COURSE STRUCTURE OF M.TECH. IN DAIRY TECHNOLOGY

SEMESTER- I

S.NO.	Course Code	Course Title	L-T-P	Credits
1	MAS-701	Advanced Engineering Mathematics	3-1-0	4
2	MAS-815	Experimental Design	2-0-2	3
3	CSIT-702	Computer Programming	2-0-2	3
4	DT-809	Advances in Dairy Processing-I	2-0-2	3
5	DT- 814	Steam & Refrigeration Engineering	2-0-2	3

SEMESTER- II

S.NO.	Course Code	Course Title	L-T-P	Credits
1	DC-810	Advances in Dairy Chemistry	2-0-2	3
2	DM-810	Advances in Dairy Microbiology	2-0-2	3
3	DT-812	Advances in Dairy Processing-II	2-0-2	3
4	DT- 815	Dairy Process Equipment Design & Plant Layout	4-0-0	4
5	DT-817	Dairy Plant Instrumentation & Process Control	3-0-0	3

SEMESTER – III

S.NO.	Course Code	Course Title	L-T-P	Credits
1	DT-801	Dairy Plant Management	2-0-2	3
2	DT-805	Quality Assurance in Dairy Industry	2-0-2	3
3	DT-813	Advances in Dairy Processing – III	2-0-2	3
4	FST-703	Instrumentation and analytical techniques	2-0-2	3
5	DT-880	Seminar	0-0-2	1

SEMESTER - IV

S.NO.	Course Code	Course Title	L-T-P	Credits
1	DT- 899	Dissertation	0-0-60	30

SYLLABUS OF MASTERS OF TECHNOLOGY IN DAIRY TECHNOLOGY

I SEMESTER

MAS-701   ADVANCED   ENGINEERING MATHEMATICS   (3-1-2) 4 Credits

Gamma, Beta and Legendre's functions, Euler's equations, Lang-range equations, the Rix method, the Green's functions. Solzane Woirestrass theorem in finite products.

Laplace transforms, Inverse Laplace Transforms, and application to differential equations. Fourier series, Fourier transforms, Solution of non-linear algebraic and transcendental equation by Regula falsi method. Newton Raphson method.

Newton's forward and backward interpolation formula divided differences. Trapezoidal Rule, Simpson's $\frac{1}{3}$ rule, Numerical Solution of Ordinary differential equations by Runge Kutta Method, Picard's equations.

MAS-815   EXPERIMENTAL DESIGN   (2-0-2) 3 Cr.

Analysis of variance techniques, Definitions and assumptions, One way classification, two way classification with more than one observation per cell.

Designs of experiment, principles of experimental design, randomized block design (R.B.D), Latin square design (L.S.D.),
Missing plot technique in R.B.D. and L.S.D., critical difference (C.D.), split plot design

Factorial experiment $2,^2$ 2^2, 3^2 , 3^3, 2 x 3, 2x4

Sampling techniques, simple random sampling, stratified random sampling and systematic sampling.

CSIT-702   COMPUTER PROGRAMMING   (2-0-2) 3 Credits

1. Algorithms & Flow Charts
2. 'C' Programming
    (i)   Preliminaries
    (ii)   Constants & Variables
    (iii)   Arithmetic Expressions
    (iv)   Input – Output statements
    (v)   Control Statement
    (vi)   Looping Statements

   (vii)   Subscripted Variables
   (viii)   Elementary Format Specifications
   (ix)   Logical statements & Decision tables
   (x)   Functions & Subroutines
3.   Computer oriented numerical methods
   (a) Solution of Non- Linear Equation
       (i) Bisection Method
       (ii) Newton Method
   (b) Numerical integration
       (i) Trapezoidal Method
       (ii) Simpson's 1/3 & 3/8 rule
   (c) Curve Fitting
       (i) Construction of forward, backward difference table
       (ii) Interpolation
4.   Application of statistical packages

Practical List
1.   To find the largest among three numbers.
2.   To check whether a given string is a palindrome or not
3.   To find factorial of a given number by iteration
4.   To find whether the given integer is a prime number.
5.   To find sum n terms of series: $a.n*2/2!+n*3/3!-n*4/4! + \ldots\ldots$
6.   To find the sum and average of n integers using a linear array.
7.   To read n umbers from the keyboard and display these numbers in the reverse order their entry.
8.   To search a given number within a linear array.
9.   To generate the fibbonacci series.
10. To find factorial of a given number using a function.
11. To deduce error involved in polynomial equation.
12. To find out the root of the Algebraic and Transendal equations using Bisection, regula-falsi, Newton Raphson and Ilterative methods. Also give the rate of convergence of roots in tabular form for each these methods.
13. To implement Newton's forward and backward Interpolation formula
14. To implement gauss forward and backward, bessel's Sterling and Evertt's Interpolation formula
15. To implement Newton's Divided difference and Lang ranges Interpolation formula.
16. To implement numerical differentiations.
17. To implement Numerical integration using trapezoidal, simpson 1/3 and simpson 3/8 rule.
18. To implement least square method for curve fitting.

DT-809   Advances in Dairy Processing-I   2-0-2   3
   1.   Preservation of raw milk
   2.   Thermal processing of milk
   3.   Bactofugation/Bacto therm processes.
   4.   Cream separation cream products
   5.   Butter & dairy spreads.
   6.   Current trends in cleaning & sanitization of dairy equipments
   7.   Frozen dairy products

DT-814   STEAM AND REFRIGERATION ENGINEERING   (2-0-2) 3 Credits

Properties of Steam

Introduction, Formation of Steam, Total Heat (or Enthalpy) of Water, Latent Heat of Steam, Dryness Fraction, Wetness Fraction, Total Heat (or Enthalpy) of Wet Steam, Total Heat of Superheated Steam, Advantages of Superheating Steam Use of Steam Tables, Specific Volume of Steam, Volume of Superheated Steam, External Work Done during Evaporation, Internal

4

Energy of Steam, Entropy of waters, Entropy of Evaporation's Entropy of Wet Steam s_g , Entropy of Superheated Steam,

Temperature Entropy Diagram for Water and Steam, Isothermal Lines on Temperature Entropy Diagram, Adiabatic Lines on the Temperature Entropy Diagram, Mollier Diagram or Total Heat Energy Chart for Steam, Methods of Heating and Expanding the Steam, Determination of Dryness Fraction of Steam; Type of Steam.

Boilers
Definition, Classification of Boilers, Comparison of Fire Tube and Water, Tube Boilers, Essentials of a Good Boiler, Factors Affecting Boiler Selection, Simple Vertical Boiler, Fraser Culman Boiler, Cochran Boiler, Lancashire Boiler, Cornish Boiler, Locomotive Boiler, Nestler Oil Fired Boiler, Babcock and Wilcox Boiler, Stirling Boiler, High Pressure Boilers, The Benson Boiler, The Loeffler Steam Generator, The Volex Steam Generator, La Mont Boiler, Boiler Mountings, Boiler Accessories, Steam Dryers or Separators, Steam Trap, Pressure Reducing Valve.

Performance of Boilers
Equivalent Evaporation, Factor of Evaporation, Boiler Efficiency, Efficiency of Economiser, Boiler Horse Power, Heat Losses in a Boiler, Heat Balance Sheet of a Boiler, Methods of Minimising the Heat Loss through Different sources, Boiler Draught, Natural Draught, Determination of the Height of Chimney, Determination of the Diameter of Chimney, Condition for Maximum Discharge through a Chimney, Efficiency of the Chimney, Artificial Draught, Steam jet Draught, mechanical Draught, Water treatment for boiler operation, Water Effiueat treatment, Germicidal activity of chlorine, hypochlorites & chloramines. General consideration in cleaning, Detergents for cleaning. Pollution Control, Natural cycles of waste decomposition, concept of BOD-Measurement. Kinetics of biological growth, kinetics of biological decay. Application of kinetics to biological treatment Reactor with recycles. Trickling filter model Design of an aerated tank without recycle Design of trickle filter system.

Introduction.
Brief History of Refrigeration, Unit of Refrigerating Capacity, Thermodynamic State of a Pure Substance, Pressure-Temperature Diagram, Other Phase Diagrams, Thermodynamic Systems and Energy Conservation Equations, The First Law of Thermodynamics, Steady Flow Energy Equation,

Production of Low Temperatures, Expansion of a Liquid with Flashing, Reversible Adiabatic Expansion of a Gas, Irreversible Adiabatic Expansion (Throttling) of a Real Gas, Thermoelectric Cooling, Adiabatic Demagnetization.

Application of Second Law of Thermodynamics
The Second Law of Thermodynamics, A Refrigerating Machine - The Second Law Interpretation, Heat Engine, Heat Pump and refrigerating Machine, Best Refrigeration Cycle.

Vapour Compression System
Vapour Compression Cycle, Pressure Enthalpy Diagram and Calculations, Actual Vapour Compression Cycle.

Refrigerants
Selection of a Refrigerant, Thermodynamic Requirements, Chemical Requirements, Physical Requirements, Refrigerant Piping and Design. Secondary Refrigerants, Using Mixed Refrigerants.

Multi pressure Systems
Cascade Systems
Refrigerant Compressors
Types of Compressors, Thermodynamic Processes during Compression, Rotary Compressors, Screw Compressors, and Centrifugal Compressors.

II SEMESTER

DC- 810   **ADVANCES IN DAIRY CHEMISTRY**   **2-0-2 = 3 Credit**

Nomenclature of milk proteins; major milk proteins: caseins (acids and micellar), fractionation of casein; primary and secondary structure of different fractions; casein models; alpha-lactalbumin and beta-lactoglobulin-distribution, whey protein concentrates and their functional properties; minor milk proteins: proteose-peptone, non-protein nitrogen constituents, immunoglobulins, lactotransferrin (lactoferrin), lipoprotein and fat globule membrane proteins; milk enzymes: properties and their significance with particular reference to lipases;

Milk lipids: classification, gross composition and physical properties; neutral and polar lipids and their role in milk and milk products; fatty acids profile: composition, properties and factors affecting them; unsaponifiable matter: composition with special reference to sterols and fat soluble vitamins and caretenoids, chemistry, physiological functions and levels in milk..

Lactose: occurrence, isomers; molecular structure; physical properties:- crystaline habits; hydrate; lactose glass; equilibrium of different isomers in solution; solubility; density sweetness; chemical properties:- hydrolysis; pyrolysis; oxidation; reduction; degradation with strong bases; derivatives; dehydration and fragmentation browning reaction; oligosaccharides in milk.

Major and minor minerals; factors associated with variation in salt composition; partitioning of salt constituents and factors affecting it; effect of various treatments on salt equilibrium; protein mineral interactions; distribution and importance of trace elements in milk.

Water soluble vitamins: thiamin; riboflavin; niacin; pantothenic acid; pyridoxine; biotin; folacin and cynocobalamin; molecular structure; levels in milk and milk products.

DM- 810   **ADVANCES IN DAIRY MICROBIOLOGY**   **2-0-2 = 3 Credit**

Theory
Unit I
Microflora associated with milk and milk products and their importance. Food poisoning, food infection, emerging food borne pathogens associated with milk and other milk borne diseases.

Unit-II
Lactic Acid bacteria and food fermentations. Current status of metabolism of starter cultures. Novel starter preservation techniques. Quality control tests of starter culture.

Unit-III
Naturally occurring preservative systems in milk like LP system, Immunoglobulins, Lysozyme, Lactoferrin etc. Food grade bio-preservative. Bacteriocin of lactic acid bacteria, structure, functions, transport and mode of action. Application of bacteriocin in food bio preservation.

Unit-IV
Bacteriological aspects of processing techniques like bactofugation,, thermisation, pasteurization, sterilization, boiling, UHT, Pulse field treatment and membrane filtration of milk. Types of spoilages of heat treated milk. Bacteriological grading of raw and heat treated milk.

Practical
1. Isolation and identification of common microflora in dairy products
2. Isolation and identification of pathogenic microbes from dairy products by using selective media
3. Preparation and propagation of starters
4. Quality evaluation of starter cultures.
5. Antimicrobial activity of LAB isolated from foods.
6. Antibiotic susceptibility of pathogenic bacteria from dairy products.
7. Isolation of bacteriocin producing LAB.

Dairy Chemistry

Chemistry and Metabolic functions of different milk products, compositions and properties of milk and milk products, Effect of processing on various constituents of milk in relation to physical, chemical and functional properties, chemical spoilage of milk; processing and waste treatments.

Instrumental measurements of colour, viscosity tenderness, specific gravity, size and size distribution, firmness, texture etc. of various milk products. Analysis of major constituents, such as moisture, fat, protein and carbohydrates of milk and milk products, pH and acidity measurements.

DT-812   ADVANCES IN DAIRY PROCESSING-II   (2-0-2) 3 Credits

1. Non- thermal process
2. Extrusion processing
3. Food emulsions/ Foams/Gels
4. Membrane processing
5. Rheology of dairy products
6. Hurdle Technology & its application
7. Fermented Dairy Products

DT -815   DAIRY PROCESS EQUIPMENT DESIGN & PLANT LAYOUT
(4-0-0) 4 Credits

Dairy Equipment Design

Codes and regulation, materials of construction, design of pressure vessel, storage tank, milk coolers, pasteurizing plants, flavour treating equipment, evaporation systems - evaporator; milk dryers; spray dryer and roller dryer; ice cream freezers. Design of material handling system and equipment. Design and evaluation of packages and packaging systems; methods and equipment for packaging.

Dairy Plant Layout

Special features of dairy industry; site selection of equipment before designing a plant; estimation of services required, peak and critical loads, stand-by plants; important considerations in planning and layouts of equipment; controls, pipelines, conveyors and services etc. Preparation of sample layouts; selection of building materials, internal construction, grid structure, foundations, drains illumination, ventilation, installation procedures in dairy plants.

DT- 817   DAIRY PLANT INSTRUMENTATION & PROCESS CONTROL
(3-0-0) 3 Credit

Principles of measurement of temperature, pressure, vacuum, flow rate, liquid level, emissivity, pH, refractive index, viscosity, surface tension, colour, humidity and moisture content. Methods of measurement of textural parameters e.g. Hardness, gumminess, chewiness and cohesiveness. Chromatographic method of analysis of milk constituents.

Principles of feed back theory and process control. Process characteristics and controller characteristics. Automotive control of temperature, pressure, vacuum, flow rate, liquid level refractive index, consistency and humidity, stability analysis. Process control applications in dairy plants.

III SEMESTER

DT -811   **DAIRY PLANT MANAGEMENT**   **(2-0-2) 3 Credits**

Process selection and optimization, process design cost analysis, profitability, alternative investments, replacements, optimization in process design and equipment design, organizational structure, job evaluation and incentives, preventive maintenance and servicing of equipment, safety engineering, plant sanitation, food legislation and safety requirements.

DT-805   **QUALITY ASSURANCE IN DAIRY INDUSTRY**   **(2-0-2) 3 Credits**

Importance of chemical quality control in dairy industry, setting up quality control laboratories and testing facilities; mobile testing laboratories.

Sampling procedures; Labelling of samples for analysis; choice of analytical tests for milk and milk products for chemical analysis; instrumental methods of analysis.
Calibration of dairy glassware's including butyrometers, pipettes, burettes, hydrometers, lactometers and freezing point thermometer.
Preparation and standardization of reagents required in the analysis of milk and milk products.
Legislation on production, transport, processing and marketing of milk and milk products; application of PFA, Agmark BIS, IDF, ISO, IPO and international senitory regulations related to dairy products to the quality control of milk and milk products.
Dairy effluents and their recycling.

Prediction of shelf-life behaviour and quality assurance in milk and milk products.
Dairy Microbiology
Selection of tests for microbiological analysis of milk and milk products and "their interpretations
Rapid methods of milk testing; non culture methods.
Organizational aspects of microbiological quality of dairy products.
Role of various agencies in the formulation of standards and controlling quality of dairy products.
Various microbiological standards of BIS. PFA, ISO, CCFS for dairy products.
Quality of dairy water supplies and purification procedure and waste disposal. Treatment and disposal and waste water and effluent.
Dairy products borne infections and intoxications and of public health significance: Microbial toxins in dairy products and their significance in public health.
Detection and control measures.
Indicator organisms and their significance in dairy products: faecal and non-faecal coliform including faecal streptococci, total gram negative bacteria including salmonella and shigella group.
Predictions of shelf life behaviour and quality assurance in UHT processed/sterilized milk and milk products.
Application of HACCP in dairy industry.
Practicals

Dairy Chemistry
1. Calibration of dairy glassware such as pipette, burette, volumetric flasks, hydrometer, butyrometers.
2. Preparation and standardization of dairy reagents such as acids alkalies Na2Sp3' AgN03, Fehling's, EDTA solutions etc.
3. Detection of adulterants, preservatives and neutralizers in milk and milk products.
4. Chemical analysis of permissible additives used in milk and dairy products.
5. Chemical analysis of detergents and sanitizers.
6. Preparation and testing of Gerber H2SO4 used in fat determination.
7. Testing the amyl alcohol used for fat determination.

Dairy Microbiology
1. Evaluation of common sanitizing agents used in dairy plants by
     (a) suspension
     (b) capacity test.
2. Bacteriological quality analysis of dairy water (a) total viable counts - SPC
                                   (b) total coliform counts - "MPN method
3. Determination of BOD in dairy waste
4. Microbiological tests for dairy effluent
5. Detection and enumeration of *Staphylococcus aureus* in dairy products
6. Detection of staphylococcal toxin in dairy products.
7. Detection of faecal and non faecal coliform and faecal streptococci in dairy products.
8. DeJection of total gram negative bacteria, salmonella and shigella groups in dairy products.
9. Quality evaluation by HACCP in the preparation of dairy products.

DT-813   ADVANCES IN DAIRY PROCESSING -III   (2-0-2) 3 Credits

1.   Functional Foods
2.   Food value addition
3.   Food Biotechnology
4.   Advances in dairy/ food packaging
5.   Dairy By-products
6.   Imitation dairy products
7.   Condensing & Drying of milk

FST- 703   INSTRUMENTATION AND ANALYTICAL TECHNIQUES   2-0-2= 3

Unit – I
Preparation of Chemical solutions: Concept of molar, molal, and normal solutions, pH and Buffers; importance and measurement of pH.
Chromatographic Techniques: General principles. Partitions and adsorption chromatography. Paper, thin layer, gas liquid, ion exchange and affinity chromatography. Gel filtration. Introduction to high pressure liquid chromatography.
Unit- II
Electrophoretic Techniques: General principles. Paper and Gel Electrophoresis. Polyacrylamide Gel Electrophoresis.
Colorimetry: Beers and Lambert's law. General principles of Colorimeters and Spectrophotometers

Photometry: Spectroflorometers.
Unit – III
Flame photometry: atomic absorption spectrophotometry
Carbohydrates: Qualitative and quantitative measures for reducing and non-reducing sugars, starch and fiber.
Fats: Physicochemical-extraction and separation procedures, quantitative measures for various lipids.
Unit – IV
Proteins: Physico-chemical properties, extraction and separation procedures, and quantitative measures for total proteins, amino acids and enzymes.
Vitamins: Colorimetric Flourimetric, Microbiological, Chromatographic and other methods for estimation of various vitamins.
Minerals: processing samples of analysis, colorimetric, spectroscopic and other methods for estimation of various minerals.
Unit – V
Total Quality Management in Food Industry (TQM), ISO certifications, Hazard Analysis and Critical Control Point (HACCP), Intellectual property Right and Patent

DT-880 **Seminar** **(0-0-2)1 Cr.**

IV SEMESTER

DT-899 **Dissertation** **(0-0-60) 30 Cr.**