10
4	Application of enzymes in biochemical and food processing industries; Milling and baking, Starch, starch syrups and dextrose, fruit products and wine, Dairy, Meat and Other Proteinaceous Foods, Candy, Cacao, Chocolate, Tea processing, Coffee, Flavors and other applications	8
5	Introduction to immobilization; its advantages and different types (entrapment, micro-encapsulation, covalent bonding, cross-linking), Diffusional limitation to immobilized cell systems, Damkohler no, Application of immobilized enzymes	4

6	Basic principles of biosensors and use of enzymes in biosensors, Legal Aspects of the use of Enzymes	3

Text and reference books:

Text:

1. Bioprocess Engineering: Basic Concepts, 2nd Edition- Michael L. Shulur and Fikret Kargi
2. Biochemical Engg Fundamentals-Baily, Ollis. MGH
3. Biochemical Engineering: A Textbook for Engineers, Chemists and Biologists- Shigeo Katohand Fumitake Yoshida
4. Enzyme Kinetics: A Modern Approach – Alejandro G. Marangoni
5. Enzyme Kinetics and Mechanisms- Kenneth B. Taylor

References:

1. Biochemical Engg Fundamentals-Baily, Ollis. MGH
2. Prescott & Dunn's Industrial Microbiology Macmiller
3. Principles of Fermentation Technology- Allan Whitaker, Peter F. Stanbury, and Stephen J. Hall

Course Outcome:

After completion of the course the students will be able to

CO1: Define and relate basic principles of enzyme functioning and its relevance to food processing, biochemical and allied sector

CO2: Outline and review research literature in relation to enzyme production and downstream techniques considering techno-economic feasibility

CO3: Design and develop processes to find solutions of batch, fed-batch and Continuous reactors (CSTR) based problems to optimize enzyme production technology.

CO4: Interpret and validate different modeling and simulation strategies for enzyme upstream and downstream processing through analysis of data, and synthesis of information for final product stability and functionality, scale-up, process economics and sustainability.

CO5: Determine modern techniques like immobilizations, recombinant technologies to formulate high value bio-chemicals for food and allied industries in compliance to legal, ethical and environmental guideline.

CO6: Design, modify and adopt changes relating nature, structure, function and activity of different food enzymes and proteins in commercial food products for future market meeting the societal and cultural needs through effective communication with the engineering community in multidisciplinary.

Name of the Course: Renewable Energy Technology	
Course Code OE-FT 501B	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points:3	

Objective:	
1	Understand the types of renewable energy sources
2	Provide fundamental knowledge on energy sources and their applications in food processing industry
3	Understand the function of renewable energy sources for food product development
4	Build the concept of application of renewable energy source in respective food industry
5.	Assess the importance of food industry waste management by converting them to renewable energy sources
Pre-Requisite:	
1	To have basic scientific and technical knowledge of renewable sources of energy andtheir use

Details of Syllabus:

Unit	Content	Hrs/Unit
1	Introduction (world energy status, current energy scenario in India, environmental aspects of energy utilization, energy and sustainable development	2
2	Biological fuel generation; Biomass as a renewable energy source; Types of biomass: forest, agricultural and animal residues; Industrial and domestic organic wastes; Conversion of biomass to clean fuels and petrochemical substitutes by physicochemical and/or fermentation processes.	10
3	Biogas from anaerobic digestion; Thermal energy from biomass combustion; Ethanol/ Biofuel from biomass	8
4	Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xanthum gum), biosurfactants.	8
5	Solar energy: Basic concepts, Solar collectors, photovoltaic cells, solar desalination, solar pumping, solar pond, solar cells	6
6	Wind energy (availability, wind power plants, wind energy conversion	6

	systems, site characteristics, types of wind turbines); Operating principles of different types of wind energy mills	
7	Other Renewable Sources: Tidal wave energy; geothermal energy; hydroelectric; Nuclear energy; Nuclear reactions and power generation	5

Text and Reference Books:

1. O.P. Gupta, Energy Technology, Khanna Publishing House (AICTE Recommended Textbook – 2018
2. J.E.Smith – Biotechnology, 3rd edn. Cambridge Univ Press.
3. S.Sarkar – fuels and combustion, 2nd edn., University Press.
4. O.P. Gupta, Elements of Fuels and Combustion Technology (ISBN: 978-93-86173-324), Khanna BookPublishing Company, New Delhi

Course Outcome:

After completion of the course the students will be able to

CO1: Recognize the need of renewable energy technologies and their role in the world energy demand and describe the major factors affecting the potential contribution to the world's needs of the various sources of energy.

CO2: Describe and identify the various renewable energy sources and the possible conversion paths to a useful form of energy.

CO3: Distinguish between the sustainable energy sources and fossil energy sources with emphasis on wind and photovoltaic systems.

CO4: Describe and introspect how biomass is currently used as source of energy , types of biomass, conversion of biomass to clean fuels and finally its future potential.

CO5: Knowledge of security and operational requirements of autonomous and net connected renewable energy system and ability to compare the advantages and disadvantages of various renewable energy technologies.

CO6: Review the latest advancement in the materials development applied to renewable energy and develops a personal well-argued and qualified view of a possible energy future.

Name of the Course: Flavor Technology	
Course Code : OE-FT 501C	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 3	

Objective:	
1	Able to define the class, function and uses of flavours in various food products
2	Able to relate extraction, isolation and identification of food flavours with respect to their fooduses.
Pre-Requisite:	
1	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Basics of flavour, smell , taste sensation, olfaction, flavor compounds, volatile flavor compounds, Classification: flavors : soild and liquid forms (water soluble form, oil soluble form, flavor emulsion form, spray dried form)	10
2	Methods of flavour extraction, isolation, separation; Distillation, solvent extraction, enzymatic extraction, static headspace, dynamic headspace etc, flavor encapsulation	10
3	Flavour characteristics: natural, nature identical and artificial materials Nature-identical flavoring substances, Artificial flavoring substances (Flavoring substances not identified in a natural product intended for human consumption, whether or not the product is processed), Guide line for flavoring agents as per FSSAI	10
4	Principal types of flavorings used in foods, natural flavoring substances, Flavor constituents from Onion, garlic, cheese, milk, meat, vegetables, fruits; Flavor constituents of wine, coffee, tea, chocolate, spices and condiments	5
5	Effect of processing on organoleptic quality of food, flavour precursors flavour development on cooking, microwave heating, roasting, baking, smoking,boiling, cooling, freezing, storage, Maillard reaction, caramalization, fermentation, Effect of storage , transportation , and environmental conditions on flavor compound	10

Text and Reference Books:

1. Reineccius, G. Source Book of Flavors
2. Heath, H. B. Flavour chemistry and technology
3. Piggott, J. R., Paterson, A. Understanding Natural Flavors.
4. Morton, I. D., Macleod A. J. Food Flavor

Course Outcome:

After completion of the course the students will be able to

CO1: Relate to the significance and role of flavours in various food products.

CO2: Identify and apply their knowledge in extraction, isolation and identification of different food flavouring components.

CO3: Select suitable flavours in various food matrices.

CO4: Distinguish the changes of flavouring components starting from harvesting of food, food processing operations, storage to consumer and take suitable action to prevent that change.

CO5: Classify flavours in accordance with the food of concern in order to incorporate, minimize, analyze or enhance certain flavour components through the use of sensitive instruments and testing methodologies.

CO6: Recognize and interpret the national and international regulations for food flavours to meet societal, economical and cultural need in the context of human health and safety assessment operations

Name of the Course: Engineering Economics	
Course Code: HM-FT 501	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points:3	

Objective:	
1	To develop the knowledge of students regarding project management, targets and cash flow in an industry
2	To enable the students to analyze the various economic aspects of a project and optimize investment
3	To enable the students to understand depreciation and assess the financial health of the company
Pre-Requisite:	
1	Basic mathematics and book keeping

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Economic Decisions Making – Overview, Problems, Role, Decision making process. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.	9
2	Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value Of Money, Debt repayment, Nominal & Effective Interest. Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. Cash Flow & Rate Of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate Of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Economic Analysis In The Public Sector - Quantifying And Valuing Benefits & drawbacks.	15

3	Uncertainty in future events - estimates & their use in economic analysis, range of estimates, probability, joint probability distributions, expected value, economic decision trees, risk, risk vs return, simulation, real options. Depreciation - basic aspects, deterioration & obsolescence, depreciation and expenses, types of property, depreciation calculation fundamentals, depreciation and capital allowance methods, straight-line depreciation declining balance depreciation, common elements of tax regulations for depreciation and capital allowances.	8
4	Replacement Analysis - replacement analysis decision map, minimum cost life of a new asset, marginal cost, minimum cost life problems. Inflation And Price Change – definition, effects, causes, price change with indexes, types of index, composite vs commodity indexes, use of price indexes in engineering economic analysis, cash flows that inflate at different rates.	8
5	Accounting – function, balance sheet, income statement, financial ratios capital transactions, cost accounting, direct and indirect costs, indirect cost allocation.	5

Text and Reference Books:

1. James L.Riggs, David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , TataMcGraw-Hill
2. Donald Newnan, Ted Eschembach, Jerome Lavelle : Engineering Economics Analysis, OUP
3. John A. White, Kenneth E.Case,David B.Pratt : Principle of Engineering Economic Analysis, JohnWiley
4. Sullivan and Wicks: Engineering Economy, Pearson
5. R.Paneer Seelvan: Engineering Economics, PHI
6. Michael R Lindeburg : Engineering Economics Analysis, Professional Pub
7. Premvir Kapoor, Sociology & Economics for Engineers, Khanna Publishing House, New Delhi.

Course Outcome:

After completion of the course the students will be able to

CO1: Encounter different problem issues in engineering related to system design, system deployment,project management, etc. and approach towards optimal solution.

CO2: Prepare estimation for short term targets in an industry and compare the actual costs incurred for thesame to determine the efficiency of the system.

CO3: Prepare estimation of supply, installation and commissioning in live projects and take necessary measures of cost control.

CO4: Take long term investment decision; select the most profitable project, take decision related toreplacement of assets.

CO5: Identify the assets that are subject to depreciation, maintain depreciation account to access thebenefit as per tax regulations.

CO6: Can prepare and analyze the financial statements of the company, and determine its financial health.

Sessional

Name of the Course: Mandatory Course (Constitution of India)	
Course Code: MC-FT 501A	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: 3 hrs./ week	Total Marks: 100
Tutorial: Nil	
Practical: Nil	
Credit Points: 0	

Details of Syllabus

Unit	Content	Hrs/ Unit
1	Meaning of the constitution law and constitutionalism	
2	Historical perspective of the Constitution of India	
3	Salient features and characteristics of the Constitution of India	
4	Scheme of the fundamental rights	
5	The scheme of the Fundamental Duties and its legal status	
6	The Directive Principles of State Policy – Its importance andimplementation	
7	Federal structure and distribution of legislative and financialpowers between the Union and the States	
8	Parliamentary Form of Government in India – The constitutionpowers and status of the President of India	
9	Amendment of the Constitutional Powers and Procedure	
10	The historical perspectives of the constitutional amendments in India	
11	Emergency Provisions: National Emergency, Financial Emergency,President Rule	
12	Local Self Government – Constitutional Scheme in India	
13	Scheme of the Fundamental Right to Equality	
14	Scheme of the Fundamental Right to certain Freedom under Article 19	
15	Scope of the Right to Life and Personal Liberty under Article 21.	

Name of the Course: Mandatory Course (Essence of Indian Knowledge Tradition)	
Course Code: MC-FT 501B	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Total Marks: 100
Tutorial: Nil	
Practical: Nil	
Credit Points: 0	

Module No.	**Description of Topic**	**Contact Hrs.**
1	**Indian Ethos- An Overview:** Introduction, Indian Ethos, Requisites for Indian Ethos, Indian Ethos for Management, Work Ethos and values for Indian managers, Indian heritage in business, Impact of values on stakeholders, Value system in work culture, Trans-cultural human values, Importance of Karma to managers, Nishkama Karma and its impact on employees today, Teaching Ethics, Gurukul system of learning.	**3**
2	**Understanding Ethics:** Ethics- Meaning & Concept, Types of Ethics, Ethics in Work life**,** Some unethical issues in society, Ethical Theories**:** Moral Development Theories (Piagets Theory, Kohlberg's Theory, Gilligan's Theory); Basic Theories (Deontology, Utilitarianism, Virtue Theory, Rights Theory), Role of Scriptures in Understanding Ethics.	**3**
3	**Business Ethics:** Engineering as a profession**,** Engineering Ethics**,** Code of Ethics, Business Ethics – concept, meaning, importance**,** Factors influencing business ethics**,** Ethical principles in business**,** Conflict between business deal and professional ideal**,** Ethical issues and challenges in business**,** Ethical governance in business**,** Good corporate Governance.	**3**
4	**Ethical Dilemma and Ethical Decision Making:** Ethical Dilemma, Ethical dilemma in different business areas**,** Managing ethical dilemmas**,** Business Decision Making and difficulties, Moral Development and Moral Reasoning**,** Role of moral philosophies in decision making**,** Using Ethical Reasoning**,** Ethical Leadership**.**	**3**
5	**Understanding Human Values:** Human Values – Meaning and concept, value system, importance, classification, role of socialization in formation of values; Types of Values –*Societal values*: The modern search for a good society, justice, democracy, secularism, rule of law, values in Indian Constitution**;** *Moral and ethical values*: Nature of moral judgments; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility**;** *Psychological values*: Integrated personality; Maslow's Need Hierarchy theory, mental health**,** *Aesthetic values:* Perception and enjoyment of beauty, simplicity, clarity**;** Meaning of a good life**,** Value spectrum of a good life**,** Values Crisis in contemporary society – Individual crisis, Social crisis, Cultural crisis, Intellectual crisis	**4**

Practical

Name of the Course: Food Processing Lab - I	
Course Code: PC-FT 591	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva – 20 Marks

Objectives:	
1	To learn different methods applied to processing of foods
2	To identify changes of raw food materials during postharvest storage and transformation into food products
3	To understand the significance of food processing on food preservation
Pre-Requisite:	
1	Elementary chemistry
2	Plant biology
3	Unit operations
Practical:	
	1) Intellectual skills-
	2) Motor skills- Juicer, Pulper, Crown corking machine, Double jacketed Kettle, Spray drier, Freezer, Refractometer

Laboratory Experiments:	
1	Preparation of fruit juice/ squash/ nectar
2	Preparation of jam & jelly using suitable fruits
3	Preparation of tomato ketchup/ sauce
4	Preparation of pickle
5	Preparation of candied fruit/ fruit peel
6	Preparation of potato powder
7	Canning of fruits/ vegetables
8	Freezing of fish/ meat
9	Dehydration of whole egg/ egg white/ egg yolk

Text and Reference Books:

1. Sivasankar, B. “Food Processing & Preservation”, Prentice Hall of India, 2002.
2. Khetarpaul, Neelam, “Food Processing and Preservation”, Daya Publications, 2005.
3. Food Science by Potter
4. Fruit and Vegetable Preservation by Srivastava and Sanjeev Kumar

Course Outcome:

After completion of the course the students will be able to

CO1: Define and describe diverse fields of product technology and unit operations employed in food processing both conceptually and in the pilot plant.

CO2: Understand and classify complex biochemical reactions of raw food materials during postharvest storage and their transformation into food products and accordingly outline food processing and preservation techniques.

CO3: Construct process flow diagrams along with their combinations and sequences within the context of more advanced ideas, practical applications, economy, laws and regulations.

CO4: Analyze the role of various processing aids used and operate equipments with an understanding of the impact of processing conditions on physical, chemical and sensory properties of the food products.

CO5: Calculate, evaluate, interpret, and present analytical results obtained during practical experiments in a safe and responsible way.

CO6: Design appropriate research methods and techniques to execute targeted experiments in industry like situation.

Name of the Course: Food Analysis & Quality Control Lab – I	
Course Code: PC-FT 592	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva – 20 Marks

Objectives:	
1	To know the methods of selecting appropriate techniques for analysis of food products.
2	To determining the relative amounts of components in food sample.
3	To gain knowledge on food standards, regulations and quality control
4	To familiarize with the current state of Knowledge in food analysis.

Pre-Requisite:	
1	Basic analytical techniques
2	Handling of glasswares, chemicals and equipments
3	Basic knowledge of solution preparation, chemical reactions
4	Spectrophotometric , titrimetric, gravimetric, volumetric and chromatographic principles
5	Basic knowledge of Food Chemistry, Food Microbiology and Food preservation

Practical:	
	1) Intellectual skills-
	2) Motor skills- Spetrophotometer, pH meter, Hot Air Oven/ MoistureAnalyzer, Soxhlet Apparatus, Kjeldhal Unit, Viscometer, Turbidity Meter, Muffle Furnace, Laminar Air Chamber, Autoclave, Incubator, Colony Counter
	Glasswares, chemicals & consumables

Laboratory Experiments:	
1	Analysis of potable water
2	Analysis of jam, jelly & pickles
3	Analysis of spices
4	Analysis of tea and coffee including antioxidant(s) / polyphenol(s)
5	Analysis of non-alcoholic beverages
6	Estimation of crude fiber in food sample
7	Analysis of lysine content in animal /vegetable sources

Text and Reference Books:

1. FSSAI Manuals
2. Raghuramulu, N. et al., "A Manual of Laboratory Techniques". 2nd Edition. NIN, 2003.
3. Nielson, S. Suzanne. "Food Analysis" 3rd Edition. Springer, 2003.
4. Pomeranz, Yeshajahu and Clifton E. Meloan "Food Analysis : Theory and Practice". 3rdEdition. Springer, 2000.

Course Outcome:

After completion of the course the students will be able to

CO1: Know the methods of selecting appropriate techniques for analysis of food products.

CO2: Apply knowledge in identifying and determining the relative amounts of components in food sample.

CO3: Gain knowledge on food standards, regulations and quality control

CO4: Obtain knowledge of adulterants in foods.

CO5: Appreciate the role of Food Analysis in food standards and regulation for the manufacture and the sale of food products and food quality control in food industries.

CO6: Familiarize with the current state of Knowledge in food analysis.

Name of the Course: Food Engineering Lab	
Course Code: PC-FT 593	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva – 20 Marks

Objectives:	
1	To know operating principles of various machines used in food processing
2	To understand the calculations in processing operations
Pre-Requisite:	
1	Elementary Physics, Mathematics
2	Knowledge of Unit Operations
Practical:	
	1) Intellectual skills-
	2) Motor skills-Autoclave/ Canning Unit, Spray Drier/ Tray Drier/ Drum Drier/ Freeze Drier, Plate Freezer, Vacuum Evaporator, Oil Extractor, Extruder

Laboratory Experiments:	
1	Determination of thermal destruction parameters during canning of fruits/ vegetables – F value, D value, z value
2	Study of dehydration characteristics of food materials and drying efficiency calculation during drying of food products in spray drier, tray drier, drum drier, freeze drier
3	Freezing efficiency and freezing time calculation of selected food materials
4	Fruit juice concentration using vacuum evaporator/ other suitable techniques
5	Oil extraction from oils seeds
6	Crude oil refining
7	Study the working principle, operation and yield estimation of an extruder
8	Freeze concentration of alcohol beverage
9	Kinetic study of osmotic dehydration of fruits or vegetables

Text and Reference Books:

1. Fundamentals of Food Process Engineering; Toledo RT; 2nd edition, 2000, CBS Publishers.
2. Berk, Zeki "Food Process Engineering and Technology" Academic Press, 2009
3. Engineering Properties of Foods; Rao MA & Rizvi SSH; 1986, Marcel Dekker Inc.

Course Outcome:

After completion of the course the students will be able to

CO1: Understand the basics of various food processing operations.

CO2: Understand the principles of Process calculations.

CO3: Understand different line or flow diagrams for different food processing operations

CO4: Knowledge in application of scientific principles in the processing technologies specific to the materials.

CO5: Better knowledge about the changes in the composition of foods with respect to the type of processing technology used

CO6: Develop solutions for practical engineering problems related to industries.

Name of the Course: Report and Seminar on Industrial Training	
Type of Course: Sessional	
Course Code: SI-FT 581	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	
Practical: Nil	
Credit Points: 2	

Details of Syllabus

The Industrial Training will be undertaken by each student during the summer recess after the completion of the 4th semester examination and prior to commencement of the 5th semester. A report on the training which is required to be submitted shall consist of:

6. A general overview of the plant.
7. The products & raw material sources of the plant.
8. Detail description of different processing lines and other equipment.
9. Scheduling of plant operations.
10. Conclusion.

A viva will be conducted after submission of the report and presentation of a seminar

Course Outcomes:

After completion of the course the students will be able to

CO1: Relate different components of food science and technology, skills and scientific techniques followed in various food business/industry.

CO2: Understand hands on expertise in their relevant fields.

CO3: Bridge the gap between academia and ever-changing demand driven industrial business scenario to develop the need of industry with the polarization paradigm.

CO4: Analyze the skills and knowledge required for a particular job function.

CO5: Get exposure to advanced manufacturing and analytical tools to evaluate complex engineering problem.

CO6: Adopt basic industrial practices with ever changing food regulatory standards, ethics, legislation and food safety issues

Third Year: Sixth Semester

Theory

Name of the Course: Milk & Milk Products Processing Technology		
Course Code: PC-FT 601	**Semester: VI**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points: 3		
Objective:		
1	To understand need and importance of processing technologies used for milk and the various products derived from milk	
2	To know the compositional and technological aspects of milk	
3	To grasp the changes in the composition of milk and milk products with respect to the type of processing technology used	
Pre-Requisite:		
1	Chemistry of food and chemical deterioration	
2	Principles of food preservation	
3	Unit operations	
4	Concept of food process engineering	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	**Introduction to milk:** PFA & FSSAI definition, Composition of milk; Factors affecting composition of milk; Types of milk as per FSSAI specification; Synthetic milk; Physico-chemical properties and microbiological quality of milk; Checks for purity of milk; Handling, transportation and reception of freshly produced milk	7
2	**Cleaning and sanitization:** Dairy equipments and plant cleaning and sanitization	2
3	**Processing of fluid milk:** Pasteurization (LTLT and HTST), sterilization and UHT techniques; Homogenization principle & its application in dairy industry;Packaging of fluid milk; Flavoured milk; Lactose free milk	7
4	**Fermented milk products:** Dahi, yogurt, acidophilus milk, kefir, kumiss & related products; Probiotics & prebiotics	3
5	Manufacturing of cream, butter, ghee	6

6	Manufacturing of Ice-cream	4
7	Manufacturing of Cheese (classification, manufacturing process of cheddar, cottage cheese, mozzarella cheese, processed cheese)	4
8	Processing of concentrated (Sweetened condensed milk, evaporated milk)	3
9	Processing of dried milk products (Milk powder, Infant formulae)	5
10	Manufacturing process of Chhana, paneer and khoa; Traditional Indian sweets (Rasogolla, Sandesh, Peda, Burfi, Kalakand, Gulabjamun etc.)	1
11	Dairy industry byproduct utilization (manufacturing of whey beverages, whey cheese, whey powder, lactose, WPC, WPI)	2
12	Application of advanced technologies in dairy industry (membrane technology, high pressure processing, pulsed electric field, bactofugation etc.)	1

Text and Reference Books:

Text

1. Outlines of Dairy Technology, De S; Oxford.
2. Robinson RK; 1996; Modern Dairy Technology, Vol 1 & 2; Elsevier Applied Science Pub.
3. Indian Dairy Industry KS Rangappa and K L Acharya, Asia publishing house, Mumbai
4. Technology of Milk Processing Khan QA and Padmanabhan ICAR, New Delhi

Reference

1. Dairy Science and Technology by P. Walstra, Jan T.M. Wouters and T.J. Geurts . Second Edn.CRC Press. Taylor and Fransis
2. Milk & Milk Processing; Herrington BL; 1948, McGraw-Hill Book Company.
3. Modern Dairy Products, Lampert LH; 1970, Chemical Publishing Company.
4. Principles of Dairy Processing JN Warner, Wiley Eastern Ltd, New Delhi

Course Outcome:

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

CO1: Understand the various properties and composition of milk.

CO2: Understand the technology of manufacturing of various milk products.

CO3: Appreciate the safety and quality factors that determine the acceptability of the dairy products byconsumers.

CO4: Select and apply appropriate techniques for solution of practical problems of milk processing lines.

CO5: Develop understanding of by-product utilization of dairy industry.

CO6: Apprehend the importance of cleaning, sanitation and CIP in dairy industry

Name of the Course: Edible Fats and Oils Processing Technology		
Course Code: PC-FT 602	**Semester: VI**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points:3		
Objective:		
1	Understands the basic processing of extraction, purification and quality of refined vegetable oil	
2	Build the concept of plastic fat and its possible applications	
3	Learn different processing technology for preparation of industrially important fats/oils extruded food items	
4	Assess different fat or fat-based foods with respect to quality standards.	
5.	Explores possibility of enzyme application in fats/oils.	
Pre-Requisite:		
1	To have basic concept of chemistry of fats/oils, physical and chemical properties of fats/oils	
2	To have idea about true and crude fat	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Importance of fats and oils in foods; Sources, composition and properties of vegetable oils and animal fats (milk fat, lard and tallow); Reversion and rancidity of fats and oils; Extraction of fats and oils – Rendering (only definition), pressing, solvent extraction, supercritical fluid extraction, enzyme-derived oil	9
2	Processing/refining of oils – Degumming, neutralization, bleaching, deodorization, winterization (continuous operation) for production of RBD oil; characteristics of cooking/frying oil, effect of heat on fats/oils (trans fat, other toxicity)	10
3	Processing of refined oil – Hydrogenation, Inter-esterification, fractionation, esterification ; Plastic fat – definition, characteristics, common plastic fat – shortenings and margarine ; process flow-sheet of plastic fat (industrial shortenings and margarine); Application of plastic fat in bakery, confectionary (including cocoa butter replacers),	10

4	By-products of fat/oil processing industries – Lecithin, crude fibre, protein isolate; Quality standards (sensory, physical and chemical) of fats and fat-based products(industrial shortenings, margarine, ghee); Antioxidants and its mechanism of application.	8
5	Biotechnology in fats/oils – Enzymatic degumming; enzymatic interesterification ; vegetable fat/oil as functional food; Genetically modified fat/blended oil	8

Text and Reference Books:

1. Bailey's Industrial Oil and Fat Products, Vol 1 & 2; Swern D; 4th ed, 1982, John Wiley & Sons.
2. The Chemistry & Technology of Edible Oils and Fats; Devine J & Williams PN 1961, PergamonPress.
3. Food Oils and their Uses; Weiss TJ; 1983, AVI.
4. Edible Oils & Fats: Developments since 1978 (Food Technology Review # 57); Torrey S; 1983, NDC.

Course Outcome:

After completion of the course the students will be able to

CO1: Recall lipid/fat as basic component of food, plant and animal sources of fats, their occurrence, health benefits, physical and chemical properties

CO2: Illustrate basic extraction and refining process of crude fat/oil and various processing of true fat (hydrogenation, winterization etc.) and other process-flow for by –products.

CO3: Classify fats/oils or fat-based ingredients as per different groups of vegetable oil/ cooking oil/plastic fat/confectionery fat/shortenings etc

CO4: Assess quality of fat/oil as raw material/ingredients in the food industries.

CO5: Choose different processing techniques of true fat/oil in preparation of fat based raw material for bakery and confectionery industries.

CO6: Communicate effectively own idea and activities with the engineering community and the society at large through writing and presentation, to give and receive clear instruction, and to enhance societal awareness on processing and preservation of fats and oils while acquiring capability of adapting with the future advancement of research.

Name of the Course: Technology of Bakery, Confectionaryand Extruded Foods Processing		
Course Code: PC-FT 603	**Semester: VI**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points:3		
Objective:		
1	Understand the operations of different bakery and extrusion process and role of ingredients	
2	Build the concept of plant safety sanitation and personal hygiene of the Bakery plant and CIP of extrusion process plant	
3	Analyze the different bakery confectionery and extruded food items	
4	Apply this knowledge for technological improvement of bakery products	
5.	Assess the importance of various operations in extrusion plant	
Pre-Requisite:		
1	To have basic concept of Role of Ingredients in Bakery, confectionary and extruded foods	
2	Knowledge of wheat flour testing is preferred	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Introduction to baking; Bakery ingredients and their functions; Machines and equipment for batch and continuous processing of bakery products Baking oven: Different types. Functions of different parts present in baking oven. Different zones present in baking oven and their role (s) in baking. Heat transfer inside oven. Thermal conductivity, specific heat of bakery products. Importance of temperature and humidity during baking.	12
2	Testing of flour; Manufacture of bread, cake and biscuits; Analysis of bakery Products; Cake icing techniques, wafer manufacture, cookies, crackers, dustingor breading. Manufacture of bread rolls, sweet yeast dough products, cake specialties, pies and pastries, doughnuts,); Maintenance, safety and hygiene ofbakery plants.	12

3	Confectionary: Candies: Introduction. Crystalline and non-crystalline candies. Variation of sugar-water ratio at different temperatures to produce crystalline candies. Super-saturation, nucleation, crystal growth dependable factors. The ingredients required for candies. Chocolates: Introduction. Different ingredients require for chocolate preparation and their functions. Type of chocolates. Description of chocolate preparation by using definite flow diagram. Problems and solutions for chocolate making.	12
4	Importance and applications of extrusion in food processing; Pre and post extrusion treatments; Manufacturing process of extruded products; Change of functional properties of food components during extrusion. Extruder as a Biochemical reactor	9

Text and Reference Books:

1. Extrusion of Food, Vol 2; Harper JM; 1981, CRC Press.
2. Bakery Technology & Engineering; Matz SA; 1960; AVI Pub.

Course Outcome:

After completion of the course the students will be able to

CO1: Understand the basics of Bakery, confectionary & Extruded Food products.

CO2: Understand different raw materials used and their testing methods of Bakery products.

CO3: Understand different line or flow diagrams for different bakery, confectionary and extruded products processing operations.

CO4: Cope up with modern bakery and confectionary products processing operations as well as modern extruded products (third generation products) and their techniques already implemented.

CO5: Understand to maintain bakery hygiene, bakery processing laws & ethics and prevent food processing hazards.

CO6: Apply knowledge (hygiene) on laws and regulations related to bakery foods and also ability to function effectively as an individual, and as a member or leader in diverse teams in multi-disciplinary settings, and to develop budding entrepreneurs.

Name of the Course: Fermentation Technology & Biochemical Engineering		
Course Code PE-FT 601A	**Semester: VI**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points: 3		
Objective:		
1	Knowledge of this paper helps them competent to analyze problems in fermentation plant and to rectify defects.	
2	It also help them to develop bankable project report for development of Biochemical plants	
3	To understand different Biochemical pathway different fermentation process.	
4	Students can make use of these knowledge in any fermentation industry	
Pre-Requisite: The following modules (or equivalents) should be preferably completed prior to, this module:		
1	Basic of Food Microbiology	
2	Basic of Biochemical pathway of microbial fermentation	
3	Basic of mass transfer and heat transfer operation	
4.	Knowledge of separation Technology	
5	Knowledge of project Engineering	

Detailed Syllabus

Unit	Content	Hrs/ Unit
1	Introduction to industrial microbiology; Production of organic acids (vinegar, lactic acid), alcoholic beverages (beer, wine, and distilled alcoholic beverages such as whiskey, rum, vodka), glycerol	8
2	Propagation of baker's yeasts; S i ng l e c e l l p r o t e i n ; Microbial production of vitamins (B_2 and B_{12}), antibiotics (penicillin, streptomycin)	8
3	Bioreactor design: Mechanisms and kinetics (Monod model), Fermentation - types of fermenters, chemostat, chemostat with recycle, turbidostat, PFR, fluidized bed reactor, air lift fermenter, Mass transfer in microbial reactors; scale-up and scale down of bioprocess	12
4	Bio product recovery: Downstream processing - separation process for cell mass and product, filtration, centrifuging, membrane processes (reverse osmosis, ultrafiltration, chromatographic separation)	9

5	Bioprocess economics, Cost analysis of alcohol production plant, Fermentationplant design project, Bio-product regulation	8

Text and reference books:

1. Biochemical Engineering Fundamentals: J.E Bailey, D F Olli, MGH
2. Biochemical Engineering: Aiba S; Academia press, NY
3. Bioprocess Engineering: Basic Concepts, 2nd Edition- Michael L. Shulur and Fikret Kargi
4. Biochemical Engineering: A Textbook for Engineers, Chemists and Biologists- Shigeo Katohand Fumitake Yoshida
5. Principles of Fermentation Technology- Allan Whitaker, Peter F. Stanbury, and Stephen J. Hall

Course Outcome:

CO1: Define and relate basic principles of industrial microbiology, fermentation techniques and biochemical engineering to food processing sector

CO2: Outline and review research literature in relation to production and downstream techniques for ethanol, antibiotics, organic acids and allied biochemicals through fermentation considering techno- economic feasibility

CO3: Design and develop processes to address problems and find solutions for various fermentation plants to optimize production of high value biochemicals

CO3: Interpret and validate different modeling and simulation strategies for upstream and downstream processing through analysis of data, and synthesis of information for final product stability and functionality, scale-up and sustainability

CO5: Determine modern techniques like immobilizations, recombinant technologies to formulate fermentative products for food and allied industries in compliance to legal, ethical and environmental guideline

CO6: Design, modify and adopt changes relating nature, structure, function and activity of different commercial biochemicals for future market meeting the societal and cultural needs through effective process economics and communication with in multi-disciplinary setting

Name of the Course: Management of Food Industry Wastes		
Course Code: PE-FT 601B	**Semester: VI**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3hr./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points: 3		
Objective:		
1	To learn about different type of wastes in different food and Fermentation industries,	
2	Solid and liquid waste management, Isolation of value added products from different waste, biogas generation	
3	Composting of solid waste and removal technology of different toxic metals from industrial effluents like bioremediation and membrane separation technology	
Pre-Requisite: The following modules (or equivalents) should be preferably completed prior to, this module:		
1	Basic of Microbiology	
2	Basic of Biochemical Engg	
3	Basic separation process like Membrane separation technology	
4	Mechanical operation and settling process	

Details of Syllabus

Unit	Content	Hrs/ Unit
1	Introduction: Classification and characterization of food industrial wastes from fruit and vegetable processing industry, beverage industry, fish, meat and poultry industry, sugar industry and dairy industry; Waste disposal methods – physical, chemical and biological; Economical aspects of waste treatment and disposal.	6
2	Production of pectin, ethanol, natural gas, citric acid, activated charcoal, fibre extract from apple pomace, vitamins; Production of citrus oil from peels of citrus fruits; Manufacture of candied peel and pectin from albedo of citrus fruits. Production of single cell protein by utilizing waste products, use of potato wastes	9
3	Production of fish meal; Fish protein concentrate; Animal feed; Shell product; Glue from seafood processing waste. Texturized fish protein concentrate; Utilization of organs and glands of animal as human food. Production of human food from animal blood and blood protein; Marketable products like chitin, chitosan, fertilizer, nutritional enhancer animal feed from shells.	6

4	Treatment methods for liquid wastes from food process industries; Design of activated sludge process, Trickling filters, Rotating biological contactors UASB, Biogas plant.	10
5	Treatment methods of solid wastes: Biological composting, drying and incineration; Design of solid waste management system: Landfill digester,Vermi-composting pit.	8
6	Biofilters and bioclarifiers, Ion exchange treatment of waste water, Drinking-water treatment, Recovery of useful materials from effluents by differentmethods	6

Text and References Books:

1. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science PubLtd.
2. Water & Wastewater Engineering; Fair GM, Geyer JC &Okun DA; 1986, John Wiley & Sons, Inc.
3. Wastewater Treatment; Bartlett RE; Applied Science Pub Ltd.
4. Symposium: Processing Agricultural & Municipal Wastes; Inglett GE; 1973, AVI.
5. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.
6. Environmental Biotechnology: Principles and Applications; Rittmann BE & McCarty PL; 2001,Mc-Grow-Hill International editions.
7. Environmental Biotechnology; Bhattacharyya B C & Banerjee R; Oxford University Press.
8. O.P. Gupta, Elements of Solid Waste & Hazardous Management, Khanna Publishing House (AICTERecommended Textbook – 2018)

Course Outcome:

After completion of the course the students will be able to

CO1: Make the students in understanding about the source and nature of wastes obtained from various food industries.

CO2: Study the ways to convert the food wastes into valuable products.

CO3: List the nature of the wastes obtained from different food processing industries.

CO4: Understand the properties of different food industry wastes.

CO5: Recognize and communicate common processes which allow the different food processing waste to be converted into valuable products.

CO6: Communicate effectively on professional activities with the engineering community and with the society at large.

Name of the Course: Food Additives		
Course Code : PE-FT 601C	**Semester: VI**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points: 3		
Objective:		
1.	Able to define the class, function and uses of additives	
2.	Able to relate the various role of additives	
3.	Able to apply their knowledge in formulation with the uses of different additives.	
4.	Able to select suitable additives in food composition	
5.	Able to categorize uses of additives with regulations and food laws	
Pre-Requisite:		
1.	Basic knowledge of organic, inorganic and physical chemistry	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Definitions of Food Additives, Basic criterion of additives, Classification and Functions, Legitimate uses of Additives in foods, Intentional & Non Intentional additives, Indirect food additives; Food uses and functions in formulations; Toxicological evaluation of food additives (intake assessments), generally recognized as safe (GRAS)	10
2	Regulations and food laws on food additives, Joint FAO/WHO Expert Committee (JECFA)/CODEX recommendation for harmonization and controlof food additives, GFSA	5
3	Uses & functions of:Acid, Base, Buffer systems, Salts, acidulants and Chelating/Sequestering agents, Artificial sweeteners and health implications; Low calorie and non nutritive sweeteners, Polyols.	8
4	Antioxidants and chelating agents, Emulsifying and stabilizing agents, Anti-caking agents and Humectants, Thickeners, Firming agents. Flour bleaching agents and Bread improvers. Fat mimetics and replacers	9
5	Anti microbial agents / Class I, Class II and Class III preservatives as per PFA Act. Acceptable Daily Intake (ADI) recommendation by JECFA, Carry-Over of Food Additives from ingredients and raw materials into foods, Clarifying agents. Tracers and other additives.	4

6	Colours and Flavours (synthetic and natural) Types of flavors, flavor emulsions; essential oils and oleoresins, Flavor enhancer, Method of analysis	8
7	Risks and benefits of food additives, Food additives and hypersensitivity, Nutritional additives	3

Text and Reference Books:

1. Gerorge AB. 1996. Encyclopedia of Food and Color Additives. Vol. III.CRC Press.
2. Branen AL, Davidson PM & Salminen S. 2001. Food Additives. 2nd Ed. Marcel Dekker.
3. Fenaroli's Handbook of Flavor Ingredients. 5th Ed.CRC Press.
4. Fennema OR.1996. Food Chemistry. Marcel Dekker
5. Stephen AM. (Ed.). 2006. Food Polysaccharides and Their Applications. Marcel Dekker.

Course Outcome:

After completion of the course the students will be able to

CO1: Have basic theoretical knowledge about definition, criteria, functional classification and need of food Additives with respect to different food commodities.

CO2: Assess their significance in the light of current national and international food regulations on additives giving emphasis on safety assessment keeping in mind the acceptable daily intake recommendations.

CO3: Provide basic concepts about formulation technology in regard to incorporation of food additives in the context the functional ingredient and/or additive-structure-performance relationship for processed food products.

CO4: Develop the scientific outlook coupled with critical thinking and technology based communication skills required for the assessment of the impacts of food additive applications on health, food safety, and quality, and the current advancements related to food additives.

CO5: Understand and impart knowledge about the EU regulatory framework, JECFA and EFSA's assessment of consumer safety and exposure on food additives and interpret them in practical real time situations to inculcate societal, economical and cultural development through lifelong learning.

CO6: Create food technology professionals who are equipped with thorough knowledge of the application based methodologies with respect to food additives that can emerge as entrepreneurs with perseverance and calibre.

Name of the Course: Data Structure & Algorithm	
Course Code: OE-FT 601A	**Semester: VI**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 2 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 2	

Objective:

1. To impart the basic concepts of data structures and algorithms
2. To understand concepts about searching and sorting techniques
3. To Understand basic concepts about stacks, queues, lists, trees and graphs
4. To understanding about writing algorithms and step by step approach in solving problems with the help of fundamental data structures

Pre-Requisite: Basic knowledge of mathematics, algorithm, programming

Details of Syllabus

Unit	Content	Hrs/ Unit
1	Linear Data Structures – Sequential representations, Arrays and Lists, Stacks, Queues and Dqueues, String and their applications. Link Representation – Linearly linked lists, Circularly linked lists, Doubly linked lists and applications.	10
2	Algorithms for creating and manipulating different linear data structures; Non-linear data structure – Trees including Binary Trees, Binary Search Trees, Insertion and Deletion algorithms, Height-balanced and Weight-balanced trees, B-trees.	10
3	Graph Representations, Breadth first search (BFS) and Depth first search (DFS); Graph Theoretic Algorithms – Incidence Matrix, Adjacency Matrix, Algorithms for Minimal Spanning Tree (Prim's and Kruskal's Algorithm).	10
4	Sorting and Searching Algorithms – Bubble sort, Insertion sort, Quick sort, Merge sort; File Structures – Record and Table Structures, Sequential and Direct access, Indexed Files, Inverted Files, Hashed Files	10

Text & Reference Books:

Text:

1. Aho Alfred V., Hopperoft John E., Ullman Jeffrey D., "Data Structures and algorithms", Pearson Education
2. Berman, Data Structure Via C++, OUP

References:

1. Horowitz Ellix & Sartaj Sahani, "Fundamentals of Data Structures", Galgotria Pub.
2. Tenenbaum A. S., "Data Structures using C", Pearson Education/PHI

3. Graph Theory – N. Deo, PHI

Course Outcome:

After completion of the course the students will be able to

CO1: Learn the basic types for data structure, implementation and application.

CO2: Know the strength and weakness of different data structures.

CO3: Select basic data structures and algorithms for autonomous realization of simple programs or program parts.

CO4: Determine and demonstrate bugs in program, recognise needed basic operations with data structures.

CO5: Use the appropriate data structure in context of solution of given problem

CO6: Develop programming skills which require to solve given problem.

Name of the Course: Data Base Management System (DBMS)	
Course Code: OE-FT 601B	**Semester: VI**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 2 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 2	

Objective:

To learn about the basics of DBMS

To provide a general introduction to relational model

To learn about SQL

To learn about ER diagrams

To learn about Transaction Processing

Pre-Requisite: Basic knowledge of mathematics, algorithm, programming

Details of Syllabus

Unit	Content	Hrs/ Unit
1	**Introduction:** Concept & Overview of DBMS, Data model, Database language, Database administrator, Database users, Three Schema architecture of DBMS.	4
2	**Entity-Relationship Model**: Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity sets, Extended E-R features.	4
3	**Relational Model:** Structure of relational Databases, Relational Algebra, Relational; calculus, Extended Relational Algebra operations, Views, Modificationof the Database.	4
4	**SQL and Integrity Constraints**: Concept of DDL, DML, DCL. Basic structure, Set operations, Aggregate functions, Null values, Domain constraints, Referential integrity, Constraints, assertions, views, Nested sub queries, Data base security application development using SQL, Stored procedures and triggers	5
5	**Relational Database design**: Functional dependency, Different anomalies in designing a Database, Normalization using functional dependencies, Decomposition, Boyce-Codd normal form, 3NF, Normalization using multi-valuedependencies, 4NF, 5 NF.	5
6	**Internal of RDBMS**: Physical data structures, Query optimization: join algorithm, statistics and cost base optimization, Transaction processing, Concurrency control and recovery management: transaction model properties, state serializability, look base protocols, two phase lockin	4

7	**File organization & index** structures File & records concepts, Placing file records on disk, Fixed and variable sized records, Types of single – Level index (primary. Secondary, clustering), Multilevel Indexes, Dynamic multilevel indexes using B tree and B+ tree.	4

Text & Reference Books:

1. Abraham Silberschatz,Henry F.Korth,S.Sudarshan,2010,McGraw Hill,ISBN 00352332-1
2. Data CJ –An introduction to database, 8th edition, 0321197849
3. Elmasri and Navathe,Fundamentals of Database system Publishing,ISBN,9780136086208
4. Peter rob,CarlosCoronet,Database systems-Disgn,Edition,2009,Thomson Learning, ISBN:978-0538469
5. R.P. Mahapatra, Database Management Systems, Khanna Publishing House, New Delhi

Course Outcomes

After completion of the course the students will be able to

CO1: Define and understanding introductory concepts of data structure, time and space analysis of algorithms using different asymptotic notations.

CO2: Understanding linear data structures with its applications and operations on different Linked lists.

CO3: Illustrate the concept and implementation of stack, queue, dequeue, circular queue, and applications of stack using recursion.

CO4: Understanding and build non-linear data structure such as trees, its traversal, insertion, deletion, height-balanced and B-trees.

CO5: Analyze and evaluate various searching and sorting algorithms, problem analysis and representation of graphs such as BFS and DFS.

CO6: Analyze and evaluate the importance of data structure and be able to correlate future programming structure, and its market issues specific to complex engineering problems.

Name of the Course: Nanoscience in Food Technology		
Course Code: OE-FT 602A	**Semester: VI**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points:3		
Objective:		
1	To learn about basis of nanomaterial science, preparation method and different types	
2	To enable the students to learn about potential applications of nanomaterials in food research	
Pre-Requisite:		
1	Basic knowledge of physics, mathematics, mechanics, electronics and chemistry	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires, ultra-thin-films-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only)	8
2	Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE	7
3	Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis (arc growth, laser ablation, CVD routes, Plasma CVD), structure-property relationships applications, Nanometal oxides- ZnO, TiO_2,MgO, NiO, nanoalumina, CaO, $AgTiO_2$, Ferrites, Nano clays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.	10
4	X-ray diffraction technique (XRD), Scanning Electron Microscopy (SEM) , Transmission Electron Microscopy (TEM) including high-resolution imaging, Surface Analysis techniques AFM, SPM, STM, SNOM, ESCA, SIMS- Nanoindentation.	8

5	Nanotechnology in food processing: nanoprobes/nano-biosensors in food application: single cell detection of food-borne pathogens, toxins. Applications of Nano-composite materials in active/smart packaging, Nanoencapsulation: techniques and targeted controlled release of nutrient/ bioactives delivery systems, Inorganic NPs for bacterial inhibition, Nano-emulsion and liposomes: stability and applications in food industries. Safety issues and risk assessment studies of nanoparticals / nanomaterials, Legal/legislative/regulatory guidelines for use of nanomaterials in food products; concerns, limitation and challenges	12

Text Books:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications",Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition,Weinheim Cambridge, Wiley-VCH, 2000.

References:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.

2. Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling andSimulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Course Outcome:

After completion of the course the students will be able to

CO1: Familiarize about the science of nanomaterials and nanoparticals

CO2: Comprehend the importance of nanoparticals and demonstrate the preparation of nanomaterials

CO3: Apply the knowledge acquired for characterization of different nanomaterials/ nanoparticals

CO4: Analyze the risk assessment and safety issues of nanoparticals in food and packaging applications

CO5: Evaluate further area of research in food nanotechnology/nano encapsulation/ nano packaging

CO6: Design and develop different process control system of nano technology applied in food industries

Name of the Course: Protein Technology	
Course Code : OE-FT 602B	**Semester: VI**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 3	

Objective:	
1	To know about properties of proteins
2	To know manufacturing of different protein preparations
Pre-Requisite:	
1	Chemistry

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Determination of protein structure; Nutritional and commercial importance of proteins; Physical, chemical and functional properties of proteins; Folding of proteins; Commercial sources of proteins; Creation of new proteins by bio-composite synthesis technique.	15
2	Process of making protein isolates and concentrates; Factors affecting quality of isolates and concentrates; Treatment to isolate and concentrate; Packaging of protein isolates and concentrates; Food and non food uses of isolates and concentrates.	10
3	Methods of manufacturing protein hydrolysates; Factors affecting quality of hydrolysates; Food uses of hydrolysates; Fibre spinning process of proteins; Textured protein gels and expanded products; Simulated milk products; Restructured protein; Nonconventional sources of protein.	10
4	Centrifugation; Cell disruption; Protein precipitation and its recovery; Aqueous two-phase separation; Ion exchange chromatography; Gel filtration; Affinity chromatography; Electrophoresis; Cross filtration; Ultra filtration.	10

Text and Reference Books:

1. Altschul, A.M and Wilcke, , H.L Ed 1978. new protein Foods. Vol III. Academic Press, New York
2. Bodwell, C.E.Ed. 1977. evaluation of proteins for Humans. AVI, Westport
3. Milner,M., Scrimshaw, N.S and Wang, D.I.C.Ed. 1978. Protein Resources and Technology. AVI, Westport
4. Salunkhe, O.K and Kadam, S.S Eds. 1999. Handbook of world legumes; Nutritional Chemistry, Processing Technology and

1. Utilization. Volume I to III, CRC Press, Florida
5. Salunkhe, D.K. Chavan, J.K.,Adsule, R.N Kadam, S.S 1992. World Oilseeds: Chemistry, Technology and Utilization, Van

2. Nostrand Reinhold, New York

6. Bioseparation Engineering: Principles, Practise and Economics, M.Ladish; Wiley Inter science
7. Proteolytic enzymes: a practical approach, Beynon, R.J and Bond, J.S; IRL Press, Oxford
8. Protein Biotechnology, Franks, F.; Humana Press

Course Outcome:

After completion of the course the students will be able to

CO1: Describe and identify various commercial sources of proteins and its structure, quality and application in food sector

CO2: Understand the importance of protein engineering in improving the nutritional and functional properties of food

CO3: Describe and identify the process of manufacturing protein isolate, concentrate and hydrolysates from different sources to understand and define Factors affecting quality of protein isolate, concentrate and hydrolysates**.**

CO4: Designing new range of products with improved nutritional characteristics

CO5: Understand and apply knowledge of various techniques to improve nutritional values of food by using protein technology in food industry

CO6: Able to communicate effectively own idea and activities with the engineering community and the society at large through writing and presentation and to give and receive clear instruction and to enhance societal awareness on protein technology

Name of the Course: New Product Development		
Course Code : OE-FT 602C	**Semester: VI**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points: 3		
Objective:		
1	To know about product development techniques	
2	To know about customer needs	
Pre-Requisite:		
1		

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	**Managing Product Development:** Introduction, Business Models for New Products, Managing Product Development, Market research and literature survey to identify the concepts of new products based on special dietary requirements, functionality, convenience and improvisation of existing foods	8
2	**Understanding Customer Needs:** Identifying New Product Opportunities, Changing face of Consumer Demand, Screening of product concept on the basis of techno-economic feasibility	10
3	**Organizing Product Development:** Product Architecture, Design for manufacturing and Prototyping of different Food Product, Standardization and optimization of formulation process, Organizing Product Development, Proximate Analysis of New Product, Developing Services and Product Service Systems	8
4	**New Product Strategy:** Building Markets and Creating Demand for New Products, Intellectual Property Issues in Product Development, New Product Business Plans – Strategy Consulting for New Products	8
5	**Design Thinking for New Products:** Designing Products for Emerging Markets, Design Thinking for New Products, Packaging, labeling and shelf-life studies	5
6	**Product Costing, Benchmarking & Supply Chain understanding:** Cost analysis of Final Product, Benchmarking & Supply Chain understanding A summary of Project Report in small team size/group of students	6

Text and Reference Books:

Textbook:

1. Drew Boyd & Jacob Goldenberg (2013) Inside the Box: The Creative Method that Works for Everyone

2. Joseph V. Sinfield, Edward Calder, Bernard McConnell and Steve Colson (2012) How to Identify New Business Models, MIT Sloan Management Review Vol. 53, No.2.

3. Chun-Che Huang (2000) Overview of Modular Product Development, Proc. National Science Council ROC(A) Vol. 24, No. 3, pp. 149-165

4. Marc H. Meyer and Arthur DeTore (1999) Product Development for Services, The Academy of Management Executive, Vol. 13, No. 3, Themes: Teams and New Product Development (Aug., 1999), pp. 64-76

Course Outcome:

After completion of the course the students will be able to

CO1: Apply the specific knowledge for different food product formulations with market prospective.

CO2: Understand the major processing steps applied for food product prototyping and design through scientific approach.

CO3: Apply knowledge of different food processing equipment specific to the product and process development.

CO4: Design products for emerging markets based on opportunity and develop protocol for different category of food products.

CO5: Apply the engineering principles to design consumer centric novel food product.

CO6: Adopt the changing face of consumer demand and develop product with cost optimization and meeting regulatory standards.

Practical

Name of the Course: Food Processing Lab - II	
Course Code: PC-FT 691	**Semester: VI**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva – 20 Marks

Objectives:	
1	To understand the significance of food processing on food preservation
2	To construct process flow diagrams.
3	To operate various equipments
4	To calculate and present analytical results obtained during practical experiments in a safe and responsible way
Pre-Requisite:	
1	Elementary chemistry
2	Plant biology
3	Unit operations
Practical:	
	1) Intellectual skills-
	2) Motor skills- Double jacketed Kettle, Baking Oven/ OTG, Spray dryer, Incubator, Refractometer

Laboratory Experiments:	
1	Preparation of bread
2	Preparation of cake
3	Preparation of cookies/ biscuits
4	Preparation of extruded foods
5	Manufacture of Flavoured milk
6	Manufacture of ice cream
7	Manufacture of yoghurt/ dahi
8	Manufacture of paneer
9	Manufacture of traditional Indian sweetmeats (Rosogolla/ Sandesh)

Text and Reference Books:

5. Khetarpaul, Neelam, “Food Processing and Preservation”, Daya Publications, 2005.
6. Food Science by Potter
7. Outlines of Dairy Technology by Sukumar De

Course Outcome:

After completion of the course the students will be able to

CO1: Learn different methods applied to processing of foods

CO2: Understand and classify changes of raw food materials during transformation into food products

CO3: Understand the significance of food processing on food preservation

CO4: Construct process flow diagrams.

CO5: Operate various equipments.

CO6: Calculate and present analytical results obtained during practical experiments in a safe and responsible way.

Name of the Course: Food Analysis & Quality Control Lab – II	
Course Code: PC-FT 692	**Semester: VI**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva – 20 Marks

Objectives:	
1	To select appropriate techniques for analysis of food products.
2	To identify adulterants in various food sample.
3	To gain knowledge on food standards, regulations and quality control
4	To familiarize with the current state of Knowledge in food analysis.

Pre-Requisite:	
1	Basic analytical techniques
2	Handling of glassware, chemicals and equipments
3	Basic knowledge of solution preparation, chemical reactions
4	Spectrophotometric , titrimetric, gravimetric, volumetric and chromatographic principles
5.	Basic knowledge of Food Chemistry, Food Microbiology and Food preservation

Practical:	
	1) Intellectual skills-
	2) Motor skills- Spetrophotometer, pH meter, Hot Air Oven/ Moisture Analyzer, Soxhlet Apparatus, Kjeldhal Unit, Viscometer, Turbidity Meter, Muffle Furnace, Laminar Air Chamber, Autoclave, Incubator, Colony Counter, Reflux Condenser
	Glasswares, chemicals & consumables

Laboratory Experiments:	
1	Determination of adulterants in milk and milk products
2	Analysis of milk, sweetened condensed milk (SCM)
3	Analysis of wheat flour, bread, biscuits & extruded products
4	Estimation of a) Iodine value, (b) Saponification value (c) acid value (d) peroxide value, (e) RM value (f) P value of edible fats and oils
5	Determination of adulterants in fats and oils
6	Analysis of ready – to- eat (RTE) & ready-to-drink (RTD) products

Text and Reference Books:

1. FSSAI Manuals
2. Raghuramulu, N. et al., "A Manual of Laboratory Techniques". 2nd Edition. NIN, 2003.
3. Nielson, S. Suzanne. "Food Analysis" 3rd Edition. Springer, 2003.
4. Pomeranz, Yeshajahu and Clifton E. Meloan "Food Analysis: Theory and Practice". 3rd Edition. Springer, 2000.

Course Outcome:

After completion of the course the students will be able to

CO1: Select appropriate techniques for analysis of food products.

CO2: Apply knowledge in identifying and determining the relative amounts of components in food sample.

CO3: Gain knowledge on food standards, regulations and quality control

CO4: Identify and detect adulterants in foods.

CO5: Appreciate the role of Food Analysis in food standards and regulation for the manufacture and the sale of food products and food quality control in food industries.

CO6: Familiarize with the current state of Knowledge in food analysis.

Name of the Course: Fermentation Technology Lab	
Course Code: PC-FT 693	**Semester: VI**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 2 hrs./ week	External Assessment: 60 Marks
Credit Points: 1	Distribution of marks: Experiments - 40 Marks Viva -20 Marks

Objective:	
1	To analyze problems in fermentation plant and to rectify defects.
2	To understand different Biochemical pathway different fermentation process.

Pre-Requisite:	
1	Basic of Food Microbiology
2	Basic of Biochemical pathway of microbial fermentation

Practical:	
	1) Intellectual skills-
	2) Motor skills- Autoclave, Spetrophotometer, Laminar air flow cabinet, Microscope, , pH meter, Hot Air Oven/ Moisture Analyzer, Petri plate use Glassware, chemicals & consumables

Laboratory Experiments:	
1	Manufacture of alcohol from conventional and/ or non conventional substrates
2	Propagation of Bakers yeast
3	Organic acid fermentation – Vinegar/ Citric/ Lactic acid production
4	Production of nisin from lactic acid bacteria
5	Enzyme preparation: Production & purification of amylases/ proteases/ lipases
6	Amino acid production
7	Vitamin B_{12} production
8	Production of traditional fermented foods

Course Outcome:

After completion of the course the students will be able to

CO1: Know the methods of selecting appropriate techniques for fermentation.

CO2: Apply knowledge in identifying and determining the downstream techniques for allied biochemical through fermentation.

CO3: Gain knowledge on design parameters for various fermentation plants to optimize production of high value products.

CO4: Obtain knowledge of modeling and simulation for upstream and downstream processing.

CO5: Know the modern techniques to formulate fermentative products for food and allied industry.

CO6: Familiarize with the current state of knowledge in fermentation process techniques.

Name of the Course: Database Management System Lab (DBMS Lab)	
Course Code: OE-FT 691	**Semester: VI**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 2 hrs./ week	External Assessment: 60 Marks
Credit Points: 1	Distribution of marks: Experiments - 40 Marks Viva – 20 Marks

Objectives:

- Lay Foundation knowledge in database concepts, technology and practice to groomstudents into well -informed database application developers.
- Strong practice in SQL programming through a variety of database problems.
- Develop database applications using front -end tools and back –end DBMS.

Pre-Requisite:

1	Basic computing skills
2	Data analysis knowledge

Practical:

	Intellectual skills-Programming skills

Laboratory Experiments:	
1	**Creating Database:** Creating a Database, Creating a table, Specifying Relational Data Types, Specifying Constraints, Creating Indexes.
2	**Table and record Handling:** INSERT statement, Using SELECT and INSERT together, DELETE, UPDATE, TRUNCATE statements, DROP, ALTER statements
3	**Retrieving Data from Database:** The SELECT statement, Using the WHERE clause, Using Logical Operators in the WHERE clause, Using IN, BETWEEN, LIKE, ORDER,BY GROUP BYand HAVING
4	**Clause:** Using AGGREGATE function, Combining Tables using JOINS Sub queries
5	**Database Management:** Creating views ,Creating Column Aliases, Creating Database Users, Using GRANT and REVOKE
6	**Cursors** in Oracle PL / SQL :Writing Oracle PL / SQL **Stored Procedures**

Text and Reference Books:

1. Database Systems: A Practical Approach to Design, Implementation and Management"by CONNOLLY
2. Database Management Systems by R.P. Mahapatra, Khanna Publishing House, NewDelhi

Course Outcome:

After completion of the course the students will be able to

CO1: Define different operations on data structure such as insertion, deletion, merging using arrays.

CO2: Demonstrate implementation of stacks and queues: insertion, deletion of elements, circular queue: insertion, deletion of elements using array.

CO3: Solve expressions operations using multiple stacks & queues.

CO4: Construction and implementation of linked lists: inserting, deleting, and inverting a linked list, analyze implementation of stacks & queues using linked lists, polynomial addition, polynomial multiplication, sparse matrices multiplication, addition using linked list.

CO5: Evaluate recursive and non-recursive traversal of trees and implementation of recursive binary tree traversal and AVL tree.

CO6: Design and implement of different searching and sorting algorithms.

Fourth Year: Seventh Semester

Theory

Name of the Course: Food Packaging Technology		
Course Code: PC-FT 701	**Semester: VII**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points:3		
Objective:		
1	To develop the knowledge about the basics of Packaging technology that exists in society.	
2	To make the students equipped with understanding of criteria required for designing a successful packaging systems for any food product	
3	To identify the risks associated with the overall process generation and implementation.	
4	To acquire updated knowledge about the new technologies that are developing in packaging industries	
Pre-Requisite:		
1	Basic Chemistry	
2	Basic Food Microbiology	
3	Basic knowledge of mathematics, physics and mechanics	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Definition and Functions of packaging; Type of packaging materials; Selection of packaging material for different foods; Methods of packaging and packaging equipment.	10
2	Mechanical strength of different packaging materials; Printing of packages; Barcodes & other marking; Interactions between packaging material and foods; Environmental and cost consideration in selecting packaging materials.	7
3	Manufacture of packaging materials; Potential of bio-composite materials for food packaging; Packaging regulations as per FSSAI; Packaging and food preservation;	8

4	Testing of packaging materials (PM) in food industries; Rigid and semi rigid containers; Flexible containers; Sealing equipment; Labeling and symbols used in packaging products; Aseptic and shrink packaging; Secondary and transport packaging.	10
5.	Advances in Packaging Technologies; MAP, CAP, Active packaging, Intelligent Packaging, Nano-Packaging, Irradiated food Packaging.	10

Text and Reference Books:

Text

1. Food Packaging: Principles and Practice by G. L. Robertson. Taylor & Francis Inc.
2. Food Packaging Technology by Richard Coles, Derek MC Dowell and Mark J. Kirwan. Blackwell Publishing, CRC press.
3. Food and Packaging Interactions by Joseph H. Hotchkiss, (ACS symposium series - 365,April 5-10, 1987, American chemical society, Washington DC, 1988.)

Reference

1. Packaging foods with plastics by winter A. Jenkins & James P Harrington – Technomic publishing co. Inc, Lancaster. Basel.
2. Flexible food packaging (Question & Answers) by Arthur Hirsch VNB – Van Nostrand Reinhold, New York (An AVI Book),ISBN 0-442-00609-8.
3. Food Packaging and Preservation (theory & practice) by M. Mathlouthi-Elsevier Appliedscience publisher, London and New York.
4. Food Packaging Materials (Aspect of Analysis & Migration of contaminants) by N.T. crosby applied science publishers LTD. London.
5. Plastics in Packaging by A.S Athlye, TMGH, New Delhi.
6. Packaging (specifications, purchasing & Quality Control) 3rd edition by Edmond A Leonard- Marcel Dekker, INC- New York & Basel.
7. Plastics in packaging by forwarded by H.B Ajmera& M.R Subramanium – Indian institute of packaging. Published by A.P. Vaidya, Secretary IIP, E2, MIDC, Industrial Area Andheri (East), Bombay-400093.
8. Food Packaging- Stanley Sacharois & Roger C. Griffin- The AVI Publishing company Inc. 1970.
9. Principles of packaging development- Griffin & Sacharow. The AVI Publishing company, Inc. 1972.

Course Outcome:

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

CO1: Define, understand, and relate basic packaging technologies with respect to manufacturing methodologies, potential material development to address substantiated solution to practical food preservation and transportation problems.

CO2: Recognize the need, and to have the preparation for independent, life-long learning in the emerging areas of packaging technology in synergy with other technological applications.

CO3: Interpret and demonstrate as a professional, who has comprehensive knowledge on regulatory requirements for food packaging and allied areas to meet societal needs within realistic constraints such as economic, environmental, ethical, legal, cultural, health and safety, feasibility, and sustainability.

CO4: Examine and analyze problems associated with difficulties related to packaging material, methodologies and food components to be packaged.

CO5: Create, develop and formulate appropriate packaging technologies with the aid of various tools with a view to work in real life situations and as independent entrepreneurs.

CO6: Communicate to defend effectively on professional activities in order to estimate and support societal awareness and need on packaging technology.

Name of the Course: Food Safety & Quality Management		
Course Code: PC-FT 702	**Semester: VII**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points:3		
Objective:		
1	To develop the knowledge of students regarding quality control and management principles, tools and their application	
2	To enable the students to be aware of the voluntary and mandatory food standards and certifications in place- globally and nationally	
Pre-Requisite:		
1	Basic mathematics, basic biology, food preservation, quality control and assurance,	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Definition of quality, Quality specifications and quality attributes of different foods, Statistical quality control, Quality control programs: History and development, Total quality management (TQM), Quality assurance, Management Principles, ISO 9000 Family (QMS), principles and requirements	12
2	Food Safety Management System ISO-22000 – Family, Key role, Principles of FSMS and requirements, HACCP- Prerequisites; GMP/C-GMP, GHP, GLP, Cleaning and Sanitation, Safety practices in the production areas, Pest Control, Withdrawal and Recall Procedures, traceability system, Principles and steps of HACCP Plan, Hazard Identification, Risk assessment, CCP Decision Tree, CAPA Plan, document and records,	12
3	Mandatory and voluntary regulations world-wide, CODEX, FDA, WHO, EFSA, WTO, (TBT, SPSs), GATT. Role of regulatory authorities in India - functioning, legal acts and their enforcements- FSSAI (in detail), BIS, AGMARK, Legal Metrology Act, Industry Specific Regulations, ASCI, EPA, Export Quality Control and Inspection Act	12
4	Certification, Certification procedures, Certifying bodies, Accrediting bodies, International bodies. GFSI benchmarking, FSSC 22000, BRC, SQF, IFS, FSMA, OSHA	5

	Auditing procedures- types of audit, Surveillance; Mock audit, third party quality certifying audit, Auditors and Lead auditors.	
5	Sampling procedure: tools and techniques, Bio-safety guidelines for research, environmental aspects of GMOs, handling and disposal of biowaste	4

Text and Reference Books:

Text Books

1. Total Quality Management, M.P. Poonia & S.C. Sharma, Khanna Publishing House (AICTERecommended Textbook - 2018)
2. Total Quality Management, Poornima M. Charantimath**,** Pearson Education India
3. Total Quality Management for the Food Industries. WA Gould, Woodhead Publishing
4. Management and control of quality. James R Evans, William M Lindsey. Thomson South-western
5. Bioethics and Biosafety, M. K. Sateesh, I. K. International Pvt Ltd.

Reference Books

1. The Essentials of Quality Control Management, Peter N T Pang, Trafford publishing
2. Guide to Quality Management system for the food industry. Ralph Early

Course Outcome:

After completion of the course the students will be able to

CO1: Remember and relate principles of natural, biological science, and engineering fundamentals with basics food safety and quality management.

CO2: Understand the problems arising in quality control and quality assurance during food processing and interpret the tools and solutions that are being developed to solve such problems

CO3: Apply food safety management principles with an understanding of the limitations in application of the same in food quality and safety maintenance in a food industry.

CO4: Analyze existing food laws and quality management techniques in relation to follow legal limitsand supply safe food to consumers.

CO5: Evaluate and interpret data and apply resources to reach a sustainable solution in food safety and quality management system in industries.

CO6: Develop system tools to meet specific needs of food safety and maintain the effective quality of food during processing taking into consideration public health and safety, cultural, societal and environmental issues.

Name of the Course: Principles of Management		
Course Code: HM-FT 701	**Semester: VII**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points:3		
Objective:		
1	To develop the knowledge of different functional levels of management	
2	To enable the students to learn about the different personal management attributes	
	To enable the students to learn about management in technology, operations and in market	
Pre-Requisite:		
1	Basic mathematics and ethics	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Basic concepts of management: Definition – Essence, Functions, Roles, Level. Functions of Management : Planning – Concept, Nature, Types, Analysis, Management by objectives; Organisation Structure – Concept, Structure, Principles, Centralization, Decentralization, Span of Management; Organisational Effectiveness.	8
2	Management and Society – Concept, External Environment, CSR, Corporate Governance, Ethical Standards. People Management – Overview, Job design, Recruitment & Selection, Training & Development, Stress Management, Job Satisfaction. Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes	6
3	Managerial Competencies – Communication, Motivation, Team Effectiveness, Conflict Management, Creativity, Entrepreneurship Leadership: Concept, Nature, Theories of Leadership Styles Decision making: Concept, Nature, Process, Tools & techniques. Group Behaviour: Characteristics of Group, Types of Groups, Stages of Group Development, Group Decision Making. Communication: Communication Process, Direction of Communication, Barriers to Effective Communication.	10

4	Economic, Financial & Quantitative Analysis – Production, Markets, National Income Accounting, Financial Function & Goals, Financial Statement & Ratio Analysis, Quantitative Methods – Statistical Interference, Forecasting, Regression Analysis, Statistical Quality Control	8
5	Customer Management – Market Planning & Research, Marketing Mix, Advertising & Brand Management. Operations & Technology Management – Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma, MIS.	8
6	Conflict Management: Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict, Conflict Process, Negotiation – Bargaining Strategies, Negotiation Process.	5

Text and Reference Books:

1. Principles of Management – Premvir Kapoor, Khanna Publishing House, 2019
2. Management : Principles, Processes & Practices – Bhat, A & Kumar, A (OUP).
3. Essentials for Management – Koontz , Revised edition, Tata McGraw Hill(TMH)
4. Management – Stoner, James A. F. (Pearson)
5. Management - Ghuman, Tata McGraw Hill (TMH)

Course Outcome:

After completion of the course the students will be able to

CO1: Apply management principles and practices

CO2: Determine the social needs and can define the corporate social responsibilities and corporate governance and their implementation through use of latest technology

CO3: Determine the manpower requirement and device the policies and procedure of recruitment Plan and device appropriate training and development programme in adapting with changed environment and improving performance.

CO4: Conduct market feasibility study to determine the needs of the customer and plan strategies for product development, advertisement, manufacturing and distribution

CO5: Can able to prepare and analyze financial statements to determine the financial health of the company.

CO6: Ability to accomplish desired quality of the deliverables within given budget. Use MIS Softwaretools for timely and economically managing every aspects of the business.

Name of the Course: Food Laws & Standards	
Course Code: PE-FT 701A	**Semester: VII**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points:3	

Objective:	
1	To know salient features of Food Safety and Standards Act of 2006 and its Rules and Regulations
2	To know important features of Codex and its scientific principles and relevance to national standards.
3	To specify the requirements with respect to import/ export of food products.
4	To ensure the safety and quality of food products as per mandatory legal requirements and voluntary standards including export regulations if required.
Pre-Requisite:	
1	Knowledge of food safety and regulations

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Erstwhile Prevention of Food Adulteration Act and Rules, Erstwhile essential commodities act, Voluntary National Standards: BIS & AGMARK, National agencies foe implementation of International laws and standards, Food labeling	5
2	International Food Policies and Regulation and Codex Alimentarius: Principles and standards of international food regulations; roles of various international agencies : WHO, FAO, Codex, and WTO; the WTO agreements in relation to SPS (Sanitary Phytosanitary Measures) and TBT (Technical Barrier to Trade), role and function of FEHD; health inspectors; Centre for Food Safety	10
3	Food Laws and Regulations in the United States of America: Basic food laws and regulations in the United States; the roles of Food and Drug Administration (FDA), the United States Department of Agriculture (USDA), Environmental Protection Agency and the Federal Trade Commission; major food legislation in the United States: Food, Drug and Cosmetic Act, Dietary Supplement Health and Education Act, and other requirement related to GM labeling, nutrition labeling and health claims.	10

4	Regulations on harmful substances in food, imported meat and poultry, milk/dried milk labeling, food business, frozen confections, coloring matters, preservatives, sweeteners and other additives; guidelines on voluntary labeling of genetically modified (GM) food, imported foods and food recall; microbiological guidelines for ready-to-eat food; code of hygienic practice for aseptically processed and packaged low-acid foods.	10

Text and Reference Books:

1. Course MVP-002: Food Laws and Standards of "PG Diploma in Food Safety and Quality Management" programme being offered by School of Agriculture, IGNOU.
2. Food Safety and Standards Act 2006 and Regulations 2011.
3. https://www.fssai.gov.in/home
4. Codex e-Learning Centre (http://www.fao.org/ag/agn/agns/capacity_elearning_codex_en.asp)
5. Custom Act

Course Outcome:

CO1: Remember and relate principles of natural, biological science, and engineering fundamentals with elemental food laws and relevant standards.

CO2: Understand the problems arising in food policies during standardization of food laws and interpret the solutions that are being developed to solve such problems

CO3: Apply food laws and relevant regulatory principles with an understanding of the limitations in application of the same in food processing.

CO4: Analyze existing food laws and quality management techniques in relation to follow legal limitsand supply safe food to consumers.

CO5: Evaluate and interpret data and apply resources to reach a sustainable solution in food safety and quality management system in industries.

CO6: Develop system tools to meet specific needs of food laws and standards by food business operators taking into consideration public health and safety, cultural, societal and environmental issues.

Name of the Course: Emerging Trends in Food Processing	
Course Code PE-FT 701B	**Semester: VII**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points:3	

Objective:	
1	To develop the advanced knowledge in the area of food processing and technology
2	To know emerging technologies in relation to processing of foods
Pre-Requisite:	
1	Elementary Physics, Mathematics, Microbiology, Food Preservation, Food Engineering
2.	Knowledge of Unit Operations, heat transfer

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	High Pressure Processing: Principles of high-pressure processing, use of high pressure to improve food safety and stability. Effects of high pressure on food quality: Pressure effects on microorganisms, enzyme, texture and nutrients of food. Modeling HP processes. Other applications of high-pressure processing.	9
2	Pulsed electric fields processing: Historical background, PEF treatment systems, main processing parameters. Mechanisms of action: mechanisms of microbial and enzyme inactivation. PEF for processing of liquid foods and beverages, PEF Processing for solid foods. Food safety aspects of pulsed electric fields. Pulsed electric field and high-pressure processing.	8
3	Osmotic dehydration: mechanism of osmotic dehydration, effect of process parameters on mass transfer, determination of moisture and solid diffusion coefficient, application of osmotic dehydration.	4
4	Membrane concentration of liquid foods and colours: osmotic membrane distillation, direct osmosis, membrane modules, Applications of membrane concentration.	3
5	Processing by radio frequency electric fields: radio frequency electric fields equipment, RFEF non-thermal inactivation of yeasts, bacteria and spores, electrical costs.	4
6	Ultrasound processing: fundamentals of ultrasound, ultrasound as a food	4

	preservation and processing aid, effects of ultrasound on food properties.	
7	Alternate thermal processing: Microwave heating: dielectric properties of foods, heat and mass transfer in microwave processing, application of microwave processing for foods;	4
8	Radiofrequency processing: dielectric heating, material properties, radio-frequency heating and drying applications; Ohmic heating: Fundamentals of ohmic heating, electrical conductivity, modeling, treatment of products.	4
9	Hybrid drying technologies: combined microwave vacuum drying, combining microwave vacuum drying with other processes, equipment for microwave vacuum drying, product quality degradation during dehydration.	5

Text and Reference Books:

1. Sun, D. Emerging Technologies for Food Processing, (Academic Press, 2005)

2. Barbosa-Canovas, G. V., Tapia, M. S. and Cano, M. P. Novel Food Processing Technologies,(CRC Press, 2004)

3. Ohlsson, T. and Bengtsson, N. Minimal Processing technologies in the food industry,

(Woodhead Publishing Limited, 2002)

Course Outcome:

After completion of the course the students will be able to

CO1: Apply the knowledge of different unit operations in developing a process specific to food

CO 2: Analyse the effect of different process variables on the quality of food product

CO3: Analyse the effect of compositional variables on overall quality and safety attributes of food products

CO4: Design the food process and products optimizing the processing condition subject to product category

CO5: Understand the scale-up opportunities and limitations based on design parameters

CO6: Adopt the technology transfer of emerging food processing over conventional treatments

Name of the Course: Food Toxicology	
Course Code: PE-FT 701C	**Semester: VII**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points:3	

Objective:	
1	To develop the knowledge of different type of food toxicants and food allergens
2	To enable the students to learn about the severity of health implications of the toxicants
3	To enable the students to learn how to detect toxicants in food
Pre-Requisite:	
1	Basic food chemistry, food microbiology, food processing, quality control and food regulations

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Terms and Scope of Food and Nutritional Toxicology, Toxicants in foods - Naturally occurring toxicants, nutrients, anti-nutritional compounds, contaminants, microbial toxins, toxicants formed during food processing,	14
2	Dose–response relationship, Frequency response, Potency and toxicity, Reversibility of toxicity response, Hypersensitivity vs hyposensitivity Phases of toxicological effects, Exposure phase, Toxicokinetic phase, Toxicodynamic phase, acute toxicity, mutagenicity and genotoxicity, carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioural effect, immunotoxicity.	10
3	Impact of diet on the effects of toxicants, Biological factors that influence toxicity, toxin interaction and absorption with G.I. track microflora, Industrial microflora, blood, brain barrier, storage and excretion of toxins	10
4	Food allergens, chemistry of food allergens, celiac disease, food disorders associated with metabolism, lactose intolerance, symptoms and signs of allergic attack	6
5	Quantitative and qualitative analysis of toxicants in foods; Biological determination of toxicants	5

Text and Reference Books:

1. Food Toxicology, Helferich, William and Carl K.Winter, CRC Press, 2001.
2. Food Hygiene and Toxicology, Vikas Alluwalia, Paragon International Publishers, 2007
3. Introduction to Food Toxicology, Shibamoto, Taka yuki and Leonard F.Bjeldanze,s 2nd Edition.Academic Press, 2009.
4. Handbook of food toxicology by S. S. Deshpande
5. Nutritional and safety aspects of food processing by Tannenbaum SR
6. Microbiological safety of food by Hobbs BC, 1973,
7. Chemical toxicology of food by Galli, C.L, 1978
8. Food Allergy, Maleki, Soheila J. A.Wesley Burks, and Ricki M.Helm ASM Press, 2006.

Course Outcome:

After completion of the course the students will be able to

CO1: Recall the nature of food toxicants and the likelihood of their occurrences.

CO2: Understand the mechanisms of action of specific food toxicants.

CO3: Apply the knowledge of mechanism of interaction between toxicants and multiple food compounds to identify the vulnerability of food matrices.

CO4: Analyze the difference between food allergies and food toxicants.

CO5: Evaluate toxicants in food and their associated levels of toxicity with implications on health.

CO6: Devise strategies to eliminate or reduce presence of food toxicants, and create awareness in publicand help to strengthen national safety policy of our food supply

Name of the Course: Project Engineering & Food Plant Layout		
Course Code: PE-FT 702A	**Semester: VII**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points:3		
Objective:		
1	To develop the knowledge of plant design and layout of specific food industries	
2	To enable the students to learn about the regulations governing food plant design	
3	To enable the students to learn how to scale up plant designs	
Pre-Requisite:		
1	Basic mathematics, food processing, quality control and food regulations	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Basic concepts of plant layout and design including basic understanding of equipment layout ventilation; Reference to bakery and biscuit, fruits, vegetable and beverage processing, and dairy industries; Miscellaneous aspects of plant layout and design like provision for waste disposal, and safety arrangements	12
2	Design consideration for location of food plants; ISO, specific FSSAI requirements in food plant layout and design; Preparation of flow sheets formaterial movement and utility consumption in food plants	12
2	Layout and designing aspects of pilot and semi-commercial food processing plants; Scale-up; Application of Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM) in project planning and monitoringInspection Act	12
4	Introduction to project engineering; Selection of construction materials; Specifications of processing equipments and accessories	9

Text and Reference Books:

1. Manufacturing Facilities Design and Material Handling by Fred E. Meyers, and Matthew P. Stephens,3rd Edition, Pearson
2. Prentice Hall, 2000
3. James M Moore, “Plant Layout and Design”, Mcmillan & Co., (1959)

4. Bolz, Harold A George E., “Material Handling Handbook.
5. J M Apple, “ Plant layout and Material Handling”, John Willey & Sons, (1977)

Course Outcome:

After completion of the course the students will be able to

CO1: Learn and solve plant layout problems and ability to produce material flow problems related with food processing industries.

CO2: Understand and apply knowledge on laws and regulations related to food and allied areas in plant layout.

CO3: Apply mathematical and engineering techniques for project management.

CO4: Access and analyze plant layout techniques.

CO5: Communicate effectively on professional activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, give and receive clear instructions, and to enhance awareness in relevant fields.

CO6: Demonstrate knowledge and understanding of engineering and management principles, and apply these in one’s own work taking into consideration the aspects of financial management.

Name of the Course: Modeling and Simulation in Food Processing		
Course Code: PE-FT 702B	**Semester: VII**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points: 3		
Objective:		
1	Modeling equation of a fermentation process	
2	Modeling equation for absorption type mass transfer operation	
3	Optimization of a multi variable process	
Pre-Requisite: The following modules (or equivalents) should be preferably completed prior to, this module:		
1	Basic engineering mathematics	
2	Basic knowledge on fermentation	
3	Basic knowledge in mass transfer in column absorption process	
4	Experimental design and multi variable process	

Details of Syllabus

Unit	Content	Hrs/ Unit
1	Introduction to mathematical modeling; Process analysis and simulation; Model building; Classification and uses of mathematical Models; Formulation of mathematical model and fundamental laws.	10
2	Batch processes in food industry; Equilibration in batch processes; Steady state flow processes of non reacting systems; Mixing in flow processes	10
3	Simultaneous heat and mass transfer in packed tower and immobilized enzyme system.	5
4	Modeling, simulation and optimization of fermentation processes.	5
5	Modeling and simulation of extrusion process	5
6	Experimental design in multivariable Food processing	5
7	Application of Fuzzy logic to sensory evaluation and ranking of foods.	5

Text and Reference Books:

1. Text and reference books:
2. Process modeling, simulation and control: William L Luyben, TMH
3. Process analysis & simulation: Himmelblau, Kenneth & Birchoff, John Wills.

Course Outcome:

After completion of the course the students will be able to

CO1: To understand about different independent and dependent variable in Food Processing operation.

CO2: To evaluate optimum process condition in Food Processing operation.

CO3: Understand the problems arising during food processing.

CO4: Examine and analyze problems associated with difficulties related to modeling techniques and simulation process.

CO5: To develop experimental design for a multivariable process.

CO6: Development modeling equation in simultaneous heat and mass transfer process in dryer and absorption column.

Name of the Course: Plant Maintenance safety and Hygiene	
Course Code: PE-FT 702C	**Semester: VII**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 3	

Objective:	
1	Purpose to provide students about the safety measure in the plant to avoid accident
2	Can provide knowledge about the maintenance operation in the plant
3	Safety and hygiene of the operation also on the angle of Food Safety
Pre-Requisite: The following modules (or equivalents) should be preferably completed prior to, this module:	
1	Knowing the basic process Technology of different food Processing operations
2	Process flow Flow-sheet and working principle of different Food Processing equipment

Details of Syllabus

Unit	Content	Hrs/ Unit
1	Plant maintenance program; Role of maintenance staff and plant operators; Preventive maintenance; Guidelines for GMP & safety precautions; Lubrication & lubricants; Work place improvement through '5S'	10
2	The objective of safety, health & environment; Cost of safety; Accident investigation report; Safety promotional activity; ISO 45001-Occupational health and safety; Environmental pollution and its control	13
3	Indian Factories Act on safety; HACCP; Desirable safety features of some food processing equipment; Personal protective equipment; Safety from adulteration of food, Food fraud and Food defense	10
4	Hygiene and sanitation requirement in food processing and biochemical industries; Cleaning (CIP Systems), sanitizing & pest control in food processing; Safety during receiving- unloading- shifting and storage of food materials and packaging materials ;–General safety facilities in construction sites	12

Text and Reference Books:

1. Basic Concepts of Industrial Hygiene, Ronald M Scott, CRC Press.
2. Safety design criteria for industrial plants. Maurizio Cumo& Antonio Naviglia.CRC Press.
3. Industrial Hygiene & Toxicology by Josef Brozek-1948.
4. Food Hygiene, Microbiology & HACCP. S J Forsythe, P R Hayes. Springer.

Course Outcome:

After completion of the course the students will be able to

CO1: Understand safety features of different processing operations

CO2: Analyze the plant operation in food processing plant

CO3: Correlate the plant operational hazards with Food Safety

CO4: Identify different types of hazards and establishing control measures

CO5: Understand possible cause of accident in plant and its safety measure

CO6: Realize hygiene and sanitation requirement in food processing and allied industries

Name of the Course: Entrepreneurship Development for Food Technologists	
Course Code: OE-FT 701A	**Semester: VII**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: NIL	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points: 3	

Objective:

1. Acquire knowledge in Entrepreneurship Development
2. Able to study and prepare the business plan for an any organization
3. Classify and study the organization structure between small, medium and large scale manufacturing industries

Pre-Requisite: Fundamental knowledge of Project design, Project costing

Detailed Syllabus:

Unit	Content	Hrs/ Unit
1	Entrepreneurship concept- Entrepreneurship as a Career- Entrepreneur Personality Characteristics- Knowledge- Skills- Attitude Requirement	8
2	Business Environment- Role of Family and Society- Entrepreneurship Development Training and Other Support Organizational Services- Central and State Government Industrial Policies and Regulations, MoFPI scheme and support to budding food entrepreneurs, Skill Development by Central Government, International Business.	12
3	Sources of Product for Business- Prefeasibility Study- Criteria for Selection of Product- Ownership- Capital- Budgeting Project Profile Preparation- Matching Entrepreneur with the Project- Feasibility Report Preparation and EvaluationCriteria	9
4	Finance and Human Resource Mobilization- Operations Planning- Market and Channel Selection- Growth Strategies- Product Launching	8
5	Monitoring and Evaluation of Business- Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business, Overview of Start-up food business and challenges	8

Text and Reference Books:

1) Hisrich, "Entrepreneurship", Tata McGraw Hill, New Delhi, 2005.
2) Saravanavel, P., 'Entrepreneurial Development', Ess Pee kayPublishing House, Chennai, 2005.
3) Khanka, S S., "Entrepreneurial Development", S.Chand and Co Limited, New Delhi, 2001.
4) Jain, P C., "Handbook for New Entrepreneurs", Second Edition, Oxford University Press, New Delhi,2002.

Course Outcomes:

After completion of the course the students will be able to

CO1: Develop the Entrepreneurial skills for Food Technologists.

CO2: Understanding opportunities to set-up Food processing industries.

CO3: Acquire basic knowledge in Trade license and registration marks, Sources of finance, selection of land and factory sheds.

CO4: Understanding opportunities to set-up Food processing industries.

CO5: Impart knowledge on Preparation of project report, Market feasibility reports, Techno economic feasibility report.

CO6: Develop entrepreneurship knowledge to apply in food processing field.

Name of the Course: Food Security & Sustainability		
Course Code: OE-FT 701B	**Semester: VII**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points:3		
Objective:		
1	To develop the understanding of the need for Food Security and Sustainability	
2	To enable the students to learn about the severity of depletion of natural resource and its effect on food security	
3	To enable the students to learn about the different practices, policies and initiatives to ensure food security and sustainability	
Pre-Requisite:		
1	Environmental science, basic biology, agriculture, geography, microbiology, food processing, quality control and food regulations	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Food Security and Sustainability - Definition, Elements, Prospects and Challenges, Food production and nutritional aspects, impact of depletion of water resources, Land Resources of India, Population and land, Land utilization, Net Area Sown, changes in cropping pattern, land degradation, Rainfall forecasting - Adequacy of Rainfall for crop growth – Rainfall, Drought and production instability – Irrigation potential – Available, created and utilized – River basins; Watersheds and Utilizable surface water – Utilizable water in future (Ground water & Surface water)	15
2	Food –ecosystems, Factors affecting agriculture and crop yield, Indicators of Sustainable food availability, Population pressure and agricultural productivity, GMO, organic farming, vertical farming – principles and practices, Subsistence Food Production Practices, Security of foods of animal origin and its implications	10
3	Performance of major categories of food over the past decades, trends in food production, Decline in total factor productivity growth, Demand and supply projections, Impact of market force, , Sustainable food security indicators and index , Indicator of sustainability of food Security, Path to sustainable development.	10

4	International and National policies for Food Security and Sustainability, Schemes, initiatives and mass awareness programs by Government, PSUs, Case studies on CSR activities of different organizations related to Food Security and Sustainability	10

Text Books:

1. B.K.Desai and Pujari, B.T. Sustainable Agriculture : A vision for future, New India PublishingAgency, New Delhi, 2007.
2. Saroja Raman, Agricultural Sustainability – Principles, Processes and Prospects, CRC Press, 2013

Reference Books:

1. Swarna S.Vepa etal., Atlas of the sustainability of food security. MSSRF, Chennai, 2004.
2. Sithamparanathan, J., Rengasamy, A., Arunachalam, N. Ecosystem principles and sustainableagriculture, Scitech Publications, Chennai, 1999.
3. Gangadhar Banerjee and Srijeet Banerji, Economics of sustainable agriculture and alternate productionsystems, Ane Books Pvt Ltd., 2017
4. M.S. Swaminathan, Science and sustainable food security, World Scientific Publishing Co., Singapore, 2010.

Course Outcome:

After completion of the course the students will be able to

CO1: Recall the need for food and the nutritional security on global and national level

CO2: Comprehend the importance of utilization and preservation of land, water and other naturalresources for Food Security and Sustainability.

CO3: Apply the basic knowledge and principles to aid in Food Security and Sustainability.

CO4: Analyze the different existing and proposed technologies to set up sustainable food eco-systems.

CO5: Evaluate food production trends to monitor and explore various avenues to cater to development ofsustainable practices

CO6: Generate mass awareness and contribute at various levels as individuals or as active members oforganizations to uphold the magnitude of Food Security and Sustainability

Name of the Course: Food Process Equipment Design	
Course Code: OE-FT 701C	**Semester: VII**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points:3	

Objective:	
1	To understand the Engineering operations in different mixing process solid- solid mixing and liquid liquid mixing etc.
2	To assess the different simultaneous mass and energy transfer operation in industrial process like drying crystallization etc.
3	To understand different type of Mechanical operations like crushing and Grinding and Sieve separation technique
Pre-Requisite:	
1	Physics, Mathematics, Mechanical operations

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Design of Food Processes and Food Processing Plants: Introduction, Overview of Food Process and Plant Design, Process Flow Sheets, Types of Process Designs, Material and Energy Balances, Design of Equipment, Plant Layout and Buildings Economic Analysis in Process/Plant Design, Manufacturing Cost and Profitability, Computer-Aided Process/Plant Design, Design of Food Processes, Food Process Flow Sheets, Elements of Food Plant Design, Good Manufacturing Practices	8
2	Design and Selection of Food Processing Equipment: Sizing and Costing of Equipment, Materials of Construction, Metals, Plastics, Glass–Ceramics, Wood Fabrication of Equipment, Strength of Construction, Fabrication and Installation of Equipment, Hygienic Design of Food Processing Equipment, Hygienic Standards and Regulations, Cleaning of Food Equipment, Selection of Food Processing Equipment, Testing of Equipment	10
3	Mechanical Transports and Storage Equipment: Fluid Food Transport Equipment, Pneumatic and Hydraulic Transport Equipment, Mechanical Conveyors, Food Storage Equipment: Storage of Solids, Storage of Liquids Mechanical Processing Equipment: Size Reduction, Cutting, Crushing and Grinding Equipment, Size Enlargement, Agglomeration Equipment, Homogenization Equipment, Mixing and Forming Equipment, Paste and Dough Mixing Equipment, Fluid Mixing Equipment, Extrusion and Forming Equipment, Solid Mixing Equipment	9
4	Mechanical Separation Equipment: Grading, Sorting, Solid/Solid Separations, Screening, Fluid Classification, Solid/Liquid Separators, Screens, Sedimentation Equipment, Industrial Filters, Centrifuges, Mechanical Expression, Solid/Air Separators, Cyclone Separators, Bag Filters, Air Filters, Electrical Filters, Wet Scrubbers, Removal of Food-Related Parts	8

5	Equipment for Novel Food Processes: Membrane Separation Equipment, Mass Transfer Considerations, Membranes and Membrane Modules, Reverse Osmosis and Nano-filtration. . . . . Ultra-filtration, Microfiltration, Pervaporation, Electrodialysis, SCF Extraction, Supercritical Fluids, SCF Extraction Processes and Equipment, SCF Extraction in Food Processing, Crystallization from Melt, Freeze Concentration, Fat Fractionation Equipment for Non-Thermal Processing: Food Irradiation, High-Pressure Processing, Pulsed Electric Field Processing, Pulse Light	5
6	Heat Transfer Equipments: Heat Exchangers, Tubular Heat Exchangers, Plate Heat Exchangers, Direct Heat Exchangers, Baking and Roasting Ovens, Fryers Mass Transfer Equipments: Distillation Equipment, Solvent Extraction/Leaching Equipment, Gas/Liquid Absorption Equipment, Adsorption and Ion Exchange Equipment, Crystallization from Solution Equipment	5

Text and Reference Books:

1. Handbook of Food Processing Equipment Authors: George Saravacos **,** Athanasios E. Kostaropoulos, Springer, 2016.

2. Handbook of Food Processing Equipment Publisher: Springer US, ISBN: 9780306472763

Course Outcome:

After completion of the course the students will be able to

CO1: Understand different design parameters for machines used in Food Industries.

CO2: Realize different Industrial Mixing process and power consumption in Mixing.

CO3: Make use of design of different type of settling tank by applying the principle of setting.

CO4: Comprehend different type of material and Energy balance in different Food Processing Operations.

CO5: Apply of Material Balance principle in case of Microbial growth.

CO6: Understand different types of process operations during food and beverage manufacturing process.

Practical & Sessional

Name of the Course: Product Development & Quality Assurance Lab	
Course Code: PC-FT 791	**Semester: VII**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 4 hrs./ week	External Assessment: 60 Marks
Credit Points: 2	Distribution of marks: Experiments - 40 Marks Viva – 20 Marks

Pre-Requisite:	
1	Basic analytical techniques
2	Basic food processing operations
3	Handling of glasswares, chemicals and equipments
4	Basic knowledge of solution preparation, chemical reactions
5	Spectrophotometric , titrimetric, gravimetric, volumetric principles

Practical:	
	1) Intellectual skills-
	2) Motor skills- Spetrophotometer, pH meter, Hot Air Oven/ Moisture Analyzer, Soxhlet Apparatus, Kjeldhal Unit, Viscometer, Turbidity Meter,Muffle Furnace, Laminar Air Chamber, Autoclave, Incubator, Colony Counter
	Glassware, chemicals & consumables

Laboratory Experiments:	
1	**Product Identification:** Products/Processes Review, Project Feasibility, Design and Product Specification
2	**Project Planning:** Identifying Objectives, Identifying Tools/Methods, Use of Information/ Communication Technology
3	Development of a food product prototype including product formulation and specifications
4	Selection and analysis of raw materials
5	Establishment of suitable process flow-diagram and development of HACCP plan for the processing line
6	Product testing (including sensory analyses) and shelf-life study
7	**Project Presentation:** Documentation and Report, Viva Voice

Text and Reference Books:

Text

1. Brody, A.L. and J.B. Lord "Developing New Food Products for a Changing Market Place", 2nd Edition, CRC / Taylor & Francis, 2008.
2. Side, Catherine "Food Product Development: Based on Experience". Iowa State Press, 2002.

Reference

1. Fuller, G. W. "New Food Product Development from Concept to Marketplace", 3rdEdition. CRC Press, 2011
2. Lyon, D. H. "Guidelines for Sensory Analysis in Food Product Development andQuality Control", Chapman and Hall, 1992.
3. MacFie, Hal "Consumer-led Food Product Development" Woodhead Pubishers, 2007.

Course Outcomes:

After completion of the course the students will be able to

CO1: Ability to introduce a basic knowledge about the process for developing food products with market perspective.

CO2: Ability to formulate a new product through scientific approach.

CO3: Ability to apply advanced techniques for developing new products meeting regulatory standards.

CO4: Ability to understand the importance of packaging and nutritional labeling of food products.

CO5: Ability to analyze impact of food composition, processing, packaging and storage on the overall food quality attributes.

CO6: Interpret and validate data collected through market analysis and practical research

Name of the Course: Report and Seminar on Industrial Training	
Type of Course: Sessional	
Course Code: SI-FT 781	**Semester: VII**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	
Practical: Nil	
Credit Points: 2	

Details of Syllabus

The Industrial Training will be undertaken by each student during the summer recess after the completion of the 6th semester examination and prior to commencement of the 7th semester. A report on the training which is required to be submitted shall consist of:

6. A general overview of the plant.
7. The products & raw material sources of the plant.
8. Detail description of different processing lines and other equipment.
9. Scheduling of plant operations.
10. Conclusion.

A viva will be conducted after submission of the report and presentation of a seminar

Course Outcomes:

After completion of the course the students will be able to

CO1: Relate different components of food science and technology, skills and scientific techniques followed in various food business/industry.

CO2: Understand hands on expertise in their relevant fields.

CO3: Bridge the gap between academia and ever-changing demand driven industrial business scenario to develop the need of industry with the polarization paradigm.

CO4: Analyze the skills and knowledge required for a particular job function.

CO5: Get exposure to advanced manufacturing and analytical tools to evaluate complex engineering problem.

CO6: Adopt basic industrial practices with ever changing food regulatory standards, ethics, legislation and food safety issues

Name of the Course: Group Discussion & Personality Development	
Type of Course: Sessional	
Course Code: HM-FT 791	**Semester: VII**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	
Practical: 0	
Credit Points: 0	

Syllabus

The incumbent shall understand the difference between the language of conversion and group discussion. Strategies of such discussions are to teach them different ways of communication and to improve the professional acumen of an incumbent. Afterwards the classes shall be divided into small team size and the students have to discuss on various technical and socio-economic topics in relevance to their educational importance.

Interview sessions: Students shall be taught the do's and don'ts of facing an interview. They have to practice the same through several mock-interviews.

Course Outcomes:

After completion of the course the students will be able to

CO1: Learn how to effectively communicate with appropriate speaking and listening skills by involving students to take part in discussions, annotate group activities and case studies for improvement.

CO2: Understand structured attention to specific speaking and listening skills to develop the ability to listen to others

CO3: Develop thinking and reaction capabilities on any instant topic.

CO4: Use excellent speaking and listening skills to address personal targets to grow individually and assess peers for examining progress

CO5: Evaluate their learning journey to demonstrate the skills acquired and reflect it in a professional scenario.

CO6: Adopt enhanced general knowledge and public speaking capability to empower communication and soft skills

Fourth Year: Eighth Semester

Name of the Course: Supply Chain Management and Food Marketing	
Course Code: PC-FT 801	**Semester: VIII**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 2 hrs./ week	Continuous Assessment: 30 Marks
Tutorial: Nil	End Semester Exam: 70 Marks
Practical: Nil	
Credit Points:2	

Objective:	
1	To impart knowledge and understanding on supply chain management and its relevance to today's business decision making.
2	To enable students to be aware of marketing techniques, scheme and practices related to food products in place- and nationally and globally
Pre-Requisite:	
1	Basic understanding of management principles and tools

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Supply Chain definition – Objectives – Types – Various definitions – Drivers – Need for SCM – SCM as a profession – SCM decisions and skills – Strategy formulation in SCM – Value in Supply Chain – Tradeoffs – CRM Strategy relationship matrix	6
2	Strategic Sourcing – Source evaluation – collaborative perspective – Buyer Supplier Relationship – Partner Selection – develop of Partnership – importance of inventory – imbalances – uncertainties – inventory costs – inventory turnover	7
3	Transportation Selection – Trade off – modes of transportation – models for transportation and distribution – factors affecting network effectiveness – 3 PL advantages – Indian transport infrastructure – IT solutions – EDI, e-Commerce, e-Procurement – Bar Coding and RFID technology	6
4	Critical business processes and information systems – DBMS – benefits of ERP–information system and bull whip effect – SCM software packages – modeling concepts – Vendor analysis model – Coordinated SCM – Simulation modeling- Reverse Vs forward supply chain – types of reverse flows – collaborative SCM's and CPFR – agile systems – sources of variability – characteristics – supplier interface – internal processes	5
5	Supply Chain Mapping (based on quantification of customer sensitivity and risk), Supply Chain Management and profitability – quality management – mass customization and globalization – ethical Supply Chains – e-business and SCM– Balanced Score Card – Benchmarking,	4

6	Food marketers act (Advertising law and regulation), Policy makers, food marketing practices, Product Development and Commercialization, Manufacturing Flow Management, Supplier Relationship Management regulation of food markets (e.g. food safety, false advertising, etc.),	2

Text and Reference Books:

1. Mohanty R.P, S.G Deshmuki "Supply Chain Management" Biztantra, New Delhi 936 PAPERIV S

2. Jacobs F.R, Berry W.L, Whybark D.C, Vollmann T.E,. Manufacturing Planning and Control forSupply Chain Management: The CPIM Reference, Second Edition

3. Chopra S., Supply Chain Management: Strategy, Planning, and Operation (7th Edition) (What'sNew inOperations Management)

Course Outcome:

After completion of the course the students will be able to

CO1: Remember and relate principles of supply chain management principles to find the scopeof foodbusinesses

CO2: Understand the problems arising in a supply chain during food processing and interpret the toolsand solutions that are being developed to solve such problems

CO3: Apply sequential strategic planning involved in managing effective production, operation anddistribution and limitation of different processed foods

CO4: Analyze existing advertising law, regulation and policies in relation to supply of safe food toconsumers.

CO5: Evaluate and interpret data and apply resources to optimize consumer preference for a category of food product and reach sustainable solution with effective supply chain mapping and traceability systems

CO6: Design and develop system tools to meet specific need of Food Product Development andCommercialization

Name of the Course: Industrial Processing of Food and Beverage		
Course Code: PC-FT 802	**Course Code: PC-FT 802**	
Duration: 6 months	**Duration: 6 months**	
Teaching Scheme		**Examination Scheme**
Theory: 2 hrs./ week		Continuous Assessment: 30 Marks
Tutorial: Nil		End Semester Exam: 70 Marks
Practical: Nil		
Credit Points: 2		
Objective:		
1	To impart knowledge and understanding on Industrial Processing of Food and Beverage and relevance	
2	To enable students to be aware about techniques, scheme and practices related to food processing in place- and nationally	
Pre-Requisite:		
1	Basic understanding food processing principles operations	

Details of Syllabus:

Unit	Content	Hrs/ Unit
1	Fundamentals of Food Processing: Food processing equipment, its operation, maintenance, cleaning and sanitizing.	4
2	Industrial Manufacture of Selected Foods and Beverages: Process and material flow diagrams and identification and control of critical operations.	4
3	Product ingredients, formulation, composition and characteristics; Processing, factors affecting product characteristics and measurement of quality attributes	6
4	Packaging and quality control. Food Products: Bakery products - bread, biscuit, cakes and quick breads; Convenience foods - macaroni and pasta products, noodles and vermicelli.	6
5	Breakfast and RTE cereals; Condiments and confections. Energy and health foods; Infant and baby foods; Food premixes. Structured and textured protein products.	5
6	Beverages: Alcoholic- beer, wine and distilled spirits; Nonalcoholic - soft drinks, soda/mineral water and fruit beverages; Essence and flavours: tea, coffee, cocoa and energy drinks. System control in beverage industry.	5

Text and Reference Books:

1. The Omnivore's Dilemma: A Natural History of Four Meals Michael Pollan.
2. Food and Beverage Service Robert Lillicrap, D.R.; Cousins, John A.; Smith.

3. Salt: A World History Mark Kurlansky.

Course Outcome:

After completion of the course the students will be able to

CO1: To understand about different independent and dependent variable in Processing of Food and Beverage operation.

CO2: To evaluate optimum process condition in Processing of Food and Beverage.

CO3: Understand the problems arising during food processing and beverage production.

CO4: Examine and analyze problems associated with difficulties related to modeling techniques and simulation process.

CO5: To develop experimental design for a multivariable process.

CO6: Development modeling equation in simultaneous heat and mass transfer process in bioreactor.

Name of the Course: Internship Project	
Course Code: PW-FT 891	**Semester: VIII**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	Examination Scheme
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	
Practical: Nil	
Credit Points: 8	

Internship Project Scheme

Each student shall undertake project work assigned to him/her related to design/R&D /industrial problem solving in the area of food science and allied technologies under the supervision of a faculty member or a group of faculty member(s) and/or industrial supervisor(s) within a food processing industry/ biochemical industry/ allied industries/ testing laboratories/ research institutions/ academia. In principle, the design/development of the internship project work has to be carried out by a group of student(s)/an individual taking advice/guidance from respective supervisor(s) to address the specific problem identified. The work will be allotted at the beginning of the eighth semester specifying the different aspects to be carried out by the student. The internship project work shall yield outcome based meaningful results, Scientific publication/ patents. Each student shall submit a typed, hard-bound Final Internship Report for the work and its findings. Evaluation shall include an oral presentation followed by a brief viva-voce. Internship Project Dissertation Defense should be carried out in presence of respective supervisor(s) and/ or faculty members and in presence of external examiner(s)/ Central Training & Placement Cell.

Brief Project Outline

1. Brief introduction, objectives & probable outcomes of the projects

2. Literature survey/secondary search/market survey

3. Manufacturing/prototyping/designing process/products, optimization of processes and characterizationthrough analytical techniques

4. Collection and analysis of data through statistical tools.

5. Conclusion of the project and report preparation

6. Internship Project Dissertation defense and viva-voce

Course Outcomes:

After completion of the course the students will be able to

CO1: Grasp on engineering principles in the area of food science, technology, and allied areas.

CO2: Gain knowledge and skills to apply these principles in real-time problem-solving in food technology and relevant fields.

CO3: Communicate verbally with professional organizations and scientific community with reasonable clarity on topics within food science, engineering, technology, and allied areas.

CO4: Familiar with legislative aspects in India for application of problem solving skills and knowledge acquired in the program.

CO5: Correlate the skills and knowledge acquired over the degree program with a particular job function as a professional.

CO6: Understand the challenges with the exposure to professional responsibilities with appropriate level of accountability.

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