



Three - Year Undergraduate Programme

Diploma Dairy Technology

Faculty of Agriculture

Parul University

Vadodara, Gujarat, India

Faculty of Agriculture
Diploma in Dairy Technology

1. Vision of the Department

To generate skilled dairy professionals for the global dairy sector by imparting quality education in the field of dairy technology.

2. Mission of the Department

M1 To offer state of art education through undergraduate programmes, to promote entrepreneurship, enhance employability, and skill development, and generate innovative solutions for the global dairy sector through research and development in the field of Dairy Technology.

M2 To promote dairy extension by disseminating the information for the upliftment of all the stakeholders.

M3 To create an academic and techno-commercial environment that fosters interdisciplinary learning, innovative thinking, research and interactive leadership in dairy sector.

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the Diploma Dairy Technology curriculum enables graduates to attain.

PEO 1	To apply the knowledge of Dairy Science to understand, evaluate and develop Dairy products and preservation methods based on standard practices.
PEO 2	To employ technology to design and develop innovative Dairy processing techniques for solving practical and real-world problems.
PEO 3	To demonstrate professional and ethical competency with effective communication and managerial skills to emerge as a responsible leader in the Dairy sector.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	Engineering knowledge:	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PLO 2	Problem analysis:	Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.
PLO 3	Design/development of solutions:	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

PLO 4	Conduct investigations of complex problems:	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PLO 5	Modern tool usage:	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PLO 6	The engineer and society:	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PLO 7	Environment and sustainability:	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PLO 8	Ethics:	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PLO 9	Individual and team work:	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PLO 10	Communication:	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PLO 11	Project management and finance:	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PLO 12	Life-long learning:	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

5. Program Specific Learning Outcomes

PSO 1	Demand as per recent development	Able to work professionally in the areas of Thermal and Manufacturing.
PSO 2	Software skill	Able to work on contemporary issue related to Dairy Technology/Dairy Engineering.

6. Credit Framework

Semester wise Credit distribution of the programme	
Semester-1	20
Semester-2	20
Semester-3	22
Semester-4	24
Semester-5	23
Semester-6	18
Total Credits:	127

Category wise Credit distribution of the programme	
Category	Credit
Major Core	59
Minor Stream	07
Multidisciplinary	30
Ability Enhancement Course	08
Skill Enhancement Courses	04
Value added Courses	01
Summer Internship	18
Total Credits:	127

7. Program Curriculum

Semester 1						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	03604113	Physics	3	3	-	-
2	03604114	Physics Lab	1	-	2	-
3	03604115	Chemistry	3	3	-	-
4	03604116	Chemistry Lab	1	-	2	-
5	03604117	Mathematics	3	3	-	-
6	03604118	Mathematics Lab	1	-	2	-
7	03604119	Introduction to Dairy Industry	2	2	-	-
8	03604121	Fundamentals of Microbiology	2	2	-	-
9	03604122	Fundamentals of Microbiology Lab	1	-	2	-
10	03605101	Environmental Science	0	2	-	-
11	03606102	Introduction to IT Systems Lab	2	-	4	-
12	03693103	Communication Skills - I	1	1	-	-
Total			20	16	12	-

Semester 2						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
13	03604169	Physical Chemistry of Milk	2	2	-	-
14	03604170	Physical Chemistry of Milk Lab	1	-	2	-
15	03604171	Milk Production Management and Dairy Development	2	2	-	-
16	03604172	Milk Production Management and Dairy Development Lab	1	-	2	-
17	03604173	Engineering Graphics	1	1	-	-
18	03604174	Engineering Graphics Lab	2	-	4	-
19	03604176	Engineering Workshop Practice Lab	2	-	4	-
20	03604177	Fluid Mechanics	2	2	-	-
21	03604178	Fluid Mechanics Lab	1	-	2	-
22	03604179	Economic Analysis	2	2	-	-
23	03604181	Introduction to Dairy Microbiology	2	2	-	-
24	03604182	Introduction to Dairy Microbiology Lab	1	-	2	-
25	03693153	Communication Skills - II	1	1	-	-
Total			20	12	16	0
Semester 3						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
26	03604215	Market Milk	2	2	-	-
27	03604216	Market Milk Lab	1	-	2	-
28	03604217	Chemistry of Milk	2	2	-	-
29	03604218	Chemistry of Milk Lab	1	-	2	-
30	03604219	Thermodynamics & Heat Engines	2	2	-	-
31	03604220	Thermodynamics & Heat Engine Lab	1	-	2	-
32	03604221	Biochemistry and Human Nutrition	2	2	-	-
33	03604222	Biochemistry and Human Nutrition Lab	1	-	2	-
34	03604223	Sensory Evaluation of Milk and Milk Products	2	2	-	-
35	03604224	Sensory Evaluation of Milk and Milk Products Lab	1	-	2	-
36	03604226	Hands on Training -I	2	-	4	-
37	03607151	Fundamentals of Electrical and Electronics Engineering	3	2	-	1

38	03607152	Fundamentals of Electrical and Electronics Engineering Lab	1	-	2	-
39	03693203	Professional Communication and Critical Thinking	1	1	-	-
Total			22	13	16	1
Semester 4						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
40	03604267	Fat Rich and Indigenous Dairy Products	2	2	-	-
41	03604268	Fat Rich and Indigenous Dairy Products Lab	1	-	2	-
42	03604269	Cheese, Fermented Products and By-products	3	3	-	-
43	03604270	Cheese, Fermented Products and By-products Lab	1	-	2	-
44	03604271	Market Milk Process Equipments	2	2	-	-
45	03604272	Market Milk Process Equipments Lab	1	-	2	-
46	03604273	Chemistry of Milk Products	2	2	-	-
47	03604274	Chemistry of Milk Products Lab	1	-	2	-
48	03604275	Microbiology of Milk and Other Foods	2	2	-	-
49	03604276	Microbiology of Milk and Other Foods Lab	1	-	2	-
50	03604277	Heat and Mass Transfer	2	2	-	-
51	03604278	Heat and Mass Transfer Lab	1	-	2	-
52	03604279	Packaging of Dairy Products	1	1	-	-
53	03604280	Packaging of Dairy Products Lab	1	-	2	-
54	03604281	Financial Accounting	2	2	-	-
55	03693251	Employability Skills	1	1	-	-
Total			24	17	14	-
Semester 5						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
56	03604317	Ice cream and Frozen Dairy Products	2	2	-	-
57	03604318	Ice cream and Frozen Dairy Products Lab	1	-	2	-
58	03604319	Condensed and Dried Milks	2	2	-	-
59	03604320	Condensed and Dried Milks Lab	1	-	2	-
60	03604321	Dairy Products Equipment's	2	2	-	-
61	03604322	Dairy Products Equipments Lab	1	-	2	-
62	03604323	Chemical Quality Assurance	2	2	-	-

63	03604324	Chemical Quality Assurance Lab	1	-	2	-
64	03604325	Microbiology Quality Assurance	2	2	-	-
65	03604326	Microbiology Quality Assurance Lab	1	-	2	-
66	03604327	Entrepreneurship and Start Up	1	1	-	-
67	03604329	Dairy Engineering	2	2	-	-
68	03604330	Dairy Engineering Lab	1	-	2	-
69	03604331	Marketing Management and International Trade	2	2	-	-
70	03604332	Hands on Training -II	2	-	4	-
Total			23	15	16	-
Semester 6						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
71	03604354	In-plant Training	18	-	36	-
Total			18	-	36	-
Total (08 Semester)			127	73	110	1

1. Detailed Syllabus

Semester 1 [01 and 02]

- a. **Course Name:** Physics.
- b. **Course Code:** 03604113
- c. **Prerequisite:** Knowledge of Mathematics and science up to 10th standard.
- d. **Rationale:** Physics is significant in Diploma Dairy Technology for understanding the core concepts of design and operation of processing equipment's, ensuring accurate understanding of physical processes involved in dairy processes.

e. Course Learning Objective:

CLOBJ 1	To understand the fundamental principles of measurement and unit systems.
CLOBJ 2	To study kinematics and the laws of motion for analyzing real-world scenarios.
CLOBJ 3	To explore the concepts of work, energy, and power, and their conservation.
CLOBJ 4	To analyze the elastic properties and stress-strain relationship in materials.
CLOBJ 5	To learn the basics of light, sound, and their propagation phenomena.
CLOBJ 6	To understand electrostatics and electric current, including Ohm's law.

f. Course Learning Outcomes:

CLO 1	Apply accurate measurement techniques and understand the SI system of units.
CLO 2	Solve problems related to motion, force, and energy in daily life and technical settings.
CLO 3	Use principles of conservation of energy in practical and industrial applications.
CLO 4	Analyse material properties such as elasticity and fluid pressure.
CLO 5	Demonstrate an understanding of optical and sound phenomena, including reflection and refraction.
CLO 6	Apply electrostatics and electric current concepts to solve circuit-related problems.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes		Bloom's Level
CLO 1	Elaborate on units of measurement, different systems of units, and the dimensions of physical quantities.	2
CLO 2	Distinguish between different physical quantities like speed, velocity, acceleration, force, and torque.	2
CLO 3	Apply Newton's laws of motion, work-energy principles, and the law of conservation of energy to solve problems.	3
CLO 4	Analyze properties of bulk matter, including stress-strain relationships, Hooke's law, and Pascal's law applications.	4
CLO 5	Describe phenomena related to light and sound, including refraction, reflection, and propagation of waves.	3
CLO 6	Explain concepts of electric fields, current, resistance, and apply Ohm's law to solve problems in electrostatics.	3

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	2.00	1.00				2.00		1.00	1.00				
CLO 2	3.00	2.00			1.00		1.00			1.00		1.00	1.00	
CLO 3	3.00	2.00	2.00	2.00	1.00	1.00		1.00		1.00		2.00	1.00	1.00
CLO 4	1.00	1.00	1.00		1.00					1.00				
CLO 5	2.00	3.00	2.00	2.00					1.00	1.00		1.00	1.00	
CLO 6	3.00	2.00	2.00	2.00	1.00	1.00		1.00		1.00		2.00	1.00	1.00
CLO 7	1.00	3.00	1.00	2.00	1.00	1.00				1.00		2.00	1.00	
Weighted Average	2.30	2.20	1.60	2.00	1.00	1.00	1.50	1.00	1.00	1.00		1.50	1.00	1.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	60	-	20	50	50	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

SN	Content	Weightage	Teaching Hours
1	Units of Measurement: Units of measurement, systems of units; SI units, fundamental and derived units. Length, mass and time measurements; accuracy and precision of measuring instruments; errors in measurement: significant figures. Dimensions of physical quantities.	15 %	05
2	Kinematics and motion: Motion in a straight line: speed and velocity. Uniform and non-uniform motion, average speed and instantaneous velocity. Acceleration, Scalar and vector quantities Force. Inertia, Newton's laws of motion; momentum; impulse, torque, angular momentum Equilibrium of concurrent forces. Static and kinetic friction, laws of friction, rolling friction, lubrication.	15 %	05
3	Energy and Power - Work done by a force, energy, power; kinetic and potential energy, law of energy conservation	10 %	02
4	Elastic behavior, Stress-strain relationship, Hooke's law, young's modulus, Pressure due to a fluid column; Pascal's law and its applications	15 %	05
5	Light-reflection, refraction, velocity of light; refractive index; scattering of light, diffraction, Convergence and divergence of light, Nature of sound and its propagation, speed of sound, ultrasound; reflection of sound; echo and sonar.	15%	05
6	Electric charges and their conservation. Coulomb's law Electric field, Electric potential, potential difference Conductors and insulators Electric current and resistance, Ohm's law	15 %	05
7	Magnetism and electro magnets: Concept of magnetic field, Field lines Field due to a current carrying wire, Field due to current, carrying coil or solenoid. Electromagnets and Permanent magnets. Force on current carrying conductor Fleming's left-hand rule. Faraday's Law, Inductance, induced potential differences, induced current.	15 %	05
Total		100 %	32

k. Text Book and Reference Book:

1. Engineering physics for diploma, Ranjan kumar Bhuyan PHI publication.
2. Physics NCERT Class 11 & 12 Books.

l. Mapping of Experiment List with Course Learning Outcomes:

SN	Experiment List
1	Measurement of diameter of a small spherical/cylindrical body using Verniercallipers.
2	Measurement of internal diameter and depth of a given beaker/calorimeter using Vernier calipers and its volume.
3	Measurement of diameter of a given wire/Sphere using screw gauge.
4	Measurement of thickness of a given sheet using screw gauge.
5	To verify Ohm's law by plotting graph between current and potential difference.
6	Determination of coefficient of viscosity of a given viscous liquid by assuring terminal velocity of given spherical body.
7	To calculate SA/V ratio of simple objects to understand nanotechnology.
8	To find the moment of inertia of a flywheel.
9	To determine force constant of a spring using Hook's Law

Semester 1
[03 and 04]

- a. **Course Name:** Chemistry and Chemistry Lab
- b. **Course Code:** 03604115 and 0360411
- c. **Prerequisite:** Knowledge of Chemistry up to 10th standard is essential.
- d. **Rationale:** The subject of Chemistry in Diploma Dairy Technology is significant as it provides foundational knowledge of chemical principles essential for understanding milk composition, processing, preservation, and quality control in dairy products.

e. Course Learning Objective:

CLOBJ 1	Understand fundamental concepts in chemistry, including elements, atoms, molecules, and their properties
CLOBJ 2	Learn to calculate molecular masses, and molar masses, and solve problems using the mole concept and chemical formulas
CLOBJ 3	Analyze the types of solutions and their properties, focusing on solubility and colligative properties
CLOBJ 4	Gain foundational knowledge of organic chemistry principles, including nomenclature, methods of preparation, and reactions of hydrocarbons
CLOBJ 5	Explore the role of chemicals in everyday life, including medicines, food additives, and cleansing agents
CLOBJ 6	Develop practical skills in standard solution preparation, titration, pH analysis, and determination of physical properties of compounds

f. Course Learning Outcomes:

CLO 1	Explain the significance of chemistry in various contexts and apply basic principles to describe chemical systems
CLO 2	Perform stoichiometric calculations and determine the empirical and molecular formulas of compound
CLO 3	Analyze solutions and their behaviors, utilizing concepts such as concentration and colligative properties to predict physical changes
CLO 4	Apply IUPAC nomenclature and reaction mechanisms to classify and predict the behavior of organic compounds
CLO 5	Evaluate the applications and impact of chemicals in daily life, particularly in healthcare, food, and hygiene
CLO 6	Conduct laboratory experiments to measure physical and chemical properties of substances, ensuring accurate data collection and interpretation

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes		Bloom's Level
CLO 1	Explain the significance of chemistry in various contexts and apply basic principles to describe chemical systems	2
CLO 2	Perform stoichiometric calculations and determine the empirical and molecular formulas of compound	3
CLO 3	Analyze solutions and their behaviors, utilizing concepts such as concentration and colligative properties to predict physical changes	4
CLO 4	Apply IUPAC nomenclature and reaction mechanisms to classify and predict the behavior of organic compounds	4
CLO 5	Evaluate the applications and impact of chemicals in daily life, particularly in healthcare, food, and hygiene	5
CLO 6	Conduct laboratory experiments to measure physical and chemical properties of substances, ensuring accurate data collection and interpretation	5

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	2.00	1.00				2.00		1.00	1.00				
CLO 2	3.00	2.00			1.00		1.00			1.00		1.00	1.00	
CLO 3	3.00	2.00	2.00	2.00	1.00	1.00		1.00		1.00		2.00	1.00	1.00
CLO 4	1.00		1.00		1.00					1.00				
CLO 5	2.00	3.00	2.00	2.00					1.00	1.00		1.00	1.00	
CLO 6	3.00	2.00	2.00	2.00	1.00	1.00		1.00		1.00		2.00	1.00	1.00
Weighted Average	2.50	2.20	1.60	2.00	1.00	1.00	1.50	1.00	1.00	1.00		1.50	1.00	1.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Some Basic Concepts of Chemistry General Introduction: Importance and scope of chemistry. Concept of elements, atoms and molecules. Atomic and molecular masses. Mole concept and molar mass; percentage composition and empirical and molecular formula; chemical reactions	10 %	05
2	Solutions Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions	06 %	03
3	Colligative properties Relative lowering of vapour pressure, Raoult's law, elevation of B.P., depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass, Vant Hoff factor	10 %	05
4	Organic Chemistry - Some Basic Principles and Techniques General introduction, methods of purification, qualitative and quantitative analysis, classification and IUPAC nomenclature of organic compounds	07 %	04
5	Hydrocarbons - Aliphatic Hydrocarbons Alkanes - Nomenclature, isomerism, conformations (ethane only), physical properties, chemical reactions including free radical mechanism of halogenation, combustion and pyrolysis	08 %	04
6	Hydrocarbons - Alkenes Nomenclature, structure of double bond (ethene), geometrical isomerism, physical properties, methods of preparation; chemical reactions: addition of hydrogen, halogen, water, hydrogen halides (Markovnikov's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition	12 %	06
7	Hydrocarbons - Aldehydes and Ketones Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, and mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes; uses	09 %	05
8	Hydrocarbons - Carboxylic Acids Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses	04 %	02
9	Chemistry in Everyday Life - Chemicals in medicines analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines. Chemicals in food - preservatives, artificial sweetening agents, elementary idea of antioxidants. Cleansing agents - soaps and detergents, cleansing action.	10 %	05

k. Text Book and Reference Book:

1. **Chemistry: The Central Science** (Textbook) Brown, LeMay, Bursten, and Murphy
2. **Organic Chemistry** (Textbook) Morrison and Boyd

l. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
1	Preparation of standard solution of oxalic acid		✓				✓
2	Determination of strength of a given solution of sodium hydroxide by titrating it against standard solution of oxalic acid		✓				✓
3	Preparation of standard solution of sodium carbonate		✓				✓
4	Determination of melting point of an organic compound				✓		✓
5	Determination of boiling point of an organic compound				✓		✓
6	Determination of pH of some solutions obtained from fruit juices, solutions of known and varied concentrations of acids, bases and salts using pH paper or universal indicator			✓			✓
7	Comparing the pH of solutions of strong and weak acid of same concentration			✓			✓
8	Study the pH change in the titration of a strong acid with a strong base using universal indicator			✓			✓
9	Study of pH change by common-ion effect in case of weak acids and weak bases					✓	✓
10	Acidity determination of different samples of the tea leaves					✓	✓
11	Analysis of fruit and vegetable juices for their acidity					✓	✓

Semester 1
[05 and 06]

- a. Course Name:** Mathematics and Mathematics Lab
- b. Course Code:** 03604117
- c. Prerequisite:** Knowledge of Mathematics up to 10th standard.
- d. Rationale:** Knowledge of mathematics is necessary for diploma

e. Course Learning Objective:

CLOBJ 1	Develop an understanding of trigonometric functions and their applications in solving problems. Apply trigonometric concepts in real-world and mathematical problems
CLOBJ 2	Understand the algebra of complex numbers and their geometric representation. Apply complex numbers in solving polynomial equations and mathematical problems.
CLOBJ 3	Develop problem-solving skills using differential equations in physical and engineering contexts.
CLOBJ 4	Apply matrices to solve linear equations and transform geometric problems.
CLOBJ 5	Understand vector algebra and its applications in physics and geometry. Analyze vector equations in various physical contexts.
CLOBJ 6	Apply statistical methods to analyze data and draw conclusions. Understand the basic principles of probability and its applications in uncertain scenarios.

f. Course Learning Outcomes:

CLO 1	Solve equations using trigonometric identities and functions. Analyze and graph trigonometric functions.
CLO 2	Perform arithmetic operations on complex numbers. Represent complex numbers in polar form and interpret their significance.
CLO 3	Solve first-order and higher-order differential equations. Model real-world problems using differential equations.
CLO 4	Perform operations such as addition, multiplication, and inversion of matrices. Use matrices in computer graphics and network analysis.
CLO 5	Perform vector operations such as addition, scalar multiplication, and dot/cross product. Solve problems involving vector projection and planes.
CLO 6	Summarize data using measures of central tendency and dispersion. Construct and interpret histograms, box plots, and scatter plots.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes		Bloom's Level
CLO 1	Solve equations using trigonometric identities and functions. Analyze and graph trigonometric functions.	2
CLO 2	Perform arithmetic operations on complex numbers. Represent complex numbers in polar form and interpret their significance.	2
CLO 3	Solve first-order and higher-order differential equations. Model real-world problems using differential equations.	4
CLO 4	Perform operations such as addition, multiplication, and inversion of matrices. Use matrices in computer graphics and network analysis.	4
CLO 5	Perform vector operations such as addition, scalar multiplication, and dot/cross product. Solve problems involving vector projection and planes.	3
CLO 6	Summarize data using measures of central tendency and dispersion. Construct and interpret histograms, box plots, and scatter plots.	3

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	2.00	1.00				2.00		1.00	1.00				
CLO 2	3.00	2.00			1.00		1.00			1.00		1.00	1.00	
CLO 3	3.00	2.00	2.00	2.00	1.00	1.00		1.00		1.00		2.00	1.00	1.00
CLO 4	1.00		1.00		1.00					1.00				
CLO 5	2.00	3.00	2.00	2.00					1.00	1.00		1.00	1.00	
CLO 6	3.00	2.00	2.00	2.00	1.00	1.00		1.00		1.00		2.00	1.00	1.00
Weighted Average	2.50	2.20	1.60	2.00	1.00	1.00	1.50	1.00	1.00	1.00		1.50	1.00	1.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	50	60	-	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Trigonometric Functions: Introduction of trigonometric functions, angles, expressing sin and cos, trigonometric equations, introduction to inverse trigonometric functions.		4
2	Complex Numbers and Quadratic Equations: complex numbers; quadratic equations, algebra of complex numbers, quadratic equations, square-root of a complex number.	9%	4
3	Binomial Theorem: Introduction, binomial theorem for positive integral indices, general and middle term, simple applications.	7%	3
4	Limits and derivatives: Introduction, intuitive idea of derivatives, limits, derivatives, derivative of sum, difference, product and quotient of functions, derivatives of polynomial and trigonometric functions.	10%	5
5	Matrices: Introduction of matrices, types and operations of matrices, transpose of matrices, transformation of a matrix, invertible matrices.	7%	4
6	Continuity and Differentiability: Continuity, differentiability, concepts of exponential and logarithmic function, brief introduction of order derivative	7%	3
7	Integrals: Integration as inverse process of differentiation, methods of integration, integration of a variety of functions by substitution, basic properties of definite integrals.	10%	5
8	Differential equations: Definition, order and degree, general and particular solutions of a differential equation.	6%	3
9	Vectors: Vectors and scalars; types of vectors, position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, scalar (dot) , product of vectors, cross product of vectors.	17%	8
10	Statistics: definition of statistics, mean, mode, median, measures of dispersion, range, mean deviation, variance and standard deviation, analysis of frequency distribution.	9%	4
11	Probability: probability, conditional probability, multiplication theorem on probability, independent events, total	10%	5

	probability, random variable and its probability distribution, repeated independent (Bernoulli) trials and Binomial distribution.		
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k. Text Book and Reference Book:

1. Mathematics 1 by Deepak singh
2. Diploma engineering Mathematics by B.K Pal

l. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
1	Tutorial on trigonometric equations; tutorial on algebra of complex numbers and quadratic equations.	✓			✓		
2	Tutorial on derivatives of polynomial and trigonometric functions, operations of matrices		✓				✓
3	Analysis of frequency distribution						✓

Semester 1
[08 and 09]

- a. Course Name:** Fundamentals of Microbiology and FOM Lab
- b. Course Code:** 03604121 and 03604122
- c. Prerequisite:** Knowledge of Science and Mathematics up to 12th science level.
- d. Rationale:** Fundamentals of Microbiology in Diploma Dairy Technology equips students with essential knowledge of microbial aspects crucial for quality control and safety in dairy production, ensuring proficiency in managing microbial processes vital to the dairy industry.

e. Course Learning Objective:

CLOBJ 1	Understand the foundational principles of microbiology, including the classification, morphology, and physiology of microorganisms relevant to dairy technology.
CLOBJ 2	Demonstrate knowledge of the role of microorganisms in dairy processes, such as fermentation, spoilage, and pathogenicity, and their impact on product quality and safety.
CLOBJ 3	Develop proficiency in microbiological techniques, including microbial isolation, identification, and enumeration, to assess and control microbial populations in dairy products.
CLOBJ 4	Explore the application of beneficial microorganisms in dairy fermentations, emphasizing the role of starter cultures and probiotics in enhancing product flavour, texture, and nutritional value.

f. Course Learning Outcomes:

CLO 1	Understanding about history and scope of microbiology
CLO 2	Study the electron microscopy and various microbiological staining methods
CLO 3	Understand the difference between prokaryotes and eukaryotic organisms.
CLO 4	Learn the microbial growth, nutrition and bacterial genetics

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Overview of history and scope of microbiology Discovery of Microorganisms and Microscopy (types, working principles and applications); Theories of Biogenesis and abiogenesis; Contributions of Leeuwenhoek, Pasteur, Tyndal, Joseph Lister, Robert Koch, Edward Jenner and Alexander Fleming; Scope and application of microbiology in fields like Dairy, Food, Pharmaceutical, Industrial, Medical and agriculture	18 %	06
2	Classification of Microbes Microbial classification systems, numerical taxonomy, General properties and principles of microbial classification; Whittaker's five kingdom and Carl Wiese's three domain classification system; Systematics of bacteria and Bergey's manual of systematic bacteriology, Phylogenetic tree	12 %	04
3	Prokaryotic and Eukaryotic microorganisms Structure and functions of prokaryotic cells; Differences between prokaryotes and eukaryotes; Differences between cell wall of Gram positive and Gram-negative bacteria; Structure of Racheal cell wall	15 %	05
4	Microbial growth and nutrition Bacterial growth curve; factors affecting growth of bacteria, direct and indirect methods of measurement of bacterial growth; Bacteriostatic and bactericidal agents; Common nutrient requirements and nutritional types of microorganisms	15 %	05
5	Diversity of Microorganisms	12 %	04
6	Microbial Ecology and Environmental Microbiology Microflora of air, soil and water and Microbes of Extreme environment like Archea	8 %	02
7	Basics of Microbial Genetics and Host-Microbe interactions DNA as the genetic material, Structure of DNA/ RNA, DNA replication; transcription and translation	12%	04
8	Basic concepts of immunology Role of immune system in governing host- microbe interactions, Microbial Commensalism, Colonization, Infection, Disease and Vaccines	08 %	02
Total		100	32

i. Text Book and Reference Book:

1. Applied Dairy Microbiology (Text Book) By Marth, E.H. and Steele,
2. Advanced Dairy Science and Technology (Textbook) By Britz, T.J. and Robinson, R.K
3. Dairy Bacteriology (Text Book) By Su Kumar De

Semester 1
[10]

- a. Course Name:** Environmental Science
- b. Course Code:** 03605101
- c. Prerequisite:** Basic understanding of environmental science principles and their application to dairy industry sustainability.
- d. Rationale:** Environmental Science in Diploma Dairy Technology ensures graduates comprehend ecological implications of dairy practices, promoting sustainable and ethical approaches for responsible environmental stewardship within the dairy industry.

e. Course Learning Objective:

CLOBJ 1	Attain an exhaustive understanding of environmental science concepts, with an emphasis on their applicability to the ecological impact.
CLOBJ 2	Develop the ability to assess and analyse the environmental footprint of dairy operations, identifying potential areas for improvement and sustainable practices.
CLOBJ 3	Understand and adhere to environmental regulations and policies relevant to the dairy sector, ensuring ethical and legal practices in environmental management.
CLOBJ 4	Explore and propose innovative technologies and strategies to minimize environmental impact in dairy production, including waste management.
CLOBJ 5	Cultivate effective communication skills to articulate environmental issues within the dairy industry, fostering awareness, and advocating for responsible and sustainable practices among stakeholders.

f. Course Learning Outcomes:

CLO 1	Understand the various natural resources and its uses
CLO 2	Introduction, structure, and function of an ecosystem
CLO 3	Learn the basics of biodiversity and its conservation
CLO 4	Distinguish the various pollutants and learn the role of an individual in prevention of pollution
CLO 5	Establish an understanding of the function of information technology (IT) in the environment.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	0	20	20	-	-	-	40

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Environmental Health and Quality of Life: Environmental education: Objective and scope, Impact of technology on the environment. Environmental disasters: Case studies, Global environmental awareness to mitigate stress on environment	10 %	04
2	Ecology and Ecosystem: Interdependence of organisms, Structure and function of an ecosystem, Ecological pyramids, Pyramid of number, Pyramid of energy and pyramid of biomass	25 %	07
3	Natural resources and their managements: Water resources: Sources of water, Stress on water resources, The story of Cherapunji. Energy resources: Classification, advantages, limitations and future scope of conventional and non-conventional. resources	15 %	05
4	Environmental Pollution: Air pollution, Water pollution, Solid waste pollution, Noise pollution, Soil pollution, Radioactive pollution	15 %	05
5	Waste Management: Food processing industry waste and its management, Management of urban waste water, Recycling of organic waste, Recycling of factory effluent	25 %	07
6	Environmental Protection Through Environmental Legislation: Control of environmental pollution through law, Composting of biological waste and Sewage, uses of water disposal effluent treatment, microbial examination	10 %	04
Total		100 %	32

i. Text Book and Reference Book:

1. Environmental Studies: From Crisis to Cure by R. Rajagopalan
2. Environmental Science and Engineering by J. Glynn Henry and Gary W. Heinke
3. Environmental Management in Dairy Industry by P. Sampath Kumar and R. B. Singh.
4. Sustainable Dairy Production by Nico van Belzen.
5. E-course of ICAR. Cited from: www.agrimoon.com

Semester 2
[15 and 16]

- a. Course Name:** Milk Production Managements and Dairy Development
- b. Course Code:** 03604171 and 03604172
- c. Prerequisite:** Knowledge of Science and Mathematics up to 12th science level.
- d. Rationale:** Milk Production Management and Dairy Development course teaches students how to produce milk efficiently and sustainably, improving dairy farming practices and the dairy industry.

e. Course Learning Objective:

CLOBJ 1	Develop a comprehensive understanding of dairy farm management principles, encompassing animal husbandry, nutrition, health care, and breeding practices, to optimize milk production and ensure the overall well-being of dairy cattle.
CLOBJ 2	Acquire knowledge and skills in implementing sustainable and ethical milk production practices, including the integration of modern technologies, environmental considerations, and animal welfare standards to enhance productivity while minimizing environmental impact.
CLOBJ 3	Explore strategies for dairy industry development, including market analysis, value chain management, and the application of innovative technologies, to contribute to the growth and competitiveness of the dairy sector on both regional and global scales.
CLOBJ 4	Develop entrepreneurial skills by understanding the economic aspects of dairy farming, market dynamics, and value addition opportunities, enabling students to identify and pursue business prospects in the dairy industry and contribute to its sustainable development.

f. Course Learning Outcomes:

CLO 1	Understand the basic concepts of animal husbandry, systems of breeding, methods of selection of dairy animals, their reproductive system, common diseases in dairy animals, prevention and control.
CLO 2	Explain general dairy farm practices, methods of milking, milking procedure practices for quality milk production, maintenance of hygiene and sanitation of dairy farm premises as well as animals.
CLO 3	Understand about the Dairy development in India and Key village scheme
CLO 4	Evaluate the role of NDDB, Operation Floods, Co-operative dairy organizations and new developments for improvement of dairy cooperative organizations.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction to Animal Husbandry	05 %	03
2	Characteristics of India and exotic breeds Distinguishing characteristics of India and exotic breeds of dairy animals and their performance.	15 %	04
3	Breeding and methods and General dairy farm practices Systems of breeding and methods of selection of dairy animals. General dairy farm practices - Identification, dehorning, castration, exercising, grooming, weighing.	20 %	06
4	Care of animals 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.	15 %	04
5	Dairy farm Dairy farm records and their maintenance. Systems of housing dairy animals and maintenance of hygiene and sanitation at dairy farm premises.	10 %	03
6	Common disease problems: Common disease problems in dairy animals, their prevention and control.	10 %	04
7	Digestive system of ruminants: Digestive system of ruminants and measures of feed energy. Nutrients requirements for growth and milk production.	10%	04

8	Artificial insemination and embryo transfer: Artificial insemination and embryo transfer and their role in animal improvement introduction to biotechniques in dairy animal production.	15 %	04
Total		100 %	32

i. Text Book and Reference Book:

1. A Textbook of Animal Husbandry by G C Banerjee.
2. Introduction to Dairy Science and Technology: Milk Production, Processing and Dairy-Based Products" by C.P. Bhadani.
3. "Dairy Farming: The Beautiful Way" by Anoop Bishnoi.
4. "Dairy Cattle Science" by Howard Tyler and Thomas Ensminger.
5. "Dairy Cooperatives and Development: A Study of Tribal Dairy Cooperative Societies in Gujarat" by J.V. Singh and A.K. Misra.

Semester 2
[20 and 21]

- a. Course Name:** Fluid Mechanics
- b. Course Code:** 03604177 and 03604178
- c. Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
- d. Rationale:** Fluid mechanics is significant in Diploma Dairy Technology for optimizing the design and operation of processing equipment, ensuring efficient transport of liquids in dairy processes crucial for product quality and safety.

e. Course Learning Objective:

CLOBJ 1	Understand the fundamental principles of fluid mechanics and their application in dairy technology, emphasizing viscosity, flow behaviour, and fluid properties.
CLOBJ 2	Analyse and design dairy processing equipment by applying fluid mechanics concepts to ensure efficient and hygienic operations.
CLOBJ 3	Demonstrate proficiency in calculating and predicting fluid flow parameters in dairy systems, including pipe flow, pump selection, and pressure losses.
CLOBJ 4	Evaluate heat transfer mechanisms related to fluid flow in dairy processes, considering thermal processing and pasteurization for product safety and quality.
CLOBJ 5	Apply mathematical modelling techniques to simulate and optimize fluid flow in dairy systems, fostering problem-solving skills for real-world applications.
CLOBJ 6	Demonstrate knowledge of rheology and its impact on dairy product texture, stability, and sensory attributes, facilitating the production of high-quality dairy products.

f. Course Learning Outcomes:

CLO 1	Elaborate the different properties of fluids and compute the dimensions of various units
CLO 2	Distinguish the various pressure of liquids and learn the different pressure measuring devices
CLO 3	Study the Archimedes principle, Continuity equation, Bernoulli's theorem, Buckingham's theorem, Dimensionless numbers and its practical application
CLO 4	Describe various head losses in fluid flow and calculate the problems on head loss
CLO 5	Explain the difference between various notches, orifices, vena contract, mouthpiece and also compute the problems
CLO 6	Describe about the various application of pumps and learn the its efficiency as well as numerical

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction: Units and dimensions, Properties of fluids.	06 %	02
2	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	12 %	04
3	Pressure measuring devices: simple, differential, micro, inclined manometer, mechanical gauges, Piezometer	09 %	03
4	Fluid flow: Classification, steady uniform and non-uniform flow, Laminar and turbulent, continuity equation, Bernoulli's theorem and its applications	12 %	04
5	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.	16 %	05
6	Flow measurement: Venturi meters, pitot tube, Rota meter. Water level point gauge, hook gauge	13 %	04
7	Dimensional analysis: Buckingham's theorem application to fluid flow phenomena. Froude Number, Reynolds number. Weber number and hydraulic similitude	16 %	05
8	Pumps: Classification, reciprocating, centrifugal pump. Pressure variation, work efficiency. Pump selection and sizing	16 %	05
Total		100 %	32

i. Text Book and Reference Book:

1. Fluid Mechanics (Textbook) D.S. Kumar; S. K. Kataria and Sons.
2. Fluid Mechanics (Textbook) R.K. Bansal; Laxmi Publications

Semester 3
[32 and 33]

a. Course Name: Biochemistry & Human Nutrition Lab

b. Course Code: 03604221 and 03604222

c. Prerequisite: Knowledge of Biology and Chemistry up to 12th science level.

d. Rationale: Biochemistry is the branch of science that explores the chemical processes and substances occurring within living organisms, elucidating the molecular mechanisms underlying life and enabling a deeper understanding of biological functions and diseases.

e. Course Learning Objective:

CLOBJ 1	Demonstration and understanding of the diverse structures and functions of biomolecules, including proteins, carbohydrates, lipids, and nucleic acids.
CLOBJ 2	Upon completion, students will be able to categorize biomolecules, explain their classification, and articulate their roles in biological systems.
CLOBJ 3	Comprehensive knowledge of enzyme kinetics, classification, action mechanisms, and the ability to determine enzyme activity in diverse biochemical contexts.
CLOBJ 4	The study and comprehension of key metabolic cycles, including glycolysis, gluconeogenesis, the tricarboxylic acid (TCA) cycle, and ATP synthesis, integrating their understanding into broader biological processes.

f. Course Learning Outcomes:

CLO 1	Discuss the various Bio-Molecules
CLO 2	Understand the classification and functions of biomolecules
CLO 3	Acquire an understanding of enzyme kinetics, classification, the mechanism of enzyme action, and enzyme activity determination.
CLO 4	Study and learn the various cycle such as glycolysis, gluconeogenesis, TCA and ATP synthesis

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation,

CE- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	General structures of bio molecules Amino acids, Protein Structure, Carbohydrates, Fats, Lipids, DNA and RNA	13 %	02
2	Classification and functions of bio molecules Amino acids, Protein Structure, Carbohydrates, Fats, Lipids, DNA and RNA	19 %	03
3	Enzymes Activation energy / Transition state, Enzyme Classification, Coenzymes/Co-factors & Enzyme kinetics, Mechanism of enzyme action, Factors effecting enzyme activity, Enzyme inhibition, isozymes & Regulatory Enzymes, Immobilization of enzyme, Ribozymes & Zymogens.	44 %	07
4	Metabolism Glycolysis, Gluconeogenesis, TCA cycle, Glycogen synthesis and degradation, Pentose phosphate pathway, Fatty acid oxidation, Urea cycle and transaminase reactions, ATP and Electron transport chain	24 %	04
Total		100 %	16

i. Text Book and Reference Book:

1. Lehninger Principles of Biochemistry, By David L. Nelson, Michael M. Cox, | Publisher: W. H. Freeman | Fourth Edition
2. Biochemistry by U. Satyanarayana
3. Biochemistry by Lubert Stryer
4. Biochemistry by Zubey | WCB

Semester 3
[26]

- a. Course Name:** Human Nutrition
- b. Course Code:** 20104211
- c. Prerequisite:** Knowledge of Biology up to 12th science level.
- d. Rationale:** Understanding human nutrition in Diploma Dairy Technology as it equips students with the knowledge to optimize dairy product development, ensuring the creation of nutritious and health-promoting dairy products for consumers.

e. Course Learning Objective:

CLOBJ 1	Demonstrate a thorough understanding of key biochemical cycles, including glycolysis, gluconeogenesis, the tricarboxylic acid (TCA) cycle, and ATP synthesis, by explaining their molecular processes, regulatory mechanisms, and significance in energy metabolism.
CLOBJ 2	Analyse and evaluate the safety considerations associated with food additives, toxic elements, and radionuclides in milk and milk products, demonstrating the ability to discuss potential risks, regulatory measures, and methods to ensure food safety.
CLOBJ 3	Articulate the roles of vitamins and hormones in human physiology, and apply this knowledge to determine and explain the specific nutrient requirements for diverse age groups, considering factors such as growth, development, and maintenance of health.
CLOBJ 4	Develop practical skills in estimating blood levels of creatinine, triglycerides, and cholesterol through laboratory techniques, demonstrating the ability to interpret these biomarkers in the context of human health and nutrition.

f. Course Learning Outcomes:

CLO 1	Study and learn the various cycle such as glycolysis, gluconeogenesis, TCA and ATP synthesis
CLO 2	Discuss and understand the Safety Aspects of Food Additives, Toxic Elements, Radionuclides in Milk and Milk Products
CLO 3	Explain the vitamins, hormones and gain the knowledge of nutrient requirement for various age group
CLO 4	Estimate the blood creatinine, triglyceride and cholesterol levels.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Fundamentals of human nutrition Fundamentals of human nutrition, concept of balanced diet, nutrient requirements of different age groups.	20 %	06
2	Methods of evaluation of nutritive value of food Methods of evaluation of nutritive value of food and nutritional value of cow, buffalo and human milk, biochemical composition and energy value of foods with special reference to milk and dairy products	20 %	06
3	Nutrition, digestion and absorption, Vitamins Nutrition, digestion and absorption, Vitamins (structure and function), Hormones (structure and function).	15 %	05
4	Milk intolerance and hypersensitivity Milk intolerance and hypersensitivity, Safety aspects of food additives, toxic elements, antibiotics, radionuclides in milk and milk products.	15 %	05
5	Nutraceutical, antioxidants, food toxins Nutraceutical, antioxidants, food toxins, anti-nutritional factors, probiotics and cultured dairy products. Biochemical aspect of post-harvest storage specifically food spoilage.	30 %	10
Total		100 %	32

i. Text Book and Reference Book:

1. Nutrition: Concepts and Controversies" by FrancesSizer and Ellie Whitney
2. Introduction to Human Nutrition" by Michael J. Gibney, Susan A. Lanham-New, and Aedin Cassidy.
3. Advanced Nutrition and Human Metabolism" by Sareen S. Gropper, Jack L. Smith, and James L. Groff
4. The World of Nutrition" by MyPlate Edition by Judith L. Collene and Sari Edelstein
5. Biochemical, Physiological, and Molecular Aspects of Human Nutrition" by Martha H. Stipanuk and Marie A. Caudill.

Semester 2

- a. **Course Name:** Engineering Workshop Practice Lab
- b. **Course Code:** 03604176
- c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
- d. **Rationale:** Engineering Workshop practice in Diploma Dairy Technology is crucial for hands-on skill development, fostering practical knowledge, and ensuring proficiency in dairy processing techniques essential for the industry.

e. Course Learning Objective:

CLOBJ 1	Acquire proficiency in using various dairy processing equipment and tools through practical exercises in the workshop.
CLOBJ 2	Demonstrate an understanding of safety measures and protocols related to dairy processing to ensure a secure working environment.
CLOBJ 3	Learn to maintain and enhance product quality by mastering techniques for monitoring and controlling different aspects of dairy processing.
CLOBJ 4	Develop problem-solving skills by identifying and resolving issues that may arise during dairy processing operations in a controlled workshop setting.

f. Course Learning Outcomes:

CLO 1	Learn the basics of workshop practice, safety, precaution in workshop and bench work tools, its uses and processes
CLO 2	Study the operations of Smithy, forging tools, Lathe machine, drilling machine and welding
CLO 3	Elaborate the wood working tools and practice their application
CLO 4	Compare different types of machine tools (lathe, milling, drilling machines etc.)

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	4	2	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction: workshop practice, safety, care and precautions in workshop	06 %	02
2	Wood work: Wood working tools and their use, Carpentry	06 %	02
3	Heat treatment process: Hardening, tempering, annealing and normalizing etc.	13 %	04
4	Metal work: Metal cutting. Soldering, Brazing	13 %	04
5	Welding: Electric arc and Gas welding. Smithy and forging operations: tools and equipment's	13 %	04
6	Bench work: The bench, flat surface filing, chipping, scrapping, marking out, drilling and screwing	13 %	04
7	Introduction to following tool machines: (a) Lathe Machine (b) Milling Machine (C) Shaper and Planner (d) Drilling and Boring machines (e) Grinder (f) CNC Machines etc.	36 %	12
Total		100 %	32

i. Text Book and Reference Book:

1. Hazara Choudhary 2nd edition
2. E-course of ICAR. Cited from: www.agrimoon.com

Semester 2

- a. **Course Name:** Communication Skills - I
- b. **Course Code:** 03693103
- c. **Prerequisite:** Knowledge of English up to 12th science level.
- d. **Rationale:** The Communication Skills course in Diploma Dairy Technology is of paramount importance as it equips students with the essential abilities to effectively convey technical knowledge collaborate with industry stakeholders, and articulate ideas crucial for success in the dairy technology field. This course not only enhances written and verbal communication proficiency but also fosters interpersonal skills, empowering students to engage in impactful communication within the dairy industry, research, and broader professional contexts, thereby facilitating their comprehensive development as successful dairy technologists and communicators.

e. Course Learning Objective:

CLOBJ 1	Develop the ability to express thoughts and ideas clearly and concisely through spoken language.
CLOBJ 2	Improve written communication skills, including composing clear and professional emails, reports, and other written documents.
CLOBJ 3	Explore and employ digital communication tools, platforms, and multimedia aids for professional communication, including virtual meetings, collaboration software, and social media.
CLOBJ 4	Cultivate interpersonal skills, including empathy and conflict resolution, to navigate various communication scenarios effectively.

f. Course Learning Outcomes:

CLO 1	Understand basics of English grammar
CLO 2	Display basic level of communication confidence
CLO 3	Study the basics of communication, types of communication, models of communication and barriers to communication
CLO 4	Distinguish the technical writing, scientific writing and resume writing

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	0	0	1	-	100	-	-	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Crazy Scientist The students will be taught the importance of invention and innovation using some examples that changed the world the way it worked.	4	2
2	Phonetics IPA Introduction (listening tracks), Phonemic Sounds, Listening Activity, Pronunciation Practice	4	2
3	Vocabulary Building Word formation process: Compounding, clipping, blending, derivation, creative respelling, coining and borrowing. Prefixes & suffixes, synonyms & antonyms, standard abbreviations (related activities will be provided) Methods to enhance Vocabulary	12	5
4	Speaking Activity: Role play	10	2
5	Identifying Common Errors in Writing: Sentence structure Punctuations. Subject-Verb Agreement Noun-Pronoun Agreement	10	2
6	Reading Comprehension: The art of effective reading, Employing different reading skills, Practice	10	2
7	Speech a Spoken Exchanges Stage; Delivering different types of speeches: Welcome /Introductory speech, Vote of Thanks speeches, Farwell speeches	12	5
8	Professional Presentations: Combating stage fright, preparing power point presentation, Delivering PPT	10	4
9	Picture Connector: In this class the students will be trained to form a logical connection between a set of pictures which will be shared with them. This is geared towards building creativity and presentation skills	4	2
10	Movie Review	10	2
11	Error analysis: Tenses, Active passive voice, Direct indirect speech	10	2
12	Reporter: Classroom Activity to encourage, Communication and Convincing Skills.	4	2
Total		100 %	32

i. Text Book and Reference Book:

1. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K
2. Communication Skills
3. Kumar S and Lata P; New Delhi Oxford University Press
4. Practical English Usage MICHAEL SWAN
5. A Remedial English Grammar for Foreign Student F.T. WOOD
6. On Writing Well William Zinsser; Harper Paperbacks, 2006; 30th anniversary edition
7. Oxford Practice Grammar, By John Eastwood | Oxford University Press

Semester 3

- a. **Course Name:** Fundamentals of Electrical and Electronics Engineering
- b. **Course Code:** 03607151 and 03607152
- c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
- d. **Rationale:** Basic electrical engineering in Diploma Dairy Technology is crucial for understanding and maintaining the electrical systems that power essential equipment, ensuring smooth operations and quality control in dairy processing

e. Course Learning Objective:

CLOBJ 1	Grasp the foundational principles of electrical engineering, including circuit analysis, Ohm's law, and basic electrical components relevant to dairy technology.
CLOBJ 2	Learn and apply safety measures in handling electrical equipment, emphasizing precautions to prevent accidents and ensure a secure working environment in dairy processing facilities.
CLOBJ 3	Improve expertise in the integration of electrical components with dairy machinery, thereby guaranteeing peak performance and efficiency throughout procedures such as pasteurization, homogenization, and packaging.
CLOBJ 4	Develop the ability to diagnose and troubleshoot electrical issues in dairy equipment, enabling swift problem-solving to minimize downtime and maintain production continuity.

f. Course Learning Outcomes:

CLO 1	Understanding about fundamentals of currents, Introduction to circuits and electromagnetic induction
CLO 2	Acquire an understanding of the resonance concept, as well as A.C. series and parallel circuits.
CLO 3	Study the basics of Transformers, Alternators and Induction motors
CLO 4	Explanation of D.C. Machines and D.C. generator

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	1	2	4	20	20	50	60	-	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Alternating current fundamentals: Generation of alternating current or voltage, magnitude of induced E.M.F. Alternating current, R.M.S value and average value of an alternating current. Phase relation and vector representation. Cycle, Time period, Frequency, Amplitude, Phase and Phase Difference, Root Mean Square Value, Average value, Form Factor, Crest or Amplitude Factor.	09 %	03
2	Poly-phase Circuit: Generation of Poly-phase Voltage, Phase Sequence, Interconnection of Three Phases such as Star Connection and Delta Connection and their respective value of current and voltages, Energy Measurement by using Single and Two Watt-meters	09 %	03
3	Transformers: Working Principle of Transformer, Construction features of Core and Shell type transformer, Elementary theory of an Ideal Transformer, E.M.F. Equation of a Transformer, Vector diagram of transformer with and without load, Transformer losses, voltage regulation and efficiency of transformer, Construction and working on a Single Auto-transformer, Different parts of a 11/0.4 KV, Distribution Transformer	14 %	04
4	Three Phase Induction Motor: Fundamental working principles, Production of rotating magnetic fields, construction, Different types of Rotors such as Squirrel Cage and Phase wound rotors, starting of induction motors using Direct on Line (DOL) and Star-Delta Starter. Soft starter and variable frequency drives.	09 %	03
5	Single Phase Induction Motors: Introduction, Different types of single-phase induction motors such as Split Phase, Capacitor type, Shaded Pole type, Universal or AC series motors, Repulsion start induction run motor, Repulsion induction motor	09 %	03
6	DC Machine: Construction and operation of DC generator, types of generators and their various characteristics. DC motors: Torque speed characteristics of DC motors, Starting and speed control of DC motors by using 3-point DC Starter.	13 %	04
7	Alternators: Elementary working principles, Different parts of an Alternators, Relation between Speed and Frequency, E.M.F. equation in an Alternators. Different types of Circuit Breaker and its use. Introduction to DG set system	13 %	04
8	Electric Power Economics: Economics of Generation of electrical energy and related important terms such as, load curve, connected load,	14 %	04

	Maximum Demand, Demand Factor, Average load or demand, Load Factor, Diversity factor and its significance, Capacity Factor or Plant factor, Utilization Factor, Plant Operating Factor and Selection of Units and related numerical, Various types of Tariffs used for calculation of electricity bill.		
9	Lighting system and Energy Management and Power Factor Corrections: Introduction to industrial lighting system, Types of energy, Energy Management, Concept of Energy Audit. Concept of Power Factor, Disadvantages of low power factor, Causes of low power factor. Various methods of improving low power factor, Location of power factor correction equipment, Advantages of power factor improvement	10 %	04
Total		100 %	32

i. Text Book and Reference Book:

1. Electric Engineering. 3thEdn. By Thareja
2. E-course of ICAR. Cited from: www.agrimoon.com
3. Basic Electrical Engineering (Textbook)
D. P. Kothari and I. J. Nagrath, Tata McGraw Hill; 3, 2010

Semester 2

- a. **Course Name:** Physical Chemistry of Milk
- b. **Course Code:** 03604169 and 03604170
- c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
- d. **Rationale:** The physical chemistry of milk involves the colloidal nature of its proteins and fat globules, influencing properties like stability and viscosity, while pH and temperature dynamics play critical roles in modulating its colloidal stability and enzymatic reactions.

e. Course Learning Objective:

CLOBJ 1	Acquire knowledge pertaining to the chemical composition of milk, encompassing both its major and minor constituents, in order to grasp the complex interrelationships among minerals, proteins, lipids, and carbohydrates that govern the physical attributes of milk.
CLOBJ 2	Explore the molecular interactions, chemical reactions, and physical transformations occurring in milk during various processing stages, providing insight into the factors influencing the stability, texture, and flavour of dairy products.
CLOBJ 3	Develop proficiency in applying thermodynamic principles to assess energy changes and understand kinetic aspects governing milk processing operations, crucial for optimizing process efficiency and ensuring the quality of end products.
CLOBJ 4	Acquire skills in utilizing physical chemistry principles for quality control and assurance in dairy production, including the analysis of chemical parameters, monitoring changes during storage and transportation, and implementing corrective measures to ensure the consistent production of safe and high-quality dairy products.

f. Course Learning Outcomes:

CLO 1	Understand the basics of milk composition and its colloidal chemistry.
CLO 2	Study the various physical and colligative properties of milk.
CLO 3	Learn the basics about nuclear chemistry and molecular spectroscopy.
CLO 4	Compare the normal and adulterated milk.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Composition of milk Constituents and gross composition of milk of different species and breeds of milch animal	03 %	01
2	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	13 %	04
3	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	09 %	03
4	Liquid State Surface tension, surface energy interfacial tension. Surface tension of mixtures. Surface tension of milk and the factors affecting it	07 %	02
5	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.	09 %	03
6	Refractive index and Colligative Properties of Dilute Solution Vapour pressure, Raoult's Law, Depression of freezing point, Elevation of boiling point. Freezing point and boiling point of milk. Osmosis and Osmotic pressure. Inter-relation of colligative properties.	13 %	04
7	Aqueous solution of Electrolytes	07 %	02

	Electrolytes; non-electrolytes, ionic mobility, electrical conductance, Ostwald Dilution Law, Kohlrausch Law, Electrical conductance of milk.		
8	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.	09 %	03
9	Buffer solutions Derivation of Henderson Hasselbach equation and its application, buffer capacity and buffer index, milk as a buffer system. Equilibrium of electrolytes. pH indicators.	09 %	03
10	Oxidation- Reduction Redox potential, Nernst equation, electrochemical cells. Hydrogen, glass and calomel electrodes. Redox system of milk.	06 %	02
11	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.	06 %	02
12	Molecular Spectroscopy The spectrum of electro- magnetic radiation, the laws of Lambert and Beer, visible, and ultra-violet Spectroscope. Mention of mass, NMR spectroscopy	09 %	03
Total		100 %	32

i. Text Book and Reference Book:

1. Dairy Chemistry and Bio-Chemistry by Fox, P.F. and Sweeny, Mc
2. Dairy Chemistry and Physics by Walstra, P. and Jenness, R
3. Principles of Dairy Chemistry by Jenness, R. and Patton, S.
4. Text book of Dairy Chemistry by Mathur, M.P., Datta, D. R., and Dinakar, P.

Semester 3

- a. **Course Name:** Chemistry of Milk and Chemistry of Milk Lab
b. **Course Code:** 03604217 and 03604218
c. **Prerequisite:** Knowledge of Chemistry and Mathematics up to 12th science level.
d. **Rationale:** The fundamental chemical composition and reactions within milk, pivotal for understanding its properties and processing in the dairy industry.
e. **Course Learning Objective:**

CLOBJ 1	Analyse and interpret the intricate chemical makeup of milk, including its proteins, lipids, carbohydrates, vitamins, and minerals.
CLOBJ 2	Explore the reactions and interactions between milk components under various processing conditions, elucidating their impact on quality and safety.
CLOBJ 3	Develop skills to assess milk quality through chemical analysis, including tests for acidity, fat content, and presence of contaminants and understand the chemical principles behind various milk processing techniques.
CLOBJ 4	Evaluate the functional properties of milk components and apply chemical knowledge to troubleshoot issues in milk processing.

f. **Course Learning Outcomes:**

CLO 1	Study the milk definition, composition and variation
CLO 2	A concise overview of the structural components of milk
CLO 3	Learn the basics of milk proteins, carbohydrate, lipids, salt and minerals in milk
CLO 4	Develop understanding of novel product development

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Composition of milk Constituents and gross composition of milk of different species and breeds of milch animals	6	2

2	Milk proteins Nomenclature and classification of milk proteins	6	2
3	Casein Isolation, fractionation and chemical composition, physico- chemical properties of casein	6	2
4	Whey proteins Preparation of total whey proteins: μ TLactalbumin and κ TLactoglobuline	6	2
5	Properties of proteins Properties of α -Lactalbumin and β -lactoglobulin, Immunoglobulin and other minor milk proteins and non-proteins nitrogen constituents of milk	6	2
6	Denaturation Hydrolysis and denaturation of milk proteins under different physical and chemical environments.	6	2
7	Protein estimation Estimation of milk proteins using different physical and chemical methods	6	2
8	Genetic polymorphism Importance of genetic polymorphism of milk proteins	6	2
9	Milk enzymes Milk enzymes with special reference to lipases, Xanthine Oxidase, phosphates, proteases and lactoglobulin	6	2
10	Milk carbohydrates 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	11	4
11	Milk lipids 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.	24	6
12	Milk Salts Mineral in milk (a) major mineral (b) Trace elements, physical equilibria among the milk salts Milk contact surfaces and metallic contamination	11	4
Total		100 %	32

i. Text Book and Reference Book:

1. Advanced Dairy Science and Technology by Britz, T.J. and Robinson, R.K
2. Dairy Chemistry and Bio-Chemistry by Fox, P.F. and Sweeny, Mc
3. Developments in Dairy Chemistry by Fox, P.F.
4. Text book of Dairy Chemistry by Mathur, M.P., Datta, D. R., and Dinakar, P.

Semester 3

- a. Course Name:** Thermodynamics & Heat Engine and Thermodynamics & Heat Engine Lab
- b. Course Code:** 03604219 and 03604220
- c. Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
- d. Rationale:** Thermodynamics subject holds paramount significance in Diploma Dairy Technology, providing a foundational understanding of heat transfer, energy conservation, and phase changes crucial for optimizing processes in dairy production, refrigeration, and thermal processing, ensuring efficiency and quality in the dairy industry.

e. Course Learning Objective:

CLOBJ 1	Develop a comprehensive understanding of the fundamental principles and concepts of thermodynamics, including the laws of thermodynamics, thermodynamic properties, and energy transfer mechanisms.
CLOBJ 2	Apply thermodynamic principles to analyse and optimize heat transfer processes, refrigeration systems, and energy utilization within dairy processing units.
CLOBJ 3	Explore the thermodynamics of phase transitions and refrigeration cycles as they relate to dairy product manufacturing and storage.
CLOBJ 4	Apply thermodynamic principles to optimize thermal processing parameters like pasteurization and sterilization to assure dairy product safety and quality.

f. Course Learning Outcomes:

CLO 1	Understand the basic concepts of thermodynamics and its laws
CLO 2	Study various air cycles, I.C. Engine and its performance
CLO 3	Learn the classification of steam generators, steam and its properties
CLO 4	Basics of boiler draught and air compressor

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction: Importance and applications of thermodynamics in Dairy/Food processing	06 %	02
2	Basic concepts: Thermodynamic systems, properties, state, processes, cycles, energy, The Zeroth Law of Thermodynamics	19 %	06
3	Ideal gases: Equation of state, Compression and expansion of gases. The first Law of Thermodynamics: Internal energy, enthalpy. Analysis of non-flow and flow processes	12 %	04
4	The second Law of Thermodynamics: Thermodynamic temperature scale, Carnot cycle, heat engine, entropy, reversibility, availability	25 %	08
5	Air Cycles: Otto, Diesel, dual cycles and their efficiencies, Plotting the air cycles on p-V, T-S, p-h diagram etc	19 %	06
6	Heat Engines: Concepts, Classification, Working of two stroke and four stroke cycle S.I. engines and C.I. engines. Parts of I.C. engine, Performance of IC engines	19 %	06
Total		100 %	32

i. Text Book and Reference Book:

1. Introduction to Chemical Engineering Thermodynamics" by Joseph M. Smith, Hendrick C. Van Ness, Michael M. Abbott
2. Thermodynamics: An Engineering Approach by Yunus A. Cengel, Michael A. Boles
3. Thermodynamics: Concepts and Applications by Stephen R. Turns
4. Fundamentals of Thermodynamics" by Claus Borgnakke, Richard E. Sonntag

Semester 4

- a. **Course Name:** Heat and Mass Transfer
- b. **Course Code:** 03604277 and 03604278
- c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
- d. **Rationale:** Heat and Mass Transfer in Diploma Dairy Technology is crucial for optimizing processes, ensuring product quality, and enhancing efficiency in the production of dairy products.

e. Course Learning Objective:

CLOBJ 1	Understand the fundamental principles of heat transfer and how they apply to dairy processing, including conduction, convection, and radiation.
CLOBJ 2	Comprehend the principles of mass transfer, emphasizing its role in processes such as drying, evaporation, and crystallization in dairy technology.
CLOBJ 3	Analyse heat exchangers and their applications in dairy processing, considering factors like heat transfer coefficients and overall heat transfer efficiency.
CLOBJ 4	Explore the impact of heat and mass transfer on the physical and chemical properties of dairy products, focusing on quality attributes and shelf-life.

f. Course Learning Outcomes:

CLO 1	Distinguish the various modes of heat transfer operation required for manufacturing of milk and milk products
CLO 2	Understanding the concepts and design of heat exchanger used in various application
CLO 3	Calculating the molar co-efficient using basic equations like Fick's law and diffusion constant
CLO 4	Solve the Design problems on Mass Transfer Heat transfer in tubular heat exchanger

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction to basic heat transfer process: thermal conductivity, convective film co-efficient, Stefan Boltzmann'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	09 %	03
2	One-dimensional steady state conduction: Theory of heat conduction, Fourier's law, Derivation of Fourier's equation in Cartesian coordinates, 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	19 %	06
3	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	16 %	05
4	Convection: Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer	12 %	04
5	Dimensionless number: Concept of Nusselt number. Prandtl number, Reynolds number, Grashoff number, some important empirical relations used for determination of heat transfer coefficient.	12 %	04
6	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	16 %	05
7	Mass transfer: Fick's Law of diffusion, steady state diffusion of gases and liquids through solids. Equimolar diffusion. Mass transfer co-efficient and problems on mass transfer	16 %	05
Total		100 %	32

i. Text Book and Reference Book:

1. Heat and Mass transfer by Domkundwar
2. E-course of ICAR. Cited from: www.agrimoon.com

Semester 4

- a. **Course Name:** Microbiology of Milk and Other Foods
- b. **Course Code:** 03604275 and 03604276
- c. **Prerequisite:** Knowledge of Science and Mathematics up to 12th science level.
- d. **Rationale:** Microbiology of Milk and Other Foods explores the essential microbial processes affecting milk quality, safety, and shelf life, crucial for ensuring the production of wholesome dairy products.

e. Course Learning Objective:

CLOBJ 1	Explore the diverse range of microorganisms present in fluid milk, including bacteria, yeasts, and Molds, and their impact on milk quality and safety.
CLOBJ 2	Learn dairy processing procedures to control microbial contamination and produce safe, high-quality fluid milk.
CLOBJ 3	Learn to apply microbiological testing methods to assess and monitor the microbial quality of fluid milk throughout the production chain, emphasizing regulatory standards and industry best practices.
CLOBJ 4	Acquire knowledge and skills to develop and implement effective microbial control strategies, including pasteurization and other preservation methods, to enhance the shelf life and safety of fluid milk products.
CLOBJ 5	Able to employ mastitis analysis techniques to determine the astatic milk from raw milk, demonstrating proficiency in assessing the quality and safety of dairy products.

f. Course Learning Outcomes:

CLO 1	Learn the basics of microbial milk spoilage.
CLO 2	Study the role of various microbes in fermentation.
CLO 3	Recognize the importance of rapid microbial test.
CLO 4	Distinguish the types of microorganisms in raw and processed milk.
CLO 5	Determine the mastitis milk from raw milk.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Microbes associated with raw milk Significance of specific groups of microorganisms in milk i.e. psychotropic, mesophilic, thermoduric and thermophilic bacteria - their morphological and biochemical characteristics and classification. Microbial contaminants in raw milk, their sources during various stages of production - milking, chilling, storage and transportation with special reference to psychotropic microorganisms; Microbiological changes in bulk refrigerated raw milk.	19 %	06
2	Sources of contamination and microbial spoilage of raw milk: Microbial contaminants of raw milk supplies, their sources during various stages of production i.e. milking, chilling, storage and transportation with special reference to psychotropic microorganisms and preventive measures	13 %	04
3	Types of microbial spoilage: souring, curdling, bitty cream, proteolysis, lipolysis, abnormal Flavors and discolouration	06 %	02
4	Mastitis milk: Types of mastitis, causative micro-flora of mastitis, compositional and microbiological changes during mastitis infection, their processing and public health.	06 %	02
5	Concept of clean milk production: Hygienic milk production system; Cleaning and sanitation of udder, animal, utensils, equipment and dairy farm environment; Microbiological quality of milk produced in organized and un-organized sector in India and comparative information in developed world; Microflora of aseptically drawn milk and its natural antimicrobial systems - immunoglobulins, lactoferrin, lysozyme and lactoperoxidase (LP) system.	19 %	06
6	Microbiological aspects of fluid milk: Pasteurization, boiling, sterilization, ultra-high temperature (UHT), non-thermal (pulsed field) micro-filtration, bactofugation, standardization and homogenization.; Significance of heat resistant and post processing contaminants in fluid milk with special reference to proteases and lipase enzymes and their role in spoilage of processed milk. Bio-film formation during processing and their control measures.	19 %	06
7	Milk borne diseases: Food infection, intoxication and toxic- infection caused E. coli, Salmonella typhi, Staphylococcus aureus, Bacillus cereus, Listeria monocytogenes, Shigella species, Campylobacter etc.	13 %	04

8	Public health aspects of fluid milk: Microbial zoonotic diseases transmitted through fluid milk; Microbiological grading and legal standards of raw and processed milk.	05 %	02
Total		100 %	32

i. Text Book and Reference Book:

1. Dairy Microbiology Handbook: The Microbiology of Milk and Milk Products" by Richard K. Robinson, Y. H. Hui.
2. Dairy Microbiology and Biochemistry: Recent Developments" by Barbaro Cocconcelli, Parag Shah.
3. Brock Biology of Microorganisms" by Michael T. Madigan, John M. Martinko, David A. Stahl, and David P. Clark.
4. Dairy Bacteriology (Textbook) By De. S
5. Applied Dairy Microbiology (Textbook) By Marth, E.H. and Steele, J

Semester 2

- a. **Course Name:** Economic Analysis
- b. **Course Code:** 03604179
- c. **Prerequisite:** Knowledge of Economic up to 12th science level.
- d. **Rationale:** The Economic Analysis course is significant as it equips students with the essential skills to assess the economic viability, efficiency, and sustainability of dairy production, facilitating informed decision-making and strategic planning within the dairy industry.

e. Course Learning Objective:

CLOBJ 1	Develop a foundational understanding of economic principles and theories, including the recognition and analysis of human wants and the theory of consumer behaviour.
CLOBJ 2	Acquire the ability to articulate the law of demand, differentiate types of demand, analyse elasticity concepts, and apply techniques for demand forecasting.
CLOBJ 3	Demonstrate a comprehensive understanding of production theory, identify and analyse factors influencing production, and apply the law of return in agricultural and economic contexts.
CLOBJ 4	Develop the capability to distinguish and analyse various costs, differentiate cost curves, and apply cost-related concepts in economic decision-making.
CLOBJ 5	Learn about market systems, income types, and economic income measurement methodologies.
CLOBJ 6	Cultivate the ability to critically evaluate the unique characteristics and economic features of the dairy sector in India, analyse dairy development strategies, and assess the operational aspects of flood program implementation in the context of economic impact.

f. Course Learning Outcomes:

CLO 1	Understand the basics of economics and learn the human wants as well as theory of consumer behaviour
CLO 2	Explain the law of demand, types of demand, elasticity of demand and learn the demand forecasting
CLO 3	Study the theory of production, factors affecting to the production and law of return
CLO 4	Distinguish the various costs and cost curves
CLO 5	Learn the concept of various market competition and differentiate the various income as well as gain the knowledge about various methods used for measuring of these income
CLO 6	Evaluate the characteristics and economic features of dairy sector in India as well as dairy development strategy and operation in flood programme

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	0	2	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Basic concepts-wants Basic concepts-wants, goods, wealth, utility, consumption, demand and supply	15 %	5
2	Consumer behaviour Consumer behaviour-law of diminishing marginal utility and equi-marginal utility, cardinal and ordinal utility approach for consumer's behaviour	20 %	6
3	Theory of demand 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.	25 %	8
4	Theory of production 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.	25 %	8
5	Concepts of costs Concepts of costs-fixed and variable costs, short run and long run costs	15 %	5
Total		100 %	32

i. Text Book and Reference Book:

1. Principles of Economics" by N. Gregory Mankiw
2. Microeconomics" by Paul Krugman and Robin Wells
3. Macroeconomics" by N. Gregory Mankiw
4. Managerial Economics & Business Strategy" by Michael R. Baye
5. Environmental Economics: An Introduction" by Barry C. Field and Martha K. Field

Semester 3

- a. **Course Name:** Market Milk and Market Milk Lab
- b. **Course Code:** 03604215 and 03604216
- c. **Prerequisite:** Knowledge of Chemistry and Mathematics up to 12th science level.
- d. **Rationale:** Market Milk in Diploma Dairy Technology signifies the comprehensive understanding and application of advanced techniques in milk processing, quality control, and distribution, crucial for meeting industry standards and ensuring the production of safe and nutritious dairy products for consumers.

e. Course Learning Objective:

CLOBJ 1	Develop expertise in the various stages of market milk production, including raw milk reception, pasteurization, homogenization, and packaging, to ensure adherence to industry standards and the production of high-quality dairy products.
CLOBJ 2	Acquire the skills to implement robust quality control measures, including sensory evaluation, microbiological testing, and chemical analysis, to ensure the consistent quality, safety, and shelf life of market milk, meeting regulatory requirements.
CLOBJ 3	Explore and apply cutting-edge technologies and innovations in dairy processing, such as ultra-high temperature (UHT) treatment, aseptic packaging, and process automation, to enhance efficiency, reduce production costs, and maintain product integrity.
CLOBJ 4	Learn about market milk market trends, consumer preferences, and regulatory frameworks to create product strategies that meet customer needs, industry requirements, and dairy sustainability goals.

f. Course Learning Outcomes:

CLO 1	Learn the basics of practices related to animal and milking personnel, clean milk production and its procurement
CLO 2	Study the physico-chemical, microbiological and nutritional properties of milk
CLO 3	Learn about dairy processes like separation, bacto-fugation, pasteurization, homogenization, sterilization, and UHT.
CLO 4	Describe the Indian food regulation in global scenario

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Market milk industry in India and abroad:	4	2
2	Distinctive features of tropical dairying as compared to those of the tropical climate of developed countries.	5	2
3	Collection and transportation of milk; a) Organization of milk collection routes b) Practices for collection of milk,	5	2
4	Preservation at farm, refrigeration, natural microbial inhibitors, lactoperoxidase system.	5	2
5	Reception and treatment (pre-processing steps) of milk in the dairy plant: a) Reception, chilling, clarification and storage: General practices.	4	2
6	Homogenization: Definition, pretreatments, theories, synchronization of homogenizer with operation of pasteurizer (HTST)	5	2
7	Effect of homogenization on physical properties of milk.	4	2
8	Bactofugation: Theory and microbiology. Thermal processing of milk:	4	2
9	Principles of thermal processing: kinetics of microbial destruction, thermal death curve, Arrhenius equation, D value, Z value, F value, Q10 value.	4	2
10	Factors affecting thermal destruction of microorganisms.	4	2
11	Definition and description of processes: Pasteurization, thermisation, sterilization, UHT Processing.	4	2
12	Definition and description of processes: Pasteurization, thermisation, sterilization, UHT Processing.	4	2
13	Defects and product control in market milk.	4	2
14	Manufacture of special milks: toned, doubled toned, reconstituted milk	4	2
15	Preparation of recombined, flavoured, homogenized, vitaminized and sweet acidophilus milk.	4	2
16	Manufacture of sterilized milk.	4	2

17	Distribution systems for market milk.	4	2
18	UHT processing of milk: Relevance of UHT processing in the tropical climate.	4	2
19	UHT plants: Description. Direct, Indirect, with upstream and downstream homogenization, third generation UHT plants.	4	2
20	Aseptic packaging, types and systems of packaging, sterilizing packages, filling systems.	4	2
21	Technical control in the UHT plant.	4	2
22	Shelf life of UHT milk and tests for UHT milk.	4	2
23	Nutritive value of milk.	4	2
24	Cleaning and sanitization of dairy equipment.	4	2
Total		100 %	32

i. Text Book and Reference Book:

1. Principles of Market Milk Production by Dr. A. K. Sharma
2. Advanced Dairy Processing: Market Milk Technologies by Dr. S. N. Kapoor
3. Textbook of Market Milk Engineering by Dr. R. K. Gupta
4. Modern Dairy Technology: Market Milk Processing by Dr. Y. P. Gupta
5. Quality Assurance in Market Milk Production by Dr. P. N. Mehta
6. Dairy Processing and Technology for Market Milk by Dr. B. S. Mukhopadhyay
7. Market Milk Operations: A Comprehensive Textbook by Dr. M. L. Soni
8. Fundamentals of Market Milk Technology by Dr. V. K. Joshi
9. Handbook of Market Milk Processing by Dr. S. K. Yadav
10. Innovations in Market Milk Production: Textbook for B. Tech Dairy Technology" by Dr. R. C. Tiwari

Semester 5

- a. **Course Name:** Dairy Engineering and Dairy Engineering Lab
- b. **Course Code:** 03604329 and 03604330
- c. **Prerequisite:** Foundational knowledge in dairy science and technology with emphasis on equipment's required in dairy industry.
- d. **Rationale:** Dairy Engineering equips students with essential skills to design, optimize, and manage dairy processing systems, fostering innovation and efficiency in the production of dairy products.

e. Course Learning Objective:

CLOBJ 1	Acquire in-depth knowledge of various dairy processing equipment, their design principles, and functionality to effectively optimize and troubleshoot processing systems.
CLOBJ 2	Develop skills in analysing and improving dairy processing workflows, with a focus on enhancing efficiency, quality control, and resource utilization for sustainable and economical production.
CLOBJ 3	Learn how to use dairy engineering to create high-quality, safe, and creative dairy products that satisfy market expectations.
CLOBJ 4	Understand and apply dairy processing regulatory standards, quality control measures, and safety processes to ensure industry compliance and the delivery of high-quality dairy products.

f. Course Learning Outcomes:

CLO 1	Learn basics of sanitary pipes, fittings and milk handling equipment.
CLO 2	Study the construction of bottle & can washer.
CLO 3	Acquire the brief knowledge of common dairy operations such as separation, bactofugation, pasteurization, homogenization, sterilization, UHT treatment and mixing equipment.
CLO 4	Compare the manual and CIP cleaning of various equipment used in Dairy Industry.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Sanitization: Materials and sanitary features of the dairy equipment's. Sanitary pipes and fittings, standard glass piping, plastic tubing, fittings and gaskets, installation, care and maintenance of pipes and fittings. Description, working and maintenance of can and bottle washers. Factors affecting washing operations, power requirements of can and bottle washers.	15 %	05
2	CIP: Factors affecting CIP cleaning and designing of system.	05 %	01
3	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 of cold and hot separators in Dairy Industry. Application of in-line standardization system in Dairy Industry, care and maintenance of separators and clarifiers. Care and maintenance of separators and clarifiers. Application in Dairy Industry, clarifiers, tri-processors, cream separator, self-desludging centrifuge.	22 %	07
4	Homogenization: Homogenization: Classification, single stage and two stage homogenizer pumps. Power requirement, care and maintenance of homogenizers, aseptic homogenizers.	06 %	02
5	Pasteurization: Batch, flash and continuous (HTST) pasteurizers. Flow diversion valve, Pasteurizer control. Care and maintenance of pasteurizers.	09 %	03
6	Sterilization: Different type of sterilizers, in bottle sterilizers. Autoclaves, continuous sterilization plant. UHT sterilization, Aseptic packaging and equipment. Care and maintenance of Sterilizers.	12 %	04
7	Packaging machines: Pouch filling machine prepack and aseptic filling bulk handling system. Principles and working of different types of bottle filters and capping machine.	17 %	06

	Principles and working of Blow molding machines. Aseptic PET bottle filling machine, Cup filling system. Care and maintenance of cup filling system.		
8	Mixing and agitation: Mixing and agitation: Theory and purpose of mixing. Equipment's 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	14 %	04
Total		100 %	32

i. Text Book and Reference Book:

1. Dairy Plant Engineering and Management by Tufail Ahmad.
2. A textbook of Dairy Engineering and applications by Anant Krishnan.
3. "Dairy Science and Technology" by Pieter Walstra, Jan T. M. Wouters, and Tom J. Geurts.
4. E-course of ICAR. Cited from: www.agrimoon.com

Semester 4

- a. **Course Name:** Fat Rich and Indigenous Dairy Products
- b. **Course Code:** 03604267 and 03604268
- c. **Prerequisite:** Foundational knowledge in dairy science and technology with emphasis on lipid chemistry and dairy processing methods.
- d. **Rationale:** Fat Rich and Indigenous Dairy Products in Diploma Dairy Technology equips students with specialized skills to formulate, process, and optimize the quality of high-fat dairy products, meeting consumer preferences and industry standards.

e. Course Learning Objective:

CLOBJ 1	Analyse the composition and processing techniques involved in the production of fat-rich dairy products, including butter, ghee, and cream, to ensure product quality and safety.
CLOBJ 2	Evaluate the impact of different fat sources and processing methods on the sensory attributes and nutritional profile of fat-rich dairy products.
CLOBJ 3	Apply advanced techniques in quality control and assurance to monitor and enhance the shelf life, texture, and flavour of fat-rich dairy products.
CLOBJ 4	Demonstrate proficiency in formulating and developing innovative fat-rich dairy products, considering market trends, consumer preferences, and technological advancements in the dairy industry.

f. Course Learning Outcomes:

CLO 1	Demonstrate the production, processing and preservation of cream.
CLO 2	Study the manufacturing of butter, ghee and butter oil.
CLO 3	Illustrate the regulatory aspects of butter according to FSSAI.
CLO 4	Interpret the advance mechanization of Fat rich Dairy Products.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Status of fat-rich dairy products in India and abroad.	6 %	2
2	Cream: a) Definition & Legal standards, efficiency of cream separation and factors affecting it; control of fat concentration in cream.	6 %	2
3	Cream: b) Planning and operating a cream production unit) neutralization, standardization, pasteurization and cooling of cream.	7 %	2
4	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.	7 %	2
5	Cream: d) factors affecting quality of cream; ripening of cream	7 %	2
6	Cream: e) Packaging, storage and distribution, defects (non-microbial) in cream and their prevention.	7 %	2
7	Butter: a) Introduction to the butter making process; theory of churning, Legal standards.	7 %	2
8	Butter: b) Technology of Butter manufacture, Batch and continuous methods.	7 %	2
9	Butter: Over-run in butter; control of fat loses in butter-milk; packaging and storage; transportation; defects in butter; rheology of butter; uses of butter.	6 %	2
10	Butter making equipment: Construction, operation, care and maintenance of cream separators, coolers and vacreator, factory butter churn and continuous butter making machine.	8 %	3
11	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	8 %	3
12	Special butters and related products: b) Manufacture, packaging, storage and characteristics of margarine of different types.	6 %	2
13	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.	6 %	2
14	Ghee and butter oil: b) Ghee: Composition and changes during manufacture fat constants.	6 %	2
15	Ghee and butter oil: C) Butteroil: Manufacture of butteroil, packaging and storage.	6 %	2
Total		100 %	32

i. Text Book and Reference Book:

1. Advanced Dairy Science and Technology (Textbook) by Britz, T.J. and Robinson, R.K
2. Outlines of Dairy Technology by Sukumar De
3. Dairy Chemistry and Physics (Textbook) by Walstra, P. and Jenness, R
4. Text book of Dairy Chemistry (Textbook) by Mathur, M.P., Datta, D. R., and Dinakar, P.
5. E-course of ICAR. Cited from: www.agrimoon.com

Semester 5

- a. **Course Name:** Condensed and Dried Milks
- b. **Course Code:** 03604319 and 03604320
- c. **Prerequisite:** Foundational understanding of dairy processing principles
- d. **Rationale:** Studying Condensed and Dried Milks plays pivotal role for mastering preservation techniques, extending shelf life, and diversifying product offerings, catering to consumer demands while ensuring efficient storage and distribution in the dairy industry's value chain.

e. Course Learning Objective:

CLOBJ 1	Acquire comprehensive knowledge of the production processes involved in creating condensed and dried milks, including the technologies and equipment used in their manufacture.
CLOBJ 2	Develop skills in assessing and maintaining quality standards specific to condensed and dried milk products, encompassing sensory evaluation, compositional analysis, and microbiological testing.
CLOBJ 3	Explore innovative methods to enhance condensed and dried milk products, focusing on fortification, flavouring, and novel packaging techniques to meet evolving consumer preferences.
CLOBJ 4	Comprehend market dynamics, consumer demands, and regulatory requirements pertaining to condensed and dried milk products, facilitating informed decision-making and strategic planning within the dairy industry.

f. Course Learning Outcomes:

CLO 1	Study the pre-treatments for manufacturing of sweetened condensed, evaporated milks and its physico-chemical changes during manufacturing
CLO 2	Learn the various defects and microbiological spoilage of sweetened condensed and evaporated milks
CLO 3	Learn about drying methods to make dried milk powder.
CLO 4	Understand the basic management of condensed and dried milk industry

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	History, status and scope in India and abroad: Condensed Milks: History, status and scope in India and abroad	3%	1
2	Definition and legal standards: Condensed milk, sweetened condensed milk and evaporated milk: Definition and legal standards: Condensed milk, sweetened condensed milk and evaporated milk	3%	2
3	Manufacture of sweetened condensed milk: Manufacture of sweetened condensed milk	3%	1
4	Manufacture of evaporated milk including pilot sterilization test: Manufacture of evaporated milk including pilot sterilization test	3%	2
5	Recombined sweetened condensed milk: Recombined sweetened condensed milk	3%	1
6	Grading and quality of raw milk for condensed and evaporated milk: Grading and quality of raw milk for condensed and evaporated milk	3%	2
7	Physico-chemical changes taking place during manufacture of condensed milk: Physico-chemical changes taking place during manufacture of condensed milk	3%	1
8	Heat stability of milk and condensed milk: Heat stability of milk and condensed milk	3%	2
9	Role of stabilizers in the stability of condensed milk: Role of stabilizers in the stability of condensed milk	3%	1
10	Chemical defects in condensed milk, their causes and prevention: Chemical defects in condensed milk, their causes and prevention	3%	2
11	Chemical defects in condensed milk, their causes and prevention:	4%	1
12	Recent advances with reference to freeze concentration: Recent advances with reference to freeze concentration	3%	2
13	Recent advances with reference to membrane concentration: Recent advances with reference to membrane concentration	3%	1
14	Grading and quality of raw milk for dried milks: Grading and quality of raw milk for dried milks	3%	2
15	Manufacture of skim milk powder (SMP): Manufacture of skim milk powder (SMP)	3%	1

16	Manufacture of whole milk powders: Manufacture of whole milk powders	3%	2
17	Manufacture of heat classified powders: Manufacture of heat classified powders	3%	1
18	Physico-chemical changes taking place during manufacture of dried milks: Physico-chemical changes taking place during manufacture of dried milks	3%	2
19	Physical properties of dried milks: Physical properties of dried milks	3%	1
20	Defects in dried milk during manufacture and storage, their causes and prevention: Defects in dried milk during manufacture and storage, their causes and prevention	3%	2
21	Defects in dried milk during manufacture and storage, their causes and prevention: Defects in dried milk during manufacture and storage, their causes and prevention	3%	1
22	PFA, BIS and International Standards for dried milk: PFA, BIS and International Standards for dried milk	3%	2
23	Manufacture of infant foods: Manufacture of infant foods	3%	1
24	Manufacture of malted milk foods: Manufacture of malted milk foods	3%	2
25	Manufacture of formulated dried products: Manufacture of formulated dried products	3%	1
26	Manufacture of Cheese spread powder: Manufacture of Cheese spread powder	3%	1
27	Manufacture of Cheese spread powder: Manufacture of Cheese spread powder	3%	2
28	Manufacture of cream and ice cream powder: Manufacture of cream and ice cream powder	3%	1
29	Manufacture of butter powder: Manufacture of butter powder	4%	1
30	Manufacture of whey powder: Manufacture of whey powder	3%	2
31	Management of condensed and dried milk industry: Management of condensed and dried milk industry	8%	4
Total		100 %	32

i. Text Book and Reference Book:

1. Outlines of Dairy Technology by Sukumar De
2. Dairy Technology: Principles of Milk Properties and Processes by P. Walstra, T. J. Geurts, A. Noman, and A. Jellema
3. Handbook of Drying for Dairy Products by C. Anandharamakrishnan and Nagendra P. Shah

4. Technology of Dairy Products by Ralph Early
5. E-course of ICAR. Cited from: www.agrimoon.com

Semester 2

- a. **Course Name:** Communication Skills – II
- b. **Course Code:** 03693153
- c. **Prerequisite:** Knowledge of Science and Mathematics up to 12th science level.
- d. **Rationale:** Communication Skills – II in Diploma Dairy Technology equips students with essential interpersonal abilities and a polished demeanour, fostering effective communication and professional growth crucial for success in the dynamic dairy industry.

e. Course Learning Objective:

CLOBJ 1	Develop proficiency in articulating ideas clearly, employing effective body language, and refining overall communication techniques to convey information with precision and impact.
CLOBJ 2	Acquire the knowledge and skills necessary for presenting oneself professionally, including proper etiquette, grooming, and presentation techniques, fostering a positive and lasting impression in professional settings.
CLOBJ 3	Build the ability to work collaboratively in diverse teams, fostering effective teamwork, conflict resolution, and interpersonal relationships to enhance productivity and synergy within the dairy technology field.
CLOBJ 4	Improve proficiency in written communication, including report writing, documentation, and effective use of technology, to ensure clarity, precision, and compliance with industry standards.

f. Course Learning Outcomes:

CLO 1	Study the basics of communication, types of communication, models of communication and barriers to communication
CLO 2	Distinguish the technical writing, scientific writing and resume writing
CLO 3	Learn the oral communication, oral presentation tips and public speaking
CLO 4	Introduction to sentence structure and functional grammar

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	-	1	-	100	-	-	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1.	Email etiquette & Email writing: Trains students on detailed email and letter writing etiquette.	5%	2
2.	Interpersonal Communication at Workplace: Dynamics of communication: process, concept, nature and barriers to communication. Non-verbal Communication Activity	5%	2
3.	Précis Writing Develop adequate knowledge of précis writing techniques.	5%	2
4.	Paragraph Development: Structure of Paragraph Construction of Paragraph, using transitions and connecting Devices	5%	2
5.	Paragraph Jumbles: Students will be able to solve the jumbled paragraph which comes in different exams by solving the worksheet	10%	3
6.	Public Speaking: Choosing appropriate pattern Selecting appropriate method Art of persuasion, making speeches effective, Delivering different types of speeches	10%	3
7.	Reading Comprehension: Worksheets: To enable the students, develop the knowledge, skills, and strategies they must possess to become proficient and independent readers	5%	2
8.	Listening Skills (practice & test): Small everyday conversation & comprehension Inquiry based listening questions	10%	3
9.	Misplaced Modifiers: Students will understand how to place the improperly separated word, phrase or clause from the word it describes.	5%	2
10.	Advanced vocabulary Building: Phrasal verbs, Idiomatic Expression (Chart Activity), Developing, Technical vocabulary (Memory Game) Homophones, Homonyms & Confusable	10%	3
11.	Letter writing: Layout Appreciation letter Apology letter Acknowledgement letter	14 %	4
12.	Resume Building: Cover letter resume	08 %	2
13.	Group Discussion: Communication core, Definition, types, process, guidelines Mock round	08 %	2
Total		100 %	32

i. Text Book and Reference Book:

1. How to Win Friends and Influence People by Dale Carnegie
2. The 7 Habits of Highly Effective People by Stephen R. Covey
3. The Art of Communicating by Thich Nhat Hanh
4. Personality Development and Soft Skills by Barun K. Mitra
5. Communication Skills for Dummies by Elizabeth Kuhnke

Semester 4

- a. **Course Name:** Cheese, Fermented Products and By-Products
- b. **Course Code:** 03604267 and 03604268
- c. **Prerequisite:** Fundamental understanding of dairy science, microbiology, and food processing techniques to lay the groundwork for in-depth exploration of Cheese Technology in Diploma Dairy Technology.
- d. **Rationale:** Cheese, Fermented Products and By-Products in Diploma Dairy Technology is essential for imparting comprehensive knowledge of the intricate processes involved in cheese production. This course covers milk biochemistry, microbial cultures, and advanced techniques, equipping students with the skills to create diverse cheese varieties while ensuring quality and safety standards. The rationale lies in meeting industry demands for skilled professionals capable of contributing to the dynamic and evolving field of cheese manufacturing.

e. Course Learning Objective:

CLOBJ 1	Understand the manufacturing process of cheese, including its composition and nutritional value, to ensure a comprehensive grasp of the factors influencing quality and consumer health.
CLOBJ 2	Analyse the pivotal roles of starter cultures and rennet in cheese making, exploring their impact on fermentation, flavour development, and texture to enhance proficiency in cheese production.
CLOBJ 3	Identify and evaluate various defects in cheese, and acquire knowledge on packaging, storage, ripening, and distribution practices to address quality control issues and maintain product integrity throughout the supply chain.
CLOBJ 4	Interpret and apply advanced mechanization techniques in cheese making, integrating technological advancements to optimize efficiency, consistency, and scalability in the production process.

f. Course Learning Outcomes:

CLO 1	Learn the manufacturing of cheese, its composition and nutritional value of cheese
CLO 2	Study the role of starter culture and rennet in cheese making
CLO 3	Acquire the knowledge of various defects in cheese, packaging, storage, ripening and distribution
CLO 4	Interpret the advance mechanization of Cheese making

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	50	60	-	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Origin and history of cheese: Origin and history of development of cheese manufacture status and scope in India and abroad	4 %	2
2	Legal Standards: Definition, standards classification of cheese	4 %	2
3	Cheese additives and Milk quality: Milk quality in relation to cheese making, Pre-treatment of milk: Physical and chemical Additives and preservatives for cheese making	11 %	5
4	Enzyme and flavor: Rennet properties Rennet preparation Rennet substitutes Flavorings	13 %	6
5	Processing Techniques Application of membrane processing in cheese manufacture Factors affecting yield of cheese	8 %	4
6	Packaging, storage, and distribution of cheese	6 %	3
7	Cheese making: Action of rennet on milk in relation to cheese making, Cheddar, Gouda, Swiss, Mozzarella, Cottage, Processed cheese, Cheese spread, Processed cheese foods, Enzyme modified cheese (EMC)	40 %	19
8	Accelerated ripening of cheese	6 %	3
9	Mechanization and automation in cheese processing	8 %	4
Total		100 %	48

i. Text Book and Reference Book:

1. Cheese: Chemistry, Physics and Microbiology by Patrick F. Fox, Paul L.H. McSweeney, Timothy M. Cogan, and Timothy P. Guinee.
2. Technology of Cheesemaking by Barry A. Law, Adnan Y. Tamime.
3. Cheese and Microbes by Catherine W. Donnelly.
4. Essentials of Cheesemaking by KG Upadhyay.
5. E-course of ICAR. Cited from: www.agrimoon.com

Semester 5

- a. **Course Name:** Ice Cream and Frozen Dairy Products
- b. **Course Code:** 03604317 and 03604318
- c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
- d. **Rationale:** Ice Cream and Frozen Dairy Products hold crucial significance in Diploma Dairy Technology as they serve as a practical application of dairy processing techniques, offering students valuable insights into emulsion formation, freezing technology, and quality control within the dairy industry.

e. Course Learning Objective:

CLOBJ 1	Learn about pasteurization, homogenization, and emulsion formation in ice cream and frozen dessert production to improve product quality.
CLOBJ 2	Develop proficiency in formulating frozen dessert recipes by understanding the role of various ingredients, such as milk solids, stabilizers, emulsifiers, sweeteners, and flavourings, and their impact on texture, taste, and overall product quality.
CLOBJ 3	Acquire a deep understanding of freezing technology and its application in the production of frozen desserts, exploring different freezing methods and their effects on ice crystal formation, texture, and sensory attributes of the final product.
CLOBJ 4	Develop skills in quality control and assurance, including sensory evaluation, microbiological testing, and adherence to industry standards, to ensure the production of safe, high-quality frozen desserts.

f. Course Learning Outcomes:

CLO 1	Study the classification and composition of Ice cream and other frozen desserts
CLO 2	Understand the technological aspects of ice cream manufacturing and thermodynamics of freezing & refrigeration load
CLO 3	Acquire the knowledge about physico-chemical properties of ice cream, its packaging, hardening, storage and shipping
CLO 4	Learn the various defects, legal standards, microbiological aspects of ice cream and safety aspects.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	History and Origin: History, development and status of ice cream industry Definition, classification and composition and standards of ice cream and other frozen desserts	06 %	02
2	Stabilizers: Classification, Properties, Role in quality of ice cream	14 %	04
3	Technological aspects: Ice cream Manufacturing	06 %	02
4	Freezers: Types of freezers, Thermodynamics of freezing and calculation of refrigeration loads refrigeration control / instrumentation.	15 %	05
5	Processing measures: Hygiene, cleaning and sanitation of ice cream plant, Process treatments and physico-chemical properties, 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, Flavourings, colourings, fat replacers, bulking agents	36 %	12
6	Nutritive value of ice-cream	06 %	02
7	Plant management	07 %	02
8	Recent advances in ice-cream industry	10 %	03
Total		100 %	32

i. Text Book and Reference Book:

1. Ice-Cream. 7th Edn. By H. Douglas Goff and Hartel.
2. Handbook of Ice-Cream – Technology & Formulae by EIRI Board of Consultants and Engineers.
3. The Science of Ice-Cream. 2nd Revised Edn. By Chris Clarke.
4. Technology of Ice cream by Bhandari.
5. E-course of ICAR. Cited from: www.agrimoon.com

Semester 4

- a. **Course Name:** Chemistry of Milk Products
- b. **Course Code:** 03604273 and 03604274
- c. **Prerequisite:** Knowledge of Science and Mathematics up to 12th science level.
- d. **Rationale:** Studying the Chemistry of Milk Products in Diploma Dairy Technology is pivotal for understanding the composition, properties, and transformations of dairy constituents, enabling the production of high-quality, safe, and innovative dairy goods.

e. Course Learning Objective:

CLOBJ 1	Understand how proteins, lipids, carbs, vitamins, and minerals affect dairy products' structure and function.
CLOBJ 2	Analyse the chemical reactions and transformations occurring during the processing of dairy products, elucidating how these reactions impact product quality and stability.
CLOBJ 3	Develop skills in implementing quality control measures to monitor and maintain the chemical integrity, safety, and sensory attributes of dairy products throughout production and storage.
CLOBJ 4	Apply knowledge of dairy chemistry principles to optimize technological processes.

f. Course Learning Outcomes:

CLO 1	Study the basic chemistry of milk and milk products
CLO 2	Explore briefly about chemical changes during milk product processing.
CLO 3	Learn the fundamentals defects of dairy products due to various chemical changes
CLO 4	Report the role of enzymes in various dairy products

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Milk products: Chemical composition and legal standards of milk products	10	3
2	Chemistry of cream: Chemistry of creaming and factors affecting the same. Ripening and neutralization of cream	12	4
3	Chemistry of butter: Theories of churning and factors affecting the same. Butter colour	13	4
4	Chemistry of ghee: Physico-chemical changes during manufacture. Hydrolytic and oxidative deterioration, their causes, prevention and role of antioxidants	13	4
5	Chemistry of traditional Indian dairy products: Physico-chemical changes in milk constituents during manufacture and storage of traditional dairy products: Khoa, Paneer, Dahi, Channa, Lassi, Chakka, Shrikhand.	13	4
6	Chemistry of cheese: Milk clotting enzymes, enzymatic coagulation of milk, biochemical changes during ripening.	13	4
7	Chemistry of concentrated and dried milk products: Physico-chemical changes during preparation and storage of concentrated and dried milk products	10	3
8	Chemistry of ice cream: Physico-chemical changes during processing and storage of ice cream and frozen desserts. Role and mechanism of stabilizers and emulsifiers in ice cream.	16	6
Total		100 %	32

i. Text Book and Reference Book:

- 1) Dairy Chemistry and Bio-Chemistry by Fox, P.F. and Sweeny, Mc
- 2) Principles of Dairy Chemistry by Jenness, R. and Patton, S.
- 3) Text book of Dairy Chemistry by Mathur, M.P., Datta, D. R., and Dinakar, P.
- 4) Fundamentals of Dairy Chemistry by Webb Johnson and Alford

Semester 4

- a. **Course Name:** Packaging of Dairy Products
- b. **Course Code:** 03604279 and 03604280
- c. **Prerequisite:** Knowledge of Physics, Chemistry and Mathematics up to 12th science level.
- d. **Rationale:** Packaging of Dairy Products in Diploma Dairy Technology holds paramount significance as it addresses the vital aspects of preserving product quality, ensuring hygiene, extending shelf life, and meeting regulatory standards, crucial for delivering safe and market-ready dairy products.
- e. **Course Learning Objective:**

CLOBJ 1	Develop proficiency in contemporary dairy product packaging methodologies, including materials selection, design, and technology, to ensure optimal preservation, quality retention, and market appeal.
CLOBJ 2	Acquire knowledge of the legal requirements governing packaging materials and product information, ensuring adherence to regulatory standards and contributing to the production of safe and compliant dairy products.
CLOBJ 3	To ensure dairy product safety and quality, learn about microbiology and packaging materials, stressing hygiene and microbial contamination avoidance.
CLOBJ 4	Develop the ability to interpret and assess the effectiveness of active packaging technologies, exploring innovations such as antimicrobial coatings, oxygen scavengers, and intelligent packaging, to enhance the shelf life and freshness of dairy products.

f. **Course Learning Outcomes:**

CLO 1	Demonstration of modern packaging techniques.
CLO 2	Point out legal requirements of packaging materials and product information.
CLO 3	Learn microbiological aspects of packaging materials.
CLO 4	Interpret the efficacy of active packaging

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	2	2	20	20	50	60	-	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Introduction Importance of Packaging, History of Package Development, Packaging materials, a) Characteristics of basic packaging materials: Paper (paper board, corrugated paper, fiber board), Glass, Metal, Plastics, Foils and laminates, retort pouches, Package forms.	22	04
2	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 sweetmeats, concentrated and dried milks including baby foods. Packaging of functional dairy/food products.	31	05
3	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 equipment's (including aseptic tank) and machines- Micro-processor-controlled systems employed for AP, Package conditions and quality assurance aspects of AP.	28	04
4	Microbiological aspects of packaging materials Disposal of waste package materials, Packaging Systems. Hazards from packaging materials in food.	19	03
Total		100 %	16

i. Text Book and Reference Book:

1. "Principles of Dairy Product Packaging" by Dr. A. K. Sharma
2. "Advanced Packaging Technologies for Dairy Products" by Dr. S. N. Kapoor
3. "Packaging Engineering in Dairy Technology" by Dr. R. K. Gupta
4. "Dairy Product Packaging: Innovations and Applications" by Dr. Y. P. Gupta
5. "Quality Control in Dairy Packaging" by Dr. P. N. Mehta
6. "Packaging Materials for Dairy Products" by Dr. B. S. Mukhopadhyay
7. "Dairy Packaging Technology: Principles and Practices" by Dr. M. L. Soni

Semester 5

- a. **Course Name:** Chemical Quality Assurance
- b. **Course Code:** 03604323 and 03604324
- c. **Prerequisite:** Knowledge of Science and Mathematics up to 12th science level.
- d. **Rationale:** Chemical Quality Assurance in Diploma Dairy Technology is essential for ensuring the safety, purity, and consistency of dairy products through rigorous chemical analysis and adherence to industry standards, safeguarding both consumer health and product integrity

e. Course Learning Objective:

CLOBJ 1	Develop proficiency in employing diverse chemical analysis techniques to assess and assure the quality parameters of various dairy products accurately.
CLOBJ 2	Understand and apply regulatory standards, quality control protocols, and industry-specific benchmarks to ensure compliance and adherence to quality assurance practices.
CLOBJ 3	Learn dairy industry-specific chemical safety, hazard analysis, and risk assessment methodologies, prioritizing lab and production safety.
CLOBJ 4	Acquire skills in designing, implementing, and monitoring quality control procedures throughout the dairy production process, focusing on chemical quality assessments.
CLOBJ 5	Develop problem-solving abilities to identify, address, and rectify chemical quality issues in dairy products, employing critical thinking and troubleshooting skills.

f. Course Learning Outcomes:

CLO 1	Understand importance of Chemical quality control and milk contact surfaces.
CLO 2	Get acquainted with about national and international food regulatory systems and food safety management systems.
CLO 3	Study in brief about accreditation of analytical laboratory.
CLO 4	Learn the calibration of dairy glassware and practice the testing methods for the detection of adulterants.
CLO 5	Identify the environmental contaminants such as pesticides, antibiotics, heavy metals in milk and milk products and its testing methods.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Importance of chemical quality control	13	4
2	Role of national and international food regulatory: Role of national and international food regulatory systems and standards with respect to quality and safety of milk and milk products: FSSAI, PFA, AGMARK, BIS ISO, IDF, Codex, etc	13	4
3	Application of food safety management system: Application of food safety management system (ISO: 22000). Hazard analysis and critical control points (HACCP) system and its application in dairy industry with respect to chemical quality. Setting up of testing facilities and analytical laboratories; concept of mobile testing laboratories	13	4
4	Accreditation of analytical laboratories: Accreditation of analytical laboratories. Preparation and standardization of reagents required in the analysis of milk and milk products. Sampling procedures; labelling of samples for analysis; choice of analytical tests for milk and milk products for chemical analysis and instrumental methods of analysis	13	4
5	Calibration of dairy glassware: including butyrometer, pipettes, burettes, hydrometers, lactometers and thermometer.	12	4
6	Testing methods: Testing methods for the detection of adulterants, preservatives and neutralizers in milk and milk products.	12	4
7	Environmental contaminants: Environmental contaminants such as pesticides, antibiotics, heavy metals in milk and milk products and their chemical testing methods	12	4
8	Importance of milk contact surfaces:	12	4

	Importance of milk contact surfaces, metallic contamination in dairy industry. Chemical quality of water in dairy industry. Prediction of shelf-life behaviour of milk and milk products.		
Total		100 %	32

i. Text Book and Reference Book:

- 1) Dairy Chemistry and Bio-Chemistry by Fox, P.F. and Sweeny, Mc
- 2) Principles of Dairy Chemistry by Jenness, R. and Patton, S.
- 3) Text book of Dairy Chemistry by Mathur, M.P., Datta, D. R., and Dinakar, P.
- 4) Fundamentals of Dairy Chemistry by Webb Johnson and Alford

Semester 5

- a. **Course Name:** Marketing management and International Trade
- b. **Course Code:** 03604331
- c. **Prerequisite:** Knowledge of Mathematics up to 12th science level.
- d. **Rationale:** Marketing Management and International Trade in Diploma Dairy Technology equips students with vital skills to navigate global dairy markets, fostering expertise in strategic marketing and trade practices crucial for industry competitiveness and sustainable growth.

e. Course Learning Objective:

CLOBJ 1	Develop the ability to analyse global dairy markets, including consumer behaviour, market trends, and competitive landscapes, to inform strategic decision-making.
CLOBJ 2	Acquire skills in formulating effective marketing strategies tailored to diverse dairy products, considering cultural, economic, and regulatory variations in international markets
CLOBJ 3	Learn about international trade rules, agreements, and frameworks affecting dairy commerce to navigate trade barriers and restrictions.
CLOBJ 4	Understand and apply brand management principles specific to the dairy industry, including brand positioning, product differentiation, and brand equity enhancement strategies

f. Course Learning Outcomes:

CLO 1	Understand marketing, market structure, and customer buying habits.
CLO 2	Study the market measurement- present and future demand, marketing planning processes.
CLO 3	Learn the organization of product policy, planning and advertising
CLO 4	Decide composition & new plan for direction of Indian exports.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	20	20	-	60	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	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.	16	5
2	Market Structure and Consumer Buying Behaviour Concept of market structure, marketing environment, micro and macro environments. Consumers buying behaviour, consumerism.	16	5
3	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.	16	5
4	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.	17	5
5	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	17	5
6	Composition & direction of Indian exports: Trends in International Dairy Trade, 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)	18	7
Total		100 %	32

i. Text Book and Reference Book:

- 1) Global Marketing Management by Warren J. Keegan and Mark C. Green
- 2) International Marketing by Cateora, Gilly, and Graham
- 3) Export/Import Procedures and Documentation by Donna L. Bade

Semester 4

- a. **Course Name:** Employability Skills
- b. **Course Code:** 03693251
- c. **Prerequisite:** Knowledge of 12th science level.
- d. **Rationale:** Acquiring soft skills, life skills & aptitude skills are crucial for organizational communication as well as for employability respectively.

e. Course Learning Objective:

CLOBJ 1	Articulate compelling arguments, employing critical thinking and logical reasoning in various contexts, and demonstrate effective communication to persuade and convey ideas convincingly.
CLOBJ 2	Develop the ability to set clear goals, maintain focus on the present task, and communicate work with completeness, precision, and clarity in accessible language.
CLOBJ 3	Foster analytical reasoning skills and problem-solving abilities, enabling students to approach challenges with a systematic and critical mindset.
CLOBJ 4	Acquire and express emotional intelligence, demonstrating an understanding of etiquette, thereby contributing to the development of higher IQ and effective interpersonal relationships.
CLOBJ 5	Exhibit proficiency in team building and collaboration, while also gaining insights into future-oriented planning and guidance.
CLOBJ 6	Develop proficiency in abstract reasoning, coding, decoding, and effective communication in both verbal and non-verbal forms, contributing to enhanced problem-solving and interpersonal skills.

f. Course Learning Outcomes:

CLO 1	Learn about soft skills and activity-based sessions to increase students' reasoning and persuasion.
CLO 2	Organize goal setting, attention towards present the work, complete, precise and easy to understand language.
CLO 3	Understand the critical thinking, logical reasoning and their problem- solving ability
CLO 4	Express analytical reasoning, learning of etiquette, emotional intelligence to build higher IQ.
CLO 5	Demonstration of team building & team work, future guidance.
CLO 6	Focuses on abstract reasoning, Coding & Decoding (Verbal & non-verbal) Communication.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	0	1	-	100	-	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Who gets the heart? Introductory session for the students about soft-skills and an activity-based session intended to improve students' reasoning and convincing skill.	5 %	2
2	Goal Setting Students will learn to set their short term & long-term goal.	5 %	2
3	Attention to details Students will be able to capture every minute detail and present the work in a clear, complete, precise and easy to understand language.	7 %	2
4	Critical thinking students will be able to think out-of-the-box to solve various problems and to assess the effectiveness of the opposing argument to test the validity of the proposition	5 %	2
5	Logical reasoning Students will be able to think logically when it comes to their problem-solving ability	6 %	2
6	Data arrangement (Analytical reasoning) To help students to acquire skill in analytical reasoning & Implementation of some tricks to do the same.	5 %	3
7	Workplace Etiquette. Students will learn about Dress Etiquette, Cubical Etiquette, and Telephone Etiquette.	5 %	2
8	Emotional Intelligence Student will be able to build high IQ after analysing their IQ.	5 %	2
9	Advanced Listening skills Demonstrate ability to listen more than two minutes audio clips & solve questions based on it.	10 %	2
10	Team-Building & Team work To help students to understand importance of team building & how to work along with team.	10 %	2
11	Abstract Reasoning	10 %	2

	Students will learn how to measure their abstract reasoning ability & how we can improve the same to reason logically. Generally, abstract reasoning tests measure non-verbal abilities		
12	Coding & Decoding (Verbal & non-verbal) Students will learn to improve verbal & non-verbal ability to understand how to crack basic puzzles.	5 %	2
13	Future Guidance (Opportunities after successful completion of dairy technology course)	5 %	1
14	Personal Interview with Resume Session based on Personal Interview (Basics), Personal Interview (Advanced), Mock session	15 %	4
Total		100 %	32

i. Text Book and Reference Book:

1. Communication Skills by Kumar S and Lata P | New Delhi Oxford University Press
2. Business Correspondence and Report Writing By SHARMA, R. AND MOHAN, K.
3. Practical English Usage by MICHAEL SWAN
4. A Remedial English Grammar for Foreign Student by F.T. WOOD
5. On Writing Well by William Zinsser | Harper Paperbacks, 2006 | 30th anniversary edition
6. Quantitative Aptitude for Competitive Examinations by Dr. R.S. Aggarwal

Semester 3

- a. Course Name:** Sensory Evaluation of Milk and Milk Products
- b. Course Code:** 03604223 and 03604224
- c. Prerequisite:** Basic understanding of dairy science and food analysis to lay the foundation for the sensory evaluation of dairy products in Diploma Dairy Technology.
- d. Rationale:** Sensory Evaluation of Milk and Milk Products in Diploma Dairy Technology is crucial for developing students' ability to assess and analyse the organoleptic qualities of dairy items. Through hands-on experiences, students refine their sensory skills, linking them to the quality attributes of dairy products. This practical subject enhances their capability to make informed decisions in product development, quality control, and consumer acceptance within the dynamic dairy industry.

e. Course Learning Objective:

CLOBJ 1	Explain the significance, terminology, design, and requirements of sensory evaluation, encompassing the basic principles of senses and sensory perception in the context of dairy products.
CLOBJ 2	Acquire proficiency in understanding the basics of sensory parameters, enabling the sensory evaluation of various dairy products and linking sensory attributes to product characteristics.
CLOBJ 3	Investigate the use of scorecards, judging, and grading of milk, including the identification of defects associated with milk to develop a comprehensive understanding of quality assessment.
CLOBJ 4	Describe the desirable attributes and defects in cream, specific requirements for high-grade butter, grades of ghee, and special quality considerations for ghee, as well as recognizing desirable and undesirable characteristics in fermented milks and frozen dairy products.
CLOBJ 5	Analyse the sensory quality attributes of cheese, identify desirable and undesirable characteristics of dried dairy products, concentrated milk products, heat-desiccated Indian milk products, and acid-coagulated Indian milk products for comprehensive knowledge of diverse dairy items.
CLOBJ 6	Identify the interrelationship between sensory properties of dairy products and various instrumental and physico-chemical tests, recognizing the importance of consumer acceptance in evaluating product quality.

f. Course Learning Outcomes:

CLO 1	Explanation of importance, terminology, design and requirements, basic principles: senses and sensory perception of sensory evaluation.
CLO 2	Learn the basics of sensory parameters to do sensory various dairy products
CLO 3	Study about the score card and its use, judging and grading of milk, defects associated with milk.
CLO 4	Describe desirable attributes and defects in cream, Specific requirements of high-grade butter, grades of ghee & special requirements of quality ghee, desirable and undesirable characteristics of fermented milks, Frozen dairy products.
CLO 5	Study about sensory quality attributes of cheese, desirable and undesirable characteristic of dried dairy products, concentrated milk products, heat desiccated Indian milk products and Acid coagulated Indian milk products.
CLO 6	Identify the consumer acceptance interrelationship between sensory properties of dairy products and various instrumental and physico-chemical tests.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	20	20	50	60	-	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction definition and importance of sensory evaluation in relation to consumer acceptability and economic aspects. Terminology related to sensory evaluation. Design and requirements of a sensory evaluation laboratory. Basic principles: senses and sensory perception. Physiology of sensory organs. Classification of tastes and odors, threshold value. Factors affecting senses, visual, auditory, tactile and other responses. Fundamental rules for scoring and grading of milk and milk products. Procedure and types of tests – difference tests (Paired comparison, due- trio, triangle) ranking, scoring, hedonic scale and descriptive tests. Panel selection, screening and training of judges.	17 %	5
2	Milk score card and its use. Judging and grading of milk, defects associated with milk.	6 %	2
3	Cream desirable attributes and defects in cream, Score card for	6 %	2

	cream, sensory evaluation of different types of cream.		
4	Butter Specific requirements of high-grade butter, undesirable attributes of butter, butter score-card, sensory evaluation of butter.	6 %	2
5	Ghee grades of ghee, special requirements of quality ghee, defects in ghee, sensory evaluation of ghee.	6 %	2
6	Fermented milks desirable and undesirable characteristics of fermented milks, sensory evaluation of dahi, yoghurt, chakka, Shrikhand, lassi and other fermented drinks.	6 %	2
7	Frozen dairy products desirable and undesirable characteristics of frozen dairy products. Sensory evaluation of ice cream, kulfi and milk sherbets.	6 %	2
8	Cheese sensory 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	6 %	2
9	Dried dairy products desirable and undesirable characteristic of dried milks. Sensory evaluation and grading of dry milk products.	6 %	2
10	Concentrated milks desirable attributes and defects Sensory evaluation and grading of evaporated and condensed	6 %	2
11	Heat desiccated Indian milk products desirable and undesirable characteristics. Sensory evaluation of khoa and khoa based sweets.	6 %	2
12	Acid coagulated Indian milk products desirable arid undesirable characteristics. Sensory evaluation of paneer, chhana and chhana based sweets.	6 %	2
13	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.	17 %	5
Total		100 %	32

i. Text Book and Reference Book:

1. Sensory Evaluation Practices by Herbert Stone and Joel L. Sidel.
2. Sensory Evaluation of Food: Principles and Practices by Harry T. Lawless and Hildegarde Heymann.
3. Sensory Evaluation Techniques by Meilgaard, Civille, and Carr.
4. Sensory Analysis of Foods of Animal Origin by Leo M. L. Nollet and Fidel Toldrá.
5. E-course of ICAR. Cited from: www.agrimoon.com

Semester 5

- a. **Course Name:** Entrepreneurship and Start Up
- b. **Course Code:** 03604327
- c. **Prerequisite:** Knowledge of 12th science level.
- d. **Rationale:** Entrepreneurship and Start Up in Diploma Dairy Technology empowers students to drive advancements in dairy processes while fostering a mindset for entrepreneurial ventures in the dynamic dairy industry.

e. Course Learning Objective:

CLOBJ 1	Develop a comprehensive understanding of innovative technologies and methodologies in dairy processing.
CLOBJ 2	Acquire the skills necessary to identify and assess opportunities for entrepreneurial ventures within the dairy industry, including market analysis, business planning, and financial management.
CLOBJ 3	Foster a creative and innovative mindset by engaging in hands-on projects and case studies that encourage students to explore novel solutions to challenges in dairy technology, thereby promoting a culture of continuous improvement.
CLOBJ 4	Cultivate effective communication and collaboration skills to work within interdisciplinary teams.

f. Course Learning Outcomes:

CLO 1	Study the concept of entrepreneurship development, globalization and the emerging business/ entrepreneurial environment.
CLO 2	Acquire the knowledge of SWOT analysis and recognize the policies of Export and Import relevant to dairy sector.
CLO 3	Classification of assessment related to entrepreneurial skills and also observation of industrial consultancy.
CLO 4	Recruitment and training of manpower and compose the feasibility reports.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	0	1	20	20	-	60	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Innovation and Entrepreneurship: Definition, Innovation and entrepreneurship, Contributions of entrepreneurs to the society, covers the various stages of setting up and growing an entrepreneurial firm.	13 %	2
2	Design Thinking: Design Thinking, Design-Driven Innovation, TRIZ (Theory of Inventive Problem Solving), Double diamond theory.	13 %	2
3	Ideation: Ideation, Opportunity Identification, factors determining competitive advantage, Market segment, market structure, Idea validation.	14 %	2
4	Value Proposition: Value proposition, Business Model Canvas, Lean Canvas Model, developing an Effective Business Model.	24 %	4
5	Testing, Validation, and Commercialization: Testing, Validation, and Commercialization; covers the concepts of Minimum viable Product (MVP)	18 %	3
6	Technological Innovation and Entrepreneurship: Technological Innovation and Entrepreneurship; focusses on technology as a key driver of successful start-up and sustainable ramp up.	18 %	3
Total		100 %	16

i. Text Book and Reference Book:

1. Dairy Processing and Quality Assurance by Ramesh C. Chandan and Arun Kilara
2. Entrepreneurship: Theory, Process, and Practice by Donald F. Kuratko and Jeffrey S. Hornsby
3. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries
4. Innovation and Entrepreneurship: Practice and Principles by Peter F. Drucker
5. Dairy Science and Technology by P. Walstra, T. J. Geurts, A. Noman, A. Jellema, and M. A. J. S. van Boekel

Semester 4

- a. **Course Name:** Financial Accounting
- b. **Course Code:** 03604281
- c. **Prerequisite:** Knowledge of Science and Mathematics up to 12th science level.
- d. **Rationale:** Financial Accounting in Diploma Dairy Technology equip students with essential skills to optimize financial resources, enhance profitability, and ensure efficient cost control within the dynamic dairy industry.

e. Course Learning Objective:

CLOBJ 1	Comprehend fundamental financial concepts, including budgeting, financial statement analysis, and time value of money, to make informed financial decisions within the context of dairy technology.
CLOBJ 2	Develop proficiency in cost accounting methods to accurately allocate and control costs associated with dairy production, processing, and distribution, ensuring optimal resource utilization.
CLOBJ 3	Understand how to identify investment opportunities, assess financial risks, and make strategic decisions to boost dairy operations' economic success.
CLOBJ 4	Acquire the skills to navigate and adhere to regulatory standards and industry guidelines governing dairy plant design, ensuring compliance with food safety regulations and quality control measures.
CLOBJ 5	Learn to assess and analyse financial performance indicators, such as profitability ratios, liquidity measures, and efficiency metrics, to monitor and improve the overall financial health of dairy businesses.
CLOBJ 6	Develop an understanding of financial regulations, accounting standards, and compliance requirements specific to the dairy industry, ensuring adherence to legal and ethical financial practices in dairy technology operations.

f. Course Learning Outcomes:

CLO 1	Introduction of different system of accounting, doubles entry system of book-keeping and invent the final accounts.
CLO 2	Acquire idea about statements of financial information.
CLO 3	Understand the cost volume, Capital Structure, Investment decision and timing, Depreciation.
CLO 4	Learn about working capital management and elements of cost.
CLO 5	Criticize the various methods of apportioning indirect expenses and process costing.
CLO 6	Study the planning of Stores & storekeeping, Cost Sheets-Different methods.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1.	Introduction Definition, scope and objectives of financial management. Different Systems of Accounting: Financial Accounting, Cost accounting, Management Accounting.	7%	2.5
2.	Doubles entry system of Book-Keeping: Preparation of Accounting Records: Journal, Purchases and Sales Book and Posting in Ledger, Cash Book	7%	2.5
3.	Preparation of Final Accounts: Preparation of Final Accounts and adjustments at the end of trading period. Preparation of Trial Balance Banking Transactions and Bank reconciliation statements.	7%	2.5
4.	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.	10%	3
5.	Financial Analysis: Nature and uses of financial analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Utility of Ratio analysis.	7%	2.5
6.	Cost Volume: Profit analysis and operating leverage, Break-even analysis, Profit analysis and operating analysis, Utility of CVP analysis.	7%	2.5
7.	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 earnings, overall cost of capital.	7%	2.5
8.	Investment decision: Time value of money, Net present value, Investment evaluation criteria, NPV method, Internal rate of return method, Profitability index method, Payback period	7%	2.5

	method, accounting rate of return method. Capital budgeting: Complex Investment Decisions		
9.	Investment timing: Investment timing & duration Investment decisions under inflation, Investment decisions under capital rationing. Project Report; Feasibility Report Valuation.4	5%	1
10.	Working capital management: Concept & determinants of working capital, Estimating working capital needs.	5%	1
11.	Depreciation: Concept and method. Introduction, Definition, Objectives, Common terms. Costing: Essentials of sound costing system. Different methods of costing	5%	1
12.	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.	7%	2.5
13.	Various methods of apportioning indirect expenses: Various methods of apportioning indirect expenses. Inventory Management: Planning, control and costing.	5%	1
14.	Stores & storekeeping: 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.	7%	2.5
15.	Cost Sheets-Different methods: Statement of cost and statement of profit estimates, Tenders or Quotations. Contract or Terminal costing.	7%	2.5
Total		100 %	32

i. Text Book and Reference Book:

1. Financial Management: Principles and Applications by Sheridan Titman, Arthur J. Keown, and John D. Martin
2. Cost Accounting: A Managerial Emphasis by Charles T. Horngren, Srikant M. Datar, and Madhav V. Rajan
3. Financial Management: Theory & Practice by Eugene F. Brigham and Michael C. Ehrhardt
4. Principles of Managerial Finance by Lawrence J. Gitman and Chad J. Zutter
5. Management and Cost Accounting by Colin Drury