Course Structure of B.Tech. Dairy Technology

Semester-I

S.no.	Course Code	Name of the Course	Credits
1	DC-301	Physical Chemistry of Milk	3 (2+0+2)
2	DT-301	Milk Production Management & Dairy Development	4 (3+0+2)
3	ME-301	Engineering Drawing	2 (0+0+4)
4	ME-304	Workshop Practice & Technology	2 (1+0+2)
5	CE-381	Fluid Mechanics	3 (2+0+2)
6	DM-301	Fundamentals of Microbiology	3 (2+0+2)
7	GPT-301	Moral Value & Education	3(3+0+0)
8	DE-301	Thermodynamics	3 (2+0+2)
		Total	**23**
Deficiency Courses *(to be offered to the students from the Inter Ag. stream)*			
	MAS- 312	Elementary Mathematics	4(3-1-0) NC

Semester-II

1	DT-302	Market Milk	4 (3+0+2)
2	DM-302	Introductory Dairy Microbiology	3 (2+0+2)
3	DE-302	Heat and Mass Transfer	3 (2+0+2)
4	DC-302	Chemistry of Milk	3 (2+0+2)
5	DT-303	Traditional Dairy Products	3 (2+0+2)
6	EE-302	Electrical Engineering	3 (2+0+2)
7	DC-512	Biochemistry & Human Nutrition	3 (2+0+2)
8	MAS-502	Industrial Statistics	3 (2+0+2)
		Total	**25**

Semester-III

1	COMP-407	Computer Programming	3(3+0+2)
2	DT-401	Condensed & Dried Milks	5 (3+0+4)
3	DT-402	Fat Rich Dairy Products	4 (3+0+2)
4	DE-401	Refrigeration and Air Conditioning	4 (3+0+2)
5	DE-402	Dairy Engineering	4 (3+0+2)
6	ECON-502	Economic Analysis	3 (3+0+0)
7	EXT-301	Dairy Extension Education	3 (2+0+2)
		Total	**26**

Semester-IV

1	DT-501	Cheese Technology	5 (3+0+4)
2	DT-502	Ice-Cream & Frozen Deserts	4 (2+0+4)
3	DT-504	Judging of Dairy Products	3 (2+0+2)
4	DM-401	Starter Culture and Fermented Milk Products	3 (2+0+2)
5	DE-403	Dairy Process Engineering	3 (2+0+2)
6	BAM-501	Marketing Management & International Trade	2 (2+0+0)
7	DT-509	Dairy Plant Management & Pollution Control	3 (1+0+1)
8	MCE- 304	Dairy Biotechnology	3 (2+0+2)
		Total	**26**

Semester-V

1	COMP-309	IT in Dairy Industry	2 (1+0+2)
2	*DC-501*	Quality and Safety monitoring in Dairy Industry	3 (2+0+2)
3	DT-503	By Products Technology	4 (3+0+2)
4	DE-501	Instrumentation & Process Control	3 (2+0+2)
5	BAM-428	Financial Management & Cost Accounting	3 (2+0+2)
6	DE-502	Dairy Plant Design and Layout	3 (2+0+2)
7	DC-502	Chemical Quality Assurance	3 (2+0+2)
8	DE-503	Principles of Dairy Machine Design	3 (2+0+2)
9	ENVS-415	Environmental Sciences- I	2 (2+0+0)
		Total	**26**

Semester-VI

1	DE-601	Food Engineering	4 (3+0+2)
2	DC-601	Food Chemistry	3 (2+0+2)
3	DM-501	Food and Industrial Microbiology	3 (2+0+2)
4	DT-601	Packaging of Dairy Products	3 (2+0+2)
5	FST-406	Food Technology	4 (3+0+2)
6	BAM-550	Entrepreneurship Development and Industrial Consultancy	2 (2+0+0)
7	MAS-512	Operation Research	3 (3+0+0)
8	ENVS-416	Environmental Sciences- II	2 (2+0+0)
		Total	**24**

VII Semester

Hands - on training and experiential learning: The student will undergo campus training in various departments of college or off campus training in other College of Dairy Technology, where facility of hand-on training is available.

Sr.	Course Code	Course Title	Credits
1	DT-697	Hands-on training and experiential learning	25 (0+0+50)
		Total	**25**

During Hands-on-Training and Experiential Learning, students should prepare a business plan/entrepreneurship for production of dairy products in the area of specialized processing from procurement of raw material to processing including packaging and storage, conduct manufacturing, organize resources and utilities, sell the product, maintain accounts and documents, wind up production and submit the report of performance. All the students will be provided with an advisor who will guide the students in "Hands on training". Twenty five credits are allotted for Hands on training. The evaluation of the "Hand on training" will be conducted by the Committee appointed by the Dean.

Evaluation of Hands on Training (25 Credits): It is recommended that student undergoing Hands-on training be evaluated as per following plan:

Sr.	Activity	Credits
1	**Preparation of Business Plan** i. Selection of product to be manufactured ii. Innovativeness iii. Creativity iv. Realistic plan v .Overall project report and project presentation	6
2	**Organizing the Production** i Organization of resources ii Organizing Utility iii Time management	3
3	**Production and Sales** i. Regularity in production ii. Product quality iii. Positioning of product in market iv. Evaluation of presentation v. Adhering to rules and regulations vi. Adhering to plan	5
4	**Sales**	3

	i. Sales performance ii. Sales volumes iii. Profit generated including C/B ratio, and pay back period, etc.	
5	**Documentation and Reports** i. Book keeping ii. People Management iii. Preparation of manual iv. Preparation of final report	3
6	**Oral Examination** i. Presentation ii. Oral performance	5

VIII Semester: In-plant training in Commercial Dairy plants

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Sr.	Course Code	Course Title	Credits
1	DT-698	In-Plant Training	20 (0+0+40)
2	DT-699	Training Report Evaluation	5(0+0+10)
		Total	25

Total Credits

1. Course credit up to VI semester 138
2. Hands on Training (VII semester) 25
3. In-plant Training and Report Evaluation (VIII semester) 25

Syllabus of B.Tech. Dairy Technology

Semester-I

1	DC-301	Physical Chemistry of Milk	3 (2+0+2)

Constituents and gross composition of milk of different species and breeds of milch animals, Colloidal State: Distinction between true and colloidal solution, lypophilie & lypophobic 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, pyknometer 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, Raoults 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, Kohlrawsch 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 it 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 electro magnetic radiation, the laws of Lambert and Beer, visible, and ultra-violet Spectroscope. Mention of mass, NMR spectroscopy.

Practical: Determination of density and specific gravity of milk using pyknometer, 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.

2	DT-301	Milk Production Management & Dairy Development	4 (3+0+2)

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 air; 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.

Practical: Handling and restraining of dairy animals. External body parts and judging of cows and buffaloes. Feeding and management practices of claves. 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.

3	**ME-301**	**Engineering Drawing**	**2 (0+0+4)**
	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 vivet heads, types of riveted joints, failure of riveted joints. 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**	**2 (1+0+2)**
	Simple exercises on wood working tolls 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-381**	**Fluid Mechanics**	**3 (2+0+2)**
	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 notchs, 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.		

	Practical: Study of different tools and fittings. To plot flow rate versus pressure drop with Utube manometer. Verification of Bernoulli's theorm. Determination of discharge co-efficient for venturi, Orifice, V-Notch. Verification of emptying time formula for a tank. Determination of critical Reynold's number by Reynold' 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.		
6	**DM-301**	**Fundamentals of Microbiology**	**3 (2+0+2)**
	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 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. **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 violate; 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).		
7	**GPT-301**	**Moral &Value Education**	**2(2+0+0)**
	My country and my people, the many Indians, Being and becoming and 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, Patters 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- mans 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)		
8	**DE-301**	**Thermodynamics**	**3 (2+0+2)**
	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. **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, Babcok & 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.		
	Deficiency Courses *(to be offered to the students from the Inter Ag. stream)*		
	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. **Trigonometry:** Complex numbers, De Meoivere's theorem and its simple application. **Coordinate geometry:** Equation of standard curves and their identification. Differentiation tangents and normals, maxima & minima. **Integral calculus:** definite integrals, standard methods of integrations, Applications of integral calculus to are enclosed by curve, length of arc, volume and surface of revolution. **Vector analysis:** Scalars and vectors, sum and difference of vectors, dot and cross products.

Semester-II

1	DT-302	Market Milk	4 (3+0+2)

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) Microbio- logical 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, F_0 value, Q_{10} 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, thermdzes, 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 aspectes 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 hygience. 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.

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.

2	DM-302	Introductory Dairy Microbiology	3 (2+0+2)
	Hygienic milk production system; microbial quality of milk produced under organized v/s unorganized milk sector in India and comparison with developed countries; microbial and non microbial contaminants, their sources and entry points in milk during various stages of production; Good Hygiene Practices (GHP) during milk production operations Microorganisms associated with raw milk; morphological and biochemical characteristics of important groups and their classification; significance of different groups of bacteria i.e. psychrotrophs, mesophiles, thermodurics, and thermophiles in milk. Microbiological changes in bulk refrigerated raw milk; Impact of various stages like milking, chilling, storage and transportation on microbial quality of milk with special reference to psychrotrophic organisms; Direct and indirect rapid technique for assessment of microbial quality of milk. Role of microorganisms in spoilage of milk; souring, curdling, bitty cream, proteolysis, lipolysis; abnormal flavors and discoloration. Mastitis milk: Processing and public health significance, organisms causing mastitis, somatic cells secreted in milk; detection of somatic cell count (SCC) and organisms causing mastitis in milk. Milk as a vehicle of pathogens; Food infection, intoxication and toxic infection caused by milk borne pathogens like E. coli, Salmonella typhi, Staph aureus, Bacillus cereus etc. Antimicrobial substances in milk: immunoglobulin, lactoferin, lysozymes, LP systems etc. Practical: Morphological examination of common dairy organism (size and shape, arrangement and sporulation). Enumeration of psychrotophic, thermophilic, thermoduric and spore forming bacteria in 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 discoloration. Detection of mastits milks, pH, SLST, somatic cell count, chloride content, Hotis test, CAMP test. Detection and estimation of coliforms; presumptive test, rapid coliform count, IMVIC test. Detection of important pathogens using selective media; E.coli, Staphylococcus aureus Salmonella and Bacillus cereus. Estimation of microbial load in milk by SPC and Dye reduction tests-(MBRT, RRT). Detection of antibiotic residues using qualitative test		
3	**DE-302**	**Heat and Mass Transfer**	**3 (2+0+2)**
	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 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. Equimolal diffusion. Mass transfer co-efficient and problems on mass transfer. **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 Jacketted 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.		
4	**DC-302**	**Chemistry of Milk**	**3 (2+0+2)**
	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: - Lactalbumin and - Lactoglobuline. Properties of -Lactalbumin and lactoglobulin, Immmunoglobulin 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. **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 Kjeldahal method. Determination of casein, whey proteins and NPN in milk. Estimation of alkaline 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	**DT-303**	**Traditional Dairy Products**	**3 (2+0+2)**
	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. Chhana-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. Srikhand: Chakka-product description, standards method of manufacture, small scale and industrial, packaging and preservation aspects. Shrikhand-save 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. **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 chhana 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 srikhand. Preparation of khoa and chhana based sweets. Microbiological examinations of traditional dairy products: Khoa, paneer, spore counts, coliform counts yeast, molds counts etc. Field trip		
6	**EEE-303**	**Electrical Engineering**	**3 (2+0+2)**
	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 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 (iii) 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.		
7	**DC-512**	**Biochemistry & Human Nutrition**	**3 (2+0+2)**
	Biochemistry: Enzymes Ribozymes, isozymes, allosteric enzymes, zymogens, regulatory, Classification and mechanism of enzyme action, Factors affecting rate of enzyme catalyzed reaction, enzyme inhibition, Enzymes coenzymes and co-factors immobliation of enzymes, Nucleic acids and Bioenergetics : Structure and function, definition and composition. Structure of RNA & DNA-Anabolism and Catabolism of carbohydrates, lipids and proteins. Vitamins and Hormones : Structure & functions, general description. Relationship between vitamins and hormones in terms of their biological role. Elementary knowledge of milk synthesis in mammary gland. **Human nutrition:** Theory and definition, Scope of Nutrition : Functions of the various nutrients in body. Digestion, absorption and assimilation of nutrients. Comparative requirements and nutritional requirement of different age groups. (WHO and ICMR standard) Methods of evaluation of nutritive value of foods Nutritional value of cow, buffalo and human milk. Milk intolerance: lactose deficiency and protein hyper sensitivity. Safety aspects of food additives, toxic elements, radionuclides, pesticides and antibiotic residues in milk and milk products. Institutional feeding of workers. Planning and implementation of national food and nutrition policies and programme. Regulatory aspects of nutrition, IDF code on nutrition, nutrition facts under NLEA, Nutrient descriptors, serving size and nutritional claims.		

	Practical: Biochemistry Estimation of alkaline phosphatase and the effect of temperature and pH on its activity. Estimation of catalases and the effect of temperature and pH on its activity. Determination of the Michealis constant of an enzyme. Estimation of RNA by colorimetric method Estimation of DNA by colorimetric method. Measurement of proteolysis. Lipolysis, Amylase activity. Estimation of vitamin 'A; in ghee. Estimation of ascorbic acid in milk. Estimation of vitamin D in milk. Estimation of proteins by Lowry's method. Buret method. Estimation of Lipids and Lipids analysis by TLC. Estimations of cholesterol in milk. Estimation of denaturation of proteins in heated milk by dye binding method. Estimation of HMF content in food.		
8	**MAS-502**	**Industrial Statistics**	**3 (2+0+2)**
	Definition and scope; sources of animal husbandry and dairy statistic. Measures of central tendency, Measures of dispersion, Mome skewness and kurtosis. Elementary notions of probability, Laws of addition and multiplication probability. Theoretical frequency distributions : Binomial distributions and applications, Poisson distribution and is applications, Nor distribution and its applications. Concepts of sampling methods- Simple random sampling, stratifyrandom sampling, cluster sampling, systematic sampling. Introduction to testing of hypotheses, Tests of significance-Z, t_2, a, 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, Line regression, rank correlation. Basic concepts of statistical quality control, Control charts for variables and attributes, Fundamental concepts of acceptance sampling plan. **Practical :** Measures of central tendency. Measures of dispersion, Moments. Skewness and Kurtosis Filling of bionomical and Poisson distribution. Selection of random sample. 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 chal for variables & attributes.		

Semester-III

1	**COMP-407**	**Computer Programming**	**2(1+0+2)**
	Problem solving with computers, flowchart and algorithm development, Data types variables, constants, arithmetic and logical expressions, input/output statements, conditional statements, control structures, arrays, functions, structures, unions. **Practical :** Understand different Components of Computer System. Write a C program to calculate volume of a prism having trapezoidal base. Write a program, which can input a positive integer (<=10000000) and print it in reverse order. For example 9875674 to 4765789. Write a program to calculate sum of squares of all odd integers between 17 to 335. Exclude integers divisible by 7. Ohm's law is I=V/R, Write a program to calculate I from given n sets of V and R. Write a program e to generate the Cartesian coordinates of points (x,y for the values of ranging from 0,5,10,15 -------- 90. title and label the output. Write a program to calculate the resultant focal length f, when f1 and f2 are placed in contact. Used formula is f= (f1+f2)/(f1xfx). Compute for following pairs of local lengths. f1= 10,-8,-6,-1 …….. +8, +10; f2= 0.5,-0.4, …… +0.4, +0.5 Write a program to sort an array of N elements in ascending order. Write a program to evaluate following series to calculate cos x Cosx= 1x2/2+x4/4+x6/6+ ……. Compare the calculated value with the one by using library function. Write a program which reads in indefinite number of Name, Marks1, Marks2, Marks3 from keyboard and store them in a file along with total marks, Percentage marks and Grade in a file.		
2	**DT-401**	**Condensed & Dried Milks**	**5 (3+0+4)**
	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.		

	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.		
3	**DT-402**	**Fat Rich Dairy Products**	**4 (3+0+2)**
	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 loses 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. **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.		

4	DE-401	Refrigeration and Air Conditioning	3 (2+0+2)
	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 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. **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.		
5	**DE-402**	**Dairy Engineering**	**3 (2+0+2)**
	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, 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. **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.	
6	**ECON-502**	**Economic Analysis**	**2 (2+0+0)**
	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.		

7	EXT-301	Dairy Extension Education	2 (1+0+2)
	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.	

Semester-IV

1	**DT-501**	**Cheese Technology**	**5 (3+0+4)**
	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. **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.	
2	**DT-502**	**Ice-Cream & Frozen Deserts**	**4 (2+0+4)**
	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. **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.		
3	**DM-401**	**Starter Culture and Fermented Milk Products**	**3 (2+0+2)**
	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 Bugarian milk, cultured buttermilk, Leben and Yakult; their significance. Concept of probiotic starters and their application in probiotic dairy food. **Practical:** Testing for purity of starter cultures; gram's staining, catalase test; creatine test. Starter activity tests: die reduction tests, Horrall-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 B. stearothermophilus and S. thermophilus 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 verities of cheese- such as Cheddar cheese.		
4	**DE-403**	**Dairy Process Engineering**	**3 (2+0+2)**
	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 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. **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 Vaccum pan. Visit to a milk product plant.	
5	**BAM-501**	**Marketing Management & International Trade**	**2 (2+0+0)**
	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)		

6	DT-509	Dairy Plant Management & Pollution Control	2 (1+0+1)
	Production Management. Definition, Function and structure of Production Management, Production planning & Control, Work study and measurement moiton and time study, Plant Operations. Efficiency factors losses, Financial and Managerial efficiency Provision for Industrial Legislation in India, Particularly in dairy industry, Personal 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. Cleaning and Sanitation – different type of cleaning and sanitizing agents, Effluent treatment: Type, degree and treatment of waste. **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. Identication and uses of common lubricants. 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.		
7	**MCE-304**	**Dairy Biotechnology**	**3 (2+0+2)**
	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. **Practical:** Isolation of plasmid and genomic DNA from bacteria (E. coil, lactic acid bacteria Agarose gel electroporesis of DNA fragments). Restriction analysis of DNA. During of plasmids. Preparation of competent cell. Conjugal transfer in E. coli cells. Transformation of E. coli by calcium chloride treatment/ electro oration. Preparation of protoplasts and protoplast fusion. PCR technique demonstration. Visit to a biotechnology lab.		
8	**ENV-417**	**Environmental Studies**	**3 (3+0+0)**
	1. Definition, Scope and Importance of Environment and Environmental Studies Multidisciplinary Nature of Environmental Studies. 2. Eco-system • 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 • 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 conversation of natural resources for sustainable life style. 5. Biodiversity and its conservation Introduction- Definition: genetic, species and ecosystem diversity, bio-geographical classification of India, vale of diversity: consumptive use, productive use, social and ethical aesthetic values, Bio-diversity at global, nationa and local levels, India as mega-diversity nation, Hot-spots of biodiversity, conservation of biodiversity:in-situ and ex-city conversation 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-V

1	**COMP-309**	**IT in Dairy Industry**	**2 (1+0+2)**
	Importance of Computerization and IT in dairy industries. Computers, Operating. Environments and Information Systems for various types of dairy Industries, Principles of communication. Role of Computer in Optimization; Introduction to Operation. Research. A Computer Oriented Algorithmic approach: Queuing systems and waiting models, PERT CPS and CPM. Dairy Process Modeling and Simulation. Introduction to SCADA & INTELUTION. CAD and CAM in Dairy Industries : Instrumentation, Process control, Inventory control, Automation, Robotics, Expert Systems and Artificial Intelligence, Instrumentation. **Practical:** Applications of MS Excel to solve the problems of dairy technology: Statistical quality control, Sensory evaluation of food. Chemical kinetics in dairy processing. Use of word processing software for creating reports and presentation. Familiarization with the application of computer in dairy industries : Milk plant, Dairy units, Fruit & Vegetable processing unit. Familiarization with software related to dairy industry. Visit to Industry and knowledge of computer application in the same.		
2	**DC-501**	**Quality and Safety monitoring in Dairy Industry**	**3 (2+0+2)**
	Current awareness on quality and safety of dairy foods; consumer awareness and their demands for safe foods; role of codex alimentarious 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. **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 becteria in dairy products: Staphylococus 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.		
3	**DT-503**	**By Products Technology**	**4 (3+0+2)**
	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) Cooprecipitates: 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 concentratesb) Functional properties and food applications of WPC. Lactose: methods for the industrial production of lactose, refining of 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. **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.		
4	**DE-501**	**Instrumentation & Process Control**	**3 (2+0+2)**
	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. **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.		
5	**BAM-428**	**Financial Management & Cost Accounting**	**3 (2+0+2)**
	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 cash flow statements in financial decision making. Financial Analysis : Nature and uses of financial analysis, Liquidity ratios, Leveratge 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. **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		
6	**DE-502**	**Dairy Plant Design and Layout**	**3 (2+0+2)**
	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. Ventilation, fly control, mold prevention, illumination in dairy plants. **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.		
7	**DC-502**	**Chemical Quality Assurance**	**3 (2+0+2)**
	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 contaminates such as pesticides, antibiotics, heavy metals in dairy products: methods of estimation. Soft and hard water, temporary and permanent hardness, softening of hard water. **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.	
8	**DE-503**	**Principles of Dairy Machine Design**	**3 (2+0+2)**
	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. **Practical:** Engineering Statics & Dynamics. Work and Energy. Linear and Angular Momentum. Stress-strain diagram evaluation of elastic constants. Power transmission. Shear force and bending moment diagrams. Flexural stresses. Shearing stresses in Beans. Fits and tolerances. Design stresses in elementary machine parts. Design of shafts, axles keys Springs, Couplings, Bearing		

Semester-VI

1	**DE-601**	**Food Engineering**	**4 (3+0+2)**
	Rheology of processed food, properties of fluid foods, Rheological method, Measurement of rhelogical parameters, properties of granular food and powders, Properties of solids foods, Visco-clastic models. Measurement o 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, Balanching, Dehulling, Size reduction and distillation. **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.		
2	**DC-601**	**Food Chemistry**	**3 (2+0+2)**
	Water: Water binding and chemical reactions mediated by water. Food Proteins: Classification, physico-chemical properties, Reaction involved in processing, Reactions with alkali, Enzyme catelysed reactions involving hydrolysis and proteolysis, Theories of formation of texturised proteins. Lipid : Reactions involved during deep frying of food viz., autoxidation of saturated acyl lipids and polymerization. Lipoprotein and membrane; definition, classification and involvement in the formation of biological membranes. Unsaponifiable matter contents in various fats and oils. Edible fats and oils, classification and chemical composition. Carbohydrates: Legumes, jellies polysaccharide viz. linear, branched and modified. Properties and utilization of common polysaccharides, viz. cellulose, glycogen, hemicellulose and pectin. Enzymatic degradation of polysaccharides, viz. agar, alginate. Carrangeenan, gums and starch. Production of dextrans and malto dextran. Food Enzymes: Hydrolases and lipases, utilization in food industry, effect of inihibitors, pH and temperature. Minerals in foods: Main Elements, trace elements in eggs, cereal and cereal products, vegetables and fruits. Aroma compounds in foods: Threshold value, off flavours. Food additives: Vitamins, amino acids, minerals. Aroma substance flavour enhancers-monosodium glutamate, nucleotides. Sugar substitutes, sorbitol. Sweeteners-saccharin, cyclamate. Food colours. Anti-nutritional factors and Food contanimant : Toxic-trace elements, radio nuclides. Cereals and cereal products: Individual constituents, like proteins, lipids, carbohydrates and vitamins in cereals flour and their relationship in dough making. Type of flours, bread making and non-bread making: chemical composition, influence of additives/minor ingredients on baking		

	properties. Physical, chemical changes during baking. Legumes : Classification 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. Beverages: Classification, Coffee, Tea and Cocoa-gradation, composition, chemical changes during processing, volatile compounds. Preservation of Foods: General principles of food preservation, chemical preservation, preservation through irradiation. **Practical:** Determination of moisture, acidity and gluten content in flour. Determination of total ash and acid insoluble ash in flour. Determination of starch in flour. Determination of total nitrogen in cereal products. Determination of acidity and vitamin C in citrus fruits. Analysis of tomato ketchup for total solids, acidity, ash and salt. Determination of total sugar in tomato ketchup. Determination of total ash and alkalinity of soluble ash in tea. Determination of water extractive in tea leaves. Determination of presence of Chicory in coffee powder. Determination of reducing sugars in Jam. Determination of iron in infant foods.		
3	**DM-501**	**Food and Industrial Microbiology**	**3 (2+0+2)**
	Food Microbiology: Basic aspects and scope of food microbiology. Intrinsic and extrinsic factors that affect microbial growth in foods. Microbial spoilage of fruits, fruit juices, vegetables, cereals, meat, poultry, sea foods, carbonated soft drinks, canned foods; control of spoilage. Food preservation : physical methods; chemical preservatives and natural antimicrobial compounds, biology based preservation system. Industrial Microbiology: Fermentation processes: the range, components and types (submerged, surface and solid state fermentation): criteria for selection of industrially important microorganisms; media for industrial and inoculums development; down stream processing of fermentated products. Fermenters: types, functions, design and control; chemostat and turbidostat. Microorganism and processes involved in the production of industrial alcohol, organic acids (citric lactic), enzymes (protease, lipase and rennet), vitamin (B-12), antibiotic (nisin) and microbiology of effluent treatment in food industry. **Practical:** Microbiological examination of: fresh and canned fruits/ vegetables/ juices; flour and bread, eggs and meat. Design and control of a tabletop and 10 liter lab fermenter (Demonstration). Isolation of psychrophile, salt and sugar tolerant microorganisms from foods. Isolation of industrially important microorganisms from environment. Production and assaying of microbial enzymes (protease/ lipase). Production of lactic acid from whey. Production of nisin and assaying the antimicrobial activity of the culture. Production of ethyl alcohol from molasses and whey by yeasts. Production of fermented whey beverages. Educational tour to food processing/ fermentation industries.		

4	DT-504	Judging of Dairy Products	3 (2+0+2)

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, due-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 gradidng 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 arid 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.

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 or 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 wid chhana based sweets. Judging of dahi and fermented dairy products.

5	DT-601	Packaging of Dairy Products	3 (2+0+2)
	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 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. **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).		

6	FST-406	Food Technology	4 (3+0+2)
	Status of food industry in India and abroad, magnitude and interdependence of dairy and food industry. Prospects for future growth in India. Cereal grains, legumes and oilseeds: Structure of kernel of wheat, barley, rice, com, soybean, oats, *rye.* *Dry* milling of cereal grains, legumes. Wet milling of cereal grains, legumes. Manufacture of breakfast cereals. *Bakery* products: Breads, biscuits, crackers and cakes. Soy milk. Peanut milk: Miltone (flavoured, pasteurized) Vegetable protein isolate/concentrates: technology. Malting operation: Selection of barley. Manufacture of malted milk - vacuum tray drying and spray drying processes. Vegetable, fruit and juice. Structural properties of vegetables and fruits. Harvesting and pre-processing considerations. Post-harvest processing: Washing, skin removal, cutting and trimming, blanching, canning, freezing, dehydration. Fruit processing: Freezing, blanching, ascorbic acid dip, S02 dip, sugar syrup preservation, vacuum dehydration, concentration and drying. Juice processing: Orange and Tangerine juices, Grape fruit juice, Lemon and lime juices, Pineapple juice, Apple juice, Grape juice, Miscellaneous fruit juices, tropical fruit beverages.		

	Nectars, pulpy juices, tropical blends. Tomato juice and tomato juice blends. Vegetable juices. Jams, jellies and fruit preserves. Beverage: Classification, scope, carbonated, non-alcoholic beverages manufacture. Coffee: production practices, structure of coffee / chicory. Coffee processing: Roasting, grinding, brewing, extraction, dehydration, aromatization, instant coffee. Chocolate products, Cocoa bean processing, chocolate liquor. Cocoa butter, chocolate manufacture. Manufacture of chocolate confections. Confectioneries, Toffees, Caramels **Practicals :**Production of soy milk. Production of peanut butter. Preparation of toffees and caramels. Preparation of fruit juices: Orange juice. Pineapple juice, Apple juice. Preparation of fruit jam, Preparation of fruit jellies/sugar preserves. Preparation of chocolate confections. Visit to food factory		
7	**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 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. **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.		

8	MAS-512	Operation Research	2 (2+0+0)
	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.		

VII Semester

Hands - on training and experiential learning: The student will undergo campus training in various departments of college or off campus training in other College of Dairy Technology, where facility of hand-on training is available.

Sr.	Course Code	Course Title	Credits
1	DT-697	Hands-on training and experiential learning	25 (0+0+50)
		Total	**25**

During Hands-on-Training and Experiential Learning, students should prepare a business plan/entrepreneurship for production of dairy products in the area of specialized processing from procurement of raw material to processing including packaging and storage, conduct manufacturing, organize resources and utilities, sell the product, maintain accounts and documents, wind up production and submit the report of performance. All the students will be provided with an advisor who will guide the students in "Hands on training". Twenty five credits are allotted for Hands on training. The evaluation of the "Hand on training" will be conducted by the Committee appointed by the Dean.

Evaluation of Hands on Training (25 Credits): It is recommended that student undergoing Hands-on training be evaluated as per following plan:

Sr.	Activity	Credits
1	**Preparation of Business Plan** i. Selection of product to be manufactured ii. Innovativeness iii. Creativity iv. Realistic plan v .Overall project report and project presentation	6
2	**Organizing the Production** i Organization of resources ii Organizing Utility iii Time management	3
3	**Production and Sales** i. Regularity in production ii. Product quality iii. Positioning of product in market iv. Evaluation of presentation v. Adhering to rules and regulations vi. Adhering to plan	5
4	**Sales** i. Sales performance ii. Sales volumes iii. Profit generated including C/B ratio, and pay back period, etc.	3

5	**Documentation and Reports** i. Book keeping ii. People Management iii. Preparation of manual iv. Preparation of final report	3
6	**Oral Examination** i. Presentation ii. Oral performance	5

VIII Semester: In-plant training in Commercial Dairy plants

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Sr.	Course Code	Course Title	Credits
1	DT-698	In-Plant Training	20 (0+0+40)
2	DT-699	Training Report Evaluation	5(0+0+10)
		Total	25

Total Credits

1. Course credit up to VI semester 138
2. Hands on Training (VII semester) 25
3. In-plant Training and Report and Evaluation (VIII semester) 25

Course Structure of B.Sc. Food Technology

Semester-I

S.No.	Course Code	Name of the Course	Credits
1	ME-301	Engineering Drawing	2 (0-0-2)
2	ME-304	Workshop Practice & Technology	2 (0-0-2)
3	BAM-401	Cooperation Marketing & Finance	3 (2-0-1)
4	EEE-303	Electrical Engineering	3(2-0-1)
5	DM-301	Fundamentals of Microbiology	3 (2-0-1)
6	ECON-331	Principles of Economics	2(2-0-0)
7	GPT-301	Moral Value & Education	2(2-0-0)
8	*BIOL - 201*	*Elementary Biology (Deficiency course- PCM Group)**	*3 (3-0-0)*
	MAS – 312	*Elementary Mathematics (Deficiency course -Ag. & Bio group)**	*3 (3-0-0)*
		Total	**20**

Semester-II

1	CHEM-563	Food Chemistry	4(3-0-1)
2	APFE - 302	Principles of Food Processing & Preservation	3 (2-0-1)
3	FST-304	Post Harvest Management of Fruits & Vegetable	3 (2-0-1)
4	DT-304	Milk & Milk Processing	3 (2-0-1)
5	FST-305	Food Microbiology	3 (2-0-1)
6	DC-512	Biochemistry & Human Nutrition	3 (2-0-1)
7	COMP-410	Computer And Languages	4(2-0-2)
		Total	**23**

Semester-III

1	DE-401	Refrigeration and Air Conditioning	3 (2-0-1)
2	DT-401	Condensed & Dried Milks	5 (3-0-2)
3	ME-503	Heat and Mass Transfer	4 (3-0-1)
4	MBGE – 455	Food Bio-technology	3(3-0-0)
5	MAS-410	Applied Mathematics	4(3-1-0)
6	APFE -410	Principles of Food Quality & Safety	3(3-0-0)
7	MAS - 511	Statistical Methods	3(2-0-1)
		Total	**25**

Semester-IV

1	DT-304	Fat Rich & Traditional Dairy Products	3 (2-0-1)
2	FST-509	Sensory evaluation of food Products	3 (2-0-1)
3	FST-401	Cereal Processing	3 (2-0-1)
4	FST-403	Fermentation & Industrial Microbiology	3 (2-0-1)
5	FST-508	Legumes & oilseed technology	3 (2-0-1)
6	ENV-417	Environmental Studies	3(3-0-0)
7	BAM-501	Marketing Management & International Trade	2 (2-0-0)
8	FST-515	Quality Assurance and Certification	2 (2-0-0)
		Total	**22**

Semester-V

1	COMP-	IT Application in Food Industry	2 (1-0-1)
2	FST-504	Techniques in Food Analysis	3 (2-0-1)
3	FST-513	Specialty Foods	3 (2-0-1)
4	FST-506	Food Industry Byproducts & Waste Utilization	3 (2-0-1)
5	FST-507	Food Safety and Microbial Standards.	3 (2-0-1)
6	APFE-409	Processing of Marine Products	2 (2-0-0)
7	APFE-611	Food Packaging Technology	3 (2-0-1)
		Total	**19**

Semester-VI

1	DE-601	Food Engineering	4 (3-0-1)
2	ABM-402	Agri-Business Management	3 (3-0-0)
3	APFE-614	Food Laws and Legislation	2 (2-0-0)
4	APFE-605	Baking & Confectionary Technology	3 (2-0-1)
5	APFE-503	Technology of Meat and Poultry Products	3 (3-0-0)
6	APFE-506	Fruits and Vegetable Processing	3 (2-0-1)
7	APFE-515	Food Additives	2 (2-0-0)
		Total	**20**

Semester-VII

1	APFE-616	Processing of Spices and Plantation Crops	3(2-0-1)
2	BAM-502	Entrepreneurship Development and Communication Skill	2(1-0-1)
3	FST-512	Product Development and Formulation	3(2-0-1)
4	FST-514	Food Production Trends and Programs	2(2-0-0)
5	FST-516	Food Plant Design And Layout	3(2-0-1)
6	APFE-604	Extrusion technology	3(2-0-1)
7	APFE-507	Quality control in food industry	3(2-0-1)
8	APFE-509	Fermented Food Products	3(2-0-1)
9	FST-517	Seminar	1(0-0-1)
		Total	**23**

Semester-VIII

1	FST-518	Industrial Training	**30**

Eligibility: Inter(PCM)/(PCB)/(Ag.)

SYLLABUS OF B.SC. FOOD TECHNOLOGY

Semester I

1	**ME-301**	**Engineering Drawing**	**2 (0-0-2)**
	Introduction to the engineering drawing, machine drawing, conventional lines and breaks. Drawing section symbols of various materials Projection, principal planes, orthographic projection, a brief introduction to oblique, perspective and isometric views **Practicals** 1. Drawing elevation, side and plane of simple objects/machine parts to scale in both 1st angle projection and 3rd angle projection systems. 4 2. Drawing sectional views of various machine parts such as pulleys, bearings keys and couplings, pipe joint, etc. From given pictorial/isometric views. 4 3. Fastening, temporary and permanent. Helix, screw threads-various forms. 3 4. Multiple start screw threads rivets and riveted joints. 3 5. Drawing an isometric view. 2 6. Exercise on development of surfaces 2 7. Preparation of working drawing of a simple machine part. 2		
2	ME-304	Workshop Practice & Technology	2 (0-0-2)
	Introduction to workshop practice, safety, care and precautions in workshop. Wood working tools and their use, carpentry and pattern making, mould material and their applications. Heat treatment processes: hardening, tempering, annealing, normalizing etc. metal cutting. Soldering & brazing; electric arc welding, gas welding. Smithy and forging operations, tools and equipment. The bench: flat surface filing, chipping, scraping, marking out, drilling and screwing. Use of jigs and fixtures in production. Introduction to: (a) lathe; (b) milling machine; (c) shaper and planer; (d) drilling and boring machines; (e) grinder. Introduction to the engineering drawing, machine drawing, conventional lines and breaks. Drawing section symbols of various materials. Projection, principal planes, orthographic projection, a brief introduction to oblique, perspective and isometric views. **Practicals** 1. Filing, fitting, chipping and hack sawing 2 2. Chiseling, tapping and smithy practice. 2 3. Simple exercises in arc, gas and argon welding. 4 4. Simple exercises in soldering and brazing 2 5. Basic joints in carpentry 2		
3	**BAM-401**	**Cooperation Marketing & Finance**	**3 (2-0-1)**
	Co-operation–philosophy and principles: History of Indian Co-operative movement, Cooperative credit structures in regional level and their study and singly window systems. Marketing – importance in economic development. Classification of Markets, Marketing functions, Market		

	functionaries. Marketable and Marketed surplus, Marketing costs, margins and price spread, problems in marketing of agricultural commodities – perishables, grains, oilseeds and processed foods. Remedial measures for problems in Agricultural marketing. Agricultural marketing institutions, Regulated markets, Co-operative marketing societies, MARKFED, NAFED, Ware Housing Corporation, Food Corporation of India, Nature of agricultural product prices, Agricultural price policy and need for price stabilization. Methods of fixation of MSP for agricultural commodities. Commission on agricultural costs and prices. Finance–nature and scope: Credit – meaning, definition and classification. Credit analysis and repayment plans. History of financing Agriculture in India. Commercial banks – Nationalization of Commercial banks, Lead Bank scheme, Regional Rural Banks, Scale of finance, Higher financing agencies – RBI, NABARD, AFC, ADB, World Bank. Insurance and credit guarantee corporation of India. Crop Insurance. Contract farming – strategy and scope. **Practical:** Study of a regulated market, Study of a vegetable market, Study of a fruit market, Study of a cattle market, Computation of market costs, margins and price spread, Study of Andhra Pradesh State Warehousing Corporation , Study of Central Warehousing Corporation, Study of Food Corporation of India, Study of MARKFED, Study of functioning of a commercial bank , Study of a regional rural bank, Study of food processing enterprise, Formulation of project reports for financing food Industry, Working out repayment plans, Study of Primary Agricultural Credit Society, Study of Farmers' Service Society		
4	**EEE-303**	**Electrical Engineering**	3(2-0-1)
	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. 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 & AC machines : Construction and operation of D.C A. C. Motors, Types of generators, Various characteristics of generator, D.C. motors, torque-speed characteristics of D.C. motors, Starting and speed control of D.C. motors. Electric Power Economics: Electrification and load estimation Maximum demand charge, Load factor and power factor correction. Strength of Material – engineering materials, material science, use of various metals, including plastic glass, etc in food industry, selection and specification – material design, concepts and manufacturing of various equipments and machineries for food processing plant – Characteristics properties and uses of common building materials i.e. stone, brick, lime, cement, paints ad varnishes, etc. **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 (iii) 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. To determine		

	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. Studies of building material, property and characterization. Studies on engineering materials, construction and properties. Studies of machine design of food processing plant.		
5	**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 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. **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 violate; 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).		
6	**ECON-331**	**Principles of Economics**	**2(2-0-0)**
	Basic terms and concepts of Economics, Meaning and nature of Micro and Macro Economics, nature and scope of Agricultural Economics, its role and importance, characteristics of factors of production, measures to improve land productivity, Government policies Labour – division of labour, problems of unemployment under employment and disguised unemployment, capital formation in agriculture, forms of business organizations, Demand - law of demand – types of supply, law of supply – factors influencing supply, elasticity of supply. Price determination under different market situations. –Government policy Characteristic features of developed and under developed economics. International trade in Agriculture – exim policy – role of W.T.O., International Trade in Agriculture. Financial institutions and their role; RBI, IDBI, IMF, NABARD, SIDBI		
7	**GPT-301**	**Moral Value & Education**	**2(2-0-0)**
	My country and my people, the many Indians, Being and becoming and 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, Patters 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- mans 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)		
8	***BIOL - 201***	***Elementary Biology (Deficiency course- PCM Group)****	***3 (3-0-0)***
	Life; Living and non living; Origin of Life; Oparin's abiotic theory; Evolution; Unicellular Multicellularity Complex Tissue system, Branches of Biology; Cell; Introduction Botany; History of Botany; Brief introduction of branches of Botany; Morphology; Anatomy; Taxonomy; Physiology; Palaeo Botany; Introduction Zoology: Classification of Animal kingdom; Adaptation of animals; External Morphology of Frog; Internal Anatomy of Frog, Internal organs; Different internal systems; Introduction to Lower Botany; Algae, Fungi, Bacteria, Virus; Bryophyte; Pteridophyte; Scope/Application of Biology.		
	MAS – 312	***Elementary Mathematics (Deficiency course -Ag. & Bio group)****	***3 (3-0-0)***
	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. **Trigonometry:** Complex numbers, De Meoivere's theorem and its simple application. **Coordinate geometry:** Equation of standard curves and their identification. Differentiation tangents and normals, maxima & minima. **Integral calculus:** definite integrals, standard methods of integrations, Applications of integral calculus to are enclosed by curve, length of arc, volume and surface of revolution. **Vector analysis:** Scalars and vectors, sum and difference of vectors, dot and cross products.		

Semester-II

1	**CHEM-563**	**Food Chemistry**	**5(3-0-2)**
	Nature Scope and development of food chemistry: Moisture in foods; Role and type of water in foods, Functional properties of water, water activity and sorption isotherm, Molecular mobility and foods stability. Dispersed systems of foods; Physicochemical aspects of food dispersion system, a) Sol b) gel c) foam d) emulations. Rheology of diphase systems. Carbohydrates; Functional characteristics of different carbohydrates, Changes of carbohydrates on cooking, Modification of carbohydrates, Dietary fibres and carbohydrates digestibility. Proteins in foods; Functional characteristics of proteins and amino acids, Pure proteins of plant and animal origin with their functional characteristics, Processing induced, physical, chemical and nutritional changes in protein, Chemical and enzymatic modification of protein. Lipids in foods: Role and use of lipids /fat, Physicochemical aspects of fatty acids in natural foods, crystallization and consistency, Chemical aspects of lipdysin antoxidation, thermal decomposition, Chemistry of frying Technology of fat and oil processing; a) Refining, b) Hydrogenations c) Inter etherification d) Safety use of oils and fats in food formulation. Enzymes in food industry; Carbohydrases, Proteasase, Lipases. **Practical:** Determination of moisture content of foods using different methods. Studies of absorption isotherms of different foods. Swelling and solubility characteristics of starches. Rheological properties of diphase systems. Determination of crude proteins by microkjeldhal method. Determination of essential amino acids i.e. Lysine, tryptophan, methionine etc. Isolation of egg and milk protein. Preparation of protein isolates and concentrate of plant proteins. Determination of acid value, saponification value and iodine number of fat/ oil. Assay of amylases, papain and lipases.	
2	**APFE - 302**	**Principles of Food Processing & Preservation**	**3 (2-0-1)**
	Sources of food, scope and benefit of industrial food preservation, perishable, non perishable food, causes of food spoilage. Preservation by salt & sugar – Principle, Method, Equipment and effect on food quality. Thermal processing methods of preservation – Principle and equipments: Canning, blanching, pasteurization, sterilization, evaporation. Use of low temperature – Principal, equipment and effect on quality. Chilling, cold storage, freezing. Preservation by drying dehydration and concentration – Principle, Methods, Equipment and effect on quality :Difference, importance of drying & dehydration over other methods of drying and dehydration, equipments and machineries, physical and chemical changes in food during drying and dehydration .Need and Principle of concentration, methods of concentration – Thermal concentration, Freeze concentration, membrane concentration, changes in food quality by concentration. Preservation by radiation, chemicals & preservatives. Definition, Methods of Irradiation, Direct & Indirect effect, measurement of radiation dose, dose distribution, effect on microorganisms. Deterioration of Irradiated foods-physical, chemical and biological; effects on quality of foods. Presentation of foods by chemicals, antioxidants, mould inhibiters, antibodies, acidulates etc. Preservation by fermentation- Definition, Advantages, disadvantages, types, equipments. Recent methods in preservation : Pulsed electric field processing, High pressure processing, Processing using ultrasound, dielectric, ohmic and infrared heating. Theory, equipments and effect on food quality. **Practical**: Demonstration of various machineries used in processing. Demonstration of effect of blanching on quality of foods. Preservation of food by heat treatment- canning. Canning of fruits and vegetables. Preservation of food by high concentration of sugar i.e. preparation of jam. Preservation of food by using salt- Pickle. Preservation of food by using acidulants i.e. pickling by	

	acid, vinegar or acetic acid. Preservation of food by using chemicals. Preservation of Bread, Cake using mold inhibitors. Preservation of coconut shreds using humectants. Drying of pineapple slices, apple slices in cabinet drier. Demonstration on drying of green leafy vegetables. Drying of Mango/other pulp by foam mat drying. Drying of semisolid foods using roller dryers. Drying of foods using freeze-drying process. Demonstration of preserving foods under cold v/s freezing process. Processing foods using fermentation technique i.e. preparation of saurcraut.		
3	**FST-304**	**Post Harvest Management of Fruits & Vegetable**	**3 (2-0-1)**
	Post harvest technology of fruits and vegetables: An over view of concept and science, importance of loss reduction, role in export, economy, and employment generation. Morphology, structure and composition of fruit and vegetable.- Physical, Textural characteristics, structure and composition. Maturity standards; Importance, methods of Maturity determinations maturityindices for selected fruits and vegetables. Harvesting of important fruits and vegetables. Fruit ripening- chemical changes, regulations, methods. Storage practices: Control atmospheric, Bead atmosphere, hypotactic storage, cool store, Zero emerge cool chamber, stores striation. Commodity pretreatments - chemicals, wax coating, prepackaging. Physiological post harvest diseases chilling injury and disease. Handling and packaging of fruits and vegetables ; Post Harvest handling system for citrus, mango, banana, pomegranate, tomato, papaya and carrot packaging house operations. Principles of transport and commercial transport operations. **Practical:** Studies on morphological features of some selected fruits and vegetables. Studies of maturing indices. Studies of harvesting of fruits and vegetables. Determination of RQ. Studies of export of pre cooling and storage of fruits and vegetables. Studies on wax coating on apples, papaya, citrus, mango, aonla. Studies on use of chemicals for ripening and enhancing shelf life of fruits and vegetables. Studies of regulations of ripening of banana, mango, papaya. Studies on various storage systems and structures. Studies on prepackaging of fruits. Studies on prepackaging of vegetables. Studies on physiological disorders – chilling injury of Banana and custard apple. Visit to commercial packaging house – grape, mango, pomegranate. Visit to commercial storage structures- Onion, garlic, potato.		
4	**DT-304**	**Milk & Milk Processing**	**3 (2-0-1)**
	Definition of milk. Physico-chemical properties of milk. Factors affecting the composition of milk. Reception and preliminary testing of milk at plant. Processing of market milk: Practices for reception, chilling, clarification, Separation, storage of raw milk. Homogenization of milk: definition, pretreatment of milk for homogenization, homogenization, synchronization of homogenization with HTST plant. Effect of homogenization on physico-chemical properties of milk. Pasteurization, sterilization, UHT -processing. Pasteurization methods: LTLT/HTST. Manufacture of sterilized milk. Manufacture of special milks: reconstituted recombined milks, flavoured milks, homogenized/ vitaminized milks, lactose-hydrolysed milk. **Practicals** 1. Reception of milk at the plant. 2. Pre-treatment of raw milk: chilling, clarification, filtration. 3. Cream separation, standardization of milk. 4. Operation of LTLT, HTST pasteurizer 5. Preparation of special milks, vitaminized, homogenized milks, flavoured milk, toned, double		

	toned, sterilized, recombined milks, lactose hydrolysed milk.		
5	**FST-305**	**Food Microbiology**	**3 (2-0-1)**
	Microbial spoilage of foods, Chemical changes caused by microorganisms, Principles of Food Preservation. Control of microorganisms by use of low and high temperature. Asepsis, water activity , drying, preservatives, radiation and pressure for control of microorganisms. Microbiology of milk and milk products. Sources of contamination, spoilage and prevention. Microbiology of fruits and vegetables. Sources of contamination, spoilage and prevention. Microbiology of cereal and cereal products. Sources of contamination, spoilage and prevention. Microbiology of meat and meat products. Sources of contamination, spoilage and prevention. Microbiology of fish and other sea foods. Sources of contamination, spoilage and prevention. Microbiology of poultry and eggs. Sources of contamination, spoilage and prevention. Microbiology of sugar and sugar products. Sources of contamination, spoilage and prevention. Microbiology of salts and spices. Sources of contamination, spoilage and prevention. Microbiology of canned foods. Sources of contamination, spoilage and prevention. **Practical:** Isolation of molds from foods. Microbial examination of cereal and cereal products. Identification, isolation and confirmation. Microbial examination of vegetable and fruits. Identification, isolation and confirmation. Microbial examination of meat and meat products. Identification, isolation and confirmation. Microbial examination of fish and other sea foods. Identification, isolation and confirmation, Microbial examination of Eggs and poultry. Identification, isolation and confirmation. Microbial examination of milk and milk products. Identification, isolation and confirmation. Microbial examination of sugar, salts and spices. Identification, isolation and confirmation. Thermal Death Time determination.		
6	**DC-512**	**Biochemistry & Human Nutrition**	**3 (2-0-1)**
	Biochemistry: Enzymes Ribozymes, isozymes, allosteric enzymes, zymogens, regulatory, Classification and mechanism of enzyme action, Factors affecting rate of enzyme catalyzed reaction, enzyme inhibition, Enzymes coenzymes and co-factors immobliation of enzymes, Nucleic acids and Bioenergetics : Structure and function, definition and composition. Structure of RNA & DNA-Anabolism and Catabolism of carbohydrates, lipids and proteins. Vitamins and Hormones : Structure & functions, general description. Relationship between vitamins and hormones in terms of their biological role. Elementary knowledge of milk synthesis in mammary gland. **Human nutrition:** Theory and definition, Scope of Nutrition : Functions of the various nutrients in body. Digestion, absorption and assimilation of nutrients. Comparative requirements and nutritional requirement of different age groups. (WHO and ICMR standard) Methods of evaluation of nutritive value of foods Nutritional value of cow, buffalo and human milk. Milk intolerance: lactose deficiency and protein hyper sensitivity. Safety aspects of food additives, toxic elements, radionuclides, pesticides and antibiotic residues in milk and milk products. Institutional feeding of workers. Planning and implementation of national food and nutrition policies and programme. Regulatory aspects of nutrition, IDF code on nutrition, nutrition facts under NLEA, Nutrient descriptors, serving size and nutritional claims. **Practical:** Biochemistry Estimation of alkaline phosphatase and the effect of temperature and pH on its activity. Estimation of catalases and the effect of temperature and pH on its activity. Determination of the Michealis constant of an enzyme. Estimation of RNA by colorimetric method Estimation of DNA by colorimetric method. Measurement of proteolysis. Lipolysis, Amylase activity.		

	Estimation of vitamin 'A; in ghee. Estimation of ascorbic acid in milk. Estimation of vitamin D in milk. Estimation of proteins by Lowry's method. Buret method. Estimation of Lipids and Lipids analysis by TLC. Estimations of cholesterol in milk. Estimation of denaturation of proteins in heated milk by dye binding method. Estimation of HMF content in food.		
7	**COMP-410**	**Computer And Languages**	**4(2-0-2)**
	Computer Applications in Dairy Industry Programming Concepts and computer languages. Database concepts: Characteristics of Database, approaches to data base, Normalization. dBase Programming: Commands decision making, branching and looping structures, use of functions, writing programmes, Multiple data -file handling. Information systems: Types of Information and information systems(OLTP, MIS, DSS): Characteristics of MIS, Design of MIS, System development life cycle. Applications in Dairy industry: Use of RDBMS, Milk procurement and, Financial accounting system, 'Personnel management system etc. Use of spread sheet: Cost analysis of milk and milk products, Estimation of labour efficiency, Monitoring quality standards of dairy products, Budgeting and forecasting, Estimation of losses in manufacturing and packaging, etc. Use of linear Programming package, formulation of least cost mix for ice-cream, cattle feed, baby-food, etc. Introduction to process control, control systems, process control principles, process description, process control block diagrams, control system evaluation, analog and digital processing, units, standards and definitions, process control diagrams, time response, significance and statistics. Computers in process control, Programmable controllers, data logging, supervisory control, computer based controllers, characteristics of digital data, sampled data system, Development of controller software, Input -data operations, controller modes, Computer controller, examples. **Practicals** l. Writing simple programmes with basic, Cobol, FORTRAN, C+ 2. File maintenance programmes 3. MIS report generation programmes 4. Development of MIS case studies 5. Spreadsheet package of case studies 6. Use of LP Packages 8. Use of SPSS Packages 9. Visit to a Dairy Plant: Demonstration of Process description & control system in Dairy Plant		

Semester-III

1	DE-401	Refrigeration and Air Conditioning	3 (2-0-1)
	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 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. **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.		
2	**DT-401**	**Condensed & Dried Milks**	**5 (3-0-2)**
	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. **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.		
3	**ME-503**	**Heat and Mass Transfer**	**4(3-0-1)**
	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 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. Equimolal diffusion. Mass transfer co-efficient and problems on mass transfer. **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 Jacketted 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.		
4	**MBGE - 455**	**Food Bio-technology**	**3(3-0-0)**
	Prospectus of BioTechnology. Molecular genetics i.e. fundamentals of molecular biology with special reference to chemistry and biology and DNA. (Primary secondary and tertiary) structures.		

	Biological role of DNA in cell metabolism. Genetic recombination mechanisms and technique used for improvement in microbial strains. Applications of genetical control mechanism in industrial fermentation process, (Induction, manipulation and recombination). RecombinantDNA technology (plasmids and cloning): Cell and tissue culture. Continuous cultures. Secondary metabolites synthesis. Expression of foreign genes. Promoter (Enzyme). Biomass production by using various micro organisms. Application of Biotechnology in food (Food industries), pharmaceuticals and agriculture. Biogas plant. **Practical**: Study of auxotroph, Micropropagation through tissue culture, Strain improvement through U.V. mutation for lactose utilization, Chemical mutagenesis using chemical mutagens (Ethidium bromide), Determination of survival curves using physical and chemical mutagens. Isolation and analysis of chromosomal / genomic DNA from E.coli and Bacillus cereus. Separation of protoplast using cellulytic enzymes. Production of Biomass from fruit and vegetable waste. Introduction of ELISA / Southern blot / DNA finger printing etc. Agarose gel electrophoresis of plasmid DNA. Pesticide degradation by pseudomonas spp.		
5	**MAS-410**	**Applied Mathematics**	**4(3-1-0)**
	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. **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. **Vector Analyses:** . Dot product and cross product of vectors. Scaler triple product, Vector Triple Product Vector function of one variable, Differential of vector function The operator, Gradient of scaler function, Curl and divergence of vector function. Line, surface and volume integral, divergence and stokes theorems. **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. **Fourier Series:** Introduction; Euler coefficients, Euler - Fourier Formula; Fourier expansion of periodic functions.		

6	APFE -410	Principles of Food Quality & Safety	3(3-0-0)
	Food quality and its role in food industry; Definition of Food quality, Role of food quality in Food Industry. Quality attributes; Classification of quality attributes, Color and gloss: Definition, Different colors, color measurement by spectrophotometer, muncell color system, lovibond tintometer, role in food qualities. Role of viscosity and consistency in food quality. Size and shape: Production, role in Food industry Measurements: weight, volume, weightvolume ratio, length, width, diameter, symmetry, curvature, area. Defects: Classification, Genetic physiological defects Structural, off color, character, Entomological Defects: holes, Scars, lesions, off coloring, curled aves, pathological defects. Mechanical defects, Extraneous or foreign material defects. Measurement of defects: Improving visibility by dilution, white background, color differences, standardization of conditions, reference standards, counts and measures, isolation of defects by floatation, elution, electronic sorting, Internal defects. Flavour: Definition and its role in food quality, Taste, classification, taste qualities, relative intensity, reaction time, effect of disease, temperature, and taste medium on taste, basic tastes, interaction of tastes. Odour : definition, Classification, neutral mechanisms, Olfactory abnormalities, odor testing, techniques, thresholds, odor intensities, olfaction. Visual, Auditory, Tackle and other senses, Vision, audition, oral perception other than taste. Factors influencing sensory measurements: Attitudinal factors, motivation psycological errors in Judgment, relation between stimulus and perception adaptation. Correlation of sensory and instrumental analysis. Quality Measurements: Laboratory measurement: types of tests, panel selection and testing environment, serving procedures, instruction to judges, Difference tests, directional difference tests, classification of difference tests, two sample tests, three sample tests, multisampling tests, comparison of procedures, ranking, scoring, hedonic scaling, dilution procedures, descriptive sensory analysis, contour method, other procedures, Consumer measurement: Factors influencing acceptance and preference, objectives of consumer preference studies, information obtained from consumer study, factors influencing results from consumer surveys, Methods of approach, development of the questionnaire, types of questionnaires, serving procedures. Comparison of laboratory panels with consumer panels. Limitations of consumer survey. Quality of raw materials: Physical, Chemical and microbial quality. Quality of products during processing & after processing color, taste, texture, flavour, appearance. Factors influencing the Food qualities: Soil, field practices, harvesting practices, procedures, packaging, transportation, storage, conditions, processing conditions, packaging and storage conditions of finished products. Recording and reporting of quality. **Practical:** Sensory evaluation of product. Quality evaluation of raw materials. Quality evaluation of product for colours, size, shape. Sensory evaluation of product for taste. Market testing of products. Evaluation of food standards. Determination of color by using lovibond tintometer. Visit to food factory to know sensory evaluation problems. Consumer study for food quality. Visit to fruit & Vegetable market for quality assessment.		
7	**MAS - 511**	**Statistical Methods**	**3(2-0-1)**
	Definition and scope; Statistics. Methods of condensation of data, frequency distribution Graphical representation 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 distributions and its applications Poisson distribution and its applications Normal distribution and its applications		

	Concept of sampling Simple random sampling with replacement Simple random sampling without replacement Introduction to testing of hypotheses and Tests of Significance 'Z' and 'T' test for one sample problems 'Z' and 'T' test for two sample problems 'Chi-square' test for independence of attributes and goodness of fit. Simple correlation coefficient and its test of significance Lines regression, Rank correlation Practicals 1. Formation of frequency distribution and graphical representation. 2. Measures of central tendency. 3. Measures of dispersion. 4. Applications of 'Z' test for one and two sample problems 5. Applications of '1' test for one and two sample problems. 6. Applications of Chi-square test. 8. Rank correlation coefficient.

Semester-IV

1	**DT-304**	**Fat Rich & Traditional Dairy Products**	**3 (2-0-1)**
	Cream: a) Definition & Legal standards, Methods of separation, Efficiency of cream separation and factors affecting it; control of fat concentration in cream. Neutralization, standardization, pasteurization and cooling of cream. Butter: introduction to the butter-making process; batch and continuous methods. Technology of butter manufacture; over-run in butter; packaging and storage. Butter-making equipment: construction, operation, and continuous butter making machines. 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. Product identification, process description, factors affecting yield physicochemical changes during manufacture. Chhana: Product description, Standards method of manufacture, packaging and preservation. Paneer: Product description standards method of manufacture packaging and preservation. Physicochemical changes during manufacture and storage. Ghee: Methods of ghee making-batch and industrial processes, innovations in ghee production, procedure, packaging and preservation of ghee. **Practical :** Standardization, neutralization, pasteurization and cooling of cream. . Preparation of cooking butter by the hand-operated churn. Manufacture of table butter using the power-driven chum. Preparation of khoa from cow, buffalo and concentrated milk. Analysis of khoa, chhanna and paneer for total solids, moisture, fat and acidity. Preparation of chhana from cow and buffalo milk and mixed milk. Preparation of paneer from cow and buffalo milk and mixed milk.		
2	**FST-509**	**Sensory evaluation of food Products**	**3 (2-0-1)**
	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 and the way we perceive them, Physiology of sensory organs, Classification of tastes and odours, determination of threshold value. Factors affecting senses, visual, auditory, tactile and other responses. Introduction to sensory techniques. Fundamental rules for scoring and grading of food and food products. Procedure: Types of tests –.overall difference tests, attribute difference tests, affective tests, Panel selection, screening and training of judges. Requirements of sensory evaluation, sampling procedures. Factors influencing sensory measurements. Guidelines for choice of techniques. Judging and grading of milk and milk products.. Judging and grading of food and food products –sensory evaluation of beverages, baking and confectionary products, meat and poultry products Consumer acceptance studies: Objectives. Methods, types or questionnaires, development of questionnaires, comparison of laboratory testing and Consumers studies, limitations. Interrelationship between sensory properties of food and dairy products and various instrumental and physicochemical tests. Preparation of food and dairy products with defects, techniques for simulation.		
3	**FST-401**	**Cereal Processing**	**3 (2-0-1)**
	Present status and future prospects of cereals (Rice, Wheat, Corn, Sorghum, Rye); Morphology of Rice: Physical properties; Density, Bulk density, Angle of repose, Hardness, asperity, porosity, stack of milling and moisture on physical properties. Chemical composition, Distribution of		

	nutrients and Aroma of rice. Drying of paddy: general principles and methods of drying, cracking phenomenon prevention. Methods of drying, batch type, continuous type driers. Milling of rice: i) Conventional Milling ii) Modern milling iii) Advantages and disadvantages of milling machineries. iv) By products of rice milling. Parboiling of rice: Aging of rice: Enrichment: Need of Enrichment, Methods of enrichment, Enrichment levels, fortification of amino acids. Processed Foods from rice: Breakfast cereals, flakes, puffing, canning and instant rice. Wheat: Morphology, Physicochemical properties, Wheat Quality, Wheat Milling. Corn: Morphology, Physicochemical properties, Corn milling, Milling fractions and modify starches. Barley: Morphology, Physicochemical properties and processing (Malting) Sorghum: Morphology, Physicochemical properties, Milling, Malting, Pearling and industrial utilization. Millets – Oat / Rye: Importance of Millet, composition, processing of millets for food uses. Practical: Morphological characteristics of cereals. Physical properties of cereals. Chemical properties of cereals. Determination of colour of cereals. Parboiling of Paddy. Cooking quality of rice, Milling of rice, Conditioning of wheat. Production of sorghum flakes. Production of Popcorns Preparation of sorghum Malt. Determination of Gelatinization Temp. By amylograph. Extraction of oil from rice bran. Visit to Cereal processing unit.		
4	**FST-403**	**Fermentation & Industrial Microbiology**	**3 (2-0-1)**
	Microbes as friend's primary secondary screening and the organizations involved microbiological work. Industrially important secondary metabolites, organic acids, citric acid, antibiotics, probiotics, therapeutic and medicinal value. Bacteriocins Nisin, biocolours caroptenoids, Bcarotene, lycopane, Ang kak, plant growth regulators from microbes gibberlins, IAA etc. harmones, production of microbial enzymes Downstream processing of enzymes and application of microbial enzymes. Microbial polysaccharides, types of polysaccharides and their applications xanthan, Dextran and pullulan, production of amino acids, vitamins, bioinsecticides. Plant cell cultures and metabolites, production of SCP, Safety of SCP, bakers yeast. Fermentation Technology – Types, Food based fermented products, Biochemical changes, Microbial standards. Industrial fermentors and accessories. Economic feasibility studies of few products advances in strain improvements of for high yields of metabolites, Blue green algae. Mushrooms – production, preservation and quality. **Practical:** Standardization of physical factors for higher yields of citric acid. Production and assay of antibiotics. Isolation, identification of cultures producing biocolours. Production and assay of βcarotene. Production of Ang kak (Red rice) and estimation of colouring compounds. Production, purification and assay of fungal analyses / proteases. Production of xanthan / pullulan. Production and assay of amino acids. Plant cell culture. Production and assay of nisin from Lactic acid bacteria. Single Cell Protein production. Bakers yeast effect in Bread Preparation. Mushroom Production. Preparation of food based fermented product		
5	**FST-508**	**Legumes & oilseed technology**	**3 (2-0-1)**
	Present status and future prospectus of Legumes and Oil seeds Morphology of legume. Classification and types of legumes and pulses. Chemical composition and nutritional value. Antinutritional factors, their chemistry, methods of removal of antinutritional factors. Processing of legumes of Food uses: Home scale, Cottage Scale and commercial methods of dehulling. Modern techniques in Dal mills. Processing of Red gram,. Bengal gram, Green gram, Black gram. Dal milling – Principle, methods, equipments and effect on quality. Principle products, Dry and Wet milling of pulses, Fermented Products of legumes. Soaking – Principles, Methods of socking Sprouting, Puffing, Roasting & Parboiling of Legumes, Physical and Biochemical changes during these processes. Cooking quality of dhal – methods, factors affecting quality of dhal and cooking of dhal. Quick cooking dhal, Instant dhal. Introduction, Present and future prospects of oil seeds,		

	chemical composition and characters of oil seed and Oils, Antinutritional factors, elimination Methods. Post Harvest Technology of Oil seeds, Handling Drying, Storage, Grading, Pretreatments, cleaning, Dehulling, Size reduction and flaking. Oil extraction: Traditional Methods, Ghani, Power Ghanis, Expellers Principle of Expeller, structure design of expeller. Solvent extraction process: Principle, Pretreatment Breaking, Cracking, flaking. Extraction principles, factors affecting the extraction process. Desolventization. Refining of Oils Degumming, neutralization, bleaching, filtration, deodorization, their Principles and process controls. New Technologies in oil seed processing, utilization of oil seed meals of different food uses. High protein Product, like protein concentrate and isolates. **Practical** : Physical properties of Legumes and Oil seeds. Estimation of protein. Estimation of Fat Methods and Principles of dehulling; Application Oil & Application Red Earth slurry. Dal Milling Process. Antinutritional factors, Methods of Elimination. Soaking studies .Sprouting of legumes. Cooking quality of Dal. Fermented product of legumes Dosa, Idli, Wada, Dhokala, etc. Extraction of oil by expeller press. Production of protein rich product. Visit to Dal Mill and oil extraction plant.		
6	**ENV-417**	**Environmental Studies**	**3(3-0-0)**
	1. Definition, Scope and Importance of Environment and Environmental Studies Multidisciplinary Nature of Environmental Studies. 2. Eco-system • 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 • 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 conversation of natural resources for sustainable life style. 5. Biodiversity and its conservation Introduction- Definition: genetic, species and ecosystem diversity, bio-geographical classification of India, vale of diversity: consumptive use, productive use, social and ethical aesthetic values, Bio-diversity at global, nationa and local levels, India as mega-diversity nation, Hot-spots of biodiversity, conservation of biodiversity:in-situ and ex-city conversation of bio-diversity. 6. Environmental pollution Definition, causes, effects and controlling measures of (b) Air pollution (b) Water pollution (c) Pollution (d) Noise pollution Solid waste Management: causes, effect and control measures of urban and industrial wastes		

7	**BAM-501**	**Marketing Management & International Trade**	**2 (2-0-0)**
	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)		
8	**FST-515**	**Quality Assurance and Certification**	**2 (2-0-0)**
	Quality inspection, quality control, quality management and Quality Assurance. Total quality management; Good Manufacturing Practices, Good Agricultural Practices, Good Laboratory Practices, Quality Management systems QSS. Quality Circles, SQC., ISO System. HACCP, Principles, Implementation. Plan Documentation, types of records. Auditing, Surveillance; Audit, Mock audit, third party quality certifying audit, Auditors and Lead auditors. Certification, Certification procedures, Certifying bodies, Accrediting bodies, International bodies. **Practical**: Quality Assurance procedure. T&M, GMP, GAP documentation. Preparation Quality Policy & documentation (Quality Manuals). Preparation of Laboratory manuals. Application of HACCP to Products. Preparation of documentation and records. Auditing Surveillance, Mock audit. Visit to units implementing GMP, GAP. Visit to units with ISO systems. Visit to units with HACCP certification.		

Semester-V

1	COMP-	IT Application in Food Industry	2(1-0-1)
	Importance of Computerization and IT in Food Industries: Computers, operating environments and information systems for various types of food industries, Principles of Communication. Role of Computer in Optimization; Introduction to operation Research. A Computer Oriented Algorithmic approach; Queuing systems and waiting models, PERT, CPS and CPM. Food Process Modeling and Simulation, Introduction to SCADA and INTELUTION, CAD and CAM in Food Industry; Instrumentation, Process Control Inventory Control: Automation, Robotics, Expert system and artificial intelligence, Instrumentation. **Practical**: Applications of MS Excel to solve the problems of food technology: Statistical quality control, Sensory evaluation of food, Chemical kinetics in food processing. Use of word processing software for creating reports and presentation. Familiarization with the application of computer in food industries: Milk plant, Dairy units, Fruit & Vegetable processing unit Familiarization with software related to food industry, Ergonomics application in the same, Visit to Industry and knowledge of computer.		
2	**FST-504**	**Techniques in Food Analysis**	**3 (2-0-1)**
	Nature and concepts of food analysis; Rules and regulations of food analysis, Safety in laboratory, sampling techniques. Principles and methodology involved in analytical techniques: PH Meter and use of ion selective electrodes –Spectroscopy,Ultra violet visible, florescence, Infrared spectro, Atomic absorption and emission, Mass spectroscopy, Nuclear magnetic resonance and electron spin resonance. Chromatography –Adsorption, Column , Partition, Gelfiltration, Affinity, Ionexchange, Sizeexclusion method, Gas liquid, High performance liquid chromatography. Separation techniquesDialysis, Electrophoresis i) Paper ii) DS gel electrophoresis iii) Immuno electrophoresis Sedimentation, ultrafiltration, ultracentrifugation, Isoelectric focusing, Isotopic techniques, Manometric techniques. Principles and methodology involved in analysis of foods ; Rheological analysis, Textural profile analysis of foods. Immuno assay techniques in food analysis; Isotopic and Nonisotopic immuno assay, Enzymeimmuno assay. Evaluation of analytical data ; Accuracy and precision, Statistical significance, Corelations regression, Computers for data analysis and result interpretation. Sensory analysis of food; Objective method, Objective method. **Practical:** Analysis of heavy method using atomic absorption spectrophotometer. Estimation of physic acid using spectrophotometer. Separation of amino acids by towdimensional paper chromatography. The identification of sugars in fruit juice using TLC. Separation of pralines by Ionexchange chromatography. Molecular weight determination using sephadoxgel. Identification of organic acids by paper electrophoresis. Gelelectrophoresis for analytic techniques. Quantitative determination of sugars and fatty acid profile by GLE. Quantitative makeup of water and fat soluble vitamins using HPLC.		
3	FST-513	Specialty Foods	3(2-0-1)
	Need and scope of specialty foods: Specialty food based on ease in preparation cost health benefits; Functional foods, Convenience food, Health care and medical benefits, Nutritional status, Low cost foods. Specialty foods based on sources ; Cereals and millets, Legumes and pulses, Fruits and vegetables, Animal food sources, By product based, Non conventional foods. Specialty foods based on process ; Innovative process technology, Food additives basis, Bioactive		

	components, Novel neutraceuticals products, Packaging techniques, Adaptable technology basis, Fast and PET foods. Specialty food based on genetics ; Genetically modified foods, Transgenic foods, Biotechnological aspects of detoxification. Proprietary foods. Supplementary foods. Therapeutic foods ; Modification of diets in disorders, feeding purposes Disease oriented of different organs ex: digestive tract, liver, cardiovascular system, kidney , metabolic disorders, allergy, endocrine disorders. Specific consumer oriented foods; Defence persons, Space / astronought, High altitude mountain climbers, Disaster situation – crises, care, maintenance. Specialty foods based on growing condition organic , inorganic farming. **Practical:** Preparation of specialty foods based on ; Functionality, Convenience, Low cost, Nutritional purpose. Preparation of specialty food using locally available foods crops, fruit and vegetables few products. Assessment of byproduct for preparation of value added specialty food. Isolation of phytochemical/ bioreactive agent of plant sources and their utilization in proprietory foods. Preparation of specialty food as per requirement of; Location, Nature of work, Status of worker. Evolution of food cultivated under organic conditions.		
4	**FST-506**	**Food Industry Byproducts & Waste Utilization**	**3 (2-0-1)**
	Industrial Byproducts and Waste: Potentials and prospects of developing byproducts industry in India. Agricultural waste and agro based industrial waste management. By products of cereals. By products of legumes. By products of oil seeds. By products of dairy. By products of fruit and vegetables processing industries. By products of meat, poultry and eggs. By products of fish processing units. By products of plantation crops and spices. Uses of byproducts of agro based industries in various sector. Byproducts of fermentation industries. By products of sugar and bakery industries. **Practical:** Extraction of banana fiber. Extraction of leaf proteins. Alcohol production from molasses. Use of crop residues for the production of cellulose. Use of mango kernels for starch manufacture. Pectins from organic waste. Extraction of volatile oils from organic waste.		
5	**FST-507**	**Food Safety and Microbial Standards.**	3 (2-0-1)
	Dietary Toxins: Naturally occurring in food Endogenous toxin, Exogenous toxin. Microbial toxins ; i) Bacterial, ii) Mold. Intrinsic toxin produced during processing and storage. M as toxin – sources, conditions, causes and Elimination. Pesticidal residues as toxin; i) chlorinated ii) Non – chlorinated. Non – Permitted food additives. Microbial standards of processed and preserved foods. Risk assessment and management during food preparation. **Practical :** Estimation bacterial toxins from food samples.(Different types of foods). Estimation of fungal toxins from food samples. (Different types of foods).Heavy metal detection (lead) .Risk assessment and management determination. HACCP for food industries by taking few models. Study of national and international microbial quality standards. Visit to export oriented food processing industry.		
6	APFE-409	Processing of Marine Products	2(2-0-0)
	Types of fish, composition, structure and post mortem change in fish and quality evaluation. Handling of fresh water fish. Processing and preservation of fish canning, smoking, chilling and freezing of fish. Salting, sun drying and salt curing of fish. Fish sausages. Freezedrying of fish/shrimp. Radiation processing and safety. Fish fermented products. Fish protein concentrates. Marine oils and fish meals. Marine algal products. Production of fish and sea foods & utilization fish byproducts. MFPO and BIS specifications of fish and fish products. **Practical:** Anatomy and dressing of fish. Quality evaluation of fish. Preparation of sun dried and		

	salt cured fish, fish sausages. Chilling and freezing of fish. Preparations of fish protein concentrate. Preparation of fishmeal. Preparation of marine oils and various fish products. Utilization of fish byproducts. Preparation of marine algal products.		
7	**APFE-611**	**Food Packaging Technology**	**3 (2-0-1)**
	Introduction to subject, Packaging situations in World, India, need of packaging, plastic consumption/use in World, India etc. Package requirements, package functions, Hazards acting on package during transportation, Storage and atmospheric package, labeling laws. Package Materials: classification packages, paper as package material its manufacture, types, advantages corrugated and paper board boxes etc. Glass as package material, Manufacture, Advantages, disadvantages. Metal as package material manufacture, Advantages, disadvantages, Aluminum as package material,. Its advantages and disadvantages, plastic as package material classification of polymers, properties of each plastics, uses of each plastics, chemistry of each plastic such as polyethylene, Polypropylene, polystyrene, polycarbonate, PVC, PVDC, Cellulose acetate, Nylon etc. Lamination Coating and Aseptic packaging. Lamination, need of lamination, types, properties, advantages & disadvantages of each type. Coating on paper & films, types of coatings : Need of coating, methods of coatings. Aseptic packaging Need, Advantaged, process, comparison of conventional & aseptic packaging system of aseptic packaging and materials used in aseptic packaging. Machineries used in Packing foods. Packaging of Specific Foods. Packaging of specific foods with its properties, Like bread, Biscuits, Coffee, Milk powder, egg powder, carbonated beverages. Snack foods etc. Mechanical and functional tests on Package. Various mechanical and functional testes perform in laboratories on package boxes and package materials. **Practical**: Classification of various packages based on material and rigidity. Measurement of thickness of paper, paper boards. Measurement of basis weight of paper and paperboards. Measurement of grammage and water absorption of paper, paper boards. Measurement of bursting strength of paper of paper boards. Measurement Tear resistance of papers. Measurement of puncture resistance of paper and paperboard. Measurement of tensile strength of paper of paper boards. Measurement of grease resistance of papers. Determination of gas transmission rate of package films. Determination of WVTR and QTR of films. Determination of coating on package materials. Identification of plastic films. Finding chemical resistance of films. Prepackaging practices followed for packing fruits, vegetables.		

Semester-VI

1	**DE-601**	**Food Engineering**	**4 (3-0-1)**
	Rheology of processed food, properties of fluid foods, Rheological method, Measurement of rhelogical parameters, properties of granular food and powders, Properties of solids foods, Visco-clastic models. Measurement o 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, Balanching, Dehulling, Size reduction and distillation. **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.		
2	ABM-402	Agri-Business Management	3 (3-0-0)
	Definition, History, function productive system, operations, decisions, decision frame work, produces of series & goods critical themes, operation strategy, model, objectives, types External factor, international operations, rescued operations, stages, new production introductions, new product development, technology development, quality function development, Value analysis, modular design; Quality management, quality control and improvement, process selection, service operation design, choice of technology, layout of facilities, forecasting.		
3	**APFE-614**	**Food Laws and Legislation**	**2 (2-0-0)**
	Introduction to subject, Need of enforcing the laws and various types of laws. Mandatory food laws; The food safety and standards bill 2005, Establishment of the authority, composition of authoring functions of chief executive officer, scientific part, General principles to be followed in administration of act, General provisions as to articles of food, special responsibility as to safety of food, analysis of food offences of penalties. Preventions of Food adulteration act; Definition, object of act, central committee for food standards; public analysis, food inspector, duties of Food inspectors, Report of Public analyst, sealing, fastening and dispatch of samples, powers of court. Other Mandatory acts. Standard weight of measure act, essential commodity act, consumer protection act, Environmental protection act insecticide act. Export (quality control & inspection) act. Various food orders; Fruit product order, Milk & Milk product order, plant food seed (Regulation of imports in India) order, edible oil package order meat food products order. Optional food standards; Scope of these standards, their need, procedure to obtain that standard, Agmark, Bureau of Indian Standards. Codex Standards; Scope of codex standards, codex standards for cereals, pulses, fruit & vegetables, Meat & Poultry products, Recommerided international code of hygiene for various products. **Practical**: Examination of Cereals & pulses from one of godown and market shop in relation to FPO & BIS specification. Examination of Ghee for various standards of Agmark & BIS. Examination of honey for various Agmark and BIS standards. Examination of spices for Agmark & BIS standards. Examination of milk & Milk products for BIS, of milk product order standards. Examination of fruit Jam of two to three different companies for FPO specifications. Examination of two different industries squash for FPO specifications. Examination of ketchup of two to three		

	different Companies for FPO specifications. Visit to BIS Laboratory, Visit to Agmark laboratory, Visit to quality control laboratory and Food processing industry.		
4	**APFE-605**	**Baking & Confectionary Technology**	**3 (2-0-1)**
	History, Traditional confectionary goods, Types of confectionary, classification. Basic Technical considerations, TS, TSS, pH, acidity, ERH, Sugar, Invert Sugar, Glucose syrup, RH, Crystallization. Raw Materials: Sugar, Sugar qualities, Physical, Chemical, Optical properties. Sugar grinding, Dextrose, Fructose, Lactose, caramel, maltose, Honey, sorbitol, xylitol, Iso malt, soy maltose, Polydextrose, Lactitol, Maltitol. Whipping, Release agent, thickeners, Acidulents, Flavours, for confectionery, emulsifiers and other additives, starch derivatives, colours used in confectionary. Production of glucose syrup, Acid hydrolysis, enzyme hydrolysis. Cocoa Processing: Cocoa bean, processing, roasting, Fermentation, Production of Cocoa butter Cocoa powder, its quality. Chocolate Processing: Ingredients, Mixing, Refining, Conching, Tempering, Molding, Cooling, Coating, Fat bloom. High Boiled Sweets: Introduction, Composition, Properties of high boiled sweets, preparation of high boiled sweets, Traditional, batch and continuous Method of preparation. Different types of higher boiled sweets, Recipes. Caramel: Definition, Composition, Factors affecting quality of caramel, caramel Manufacture process, batch type, continuous types, checking of faults in caramel. Toffee: Definition, Composition, types of toffee Ingredient and their role. Batch and Continuous method of toffee. Fondant: Fudge/Creamy: ingredients, Methods, Productivity. Lozenges: Definition recipe, Method of Manufacture, Compositions, factors affecting quality, Industrial production, checklist of faults. Tablets: Definitions, recipe, composition, wet granulation, Slugging, Manufacture of Tablet, and Checklist of tablet faults. Marshmallow and. Nougat: Definition, composition, recipe, and method of manufacture. Nougat. Panning: Process, types of Panning, soft and hard panning. Quality of confectionery, Standards and regulations, Packaging requirements of confectionary, economics and marketing of confectionary goods. Bakery Products, Role of Bakery ingredients (major and minor), From Hard Wheat: Bread: Processes of bread making mainly straight and sponge, role of each ingredient, quality control. Testing of raw material. Testing of final product. Bread faults, staleness, ropyness. Baked Products from soft wheat: Cookies, crackers, Biscuits, Cakes: Types, ingredients, Process, Causes, remedy. Other bakery Products: Pizza, Pastry and its Types. Macaroni Products: Including spaghetti, Noodles, VermicelliProcess. Nutritional improvement of bakery Products. Setting of bakery Unit, Bakery norms. Specifications for raw materials. Packaging. Marketing of Products. Project report on bakery. Visit to wheat milling Industry. Visit to Bakery. **Practical:** Classification of wheat based on physicochemical properties. Conditioning of wheat. Milling of wheat. Quality Testing of flour: Falling number and α amylase activity, Sedimentation value, Pelshenke value, Farinograph, Mixograph, Extensiograph, Alveograph. Manufacture of Bread, Types, Faults, remedies, shelf life bread, quality of bread Biscuits, cookies, crackers, buns: Types and quality. Other baked products Pastry, pizza. Extruded Products from wheat: Vermicelle, noodles etc. Physical properties of sugar. Production of invert sugar. Determination of Moisture in Sugar. Determination of Reducing Sugar		
5	**APFE-503**	**Technology of Meat and Poultry Products**	**3 (3-0-0)**
	Sources and developments of meat and poultry industries in India and importance of meat and meat industries in national economy. Muscle structure, chemical composition and physico-chemical properties of meat muscle. Abattoir design and layout. Pre-slaughter transport and care and anti mortem inspection. Slaughtering of animals and poultry, postmortem inspection and grading of meat. Factors affecting post-mortem changes, properties and shelf life of meat. Egg structure: Composition, quality characteristics, processing and preservation of eggs. Processing and preservation of meat- mechanical deboning, aging or chilling, freezing, pickling, curing,		

	cooking and smoking of meat. Meat tenderization. Meat emulsions. Technology of manufacture of meat and poultry products. Meat plant sanitation and safety. By-products utilization **Practical:** Pre-slaughter operations of meat animals and poultry birds. Slaughtering and dressing of meat animals. Study of post-mortem changes. Meat cutting and handling. Evaluation of meat quality. Preservation of meat by different methods and preparation of meat and poultry products. Evaluation of quality and grading of eggs. Preservation of shell eggs. Experiments in by-products utilization.		
6	**APFE-506**	**Fruits and Vegetable Processing**	**3 (2-0-1)**
	Production and processing scenario of fruits and vegetable: India and World. Scope of Fruit and Vegetable Preservation Industry in India. Present status, constraints and prospectus. Overview of principles and preservation methods of fruits and Vegetables. Commercial processing Technology of Following fruits and vegetables. Mango: Pulp, RTS, Squash canned Mango pulp. Toffee amchur, pickle Mango Powder, bar. Banana: Wafers, puree, dried banana powder. Papaya: Jam, Candy RTS, Nectar, Squash, and Papain. Pomegranate: Juice, Squash, syrup, Anardana, Dalimbmanuka, Anargoli. Guava; Jelly, Cheese, Juice, Canned guava, Squash, Toffee. Grape: Raisin, Juice, Wine. Fig: Pulp, dried fig, Toffee Powder, bar fig. Citrus Fruits: Jelly, Marmalade RTS Squash, candy. Aonla; Preserve, Jam, Candy, Juice, Squash, powder, Dried shreds, chuvenprash, pickle, chutney sauce, sweets. Tamarind: Pulp, Powder, Toffee, Bar, RTS, Slab Jamun: Jelly, RTS, Syrup, wine, Wood apple: Jelly, Marmalade, Tomato: Ketchup, sauce, puree, soup, chutney, pickle, Ginger: Preserve, Candy, dried, Ginger pickle, RTS, Syrup. Onion: Dried Onion, Powder. Garlic: Dried Garlic, Powder, Oil. Potato: Wafer; starch, Papad, Carrot: Preserve, candy, Pickle, Jam. Cauliflower and cabbage: Dried cauliflower and cabbage, Sauerkraut, Pickle Leafy vegetables; Dried Leafy Vegetables. (Spinach, Fenugreek, Coriander leaves, Curry leaves).Bitter gourd: Pickle, Dried bitter gourd **Practical:** Canning of Mango/Guava/Papaya. Preparation of Fruit Jam: Apple/ Mango/Guava,/Papaya/Aonla/Strawberry. Preparation of fruit Jelly: Wood apple, Sweet orange/mandarin/Guava,/Tamarind. Preparation of fruit marmalade: Ginner Marmalade. Preparation of fruit preserve and candy. Preparation of fruit RTS and candy Preparation of fruit squash. Preparation of fruit syrup. Preparation of grape raisin, dried fig and dried banana. Preparation of Anardana and dalmab manuka. Preparation of papain /guava cheese. Preparation of pickle, mixed pickle. Preparation of dried ginger. Preparation of Amchur. Preparation of dried onion and garlic, Preparation of Banana and Potato wafers, Preparation of dehydrated leafy vegetable.		
7	**APFE-515**	**Food Additives**	**2 (2-0-0)**
	Intentional and unintentional food additives, their toxicology and satry evaluation. Naturally occurring food additives. Food colour (natural and artificial).Pigments their importance and utilization as food colour. Taste and flavour inducer, potentiater. Food preservatives and their chemical action. Role mode of action salt, chelating agents stabilizers and thickners, polyhydric alcohol, anticaking agent, firming and colouring agent, flour bleaching agent, antioxidants, nonnutritional sweetness and antimicrobial agents. **Practical:** Evaluation of GRAS aspect of food additives. Identification of food colour by TLC. Isolation and identification of naturally occurring food pigments by paper and TLC. Spectrophotometric method of total chlorophyll (A&B). Determination of diacetyl content of Butter. Role mode of action of chelating agent in fruit juice. Role and mode of action of stabilizer and thickener in frozen dairy products. (Icecream). Role and mode of clarifying agent in fruit juices. Role and mode of antioxidant in frozen fish. Role of leaving agent in baked food product.		

Semester-VII

1	**APFE-616**	**Processing of Spices and Plantation Crops**	**3(2-0-1)**
	Production and processing scenario of spice, flavour & plantation crops and its scope. Major Spices: (1) Post Harvest Technology composition, processed products of following spices (2) Ginger (3) Chill (4) Turmeric (5) Onion and garlic (6) Pepper (7) Cardamom (8) aercanut, cashew nut, coco nut. Minor Spices, herbs and leafy vegetables : tea rubber and oil palm. Spartans, Processing and Utilization All spice, Annie seed, sweet Basil. Caraway seed, Cassia, Cinnamon. Clove, Coriander, cumin, Dill seed. Fern seed nutmeg, malt, mint marjoram. Rose merry, saffron, sage. Savory, Thyme, Ajowan. Asartida, curry leaves. Tea Types, Processing, quality control. Coffee& Cocoa: Processing. Vanilla and annatto processing. Flavours of minor spices. Flavour of major spices. Spice oil and oleoresins. Flavours of soft drinks Baking and confectionery. Standards specification of spices. Functional packaging of spices and spice products. **Practical:** Identification and characterization of flavouring compounds of spices. Valuable oil determination. Extraction of oil from clove, pepper, cardamomchili. Extraction of oleoresinsTurmeric, ginger, pepper, clove. Piperine estimation in pepper oleoresin. Steam distillation of spices. Determination of curumin content in turmeric. Chemical analysis of spices moisture, valuable oil, specific gravity, refractive index ,acid value. Study of standard specification of spices. Packaging study of spices. Preparation of curry powder. Visit to spice Industry.	
2	**BAM-502**	**Entrepreneurship Development and Communication Skill**	**2(1-0-1)**
	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, publicprivate partnerships. Overview of food industry inputs. Characteristics of Indian food processing industries and export. Social Responsibility of Business. Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences. **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, précis writing, summarizing, abstracting; individual and group presentations.		
3	**FST-512**	**Product Development and Formulation**	**3(2-0-1)**
	Need, importance and objectives of formulation for new product development. Ideas, business philosophy and strategy of new product. Formulation based on sources availability and cost		

	competitiveness for concept developments of new products. Standardization of various formulation and product design. Adaptable technology and sustainable technology for standardized formulation for process development. Process control parameters and scaleup, production trials for new product development at lab and pilot scale. Quality assessment of new developed products. Market testing and marketing plan. Costing and economic evaluation. Commercialization / product launch. **Practical**: Market survey of existing various products. Formulation of new products based on corporate decision; Proteinenergy rich, Low calorie (fat replacer), Low sodium content, Glycemic index based, Cholestrolemic index based, Phytochemical based. Product development based on above formulation depending on local sources/ technology. Quality assessment. New product development for; Infant / weaning foods, Geriatric, Physiological status, Athletes.		
4	**FST-514**	**Food Production Trends and Programs**	**2(2-0-0)**
	Food demand and supply – Qualitative and quantitative requirements. Expected Technological advances to meet the needs. Future priorities in Food Production needs –Status of Food Industry in India and Abroad. Magnitude and Inter dependence of Food Production and processing agencies. Food availability, production Trends – Factors of Production – Types of Foods like processed semi processed, Ready to eat Foods, Fast Foods. Food Characteristics Nutritional significance of major food groups. Present trends of consumption, Further requirements. Consumers change of aptitude in Food Products consumption. New food products developed Programmes aimed for making more food availability to increasing population and their prospects – Merits and drawbacks, prospects for future growth in India. National and International Trends and Programmes in Food handling, processing and marketing Potentials and Prospects of developing Food Industry in India. Food Losses –Factors affecting – Programmes and strategies to eliminate the looses and rate the required demand .Global demand for food. World Food Day – Importance and action plans.		
5	**FST-516**	**Food Plant Design And Layout**	**3(2-0-1)**
	Overall design of an Enterprise: Plant design, sales planning for plant design. Plant Location, levels of Plant location. Location of layout : location factors, plant site selection. Location theory and models, industrial buildings and grounds. Classification of Dairy and Food Plants, farm level collection and Chilling center. Space requirement. Preparation of a Plant Layout : Plant Layout problem, importance, objectives, classical types of layouts. Evaluation of Plant Layout. Advantages of good layout. Organizing for Plant Layout, Data forms. Development and Presentation of Layout : Development of the pilot layout, constructing the detailed layout : Functional design : Sitting of different sections in a plant, Layout installations. Quantitative analysis for Plant Layout: Engineering economy. Linear programming. Queing theory. Common Problems in Plant Layout and Process scheduling. Siting of Process sections, Equipment selection and capacity determination, Arrangement of process, and service equipment. Estimation of Services and Utilities. Office layout, line balancing, Flexibility. Practical Layouts. Common materials of construction of Food plant, building. Maintenance of Food Plant Building, Illumination and ventilation, Cleaning & sanitization, painting and colour coding, Fly and insect control. **Practical**: Preparation of project report. Preparation of feasibility report. Layout of Food storage wares and godowns. Layout and design of cold storage. Layout of preprocessing house. Layout of Milk and Milk product plants. Low shelf life product plant. Bakery and related product plant. Fruits processing plants. Vegetable processing plants. Layout of multi product and composite food Plants Evaluation of given layout. Waste treatment and management of food plant.		

6	**APFE-604**	**Extrusion technology**	**3(2-0-1)**
	Food proteins; Types, sources, Availability, need, properties etc. Food problems, Role, Means for increasing food supply. Amino acid fortification of foods ; Cereals, infant foods, bread, baked products. Legumes and oilseed foods ; Isolate, concentrate, and substitute to milk, variation in composition and nutritive value. Meat Analog; Commercial development, nutritional aspect, marketing aspect. New protein foods; TOFU, Miso, Texturized vegetable protein, hydrolyzed vegetable protein, formulation and quality control. Extrusion Technology; Importance, principles of extrusion cooking, methods of extrusion cooking. Extruders; Types of extruders, single screw, twin screw their applications, effect of dependent and independent variables on the product quality. Extruded products; Raw materials, process of manufacture, properties, quality, evaluation, packaging requirement, marketing. **Practical**: Physicochemical properties, functional properties of proteins, protein rich products, weaning foods, beverages, Texturized Products, Protein rich bakery products, Type of food extruders, preparation of extruded products, Factors affecting extrusion cooking, Moisture content, Diameter, Temperature, Pressure, screw speed, time, quality evaluation of these products.		
7	**APFE-507**	**Quality control in food industry**	**3(2-0-1)**
	Hygiene regulation, central of airborne contamination HACCP implementation, Indian experience, Assessing an operation, Microbiological central methods, Instrumental measurements of sensory attribute of foods; appearance, color, volume, density and specific gravity, Rheological and textural characteristics, Textural profile analysis. To relation between instrumental and sensory analysis of food quality attributes. **Practical:** Methods of evaluation of sensory quality evaluation of color and rheological attributes, Detection and estimation of food additives and adulterants, Relationship between objective and subjective methods.		
8	**APFE-509**	**Fermented Food Products**	**3(2-0-1)**
	Food fermentation, stock culture and inoculum preparation. Lactic acid fermentation of milk, vegetables, cereals and meat. Alcoholic fermentation of fruit juices, sugar and starch substrates. Vinegar fermentation, mixed fermentation of cereal legumes and milk. Malting, brewing, steeping, germination, kilning and curing. Chemical and biochemical changes during malting and mashing. Separation of wort, wort boiling and hops addition. Fermentation, separation, maturation, carbonation and packaging. **Practical:** Lactic acid fermentation. Alcoholic fermentation of fruit juices. Acetic acid fermentation and alkaline fermentation. Barley steeping. Germination, malting mashing and brewing; Preparation of wine and distillation of wine		
9	**FST-517**	**Seminar**	**1 (0-0-1)**

Semester – VIII

FST-518	**Industrial Training**	**30**

COURSE STRUCTURE OF I.D.D.(DAIRY TECHNOLOGY)

SEMESTER I

Course Code	Course Title	L-T-P	Credits
IDD-301	Dairy Technology I (Indian Dairy Industry &Market Milk)	3-0-2	4
IDD-302	Dairy Chemistry I (Chemistry of Milk & Milk constituents)	3-0-2	4
IDD-303	Dairy Microbiology I (Basic Microbiology)	3-0-2	4
LNG-300	English & Basic Technical Writing	3-0-0	3
IDD-304	Dairy Production –I (Fodder Production & Cattle Nutrition)	3-0-2	4
IDD-305	Applied Maths & Statistics	3-1-0	4

SEMESTER II

Course Code	Course Title	L-T-P	Credits
IDD-308	Dairy Production II (Cattle Breeding & Gen. Mgt.)	2-0.2	3
IDD-309	Dairy Engineering- I (Drawing & Workshop Practices)	3-0-2	4
IDD-310	Dairy Chemistry- II (Chemistry of Milk Products)	3-0-2	4
IDD-311	Dairy Microbiology -II (Microbiology of Milk)	3-0-2	4
IDD-312	Dairy Technology- II (Fat Rich Dairy Products)	3-0-2	4
IDD-313	Dairy Technology- III (Indigenous Milk products & Milk based sweets)	2.-0-1	3

SEMESTER III

Course Code	Course Title	L-T-P	Credits
IDD – 319	Dairy Production –III (Cattle Health & Reproduction)	2-0-2	3
IDD – 320	Dairy Engineering – II (Refrigeration & Steam Engineering)	3-0-2	4
IDD - 321	Dairy Microbiology – III (Microbiology of Milk Products)	3-0-2	4
IDD – 322.	Dairy Technology – IV (Cheese Fermented Milk Foods & By Products)	3-0-2	4
IDD – 323	Dairy Technology – V (Condensed & Dried Milks)	3-0-2	4
IDD – 324	Economic Principles and Financial Accounting in Dairy Business	3-1-0	4

SEMESTER IV

Course Code	Course Title	L-T-P	Credits
IDD 331	Dairy Engineering – III	3-0-2	4
IDD- 332	Dairy Engineering – IV	3-0-2	4
IDD – 333	Dairy Technology- VI (Ice Cream & Frozen Dairy Products)	3-0-2	4
IDD – 334	Quality Assurance of Diary Products	2-0-1	3
IDD – 335	Dairy Plant Management	3-0-0	3
COMP- 401	Computer Application	1-0-2	2

SYLLABUS OF I.D.D.(DT)

FIRST SEMESTER

IDD-301 DAIRY TECHNOLOGY- I 4 Credits
INDIAN DAIRY INDUSTRY & MARKET MILK

1. Market Milk: Market Milk Industry in India and Abroad
2. Clean Milk production, collection of Milk and practices followed at rural milk collection centres, chilling of milk, milk preservation by hydrogen peroxide and LP systems
3. Transportation of milk. Reception of milk. Platform tests
4. Filtration, clarification and separation of milk, Standardization of milk
5. Pasteurization of milk
6. Homogenization of milk
7. Sterilization of milk by conventional method UHT processing of milk sterilization
8. Special milks, recombined milk, toned milk, double toned milk, filled milk, vitaminised milk, flavoured milk
9. Packaging and distribution of milk
10. Metals in diary equipments manufacture
11. Cleaning and sanitation of dairy equipment
12. Defects in milk, their causes and prevention

Practical

1. Reception of milk and platform tests
2. Fat. SNF and acidity tests of milk
3. Filtration and clarification of milk
4. Preparation of standardized, recombined, toned double toned milks
5. Preparation of flavoured and sterilized milk
6. Can washing and sanitation of dairy equipments.
7. Separation of milk
8. Homogenization of milk and efficiency of homogenization.
9. Pasteurization of milk
10. Filling/ Packing of milk by FFS Machines, common problems

IDD-302 DAIRY CHEMISTRY - I 4 Credits

CHEMISTRY OF MILK & MILK CONSTITUENTS

i. Composition of Milk:
Definition of Milk: Gross Composition of milk (Cow, buffalo, goat, sheep, and human). Factors affecting composition: Colostrum and Abnormal milk. Market Milk: Standard, toned, double toned, skim, sterilized flavoured, recombined and reconstituted milks and UHT Milk.

ii. Physical properties of milk:
Colour and flavour, factors responsible, Density and specific gratity: Methods of measurements: Calculation of total solids and solids-not-fat using formula. Factors affecting density and specific gravity of milk. Racknagel effect.

Freezing point and boiling point: effect of dissolved substance on freezing point and boiling point; Use of cryscope in detecting adulteration of milk with water.

Surface tension: Explanation, factors affecting

Viscosity: Factors affecting, importance.

Electrical conductivity: factors responsible, application in detection of mastitis.

Refractive, Index: Explanation, importance.

pH and titratable acidity pH of milk, its importance; milk acidity- natural and developed; constituents responsible: extent of contribution.

Buffer value: Explanation, Buffering agents in milk.

Oxidation:- Reduction potential: Explanation, factors affecting, significance.

iii. Neutralisers and preventives in milk;

iv. Milk constituents and their chemical properties:
i) Milk lipids; Definition and composition of fat glycerides, fatty acids, saponifiable and unsaponifiable matter, sterols, fat soluble vitamin, phospholopids; Properties of milk fat- density, refractive index, iodine value, RM value, polenske value, saponification value, melting point. Relation of milk fat constants to fatty acid composition; importance in quality control.

ii) Milk proteins:

Structure, nomenclature, classification, Isolation, fractionation. Determination major milk proteins. Non protein nitrogen constituents. Properties of milk proteins-hydration, solubility, denaturation, isoelectric point, hydrolysis and colour reactions.

(iii) Major milk enzymes:

Level in milk and their role in milk processing.

Functions, influence of processing parameters.

(iv) Water soluble vitamins in milk:

Levels in milk, effects of light and heat

(v) Carbohydrates:

Definition, classification, presence in milk.

Lactose – structures, physical forms. Solubility, reducing property, hydrolysis, status of lactose in milk, estimation of lactose in milk.

(vi) Minerals in milk:

Major and trace elements: salt balance (Physical equilibrium-colloidal, soluble and lonic) and its importance: Factors affecting physical equilibrium among the salts-temperature, pH and concentration.

Practical

1. Preparation and standardization of sodium hydroxide, hydrochloric acid, sulphuric acid, silver nitrate, potassium permanganate and sodium thisulphate.
2. Sampling of milk for chemical analysis Platform tests of milk.
3. Determination of titratable acidity of milk
4. Preparation of Gerber acid and determination of fat in milk by Gerber and Milk tester methods.
5. Determination of fat by Mojonnier method
6. Determination of lactose in milk by Lane Eynon and polarimetric method.
7. Determination of milk proteins by Kjeldahl and Pyne's methods.
8. Determination of ash, phosphorus, calcium and chloride of milk.
9. Phosphates test
10. Detection of preservatives, neutralizers and adulterants in milk.
11. Detection of adulteration of milk with water by freezing point method.

IDD-303 DAIRY MICROBIOLOGY - I 4 Credits

BASIC MICROBIOLOGY

A. General Microbiology

1. Introduction to Microbiology; Definition, History of Microbiology, Microbiology, Microscope & its uses.
2. Nutrition & Metabolism of Bacteria
3. Bacterial growth
4. Effect of environment of growth of bacteria
5. Destruction of bacteria by physical & chemical modes.
6. Salient features of Moulds
7. Salient features of Actinomycetes, Rickettise and virus.

B. Salient features of Applied Microbiology

1. Soil Microbiology
2. Air Microbiology
3. Water Microbiology
4. Silage Microbiology
5. Industrial Microbiology

Practical

1. Familiarity with common equipment used in microbiological work; use of ovens, steam sterilizers, pressure sterilizers, refrigerators, care of microscope.

2. Common Bacteriological Techniques;
   Cleaning & sterilization of glassware, preparation of median, pH adjustment, preparation of dilution blanks, preparation of stains and indicators and their use in microbiology.
   Simple staining and differential staining; motility of microorganisms.

3 Evaluation of Bacterial population on agar plate and direct cell enumeration.

4 Study of important characteristics of microbes; Staphylococci, Streptococci, Micrococci, Enterococci, Aerobic and Anaerobic bacteria, Lactic acid bacteria, coliforms, streptococci, micrococci, closticidia, yeasts and moulds.

5 Microbiological examination of Soil, Air, Water and Silage.

LNG-300 ENGLISH & BASIC TECHNICAL WRITING 3 CREDIT

1. Language:

a. Word Enrichment- Antonyms, Synonyms, One wordk substitution
b. Sentence – Types, Strucsture & Parts
c. Inflection – Noun
d. Tenses
e. Parts of speech

f. Voice

2. Reading

Comprehension:

a. Listening
b. Reading

3. Writing:

Composition

a. Precis Writing
b. Essay Writing
c. Letter Writing (Components, Formats & different types)
d. CV
e. Resume

IDD-304 DAIRY PRODUCTION –I 4 CREDITS

(Fodder Production & Cattle Nutrition)

A Fodder Production:

1. Systems of forage farming and dairy production in India.
2. Classification of soils, factors affecting fertility of soil acidity, salinity and methods of reclamation.
3. Tillage, tools and implements used for tillage.
4. Manures and fertilizers, methods of application
5. Methods of sowing and implements used for sowing.
6. Weeds and their eradication methods.
7. Study of plant disease and pests, plant protection methods, use of weedicides and pesticides in fodder crops.
8. Sources of irrigation, methods of irrigation, water requirement of fodder crops, drainage of water.
9. Parts of plants and nutrients required for plant growth.
10. Classification of fodder crops, selection of fodder crop.
11. Cultivation of grasses- Hybrid Napier, Guinea grass, para grass etc.
12. Cultivation of cereal fodders- maize, oats barley, teosinte etc.
13. Cultivation of Millet fodders- jowar, ragi, bajra etc.
14. Cultivation of legumes- berseem, Lucerne, cowpea, dolichos etc.
15. Study of fodder trees and shrubs- subabul, susbenia, gliricidia etc.
16. Important crop rotations in different regions of the country, importance of crop rotations mixed cropping.
17. Conservation of fodder- silage and hay making
18. Cost of production of forage crops- working standards of labour and machinery.
19. Seed production for fodder crops available sources

Practicals

1. Use of common tools and implements for tillage.

2. Seed bed preparation- ploughing, harrowing, leveling making bunds and channels.
3. Identification of forage crops, parts of plants, quality of crops.
4. Preparing rootslips and transplanting grasses.
5. Identification of seeds, sowing maize and Lucerne, application of manures and fertilizers.
6. Study of irrigation and drainage practice.
7. Application of weedicides and pesticides.
8. Harvesting of fodder crops, assessment of fodder yield and their quality aspects.

B **Animal Nutrition:**

1. Digestive system: Digestive enzymes, their classifications and properties.
2. Importance of salivary secretion in ruminants (Amount, composition and action of saliva).
3. Digestion in the ruminant stomach, movements of the rumen.
4. Rumination and its nervous control (regurgitation, mastication, reinsalivation) Absorption through the rumen wall.
5. Functions of abdominal secretion Digestion in the small intestine.
6. Regulation and control of intestinal secretions. Role of pancreas.
   Absorption at various levels of the gut.
7. Feeding of Dairy animals; Feeding stuffs – their classifications for growth and milk production of dairy animals.
8. Importance of major and trace elements and their requirements for growth and milk production of dairy animals.
9. Vitamins necessary for dairy cattle, variation of chemical composition of feeding stuff in relation to soil fertility, soil plant, animal and human inter-relationship.
10. Digestion, absorption and utilization of feed nutrients in ruminants.
11. Digestibility coefficients, Total digestible nutrients, Nutritive ratio, starch equivalent.
12. Various measures of feed energy-gross, metabolisable and net energy.
13. Feeding standards in different countries.
14. Basal metabolism, Maintenance requirement. Requirement for growth and milk production.
15. Feeding standards, Computation and preparation of balanced rations under various conditions.
16. Machines used for feed processing:: formulation of concentrate feed stuffs for various categories of cattle.
17. BIS standards –least cost ration formulation for dairy animals. Concentrate preparation as mash and pellets.
18. Complete feed formulation and feeding system.

Practical

1. Identification of common feeds and fodders Examination of common concentrate feeds for quality control.
2. Chemical composition of feeds for moisture, crude and true protein, either extract, fibre, total and soluble ash, calcium and phosphorous.
3. Study of feed mixing and pellet making plant and its operations. Visit to a feed factory in organized sector.
4. Metabolism trial. Least cost ration formulations for various categories of cattle.

IDD-305 Applied Maths & Statistics 4 Credit

Applied Maths

1. Differential calculus

Differential co-efficient, simple applications, meaning of the sign of differential co-efficient, application to small errors and the theory of equations. Higher order derivatives, Leibhitz theorem, Geometrical applications, Tangent and normal's, angle between curves, sub- tangent and sub- normal, Asymptotes, Curvature radius of curvature, centre of curvature, Concavity and convexity, points of inflexion, maxima and minima of functions of single variable, elements of curve tracing, Partial differentiation. Roll's theorem, mean value theorem, Taylors theorem, Taylors and Maclaurins series, evaluation of indeterminate forms, L' Hospital's rule.

2. Integral calculus.

Definite integral as a limit of a sum, rectification of simple plans curves, areas of plane curves, areas of plane curves, surfaces and volumes of revolution, theorem of pappar. Centre of gravity, centre of pressure, moment of inertia, Approximate integration, transpezidal, Simposons rule.

3. Vector calculus

Scalar and vector fields, Directional derivative, gradient of a scalar field, divergence and curl of vector field. Line integral, evaluation of line integrals, Multiple integrals and their evaluation. Surface and volume integrals, Divergence theorem and strokes theorem.

Basic Statistics

Compilation of Data: Introduction, Scores: Discrete and Continuous, Frequency distributions, graphical Representation of the data (Polygon, histogram & pie- diagram)

Measures of Central Value Arithmetic Mean, Median, Mode

Measures of Dispersion of scores – range, Q, mean deviation, standard deviation, co-efficient of variation.

Normal curve- characteristics, Non- normal curves- skewness and kurtosis.

Causes of non- normality

Significance of the difference between two means by t- test, x2 – test (chi- square test)

Significance of the differences among more than two means by F-test

Sampling methods: types, requisites for randomization, use of random numbers.

SECOND SEMESTER

IDD-308 Dairy Production II 3 Credit
(Cattle Breeding & Gen. Mgt.)

General Introduction: Importance if inheritance and environment in development of cattle, concept and significance of Dairy Farm management.

Cattle Breeding: Systems of breeding and their relative advantages and disadvantages. In breeding coefficient, Heat and its detection in cows.

Artificial Insemination : Merits, demerits, limitations, A.I. for higher rate of contraception. Current breeding policies and salient features.

Dairy Farm Management: Indian and exotic breeds of cattle, systems of raising calves, care of milking herd, marking of animals, Dehorning and disbudding, Castrating male calves, clean milk production.

Practicals

1. Identification of different equipments used in animal reproduction and dairy farm management.
2. Problems on inbreeding co-efficient.
3. Familiarity with various breeding records maintained at dairy farm.
4. Care of newly born calf.
5. Marking and dehorning disbudding of animals
6. Detection of heat in cow.

IDD-309 DAIRY ENGINEERING- I 4 Credit
(DRAWING & WORKSHOP PRACTICES)

1. Engineering Drawing: Principles, first and third angle projections, Principal planes, orthographic projection
2. Isometric Views
3. Drawing elevation, side and plan of simple objects/machine parts.
4. Elements of Workshop Technologys' workshop practice, safety care
5. Welding, brazing and soldering, gas and electric welding
6. Working of lathe, milling machine, shaper & planer
7. Grinding machines and drilling machines
8. Hydraulics: Pressure, pressure head units: Measurements of pressure
9. Meaning of laminar and turbulent flow: Statement of continuity equation
10. Bernoulli's theorem and its application

11. Flow measurement with orifice, venture meter and rotameter.
12. Water supply for the Dairy: Sources, water Quality
13. Selection of pumping equipment: Classification of pumps: principles of working, operation and maintenance of centrifugal and reciprocating pumps, sanitary pumps
14. Elements of heat transfer: Modes of heat transfer: Fouriers law.
15. Heat transfer through slab and composite wall: Overall heat transfer coefficients
16. Typ3es of heat exchangers and their application in the Dairy: Efficiency of plate heat exchangers Heat insulators.
17. Temperature measurement devices

PRACTICALS

1. Operation of lathe machine
2. Operation of drilling and grinding machine
3. Soldering and welding practice
4. Performance of a centrifugal pump
5. Study of sanitary milk pumps
6. Measurement of thermal conductivity
7. Pressure, temperature and flow measurement in liquid lines.
8. Preparation of G.I. and S.S. pipe joints and fittings.
9. Study of different types of heat esxchangers.

IDD-310 Dairy Chemistry- II 4 Credit
(Chemistry of Milk Products)

1. Physicochemical changes in milk and milk constituents during heating, concentration and drying: effect on nutritional value.
2. Cream: Creaming, strokes law; factors affecting creaming, rheological characteristics of cream, composition and properties of dry cream, standards.
3. Butter: Structure of butter, mechanism of churning, factors affecting fat losses. Ageing: Churning time and consistency of butter. Influence of fatty acid composition and physical state of state of fat on the consistency of butter, defects in butter, flavour of butter, standards, packaging.
4. Butter oil and Ghee: Composition, characteristics far constants, organoleptic properties. Genesis of flavour and texture. Hydrolytic and auto oxidative spoilage of ghee and its prevention. Natural and synthetic anti oxidants , Ghee residue. Common adulterants and their detection, standards, packaging.
5. Concentrated milk: Evaporated and sweetened condensed milk. Physico chemical aspects involved in the manufacture of evaporated and condensed milk. Heat stability of concentrated milk as affected by process variables. Milk constituents and additives. Storage defects and their prevention, standards, packaging.

6. Dried milk: roller drying and spray drying. Instantisation. Physico-chemical aspects during processing. Factors influencing the formation and quality of the products. Storage defects, standards packaging.
7. Infant milk foods: Milk for infant feeding Special features.
8. Malted milk foods: Composition, physico chemical aspects in the preparation of malted milk foods, standards packaging
9. Coagulated products: milk clotting enzymes from different sources- Animal, microbial and plant. Factors affecting coagulation of milk and characteristics of curd. Rennet action: Changes taking place during manufacture and ripening of cheese. Types of cheese. Packaging, standards.
10. Fermented products: Varieties, change in milk constituents during fermentation. Flavour development Nutritional and therapeutic value of fermented milk products. Packaging, standards.
11. Indigenous milk products: khoa, chhana, paneer, chakka, srikhand, peda, burfi, rasagolla, basundi etc. composition, quality attributes and defects, packaging, standards.
12. Frozen products: Composition of icecream and kulfi, emulsifiers and stabilizers, role of different constituents and processing parameters (Homogenization, whipping, over run) in Physical attributes of ice cream and kulfi. Defects in ice cream and kulfi, Packaging, standards.
13. Caseinates and co-precipitates: Different types of casein preparations, their uses and standards, preparations of co-precipitates. Functional properties of caseinates and co-precipitates.
14. Whey proteins: Whey proteins concentrate and whey protein isolates. Applications of whey proteins as functional proteins in various food systems.
15. Lactose: manufacture and use in food and pharmaceutical preparations.
16. Nutritional quality of Dairy foods: Nutritive requirements of specific groups. Nutritive value of dairy foods and their constituents. Effects of processing and storage on the nutritive value of dairy foods.

Practicals

(a) Cream: Sampling and analysis of cream for fat acidity.
(b) Butter: Determination of moisture, fat, salt, curd, and acidity.
(c) Ghee: Determination of fat constants: melting point, refractive index. RM and potenke values, saponification value. Iodine value, determination of acidity and peroxide value.
(d) Concentrated milk: Sampling determination of total solids, fat, proteins, sucrose and lactose.
(e) Milk powder: sampling, determination of moisture, total solids, fat, proteins, total ash, carbohydrates, lactose, solubility percent. Insolubility index bulk density.
(f) Infant foods and malted milk foods, moisture, total ash and insoluble ash, solubility, starch.
(g) Cheese: Sampling, determination of moisture, fat, protein, salt and acidity.
(h) Dahi: sampling, Determination of total solids, fat and acidity.
(i) Yoghurt: determination of sugar.

(j) Indigenous products: Sampling and analysis of Khoa, channa, chakka, and paneer, for moisture/ total solids, fat and proteins.
(k) Ice- cream; sampling, Determination of overrun, acidity, fat total solids, protein and sucrose.
(l) Caseinate and co-precipitates, Analysis for moisture, fat, ash, colour.

IDD-311 DAIRY MICROBIOLOGY- II (MICROBIOLOGY OF MILK) 4 Credits

A **Microbiology of Milk**

1. Sources of microbial contamination of milk and their importance
2. Milk – borne disease
3. Important groups of spoilage of micro organisms and their manifestation in milk.
4. Microbial growth in milk during storage and transport
5. Taints and abnormal conditions in milk
6. Principles of sanitation practices at all stages of production and processing
7. Bacteriology of heat-treated milks
8. Evaluation of bacteriological features of milks

B Microbiology of Foods

1. Classification of foods
2. Natural functional systems of food and their interactions on shelf life
3. Food processing compulsions and options
4. Types of food spoilage and their aetiology
5. Methods of limiting microbial proliferation in foods
6. Features of food fermentations as a desirable change
7. Evaluation of microbiological features of foods

Practical

A Microbiology of milk

1. Sampling of milk for microbiological analysis
2. Application of rapid tests for evaluation of milk quality
3. Enumeration of bacterial numbers by direct and indirect methods
4. Methods used for determining psychrotropic organisms in milk
5. Assessment of pasteurized milk based on the following; standard plate count. E coil test. Phosphate test, thermoduric and thermophilic numbers
6. Evaluation of utensils and equipments for sanitation

B Microbiology of foods

1. Comparative study of raw and processed foods
2. Study of food enzymes in relation to their profiles at shelf life
3. Effect of storage temperature on shelf life foods
4. Microbiology of vegetables, eggs, meat, flour, bread, cereals and spices
5. Role of salt, sugar, inorganic acids and alkalies in food preservation

IDD-312 DAIRY TECHNOLOGY- II 4 Credit
(FAT RICH DAIRY PRODUCTS)

Status of fat rich dairy products in India and abroad.
Introduction to milk lipids - definition and general composition of milk fat.

Cream: efficiency of cream separation and factors affecting it; control of fat concentration in cream. Receiving, grading, sampling and weighing of raw cream; neutralization, pasteurization and cooling of cream. Preparation and properties of different types of cream; table cream, sterilized cream, whipped cream, plastic cream, frozen cream and cultured cream. Preparation of cream for butter making. .

Butter: introduction to the butter-making process; theory of churning; batch and continuous methods. Technology of butter manufacture; over-run in butter; control off at losses in ~utter milk; packaging and storage; transportation; defects in butter; rheology of butter; uses of butter.
Butter-making equipment: construction, operation, care and maintenance of cream separators, coolers and vacreator, factory butterchurn and continuous butter making machines.
Special butters and related products: *manufacture, packaging, storage and properties of whey butter, flavoured butter, whipped butter, renovated butter/fractionated and poly-unsaturated milk, fat products, vegetable oil-blended products and low-fat spreads.*
Manufacture, packaging, storage, and characteristics of Margarine of different types.

Ghee and butteroil:. Methods of ghee making . batch and industrial processes, innovations in *ghee* production, procedure, packaging and preservation of ghee; utilization of substandard milk and old/stored butter in the manufacture of ghee.
Continuous process for the production of ghee.
Methods of manufacture, packaging, storage, distribution and uses of butter- oil.
Nutritional aspects of cream, butter, butter-milk, ghee and ghee residue.
Health aspects of milk fat.
Technical control in butter industry: Factors affecting plant operations' efficiencies,. Losses of milk solids, methods of improving operational efficiency and product accounting.

Practicals
1. Standardization, neutralization, pasteurization and cooling of cream
2. Preparation of sterilized cream.
3. Preparation of cooking butter by the hand-operated chum.
4. Preparation of *desi* butter.
5. Manufacture of table butter using the power-driven chum.
6. Preparation of a low-fat spread.
7. Preparation of *ghee* from cream and butter.
8. Plant visit.

IDD-313 DAIRY TECHNOLOGY- III 3 Credit
(INDIGENOUS MILK PRODUCTS & MILK BASED SWEETS)

INDIGENOUS MILK PRODUCTS

1. Ghee:
(a) Definition of ghee, importance of ghee in India
(b) Methods of manufacturing ghee
(c) Grading of Ghee and factors influencing quality of ghee
(d) Difference of ghee & butter oil
(e) Utilization of ghee and resedue.

2. Khoa 3. Chhana 4. Paneer 5. Dahi 6. Indigenous Cheese

(a) Preparation & Packaging, yield and composition.
(b) Factor affecting quality
(c) Packaging & Preservation
(d) Marketing and grading
(e) Legal standards

MILK BASED SWEETS

1. Place of milk based sweets in India and abroad.
2. Method of manufacture, packaging, storage and transportation of Rasogulla, Gulab jamun, Kalakhand, Rabri, Keer, Khurcha, malai, Rasmalai, Barfi, Peda, Srikhand, Sandesh, Chakka, Milk cake, Pantoa, Payodhi and lassi.

Practicals

1. Preparation of *khoa*
2. Preparation of Ghee from butter and cream.
3. Preparation of *Paneer.*
4. Preparation of *chhana*
5. Preparation of *Dahi*
6. Preparation of Surti Cheese
7. Preparation of milk based sweets

THIRD SEMESTER

IDD-319 DAIRY PRODUCTION -III 3 Credits
(CATTLE HEALTH & REPRDUCTION)

1 General Management: Importance of ruminants, classification of breeds of the basis of utility.
2 Important dairy breeds of indigenous and exetic cattle and buffaloes.
3. Calf rearing different methods
4. Management of dairy heifers and bull calves
5. Care of pregnant animals during and after parturition.
6. Management and care of milking stock, dry stock and breeding bulls.
7. Cleaning and sanitation of cattle yard premises.
8. Clean milk production, principles of milking, milk recording. Records essential to good herd management.
9. Milk secretion.
10. Preparation of animals for cattle shows, transport of animals by roads and rail.
11. The principles and practices of breeding dairy stock.
12. Medelism, Different systems of breeding
13. In breeding, line breeding, cross breeding, grading up, pregnancy testing, culling and selection of animals in the open market.
14. Anatomy of reproductive organs Artificial Insemination.
15. Embryo transfer technology- a general concept and its role in national perspective.
16. Signs of health and ill health.
17 Diagnosis and detection of diseases care and feeding of sick animals
18 Disinfections, isolation and prophy laxis measures during cutbreak of contagious diseases of cattle like foot and mouth, Rinder Pest, Brucellosis, T.B. Jhones and mastitis.
19. Diseases of young stock, Navel-III, Pheumonia, scours, Ring work and Mange.

Practicals

1. Layout of a cattleyard, living space for each category of animal from health point of view.
2. Recognition of body parts of dairy animals
3. Physical character of the breeds maintained.
4. Calf feeding, Tattoing, Dehorning, Grooming.
5. Estimation of age and body weight
6. Preparation of animals for milking, milk cooling, observations of signs of oestrus and pregnancy.
7. Cleaning and sanitation of milking sheds and milk record room.
8. Judging of milch cows
9. Preparation of animals for show
10. Study of important cattle records

11. Identification of common cattle feeds computation of rations
12. Recording observations on temperature, pulse and respiration.
13. Identification and use of common first aid drugs and pharmaceutical instruments used in the cattle yard.
14. Dressing of wounds and bandaging
15. Diagnosis and treatment of mastitis.
16. Practice in Artificial Insemination
17 Demonstration on Embryo Transfer Technology at the appropriate centre

IDD – 320 DAIRY ENGINEERING – II 4 Credits
(REFRIGERATION & STEAM ENGINEERING)

1. Steam and steam generators; Wet, dry and super heated steam; dryness fraction, internal energy and enthalpy; Use of steam tables.
2. Classification of boilers; constructional features and operations of vertical fire tube, horizontal return flue and automatic boilers.
3. Boiler mountings, accessories and their uses
4. Capacity and horsepower of boilers; scaling of boiler and water treatment plant.
5. Electrical Engineering: Simple and three phase power supply; star and delta connections.
6. Types and working principles of transformers
7. Principles of working, operation, selection and maintenance of single and three phase induction motors and starters.
8. Instruments for measurements of voltage current. Power and energy
9. Refrigeration Engineering: Unit of refrigeration; important components and controls of Mechanical vapour compression refrigeration system and their functions.
10. Common refrigerants
11. Application of sealed units
12. Ice bank systems
13 Features of cold stores, insulting materials, vapour barriers etc.

Practical

1 Study of constructional features of vertical fire tube boiler
2. Study of constructional features of horizontal return flue type boiler
3. Boiler fittings
4. Boiler safety devices
5. Measurement of electrical power in A.C. circuits
6. Fluorescent tube connections
7. Starting of three phase induction motor with DOL starter
8. Star delta starters
9. Study of different types of motors
10 Study of performance of different types of compressors
11. Study of refrigeration evaporators and condensers

12. Study of different types of expansion devices
13. To determine C.O.P. of a refrigeration system

IDD - 321 DAIRY MICROBIOLOGY – III 4 Credits
(MICROBIOLOGY OF MILK PRODUCTS)

1. Starter cultures; Functions, classifications, maintenance, evaluation of cultures, hecterophages and recent concepts of starter technology.
2. Microbiology of fermented milk; History, features of fermentation, nutritive and therapeutic values. Methods of manufacture, problems of spoilage and evaluation.
3. Microbiology of cheese: classification, features of cheese in relation to microbial metabolism, selection of starter systems. Brief techno-microbial features of Chedder, Gouda, Swiss, Blue, Cammemert, Bric, oft unripended and Cream cheeses.
4. Microbiology of cream and Butter: types of cream. Microbiology or raw cream and their manifestations; evaluation of raw cream. Pasteurization of cream, storage and its evaluation.

   Definition and composition of butter, comparative microbiology of Desi and Creamery butter, Microbial metabolism in butter, Rippened and cultured butter, and their manifestation.

   Influence of technologies on microbial load and functioning. Production, handling, storage and microbial defects in butter, Ripended and cultured butter, their advantages and limitations.

5. Microbiology of ice – cream and other frozen dairy products; Definition and composition of ice-cream. Microbial load in ice cream. Growth of microorganisms in ice cream mix. Types of organisms found in ice cream.

   Effect of addition of ingredients on quality of ice cream. Sources of contamination during production, handling and packaging. Brief description of Kulfi and other frozen milk products.

6. Microbiology of dry milks; Types of dried milks, Brief description of drying methods. Effect of process technology on microbial content. Influence of packing and storage on microbiological features, public health safety and evaluation.

   Microbiology of reconstituted dry milks, dry milk as food adjunct and its impact on foods.

7. Microbiology of frozen desserts; Types of frozen desserts- Microbiological integrity of ingredients used. Public health hazards. Processing features and their impact on microflora. Effect of storage, transport, retailing and parlour dispensing on microbiology, plant and handling sanitation and evaluation.

8. Microbiology of indigenous milk products; Paneer/ Chahana; Physio-chemical features and their influence on microbial metabolism. Sanitation practices to check flora. Effect of storage spoilage and evaluation.

   Khoa/ burfi/ mawa; Products suitability for proliferation of Microbes. Production and handling hygiene. Public health hazards. Shelf life, spoilage and evaluation.

   Chakka/ Shrikhand; Microbial features in relation to basal material, production hygiene and storage. Spoilage and evaluation.

Practical

1. Preparation and evaluation of starter cultures Microbiological examination of
2. Cream, butter
3. Ice cream
4. Cheese
5. Evaporated milk, sweetened condensed milk. Plain condensed milk & dried milks
6. Dahi, Yoghurt, Acidophilus
7. Khoa and Channa

IDD – 322 DAIRY TECHNOLOGY – IV 4 Credits
(CHEESE FERMENTED MILK FOODS & BY PRODUCTS)

1. Fermented Products:- History and development
2. Production of Dahi, Yoghurt, Acidophilus milk, Lassi
3. Packaging of fermented products
4. Nutritive value and legal standards
5. History of cheese making
6. Legal standards
7. Classification and composition of common varieties of Cheese
8. Technology of manufactures of Cheddar, Gauda, Mozarella, Cottage cheeses
9. Processed cheese, Cheese spread, Cheese foods and cheese
10. Stabilizers and emulsifiers used in processed cheese
11. Physical, Chemical and Bacteriological changes during ripening process, packaging and defects.
12. Judging and grading of cheese
13 By products- classification and characterization
14 Use of whey, preparation of whey protein
15 Manufacture of lactose and its use
16 Manufacture of casein and its use

Practical

1. Production of Dahi, Yoghurt, Acidophilus milk, lassi
2. Production of cheddar Cheese
3. Production of Gouda Cheese
4. Production of Mozarella cheese
5. Production of processed cheese and cheese spread
6. Production of cottage cheese
7. Packaging and analysis of cheese
8. Judging and grading of cheese
9. Manufacture of Byproduct (Preparation of lactose lactical rennet casein, calcium caseinate, why protein concentrate, whey powder and whey drink)
10. Preparation of lactic acid and rennet casein
11. Preparation of calcium caseinates
12. Preparation of whey protein concentrates
13. Preparation of whey powder
14. Preparation of lactose
15. Preparation of whey milk.

IDD – 323 DAIRY TECHNOLOGY – V (CONDENSED & DRIED MILKS) 4 Credit

1. Status of condensed and dried milk industry in India and abroad
2. Composition and legal standards of condensed and dried milk products
3. Technology of manufacture of Sweetened condensed milk and evaporated milk
4. Defects, causes and remedies
5. Packaging and keeping quality of condensed and evaporated milks
6. Principle of drum drying, spray drying, foam drying
7. Manufacture of skim, whole, malted milk powders
8. Defects in dried milks and their causes
9. Packaging and storage
10. Instantized milk powder, infant food formulation and method of manufacture

Practical

1. Vacuum pan operation
2. Operation of roller and spray drier
3. Production of sweetened condensed and evaporated milks
4. Production of roller and dried milk powders
5. Production of spray dried skim milk powder
6. Production of malted milk
7. Judging and grading of condensed and dried milk products

IDD – 324 ECONOMIC PRINCIPLES AND FINANCIAL ACCOUNTING IN DAIRY BUSINESS 4 Credit

1. Basic concept; Nature of Economics, Meaning, definition, scope of Economics, Utility, Goods value, Wealth.
2. Concept of consumption: Meaning and importance, determination and characteristics, classification of wants, Law of Diminishing utility, Law of Equi-marginal utility.
3. Concept of Production: Meaning, Factors of production, Land, Labour, Capital, organization, Enterprise.
4. Concept of Exchange: Meaning, Definition, Advantages of Exchange, Forms of Exchange.
5. Concept of Market, Meaning, Definition, Degree of compelition in market, Demand and supply.
6. Concept of Distribution: Meaning, Definition, problem of distribution, Method of Distribution, Rent, Wages, etc.
7. Financial Management and its planning: Meaning, Objectives.
8. Concept of Financial accounting: Subject matter, Basic principles, classification and its importance.
9. Concept of Accounting procedure, Journal, Definition, Meaning, Role for Debit and Credit.
10. Concept of Double Entry System: Advantages of Double entry system.
11. Ledger: Concept, Necessities, Types of ruling, Deference between Journal and Ledger
12. Cashbook: Meaning, Types of cash book, Advantages, Difference & Sanitarities with Ledger.
13. Trial Balance: Meaning, Definition, Its objectives, advantages, and Limitation, Characteristic s
14. Concept of Depreciation: Definition, Meaning Objectives, Different method of calculating Depreciation.

Practical

1. Preparation of Journal
2. Preparation of Ledgers
3. Preparation of Cash Book
4. Preparation of Trial Balance
5. Preparation of Format of milk reception
6. Preparation of stock sheet
7. Calculation of Depreciation

FOURTH SEMESTER

IDD 331 DAIRY ENGINEERING – III 4 Credits

1. Sanitary metal and features of sanitary designs
2. S.S. Pipes and Fittings
3. Receiving room equipments
4. Working and maintenance of mechanical can washers
5. Different types of milk chilling equipments and their application.
6. A study of constructional features of milk storage tanks.
7. Principles of centrifugal separation: cream separators: self desludging clarifiers.
8. Efficiency, capacity and maintenance of separators
9. Constructional features, operation and maintenance of batch and HTST: pasteurizers and controls.
10. Equipment for milk sterilization and UHT processing
11. Homogenizers: Constructional features, operation and maintenance of homogenizers and accessories.
12. A study of milk sachet and asceptic filling machines and their maintenance.
13. C.I.P. cleaning systems.

PRACTICALS

To conduct the study of constructional features and operation of:

1. Mechanical can washer
2. Plate chiller
3. Milk storage tank
4. Cream separator
5. Study of Homogenizers
6. Batch Pasteurizer
7. H.T.S.T. pasteurizer
8. FDV controller
9. Sachet filling machine

IDD- 332 DAIRY ENGINEERING – IV 4 Credits

1. A study of equipments for indigenous dairy products
2. Equipments for fermented and coagulated dairy products.
3. Ice cream freezers: batch type
4. Ice cream freezer continuous type, accessories
5. Equipments for condensed milk, vacuum pan
6. Classification of continuous evaporators
7. Multiple effect evaporator and accessories Equipments for drying milk: roller drier: parallel and counter flow spray driers and their accessories

8. Plant layout and design: site selection
9. Factors concerning design and layout; example
10. Features of dairy floors and ventilation
11. Dairy waste treatment and methods of disposal

PRACTICALS

To conduct the study of constructional features and operation of:

1. Equipments for manufacture of indigenous dairy products.
2. Cheese equipment.
3. Butter churn
4. Vacuum pan
5. Multiple effect evaporator
6. Roller drier
7. Spray drier

To draw layouts for:

8. Chilling centers
9. Market milk plant
10. A plant with market milk and milk products (Composite milk plant)

IDD– 333 DAIRY TECHNOLOGY- VI 4 Credit
(ICE CREAM & FROZEN DAIRY PRODUCTS)

1. Status of Ice Cream Industry
2. Classification of Frozen dairy products
3. Composition of Ice Cream, BIS and PFA standards for Ice Cream. Calulation of mixes. Ice Cream ingredients, stabilizers and emulsifiers, flavouring and colouring materials
4. Mix processing, Ice cream freezers, packaging and handling of Ice Cream
5. Judging and grading of Ice Cream
6. Fruit Ice Cream, Nut Ice cream, Kulfi preparation
7. Frozen Yoghurt, characteristics and production
8. Defects in frozed products, prevention and remedies

Practical

1. Selection of ingredients for Ice cream, calculation of mix preparation
2. Preparation of Ice Cream and kulfi
3. Preparation of Fruit Ice Cream
4. Preparation of Casata Ice Cream
5. Studies on the characteristics of stabilizer and emulsifiers
6. Effect of homogenization on the quality of Ice Cream
7. Production of Frozen yoghurt
8. Judging and grading of frozen dairy products
9. Packaging materials and packaging of Frozen Dairy products.

IDD – 334 QUALITY ASSURANCE OF DAIRY PRODUCTS 3 Credit

Chemical Quality Control:

1. Responsibility and organization of quality control department general principles.
2. Food and laws and standards – PFA, BIS, Agmark, IDF
3. Calibration: Calibration of dairy glassware lactometer, butyrometer, milk pipette end.
4. Colour and gloss: Natural synthetic colours, Specification of colour for dairy foods.
5. Flavour: Flavor components in diary foods, Artificial flavours.
6. Addictive: stabilizers, emulsifiers, sweeteners, vitamins, minerals, amino acids/ protein hydrolysate antioxidants, preservatives, neutralizers, coloring matter and flavouring agents.
7. Packaging: packaging material for dairy foods- types and properties.
8. Contaminate pesticide residues, heavy metals, toxins, antibiotics, detergents, sanitizers and contaminants from packaging materials.
9. Sensory evaluation: General introduction, testing conditions, taste, odour, aroma, texture appearance, and other parameters. Difference testes and ranking tests. Individual tests, Individual steps in selection of test subjects.
10. Water, analysis, treatment
11. Detergents and sanitizers: types, properties and analysis.
12. Elementary knowledge of instrumental analysis.
13. Prediction of self- life of dairy products including UHT processed Sterilized milk

Practical

1. Standardization of milk testing equipments butyrometer, lactometer, milk pipette, thermometers etc,
2. Physical properties of dairy foods, Estimation of pH, acidity, density, specific gravity, viscosity, surface tension, electrical conductivity, buffering capacity and oxidation potential.
3. Estimation of browning in dairy foods.
4. Estimation of antioxidant, preservatives, neutralizers and monostearate.
5. Estimation of organ chlorine pesticide resdue in dairy foods.
6. Sensory evaluation of dairy foods for colour, appearance, taste, odour, texture and acceptability. Difference taste and ranking taste.
7. Estimation of temporary and permanent hardness of water.
8. Estimation of alkanities in detergent solutions.
9. Estimation of available chlorine and Iodine in sanitizer.
10 Determination of iron in fortified dairy foods.
11. Separation of dairy food colours by thin layer chromatography.

Microbiological Quality Assurance:

1. Basic Concept of Food biology: their relation to quality assurance. Food class orientation plant and animal origin. Problems associated with natural foods for human consumption. Role of microbial systems in conversation of Taw foods for better utility.
2. Food Safety: Traditional problems. Emerging problems

3. Regulatory systems/ agencies: Government / NGO / Professional / Other agencies. Mandatory regulation like PFA, etc, Optional Advisory systems like BIS, IDF Agmark based etc. Comparative standards of milk produce and milk foods of countries pioneering in specified foods.
4. Role of supporting service systems in quality food processing: water, Air, Personnel, their health, hygiene and habits, equipments design, material used, construction, finish, maintenance and hygiene, packing material, nature, design and type: warehousing and condition of their maintenance, shipping, transport systems and their handling.
5. Food plant hygiene: Need for providing consumer guidance on the time limit for safe consumption. Consumer assessable methods for safety of canned feeds.
6. Sampling procedure for microbiological evaluation of foods.
7. Total quality management system for food industry, Quality audit concepts (ISO etc) a wholistic growth from elementary. Quality control to quality Assurance culminating in total quality system.
8. Hazard analysis of critical control points (HACCP): HAACCP- an essential tool for supporting operation of TQM in food processing industries.
9. Microbiological quality of milk and milk products Historical to current state of art.
10. Organization of microbiological evaluation laboratories, setting up laboratories to support TQM system.
11. Food industry effluent management: Biochemical characteristics of food industry effluents, methods for reduction of organic matter in waste waters, recycling of water for better management of ecology.

Practicals

a. Sampling procedures for microbiological evaluation of foods.
b. Evaluation of foods for public health safety, salmonella, shigella, staphylococci, clostridia, Listeria,
bacillus cereus, Campylobacter.
c. Monitoring microbial density of air-environment of processing plant.
d. Evaluation of microbiological quality of water for the processing plant.
e. Assessment of hygiene of personnel working in the plant.
f. Evaluation of equipment decision, material used, consyruction, finish and maintenance, for hygiene.
g. Assessment of packing material for hygiene.
h. Assessment of warehouse and their maintenance of microbiological contamination.
i. Evaluation of basic cleaning systems, detergent support and sanitisers.
j. HAACP evaluation of manufacturing process.
k. Assessment of microbiological quality of milk and milk products.
l. Study of microbiological laboratories with reference to their layout and their functioning.

IDD – 335 DAIRY PLANT MANAGEMENT 3 Credit

Production management
Definition, functions and structure of production management.
Production planning and control, work study and measurement, motion and method study.

Plant operations: efficiency factors, losses, BEP, financial and managerial efficiency.
Provisions of industrial legislation in India particularly for the dairy industry.
Personnel management: manpower planning. recruitment. training. transfer and promotion policies.
Job specifications, job evaluation, job enhancement, job enrichment, MBO.

Practicals

1. Flow Process Charts of different milk products
2. Identification of steps of material losses in the plant.
3. Identification of hazardous processes and equipments, safety and precautions
4. Identification and uses of common lubricants
5. Waste utilization processes

COMP- 401 COMPUTER APPLICATION 2 Credit

1. Introduction to Computers
2. H/W and S/W Concepts and Terminology
3. Operating System
   (a) DOS
   (b) Windows
4. Introduction to commonly used application software
   (a) MS Word
   (b) MS Excel
5. Computer Languages & Introduction to 'C' Programming Language
   (a) Input & Out put statements
   (b) Declaration of variables
   (c) Operators
   (d) Control Statements (Branching and Looping)
6. Introduction to computer Networks
7. Introduction to Internet
8. Application of I.T.

Practical List:

(a) Working with operating systems like MS. DOS, Windows
(b) Study of Software packages, Like MS Word, MS Excel and MS. PowerPoint
(c) Packages related to medical applications
(d) How to search data, workable knowledge of Internet
(e) Simple programs in C languages
   (i) To find the largest among three numbers
   (ii) To check whether the given number is palindrome or not.
   (iii) To find whether the given number is the prime
   (iv) To find sum and average of n integer using linear array
   (v) To generate the Fibonacci series
   (vi) To find factorial of a given number using functions.

COURSE STRUCTURE OF I.D.D.(DAIRY HUSBANDRY)

SEMESTER I

Course Code	Course Title	L-T-P	Credits
IDD-301	Dairy Technology I (Indian Dairy Industry &Market Milk)	3-0-2	4
IDD-302	Dairy Chemistry I (Chemistry of Milk & Milk constituents)	3-0-2	4
IDD-303	Dairy Microbiology I (Basic Microbiology)	3-0-2	4
LNG-300	English & Basic Technical Writing	3-0-0	3
IDD-306	Dairy Production-I (Forage Production)	3-0-2	4
IDD-307	Dairy Production-II (Cattle Nutrition)	3-0-2	4

SEMESTER II

Course Code	Course Title	L-T-P	Credits
IDD-314	Elementary Statistics	2-1-0	3
IDD-315	Dairy Production III (Genetics & Cattle Breeding)	3-0-2	4
IDD-316	Dairy Production IV (General Mgt. & Care of Dairy Herd)	3-0-2	4
IDD-311	Dairy Microbiology II (Microbiology of Milk)	3-0-2	4
IDD-317	Dairy Technology II (Milk Products)	3-0-2	4
IDD-318	Dairy Farm Engg.	3-0-2	4

SEMESTER III

Course Code	Course Title	L-T-P	Credits
IDD – 325	Dairy Production – V (Animal Physiology and Reproduction)	3-0-2	4
IDD – 326	Dairy Production – VI (Animal Disease & Hygiene)	3-0-2	4
IDD – 327	Poultry Production	3-0-2	4
IDD – 328	Extension Education	3-0-2	4
IDD – 329	Principles of Economics	3-0-0	3
IDD – 330	Financial Accounting in Dairy Business	3-0-0	3

SEMESTER IV

Course Code	Course Title	L-T-P	Credits
IDD – 336	Breeding & Management of Sheep	2-0-2	3
IDD – 337	Breeding & Management of Goats	2-0-2	3
IDD – 338	Breeding & Management of Pigs	2-0-2	3
IDD – 339	Dairy Business Management	3-0-2	4
IDD- 340	Preservation & Processing of Animal Foods	3-0-2	4
COMP- 401	Computer Application	1-0-2	2

SYLLABUS OF I.D.D.(DH)

FIRST SEMESTER

IDD-301 **DAIRY TECHNOLOGY- I** **4 Credits**

INDIAN DAIRY INDUSTRY & MARKET MILK

S.No.	Topic	No. of Lectures
1.	Market Milk: Market Milk Industry in India and Abroad	
2.	Clean Milk production, collection of Milk and practices followed at rural milk collection centres, chilling of milk, milk preservation by hydrogen peroxide and LP systems	
3.	Transportation of milk. Reception of milk. Platform tests	
4.	Filtration, clarification and separation of milk, Standardization of milk	
5.	Pasteurization of milk	
6.	Homogenization of milk	
7.	Sterilization of milk by conventional method UHT processing of milk sterilization	
8.	Special milks, recombined milk, toned milk, double toned milk, filled milk, vitaminised milk, flavoured milk	
9.	Packaging and distribution of milk	
10.	Metals in diary equipments manufacture	
11.	Cleaning and sanitation of dairy equipment	
12.	Defects in milk, their causes and prevention	

Practical

1. Reception of milk and platform tests
2. Fat. SNF and acidity tests of milk
3. Filtration and clarification of milk
4. Preparation of standardized, recombined, toned double toned

milks

5. Preparation of flavoured and sterilized milk
6. Can washing and sanitation of dairy equipments.
7. Separation of milk
8. Homogenization of milk and efficiency of homogenization.
9. Pasteurization of milk
10. Filling/ Packing of milk by FFS Machines, common problems

IDD-302 DAIRY CHEMISTRY - I 4 Credits

CHEMISTRY OF MILK & MILK CONSTITUENTS

1. Composition of Milk:
   Definition of Milk: Gross Composition of milk (Cow, buffalo, goat, sheep, and human). Factors affecting composition: Colostrum and Abnormal milk. Market Milk: Standard, toned, double toned, skim, sterilized flavoured, recombined and reconstituted milks and UHT Milk.

2. Physical properties of milk:
   Colour and flavour, factors responsible, Density and specific gratity: Methods of measurements: Calculation of total solids and solids-not-fat using formula. Factors affecting density and specific gravity of milk. Racknagel effect.

   Freezing point and boiling point: effect of dissolved substance on freezing point and boiling point; Use of cryscope in detecting adulteration of milk with water.

   Surface tension: Explanation, factors affecting

   Viscosity: Factors affecting, importance.

   Electrical conductivity: factors responsible, application in detection of mastitis.

   Refractive, Index: Explanation, importance.

   pH and titratable acidity pH of milk, its importance; milk acidity- natural and developed; constituents responsible: extent of contribution.

   Buffer value: Explanation, Buffering agents in milk.

Oxidation:- Reduction potential: Explanation, factors affecting, significance.

3. Neutralisers and preventives in milk;

4. Milk constituents and their chemical properties:
   i. Milk lipids; Definition and composition of fat glycerides, fatty acids, saponifiable and unsaponifiable matter, sterols, fat soluble vitamin, phospholopids; Properties of milk fat- density, refractive index, iodine value, RM value, polenske value, saponification value, melting point. Relation of milk fat constants to fatty acid composition; importance in quality control.
   ii. Milk proteins:
   Structure, nomenclature, classification, Isolation, fractionation. Determination major milk proteins. Non protein nitrogen constituents. Properties of milk proteins-hydration, solubility, denaturation, isoelectric point, hydrolysis and colour reactions.
   (iii) Major milk enzymes:
   Level in milk and their role in milk processing.
   Functions, influence of processing parameters.
   (iv) Water soluble vitamins in milk:
   Levels in milk, effects of light and heat
   (v) Carbohydrates:
   Definition, classification, presence in milk.
   Lactose – structures, physical forms. Solubility, reducing property, hydrolysis, status of lactose in milk, estimation of lactose in milk.

   (vi) Minerals in milk:
   Major and trace elements: salt balance (Physical equilibrium-colloidal, soluble and lonic) and its importance: Factors affecting physical equilibrium among the salts-temperature, pH and concentration.

Practical

1. Preparation and standardization of sodium hydroxide, hydrochloric acid, sulphuric acid, silver nitrate, potassium permanganate and sodium thisulphate.
2. Sampling of milk for chemical analysis Platform tests of milk.
3. Determination of titratable acidity of milk
4. Preparation of Gerber acid and determination of fat in milk by Gerber and Milk tester methods.
5. Determination of fat by Mojonnier method
6. Determination of lactose in milk by Lane Eynon and polarimetric method.
7. Determination of milk proteins by Kjeldahl and Pyne's methods.
8. Determination of ash, phosphorus, calcium and chloride of milk.

9. Phosphates test
10. Detection of preservatives, neutralizers and adulterants in milk.
11. Detection of adulteration of milk with water by freezing point method.

IDD-303 DAIRY MICROBIOLOGY - I 4 Credits

BASIC MICROBIOLOGY

A. General Microbiology

1. Introduction to Microbiology; Definition, History of Microbiology, Microbiology, Microscope & its uses.
2. Nutrition & Metabolism of Bacteria
3. Bacterial growth
4. Effect of environment of growth of bacteria
5. Destruction of bacteria by physical & chemical modes.
6. Salient features of Moulds
7. Salient features of Actinomycetes, Rickettise and virus.

B. Salient features of Applied Microbiology

1. Soil Microbiology
2. Air Microbiology
3. Water Microbiology
4. Silage Microbiology
5. Industrial Microbiology

Practical

1. Familiarity with common equipment used in microbiological work; use of ovens, steam sterilizers, pressure sterilizers, refrigerators, care of microscope.

2. Common Bacteriological Techniques;
Cleaning & sterilization of glassware, preparation of median, pH adjustment, preparation of dilution blanks, preparation of stains and indicators and their use in microbiology.
Simple staining and differential staining; motility of microorganisms.

3 Evaluation of Bacterial population on agar plate and direct cell enumeration.

4 Study of important characteristics of microbes; Staphylococci, Streptococci, Micrococci, Enterococci, Aerobic and Anaerobic bacteria, Lactic acid bacteria, coliforms, streptococci, micrococci, closticidia, yeasts and moulds.

5 Microbiological examination of Soil, Air, Water and Silage.

LNG-300 English & Basic Technical Writing 3 Credit

1. Language:

a. Word Enrichment- Antonyms, Synonyms, One wordk substitution
b. Sentence – Types, Strucsture & Parts
c. Inflection – Noun
d. Tenses
e. Parts of speech
f. Voice

2. Reading

Comprehension:

a. Listening
b. Reading

3. Writing:

Composition

a. Precis Writing
b. Essay Writing
c. Letter Writing (Components, Formats & different types)
d. CV
e. Resume

IDD-306 Dairy Production-I (Forage Production) 4 Credits

1. **Soils –** Definition, functions, composition, texture, structure, moisture, K, pH, acid, alkaline and saline soils and reclamation, soil organism, fertility and productivity, important soil types of India, erosion and control.
2. **Tillage-** Definition of Tillage and tilth, objective, implements-primary, secondary sowing, planting-functions. Farm mechanization- advantages, limitations and scope under Indian conditions.
3. **Irrigation-** Definition of irrigation- needs, irrigation water sources quality, devices and methods of irrigation commonly used, measurement of irrigation water factors determining frequency, water requirement of important forage crops.
4. **Drainage-** Definition needs principles of layouts systems and layouts.
5. **Dry farming-** Definition, objectives, practices, crops suited manure- fertilizers-classification of plant nutrient- major, minor micro, N.P.K.- role on plant growth, deficiency symptoms, role and deficiency symptoms of minor and trace elements, classification of manures and fertilizers: FYM, compost, liquid

manure, slurry, green manure, concentrated organic manures, composition of commonly used nitrogenous, phosphatic and potassium fertilizers, method and time of application of manures and fertilizers and residual effects.

6. **Weeds-** Definition, economic weed, common weeds and methods of eradication
7. **Forage crop classification-** Herbs, shrubs, trees, grasses, legumes and others, common crops in each group, plant habits-annual, biennials, perennials-common crops in each group, cash crops, companion crops, soiling crops, silage crops hay crops.

   Cropping seasons- Zaid (prekharif), Khrif and Rabi- common crops in each group. Important objectives in forage evaluation factors determining selection of forage crops.
8. **Cultivation of important crops-** Botanical name, common name, morphology, origin, package of practices, varieties, utilization, nutritive values, cost of production-per heacare, per unit of green, per unit of D.G.P. & T.D.N. – maize, Jowar, bajra, Cowpea, Guar, Rice bean and tetrakalia, oats, Berseem Lucerne, Mustards, Japanrape, Chinese Cabbage, Hybrid Napier (Napier X Bajra) Para Guinea, Dinanath, forage beet, Tapioca, fodder, turnip, fodder trees.
9. **Cropping schemes-** Rotations- Definition, principles advantages, common rotations with fodder crops. Mixed cropping- definition, advantage, principles, common mixtures of fodder crops, cropping schemes – definition advantages, points to be considered, intensity of cropping, carrying capacity. Drawing of model schemes for supply of fodder all the year round varied conditions- high, medium, low marsyland irrigated non-irrigated and partly irrigated conditions. Comparative economics of forage crops v/s cereal and cash crops.
10. **Pastures –** Different kinds, advantages, scope in India, Characteristics of good pasture species, and name of important pasture crops, establishment & management of pasture rotational grazing, silvi –pastoral concept and practices, social forestry.
11. **Forage seeds -** Importance of good seed, standard, sources, storage, protection.
12. **Conservation of fodder** – Need, forms, advantages and limitations silage making- objective, biochemical changes, types of silos, suitability of types, method of filling and co erring, crops for silage, stages of harvesting, additives and preservatives, silage quality. Hay making-crops, stage of harvesting, methods, quality under different methods. Losses in silage and hay making-comparison, comparative advantages & disadvantages of silage and hay making under different conditions.
13. **Agro Industrial By Products –** Utilisation, feed values, need under Indian condition.

Practical

1. General Introduction to a fodder farm, study of hand tools and uses, stud of bullock drawn implements, ploughing methods and practices-bullock drawn,

operation of a disc harrow, operation of cultivator, rollers and wooden planks, Identification of manures and fertilizers, application of F.Y.M., application of fertilizers, compost making, Demonstration on water lifting devices and methods of irrigation, practice on flood irrigation study to drainage system and practice on surface drainage. Methods of sowing-practices on broadcasting and line sowing. Demonstration of drilling. Identification of forage crops, harvesting of different forage crops and loading on trailors. Testing of seeds for germination and purity. Seed bed preparation for principal forage crops-non-irrigated and irrigated. Silage making practices, hay making practices-barn curing, estimation of quantity of straw in stacks. Cost of cultivation of important forage crops. Layout of a fodder farm. Study different types of farm fence-cost per running metre.

IDD-307 Dairy Production-II (Cattle Nutrition) 4 Credits

1. **General Introduction-** Importance of Science of Animal Nutrition, role of feeds in maintaining life process, Nutrients- definition, essential nutrients in feeds water, proteins, lipids, carbohydrates, minerals vitamins. Harmful substances in feeds names, sources and their effects.
2. **Digestive organs and Processes in cattle-** Introduction, significance of the term "Digestion" digestive system- division and functions (i) Alimentary canal and (ii) Accessory Organs, identification of the parts with the help of diagrams and models.
3. **Digestive Processes-** Mechanical, secretary, chemical, role of enzymes, digestion, absorption and metabolism of carbohydrates, fat and proteins, factors affecting digestibility and measures to improve digestion of feeds in cattle.
4. **Feed quality and Nutritive Value-** Importance and methods, chemical analysis-proximate analysis- tractions of feed components, Digestibility trail-conventional type-estimation of Energy contents- by calculation of TDN from digestion trail, Evaluation of protein quality-DGP estimation by digestion trial, calculations of Digestive co-efficient, Digestive Nutrients, TDN & DGP, different system of expressing feed value. (Elementary ideas only).
5. **Nutritional Requirements-** Ration, maintenance and production ration, requirements of dry matter, energy requirements for maintenance and lactation, feeding standards, formulation of ration-principles and requirements according to different categories of animals.
6. **Classification of feedstuffs for cattle-** Roughages and concentrates, coarse fodder and succulent fodder, straws and their uses in feeding cattle, fortification of paddy sraw urea treatment, treatments for oxalates, mineral supplementations concentrates – energy rich grains, seeds, brans, chuni,

roots, oil cakes their feed values and extent of their uses.

Whole Milk, skimmed milk powder, tapioca roots, molasses feed values and extent of their uses, scarcity fooders under adverse conditions-tree leaves, seed kernels, water hyacinth extent of their uses.

Use and minerals and vitamins in cattle feed requirement and limitations, feed additives-their extent of uses.

7. **Computation of Rations for cattle-** Desirable characteristics of a balances ration, general considerations for computation of ration, computation of ration for cattle at different stages of growth feeding of calf of different ages, milk replacers, calf of different ages, milk replacers, calf starters, pregnant heifers, cows in milk, dry cow, bull in service, working bullock, economics of feed formulation, unit cost calculation.

   Compounding of feed- selection of feed ingredients, grinding, mixing, bagging, storage and distribution- different methods and limitations of their uses under different conditions, quality control of compounded feeds and chemical processes.

Practicals

Identification of digestive organs of cattle and accessory digestive organs.

Identification of fodders and feeds

Feeding of colostrums and milk to calves, measurement of total milk yield of cow

Computation of ration for different categories of animals, compounding of feed-grinding, mixing, bagging stitching and storage programme.

Identification of glasswares, equipment and apparatus for proximate analysis of feed stuff.

Demonstration on proximate analysis of feeding stuff

Estimation of drymatter in fodder and feeds.

Estimation of watter requirements

Quality control of compounded feeds-sampling , physical analysis, chemical analysis

Demonstration on microscopic study of the histological characteristics of digestive organs of cattle.

Demonstration on identification of carbohydrates, lipids and proteins by qualities tests.

SECOND SEMESTER

IDD-314 ELEMENTARY STATISTICS 3 Credit

Compilation of Data: Introduction, Scores: Discrete and Continuous, Frequency distributions, graphical Representation of the data (Polygon, histogram & pie- diagram)

Measures of Central Value Arithmetic Mean, Median, Mode

Measures of Dispersion of scores – range, Q, mean deviation, standard deviation, co-efficient of variation.

Normal curve- characteristics, Non- normal curves- skewness and kurtosis.

Causes of non- normality

Significance of the difference between two means by t- test, x2 – test (chi- square test)

Significance of the differences among more than two means by F-test

Sampling methods: types, requisites for randomization, use of random numbers.

IDD-315 DAIRY PRODUCTION III 4 Credits
(GENETICS & CATTLE BREEDING)

1 General Management: Importance of ruminants, classification of breeds of the basis of utility.
2 Important dairy breeds of indigenous and exetic cattle and buffaloes.
3. Calf rearing different methods
4. Management of dairy heifers and bull calves
5. Care of pregnant animals during and after parturition.
6. Management and care of milking stock, dry stock and breeding bulls.
7. Cleaning and sanitation of cattle yard premises.
8. Clean milk production, principles of milking, milk recording. Records essential to good herd management.
9. Milk secretion.
10. Preparation of animals for cattle shows, transport of animals by roads and rail.
11. The principles and practices of breeding dairy stock.
12. Medelism, Different systems of breeding
13. In breeding, line breeding, cross breeding, grading up, pregnancy testing, culling and selection of animals in the open market.
14. Anatomy of reproductive organs Artificial Insemination.
15. Embryo transfer technology- a general concept and its role in national

perspective.

16. Signs of health and ill health.
17 Diagnosis and detection of diseases care and feeding of sick animals
18 Disinfections, isolation and prophy laxis measures during cutbreak of contagious diseases of cattle like foot and mouth, Rinder Pest, Brucellosis, T.B. Jhones and mastitis.
19. Diseases of young stock, Navel-III, Pheumonia, scours, Ring work and Mange.

Practical

1. Layout of a cattleyard, living space for each category of animal from health point of view.
2. Recognition of body parts of dairy animals
3. Physical character of the breeds maintained.
4. Calf feeding, Tattoing, Dehorning, Grooming.
5. Estimation of age and body weight
6. Preparation of animals for milking, milk cooling, observations of signs of oestrus and pregnancy.
7. Cleaning and sanitation of milking sheds and milk record room.
8. Judging of milch cows
9. Preparation of animals for show
10. Study of important cattle records
11. Identification of common cattle feeds computation of rations
12. Recording observations on temperature, pulse and respiration.
13. Identification and use of common first aid drugs and pharmaceutical instruments used in the cattle yard.
14. Dressing of wounds and bandaging
15. Diagnosis and treatment of mastitis.
16. Practice in Artificial Insemination
17 Demonstration on Embryo Transfer Technology at the appropriate centre

IDD-316 DAIRY PRODUCTION IV 4 Credit
(GENERAL MGT. & CARE OF DAIRY HERD)

General Introduction: Definition of Dairying, Present condition and status of Dairying in Indian, Present condition and status of dairy farmers in India, Seasonal nature of milk production, Mixed farming.

Breeds: Indian and exotic breeds of cattle, Breeds of buffaloes in India.

General Management and Care of Dairy Herd: Rearing and management of calves, Weaning of calves, management and care of milking herd, care of breeding bulls. Different systems of housing for dairy animals, Marking of animals, Dehorning/ disbudding of dairy animals, Castration of male calves, Clean milk production, principles and methods of milking.

Practicals

1. General Introduction to Institute dairy farm.
2. Recognition of body parts of cow.

3. Care of newly born calf.
4. Feeding of milk to calf by pail method.
5. Identification of different equipments used on dairy farm.
6. Estimation of body weight by measurements.
7. Practice on marking, disbudding and milking of dairy animals
8. Cleaning and disinfections of barn.

IDD-311 DAIRY MICROBIOLOGY- II (MICROBIOLOGY OF MILK) 4 Credits

A Microbiology of Milk

1) Sources of microbial contamination of milk and their importance
2) Milk – borne disease
3) Important groups of spoilage of micro organisms and their manifestation in milk.
4) Microbial growth in milk during storage and transport
5) Taints and abnormal conditions in milk
6) Principles of sanitation practices at all stages of production and processing
7) Bacteriology of heat-treated milks
8) Evaluation of bacteriological features of milks

B Microbiology of Foods

1) Classification of foods
2) Natural functional systems of food and their interactions on shelf life
3) Food processing compulsions and options
4) Types of food spoilage and their aetiology
5) Methods of limiting microbial proliferation in foods
6) Features of food fermentations as a desirable change
7) Evaluation of microbiological features of foods

Practical

A Microbiology of milk

1) Sampling of milk for microbiological analysis
2) Application of rapid tests for evaluation of milk quality
3) Enumeration of bacterial numbers by direct and indirect methods
4) Methods used for determining psychrotropic organisms in milk
5) Assessment of pasteurized milk based on the following; standard plate count. E coil test. Phosphate test, thermoduric and thermophilic numbers
6) Evaluation of utensils and equipments for sanitation

B Microbiology of foods

1) Comparative study of raw and processed foods
2) Study of food enzymes in relation to their profiles at shelf life
3) Effect of storage temperature on shelf life foods
4) Microbiology of vegetables, eggs, meat, flour, bread, cereals and spices
5) Role of salt, sugar, inorganic acids and alkalies in food preservation

IDD-317 **Dairy Technology II (Milk Products)** **4 Credit**

Status of fat rich dairy products in India and abroad.
Introduction to milk lipids - definition and general composition of milk fat.

Cream: efficiency of cream separation and factors affecting it; control of fat concentration in cream. Receiving, grading, sampling and weighing of raw cream; neutralization, pasteurization and cooling of cream. Preparation and properties of different types of cream; table cream, sterilized cream, whipped cream, plastic cream, frozen cream and cultured cream. Preparation of cream for butter making. .

Butter: introduction to the butter-making process; theory of churning; batch and continuous methods. Technology of butter manufacture; over-run in butter; control off at losses in ~utter milk; packaging and storage; transportation; defects in butter; rheology of butter; uses of butter.
Butter-making equipment: construction, operation, care and maintenance of cream separators, coolers and vacreator, factory butterchurn and continuous butter making machines.
Special butters and related products: *manufacture, packaging, storage and properties of whey butter, flavoured butter, whipped butter, renovated butter/fractionated and poly-unsaturated milk, fat products, vegetable oil-blended products and low-fat spreads.*
Manufacture, packaging, storage, and characteristics of Margarine of different types.

Ghee and butteroil:. Methods of ghee making . batch and industrial processes, innovations in *ghee* production, procedure, packaging and preservation of ghee; utilization of substandard milk and old/stored butter in the manufacture of ghee.
Continuous process for the production of ghee.
Methods of manufacture, packaging, storage, distribution and uses of butter- oil.
Nutritional aspects of cream, butter, butter-milk, ghee and ghee residue.
Health aspects of milk fat.
Technical control in butter industry: Factors affecting plant operations' efficiencies,. Losses of milk solids, methods of improving operational efficiency and product accounting.

INDIGENOUS MILK PRODUCTS

3. Ghee:

a) Definition of ghee, importance of ghee in India
b) Methods of manufacturing ghee
c) Grading of Ghee and factors influencing quality of ghee
d) Difference of ghee & butter oil
e) Utilization of ghee and resedue.

4. Khoa 3. Chhana 4. Paneer 5. Dahi 6. Indigenous Cheese

a) Preparation & Packaging, yield and composition.
b) Factor affecting quality
c) Packaging & Preservation
d) Marketing and grading
e) Legal standards

MILK BASED SWEETS

3. Place of milk based sweets in India and abroad.
4. Method of manufacture, packaging, storage and transportation of Rasogulla, Gulab jamun, Kalakhand, Rabri, Keer, Khurcha, malai, Rasmalai, Barfi, Peda, Srikhand, Sandesh, Chakka, Milk cake, Pantoa, Payodhi and lassi.

Practicals

1. Standardization, neutralization, pasteurization and cooling of cream
2. Preparation of sterilized cream.

3. Preparation of cooking butter by the hand-operated chum.
4. Preparation of *desi* butter.
5. Manufacture of table butter using the power-driven chum.
6. Preparation of a low-fat spread.
7. Preparation of *ghee* from cream and butter.
8. Plant visit.
9. Preparation of *khoa*
10. Preparation of Ghee from butter and cream.
11. Preparation of *Paneer.*
12. Preparation of *chhana*
13. Preparation of *Dahi*
14. Preparation of Surti Cheese
15. Preparation of milk based sweets

IDD-318 Dairy Farm Engg. 4

1. Farm machinery and power: Conventional country tools & implements type, principal parts & functions deshi plough, patella, hoe, sickles, Khurpi etc, yokes for desi bullocks, crossbred bullocks.
   Internal combustion engine and its principal parts and principles of operations: Agricultural Tractor and its principal parts maintenance and selection, driving the tractor, common troubles and remedies terminology.
2. Associated Implements in mechanized farming: Functions, principal parts and maintenance of board and disc plough, harrows, and cultivators, seed drill chaff cutter, weighing machine and its principal parts types maintenance. Milking machine principal parts, operation and maintenance.
3. Electrical machines: A.G. motors- principal parts, function types, difference between generator and motor, maintenance of motor.
4. Refrigeration: Importance in dairy industry, natural refrigeration, artificial refrigeration by mechanical compression system or absorption system, calculation of quantity of ice or dry ice required for certain amount of cooling , Mechanical refrigeration cycle, refrigerants, bulk milk coolers –construction function and maintenance, cold stores, operation and maintenance of cold stores
5. Water supply :- Principles of water supply, water requirement, sources of water, pumps terminology, general construction of pumps, types-positive pumps, non-positive pumps, calculation of requirements of H.P., sanitary and irrigation pumps, maintenance of total head discharge.
6. Dairy machinery: milk cans- constructional features, metals used, types- conventional and insulated maintenance, handling cleaning, storage, Gerber's centrifuge- principles, construction function and maintenance.
7. Storage tank: Types functions and constructional features, types and maintenance of clarifiers separators, homogenizers, heat exchangers, pasteurizers, milk sterilizers, can washers bottle washers ghee kettles, butter churns ice cream freezing equipments.
8. Farm building- principles of site selection, layout farm building, factors involved in assembling, lighting and ventilation requirements, importance of ventilation in dairy farm building factors involved in constructive features for temperatures and ventilation control, maintenance of building, feed go downs- constructional features, storage space and space requirement, damp and rodent proofing ventilation, anticorrosive measures, disinfection, fumigation cleaning.

9. Bio –Gas Plant: Need for drainage and sewage in dairy farm, disposal and cattle hardware, biogas plant constructional and operational features, uses of biogas plant, products and by products and utilization.
10. Feed grinding and mixing machines: Constructional features, maintenance and improvements in trailors and animal drawn vehicles, functions, types, milk van tanker-types, constructional features and maintenance.
11. Meteorology: Introduction to agricultural meteorology, importance, study of meteorological instruments in an Agr met observatory.
12. Fencing: uses, types, constructional features, estimation, periodical checks and maintenance.

Practicals:

(a) Identification of principal parts and practice on starting stopping- petrol engine, diesel engine and tractor.
(b) Identification of principal parts and hitching to a tractor- mould board and disc ploughs and disc harrow.
(c) Chaff cutter- principal parts and their functions, operations of chaff cutter- milking machine- principal parts and their functions and operations.
(d) Phase induction motor with star delta and their functions, demonstration of operation, calculation of discharge.
(e) Demonstration of operation of dairy plant machinery. Study of the general features of feed grinder and mixture- principal parts and their function
(f) Acquaintance with carpentry tools- their functions and operations.
(g) Acquaintance with agricultural meteorological equipment, apparatus and their functions.
(h) Acquaintance with soldering, gas, and arc welding equipment their functions and operations.
(i) To Draw a plan of a – (i) Model of milking shed
(ii) Model of bull pen
(iii) Model of calf pen
(iv) Model of calving shed

THIRD SEMESTER

IDD – 325 Dairy Production – V 4
(Animal Physiology and Reproduction)

General Introduction: Familiarity with the concept of Animal Physiology and reproduction and its significance in Livestock rearing.

Reproduction and Lactation: Hormones- classification and functions, Male and female reproductive organs in dairy cattle, Sexual cycle, Heat and its detection in cows, Ovulation, Fertilization, Implantation, pregnancy diagnosis, parturition, sterility and infertility. Lactogenenis and galactopoiesis, milk let down.

Artificial Insemination: History merits, demerits and limitations, phases of A.I. viz, collection of semen, evaluation of semen, Dilution of semen, Storage of semen and deposition of semen for higher rate of conception.

Practicals

1. Identification of male and female reproductive organs.
2. Identification of different equipments used in animals Physiology and reproduction.
3. Detection of heat in cows.
4. Preparation of artificial vagina and collection of semen.
5. Evaluation of semen- Macroscopic, Microscopic and chemical.
6. Preparation of semen- dilutors
7. Maintenance of records at A.I. sub centre.
8. Study of morphology of udder.

IDD – 326 Dairy Production – VI 4 Credit
(Animal Disease & Hygiene)

General Introduction: Definition and concept of disease and health. Factors affecting the health of animal, signs of ill health.
Care and feeding of sick animals.

Immunization: Types of immunity, Antigens and antibodies, vaccination.

Communicable Diseases: causes of communicable diseases, FMD, Rinderpes, cowpox, Tuberculosis John's Disease, Haemorrhagic Septicaemia, Anthrex, Black Quarter and their etiology, incubation period, mode of infection, mortality, symptoms, treatment and prophylactic measures.

Common Parasites Disease: Causes, symptoms, treatment and preventive measures of common parasitic diseases.

Diseases of Digestive & reproductive organs: Causes , symptoms, treatment and preventive measures of common diseases of digestive and reproductive tract viz, Bloat, Impaction of rumen, diarrhea, dysentery, vaginitis, Trichomoniasis, vibriosis etc.

Practicals

1. Identification and use of common instruments and drugs.
2. Practice on casting and castration of animals
3. Signs of ill health.
4. Methods of drug administration.

IDD – 327 POULTRY PRODUCTION 4 Credits

S.No.	Topic	No. of Lectures
1.	Poultry keeping in India:- History, status of poultry in India, various improvement programmes	3
2.	Breeds: Breeds of Ducks, geese, Fowl, Quails	8
3.	Feeds and Feeding: Digestion & Digestive system of fowl, composition, classification of poultry feeds, formulation of Balanced ration for various class of birds.	6
4.	Breeding: Reproductive systems of fowl, systems and methods breeding	4
5.	Health care & Management: Hygiene and sanitation, common poultry diseases, prevent in India, vaccination programme for broilers and layers. Poultry housing & equipment, Breeding, Management of layer, management of broiler.	20
6.	Poultry products: Egg structure, Fromation composition grading & preservation. Slaughter of poultry for meat. Defethering, removal of waste processing and preservation of meat.	8
7.	Economics of poultry farming: economics of Eggs production, Economics of Broiler production.	6

Practical

1. Body parts of fowl
2. Visceral organ of domestic fowl
3. Slaughtering of poultry
4. Defethering of Poultry
5. Evisceration, removing & cleaning of giblets
6. Calculation of dressing percentages
7. Candling and grading of eggs
8. Egg quality and their measurement
9. Preservation of eggs
10. Sesing of chicks
11. Feeding, watering and space requirement for various class of poultry under different housing system.
12. Care of day old chicks
13. Management of broilers
14. Post mortem of birds
15. Computation of balance ration for various class of poultry.

IDD – 328 EXTENSION EDUCATION 4

1. Dairy Extension- meaning and purpose, extension education- meaning, history, objectives, philosophy and principles, basic elements of effective extension work.
2. Rural sociology- meaning and role in rural development, characteristics of rural life-physical structure of village society- social structure, concepts of culture, society, social change and their relevance to extension work.
3. Extension Education and Dairy Extension- role of extension education in development of Dairying. Training of extension personnel at different levels, extension teaching – methods and techniques and teaching aids, basic principles of learning and teaching, visit and training method.
4. Planning an extension programme- objectives, principles and steps, extension evaluation. Planning and execution of extension work in relation to development of animal husbandry and Dairying. Involvement of youth, women and other strategic units in development work.
5. Dairy Development Project and other Rural Development Projects- contribution to Animal Husbandry and Dairy Development- Operation Flood- I & II, National Extension Service (NES), Community Development Programme, Intensive Agricultural District Programme (I.A.D.P.) Drought Prone Area Programme (D.P.A.P.) Command Area Development (C.A.P.), Intensive Agricultural Area Programme (I.A.A.P.) High Yielding Varieties Programme (H.Y.V.P.), Integrated Tribal Development (I.T.P.), Integrated Dryland Agricultural Development (I.D.A.D), Margin Farmers and Agricultural Labour Programme (M.F.A.L), Small Farmers Development Agency (S.F.D.A.), Integrated Rural Development Programme (I.R.D.P.) Krishi Village Scheme (K.V.S) Intensive Cattle Development Project (I.C.D.P.), Cattle and Dairying Development (C.D.D.), Farmers Training Centre (F.T.C.), Krishi Vighyan Kendra (K.V.K.-ICAR), Trainers Training Centre (T.T.C.) Lab to Land programme and other technology transfer programmes.

Practicals

Observation and study of village extension work carried out at the key village (1.) Artificial Insemination (2) Fodder Development (3) Animal Management (4) Other rural extension activities (5) Visit and observation of village panchayats (6) Block Development Committee, (7) N.E.S. Block Development and District Planning meeting.

Practice in use of extension education methods- such as (8) Group discussion method and result demonstrations (9) Use of audio visual aid in extension teaching, use of puppetry, song, poetry and drama for extension work in the villages, Preparation of extension teaching materials such as (10) posters (11)

Charts exhibits etc (12) Organization of vikas melas, vikas Sammelans (13) Cattle shows and rallies with emphasis on dairy and animal husbandry development, (14) Survey of a village for the purpose of planning extension programme for Dairy and Animal husbandry development

IDD – 329 PRINCIPLES OF ECONOMICS 3 Credit

1. Basic concept; Nature of Economics, Meaning, definition, scope of Economics, Utility, Goods value, Wealth.
2. Concept of consumption: Meaning and importance, determination and characteristics, classification of wants, Law of Diminishing utility, Law of Equi-marginal utility.
3. Concept of Production: Meaning and definition, Factors of production, Land, Labour, Capital, organization, Enterprise.
4. Concept of Exchange: Its Meaning, Definition, Advantages and form of Exchange.
5. Concept of Market, Meaning, Definition, Degree of competion in market, Demand and supply.
6. Concept of Distribution: Meaning, Definition, problem of distribution, Rent, Wages, Interest Profit etc.

IDD – 330 FINANCIAL ACCOUNTING IN DAIRY BUSINESS 3 Credits

1. Financial Management; its planning meaning, objective, functions, its role and importance
2. Concept of financial accounting; its subject matter, basic principles involve in accounting, classification and importance.
3. Concept of Accounting procedure; Journal, Definition; Role of debits
4. Concept of Double Entry System; meaning, advantages of Double Entry System
5. Ledger: Its concept, necessasity, types ruling, difference between Journal and Ledger
6. Cash book; Meaning, types of cash, advantages, difference and similarities with ledger.
7. Trial balance; its meaning, definition, objective and characteristics of Trial balance, limitation etc.

Tutorial

1. Preparation of Journal
2. Preparation of Ledger
3. Preparation of cash book
4. Preparation of Trial balance
5. Preparation of Purchase Book
6. Preparation of Purchase return Book

7. Formate of sales return book
8. Formate of sales book
9. Formate preparation of Inventory
10. Preparation of Purchase register

11 Preparation of Sales register

12 Depreciation

FOURTH SEMESTER

IDD – 336 BREEDING & MANAGEMENT OF SHEEP 3 Credit

1. Contribution of sheep industry in India and its statistics.
2. Breeds and breeding of sheep:
   - Indian and exotic breeds of sheeps
   - Mating and A.I. in sheeps
3. Feeds and feeding of sheeps
   - Nutrient contents of daily diets, feeding of lamp and ewe at and after lambing
   - Common diseases of sheep and their control measures
4. Sheep products:
   - Sheep production statistics
   - Wool: Parameters of judging, wool quality, grading system of wool.
   - Economics of sheep farming

Practical

1. Body parts of sheep
2. Feeding, watering and space requirement for different class of sheep under various housing system
3. Marking of sheep
4. Shearing
5. Docking of lamp
6. Castration of lamp
7 Grading of wool
8. Economics of sheep farming
9. Cleaning and disinfection of houses

IDD – 337 BREEDING & MANAGEMENT OF GOATS 3 Credits

1. Importance of goat farming in India
2. Annual production statistics of goat and goat products
3. Breeds and breeding of goat:
   - Indian breeds of goats, Erotic breeds of goats
   - Breeds and breeding management of goats
4. Feeds and feeding of goats:
   - Nutrient requirement for goats
   - Feeding systems and feeding strategies for goats
   - Feeding management of goats
5. Management of goats:
   - Housing Management

Tathering, Determination age of goats, disbudding, castration, exercise, hoof trimming

- Clean milk production
- Care of doe after kidding

6. Health care for Goats:
   - control measures of common diseases
   - Health management

7. Economics of goat farming

Practical

1. Body parts of goat
2. Feeding, watering and space requirement for different classes of goats under various housing system
3. Determination of age of goats
4. Disbudding in Kids
5. Castration
6. Cleaning and disinfections of houres
7. Hoof trimming in goats
8. Economics of goat farming

IDD – 338 BREEDING & MANAGEMENT OF PIGS 3 Credits

1. Scope and importance of swine farming statics on swine
2. Breeds and breeding of pigs Important feeds of pigs experience in India
   - Guidelines for selection of sow and boar
   - Guidelines for normal reproduction in pigs and detection of heat in sows
3. Feeds and feeding of pigs: Nutritive requirement, creep feeding weaning Recommended rations for different class of pits
4. Management practices for hogs Housing of hogs castration management at farrowing, Pig fenders, Pig wallows, management at breeding (flushing), Needle teeth Common disease of pigs and their control vaccination
5 Pork:
   - Steps of slaughter of hogs
   - Curing of pork
   - Economics of pig farming

Practical

1. Body parts of pig
2. Feeding watering and space requirement for different class of pigs under various housing system
3. Marking of pig
4. Removal of needle teeth in piglets
5. Feed mixing for pigs
6. Castration of pigs

7. Slaughtering of pigs
8. Economics of pig farming
9. Cleaning and disinfections of houses

IDD – 339 DAIRY BUSINESS MANAGEMENT 4 Credit

1. Genesis of the Management- Introduction, Dairying as a Business, Selection of Enterprise, Management.
   Industrial Management: Principles of Farm Management, Law of substitution, Authority, responsibility.
   Organization: Types, methods of organization, line organization, Functional organization.
2. Dairy Development: Historical of Dairy Industry in the country present status of dairying in India, Livestock statistics, Important Magazines and Journals of Dairying.
3. Management Functions: What is good management, function of Management, Leadership, Quality of a Leaders, Quality of a Supervisor, Attitude towards himself, Attitude towards others, Attitude towards his job.
   Delegation of authority: responsibility, authority, decision making.
   Reviewing management performance: Objectives
4. Personnel management: organization and control of labour, Duties of labour department, control of labour, labour efficiency.
   Staff Welfare:
   Public relations: What is public relations, public relations and its three purposes, public relations and its application to Dairy Industry, Public relations with reference to consumers, Public relation with reference to local authorities and government.
   Labour Legislation in India: factory act 1948 amended in 1954, Definition, Inspection, health and cleanliness, safety.
   Employee Morale: Introduction – Meaning.

IDD- 340 PRESERVATION & PROCESSING OF ANIMAL FOODS 4 Credits

1. Cooling, Pasteurisation and Preservation of milk
2. Indian meat industry
3. Structure, composition and nutritive value of meat tissues
4. Post mortal changes
5. Meat quality parameter
6. Meat cutting and packing
7. Principles of various preservation techniques:-
   Chilling, freezing, curing and smoking dehydration and freeze drying
8. Processing of meat and meat products- curing and smoking of Pork, grading, packaging & preservation of eggs as well as dressed chicken, chevon, mutton and pork.

9. Factors affecting meat quality.
10 Meat products:-
   (ii) Sausage
   (iii) Salami
   (iv) Kabab
   (v) Tanduri chicken
   (vi) Ham and bacon

Practical

1. Familiarity with various tools and equipments of meat processing
2. Slaughtering of Animals and Birds
   (a) Halal Method
   (b) Jharka Method
   (c) Jewish method
3. Dressing of Birds, packing and sale
4. Judging of meat of different animals
5. Grading, judging and preservation of eggs as well as carcass
6. Cut- up parts of carcass- display
7. Curling of pork
8. Egg parts.

COMP- 401 COMPUTER APPLICATION 2 Credit

1. Introduction to Computers
2. H/W and S/W Concepts and Terminology
3. Operating System
   (c) DOS
   (d) Windows
4. Introduction to commonly used application software
   (c) MS Word
   (d) MS Excel
5. Computer Languages & Introduction to 'C' Programming Language
   (e) Input & Out put statements
   (f) Declaration of variables
   (g) Operators
   (h) Control Statements (Branching and Looping)
6. Introduction to computer Networks
7. Introduction to Internet
8. Application of I.T.

Practical List:

1. Working with operating systems like MS. DOS, Windows
2. Study of Software packages, Like MS Word, MS Excel and MS. PowerPoint

3. Packages related to medical applications
4. How to search data, workable knowledge of Internet
5. Simple programs in C languages
   (i) To find the largest among three numbers
   (ii) To check whether the given number is palindrome or not.
   (iii) To find whether the given number is the prime
   (iv) To find sum and average of n integer using linear array
   (v) To generate the Fibonacci series
   (vi) To find factorial of a given number using functions.