

Revised Course Structure of B. Tech. Dairy Technology prepared in the light of as per Fifth Dean's committee's recommendation to be implemented from 2017-18 batch

Course Structure of B.Tech. Dairy Technology

w.e.f. 2017

Semester-I

S.no.	Course Code	Name of the Course	Credits
1	DT-301	Milk Production Management & Dairy Development	4 (3-1-0)
2	DC-301	Physical Chemistry of Milk	3 (2-0-1)
3	ME-301	Engineering Drawing	2 (0-0-2)
4	ME-304	Workshop Practice & Technology	4 (3-0-1)
5	CE-406	Fluid Mechanics	4 (2-1-1)
6	DM-301	Fundamentals of Microbiology	3 (2-0-1)
7	GPT-301	Moral Value & Education	3 (3-0-0)
8	EE-303	Elements of Electrical Engineering	3 (2-0-1)
9	LNG-305	English & Technical Writing	3 (3-0-0)
		Total	29
Deficiency Courses <i>(to be offered to the students from the Inter Ag. stream)</i>			
10	MAS- 312	Elementary Mathematics	3(3-0-0) NC

Semester-II

1	DT-302	Market Milk	4 (3-0-1)
2	DM-302	Microbiology of Fluid milk	2 (1-0-1)
3	ME-503	Heat and Mass Transfer	3 (2-0-1)
4	DC-302	Chemistry of Milk	3 (2-0-1)
5	DE-301	Thermodynamics	3 (2-0-1)
6	MAS- 410	Applied Mathematics	4(4- 0-0)
7	ECON-502	Economic Analysis	2 (2-0-0)
8	DT-695	STUDENT READY-Experiential Learning Programme- I (Summer Break)	5 (0-0-10)
		Total	26

Semester-III

1	DC-512	Biochemistry	2 (1-0-1)
2	DT-401	Condensed & Dried Milks	4(3-0-1)
3	DT-402	Fat Rich Dairy Products	3 (2-0-1)
4	ME-502	Refrigeration and Air Conditioning	3 (2-0-1)
5	DE-402	Dairy Engineering	3 (2-0-1)
6	DT-303	Traditional Dairy Products	3 (2-0-1)
7	EXT-301	Fundamentals of Dairy Extension	3 (2-0-1)
8	DC-513	Human Nutrition	2 (1-0-1)
9	BAM-501	Marketing Management & International Trade	2 (2-0-0)

10	ECE-301	Basic Electronics	4 (2-1-1)
		Total	29

Semester-IV

1	DT-501	Cheese Technology	5 (3-0-2)
2	DT-502	Ice-Cream & Frozen Deserts	3 (2-0-1)
3	DT-504	Sensory Evaluation of Dairy Products	3 (2-0-1)
4	DM-401	Starter Culture and Fermented Milk Products	3 (2-0-1)
5	DE-403	Dairy Process Engineering	3 (2-0-1)
6	MCE- 304	Dairy Biotechnology	3 (2-0-1)
7	DT-696	STUDENT READY-Experiential Learning Programme- II (Summer Break)	5(0-0-10)
		Total	25

Semester-V

1	CSIT-501	Application of Information Technology	4 (2-1-1)
2	DC-501	Quality and Safety monitoring in Dairy Industry	3 (2-0-1)
3	DT-503	By Products Technology	3(2-0-1)
4	DE-501	Instrumentation & Process Control	3 (2-0-1)
5	BAM-428	Financial Management & Cost Accounting	3 (2-0-1)
6	DE-502	Dairy Plant Design and Layout	2 (1-0-1)
7	DC-502	Chemical Quality Assurance	2 (1-0-1)
8	DE-503	Material Strength and Dairy Machine Design	3 (2-0-1)
9	DE-504	Boilers & Steam Generation	2 (1-0-1)
		Total	25

Semester-VI

1	DE-601	Food Engineering	4 (3-0-1)
2	DC-601	Chemistry of Dairy Products	3 (2-0-1)
3	DM-501	Microbiology of Dairy Products	3 (2-0-1)
4	DT-601	Packaging of Dairy Products	3 (2-0-1)
5	FST-406	Food Technology I	3 (2-0-1)
6	BAM-550	Entrepreneurship Development and Industrial Consultancy	2 (2-0-0)
7	MAS-512	Operation Research	3 (3-0-0)
8	ENVS-417	Environmental Studies	3 (3-0-0)
		Total	24

Semester-VII

Sr.	Course Code	Course Title	Credits
1	MAS-502	Industrial Statistics	3 (2-0-1)
2	DT-509	Dairy Plant Management	2 (1-0-1)
3	FST-407	Food Technology- II	3 (2-0-1)
4	DT-510	Waste Disposal & Pollution abatement	2 (1-0-1)
5	DC-602	Food Chemistry	3 (2-0-1)

6	DT-511	Energy Conservation and Management	2 (1-0-1)
7	DT-697	STUDENT READY-Experiential Learning Module	10 (0-0-10)
		Total	25

Semester-VIII

Sr.	Course Code	Course Title	Credits
1	DT-698	In-Plant Training	20 (0-0-20)
2	DT-699	Training Report Evaluation	5(0-0-5)
		Total	25

Course Structure of B. Tech. Dairy Technology

Semester-I

1	DT-301	Milk Production Management & Dairy Development	4 (3-1-0)
	<p>Introduction to Animal Husbandry. Distinguishing characteristics of Indian and exotic breeds of dairy animals and their performance. Systems of breeding and methods of selection of dairy animals. General dairy farm practices- identification, dehorning, castration, exercising, grooming, weighing. Care of animals at calving and management of neonates. Management of lactating and dry cows and buffaloes. Methods of milking, milking procedure and practices for quality milk production. Dairy farm records and their maintenance. Systems of housing dairy animals and maintenance of hygiene and sanitation at dairy farm premises. Common disease problems in dairy animals, their prevention and control. Feed nutrients required by animal body. Feed resources for milk production and their nutritive values. Digestive system of ruminants. Measures of feed energy. Nutrients requirements for growth and milk production. Feeding standards. Structure and function of mammary system. Milk secretion and milk let-down. Male and female reproductive system. Estrus to reproductive cycle. Ovulation, fertilization, gestation, parturition, pregnancy diagnosis. Artificial insemination and embryo transfer and their role in animal improvement. Introduction to biotechniques in dairy animal production. Socio-economic and geographical features of Indian dairying. Traditional Systems of cattle keeping, estimates of milk production, utilization and sale; cattle & buffalo population and its distribution; trends in population growth, annual milk production and per capita availability; productivity profile of indigenous dairy stock, industrial by-products of livestock industry. Five year plans and dairy development; resource inadequacy, post partition pressure; catalytic action of international aid; major aided dairy projects; public sector milk supply schemes; co-operative dairy organizations, Anand pattern and perspectives; milk products manufacture in private sector, import substitutions in dairy products. Strategy of cattle improvement; pioneering role military dairy farm; key village scheme and its limitations, intensive cattle development programme concept, approach and achievements. Public sector dairy schemes, Economic burden performance analysis, National Dairy Development Board-aim and objectives, policy orientation in dairy development. Operation Flood-I,II,III : programmes & Outlay, implementation, success, achievements, integrated infrastructure of milk production, improvements of dairy co-operative organization, Dairy development Corporations, Co-operative Dairy Federations, Self- reliance in dairy development, income & employment potential. Conversion of milk into products, utilization pattern indigenous & western products. Dairy problems and policies.</p> <p>Practical: Handling and restraining of dairy animals. External body parts and judging of cows and buffaloes. Feeding and management practices of calves. Identification of common feeds and fodders. Preparation of rations for adult animals. Milking of dairy animals and cleaning and sanitation of milking equipments. Identification of reproductive and digestive organs. Demonstration of semen collection, processing and artificial insemination.</p>		

2	DC-301	Physical Chemistry of Milk	3 (2-0-1)
	<p>Constituents and gross composition of milk of different species and breeds of milch animals, Colloidal State: Distinction between true and colloidal solution, lyophilic & lyophobic solution, properties of colloidal system. Properties of colloidal systems, Gels-their formation and properties. Milk as a colloidal system and its stability. Elementary idea about emulsion. Density : Density and specific gravity, pycnometer method, hydrometer lactometer. Density and specific gravity of milk, effect of various processing variables on the density and specific gravity of milk. Liquid State : Surface tension, surface energy interfacial tension. Surface tension of mixtures. Surface tension of milk and the factors affecting it. Viscosity- Definition of viscosity, Newtonian and Non-Newtonian liquids, Stokes Law, influence of temperature and concentration of solute on viscosity. Viscosity of milk, evaporated milk and condensed milk. Refractive index. Colligative Properties of Dilute Solution: Vapour pressure, Raoult's Law, Depression of freezing point, Elevation of boiling point. Freezing point and boiling point of milk. Osmosis and Osmotic pressure. Inter-relation of colligative properties. Aqueous solution of Electrolytes : Electrolytes ; non-electrolytes, ionic mobility, electrical conductance, Ostwald Dilution Law, Kohlrausch Law, Electrical conductance of milk. Ionic Equilibria: Dissociation of water, ionic product of water, concept of pH and pOH and their scale. Acids and bases : Bronsted Lewis concepts of acids and bases, dissociation constants of acids and bases. Salt-their hydrolysis. Buffer solutions. Derivation of Henderson – Hasselbach equation and its application, buffer capacity and buffer index, milk as a buffer system. Equilibrium of electrolytes. pH indicators. Oxidation-Reduction: Redox potential, Nernst equation, electrochemical cells. Hydrogen, glass and calomel electrodes. Redox system of milk. Nuclear Chemistry: The nature of isotopes, radio isotopes. Half-life period of radio isotopes. Some of the important radio isotopes. Occurrence of radio nuclide in milk & milk products. Molecular Spectroscopy: The spectrum of electromagnetic radiation, the laws of Lambert and Beer, visible, and ultra-violet Spectroscope. Mention of mass, NMR spectroscopy.</p> <p>Practical: Determination of density and specific gravity of milk using pycnometer, hydrometer and lactometer. Determination of viscosity of milk using Ostwald viscometer. Determination of surface tension of milk using Stalagmometer. Interfacial tension between water-oil phase. Determination of freezing point of milk. Preparation of a buffer solution. Determination pH of buffer solution and milk electrometrically. Determination of acidity of milk electrometrically. Determination of electrical conductance of milk. Determination of redox potential of milk. Coagulation of milk using electrolytes. Determination of refractive index of skim milk and whey. Titration of amino acid in the presence and absence of formaldehyde. Determination of PKa1 PKa2 and PL. Verification of Lambert Beer Law.</p>		
3	ME-301	Engineering Drawing	2 (0-0-2)
	<p>Drawing of lines, lettering and dimensioning types of lines, types, types of lettering, types of dimensioning. Drawing of scales. Plain scale, diagonal scale, comparative scale and Vernier scale. Drawing of projections. Orthographic projections, methods of projections. Drawing of screw threads. Types of threads and terminologies used in it. Screw fastening Types of nuts, types of bolts, stud, locking arrangements for nuts and foundation bolt. Drawing of rivets and riveted joints forms of rivet heads, types of riveted joints, failure of riveted joints.</p>		

	Drawing of welded joints. Forms of welds, location and dimensions of welds. Drawing of keys, cotter joint, pin joints types of keys, types of cotter joints, pin joints. Drawing of shaft couplings. Rigid couplings, loose couplings, flexible couplings universal coupling. Drawing of shaft bearings. Journal bearings, pivot bearings, collar bearings.		
4	ME-304	Workshop Practice & Technology	4 (3-0-1)
	Simple exercises on wood working tools and their use, Carpentry and pattern making, mould material and their applications, heat treatment processes: hardening, tempering, annealing, normalising etc. Metal cutting. Soldering & Brazing, Electric arc welding, Gas welding, Smithy and forging operations, bench: Flat surface filing, Chipping, Scraping Marking out, Drilling and Screwing. Use of jigs and fixtures in production. Simple exercise on:(a) Lathe (b) Milling machine (c) Shaper and planer (d) Drilling and boring machines (e) Grinder. Practical: Simple exercises in Filing and Fitting, Chipping and Hack sawing Chiseling, Tapping and Smithy practice. Simple exercises in Arc, Gas, & Argon welding. Simple exercises in Soldering, Brazing, Basic joints in carpentry.		
5	CE-406	Fluid Mechanics	4 (2-1-1)
	<p>Units & dimensions, Properties of fluids. Static pressure of liquids: Hydraulic pressure, absolute and gauge pressure, pressure head of a liquid. Pressure on vertical rectangular surfaces. Compressible and non compressible fluids. Surface tension, capillarity. Pressure measuring devices, Simple, differential, micro, inclined manometer, mechanical gauges, Piezometer. Floating bodies : Archimedis principle, stability of floating bodies. Equilibrium of floating bodies. Metacentric height. Fluid flow : Classification, steady, uniform and nonuniform, laminar and turbulent, continuity equation. Bernoulli's theorem and its applications. Flow through pipes : Loss of head, determination of pipe diameter. Determination of discharge, friction factor, critical velocity. Flow through orifices, mouthpieces, notches and weirs. Vena contracta, hydraulic coefficients, discharge losses. Time for emptying a tank. Loss of head due to contraction, enlargement at entrance and exit of pipe. External and internal mouthpieces, types of notches, rectangular and triangular notches, rectangular weirs. Venturimeters, pitot tube, rotameter. Water level point gauge, hook gauge. Dimensional analysis: Buckingham's theorem application to fluid flow phenomena. Froude Number, Reynolds number. Weber number and hydraulic similitude. Pumps : Classification, reciprocating, centrifugal pump. Pressure variation, work efficiency. Types of chambers, selection and sizing.</p> <p>Practical: Study of different tools and fittings. To plot flow rate versus pressure drop with U-tube manometer. Verification of Bernoulli's theorem. Determination of discharge coefficient for venturi, Orifice, V-Notch. Verification of emptying time formula for a tank. Determination of critical Reynold's number by Reynold's apparatus. Study of reciprocating, centrifugal and gear pump. Calibration of Rotameter. Study of different types of valves. Problems on following topics: Pressure, capillarity and surface tension. Floating bodies, Liquid flow, venturimeter, orifice, weir, flow through pipes, pumps.</p>		
6	DM-301	Fundamentals of Microbiology	3 (2-0-1)
	Microbiology: history and scope; contributions of Leeuwenhock, Pasteur and Koch. Principle of microbiology: Light Microscopy (Bright field, dark field, phase contrast, fluorescence); preparation and staining of specimens; electron microscopy. Microbial taxonomy: principles; numerical taxonomy; major characteristics used in taxonomy; classification		

	<p>according to Bergey's manual of systematic bacteriology. Structure and functions of prokaryotic cells; difference between prokaryotes and eukaryotes. Microbial growth and nutrition: the growth curve; factors affecting growth of microorganisms, estimation of bacterial growth; bacteriostatic and bactericidal agents; the common nutrient requirements and nutritional types of microorganisms. Bacterial genetics; DNA as the genetic material; structure of DNA; bacterial mutations (spontaneous and induced); genetic recombination- (transformation, transduction, conjugation). Micro flora of air, soil and water: methods for controlling microorganisms in air; water as carrier of pathogens.</p> <p>Practical: General instruction for microbiological laboratory. Microscope- simple and compound; Microbiological equipments; autoclave, hot air oven, incubator, centrifuge, colorimeter, laminar airflow, membrane filter. Simple staining- methylene blue; crystal violet; negative staining. Differential staining (Gram, spore, acid fast). Mortality of microorganisms; hanging drop technique. Measurement of microorganisms by micrometry. Preparation of commonly used growth media liquid and solid: simple and differential media. Isolation technique for microorganisms- Streak & pour plate Enumeration of microorganisms in air and soil. Enumeration of microorganisms in water: total viable count, coliform (MPN).</p>		
7	GPT-301	Moral Value & Education	3 (3-0-0)
	<p>My country and my people, the many Indians, Being and becoming an Indian, nationalism and Internationalism. Some life issues- Love, Sex and Marriage, Men and money- value of time, Meaning of work, Human communication, Human suffering, Addiction, Ecology, Women's issue. Understanding one's neighbor. Neighbourhood groups: their structure and function, Patterns of social interaction of group dynamics. Preparation for a career, Choice of vocation, Motivation for study and research. The present educational system. Curriculum and Syllabus, Teaching methods, Examination and work experience. Definition of value Education, Moral and ethics, laws and Morale based on Ten Commandments and two great commandments. Discovery of self, self- awareness growth of Intellect- man's spiritual Nature emotions, Will, Respect the Rights of Life, Liberty, property, Truth Reputation. Sin, Origin of sin, manifestation of sin, The results of sin, the remedy of sin, sin as an act, Sin as a state, sin as nature. Conscience- as defined in Oxford Dictionary and Winston Dictionary, Types of consciousness (Such as Evil, convicted, purged, pure, weak, good, void of offence)</p>		
8	EE-303	Elements of Electrical Engineering	3 (2-0-1)
	<p>Alternating current fundamentals: Electromagnetic induction magnitude of induced E.M.F. Alternating current, R.M.S. value and average value of an alternating current. Phase relations and vector representation. A.C. series and parallel circuits, Concept of resonance, polyphase alternating current circuits, three-phase concept, Star and delta connections, star delta transformation, Energy measurement. Transformers: Fundamental of transformer, Theory, vector diagram without load and with load, Losses, voltage regulation and efficiency of transformer, auto-transformer. Alternators: Elementary Principles, Construction and different types of alternators, E.M.F. in alternators, circuit breakers. Induction motors : Fundamental principles, production of rotating fields, construction, Rotor winding-squirrel cage and phase wound rotors, Analysis of current and torque, starting of induction motors, Motor housing, selection of motor and its controls. D.C. Machines: Construction and operation of D.C. generator, Types of generators, various</p>		

	characteristics of generator, D.C. motors, orquespeed characteristics of D.C. motors, Starting and speed control of D.C. motors. Electric Power Economics: Maximum demand charge, Load factor and power factor correction. Measuring Instruments: Classification of instruments, Elements of a generalized measurement system, static and dynamic characteristics. Practical: Study of voltage resonance in L.C.R. circuits at constant frequency; (a) Star connection-study of voltage and current relation (b) Delta connection-study of voltage and current relation. Measurement of power in 3-phase circuit; (a) For balanced loads (b) For unbalanced loads, by wattmeter and energy meters. Polarity test, no-load test, efficiency and regulation test of single phase. Voltage and current relation in a 3-phase transformer of various kinds of primary and secondary connection systems. Starting of induction motor by the following starters : (i) D.O.L. (ii) Manual star- delta (ii) Automatic star-delta (iv) Manual auto-transformer. Starting of slip-ring induction motor by normal and automatic rotor starters. Test on 3-phase induction motor, determination of efficiency, line current, speed, slip, power factor at various outputs. Determination relation between the induced armature voltage and speed of separately excited D.C. generator. Magnetization characteristic of D.C. generator. Study the starter connection and starting reversing and adjusting speed of a D.C. motor. Study of various measuring instruments.		
9	LNG-305	English & Technical Writing	3 (3-0-0)
	I–Language: i) Tenses ii) Agreement of Subject and Verb iii) Prepositions iv) Use of Articles v) Punctuation II–Written Communication: i) Technical Report ii) Introduction to Sound–Vowels, Diphthongs and Consonants iii) Phonetic Transcription iv) Word Stress and Exercises on Pronunciation III–Spoken English: i) Group Discussion on current topics ii) Presentation iii) Interview		
Deficiency Courses (to be offered to the students from the Inter Ag. stream)			
10	MAS- 312	Elementary Mathematics	4(3-1-0) NC
	Algebra: Theory of quadratic equations. Binomial index (for positive integral index only), Exponential and logarithm series, partial fractions, theory of matrices, sum, difference and multiplication of matrices, transpose, elementary idea of ad joint, inverse of matrices, solution of linear equations, permutation and combination.		

	<p>Trigonometry: Complex numbers, De Moivre's theorem and its simple application.</p> <p>Coordinate geometry: Equation of standard curves and their identification. Differentiation tangents and normals, maxima & minima.</p> <p>Integral calculus: definite integrals, standard methods of integrations, Applications of integral calculus to area enclosed by curve, length of arc, volume and surface of revolution.</p> <p>Vector analysis: Scalars and vectors, sum and difference of vectors, dot and cross products.</p>
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Semester-II

1	DT-302	Market Milk	4 (3-0-1)
		<p>Market milk industry in India and abroad: Distinctive features of tropical dairying as compared to those of the tropical climate of developed countries. Collection and transportation of milk; a) Organization of milk collection routes b) Practices for collection of milk, preservation at farm, refrigeration, natural microbial inhibitors, lactoperoxidase system. c) Microbial quality of milk produced on farm. Effect of pooling and storing on microbial quality of refrigerated milk. Role of psychrotrophs, Role of tropical climate on spoilage of milk. d) Chemical tests for grading raw milk. e) Microbiological tests for grading raw milk. Reception and treatment (pre-processing steps) of milk in the dairy plant: a) Reception, chilling, clarification and storage: General practices. b) Homogenisation: Definition, pretreatments, theories, synchronization of homogenizer with operation of pasteurizer (HTST) c) Effect of homogenization on physical properties of milk. d) Bactofugation: Theory and microbiology. Thermal processing of milk: a) Principles of thermal processing: kinetics of microbial destruction, thermal death curve, arrhenius equation, D value, Z value, F0 value, Q10 value. b) Factors affecting thermal destruction of micro-organisms. c) Definition and description of processes: Pasteurization, thermisation, sterilization, UHT Processing. d) Microbiology of pasteurised milk, thermized, sterilized & UHT milk. e) Product control in market milk plant. f) Defects in market milk. g) Manufacture of special milks: toned, doubled toned, reconstituted, recombined, flavoured, homogenized vitaminised and sweet acidophilus milk. h) Manufacture of sterilized milk. i) Distribution systems for market milk. Quality and safety aspects in dairy food chain, good manufacturing practices (GMP) in dairy processing. UHT processing of milk : a) Relevance of UHT processing in the tropical climate b) UHT plants: Description. Direct, Indirect, with upstream and downstream homogenization, third generation UHT plants. c) Aseptic packaging, types and systems of packaging, sterilizing packages, filling systems. d) Technical control in the UHT plant. Training of personnel. Plant hygiene. e) Shelf life of UHT milk and tests for UHT milk. Nutritive value of milk. Effect of heat processing on nutritive value. Efficiency of plant operation: product accounting, setting up norms for operational and processing losses for quantity, fat and SNF, monitoring efficiency. Maintaining plant hygiene & HACCP.</p> <p>Practical : Familiarization with equipments for reception of milk in plant; Pretreatments: Chilling, clarification, filtration. Standardization and numericals relating to it. Cream separation: parts of separator and the process. Operation of LTLT, HTST pasteurizer, laboratory steriliser. Sampling and chemical examination of pasteurized, sterilized and UHT processed milk. Sampling and routine microbiological examination of microbiological examination of pasteurized and sterilized milk. Preparation of special milks; toned, double toned, standardised, flavoured, sterilised. Cleaning of storage tanks, cream separators, HTST plants; manual cleaning and CIP. Detection of adulterants and preservatives in milk. Assessment of homogenisation efficiency in milk. Strength of common detergents and sanitizers used in market milk plant.</p>	

2	DM-302	Microbiology of Fluid Milk	2 (1-0-1)
	<p>Microbes associated with raw milk: Significance of specific groups of microorganisms in milk i.e. psychrotrophic, mesophilic, thermoduric and thermophillic bacteria - their morphological and biochemical characteristics and classification. Microbial contaminants in raw milk, their sources during various stages of production - milking, chilling, storage and transportation with special reference to psychrotrophic microorganisms; Microbiological changes in bulk refrigerated raw milk. Sources of contamination and microbial spoilage of raw milk: Microbial contaminants of raw milk supplies, their sources during various stages of production i.e. milking, chilling, storage and transportation with special reference to psychrotrophic microorganisms and preventive measures. Types of microbial spoilage - souring, curdling, bitty cream, proteolysis, lipolysis, abnormal flavors and discolouration. Mastitis milk - types of mastitis, causative micro-flora of mastitis, compositional and microbiological changes during mastitis infection, their processing and public health. Concept of clean milk production: Hygienic milk production system; Cleaning and sanitation of udder, animal, utensils, equipments and dairy farm environment; Microbiological quality of milk produced in organized and un-organized sector in India and comparative information in developed world; Microflora of aseptically drawn milk and its natural antimicrobial systems - immunoglobulins, lactoferrin, lysozyme and lactoperoxidase (LP) system. Microbiological aspects of fluid milk: Pasteurization, boiling, sterilization, ultra high temperature (UHT), non thermal (pulsed field) micro-filtration, bacto-fugation, standardization and homogenization. Significance of heat resistant and post processing contaminants in fluid milk with special reference to proteases and lipase enzymes and their role in spoilage of processed milk. Bio-film formation during processing and their control measures. Public health aspects of fluid milk: Microbial zoonotic diseases transmitted through fluid milk; Milk borne diseases - food infection, intoxication and toxin-infection caused <i>E. coli</i>, <i>Salmonella typhi</i>, <i>Staphylococcus aureus</i>, <i>Bacillus cereus</i>, <i>Listeria monocytogenes</i>, <i>Shigella species</i>, <i>Campylobacter</i> etc. Microbiological grading and legal standards of raw and processed milk.</p> <p>Practical: Morphological examination of common dairy microorganisms (size and shape, arrangement and sporulation). Estimation of microbial load in raw milk by standard plate count (SPC) and dye reduction tests (MBRT, RRT). Grading of processed/ market milk by total viable count, coliform and methylene blue reduction time. Enumeration of psychrotrophic, thermophillic, thermoduric and spore forming bacteria in raw and market milk. Detection of sources of contamination: Air, water, utensils, equipment and personnel, line testing. Spoilage of milk caused by microorganisms: souring, sweet curdling, gassiness, lipolysis, ropiness, proteolysis and discolouration. Detection of mastitis milks: pH, SLST, somatic cell count, chloride content, Hotis test and CAMP test. Detection and estimation of coliforms: presumptive, rapid coliform and IMViC Test.</p>		
3	ME-503	Heat and Mass Transfer	4 (3-0-1)
	<p>Basic heat transfer process, thermal conductivity, convective film co-efficient, Stefan Boltzman's constant and equivalent radiation co-efficient, Overall heat transfer co-efficient, physical properties related to heat transfer. Working principles and application of various instruments for measuring temperature. One-dimensional steady state conduction: Theory of heat conduction, Fourier's law, Derivation of Fourier's equation in Cartesian co-ordinates, Linear heat flow through slab, cylinder and sphere. Heat flow through slab, cylinder and sphere with non-uniform thermal conductivity. Concept of electrical analogy</p>		

	<p>and its application for thermal circuits, Heat transfer through composite walls and insulated pipelines. One dimensional steady state heat conduction with heat generation: Heat flow through slab, hollow sphere and cylinder with uniform heat generation, Development of equations of temperature distribution with different boundary conditions. Steady-state heat conduction with heat dissipation to environment: Introduction to extended surfaces (FINS) of uniform area of cross-section. Equation of temperature distribution with different boundary conditions. Effectiveness and efficiency of the FINS. Introduction to unsteady state heat conduction. Convection: Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer, Concept of Nusselt number. Prandtl number, Reynolds number, Grashoff number, Some important empirical relations used for determination of heat transfer coefficient. Heat Exchangers: General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, Shell and tube and plate heat exchangers, Heat exchanger design. Application of different types of heat exchangers in dairy and food industry. Fick's Law of diffusion, steady state diffusion of gases and liquids through solids. Equimolar diffusion. Mass transfer co-efficient and problems on mass transfer.</p> <p>Practical : Determination of thermal conductivity: milk, solid dairy & food products. Determination of overall heat transfer co-efficient of : Shell and tube, plate heat exchangers and Jacketed kettle used in Dairy & Food Industry. Studies on heat transfer through extended surfaces. Studies on temperature distribution and heat transfer in HTST pasteuriser. Design problems on heat exchangers. Study of various types of heat exchangers. Design problems on Mass Transfer.</p>		
4	DC-302	Chemistry of Milk	3 (2-0-1)
	<p>Definition and structure of milk, factors affecting composition of milk, Nomenclature and classification of milk proteins, Casein: Isolation, fractionation and chemical composition, physico-chemical properties of casein, Whey proteins: Preparation of total whey proteins: α- Lactalbumin and β- Lactoglobuline. Properties of α-Lactalbumin and β-lactoglobulin, Immunoglobulin and other minor milk proteins and non proteins nitrogen constituents of milk, Hydrolysis and denaturation of milk proteins under different physical and chemical environments, Estimation of milk proteins using different physical and chemical methods, Importance of genetic polymorphism of milk proteins ,Milk enzymes with special reference to lipases, Xanthine Oxidase, phosphates, proteases and lactoperoxidase ,Milk carbohydrates their status and importance. Physical and chemical properties of lactose, Sugar amine condensation, amadori re arrangement, production of hydroxyl methyl furfural (HMF), Processing related degradation of lactose, Definition, general composition and classification of milk lipids. Nomenclature and general structure of glycerides, factors affecting the fatty acid composition. Milk phospholipids and their role in milk products, Unsaponifiable matter and fat soluble vitamins, Milk Salts: Mineral in milk (a) major mineral (b) Trace elements, physical equilibria among the milk salts and Milk contact surfaces and metallic contamination.</p> <p>Practical: Sampling techniques of chemical examination of milk. Determination of pH and titratable acidity of milk. Determination of fat in milk by different methods. Determination of total solids and solids not fat in milk. Determination of total milk proteins by Kjeldahl method. Determination of casein, whey proteins and NPN in milk. Estimation of alkaline</p>		

	phosphatase and lipase in milk. Determination of lactose in milk. Determination of ash in milk. Determination of phosphorus and calcium in milk. Determination of chloride in milk. Determination of temporary and permanent hardness of water. Estimation of available chlorine from bleaching powder.		
5	DE-301	Thermodynamics	3 (2-0-1)
	<p>Basic concepts: systems, processes, cycles, energy, The Zeroth Law of Thermodynamics. Ideal gases: Equation of state, Compression and expansion of gases. The first Law of Thermodynamics: Internal energy, enthalpy. The second Law of Thermodynamics: Thermodynamic temperature scale, Carnot cycle, entropy, reversibility, availability. Air Cycles: Otto, Diesel, dual efficiencies, Plotting the cycles on various thermodynamic planes viz., p-V, T-S, p-h diagram; etc. IC. Engines: Two stroke and four stroke cycles, construction, injection and ignition of fuel, Performance of IC engines. Fuels: Chemical properties, air for combustion, Calorific value and its determination, Burners, firing of fuels. Renewable energy sources. Properties of steam: Wet, dry saturated, superheated steam, Use of steam tables and Molier charts. Steam generators: Fire tube boilers, Water tube boilers. Boiler mountings and Boiler accessories. Draught: Natural, forced, fan, jet, Measurement of Height of chimney. Condensers. Layout of pipe-line and expansion joints. Boiler trial: Codes, Indian Boiler Regulation acts. Air Compressors: Reciprocating, Single and two stage air compressors.</p> <p>Practical: Application of thermodynamics in engineering problems. Study of 2-stroke engine and 4-strokes engines. Performance tests on I.C. engines. Determination of dryness fraction of steam. To study the boiler installed in Model Plant, Water softening plant, Lancashire boiler, Locomotive boiler, Babcock & Wilcox boiler, Electrode boiler, Boiler mounting and steam-line layout and steam traps. Visit to sugar mill/rice mill or plant with steam urilization. Study of Solar water heater and biogas plants and appliances.</p>		
6	MAS- 410	Applied Mathematics	4(4- 0-0)
	<p>Differential Calculus: Rolley's theorem, Langrange's theorem, Expansion of functions in a Taylor Series Maxima and Minima of functions to application of theory of maxima and minima of functions, the solution of problems Partial derivative of function of several variables Partial derivatives of higher order.</p> <p>Integral Calculus: Geometric & Mechanical application of Definite Integral The Arc length of curve, computation of surface area Computation of volume of solid of revolution Computation of moment of inertia of a circle and a cylinder by means of definite integral.</p> <p>Vector Analyses: Dot product and cross product of vectors. Scaler triple product, Vector Triple Product Vector function of one variable, Differential of vector function</p>		

	<p>The operator, Gradient of scalar function, Curl and divergence of vector function. Line, surface and volume integral, divergence and stokes theorems.</p> <p>Ordinary Differential Equation Separable first order equations, Homogenous first order equations Exact first order equations Application of first order differential equations The general linear second order equations The homogenous linear equation with constant coefficients The non - homogenous equation and Particular integrals Application of second order differential equations.</p> <p>Fourier Series: Introduction; Euler coefficients, Euler - Fourier Formula; Fourier expansion of periodic functions.</p>		
7.	ECON-502	Economic Analysis	2 (2-0-0)
<p>Basic concepts-wants, goods, wealth, utility, consumption, demand and supply, Consumer behaviour-law of diminishing marginal utility and equi-marginal utility, cardinal and ordinal utility approach for consumer's behaviors. Theory of demand-law of demand, demand schedule, demand function, determinates of demand, individual consumer demand and market demand, demand forecasting, elasticity of demand, price elasticity, income elasticity and cross elasticity, Consumer's surplus. Theory of production- concepts of firm and industry, basic factors of production and their role, production function for a single product, nature of production function, laws of returns. Concepts of costs-fixed and variable costs, short run and long run costs, average and marginal costs, economics and diseconomies of scale. Concept of market- types of market, pricing and output under different market situations, market price and normal price, price determination under perfect Competition, monopoly, oligopoly and monopolistic competition. National income – GDP, GNP, NNP, disposable personal Income, per capita income, inflation. Economic features and characteristics of dairy sector in India. Dairy development strategy with special emphasis in post-independence era and Operation Flood Programme.</p>			

Semester-III

1	DC-512	Biochemistry	2 (1-0-1)
	<p>Bio-Molecules: General structures, classification and functions of bio molecules-Amino acids, Protein Structure, Carbohydrates, Fats, Lipids, DNA and RNA. Enzymes: Activation energy /Transition state & Enzyme Classification, Coenzymes/Co-factors & Enzyme kinetics, Mechanism of enzyme action, Factors effecting enzyme activity, Enzyme inhibition, isozymes & Regulatory Enzymes, Immobilization of enzyme, Ribozymes & Zymogens. Metabolism : Glycolysis, Gluconeogenesis, TCA cycle, Glycogen synthesis and degradation, Pentose phosphate pathway, Fatty acid oxidation, Urea cycle and transaminase reactions, ATP and Electron transport chain.</p> <p>Practical: Estimation of alkaline phosphatase by conversion of a non-chromogenic substrate to a chromogenic substrate. Effect of temperature, pH and enzyme inhibitors on the activity of the enzyme. Estimation of catalase by spectrophotometric method. Determination of the MichaelisMenten constant of an enzyme. Estimation of RNA by colorimetric method. Estimation of DNA by colorimetric method. Measurement of proteolysis and lipolysis. Estimation of Vitamin A in Ghee. Estimation of Ascorbic acid in plasma.</p>		
2	DT-401	Condensed & Dried Milks	4 (3-0-1)
	<p>History, status and scope in India and abroad, Definition and legal standards: Condensed milk, sweetened condensed milk and evaporated milk., Manufacturing techniques; a) Manufacture of evaporated milk including pilot sterilization test b) Manufacture of sweetened condensed milk c) Recombined sweetened condensed milk. Grading and quality of raw milk for condensed and evaporated milk, Physico-chemical changes taking place during manufacture of condensed milk, Heat stability of milk and condensed milk, Physico-chemical properties of condensed milk and role of stabilizers in the stability of condensed milk, Chemical defects in condensed milk, their causes and prevention., Microbiological qualities of condensed milks, preservative used in evaporated, condensed & dried milks, a) Type of microorganisms occurring in condensed milks b) Survival and growth of microorganisms during manufacture and storage.c) Microbiological standards, d) Type of spoilage and their prevention. Recent advances with reference to freeze concentration and membrane concentration, Dried Milks: History and status in India and abroad, Grading and quality of raw milk for dried milks, Manufacture of skim milk powder (SMP), whole milk powders and heat classified powders, Physico-chemical changes taking place during manufacture of dried milks, Physical properties of dried milks, Defects in dried milk during manufacture and storage, their causes and prevention, PFA, BIS and International Standards for dried milk, Manufacture of infant foods, malted milk foods and other formulated dried products, Microbiological quality of various dried milks including infant foods and Management of condensed and dried milk industry.</p> <p>Practical : Manufacture of plain skim concentrated milk. Chemicals and microbiological examination of concentrated and dried milks for (a) Moisture, T.S., Fat, lactose, sucrose, bulk density, solubility index, and (b) SPC, coliforms, yeasts and molds, toxins etc. Manufacture of SCM.Manufacture of EM. Concentration of milk by membrane processing. Manufacturing of SMP by spray drying/roller drying. Manufacture of instant milk powder.</p>		

3	DT-402	Fat Rich Dairy Products	4 (2-0-1)
		<p>Status of fat-rich dairy products in India and abroad. Cream: a) Definition & Legal standards, Efficiency of cream separation and factors affecting it; control of fat concentration in cream. b) Planning and operating a cream production unit) neutralization, standardization, pasteurization and cooling of cream. c) Preparation and properties of different types of cream; table cream, sterilized cream, whipped cream, plastic cream, frozen cream and chip-dips (cultured cream), UHT processing of cream. d) Bacteriology of cream including defects, factors affecting quality of cream; ripening of cream e) Packaging storage and distribution, defects (non-microbial) in cream and their prevention. Butter: a) Introduction to the butter making process; theory of churning, Legal standards. b) Technology of Butter manufacture, Batch and continuous methods. Over-run in butter; control of fat losses in butter-milk; packaging and storage; transportation; defects in butter; rheology of butter; uses of butter. Microenvironment in cream and butter, impact of critical process factors on entry of spoilage and pathogenic organisms in cream & butter, their spoilages & control measures. Legal microbiologies specifications of cream & butter. Butter making equipment: Construction, operation, care and maintenance of cream separators, coolers and vacreator, factory butterchurn and continuous butter making machine. Special butters and related products: a) Manufacture, packaging, storage and properties of whey butter, flavoured butter, whipped butter, renovated butter / fractionated and polyunsaturated milk fat products, vegetable oil-blended products and low-fat spreads. b) Manufacture, packaging, storage and characteristics of margarine of different types. Ghee and butter oil: a) Methods of ghee making-batch and industrial processes, innovations in ghee production, procedure, packaging and preservation of ghee; utilization of substandard milk. b) Ghee: Composition and changes during manufacture fat constants.</p> <p>Practical: Microbiological examination of cream: Direct microscopic count, Dye reduction tests. Microbiological examination of cream: a) Total viable count b) Lipolytic count c) Coliform count. Standardization, neutralization, pasteurization and cooling of cream. Preparation of sterilized cream. Study of construction and cooperation of the power operated butter churn and butter packaging machine. Preparation of cooking butter by the handoperated churn. Preparation of desi butter. Manufacture of table butter using the power-driven churn. Preparation of ghee from cream and butter. Study and operation of continuous ghee plant. Sampling, determination of melting/slip point, moisture by gravimetric method, B.R. Index and Baudouin Test. Acidity, Helphen Test for the presence of cotton-seed oil. R.M. value and Polenske value. Saponification value. Iodine value. Peroxide value. Detection of animal body fats and vegetable oils. Examination of the quality of sodium chloride for butter making.</p>	
4	ME-502	Refrigeration and Air Conditioning	3 (2-0-1)
		<p>Basic refrigeration cycles and concepts : Standard rating refrigerating machines, Elementary vapour compression refrigeration cycle with reciprocating, rotary and centrifugal compressors. Theoretical vapour compression cycle, Departure from theoretical vapour compression cycle, representation on T- and p-h diagrams, Mathematical analysis of vapour compression refrigeration system. Refrigerants: Primary and secondary refrigerants, common refrigerants (Ammonia, Freon), Brine, their properties and comparison. Multiple evaporator and compressor systems: Applications, One compressor systems: dual</p>	

	<p>compression, comparison of system, Control of multiple evaporator system, Working and mathematical analysis of above systems. Refrigeration equipments: Compressor, Condenser, evaporator, Cooling tower, spray pond, Basic elements of design, Construction, operation and maintenance, balancing of different components of the system. Refrigeration Controls: Low side and high side float valves, capillary tube, thermostatic expansion valve, automatic expansion valve, solenoid valve, High pressure and low pressure cutouts, thermostat, overload protector, common defects and remedies. Refrigeration Piping: Purpose, materials, joint and fittings, water and brine pipe size selection. Absorption Refrigeration Systems: Simple vapour absorption refrigeration systems, Practical absorption system, Refrigerant absorbent combinations Absorption cycle analysis. Psychrometry: definition, properties of air-vapour mixtures, Psychrometric charts, Processes involving air vapor mixtures, Dehumidification, humidifiers, Humidity measurements, humidity control. Wet bulb, dry bulb temperature dew point temperature. Cooling load calculations: Types of loads, design conditions for air cooling, air conditioning loads. Cold storage: Types of cold storage, Types of loads in cold storage, Construction of cold storage. Insulating materials and vapour barriers.</p> <p>Practical : Study of tools used in installation of a refrigeration plant including charging and detection of leaks. To study different parts and learn operation of bulk milk cooler. Study of different parts and learn the operation of a refrigeration plant/ice plant using ammonia refrigerant. Study of different parts and learn the operation of a vapour absorption refrigeration plant. Dismantling and assemble an open compressor and a sealed unit. Study different parts and refrigeration controls of the following (a) Refrigerator (b) Water cooler (c) Deep Freezer (d) Compare their cooling coils and other systems. To find out the rating (cooling rate) at different suction temperatures (temperature differences) and air handling capacity of the air cooling unit. Plotting the practical refrigeration cycle on a pressure enthalpy diagram and to compare it with a theoretical refrigeration cycle. Study different parts and operation of a (a) Air washer, (b) Room cooler, (a) Air conditioner, (d) Chemical dehumidifiers, (e) Cooling. Plotting of psychrometric process: Sensible heating & cooling. Dehumidification & cooling and heating & humidification. Study of different humidity indicating, recording and controlling devices. Problems on cold storage. Visit to cold storage.</p>		
5	DE-402	Dairy Engineering	3 (2-0-1)
	<p>Sanitization : Materials and sanitary features of the dairy equipment. Sanitary pipes and fittings, standard glass piping, plastic tubing, fittings and gaskets, installation, care and maintenance of pipes & fittings. Description, working and maintenance of can washers, bottle washers. Factors affecting washing operations, power requirements of can the bottle washers, CIP cleaning and designing of system. Mechanical Separation: Fundamentals involved in separation. Sedimentation, Principles involved in filtration, Types, rates of filtration, pressure drop calculations. Gravity setting, principles of centrifugal separation, different types of centrifuges. Application in Dairy Industry, clarifiers, tri processors, cream separator, selfdisludging centrifuge, Bacto-fuge, care and maintenance of separators and clarifiers. Homogenization : Classification, single stage and two stage homogenizer pumps, power requirement, care and maintenance of homogenizers, aseptic homogenizers. Pasteurization: Batch, flash and continuous (HTST) pasteurizers, Flow diversion valve,</p>		

	<p>Pasteurizer control, Care and maintenance of pasteurizers. Different type of sterilizers, in bottle sterilizers, autoclaves, continuous sterilization plant, UHT sterilization, Aseptic packaging and equipment. Care and maintenance of Sterilizers. Filling Operation: Principles and working of different types of bottle filters and capping machine, pouch filling machine (Pre-pack and aseptic filling bulk handling system, care and maintenance. Mixing and agitation : Theory and purpose of mixing. Equipments used for mixing solids, liquids and gases. Different types of stirrers, paddles and agitators. Power consumption of mixer-impeller, selection of mixing equipment in dairy industry, mixing pumps.</p> <p>Practical: To study: S.S.Pipes and fitting, gasket materials and S.S.milk pumps: Milk tanker and milk storage tanks: Can washer and bottles washer: C.I.P. Cleaning equipment: Homogenizers: Batch and Continuous pasteurizers: Different controls on pasteurizer: Different sterilizers: Pouch filling machine: Different types of agitators: Bottle filling and Capping machine: Determination of the rate of filtration and settling: Visit to a dairy plant.</p>		
6	DT-303	Traditional Dairy Products	3 (2-0-1)
	<p>Status and significance of traditional milk products in India. Khoa: Classification of types, standards methods of manufacture and preservation factors affecting yield of khoa. Physicochemical changes during manufacture and storage of khoa. Mechanization in manufacture of khoa. Confectioneries made from Khoa-Burfi, peda, Milkcake, Kalakhand, Gulabjaman and their compositional profile and manufacture practices. Rabri and Basundhi: Product identification, process description, factors affecting yield physico-chemical changes during manufacture. Channa: Product description, Standards method of manufacture, packaging and preservation. Chhanna-based sweets, Rasogolla, Sandesh, Ras-malai. Mechanization of manufacturing process. Paneer: Product description standards method of manufacture packaging and preservation. Physico-chemical changes during manufacture and storage. Mechanization of paneer manufacturing/packaging process. Shrikhand: Chakka-product description, standards method of manufacture, small scale and industrial, packaging and preservation aspects. Shrikhand-sav as chakka. Physico-chemical changes and quality assurance during manufacture and storage. Sandesh: Product description method of manufacture and packaging process. Misti dahi : Product description method of manufacture and packaging process. Kheer and Payasam: Product description methods of manufacture, innovations in manufacturing and packaging processes. Microbiology of indigenous milk products, predominance of spoilage & pathogenic organisms in Khoa, Chhanna, Paneer, Shrikhand, their spoilages, control measures & legal specifications. Biopreservative principles in enhancing the self-life of indigenous milk products including active packaging.</p> <p>Practical : Preparation of khoa from cow, buffalo and concentrated milk. Analysis of khoa, chhanna and paneer for total solids, moisture, fat and acidity. Preparation of kheer. Preparation of chhanna from cow and buffalo milk and mixed milk. Preparation of paneer from cow and buffalo milk and mixed milk. Preparation of misti dahi, chhaka and shrikhand. Preparation of khoa and chhanna based sweets. Microbiological examinations of traditional dairy products: Khoa, paneer, spore counts, coliform counts yeast, molds counts etc. Field trip</p>		

7	EXT-301	Fundamentals of Dairy Extension	3 (2-0-1)
	<p>History, need definition, philosophy, principles, approaches and objectives of extension education, Present status of extension and rural Development programmes. Teaching/learning process, Extension Teaching Methods, classification and selection of teaching methods. Nature and importance of communication. Key elements of communication. Models of communication, process, feedback and problems in communication. Importance of audiovisual aids in extension education. Classification, planning and selection of A.V.Aids. Identification of rural leaders, their characteristics, roles and functions in rural development, training of rural leaders. Definition of groups, natural types, principles of working with groups and their mobilization. Need, principles and steps of programme planning. Evaluation of extension programmes. Diffusion of innovations and categories of farmers. Conceptual orientation about different terms, like- PRA, RRA, IVLP/TAR, ATMA, ATIC, PTD etc. Practical: Acquiring skill in use of audio-visual & other aids: Overheads Projector, Slide Projector, Use of VCR and PA system, Camera handling. Preparation and use of visual aids and printed material; Poster and chart, Flash card and flannel Graph, Circular letter, leaflet, pamphlet, folder. Group Discussion Technique, Developing Communication and Overall Skills, Brain-storming Technique for developing the Decision making Process, Interview technique (s), Identification of problems of village farmers through interview method, Writing a radio script.</p>		
8	DC-513	Human Nutrition	2 (1-0-1)
	<p>Fundamentals of human nutrition, concept of balanced diet, nutrient requirements of different age groups. Methods of evaluation of nutritive value of food and nutritional value of cow, buffalo and human milk, biochemical composition and energy value of foods with special reference to milk and dairy products. Nutrition, digestion and absorption, Vitamins (structure and function), Hormones (structure and function), Milk intolerance and hypersensitivity, Safety aspects of food additives, toxic elements, antibiotics, radionuclides in milk and milk products. Nutraceutical, antioxidants, food toxins, anti-nutritional factors, probiotics and cultured dairy products. Biochemical aspect of post-harvest storage specifically food spoilage.</p> <p>Practical: Estimation of serum Protein (Biuret method /Lowry method). Estimation of Blood Glucose (Folin Wu method). Estimation of Serum inorganic phosphorus (Fiske and Subba Row method). Estimation of blood creatinine, triglyceride and cholesterol levels. Estimation of calorific value of food items. Diet and nutrition surveys: (a) Identification of vulnerable and risk groups. (b) Diet survey for breast-feeding and weaning practices of specific groups. (c) Use of anthropometric measurement in children. Preparation of visual aids for nutritional disorders. Field visit to (a) Observe the working of nutrition and health oriented programmes (survey based result). (b) Hospitals to observe nutritional deficiencies. Identification of Mono, Di and Polysaccharides. Identification of Proteins (albumin, gelatin, peptone). Planning and preparation of high protein, low fat and specialized diets. Detection of antibiotic/toxin in food products.</p>		

9	BAM-501	Marketing Management & International Trade	2 (2-0-0)
	<p>Concept of marketing; Functions of marketing; concepts of marketing management; scope of marketing management; marketing management. Process; concepts of marketing- mix, elements of marketing- mix. Market Structure and Consumer Buying Behaviour: Concept of market structure, marketing environment, micro and macro environments. Consumers buying behaviour, consumerism. Marketing Opportunities Analysis: Marketing research and marketing information systems; Market measurement- present and future demand; Market forecasting; market segmentation, targeting and positioning. Allocation and Marketing resources. Marketing Planning Process. Product policy and planning : Product- mix; product line; product life cycle. New product development process. Product brand, packaging, services decisions. Marketing channel decisions. Retailing, wholesaling and distribution. Pricing Decisions. Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry. Promotion-mix decisions. Advertising; How advertising works; Deciding advertising objectives, advertising budget and advertising message; Media Planning; Personal Selling, Publicity; Sales Promotion. Food and Dairy Products Marketing. International Marketing and International Trade. Salient features of International Marketing. Composition & direction of Indian exports; International marketing environment; Deciding which & how to enter international market; Exports- Direct exports, indirect exports, Licensing, Joint Ventures, Direct investment & internationalization process, Deciding marketing Programme; Product, Promotion, Price, Distribution Channels. Deciding the Market Organization; World Trade Organization (WTO)</p>		
10	ECE-301	Basic Electronics	4(2-1-1)
	<p>1. Energy Bands in Solids: Energy band theory of solids, Concept of forbidden gap, Insulators, Metals and Semiconductors.</p> <p>2. Transport Phenomenon in Semiconductors: Mobility and conductivity, electrons and holes in an intrinsic semiconductor, Donor and acceptor impurities, Fermi level, carrier densities in semiconductor, electrical properties of semiconductor, Hall effect, Diffusion.</p> <p>3. Junction Diode: P-N junction, depletion layer, V-I characteristics, diode resistance, capacitance, switching time, diode application as a rectifier (half wave and full wave), diode circuits (clipper, clamper, voltage multipliers) Breakdown mechanism, Zener & Avalanche, breakdown characteristics, Zener diode and its applications.</p> <p>4. Bi-junction Transistor: Bipolar junction Transistor, CE, CB and CC configuration, characteristic curves (cut off, active and saturation region), Requirement of biasing, biasing types and biasing analysis, stability.</p> <p>5. Transistor as an Amplifier: Graphical analysis of CE amplifier, concept of voltage gain, current gain and power gain, h-parameter (low frequency), computation of A_v, R_i, R_o and approximate formulae.</p> <p>6. FET & UJT:</p> <p>7. Construction & characteristics of JFET -parameters of JFET -MOSFET -depletion ,enhancement modes-FET in CS,CD,CG Configurations-equivalent circuit of FET at low frequencies-FET model at high frequencies-FET Specifications.Construction, theory of operation & characteristics of UJT, PUT..</p> <p>8. Operational Amplifiers:Concepts of ideal op-amp, inverting, non-inverting and unity gain amplifiers, adders, difference amplifiers. , Integrators.</p>		

9. Switching Theory & Logic Gates: Number systems, conversion of bases, Boolean algebra, Logic Gates, concept of universal gate, canonical forms, and minimization using K-map.

10. Electronic Instruments: Multimeter, CRO and its Applications.

References:

1. Boylestad & Nashelsky/Electronic Devices & Circuits/ PHI.
2. Morris Mano/Digital Computer Design/ PHI.
3. Milliman, J. Halkias/Integrated Electronics/TMH.
4. Malvino & Leach/Digital Principles & Application/
5. Sanjeev Gupta /Electronics devices & ckts./Dhanpat Rai sons

List of Experiments:

1-Study of lab equipments and components: CRO, Multimeter, Function Generator, Power supply- Active, Passive Components & Bread Board.

2. P-N Junction Diode: Characteristics of PN Junction diode-Static and dynamic resistance measurement from graph.

3. Applications of PN junction diode: Half & Full wave rectifier- Measurement of V_{rms} , V_{dc} , and ripple factor-use of filter- ripple reduction (RC Filter)-Clipper & Clamper

4. Properties of junctions Zener diode characteristics. Heavy doping alters the reverse characteristics. Graphical measurement of forward and reverse resistance.

5. Application of Zener diode: Zener diode as voltage regulator. Measurement of percentage regulation by varying load resistor.

6. Characteristic of BJT: BJT in CB and CE configuration- Graphical measurement of h parameters from input and output characteristics. Measurement of A_v , A_i , R_o and R_i of CE amplifier with potential divider biasing.

7. Characteristic of FET: FET in common source configuration. Graphical measurement of its parameters g_m , r_d & m from input and output characteristics.

8. Characteristic of silicon-controlled rectifier.

9. To plot V-I Characteristics of DIAC .

10. To draw V-I characteristics of TRIAC for different values of Gate Currents.

Semester-IV

1	DT-501	Cheese Technology	5 (3-0-2)
	<p>Origin and history of development of cheese manufacture, status and scope in India and abroad. Definition, standards and classification of cheese. Milk quality in relation to cheese making. Treatment of milk; Physical and chemical. Cheese additives and preservatives. Role of starter culture in relation to cheese quality. Rennet preparation and properties, rennet substitutes. Action of rennet on milk in relation to cheese making. Manufacture of different varieties of cheese: Cheddar, Gouda, Swiss, Mozzarella, Cottage. Microbiological changes during preparation ripening in cheese. Role of milk constituents and changes during manufacture and ripening in cheese. Factors affecting yield of cheese. Packing, storage and distribution of cheese. Accelerated ripening of cheese. Microbiological defects in cheese; their cause and prevention. Manufacture of processed cheese, cheese spread and processed cheese foods. Mechanization and automation in cheese processing. Microbiological critical control of cheese cold store.</p> <p>Practicals: Familiarization with equipments, accessories and standardization numericals. Study of factors affecting rennet action. Manufacture of Cheddar cheese. Manufacture of Gouda cheese. Manufacture of Mozzarella cheese. Manufacture of Swiss cheese. Manufacture of Cottage cheese. Manufacture of Processed cheese. Manufacture of processed cheese spread. Manufacture of processed cheese food. Analysis of cheese; proximate composition. Determination of ripening index.</p>		
2	DT-502	Ice-Cream & Frozen Deserts	3 (2-0-1)
	<p>History, development and status of ice cream industry, History, development and status of ice cream industry, Definition, classification and composition of ice cream and other frozen desserts, Stabilizers and emulsifiers-their classification, properties and role in quality of icecream, Technological aspects of ice cream manufacture, Thermodynamics of freezing and calculation of refrigeration loads, Types of freezers, refrigeration control / instrumentation, Types of freezers, refrigeration control / instrumentation, Hygiene, cleaning and sanitation of ice cream plant, Effect of process treatments on the physico-chemical properties of ice-cream mixes and ice cream, Processing and freezing of ice-cream mix and control of over run, Packaging, hardening, storage and shipping of ice-cream, Defects in ice cream, their causes and prevention, Physico-chemical properties of ice-cream and compositional standards., Microenvironment in ice cream, microbiological quality of ingredients, critical process factors & their impact on entry of pathogen in ice cream, their survival during storage, food poisoning out breaks, food safety & legal standards, Recent advances in ice-cream industry and plant management, Technology for preparation of dried ice-cream milk mix. And Nutritive value of ice-cream.</p> <p>Practical: Calculation of standardization of ice-cream mixes. Manufacture of plain and fruit flavoured ice-cream. Manufacture of chololcate, fruit and nut ice cream. Preparation of sherbets/ices. Preparation of soft served and filled ice-cream. Manufacture of kulfi. Study of continuous and batch type freezers. Manufacture of ice-cream by continuous process. Compositional analysis of ice-cream. Microbiological examination of ice-cream and other frozen desserts; SPC, coliform, staphylococci & Salmonella. Field trips.</p>		

3	DT-504	Sensory Evaluation of Dairy Products	3 (2-0-1)
		<p>Introduction, definition and importance of sensory evaluation in relation: to consumer acceptability and economic aspects; factors affecting food acceptance. Terminology related to sensory evaluation. Design and requirements of sensory evaluation laboratory. Basic principles: Senses and sensory perception, Physiology of sensory organs, Classification of tastes and odours, threshold value factors affecting senses, visual, auditory, tactile and other responses. Fundamental rules for scoring and grading of milk and milk products. Procedure: Types of tests – difference tests (Paired comparison, duo-trio, triangle) ranking, scoring, Hedonic scale and descriptive tests. Panel selection, screening and training of judges. Requirements of sensory evaluation, sampling procedures. Factors influencing sensory measurements. Milk: Classes of raw and processed milks, defects associated with them; milk score card and its use. Judging and grading of milk. Fermented milks: Desirable and undesirable characteristics of fermented milks, sensory evaluation of dahi, yoghurt, chakka, srikhand, lassi and other fermented drinks. Cream: Desirable attributes and defects in cream, Score card for cream, Judging and grading of different types of cream. Butter: Specific requirements of high grade butter, undesirable attributes of butter, butter score- card, sensory evaluation of butter. Ghee: Grades of ghee, special requirements of quality ghee, defects in ghee, sensory evaluation of ghee. Frozen dairy products: Desirable and undesirable characteristics of frozen dairy products. Sensory evaluation of ice cream, kulfi and milk sherbets. Cheese: Quality attributes of some common cheese varieties and their defects, score card for cheese. Sensory evaluation and grading for cheddar, cottage and other varieties of cheeses. Dried dairy products: Desirable and undesirable characteristic of dried milks. Judging and grading of dry milk products. Concentrated milks: Desirable attributes and defects. Judging and grading of evaporated and condensed milk. Heat desiccated Indian milk products: Desirable and undesirable characteristics. Sensory evaluation of khoa and khoa based sweets. Acid coagulated Indian milk products: desirable and undesirable characteristics. Sensory evaluation of paneer, chhana and chhana based sweets. Consumer acceptance studies: Objectives. Methods, types or questionnaires, development of questionnaires, comparison of laboratory testing and Consumers studies, limitations. Interrelationship between sensory properties of dairy products and various instrumental and physico-chemical tests. Preparation of milk and milk products with defects, techniques for simulation.</p> <p>Practical: Determination of threshold value for basic tastes. Determination of threshold value for various odours. Selection of judging panel. Training of judges, for recognition of certain common flavour and texture defects using different types of sensory tests. Judging of milk and cream. Judging of butter and ghee. Judging of condensed and evaporated milk. Judging of milk powders. Judging of cheese and related products. Judging of frozen products. Judging of khoa and khoa-based sweets. Judging of chhana and chhana based sweets. Judging of dahi and fermented dairy products.</p>	

4	DM-401	Starter Culture and Fermented Milk Products	3 (2-0-1)
	<p>Introduction of starter cultures & their importance in dairy industry, classification of Lactic Acid Bacteria; Metabolism of Lactic Acid Bacteria and diacetyl production, production of antibacterial substances by lactic starter cultures. Mixed and define strain starter culture; propagation of starter cultures; factors affecting their propagation; starter concentrates- direct bulk and direct vat starter cultures; starter distillates. Quality and activity of starter cultures; defects in starters and their control; starter failures; antibiotic residues, sanitizers and bacteriophages. Preservation of starter cultures: freezing and freeze-drying; factors affecting the survival of cultures during preservation. Role of starter cultures in the preparation of various fermented milks; classification of fermented milks Microbiology of dahi and yoghurt; different types of dahi and yoghurt; preparation; defects and their control. Microbiology of milk products; their nutritional and therapeutic significance. Kefir and Kumiss: origin and characteristics: microbiology of Kefir grains. Microbiology of other fermented milks such as Bulgarian milk, cultured buttermilk, Leben and Yakult; their significance. Concept of probiotic starters and their application in probiotic dairy food.</p> <p>Practical: Testing for purity of starter cultures; gram's staining, catalase test; creatine test. Starter activity tests: die reduction tests, Horrell-Elliker test, Whitehead and Cox test. Preparation of single and mixed starter cultures: homofermentation and hetrofermentation separately and also in combinations. Maintenance and preservation of starter cultures- Freeze drying techniques demonstration. Preparation of concentrated starter – freeze dried and frozen types. Effect of physical factors on dairy starter: temperature, pH, salt, sugar. Testing milk for the presence of inhibitory substance using <i>B. stearothermophilus</i> and <i>S. thermophilus</i> as indicator organisms. Effect of antibiotic residues in milk on starter activity. Associative growth of microorganisms in milk and cream. Detection of bacteriophages in cheese whey by plaque assay. Preparation and evaluation of quality and grading of Dahi, Yoghurt, cultured butter milks, acidophilus milk and Kumiss. Microbiological analysis of processed cheese- Total spore count & Anaerobic spore count. Microbiological analysis at different stages of manufacture of (storage and ripening) hard varieties of cheese- such as Cheddar cheese.</p>		
5	DE-403	Dairy Process Engineering	3 (2-0-1)
	<p>Evaporation : Basic principles of evaporators, construction and operation, Different types of evaporators used in dairy industry, Calculation of heat transfer area and water requirement of condensers, Basic concepts of multiple effect evaporators, Operations and various feeding systems, Economy of operation, Thermo processor and MVR system, Care and maintenance of evaporators. Drying : Introduction to principle of drying, Equilibrium moisture constant, bound and unbound moisture, Rate of drying- constant and falling rate, Effect of Shrinkage, Classification of dryers-spray and drum dryers, spray drying, etc., air heating systems, Atomization and feeding systems. Factors affecting bulk density of power, spray dryer controls, Theory of solid gas separation, cyclone separators, Bag Filters, Care and Maintenance of drum and spray dryers. Fluidization: Mechanisms of fluidization characteristics of gas-fluidization systems, Minimum Porosity, Bed Weight, Pressure drop in fluidized bed, Application of fluidization in drying, Batch fluidization, Fluidized bed dryers. Mechanization and equipment used in manufacture of indigenous</p>		

	<p>dairy products, Butter and Ghee making machine, Ice-cream and Cheese making equipments. Packaging machines for milk & milk products. Membrane Processing : Ultra filtration, Reverse Osmosis and electro dialysis, Materials for membrane construction, Ultra filtration of milk, Effect of milk constituents on operation, membranes for electro-dialysis.</p> <p>Practical: Study of construction and operation of : Vacuum pan: Double effect evaporator: Spray dryer: Vacuum and atmospheric drum dryers. Study and operation of Butter, Ghee, Icecream and cheese making equipments, Study the Reverse Osmosis and Ultra filtration system: Design problems on Double effect evaporator and Vacuum pan. Visit to a milk product plant.</p>		
6	MCE- 304	Dairy Biotechnology	3 (2-0-1)
	<p>Definition, scope and historical development of biotechnology, achievement and future application: structure of DNA and RNA; DNA replication, protein synthesis, genetic code, mutations: Vectors, cloning strategies in bacteria and animals, DNA technology. Protoplast fusion & Tissue culture in dairy cultures. Application of biotechnology in food and dairy industry, dairy effluents. Genetic manipulation of dairy starters for improved attributes of commercial value. Dairy enzymes and whole cell immobilization. Ethical issues related to use of genetically modified foods.</p> <p>Practical: Isolation of plasmid and genomic DNA from bacteria (E. coli, lactic acid bacteria Agarose gel electrophoresis of DNA fragments). Restriction analysis of DNA. Purification of plasmids. Preparation of competent cell. Conjugal transfer in E. coli cells. Transformation of E. coli by calcium chloride treatment/ electroporation. Preparation of protoplasts and protoplast fusion. PCR technique demonstration. Visit to a biotechnology lab.</p>		

Semester-V

1	CSIT-501	Application of Information Technology	4 (2-1-1)
	<p>UNIT – 1:</p> <p>Information and Processing Concepts: Definition of Information, Need of Information, Quality of Information, Value of Information, concept of Information, Entropy Category and Level of Information in Business Organization, Data Concepts and Data Processing, Data Representation.</p> <p>Information Representation: Information Contents, Introduction to Information Representation in Digital Media, Elementary Concepts in Information Perseverance. Data Compression – Huffman coding, LZW Coding. Text, Image Compression. Introduction to JPEG, MPEG, MHEG.</p> <p>UNIT – 2:</p> <p>Database Concepts: Definition of Database, Importance of Database, Overview of Database, Models, Schemas and Instances, DBMS architecture, Database languages, Relational Database. Database applications (MS ACCESS).</p> <p>UNIT – 3:</p> <p>Programming Language Classification & Program Methodology: Overview of Programming Languages, generations and programming techniques, Software Development Methodology, Life Cycles, Software Coding, Testing, Maintenance, Industry Standards. Introduction to ISO, SEI-CMM Standards for IT Industry.</p> <p>UNIT – 4:</p> <p>Data Communications and Computer Networks: Data Transmission, Need for Data Transmission over Distances, Types of Data Transmission, Media for Data Transmission. Computer Networks, Network Classification and Network Topologies.</p> <p>UNIT – 5:</p> <p>Internet: WWW, Gopher, FTP, Telnet, Web Browsers, Net Surfing, Search Engines, Email. Basic Concepts in E-Commerce, Electronic Payments, Digital Signatures, Network Security, Firewall.</p> <p>Web Technologies: introduction to HTML, DHTML, Java Script, ASP.</p> <p>IT Industry Trends, Careers and Applications in India: Scientific, Business, Educational and Entertainment applications. Industry Automation. Weather forecasting. Awareness of ongoing IT projects in India: NICNET ERNET. e-governance.</p> <p>Reference Texts:</p> <ol style="list-style-type: none"> 1. D.S. Yadav, “ Foundation of Information Technology”, New Age Publication 2. Raja Raman, V. “Introduction To Computers”. 3. Nelson, “Data Compression”, BPB. 4. Leon & Leon “Fundamental of Information Technology”, Vikas. 5. Cistems “Internet, An Introduction”, Tata McGraw Hill. 6. Elmasri & Navathe, “Fundamentals of Database systems”, PE <p>List of Practicals</p> <ol style="list-style-type: none"> 1. Working with MS ACCESS: <ul style="list-style-type: none"> ▪ Creating tables, relating tables, inserting, deleting and updating records of a table. ▪ Designing User Interface screens ▪ Generating reports 2. Creation of web pages using HTML <ul style="list-style-type: none"> ▪ Program to illustrate operation of tables. ▪ Ordered & unordered lists ▪ Working with frames ▪ Hyperlinks 		

	3. Practicing with Web site designing tools like Microsoft FrontPage, Adobe's Dreamweaver. 4. Internet concepts: www, Internet surfing, live demo on websites, web Browser, file transfer Protocol. 5. Connecting remote machines using Telnet. 6. Working with search engines.		
2	DC-501	Quality and Safety monitoring in Dairy Industry	3 (2-0-1)
	<p>Current awareness on quality and safety of dairy foods; consumer awareness and their demands for safe foods; role of codex alimentarius commission (CAC) in harmonization of international standards; quality (ISO 9001:2000) and food safety (HACCP) system and their application during milk production and processing. National and international food regulatory standards; BIS, PFA, ICMSF, IDF etc., their role in the formulation of standards for controlling the quality and safety of dairy foods. Rapid assessment of dairy food for microbial and non-microbial contaminants; Enumeration Principles in detection of predominant spoilage organisms and pathogens like indicator organisms, E.coli, salmonella, shigella, staph aureus, Bacillus cereus and non microbial contaminants like antibiotic residues, aflatoxin, pesticides other inhibitors etc from dairy foods and their control measures. Microbial quality of water and environmental hygiene in dairy plant; chlorination of dairy water supply, quality of air. Personnel hygiene, treatment and disposal of waste water and effluents; setting up of a microbiological/ pathogen lab in a dairy plant and its safety concern.</p> <p>Practical: Evaluation of common sanitizing agents used in dairy plants by a) suspension b) capacity test. Microbiological tests for assessing equipment and personnel hygiene by swap and rinse methods. Detection of faecal and non- faecal coliforms and faecal streptococci in dairy plant. Detection and enumeration of different pathogenic bacteria in dairy products: Staphylococcus aureus, Bacillus cereus, Salmonella and Shigella. Bacteriological analysis of dairy water for: a) total viable counts b) coliform counts (MPN). Detection of antibiotic residues, pesticides, aflatoxins and staphylococcal enterotoxins in milk using rapid techniques. Determination of BOD in dairy waste water. Quality evaluation by HACCP in the preparation of dairy products.</p>		
3	DT-503	By Products Technology	3 (2-0-1)
	<p>Status, availability and utilization of dairy by-products in india and Abroad. Associated economic and pollution problems., Physico chemical characteristics of whey, butter milk and ghee residue, By-products from skim milk: a) Casein: types of commercial casein, their specifications, manufacturing processes with basic principles involved. b) Industrial and food uses of caseins c) Manufacture of sodium and calcium caseinates their physico-chemical and functional properties and food applications d) Manufacture of casein hydrolysates and its industrial application e) Coprecipitates: types, their specifications, manufacturing processes with basic principles involved, functional properties and food applications. Whey processing: a) Fermented products from whey, b) Beverages from whey c) Deproteinized and demineralized whey d) Condensed whey e) Dried whey, types and their specification, manufacturing techniques. F) Utilization of whey products. Whey protein concentrates: a) Methods of isolation with basic principles involved, physico-chemical properties of whey proteins concentrates b) Functional properties and food applications of WPC. Lactose: methods for the industrial production of lactose, refining of</p>		

	<p>lactose, uses of lactose and hydrolysis of lactose. Butter milk processing: a) Condensed butter milk b) Dried butter milk c) Utilization of butter milk products Ghee residue. Composition, processing and utilization. Nutritional characteristics of by products.</p> <p>Practical: Manufacture of edible casein from cow and buffalo milk. Manufacture of rennet casein. Manufacture of sodium caseinate. Manufacture of calcium caseinate. Manufacture of co-preceinate. Chemical analysis of whey, buttermilk, casein, casein and co-precipitates. Isolation of whey proteins by cold precipitation technique. Manufacture of whey proteins, concentration by ultra filtration process. Manufacture of whey drinks. Manufacture of dried whey. Manufacture of lactose. Chemical analysis of whey protein concentrates and lactose. Microbiological analysis of casein and dried whey. Incorporation of whey protein concentrates in processed cheese foods. Manufacture of coffee whitener.</p>		
4	DE-501	Instrumentation & Process Control	3 (2-0-1)
	<p>Absolute and secondary instruments, Types of secondary instruments, Essentials of indicating instruments, Constructional details of indicating instruments. Principle of induction type instruments- shaded pole method and two pole methods, compensation for frequency and temperature errors. Induction type voltmeter, Ammeter, advantage and disadvantages, induction type single phase watt hour meter , their errors and remedies, Numerical, wattmeter, power fractometer, etc. Characteristics of Instruments and Measuring Systems: Elements of generalized measuring system, static calibration, accuracy, sensitivity, reproducibility, static errors, dead zone, drift in measuring instruments. Analog and digital representation of signals, Factors influencing the choice of transducers. Mechanical Input Transducers: Level, Pressure, Flow, Velocity and Humidity- Resistive, Capacitive and Inductive, Dielectric system for humidity measurements. Temperature Transducers: Resistive, inductive, capacitive and thermoelectric transducer. Magnetic Transducers: Systems based on induction and magnetic effects on moving charges, Transducers based on permeability variation.</p> <p>Practical : Preparation and calibration of thermocouple; study the construction and working of Bourden pressure gauge. Study the mechanism of pH meter and its electrodes. Study a pressure transducer. Study a Proximity sensor. Study of the different parts and working of Rotameter. Study the different parts and working of pressure switch. Study the different parts of an indicating instrument. Study the different parts and their working of single phase induction type watt-hour meter. Visit to a microprocessor controlled dairy plant.</p>		
5	BAM-428	Financial Management & Cost Accounting	3 (2-0-1)
	<p>Introduction: Definition, scope and objectives of financial management. Different Systems of Accounting: Financial Accounting, Cost accounting, Management Accounting. Doubles entry system of Book-Keeping. Preparation of Accounting Records: Journal, Purchases and Sales Book and Posting in Ledger, Cash Book. Preparation of Final Accounts and adjustments at the end of trading period. Preparation of Trial Balance Banking Transactions and Bank reconciliation statements. Statements of Financial Information: Accounting system: A source of financial statements, Classification of capital and revenue expenditure, Balance Sheet, Profit and Loss Account, Statement of changes in the financial position, funds flow statements, cash flow statement, uses of funds flow and</p>		

	<p>cash flow statements in financial decision making. Financial Analysis : Nature and uses of financial analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Utility of Ratio analysis. Cost Volume – Profit analysis and operating leverage, Break-even analysis, Profit analysis and operating analysis, Utility of CVP analysis. Capital Structure: C.S Planning, risk return trade off, financial leverage. Cost of capital: Management of cost of capital, cost of debt, debentures, preference share capital, equity share capital & retained earning, overall cost of capital. Investment decision : Time value of money, Net present value, Investment evaluation criteria, NPV method, Internal rate of return method, Profitability index method, Pay back period method, Accounting rate of return method. Capital budgeting: Complex Investment Decisions: Investment timing & duration Investment decisions under inflation, Investment decisions under capital rationing. Project Report; Feasibility Report Valuation. Working capital management- Concept & determinants of working capital, Estimating working capital needs. Depreciation – Concept and method. Introduction, Definition, Objectives, Common terms. Costing : Essentials of sound costing system. Different methods of costing, elements of cost : Labour- recording of time, idle time, methods of remunerating labour, Premium & Bonus Plans, Materials, Overheads. Cost classification : Direct and Indirect expenses, fixed and variable costs. Various methods of apportioning indirect expenses. Inventory Management: Planning, control and costing. Stores & storekeeping, scope & importance, purchase procedure, types of purchase, location of stores & materials, procedure for the movement of stores, different methods of pricing materials, store records. Cost Sheets- Different methods, Statement of cost and statement of profit estimates, Tenders or Quotations. Contract or Terminal costing. Process Costing: Process losses and inter-process profits, joint products and by products costing. Ascertainment of cost of milk production. Preparation of Cost Account Information for managerial decisions.</p> <p>Practical: Preparation of Profit and Loss account. Preparation of Balance Sheet. Preparation of Cash flow statements. Preparation of Funds flow statements. Problems on Ratio analysis. Problems on Break-Even Analysis. Problems on Profit analysis. Problems on Operating Analysis. Problems on Financial leverage. Problems on Cost of Capital. Problems on Investment decisions. Problems on Capital budgeting</p>		
6	DE-502	Dairy Plant Design and Layout	2 (1-0-1)
	<p>Introduction of Dairy Plant design and layout. Type of dairies, perishable nature of milk, reception flexibility. Classification of dairy plants, Location of plant, location problems, selection of site. Dairy building planning, Process schedule, basis of dairy layout, importance of planning, principles of dairy layout. Space requirements for dairy plants, estimation of service requirements including peak load consideration. General points of considerations for designing dairy plant, floor plant types of layouts, service accommodation, single or multilevel design. Arrangement of different sections in dairy, sitting the process sections, utility/service sections, offices and workshop. Arrangement of equipment, milk piping, material handling in dairies, Common problems, office layouts- flexibility. Development and presentation of layout, model planning, use of planning table in developing plot plant and detailed layout. Choice of building construction materials, floors, general requirement of dairy floor finishes, floors for different section of dairy. Foundations, walls doors and windows, Drains and drain layout for small and large dairies.</p>		

	<p>Ventilation, fly control, mold prevention, illumination in dairy plants.</p> <p>Practical: Building symbols and convention layouts for small, medium and large size dairies. Isometric presentation of piping. Design and layout of: Milk collection/chilling centre; Fluid milk plant (small, medium and large); Single product dairy (i) Cheese, (ii) ice-cream, (iii) butter and (iv) ghee. Composite dairy plant.</p>		
7	DC-502	Chemical Quality Assurance	2 (1-0-1)
	<p>Importance of chemical quality control in dairy industry; setting up quality control laboratories and testing facilities: mobile testing laboratories. Sampling procedures; labeling of samples for analysis : choice of analytical tests for milk and milk products for chemical analysis; instrumental methods of analysis. Calibration of dairy glassware including butyrometer, pipettes, burettes, hydrometers, lactometers and freezing point thermometer. Preparation and standardization of reagents required in the analysis of milk and milk products. Application of PFA, AGMARK, BIS and codex related to dairy products for the quality control of milk and milk products. Preservatives, neutralizers and adulterants in milk and milk products and their detection. Accreditation of analytical laboratories ; Hazard analysis and critical control points (HACCP). Prediction of shelf life behavior of milk and milk products. Milk contact surfaces, metallic contamination, environmental contaminants such as pesticides, antibiotics, heavy metals in dairy products: methods of estimation. Soft and hard water, temporary and permanent hardness, softening of hard water.</p> <p>Practical : Calibration of dairy glassware such as pipette, burette, volumetric flasks, hydrometer, butyrometers. Preparation and standardization of dairy reagents such as acids, alkalies, sodium thiosulfate, silver nitrate, Fehlings. EDTA solutions etc. Detection of adulterants, preservatives, and neutralizers in milk and milk products. Chemical analysis of permissible additives used in milk and milk products. Chemical analysis of detergents and sanitizers. Preparation and testing of Gerber sulfuric acid used in fat determination. Testing the amyl alcohol used for fat determination. Analysis of market samples of milk and milk products.</p>		
8	DE-503	Material strength and Dairy Machine Design	3 (2-0-1)
	<p>Basic concepts in Statics and Dynamics. Force Systems. Equilibrium condition, friction, Law of friction, Second moments of inertia, Parallel axis theorem. Dynamics : Equation of motion. Translation and rotation of a Rigid body, work and mechanics of materials : Stress-Axial Load classification Strain-Hooke's law, stress-strain diagram, Poisson's Ratio : Shearing Stresses. Torsion, Torsion formula, Angle to Twist of circular members. Power transmission shear force and bending moments, Shear in Beams, Bending Moment in beams. Pure bending of beams, Flexural stress shearing stresses in beams relations between centre, Torsional and flexural loads. Machine Design : Procedures, Specification, strength, design factor, factor of safety selection of factor of safety. Materials and properties. Static strength, ductility, hardness, fatigue, designing for fatigue conditions. Theories of failure, Stresses in elementary machine parts, Design of a drive system. Design of length and thickness of belt. Bearing : Journal and Anti-friction bearings. Selection of ball, tapered roller and thrust bearing. Springs, helical and leaf springs. Energy stored in springs. Design and selection of springs.</p> <p>Practical: Engineering Statics & Dynamics. Work and Energy. Linear and Angular</p>		

	Momentum. Stress-strain diagram evaluation of elastic constants. Power transmission. Shear force and bending moment diagrams. Flexural stresses. Shearing stresses in Beams. Fits and tolerances. Design stresses in elementary machine parts. Design of shafts, axles keys Springs, Couplings, Bearing		
9	DE-504	Boilers & Steam Generation	2 (1-0-1)
	<p>Fuels: Chemical properties, Calorific value and its determination, Fuel Burners, Fuel combustion analysis. Renewable energy sources: Concepts, classification, Types and description of renewable energy sources. Properties of steam: Properties of wet, dry saturated, superheated steam, Use of steam tables and Mollier charts, Analysis of energy input in steam generation and heat gain in steam consumption. Steam generators: Definition, classification, fire tube boilers, water tube boilers, Boiler performance parameters, Boiler mountings and Boiler accessories. Layout of steam pipe-line and expansion joints. Introduction to Indian Boiler Regulation Act. Boiler Draught: Definition, importance and classification of draught, Natural and artificial draught, Calculation of Height of chimney, Draught analysis. Air Compressors: Definition, classification, Reciprocating, Single and multi-stage reciprocating compressors and their theoretical analysis.</p> <p>Practical: To study different types of boilers with the help of Lab models. To study Boiler mountings and steam-line layout and steam traps. Industrial exposure visit to plant with steam utilization. Study of Fire tube low pressure boiler installed in a dairy processing plant. Study of water softening plant installed with boiler in a dairy processing plant. Study the construction and working of Cochran boiler. Study of Babcock & Wilcox boiler. Study of different Boiler accessories.</p>		

Semester-VI

1	DE-601	Food Engineering	4 (3-0-1)
	<p>Rheology of processed food, properties of fluid foods, Rheological method, Measurement of rheological parameters, properties of granular food and powders, Properties of solids foods, Visco-clastic models. Measurement of food texture. Food Freezing : Thermal properties of frozen foods. Predication of freezing rates. Plank's equation, Neumanna problem and Tao solution. Design of food freezing equipment, Air blast freezers, Plate freezers and immersion freezers, storage of frozen foods. Food dehydration : Estimation of drying time for food products, constant rate period and falling rate period dehydration. Diffusion controlled falling rate period. Use of heat and mass balanced in analysis of continuous dryers, fixed tray dehydration, cabinet drying, tunnel drying. Freeze Dehydration : Heat and mass transfer, Calculation of drying times, Industrial freeze drying. Equipment for pulping, Fruit juice extraction, Blanching, Dehulling, Size reduction and distillation.</p> <p>Practical: Study of rheological properties of foods. Study of freezers and freeze dryers. Design problems on batch freezers. Design problems for continuous freezers. Design problems on dryer. Visit to cold storage. Visit to food processing plant.</p>		

2	DC-601	Chemistry of Dairy Products	3 (2-0-1)
	<p>Chemical composition and legal standards of milk products. Chemistry of creaming and factors affecting the same. Ripening and neutralization of cream. Theories of churning and factors affecting the same. Butter colour. Ghee: Physico-chemical changes during manufacture. Hydrolytic and oxidative deterioration, their causes, prevention and role of antioxidants. Physico-chemical changes in milk constituents during manufacture and storage of traditional dairy products: Khoa, Paneer, Dahi, Channa, Lassi, Chakka, Shrikhand. Chemistry of cheese: milk clotting enzymes, enzymatic coagulation of milk, biochemical changes during ripening. Physico-chemical changes during preparation and storage of concentrated and dried milk products. Physico-chemical changes during processing and storage of ice cream and frozen desserts. Role and mechanism of stabilizers and emulsifiers in ice cream.</p> <p>Practical: Cream: estimation of fat and acidity. Butter: estimation of fat, moisture, curd and salt content. Ghee: estimation of moisture, acid value, Butyro refractive reading and Reichert Meissl value /Polanske value. Determination of lactose and sucrose in sweetened condensed milk. Milk powder: moisture, fat, ash, solubility, acidity and bulk density. Ice cream: estimation of fat and total solids. Estimation of moisture, fat and salt content in cheese. Khoa/paneer: estimation of moisture and fat. Estimation of protein content in milk products and protein rich dairy products using Kjeldahl method.</p>		

3	DM-501	Microbiology of Dairy Products	3 (2-0-1)
	<p>Microbiology of Cream and Butter - Micro-environment and impact of critical process factors on entry of spoilage and pathogenic organisms in cream and butter; Microbiological aspects including defects in pasteurized (ripened/unripened cream), sterilized and UHT cream; Factors influencing the microbial growth during batch/continuous butter making process; Microbial Defects in butter - Bacterial/mold discoloration, enzymatic deterioration</p>		

and their control measures; Regulatory microbiological standards.

Microbiology of Condensed, Evaporated and Dried products: Type of microorganisms associated with condensed, evaporated and dried products, their growth/ survival during manufacture and storage; Microbial defects - Bacterial thickening / Mold button formation in SCM; Gassiness/bloating, Bacterial coagulation (Sour and sweet), Bitterness, Fishy flavor in evaporated milk; pre-heating/DSI temperature and their impact on microflora of dried products; Effect of reconstitution on microbial quality of milk powder including baby foods and survivability of pathogens; Regulatory microbiological standards

Microbiology of Ice Cream and Frozen desserts: Microenvironment in ice cream, microbiological quality of ingredients, critical process factors and their impact on entry of pathogens in ice cream and frozen desserts, their survival during storage, food poisoning out breaks and legal standards.

Microbiology of Indigenous Milk Products: Predominance of spoilage and pathogenic organisms in khoa and khoa based sweets – burfi, peda, gulabjamun, etc., paneer, Chhanna and Chhanna based sweets – rasogulla; kheer, shrikhand, dahi, kulfi etc.; Factors affecting the microbiological quality in reference to production, processing, storage and distribution; Microbial safety in relation to potential pathogens and their public health significance; Microbial defects, control measures and legal standards; Active packaging concepts and role in bio-preservation.

Practical: Microbiological examination of raw, pasteurized, sterilized and UHT cream for Standard plate count (SPC) as well as lipolytic and coliform counts, direct microscopic count (DMC), dye reduction tests and sterility test. Microbiological examination of salted and unsalted butter for SPC, psychrotrophic, lipolytic, coliforms and yeast and mold count; K.Q test. Microbiological examination of concentrated milk for SPC, coliforms, spores, yeast and mold, thermotolerant and thermophilic counts. Microbiological examination of dried milks for SPC, coliforms, *Staph. aureus*, *B. cereus*, *E. coli*, *Salmonella*, Sulphite reducing clostridia and Staphylococcal enterotoxins. Microbiological examination of ice-cream and other frozen desserts for SPC, coliforms and Staphylococcal counts; Detection of *Salmonella* spp./*E. coli*. Microbiological examination of khoa for SPC, coliforms and staphylococcal counts besides yeast and mold counts. Microbiological examination of paneer and shrikhand for SPC, Spores, coliforms, yeast and molds and Staphylococcal counts. Microbiological examination of packaging materials for SPC, Spores and Yeast and mold counts.

4	DT-601	Packaging of Dairy Products	3 (2-0-1)
	Introduction, Importance of Packaging, History of Package Development, Packaging materials, a) Characteristics of basic packaging materials: Paper (paper board, corrugated paper, fibre board), Glass, Metal, Plastics, Foils and laminates, retort pouches, Package forms, Legal requirements of packaging materials and product information. Packaging of milk and dairy products such as pasteurized milk, UHT-sterilized milk, aseptic packaging, fat rich products-ghee and butter, coagulated and desiccated indigenous dairy products and their sweetmeades, concentrated and dried milks including baby foods. Modern Packaging Techniques; Vacuum Packaging, Modified atmosphere packaging (MAP), Eco-friendly packaging, Principles and methods of package sterilization, Coding and Labelling		

	<p>of Food packages, Aseptic Packaging (AP), Scope of AP and pre-requisite conditions for AP, Description of equipments (including aseptic tank) and machines- Micro-processor controlled systems employed for AP, Package conditions and quality assurance aspects of AP, Microbiological aspects of packaging materials. Disposal of waste package materials, Packaging Systems.</p> <p>Practical: Identification of packaging materials, Flame Hot wire test, Testing of papers/paperboards: Percentage moisture, Grease resistance, Water absorptiveness, Grammage, Tearing resistance, Bursting strength. Testing of glass bottle – resistance to thermal shock. Testing of plastics and laminates – Thickness, Water vapour transmission rate (WVTR), Grease resistance. Packaging of different dairy products by using prepak and vacuum packaging machines. Microbiological evaluation of packaging materials (SPC, Y & M, spore count).</p>
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5	FST-406	Food Technology I	3 (2-0-1)
	<p>Status of food processing industries in India and abroad, magnitude and inter- dependence of dairy and food industry, prospects for future growth in India. Harvesting, transportation and storage of fruits and vegetables. Post harvest processing of fruits and vegetables: Peeling, sizing, blanching, Canning of fruits and vegetables, Drying and freezing of fruits and vegetables. Juice processing: General steps in juice processing, role of enzymes in fruit. Juice extraction, equipments and methods of fruit juice extraction, preservation of fruit juices, fruit juice clarification, concentration of fruit juices, fruit juice powders. Fruit juice processing; Orange and tangerine, Lemon and lime juice, Apple juice, Grape juice, Nectars, pulpy juices, tropical blends, Vegetable juices. Manufacture of Jam, Jelly and Marmalade: Role played by pectin, sugar and acid in jellied fruit products. Fruits and vegetable preserves, Glazed, Crystallized fruits. Tomato based products: Juice, puree, paste, sauce, ketchup. Pickles: Principle of pickling, technology of pickles. Beverages: Classification, scope, carbonated non-alcoholic beverages and their manufacture. Fruit beverages and drinks, additives for fruit based beverages. Coffee: Production practices, structure of coffee/cherry, Coffee processing including roasting, grinding, brewing extraction, dehydration, aromatization, instant coffee. Tea: Tea leaf processing, green, red, yellow, instant tea. Technology of confectionery foods: Candies, Chewing gums and bubble gums, Toffees, Caramels, Standards of confectionery products. Chocolate products: Cocoa bean processing, chocolate liquor, Standards of confectionery products. Functional foods: Introduction, Phytochemicals, Milk ingredients as nutraceuticals, fiber-rich food products etc.</p> <p>Practical: Manufacture of toffees and caramels, Testing the efficacy of blanching process, Drying of fruits and vegetables, Preparation of fruit based drinks and beverages: Ready-to-serve drink, Nectar, Squash, Whey-fruit based beverages. Manufacture of fruit jam. Manufacture of fruit jelly. Manufacture of chocolate confections. Manufacture of tomato ketchup/tomato sauce. Manufacture of soups. Manufacture of fruit preserve. Manufacture of candied fruits. Manufacture of fruit bar; Manufacture of pickles</p>		

6	BAM-550	Entrepreneurship Development and Industrial Consultancy	2 (2-0-0)
	Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing		

	<p>skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precis writing summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences. Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalisation and the emerging business / entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to horticulture sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of horti inputs industry. Characteristics of Indian horticultural processing and export industry. Social Responsibility of Business.</p> <p>Practical: Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precis writing, summarizing, abstracting; individual and group presentations.</p>
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7	MAS-512	Operation Research	3 (3-0-0)
	<p>Introduction – Elementary concepts, objectives of operations research, Applications of OR in decision-making. Modeling in Operation Research. Linear Programming: Introduction, mathematical formulation of the problem, Graphical solution, Simplex technique for solving simple LP problems. Inventory Control – Introduction and general notations, Economic lot size models with known demand.</p>		

8	ENVS-417	Environmental Studies	3 (3-0-0)
	<ol style="list-style-type: none"> 1. Definition, Scope and Importance of Environment and Environmental Studies Multidisciplinary Nature of Environmental Studies. 2. Eco-system <ul style="list-style-type: none"> • Concept, structure and function of an ecosystem(Producers, consumers and decomposes) • Introduction, types, characteristics features, structures and function of the following ecosystem: (a) Forest Ecosystem (b) Grassland Ecosystem (c) Desert Ecosystem (d)Aquatic Ecosystem (Ponds, streams, lakes, rivers, oceans, estuaries) 3. Social Issues and the Environment <ul style="list-style-type: none"> • Water conservation, rain water harvesting, Water shed Management, Climate Change, global warming, acid rain, ozone layer depletion, wasteland reclamation • Environment Protection Acts 		

4. Natural Resources

(a) Forest resources (b) Water Resources (c) Mineral Resources (d) Food Resources (e) Energy Resources (f) Land resources, Role of and individual in conservation of natural resources for sustainable life style.

5. Biodiversity and its conservation

Introduction- Definition: genetic, species and ecosystem diversity, bio-geographical classification of India, value of diversity: consumptive use, productive use, social and ethical aesthetic values, Bio-diversity at global, national and local levels, India as mega-diversity nation, Hot-spots of biodiversity, conservation of biodiversity: in-situ and ex-situ conservation of bio-diversity.

6. Environmental pollution

Definition, causes, effects and controlling measures of

(a) Air pollution (b) Water pollution (c) Pollution (d) Noise pollution

Solid waste Management: causes, effect and control measures of urban and industrial wastes

Semester-VII

1	MAS-502	Industrial Statistics	3 (2-0-1)
	<p>Definition and scope; sources of animal husbandry and dairy statistics. Measures of central tendency, Measures of dispersion, Moments, skewness and kurtosis. Elementary notions of probability, Laws of addition and multiplication probability. Theoretical frequency distributions: Binomial, Poisson and Normal distribution and their application. Concepts of sampling methods, Introduction to testing of hypotheses, Tests of significance-Z, t, F tests, and their application in the field of dairying. Analysis of variance- One-Way and two-way classification. Simple correlation coefficient and its test of significance, Linear regression, rank correlation. Basic concepts of statistical quality control, Control charts for variables and attributes, Fundamental concepts of acceptance sampling plan.</p> <p>Practical: Measures of central tendency, Measures of dispersion, Moments, Skewness and Kurtosis Fitting of binomial and Poisson distribution. Application of 'Z' test for one and two sample problems. Application of 't' test for one and two sample problems. Application of Chi-square test and F-test. Correlation and regression. Rank correlation coefficient. Control chart for variables & attributes</p>		
2	DT-509	Dairy Plant Management	2 (1-0-1)
	<p>Production Management: Definition, Function and structure of Production Management, Production planning & Control, Work study and measurement motion and time study. Efficiency of plant operation: product accounting, setting up norms for operational and processing losses for quantity, fat and SNF, monitoring efficiency. Plant Operations: Energy conservation and Auditing, Product and process control, Control charts, Process Sigma, Efficiency factors losses, Financial and Managerial efficiency. Provision for Industrial Legislation in India, particularly in dairy industry, Factory Act & Regulations. Human Resource Management: Personnel Management, Manpower planning, recruitment, training, transfer, promotions policies, Job specifications, Job evaluation, Job enhancement, Job enrichment, MBO, working conditions. Safety hazards: hazards prevention, security for plant machinery and the employees, Plant Maintenance. Prevention & Break-down maintenance: Spare parts inventory, tools & lubricants, etc. Food hygiene: personnel hygiene, plant hygiene, water quality, etc.</p> <p>Practical: Flow process charts of different milk products. Identification of steps of material losses on dairy plants. Identification of hazardous processes and equipments, safety and precautions. Identification and uses of common lubricants.</p>		
3	FST-407	Food Technology- II	3 (2-0-1)
	<p>Cereal grains, legumes and oilseeds: Structure and composition of cereals, legumes and oilseeds, Milling of paddy, quality factors of rice grains, processing of rice bran oil, Instant rice, quick cooking rice, canned rice, Milling technology of wheat, Criteria of wheat flour quality, improvers for wheat flour, Types of wheat flour, Milling technology of maize, wet milling of corn, Milling technology of barley, malting of barley and its utilization in manufacture of value added food products including malted milk foods, Dehulling and processing technology of important pulses, Dehulling and extraction of oil in major oilseed crops like soy bean, mustard, sunflower, ground nut, Vegetable protein</p>		

	<p>concentrates/isolates, Utilization of oil cake in food formulation. Bakery and Snack technology: Technology of bread, biscuits, crackers and cakes, Technology of manufacturing process of Pasta foods- Macaroni, Noodles and Spaghetti, Technology of breakfast cereals: corn flakes, puffed, extruded snacks, Potato chips. Meat, fish and egg technology: Development of meat, poultry, egg and fish industry in India, Pre-slaughter care, handling and ante-mortem inspection of animal, Stunning and slaughtering techniques, Postmortem inspection, rigor mortis and conversion of muscle to meat Slaughterhouse sanitation, meat hygiene and zoonotic diseases, Processing of poultry meat, Egg and egg products – quality assessment of egg, Types, handling, transportation and marketing of fish, Preservation of fish., Manufacturing process of dehydrated fish and fish pickles. Cleaning and sanitation, Waste management of food processing plants.</p> <p>Practical: Manufacture of barley malt. Determination of cooking quality of rice. Manufacture of bread and bun. Manufacture of biscuits. Preparation of noodles. Preparation of cake. Manufacture of potato chips. Preparation of malt based food products. Manufacture of malted milk foods, Manufacture of soy beverage and tofu, Preparation of salami. Preparation of chicken soup. Manufacture of chicken pickle.</p>		
4	DT-510	Waste Disposal & Pollution abatement	2 (1-0-1)
	<p>Wastes discharged from dairy plants: An overview. Wastewater discharged from a) Milk reception dock b) Liquid milk processing section, c) Butter and ghee manufacturing, d) Ice-cream and condensed milk manufacturing, e) Milk powder manufacturing, f) Cheese and paneer manufacturing. Packaging wastes. Environmental issues in effluent discharge: a) Effects on waterways, b) Effects on land c) Effects on the atmosphere d) Solid waste. Waste treatment process in a dairy processing plant: Wastewater treatment options for A Dairy Processing Plant. Calculation of wastes discharged and the economics thereof.</p> <p>Practical: Waste Utilization processes. Various treatments in waste disposal. Analysis of cleaning agents and sanitizers. Reports and records maintenance of dairy plant. Operational precautions. CIP cleaning.</p>		
5	DC-602	Food Chemistry	3 (2-0-1)
	<p>Water: Water binding and chemical reaction mediated by water. Food proteins: Classification and physico-chemical and structural properties. Lipids: Definition, classification of lipids, Unsaponifiable matter contents in various fats and oils, classification and chemical composition. Carbohydrates: Classification of carbohydrates, polysaccharides, viz. linear, branched and modified. Properties and utilization of common polysaccharides, viz. cellulose, glycogen, hemicelluloses, pectin. Food Enzymes: Hydrolases and lipases, utilization in food chemistry. Minerals in foods: Main elements, trace elements in eggs, cereals and cereal products, vegetables and fruits. Aroma compounds in foods: Threshold value, off-flavours. Food additives: Vitamins and Amino acids, Minerals, Aroma Substances/flavour enhancers- Monosodium glutamate, 5-nucleotides sugar substitutes, sorbitol sweeteners- saccharin, and cyclamate, Food colours and food preservatives. Antinutritional factors and Food contaminants: Toxic trace elements, radio nucleotides. Cereal and cereal products: Individual constituents like proteins, lipids, carbohydrates and vitamins in cereals flour and their relationship in dough making, influence of additives</p>		

	<p>/minor ingredients on baking properties: physico-chemical changes during baking. Legumes: Classification, general composition and physico-chemical properties. Vegetables and Fruits: Classification, general composition, chemical changes during ripening and storage. Jams, Jellies and Pickles: Classification, composition and preservation. Preservation of foods, general principles of food preservation.</p> <p>Practical: Determination of the order of hydrolysis of an ester/carbohydrate and measurement of activation energy; determination of the progress curve obtained during the hydrolysis of P-nitrophenyl phosphate by milk alkaline phosphatase; determination of the Michaelis constant for the digestion of casein by trypsin; Measurement of pH and buffering capacity of different types of milk; To study the gel formation and gel stability of milk proteins; preparation of a Tris/phosphate/citrate buffer of a given molarity/ionic strength and pH; determination of pH of the buffer; measuring the stability of an oil-in-water emulsion stabilized by milk proteins; foaming capacity and foam stability of caseins/whey proteins; drawing of an adsorption isotherm of water on casein</p>		
6	DT-511	Energy Conservation and Management	2 (1-0-1)
	<p>Introduction: Potential and opportunities of industrial energy conservation in dairy and food processing. Energy conservation Act 2001 and its important features, Schemes of Bureau of Energy Efficiency (BEE). Electricity Act 2003, Integrated energy policy. Energy management & audit: Definition, energy audit, need, types of energy audit. Energy audit approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution. Energy balances and computation of efficiencies of equipment. Role of Energy inspectors and Auditors in energy management. Electrical load management: Demand management, energy management information systems, Energy saving controllers and cost saving techniques. Quality of power, Power factor and its improvement. Transformers, losses in transformers. Energy savings in transformers. Electric motor-selection and application, Energy efficient motors. Variable Speed Drives and Variable Frequency Drives (VFD) and their role in saving electric energy. Bureau of Energy Efficiency (BEE): Power saving guide with “Star Ratings” of electrical appliances: Induction Motors, Air conditioners, Refrigerators and Water Heaters. Industrial Lighting: Quality of light, types of light sources, energy efficiency, Light controls.</p> <p>Energy efficiency and conservation in utilities:</p> <p>High efficiency boilers, improved combustion techniques for energy conservation, Fluidized Bed Combustion and multi fuel capabilities. Energy conservation in steam distribution systems, efficient piping layouts, protective & insulation coverings in utility pipes. Steam conservation opportunities. Upkeep and maintenance of steam auxiliaries and fittings. Energy conservation in Refrigeration and AC systems (HVAC), Cooling towers, Pumps and pumping systems, Fans, Blowers, Air compressors. Maintenance and upkeep of Vacuum lines and Compressed air pipe lines. Conservation and reuse of water, water auditing. Energy conservation opportunities in Wastewater treatment.</p> <p>Processing equipments: Improving efficiency and energy conservation opportunities in few important food processing operations like Thermal processes, Evaporation, Drying &</p>		

	<p>Freezing. Role of steam traps in energy saving. Energy Savings methods in hot air generator, Thermic fluid heater, Steam radiator.</p> <p>Energy conservation in buildings: Concepts of “Green Buildings”. Waste-heat recovery and thermal energy storage in food processing facilities. Condensate recovery and reuse. Application of recuperator to recover energy from flue gases from boiler, DG exhaust, hot air from spray dryer, FBD etc. Diesel generating sets (stand by AC Gen sets): Energy saving opportunities in DG sets, Fuel and Oil conservation; important regular maintenance aspects. Carbon credits and carbon trade: Concepts of CDM, economic and societal benefits. Cleaner energy sources: Introduction to Solar, and Bio-mass Energy; Solar thermal and photo-voltaic energy options for food processing industries. Role of automation in conservation of energy in dairy and food processing: Incorporation of enhanced PLC based computer controls and SCADA.</p> <p>Practicals:</p> <p>Study of Energy Conservation Act 2001. Study of schemes of BEE. Study of concepts of Energy Balance in Unit Operations and System boundaries. Solving examples on energy balances. Solving problems on electrical energy use and management: Connected load, Maximum demand, Demand factor and Load curve. Determination of Load factor of an installation. Study of use of power factor meter and determination of true power and wattles power using pf meters, Watt meter, Ammeter and Volt meter. Study of performances of a general type of induction motor and an energy efficient induction motor. Study of use of VSD. Study of various types of electrical appliances classified under different BEE Star Ratings. Drawing Energy Balance on a boiler: Collection of data, Analysis of results and determination of efficiency. Exercise on energy audit of Students Experimental Dairy Plant (SEDP-DSc College, Hebbal).</p>		
7	DT-697	STUDENT READY-Experiential Learning Module	10 (0-0-10)

Semester-VIII

Sr.	Course Code	Course Title	Credits
1	DT-698	In-Plant Training	20 (0-0-20)
2	DT-699	Training Report Evaluation	5(0-0-5)