

NEP-2020 Aligned Curriculum for

Three Year (Six Semester) Diploma Programme in

DAIRY ENGINEERING

For the State of Uttar Pradesh
(Effective from Session 2026-27)



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PREFACE

An important issue generally debated amongst the planners and educator's world over is how technical education can contribute to sustainable development of the societies struggling hard to come in the same bracket as that of the developed nations. The rapid industrialization and globalization have created an environment for free flow of information and technology through fast and efficient means. This has led to the shrinking of the world, bringing people from different culture and environments together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the forgettable years of closed economy to knowledge based and open economy in the last few decades. To cope with the challenges of handling new technologies, materials and methods, we have to develop human resources having appropriate professional knowledge, skills and attitude. Technical education system is one of the significant components of the human resource development and has grown phenomenally during all these years. Now it is time to consolidate and infuse quality aspect through developing human resources in the delivery system. Polytechnics play an important role in meeting the requirements of trained technical manpower for industries and field organizations. The initiatives being taken by Technical Education, UP to revise the existing curricula of diploma programmes as per the needs of the industry and making them NEP-2020 compliant, are laudable.

In order to meet the requirements of future technical manpower, we will have to revamp our existing technical education system and one of the most important requirements is to develop outcome-based curricula of diploma programmes. The curricula for diploma programmes have been revised by adopting time-tested and nationally acclaimed scientific method, laying emphasis on the identification of COURSE OUTCOMES of diploma programme.

The real success of the diploma programme depends upon its effective implementation. However best the curriculum document is designed, if that is not implemented properly, the output will not be as expected. In addition to acquisition of appropriate physical resources, the availability of motivated, competent and qualified faculty is essential for effective implementation of the curricula. It is expected of the polytechnics to carry out job market research on a continuous basis to identify the new skill requirements, reduce or remove outdated and redundant courses, develop innovative methods of course offering and thereby infuse the much-needed dynamism in the system

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6. All the participants from industry/field organizations, engineering colleges, polytechnics, and other technical institutions for their professional inputs during curriculum workshops.

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1. SALIENT FEATURES

- Name of the Programme: Diploma Programme Dairy Engineering
- Duration of the Programme: Three years (Six Semesters)
- Entry Qualification: Matriculation or as Prescribed by State BTE, UP
- Intake: As prescribed by the Board
- Pattern of the Programme: Semester Pattern
- Ratio between theory and Practical: 40 : 60 (Approx.)

2- EMPLOYMENT OPPORTUNITIES

Before revising the curriculum, a preliminary industry survey and manpower assessment were conducted to evaluate the emerging job potential for diploma holders in Dairy Engineering. The findings highlighted diverse employment sectors including cooperative dairies, private corporations, food processing industries, equipment manufacturing, research institutions, and self-employment avenues.

A. INDUSTRIAL SECTORS & JOB PROFILES

S. No	Department / Organisation	Position / Designation
1	Uttar Pradesh Pradeshik Cooperative Dairy Federation (Parag)	Dairy Supervisor / Senior Technician/ Maintenance Technician / Dairy Operator
2	Rajasthan Cooperative Dairy Federation (Saras)	Dairy Supervisor / Technician
3	Haryana Dairy Cooperative Federation (Vita)	Dairy Plant Operator / Quality Assistant
4	Punjab Milkfed (Verka)	Plant Technician / Cold Chain Operator
5	Gujarat Cooperative Milk Marketing Federation (Amul)	Production Assistant / Field Supervisor
6	Mother Dairy (Delhi NCR)	Process Technician / Quality Analyst
7	National Dairy Development Board (NDDB)	Project Executive / Technical Assistant
8	GlaxoSmithKline / Nestlé / Danone / Britannia	QC Executive / Process Supervisor
9	National Dairy Research Institute (NDRI), Karnal	Lab Technician / Research Assistant
10	Private Dairy Farms & Startups	Cold Chain Supervisor / Pack-house Operator/ Dairy Plant Operator/ Quality Assistant.

B. LEADING DAIRY INDUSTRY PLAYERS IN INDIA

S. No	Company Name	Type	Headquarters / Presence
1	Amul (GCMMF)	Cooperative	Gujarat, Pan India
2	Mother Dairy	Government-owned (NDDB)	Delhi NCR, North India
3	Nestlé India	Private MNC	Pan India
4	Britannia Dairy	Private MNC	Bengaluru
5	Parag Milk Foods	Private	Pune, Maharashtra
6	Heritage Foods	Private	Hyderabad, South India
7	Ananda Dairy	Private	Uttar Pradesh
8	Gyan Dairy	Private	Uttar Pradesh
9	Creamline Dairy (Godrej)	Private	South and Central India
10	Verka (Milkfed Punjab)	Cooperative	Punjab

11	VRS Foods (Paras Dairy)	Private	North India
12	Umang Dairy (by JK group)	Private	North India

C. STATE-WISE COOPERATIVE DAIRY FEDERATIONS

State	Dairy Cooperative Federation Name
Uttar Pradesh	Pradeshik Cooperative Dairy Federation (PCDF- Parag)
Gujarat	Gujarat Cooperative Milk Marketing Federation (Amul)
Maharashtra	Maharashtra Rajya Sahakari Dudh Mahasangh (Mahanand; Gokul)
Rajasthan	Rajasthan Cooperative Dairy Federation (RCDF- Saras)
Haryana	Haryana Dairy Development Cooperative Federation (Vita)
Punjab	Punjab State Cooperative Milk Producers Federation (Verka)
Karnataka	Karnataka Milk Federation (Nandini)
Tamil Nadu	Tamil Nadu Cooperative Milk Producers Federation (Aavin)
Andhra Pradesh	Andhra Pradesh Dairy Development Cooperative Federation (Vijaya)
Telangana	Telangana State Dairy Development Cooperative Federation (Vijaya)
Bihar	Bihar State Milk Cooperative Federation (Sudha Dairy)
Madhya Pradesh	Madhya Pradesh State Cooperative Dairy Federation (Sanchi)
Kerala	Kerala Cooperative Milk Marketing Federation (Milma)
West Bengal	West Bengal Co-operative Milk Producers Federation (Benmilk)
Odisha	Odisha State Cooperative Milk Producers Federation (Omfed)
Assam	West Assam Milk Producers' Co-operative Union (Purabi)
Himachal Pradesh	Himachal Pradesh Milk Federation (HIMFED)
Chhattisgarh	Chhattisgarh State Cooperative Dairy Federation (Devbhog)
Jammu & Kashmir	Jammu & Kashmir Milk Producers Co-operative Ltd (Snow Cap)
Uttarakhand	Uttarakhand Cooperative Dairy Federation Ltd (Aanchal)
Jharkhand	Jharkhand Milk Federation (Medha)

D. SELF-EMPLOYMENT AVENUES

Diploma holders can pursue entrepreneurial ventures through:

1. **Manufacturing and Sale of Dairy Products:** Paneer, ghee, lassi, butter, flavored milk, etc.
2. **Setup of Ancillary Units:** Equipment parts, packaging, cold storage.
3. **Refrigeration and Cooling Unit Maintenance:** AC, milk coolers, compressors.
4. **Small Scale Packaging and Labelling Industry.**
5. **Startup of Mobile Milk Collection Units or Mini Processing Plants.**

E. KEY JOB ACTIVITIES

1. DAIRY PLANT OPERATIONS

- Oversee and control milk processing operations.
- Implement process safety and hygiene protocols.
- Supervise technical staff and manage utility services.

2. QUALITY CONTROL & MICROBIOLOGICAL ANALYSIS

- Conduct microbial, chemical, and sensory tests.
- Analyze and interpret laboratory results.

3. ERECTION & COMMISSIONING OF DAIRY PLANTS

- Understand technical drawings and installation plans.
- Inventory control, budgeting, and cost estimation.

4. EQUIPMENT TESTING & MAINTENANCE

- Inspect equipment for performance and reliability.
- Diagnose faults and ensure rectification.

5. MARKETING & SALES

- Promote dairy products and technical equipment.
- Prepare tender documents and handle customer queries.
- Inventory and logistics coordination.

6. PROJECT PLANNING & EVALUATION

- Review feasibility and financial viability of new dairy setups.
- Monitor implementation and prepare progress reports.

7. TEACHING, TRAINING & RESEARCH

- Support faculty in practical sessions.
- Maintain lab instruments and assist in research setups.
- Draft technical specifications for procurement.

PROGRAM OUTCOMES (POs)

PO1: Basics and Discipline specific Knowledge

Assimilate knowledge of basic mathematics, science, engineering fundamentals, and electronics and communication engineering.

PO2: Problem's Analysis and solution

Identify, analyse and solve problems using standard methods and established techniques.

PO3: Design and Development

Design solutions for technical problems.

Assist in designing components, systems, or processes to meet specific requirements.

PO4: Engineering Tools, Experimentation, and Testing

Use modern engineering tools and appropriate techniques to conduct experiments as per BIS standard.

PO5: Socio/ Economic /Environmental impact assessment/remedy.

Apply relevant technologies while considering societal needs, environmental impact keeping in view sustainable and ethical responsibilities.

PO6: Project Management and Communication

Apply engineering management principles, work effectively as an individual or in a team, and communicate clearly on activities.

PO7: Lifelong Learning

Recognize the importance of continuous learning and actively pursue self-improvement to keep pace with technological developments.

3. STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN DAIRY ENGINEERING

FIFTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credit	MARKS IN EVALUATION SCHEME										Total Marks of Internal & External	Exam Type
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT								
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot				
5.1	Dairy Engineering-III	2	-	5	4	40	-	40	60	3	-	-	60	100	Practicum/ Theory		
5.2	Dairy Technology-II	2	-	5	4	40	-	40	60	3	-	-	60	100	Practicum/ Theory		
5.3	Refrigeration-II	1	-	7	4	-	60	60	-	-	40	3	40	100	Practicum/ Practical		
5.4	Program Elective (Any One) 5.4.1 Advances In Dairy Technology 5.4.2 Advances In Dairy Engineering 5.4.3 Quality Assurance and Chemical Analysis in Dairy Industry	4	-	0	4	40	-	40	60	3			60	100	Theory		
5.5	Open Elective-III ^	2	-	-	2	50	-	50	-	-	-	-	-	-	Qualifying		
	Advance Skill Development	-	-	-		-	-	-	-	-	-	-	-				
5.6	Industrial training (summer internship-II)	-	-	-	2	-	60	60	-	-	40	3	40	100	Practical		
5.7	Indian Constitution (Q)	2	-	-	-	50	-	50	-	-	-	-	-	-	Qualifying		
#Student Centred Activities (SCA)		-	-	23	-	-	50	50	-	-	-	-	-	50	-		
Total		13	-	25	20	120	170	290	180	-	80	-	260	550	-		

* Common with another diploma programme

^ : As per the AICTE Open Elective List

Student Centred Activities will comprise of co-curricular activities like extension lectures, self study, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, disaster management and safety etc. The periods allotted to SCA can also be utilized to complete the syllabus of other subjects.

Program Elective (Any One)

5.4.1 Advances In Dairy Technology

5.4.2 Advances In Dairy Engineering

5.4.3 Quality Assurance and Chemical Analysis in Dairy Industry

List of Subjects for Open Elective-III (Any One)

SR. NO.	SUBJECT NAME
1	Organic and Natural Farming Practices
2	Artificial Intelligence
3	Any Course Of Minimum 02 Credit From (Advance Skill Development) • NPTEL • MOOCS THROUGH SWAYAM • AICTE-ELIS AND CENTRALLY FUNDED TECHNICAL INSTITUTES • C-DAC • CERTIFICATES CONDUCTED BY THE INSTITUTE OF NATIONAL IMPORTANCE (IIT, NIT, IIT ETC.) • ISRO E-LEARNING • COURSES OFFERED BY TATA TECHNOLOGY (Annexure-1) OR OTHER REPUTED ORGNISATION.

Advance Skill Development:

To fulfill the requirements for Advanced Skill Development, a minimum of 20 hours of skill certification is necessary. This certification must be obtained from a recognized national or international agency or institute. The assessment and certification process will be conducted by the respective agency or institute. Students must present their certificate to earn 02 credits for this subject.

**STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN DAIRY ENGINEERING
SIXTH SEMESTER**

A: Normal Pathway

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME									Total Marks of Internal & External	Exam Type
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT							
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot			
6.1	Instrumentation Process and Control	3	-	0	3	40	-	40	60	3	-	-	60	100	Theory	
6.2	Economic Analysis and Cost Accounting	3	-	0	3	40	-	40	60	3	-	-	60	100	Theory	
6.3	*Entrepreneurship And Start-Up	2	-	-	2	40	-	40	60	3	-	-	60	100	Theory	
6.4	Project	-	-	24	12	-	240	240	-	-	160	3	160	400	Practical	
#Student Centred Activities (SCA)		-	-	2	-	-	50	50	-	-	-	-	-	50	-	
Total		10	-	26	20	120	290	410	180	-	160	-	340	750	-	

* Common with another diploma programme

Student Centred Activities will comprise of co-curricular activities like extension lectures, self study, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, disaster management and safety etc. The periods allotted to SCA can also be utilised to complete the syllabus of other subjects.

**STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN DAIRY ENGINEERING
SIXTH SEMESTER**

B: Internship Pathway

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME									Total Marks of Internal & External	Exam Type
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT							
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot			
6.1	*Entrepreneurship And Start-Ups (Online Mode)	-	-	-	2	-	-	-	100	3	-	-	100	100	Theory	
6.2	Industry Hands on Practice	-	-	-	4	-	-	-	-	-	-	-	-	350	-	
	Industrial Project	-	-	-	12	-	-	-	-	-	-	-	-	200	-	
	Seminar (In Institute)	-	-	-	2	-	100	100	-	-	-	-	-	100	Seminar	
Total		-	-	-	20	-	100	100	100	-	-	-	100	750	-	

* Common with another diploma programme

NOTE:

1. The Industrial training tenure should not be less than 4 months.
2. Industry must be registered with MSME / Directorate of industries/Limited Organization/ State/Central Government establishments.
3. Monthly progress reports of Intern/ Trainee should be attested and forwarded by industrial supervisor (allotted to Intern/Trainee) during industrial Internship/Training.
4. The Industrial unit/organisation must evaluate students using the format provided by polytechnic in the form of marks.
5. The Industrial Hands on Practice, Industrial Project and seminar must be evaluated on the basis of the BTE Internship / Training Policy - 2025.
6. "Entrepreneurship and Start-up" course is also mandatory in Industrial internship/training mode. It will be conducted online mode by his/her polytechnic institute. After completing the online course, students must appear for exam conducted by the Board of Technical Education, Lucknow.

4. GUIDELINES FOR ASSESSMENT OF STUDENT CENTRED ACTIVITIES (SCA)

It was discussed and decided that the maximum marks for SCA should be 50 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows:

- i. 10 Marks for general behaviour and discipline
(by HODs in consultation with all the teachers of the department)
- ii. 10 Marks for attendance as per following:
(by HODs in consultation with all the teachers of the department)
 - a) 75 - 80% 8 Marks
 - b) 80 - 85% 9 Marks
 - c) Above 85% 10 Marks
- iii. 30 Marks maximum for Sports/ NCC/ Cultural/ Co-curricular/ NSS activities as per following:
(by In-charge Sports/NCC/Cultural/Co-curricular/NSS)
 - a) 30 - State/National Level participation
 - b) 25 - Participation in two of above activities
 - c) 15 - Inter-Polytechnic level participation

5.1 DAIRY ENGINEERING-III

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RATIONALE

To produce dry milk for infants' food and for other needs of human being, the different types of operations with various types of equipment are done. The student should possess the knowledge of handling, operating and maintenance of these equipment's to manufacture dry milk product.

COURSE OUTCOMES

After undergoing this subject, the student will be able to;

CO
No

Course Outcome

- CO1 Evaluate evaporator performance (capacity, economy, BPE).
- CO2 Operate mechanical and thermal recompressors for low-temperature concentration.
- CO3 Manage spray-dryer atomizers, cyclone separators and bag filters safely.
- CO4 Compare UF/RO/NF processes for whey protein and lactose fractionation.
- CO5 Calculate steam requirements and energy balances for evaporation cycles.

CO-PO Mapping

CO \ PO	PO1 Basics and Discipline specific Knowledge	PO2 Problem's Analysis and solution	PO3 Design and Development	PO4 Engineering Tools, Experimentation, and Testing	PO5 Socio/ Economic /Environmental impact assessment/remedy.	PO6 Project Management and Communication	PO7 Lifelong Learning
CO1	3	2	1	NA	NA	NA	NA
CO2	3	1	NA	NA	NA	NA	NA
CO3	3	NA	NA	NA	1	NA	NA
CO4	2	NA	NA	NA	NA	NA	NA
CO5	2	3	2	NA	NA	NA	NA

DETAILED CONTENTS

Unit No.	Content	Period
1	EVAPORATION SYSTEMS IN DAIRY INDUSTRY - Basic principles of evaporators and Need for evaporation in dairy - Types of evaporators: - Single effect - Multiple effect - Falling film - Rising film - Forced circulation - Plate evaporators - Boiling point elevation, effect of liquid head and friction on temperature. - Performance evaluation: Evaporator capacity, steam economy. Practicals - Study of constructional details, dismantling, assembling, adjustment, operation, control of Different types of evaporators. - Calculation of Evaporator Performance. - Maintenance of Evaporators.	24
2	VAPOUR RECOMPRESSION & ENERGY EFFICIENCY - Working principle of mechanical vapor recompression (MVR) and thermal recompression. - Low temperature concentration using heat pump cycle. - Ancillaries: Condensers, vapor separators, ejectors. Practicals - Study of constructional details, dismantling, assembling, adjustment, operation, control of different accessories used in Evaporator. - Condensers, low temperature concentrators.	24
3	MILK DRYING SYSTEMS & EQUIPMENTS i) Types of Drying Systems - Classification: Drum, Spray, Freeze drying. ii) Spray Drying Systems - Atomization: Pressure nozzle spray, rotary atomizers, Centrifugal discs. - Air heating systems, Air flow patterns, drying chamber design. - Cyclone separators, bag filters. - Fluidized bed dryer. Practicals - Study of constructional details, dismantling, assembling, adjustment, operation, control of-Spray dryer and controls, Cyclone separators and bag filters. - Maintenance of Drum and Spray Dryers	24
4	MEMBRANE SEPARATION TECHNOLOGY	26

	• Principles and types of membrane processes. ○ Ultrafiltration (UF) ○ Reverse Osmosis (RO) ○ Nanofiltration (NF) ○ Microfiltration (MF) • Materials and module configurations (spiral, tubular, hollow fiber). • Applications in dairy: Milk concentration, whey protein separation, lactose reduction. • Comparison of UF, RO, NF based on flux, retention, and cleaning requirements. Practicals Study of constructional details of module configurations (spiral, tubular, hollow fiber).	
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INSTRUCTIONAL STATREGY

The teacher should explain about field applications before teaching the basics to develop proper understanding of the physical phenomenon.

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voce

RECOMMENDED BOOKS

1. Dairy Plant Engineering And Management : By Tufail Ahmad Publisher- Kitab Mahal
2. Dairy Engineering : Advanced Technologies and Their Application: By Murlidhar Meghwal, Megh R. Goyal, Rupesh S. Chavan Publisher- CRC Press
3. Dudh Udyog ; By-Dr. Anil Kumar Kulkarni : Publisher:Continental Publication
4. Dairy Products manufacturing Technologies By-Jagdish Prasad : Publisher: Kalayani Publisher
5. Dairy Science and Technology Hand Book ; By Y .H. Hui Publisher; John Wiley
6. Dairy Engg Practical Book ; By-Seema Tanwar , V.D Mudgal, S K Jain ; Publisher- Satish Serial Publishing House.
7. Dairy Process Engg (Practical Book) ; By VD Mudgal , KK Meena ; Publisher- Satish Serial Publishing House
8. Dairy Engineering : Advanced Technologies and Their Applications; By- Murlidhar Meghwal, Megh R. Goyal, Rupesh S. Chavan Publisher-Apple Academic Press
9. Novel Dairy Processing Technologies ; Techniques, Management and Energy Conservation; By- Megh R. Goyal, Anit Kumar, Anil K.Gupta Publisher: CRC Press

WEBSITES FOR REFERENCE:

1. <https://agrimoon.com/>
2. [Swayam.gov.in](https://swayam.gov.in)
3. <https://www.researchgate.net/>
4. <https://www.perlego.com/>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	24	25
2	24	25
3	24	25
4	26	25
Total	98	100

5.2 DAIRY TECHNOLOGY-II

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RATIONALE

Various milk products are manufactured from milk which are served as special dishes in hotels and special function without spoiling the nutrition value of milk. Preparation of these articles is a specialized job. A student aware of preparation and packaging of these dairy products will be useful in the dairy plant and entrepreneur.

COURSE OUTCOMES

After undergoing this subject, the student will be able to;

CO No Course Outcome

- CO1 Manufacture cheddar, mozzarella, cottage and processed cheeses; control defects.
- CO2 Produce sweetened condensed, evaporated milks and spray-dried powders.
- CO3 Formulate probiotic, low-fat and sugar-free ice creams.
- CO4 Apply aseptic, UHT and MAP packaging for various dairy formats.
- CO5 Assess shelf-life and packaging-material interactions.

CO–PO Mapping

CO \ PO	P01 Basics and Discipline specific Knowledge	P02 Problem's Analysis and solution	P03 Design and Development	P04 Engineering Tools, Experimentation, and Testing	P05 Socio/ Economic /Environmental impact assessment/remedy.	P06 Project Management and Communication	P07 Lifelong Learning
CO1	2	NA	NA	NA	NA	NA	NA
CO2	3	NA	NA	NA	NA	NA	NA
CO3	3	NA	2	NA	NA	NA	NA
CO4	2	NA	NA	1	NA	NA	NA
CO5	3	NA	NA	1	NA	NA	NA

DETAILED CONTENTS

Unit No.	Content	Period
1	MANUFACTURE OF CHEESE - Principles of cheese making and Average composition of different varieties of cheese. - Manufacture of: - Cottage cheese - Cheddar cheese - Processed cheese	30

	○ Mozzarella cheese • Cheese yield, maturation, and packaging. CASEIN & BY-PRODUCTS TECHNOLOGY • Classification of casein: Acid, rennet, edible, pharmaceutical grade. • Manufacture of sodium and calcium caseinate. • By-products: Whey processing (lactose, whey protein concentrate/isolate – WPC/WPI). • Uses of casein and caseinates in food and non-food industries. Practicals 1. Preparation of starter culture. 2. Preparation Cheddar Cheese, Cottage Cheese, Mozzarella and Processed Cheese. 3. Preparation of different types of casein.	
2	ICE CREAM TECHNOLOGY • Composition and standards of different types of ice cream: Plain, fruit-based, soft serve, frozen dessert. • Ingredients: stabilizers, emulsifiers, milk solids, sugars, and flavors. • Batch vs. Continuous process. • Freezing and hardening technology. • Manufacture of probiotic, low-fat, and sugar-free ice creams Practicals 1. Preparation of different types of ice cream.	24
3	CONDENSED AND DRIED MILK PRODUCTS • Manufacturing and packaging of: ○ Sweetened condensed milk ○ Evaporated milk ○ Skim and whole milk powder ○ Infant formula and weaning food ○ Instantized milk powders • Membrane-based concentration prior to drying. • Packaging and shelf-life evaluation. Practicals 1. Demonstration of preparation of Spray Dried milk powder (skim and whole milk powder) 2. Preparations of evaporated milk and sweetened, condensed milk.	24
4	PACKAGING OF DAIRY PRODUCTS • Classification of packaging materials: Rigid, semi-rigid, flexible. • Packaging techniques: ○ Vacuum packaging ○ Aseptic and UHT packaging ○ Modified atmosphere packaging (MAP) • Sterilization techniques for packaging materials.	20

	• Eco-friendly and biodegradable options. • Smart packaging – temperature/time indicators Practicals 1. Different types of packaging techniques used for dairy products. 2. Types of Sterilization techniques for packaging materials.	
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INSTRUCTIONAL STRATEGY

The teacher should explain about field applications before teaching the basics to develop proper understanding of the physical phenomenon. Use of demonstration and animations can make the subject interesting and may develop scientific temper in the students.

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voce

RECOMMENDED BOOKS

1. DAIRY TECHNOLOGY Vol-1 & Vol-2 BY- Shivashraya Singh Publisher- Nipa ISBN-13 9789383305087 & 88
2. DAIRY SCIENCE & TECHNOLOGY BY-Gavin White Publisher- Callisto
3. Milk & Dairy Product Technology By -Edgar Spreer Publisher-
4. Dairy Engineering : Advanced Technologies and Their Application: By Murlidhar Meghwal, Megh R. Goyal, Rupesh S. Chavan Publisher- CRC Press
5. Technology of Dairy Products : By-J.V.Parekh and Mukund Lal Naware Publisher: CBS Publisher
6. Dudh Udyog ; By-Dr. Anil Kumar Kulkarni : Publisher: Continental Publication
7. Dairy Products manufacturing Technologies By-Jagdish Prasad : Publisher: Kalayani Publisher
8. Dairy Technology : By-V.P Singh & Neelam Sachan : Publisher: Kalayani Publisher
9. Outlines of Dairy Technology ; By – Sukumar Dey ; Publisher- Oxford University Press (Indian Branch)
10. दुग्ध प्रौद्योगिकी एवं गुणवत्ता नियंत्रण- इन्द्रजीत जौहर, भाटी एवं लवानिया |

WEBSITES FOR REFERENCE:

1. <https://agrimoon.com/>
2. [Swayam.gov.in](https://swayam.gov.in)
3. <https://www.researchgate.net/>
4. <https://www.perlego.com/>
5. <http://ecoursesonline.iasri.res.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	30	30
2	24	25
3	24	25
4	20	20
Total	98	100

5.3 REFRIGERATION - II

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RATIONALE

Microbiological disintegration of milk can be delayed at reduced temperatures. Therefore the student of Dairy Engineering is supposed to have ample knowledge of Airconditioning and refrigeration system.

COURSE OUTCOMES

After undergoing this subject, the student will be able to;

CO No Course Outcome

- CO1 Use psychrometric charts for humidity, sensible/latent-heat calculations.
- CO2 Compute refrigeration loads (product, infiltration, equipment) for cold stores.
- CO3 Compare vapor-absorption vs. compression systems for remote dairy units.
- CO4 Design insulation systems using PU, PIR and vapor barriers.
- CO5 Operate cryogenic freezers (N₂, CO₂) for rapid product freezing.

CO–PO Mapping

CO \ PO	PO1 Basics and Discipline specific Knowledge	PO2 Problem's Analysis and solution	PO3 Design and Development	PO4 Engineering Tools, Experimentation, and Testing	PO5 Socio/ Economic /Environmental impact assessment/remedy.	PO6 Project Management and Communication	PO7 Lifelong Learning
CO1	3	NA	1	1	NA	NA	NA
CO2	3	1	NA	NA	NA	NA	NA
CO3	3	NA	NA	NA	NA	NA	NA
CO4	3	NA	3	NA	NA	NA	NA
CO5	2	NA	NA	NA	NA	NA	NA

DETAILED CONTENTS

Unit No.	Content	Period
1	PSYCHROMETRY - Terms: Specific humidity, relative humidity, degree of saturation, DBT, WBT, DPT - Sensible and latent heat; total enthalpy of air - Use of psychrometric charts - Processes involving air-vapor mixtures: cooling dehumidification, heating - Modern humidity measurement and control systems	40

	Practicals 1. Determination of Dbt, WBT, DPT. 2. To find RH of atmospheric air by using sling psychrometer	
2	COLD STORAGE TECHNOLOGY • Definition, importance in dairy cooling systems • Load calculations (product load, infiltration load, equipment load) • Chilling and freezing conditions for different dairy products • Quick freezing and blast freezing principles • Selection of equipment: compressors, evaporators, condensers • Cold room layout and construction • Modern insulating materials (PIR, PU foam, vacuum insulation) • Vapor barriers and condensation control Practicals 1. Study of construction details, dismantling, assembling, adjustment, operation, control and maintenance of different types of compressors and thermo-recompressors. 2. Cold storage design and equipment selection. 3. To learn how to fire different insulations for different applications (Thermocol, Fiber glass etc.)	40
3	REFRIGERATION PLANT PERFORMANCE & ALTERNATIVE SYSTEMS • Charging procedures and precautions. • Introduction to Vapour Absorption System (Water-Ammonia, Li-Br). • Cryogenic Freezing: Cryogenics, cryogens, properties, applications, cryogenic freezers Practicals 1. Refrigerant Charging Procedure and Safety Precautions 2. Study of Vapour Absorption Refrigeration System (Water-Ammonia / Li-Br) 3. To study food preservation by different freezing methods. 4. To study & Demonstration of Cryogenic Freezing Techniques	32

INSTRUCTIONAL STATREGY:

Teacher should make the students able to learn the cryogenics of dairy plants through different offline/online supplements.

MEANS OF ASSESSMENT:

- Theory classes.
- Assignments /quizzes
- Lab work /viva voce /field visits.

RECOMMENDED BOOKS :

1. Refrigeration and air conditioning by Arvind kumar Sharma.
2. A textbook of refrigeration and air conditioning by R.S.Khurmi,S.Chand publications.
3. A textbook of refrigeration and air conditioning by R.K.Rajput.

4. Refrigeration and air conditioning by C.P.Arora

WEBSITES FOR REFERENCE

1. www.wikipedia.com
2. www.nptel.ac.in
3. www.swayam.gov.in
4. <http://ecoursesonline.iasri.res.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	40	35
2	40	35
3	32	30
Total	112	100

PROGRAM ELECTIVE (Any One)

5.4.1 ADVANCES IN DAIRY TECHNOLOGY

L T P
4 0 0

RATIONALE:

This subject introduces students to, whey utilization and functional dairy by-products, while also grounding them in the mechanized preparation of indigenous milk products such as Khoa, Paneer, and fermented milks. The emphasis is on applied learning and hands-on exposure to emerging industry trends to equip students for future-ready dairy operations.

COURSE OUTCOMES

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

CO No Course Outcome

- CO1 Explore manufacturing, quality, and innovation in traditional Indian dairy products.
- CO2 Develop practical skills in preparing, packaging, and preserving dairy items like Khoa, Paneer.
- CO3 Utilize dairy by-products sustainably, including whey, ghee residue, and buttermilk.
- CO4 Apply fermentation techniques to create value-added dairy products such as Dahi, Yoghurt, and Kefir.
- CO5 Examine physicochemical and functional properties of dairy components relevant to the food industry.
- CO6 Prepare for careers in dairy industries, cooperatives, startups, or entrepreneurial ventures.
- CO7 Combine theoretical learning with practical exposure through projects and plant visits.

CO-PO Mapping

CO \ PO	PO1 Basics and Discipline specific Knowledge	PO2 Problem's Analysis and solution	PO3 Design and Development	PO4 Engineering Tools, Experimentation, and Testing	PO5 Socio/ Economic /Environmental impact assessment/remedy.	PO6 Project Management and Communication	PO7 Lifelong Learning
CO1	3	NA	NA	NA	NA	NA	NA
CO2	3	NA	NA	NA	NA	1	NA
CO3	3	NA	NA	NA	1	NA	NA
CO4	3	NA	NA	2	NA	NA	NA
CO5	3	1	NA	NA	NA	NA	NA
CO6	2	NA	NA	NA	NA	NA	1
CO7	2	NA	NA	NA	NA	2	NA

Detailed Content

Unit No.	Content	Period
1	Traditional Indian Dairy Products — • Khoa: Types, manufacturing methods, preservation, yield factors, mechanization. • Khoa-based sweets: Burfi, Peda, Milk-cake, Kalakhand, Gulabjamun: Compositional profile, manufacturing practices. • Rabri & Basundi: Process, yield factors, physico-chemical changes. • Chhana & Chhana-based sweets: Rasogolla, Sandesh, Rasomalai: Standards, methods, preservation, packaging, mechanization. • Paneer: Process, standards, packaging, mechanization. • Chakka/Maska & Shrikhand: Standards, production methods, packaging. • Misti Dahi: Manufacturing & packaging. • Kheer & Payasam: Process innovations, packaging.	16
2	Fermented Milks • Role of starters. • Types: Dahi, yoghurt, acidophilus milk. • Defects and their control. • Kefir & Koumiss: Origin, characteristics, microbiology. • Other fermented milks: Bulgarian milk, cultured buttermilk, Leben, Villi, Yakult. • Microbiological & therapeutic importance.	15
3	Whey Processing • Fermented whey products. • Whey beverages. • Deproteinized/demineralized, condensed & dried whey: Specifications, manufacturing techniques. • Whey Protein Concentrates (WPC): Isolation methods, functional & physicochemical properties. • Applications in food industry. • Membrane Technology in whey processing.	15
4	Ghee Residue	10

- | | | |
|--|---|--|
| | <ul style="list-style-type: none"> • Composition, processing & utilization. • Nutritional value of dairy by-products. | |
|--|---|--|

INSTRUCTIONAL STRATEGY: Teacher should explain concepts, Demonstrate preparation, packaging and preservation techniques. Group activities for sustainable dairy by-product utilization may be encouraged.

MEANS OF ASSESSMENT:

- Theory classes.
- Assignments /quizzes

RECOMMENDED BOOKS :

1. Advanced Dairy Science and Technology by Blackwell Publishing
2. Modern Dairy Technology by Chapman and Hall.
3. Outlines of Dairy Technology by Sukumar De.

WEBSITES FOR REFERENCE

1. www.wikipedia.com
2. www.nptel.ac.in
3. www.swayam.gov.in
4. www.agrimoon.com
5. <http://ecoursesonline.iasri.res.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	16	28
2	15	26
3	15	26
4	10	20
Total	56	100

5.4.2 ADVANCES IN DAIRY ENGINEERING

L T P
4 0 0

RATIONALE:

Non-thermal (PEF, HPP, ultrasound), rheology and hurdle-technology offer gentle processing to preserve nutrients and extend shelf-life. Exposure to these helps students adopt cutting-edge methods in modern plants.

COURSE OUTCOMES:

After completing this course, the student will be able to:

CO No Course Outcome

- CO1 Explain novel non-thermal technologies used in dairy processing.
- CO2 Analyze and evaluate the significance of membrane filtration in dairy applications.
- CO3 Explain rheological characteristics and texture profiling of dairy products.
- CO4 Apply hurdle technology concepts for dairy product preservation.
- CO5 Gain exposure to real-world instrumentation and industrial practices.

CO-PO Mapping

CO \ PO	PO1 Basics and Discipline specific Knowledge	PO2 Problem's Analysis and solution	PO3 Design and Development	PO4 Engineering Tools, Experimentation, and Testing	PO5 Socio/ Economic /Environmental impact assessment/remedy.	PO6 Project Management and Communication	PO7 Lifelong Learning
CO1	3	NA	NA	NA	NA	NA	NA
CO2	3	1	NA	NA	NA	NA	NA
CO3	3	NA	NA	NA	NA	NA	NA
CO4	3	NA	NA	1	NA	NA	NA
CO5	2	NA	NA	NA	NA	NA	1

DETAILED CONTENTS

Unit No.	Content	Period
1	Non-Thermal Processing - Introduction to novel technologies: advantages over conventional heat treatment. - Pulsed Electric Fields (PEF) - High Pressure Processing (HPP) - Ultrasonication - Pulsed Ultraviolet (UV) Light	16

	• Cold Plasma	
2	Membrane Processing • Principles of membrane filtration. • Types of pressure-driven membrane processes: Microfiltration (MF), Ultrafiltration (UF), Nanofiltration (NF), Reverse Osmosis (RO). • Membrane configurations and modules. • Applications in the dairy industry (e.g., whey protein concentration, milk standardization).	15
3	Rheology of Dairy Products • Introduction to texture and rheology; Definition: texture, rheology, psychophysics. • Classification of fluid foods: Newtonian and non-Newtonian behavior. • Rheological properties of dairy products.	15
4	Hurdle Technology • Concept and principles. • Major hurdles: temperature, water activity, pH, redox potential, preservatives. • Combined preservation methods for dairy.	10

INSTRUCTIONAL STRATEGY:

Teach Advances in Dairy Engineering through interactive lectures, hands-on lab sessions, and industry visits. Use case studies, guest lectures, and software simulations to analyze modern dairy technologies. Assess learning with quizzes, presentations, and project-based applications.

MEANS OF ASSESSMENT:

- Theory classes.
- Assignments /quizzes

RECOMMENDED BOOKS :

1. Advanced Dairy Science and Technology by Blackwell Publishing
2. Modern Dairy Technology by Chapman and Hall
3. Advanced Technologies and Their Applications by CRC Press

WEBSITES FOR REFERENCE

1. www.wikipedia.com
2. www.nptel.ac.in
3. www.swayam.gov.in
4. www.agrimoon.com
5. <http://ecoursesonline.iasri.res.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	16	28
2	15	26
3	15	26
4	10	20
Total	56	100

5.4.3 QUALITY ASSURANCE AND CHEMICAL ANALYSIS IN DAIRY INDUSTRY

L T P
4 0 0

RATIONALE

With the growing emphasis on food safety, environmental sustainability, and quality assurance, it is essential for Dairy Engineering students to acquire strong foundational and applied knowledge in chemical quality analysis, legal standards, contaminants, additives, packaging, hygiene, and modern instrumental techniques.

LEARNING OUTCOME

Upon completion of this course, the student will be able to:

CO No Course Outcome

- CO1 Apply FSSAI, BIS, Codex, FDA and ISO norms to dairy QC processes.
- CO2 Set up and calibrate titrators, spectrophotometers, HPLC (basic) and mobile test labs.
- CO3 Detect pesticides, antibiotics, heavy metals and adulterants in milk.
- CO4 Conduct sensory tests (difference, ranking) and predict product shelf-life.
- CO5 Implement QC documentation, sampling plans and continuous-improvement cycles.

CO–PO Mapping

CO \ PO	PO1 Basics and Discipline specific Knowledge	PO2 Problem's Analysis and solution	PO3 Design and Development	PO4 Engineering Tools, Experimentation, and Testing	PO5 Socio/ Economic /Environmental impact assessment/remedy.	PO6 Project Management and Communication	PO7 Lifelong Learning
CO1	3	NA	NA	NA	NA	NA	NA
CO2	3	NA	NA	2	NA	NA	NA
CO3	3	NA	NA	2	NA	NA	NA
CO4	3	NA	NA	1	NA	NA	NA
CO5	2	NA	NA	NA	NA	1	NA

DETAILED CONTENTS

Unit No.	Content	Period
1	INTRODUCTION TO CHEMICAL QUALITY ASSURANCE AND SAMPLING - Importance of chemical quality control in the dairy industry - Responsibilities and organization of the quality control	15

	department • Concept of HACCP and its significance in dairy operations. • Sampling procedures, labelling, and documentation FOOD LAWS AND REGULATIONS • National Standards: PFA, FSSAI, BIS, Agmark • International Standards: Codex, IDF, FDA, ISO.	
2	LABORATORY SETUP AND INSTRUMENTATION • Setting up a dairy QC laboratory and mobile testing units • Instrumental methods of analysis – elementary knowledge • Accreditation of analytical laboratories and quality certification	10
3	ANALYSIS OF CONTAMINANTS AND ADULTERANTS • Detection of neutralizers, preservatives, and adulterants in milk • Contaminants: pesticides, antibiotics, heavy metals, detergents, toxins • Contact surface contamination: packaging and processing equipment PACKAGING MATERIALS AND ADDITIVES • Packaging materials – types, properties, and safety standards • Additives – stabilizers, emulsifiers, sweeteners, vitamins, antioxidants, preservatives, artificial flavors and colors.	15
4	SENSORY EVALUATION • Sensory testing parameters: taste, aroma, appearance, texture • Conditions for testing, difference and ranking tests • Selection and training of test panel SHELF-LIFE PREDICTION AND QUALITY ASSURANCE • Prediction of shelf-life of dairy products including UHT and sterilized milk • Continuous quality improvement and assurance plans	16

INSTRUCTIONAL STRATEGY:

Use interactive lectures and lab sessions to teach dairy quality parameters and chemical analysis techniques. Incorporate industry visits, case studies, and hands-on testing of dairy products for practical exposure. Assess learning through experiments, presentations, and quality control simulations.

MEANS OF ASSESSMENT:

- Theory classes.
- Assignments /quizzes

RECOMMENDED BOOKS :

1. Dairy Processing and Quality Assurance By Ramesh C.Chandan
2. Chemical Quality Assurance Of milk & milk products by Springer
3. Handbook on Analysis of Milk By M.K. Srivastav

WEBSITES FOR REFERENCE

1. www.wikipedia.com
2. www.nptel.ac.in
3. www.swayam.gov.in

4. www.agrimoon.com
5. <http://ecoursesonline.iasri.res.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	15	26
2	10	20
3	15	26
4	16	28
Total	56	100

5.5 OPEN ELECTIVE-III/ Advance Skill Development

L T P
2 0 0

5.5.1 Organic and Natural Farming Practices

COURSE OUTCOMES

By the end of the course, students will be able to:

CO No Course Outcome

- CO1 Explain the core principles and differences of organic and natural farming.
- CO2 Explain the ecological and economic benefits of natural farming practices.
- CO3 Identify and apply inputs such as compost, Jeevamrit, Bijamrit, and botanical pesticides.
- CO4 Implement soil health management, crop care, and pest control using low-cost natural methods.
- CO5 Explain marketing, certification, and sustainable livelihood opportunities in natural and organic farming.

CO–PO Mapping

CO \ PO	PO1 Basics and Discipline specific Knowledge	PO2 Problem's Analysis and solution	PO3 Design and Development	PO4 Engineering Tools, Experimentation, and Testing	PO5 Socio/ Economic /Environmental impact assessment/remedy.	PO6 Project Management and Communication	PO7 Lifelong Learning
CO1	3	NA	NA	NA	NA	NA	NA
CO2	2	NA	NA	NA	NA	NA	NA
CO3	3	1	NA	NA	NA	NA	NA
CO4	3	2	NA	NA	NA	NA	NA
CO5	2	NA	NA	NA	NA	NA	NA

Course Content

Unit 1: Introduction to Organic and Natural Farming

- Definition, origin, and development of Organic and Natural Farming
- Principles: Health, Ecology, Fairness, and Care (IFOAM); Natural Farming (Subhash Palekar's ZBNF)
- Distinction between organic and natural farming
- Advantages, limitations, and relevance in climate-resilient agriculture

Unit 2: Organic Ecosystems, Soil and Nutrient Management

- Concepts of soil as a living system, nutrient cycling, and biological magnification
- Soil properties: texture, structure, pH, humus, and C:N ratio
- Natural soil enhancers: Jeevamrit, Ghan Jeevamrit, cow dung, and cow urine

- Composting: vermi-compost, pit and heap compost, leaf litter compost

Unit 3: Plant Nutrition and Input Preparation

- Plant nutrients: micro and macro, their role and deficiency symptoms
- Natural inputs: Bijamrit (seed treatment), Jeevamrit (soil tonic), Agniastra, Brahmastra, Neemastra
- Role of soil microbes and Rhizosphere health in plant growth

Unit 4: Farm and Crop Management

- Land and seedbed preparation using natural inputs
- Mulching and moisture retention techniques in Natural Farming
- Weed and pest control: botanical extracts, natural repellents, and trap crops
- IPM practices, crop rotation, intercropping, and post-harvest techniques

Unit 5: Certification, Marketing, and Sustainable Practices

- Participatory Guarantee System (PGS) vs Third-party certification
- Marketing strategies for natural and organic produce
- Case studies: success stories of Natural Farming (ZBNF and others)
- Role in ensuring food security, environmental sustainability, and rural livelihoods

Recommended Books / Resources

1. Sharma, Arun K. – A Handbook of Organic Farming, Agrobios, India
2. Subhash Palekar – The Philosophy of Natural Farming, and other ZBNF publications
3. T.V. Sathé – Vermiculture and Organic Farming, Daya Publishing
4. Palaniappan & Annadurai – Organic Farming: Theory and Practice, Scientific Publishers
5. Pratiksha Raghuvankar – Handbook of Organic Farming
6. Natural Farming Training Manual, Department of Agriculture, Govt. of Andhra Pradesh
7. Guidelines from the National Centre of Organic Farming (NCOF), Ministry of Agriculture
8. Dongarjal R. P. & Zade S.B. – Insect Ecology and IPM, Akinik Publications
9. Alvares, Claude – The Organic Farming Source Book, The Other India Press

5.5.2 Artificial Intelligence

Course Content:

Unit 1 – Introduction to Artificial Intelligence

- Artificial Intelligence (AI) definition
- Goals of AI
- History of AI
- Applications of AI

Unit 2 – Agents and Environments

- Agent Terminology, Types of Agents – Simple Reflex Agents, Model Based Reflex Agents, Goal Based Agents
- Nature of Environments, Properties of Environments

Unit 3 – Search Algorithms

Terminology

- Brute Force Search Strategies – Breadth First Search, Depth First Search.
- Heuristic Search Strategies, Local Search Algorithms.

Unit 4 – Fuzzy Logic Systems

Introduction to Fuzzy Logic and Fuzzy systems,

- Membership functions,
- Fuzzification/Defuzzification

Unit 5 – Neural Networks

Basic structure of Neural Networks

- Perceptron
- Back-propagation

Suggested Learning Resources:

1. Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial intelligence use cases Denis Rothman Packt Publishing ISBN – 978-1788990547

Advance Skill Development

To fulfill the requirements for Advanced Skill Development, a minimum of 20 hours of skill certification is necessary. This certification must be obtained from a recognized national or international agency or institute. The assessment and certification process will be conducted by the respective agency or institute. Students must present their certificate to earn 02 credits for this subject.

5.6 INDUSTRIAL TRAINING (SUMMER INTERNSHIP-II)

Duration and Timing:

Students will undergo a **4 week in-plant training** immediately after appearing in their theory examinations of 4th Semester.

Training Venue:

The training will be conducted in one of the following types of dairy processing facilities:

- Market milk plant
- Large or medium-sized dairy plant

Objective:

The purpose of this training is to provide students with practical exposure to real-world dairy plant operations, helping them to:

- Understand actual operational challenges
- Experience the working environment of a functional dairy plant
- Apply theoretical knowledge in a professional setting

Reporting Requirements:

- Students are required to **prepare and submit a detailed training report** to their respective institution.

Evaluation:

- A **Viva-Voce examination** will be conducted based on the training experience and submitted report.
- The concerned Faculty/HOD will be responsible for conducting the viva and assessing student performance.

5.7 INDIAN CONSTITUTION

L T P
2 - 0

COURSE LEARNING OBJECTIVES:

1. Understand the history, principles, and key interpretations of the Indian Constitution.
2. Understand the structure and key roles of the Indian Union Government, including the President, Prime Minister, and Council of Ministers.
3. Understand the composition, powers, and functions of the Lok Sabha, Rajya Sabha, and the Supreme Court.
4. Understand the roles and powers of the Governor, Chief Minister, Council of Ministers, and the State Secretariat.
5. Understand the structure and functions of local administration, including District, Municipal, and Zila Panchayat levels.
6. Understand the structure, role, and functions of the Election Commission of India.

Course Outcomes (COs)

CO No Course Outcome

CO1	Describe historical process of the Indian Constitution's creation.
CO2	Describe structure and roles of the President, Prime Minister, and Council of Ministers.
CO3	Describe composition, powers, and functions of the Lok Sabha, Rajya Sabha, and Supreme Court.
CO4	Describe the roles and powers of the Governor, Chief Minister, Council of Ministers, and State Secretariat.
CO5	Explain the structure and functions of local administration, including District Administration, Municipal Corporations, and Zila Panchayats.
CO6	Explain the structure, role, and functions of the Election Commission of India.

CO-PO Mapping

CO \ PO	PO1 Basics and Discipline specific Knowledge	PO2 Problem's Analysis and solution	PO3 Design and Development	PO4 Engineering Tools, Experimentation, and Testing	PO5 Socio/ Economic /Environmental impact assessment/remedy.	PO6 Project Management and Communication	PO7 Lifelong Learning
CO1	2	NA	NA	NA	NA	NA	NA
CO2	2	2	NA	NA	NA	NA	NA
CO3	2	NA	NA	NA	NA	NA	1
CO4	2	2	NA	NA	NA	NA	NA
CO5	2	NA	NA	NA	NA	NA	NA
CO6	2	NA	NA	NA	NA	NA	1

COURSE CONTENT

Unit 1 – The Constitution – Introduction (06 Periods)

- The History of the Making of the Indian Constitution
- Preamble and the Basic Structure, and its interpretation
- Fundamental Rights and Duties and their interpretation

Unit 2 – Union Government (06 Periods)

- Structure of the Indian Union Government
- President – Election, Role and Power
- Prime Minister and Council of Ministers

Unit 3- Indian Legislature & Judiciary (06 Periods)

- Composition of Lok Sabha and Rajya Sabha
- Powers & Functions of Lok Sabha and Rajya Sabha
- Structure of Supreme Court including Appointment of Judges
- Powers & Functions of Supreme Court

Unit 4 – State Government (03 Periods)

- Governor – Role and Power
- Chief Minister and Council of Ministers
- State Secretariat

Unit 5 – Local Administration (04 Periods)

- District Administration
- Municipal Corporation
- Zila Panchayat

Unit 6 – Election Commission (03 Periods)

- Structure of Election Commission of India
- Role and Function of Election Commission

Suggested Books

1. Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008
2. The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)
3. Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Third 2018 edition
4. Our Constitution Subhash Chand Kashyap NBT New Delhi.

Suggested Software/Learning Websites:

- a. <https://www.constitution.org/cons/india/const.html>
- b. <http://www.legislative.gov.in/constitution-of-india>
- c. <https://www.sci.gov.in/constitution>
- d. <https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/>
- e. <https://ncert.nic.in/textbook.php>

SUGGESTED DISTRIBUTION OF MARKS

SR No	Topic Time Allotted (periods)	Marks Allotted
1	6	20
2	6	20
3	6	20
4	3	12
5	4	16
6	3	12
TOTAL	28	100

6.1 INSTRUMENTATION AND PROCESS CONTROL

L T P
3 0 0

RATIONALE

Automation relies on accurate measurement and control of temperature, pressure, flow, level and density. This subject arms students with the theory and circuitry to design, install and maintain plant-wide control loops.

COURSE OUTCOMES

After undergoing this subject, the student will be able to;

1. Describe signal-flow in a general instrumentation loop
2. Calibrate pressure devices (Bourdon, manometers) and temperature sensors (RTD, thermocouple).
3. Select level sensors (float, ultrasonic, radar) for balance tanks and silos.
4. Design flow meters (Venturi, orifice, rotameter) for CIP and milk transfer.
5. Implement PID control schemes for pasteurizers, evaporators and refrigeration units.

CO–PO Mapping

CO \ PO	PO1 Basics and Discipline specific Knowledge	PO2 Problem's Analysis and solution	PO3 Design and Development	PO4 Engineering Tools, Experimentation, and Testing	PO5 Socio/ Economic /Environmental impact assessment/remedy.	PO6 Project Management and Communication	PO7 Lifelong Learning
CO1	3	NA	NA	NA	NA	NA	NA
CO2	3	NA	NA	2	NA	NA	NA
CO3	3	NA	1	NA	NA	NA	NA
CO4	3	NA	2	NA	NA	NA	NA
CO5	3	1	NA	NA	NA	NA	NA

DETAILED CONTENTS

Unit No.	Content	Period
1	INTRODUCTION TO INSTRUMENTATION SYSTEMS • Definition of process, process variables in dairy (flow, temperature, pressure, level, pH, density, etc.). • Block diagram of a general instrumentation system. • Elements of an instrument – sensor, transducer, transmitter, receiver, controller. PRESSURE MEASUREMENT SYSTEMS • Definition and units: Pa, kPa, Bar, PSI – conversions. • Types of pressure: atmospheric, gauge, absolute, vacuum. • Manometers: U-tube, inclined, ring, well-type – construction & limitations. • Elastic elements: Diaphragm, Capsule, Bellows, Bourdon tube –	12

	working and applications.	
2	TEMPERATURE INSTRUMENTATION • Temperature scales and conversions (°C, °F, K). • Contact thermometers: Mercury in glass, Bimetallic, Pressure Spring. • Electrical thermometers: Thermocouples, RTDs (Pt100), Thermistors. • Infrared thermometers, digital temperature transmitters. • Pyrometers for high temperature zones.	10
3	LEVEL AND FLOW MEASUREMENT • Direct level measurement: Sight glass, float-based devices. • Indirect level measurement: Ultrasonic, capacitive, radar sensors. • Level sensors used in milk silos, pasteurization balance tanks. • Flow measurement: Differential pressure meters, Venturimeter, Orifice plate, Rotameter. DENSITY AND HUMIDITY MEASUREMENT • Density: Definition, relation with pressure and liquid column height. • Measurement methods: Hydrometer, Displacement, Liquid level method. • In-line digital density meters for milk standardization. • Humidity: Absolute vs. relative humidity, dew point. • Measurement tools: Hygrometer, Dew point meter, Digital sensors.	10
4	PROCESS CONTROLS AND AUTOMATION • Components of a control system: sensors, controllers, actuators. • Types of control actions: On-off, Proportional (P), Integral (I), Derivative (D), PID. • PLC-based automation in dairy plants – structure, function, advantages • Pneumatic and electrical control systems.	10

INSTRUCTIONAL STRATEGY

Use interactive lectures and lab sessions to teach signal flow, calibration, and sensor selection. Conduct hands-on exercises for designing flow meters and implementing PID control in dairy processes. Reinforce learning through industry visits, case studies, and simulation-based assessments.

MEANS OF ASSESSMENT

- Theory Quiz
- Assignments

RECOMMENDED BOOKS

1. Fundamentals of Instrumentation and Process control by Dr Rahul kumar , Motion Press
2. A practical Guide for Control and Instrumentation engineers By Ankur Banarji, Book APE
3. Instrumentation and control Systems by K Padma Raju, YJ Reddy/ MC Graw Hill
4. Industrial Instrumentation and control by SK Singh
5. Instrumentation Engineers hand book- process instrumentation by Ashish Gupta

6. Instrumentation and process control by Onkar Nath Pandey/Meri Pustak.com
7. Dairy Plant Engineering And Management : By Tufail Ahmad Publisher- Kitab Mahal

WEBSITES FOR REFERENCE:

1. www.swayam.in
2. www.urise.up.gov.in
3. www.nptel.ac.in
4. <http://ecoursesonline.iasri.res.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	12	28
2	10	20
3	10	26
4	10	26
Total	42	100

6.2 ECONOMIC ANALYSIS AND COST ACCOUNTING

L T P
3 - 0

RATIONALE

This subject deals with basic concepts of economics and financial accounting which are useful for the students for further understanding of demands and supply, marginal utility of demand, GDP, NNP etc. This subject is aimed to developed the basic financial skills and economics concepts in the students so as to enable them to activity contribute in individual, business, government and global financial context.

COURSE OUTCOMES

After undergoing this subject, the student will be able to:

CO No Course Outcome

- CO1 Explain the Basic Concept of economics and financial Accounting
- CO2 Differentiate among the idea of demand & supply, marginal utility, elasticity of demand
- CO3 Describe the market type, market situation and market & Normal Price
- CO4 Determine the price of milk and other milk items based on the concepts of pricing and demand
- CO5 Calculate the selling price of product
- CO6 Calculate unit cost of product
- CO7 Explain the role if accounting in decision making

CO-PO Mapping

CO \ PO	PO1 Basics and Discipline specific Knowledge	PO2 Problem's Analysis and solution	PO3 Design and Development	PO4 Engineering Tools, Experimentation, and Testing	PO5 Socio/ Economic /Environmental impact assessment/remedy.	PO6 Project Management and Communication	PO7 Lifelong Learning
CO1	3	NA	NA	NA	NA	NA	NA
CO2	3	NA	NA	NA	NA	NA	NA
CO3	3	NA	NA	NA	NA	NA	1
CO4	3	NA	NA	NA	NA	1	NA
CO5	3	NA	NA	1	NA	NA	NA
CO6	3	NA	NA	2	NA	NA	NA
CO7	2	NA	NA	NA	NA	NA	NA

DETAILED CONTENTS

Unit No.	Content	Period
1	ECONOMIC FUNDAMENTALS IN DAIRY SECTOR • Basic economic concepts applied to dairy sector: wants, goods, utility, demand & supply in milk & milk product markets. • Law of diminishing marginal utility and equi-marginal utility. • Elasticity of demand and its types.	07
2	PRODUCTION AND COST ANALYSIS IN DAIRY INDUSTRY • Theory of production – factors of production relevant to dairy farms and plants. • Laws of returns, short-run and long-run production, cost-output relationships. • Cost concepts: Fixed, variable, total, marginal, average – with examples from dairy processing.	07
3	MARKET STRUCTURE AND FINANCIAL PLANNING • Types of market- monopoly, oligopoly and monopolistic. • Break-even analysis and its application in product planning. • National income: GDP, GNP, NNP, per capita income – and their relevance in agricultural economics.	07
4	FINANCIAL ACCOUNTING BASICS • Introduction to accounting: Definitions, objectives, basic terms. • Double-entry system, types of accounts. • Recording and classification: cash books, ledgers, purchase/sales returns.	11
5	FINANCIAL ACCOUNTING IN DAIRY BUSINESS • Preparation of trial balance and final accounts with dairy-specific examples. • Banking and digital financial literacy – UPI, online banking, payment reconciliation. • Capital and revenue expenditure, depreciation – dairy equipment and plant assets. • Financial indicators for small dairy entrepreneurs (ROI, Payback Period, etc.)	10

INSTRUCTIONAL STRATEGY : Use interactive lectures and case studies to explain economic principles and cost accounting in the dairy industry. Conduct practical sessions on financial calculations, break-even analysis, and market trends. Reinforce learning through industry visits, simulations, and real-world financial assessments.

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voce

RECOMMENDED BOOKS

1. Taxmann's Cost & Management Accounting, Ravi M Kishore
2. Introduction to Cost Accounting, Nishi Malhotra
3. Horngren's Cost Accounting, Srikant M. Datar, Madhav V. Rajan

WEBSITES FOR REFERENCE:

1. www.swayam.in
2. www.urise.up.gov.in
3. www.nptel.ac.in
4. <http://ecoursesonline.iasri.res.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	07	15
2	07	15
3	07	20
4	11	25
5	10	25
Total	42	100

6.3 ENTREPRENEURSHIP AND START-UP

L T P
2 - 0

COURSE LEARNING OBJECTIVES:

1. Acquiring Entrepreneurial spirit and resourcefulness.
2. Familiarization with various uses of human resource for earning dignified means of living.
3. Understanding the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation.
4. Acquiring entrepreneurial quality, competency, and motivation.
5. Learning the process and skills of creation and management of entrepreneurial venture.

LEARNING OUTCOME:

Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:

CO No Course Outcome

- CO1 Explain the dynamic role of entrepreneurship and small businesses
- CO2 Organizing and Managing a Small Business
- CO3 Financial Planning and Control
- CO4 Forms of Ownership for Small Business
- CO5 Strategic Marketing Planning
- CO6 New Product or Service Development
- CO7 Business Plan Creation

CO-PO Mapping

CO \ PO	PO1 Basics and Discipline specific Knowledge	PO2 Problem's Analysis and solution	PO3 Design and Development	PO4 Engineering Tools, Experimentation, and Testing	PO5 Socio/ Economic /Environmental impact assessment/remedy.	PO6 Project Management and Communication	PO7 Lifelong Learning
CO1	2	NA	NA	NA	NA	NA	NA
CO2	2	NA	NA	NA	NA	2	NA
CO3	3	NA	NA	NA	1	1	NA
CO4	2	NA	NA	NA	NA	NA	1
CO5	3	NA	NA	NA	NA	1	NA
CO6	3	NA	1	NA	NA	NA	NA
CO7	3	NA	NA	NA	NA	NA	NA

COURSE CONTENT:

Unit 1 - Introduction to Entrepreneurship and Start – Ups

- Definitions, Classification of Entrepreneur
- Traits of an Entrepreneur; Intrapreneurship, Motivation
- Types of Business Structures- On the Basis of size and On the basis of ownership
- Similarities/differences between entrepreneurs and managers

Unit 2 – Business Ideas and their implementation

- Discovering ideas and visualizing the business
- Activity map
- Business Plan (Case Study)

Unit 3 – Ideas to Start-up

- Marketing and Accounting- Definition and Importance.
- Market Analysis – STP (Segmentation, Targeting, Positioning)
- Competition evaluation and Strategy Development – Vision, Mission, Goal, Objectives.
- Risk analysis- SWOT Analysis.

Unit 4 – Management

- Definition Concept and Functions of Management
- Company's Organization Structure- Concept and Classification
- Recruitment and Selection- Definition,
- Training and Development- Importance.

Unit 5 - Financing and Protection of Ideas

- Financing methods available for Entrepreneurship/ Startups in India (Government Scheme, Banking, NBFCs, SHG and Micro Financing).
- Intellectual Property Rights- Overview of - Copyrights, Trademark, Geographical Indicators, Patenting and Licenses
- Communication of Ideas to potential investors – Investor Pitch.

Unit 6: Succession, Dissolution and Harvesting strategy

- Ways of succession
- Types of Dissolution

SUGGESTED LEARNING RESOURCES:

S. No.	Title of Book	Author	Publication
1.	The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf	K & S Ranch ISBN – 978-0984999392
2.	Entrepreneurship Development (A new Venture creation)	Vasant Desai	Himalya Publication

3.	Entrepreneurship Development	Khanka S.S.	S Chand & Company Limited New Delhi
4.	Entrepreneurship Development	Gupta and Srinivsan	S Chand & Company Limited New Delhi
5	Demand: Creating What People Love Before They Know They Want It	Adrian J. Slywotzky with Karl Weber	Headline Book Publishing ISBN – 978-0755388974
6	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries	Penguin UK ISBN – 978-0670921607
7	The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business	Clayton M. Christensen	Harvard business ISBN: 978-142219602

SUGGESTED SOFTWARE/LEARNING WEBSITES:

- <https://www.fundable.com/learn/resources/guides/startup>
- <https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate-structure/>
- <https://www.finder.com/small-business-finance-tips>
- <https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/>
- NPTEL Course on Entrepreneurship https://onlinecourses.nptel.ac.in/noc23_mg74/preview
- National Geographic Channel you tube Video on “GI Tag Crafts of Bharat”

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	05	17
2	04	14
3	05	20
4	06	17
5	06	21
6	02	11
Total	28	100

6.4 PROJECT ON DAIRY PLANT LAYOUT AND DESIGN

L	T	P
0	0	24

RATIONALE

Major Project Work aims at developing innovative skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place students for project oriented practical training in actual work situation for the stipulated period.

COURSE OUTCOMES

After undergoing the project work, students will be able to:

Apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place the learner for project oriented practical training in actual work situation for the stipulated period with a view to:

- Develop understanding regarding the size and scale of operations and nature of field-work in which students are going to play their role after completing the courses of study
- Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.
- Develop firsthand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems related to the world of work.
- Develop abilities like interpersonal skills, communication skills, positive attitudes and values etc.

General Guidelines :

The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. The activity of problem identification should begin well in advance (say at the end of second year). Students should be allotted a problem of interest to him/her as a major project work. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The project work identified in collaboration with industry should be preferred.

This practical training cum project work should not be considered as merely conventional industrial training in which students are sent at work places with either minimal or no supervision. This experience is required to be planned in advance and supervised on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant organization for providing such an experience to students. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. The

chosen activities should be such that it matches with the curricular interest to students and of professional value to industrial/ field organizations. Each teacher is expected to supervise and guide 5-6 students.

The projects given to students should be such for which someone is waiting for solution.

Model of the suggested project activities are given below:

To establish a Dairy Plant of capacity 4 lac liter/day. Raw milk available is 5.2% Fat and 8.2% SNF manufacturing the following products-(Take standard specification of products)

Standard Milk, Toned Milk, Double Toned Milk, Skimmed Milk Powder, Ghee, Butter

Any three of the indigenous Products---

Ice Cream/ Casein Powder/ Cheese/ Chhana/ Paneer/ Peda/ Yoghurt/Shree Khand/Any other modern products.

Also calculate the all requirements for Plant i.e. refrigeration, steam, water, electricity, Raw materials and other all requirements for Dairy plant. Balance the Raw milk input Fat & SNF to the total of Fat & SNF of all the products.

Each and every student must be given different capacity Plant establishment with different Products and different production volume of products.

At the end of the project student will submit a written report of his/ their accomplishment and face a viva voce examination individually.

NOTE: Each student has to take one project individually and one to be shared with a group of four-five students depending upon cost and time involved. There is no binding to take up the above projects as it is only a suggestive list of projects.

A suggestive criterion for assessing student performance by the external (person from industry) and internal (teacher) examiner is given in table below:

Sr. No.	Performance Criteria	Max.** Marks	Rating Scale				
			Excel lent	Very Good	Good	Fair	Poor
1.	Selection of project assignment	10%	10	8	6	4	2
2.	Planning and execution of considerations	10%	10	8	6	4	2
3.	Quality of performance	20%	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20%	20	16	12	8	4
5.	Sense of responsibility	10%	10	8	6	4	2
6.	Self expression/ communication skills	5%	5	4	3	2	1
7.	Interpersonal skills/human relations	5%	5	4	3	2	1
8.	Report writing skills	10%	10	8	6	4	2
9	Viva voce	10%	10	8	6	4	2
Total marks		100	100	80	60	40	20

The overall grading of the practical training shall be made as per following table.

In order to qualify for the diploma, students must get "Overall Good grade" failing which the students may be given one more chance to improve and re-evaluate before being disqualified and declared "not eligible to receive diploma ". It is also important to note that the students must get more than six

“goods” or above “good” grade in different performance criteria items in order to get “Overall Good” grade.

	Range of maximum marks	Overall grade
i)	More than 80	<i>Excellent</i>
ii)	79 <> 65	Very good
iii)	64 <> 50	Good
iv)	49 <> 40	Fair
v)	Less than 40	Poor

Important Notes

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.
2. The criteria for evaluation of the students have been worked out for 150 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.
3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.
4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

Project Report may include following topics:

1. Arrangement of different sections in a dairy building.
2. Operational layout.
3. Design of dairy (market milk plant), capacity 10000 liters per day (Small dairy).
4. Design of dairy (milk and milk products), capacity 30,000 liters per day (Medium dairy).
5. Design of dairy capacity 50,000 liters per day with provision for future expansion (Large dairy).
6. Design of dairy (milk and milk products) capacity one lac liters per day (Large dairy).
7. Model planning group project I on layout planning (Market Milk Plant/Milk and Milk product).
8. Model planning group project II on layout planning (Fluid Milk and Milk products)

A project problem on Dairy plant layout and design shall be given to students to be completed by them under the guidance of their H.O.D. Students are required to prepare detailed project report. Viva shall be conducted on this by external examiner deputed by board.

INDUSTRY INTERNSHIP (TRAINING SCHEDULE)

The student during the Industry Internship (One Semester/4-6 months) must undertake training in the following & submit the training report in the format given at annexure - III.

1. Manufacture of Dairy Engineering equipment

Study of raw materials to be used in the manufacture of dairy plant equipment & machinery.

2. Fabrication, Erection & Operation of dairy plant

Study of fabrication, erection and operational aspects of Dairy Engineering equipment's & machinery.

3. Time office, Finance & Accounts

Cash book maintenance, Salary distribution, factory schedule.

4. Store procedures & quality control

Store procedures of raw materials & dairy products.

5. Pollution aspects

Study of plant sanitation, environment & pollution control aspects.

6. Maintenance aspects

Study of maintenance aspects including preventive & breakdown of dairy plant.

RESOURCE REQUIREMENT

PHYSICAL RESOURCES

(A) Space requirement

Norms and standards laid down by All India Council for Technical Education (AICTE) are to be followed to work out space requirement in respect of class rooms, tutorial rooms, drawing halls, laboratories, space required for faculty, student amenities and residential area for staff and students.

(B) Equipment requirement:

Following Laboratories are required for Diploma Programme in Dairy Engineering:

EQUIPMENT REQUIREMENT FOR DAIRY ENGINEERING

Sr. No.	Description	Qty	Total Price (Rs)
COMMUNICATION LABORATORY			
1.	Stools	40	10,000
2.	Display Board/Screen	2	6,000
3.	Sound recording and playing system	1	6,000
4.	Audio cassettes	60	2,000
5.	Overhead Projector	1	5,000
6.	Transparencies slides	100	500
7.	TV, VCR and camera for video recording	1 each	20,000
8.	English spoken course	1	2,000
9.	A Quiz room equipped with two way audio system, back projection system and slide projector	1	30,000
10.	Miscellaneous	LS	1,500
APPLIED PHYSICS LABORATORY			
1.	Vernier calipers Working length 160 mm, Internal and external dia with locking arrangement	12	2,000
2.	Screw Gauges Working length 15 mm, pitch 0.5 mm, least count .005 mm	12	2,000
3.	Spherometers Distance between legs 2.5 mm, pitch 0.5 mm, least count .005 mm.	12	2,000
4.	Mirrors (convex, concave)	5 Each	1,500
5.	Pendulum Setup	02	4,000
6.	Gravesand's Apparatus	02	3,000
7.	Inclined Plane Setup	02	2,000
8.	Flywheel Setup	02	4,000
9.	Prism	05	1,500
10.	Spectrometer	02	25,000
11.	DC Ammeters Moving coil weston-type ammeter with ebonite stand	10	3,500

12.	DC Miliammeters	2	1,000
13.	DC Microammeters	2	700
14.	DC voltmeters	10	700
15.	DC Millivoltmeters	10	2,000
16.	Sensitivity Galvanometer	2	800
17.	Student Galvanometers	10	4,000
18.	Demonstration type DC Ammeters Range; 0 to 1 Amp.	2	1,000
19.	D type DC Voltmeter Range : 0 to 1 Volt	2	1,000
20.	D type Galvanometers Sensitivity : 20 microamperes per scale division,	8	8,000
21.	Resistance boxes (dial type) assorted	8	8,000
22.	Rheostats	10	4,000
23.	Miscellaneous items (Spring, Pan, Glycerine, Optic fibre, Ferromagnetic material)	LS	2,000
24.	Fortin's Barometer (Wall type)	2	20,000
25.	Stoke's Apparatus	2	10,000
26.	Gumther's Apparatus	2	16,000
27.	Resonance Tube Apparatus with accessories and Tuning fork set	2	14,000
28.	Sodium Lamp setup with Biprism	2	10,000
29.	Ohmic resistance coil	10	5,00
30.	Slide wire bridge	2	8,000
31.	PN Junction diode Apparatus	2	10,000
32.	Laser (as per requirement)	1	1,00,000
33.	Numerical aperture setup	1	25,000
34.	Miscellaneous	LS	3,000
APPLIED CHEMISTRY LABORATORY			
1.	Digital Balance	1	80,000
2.	Burette 50ml	30	3,000
3.	Pipette 25ml	60	4,000
4.	Beakers 100ml	60	4,000
5.	Burette stand	30	30,000
6.	Glazed tile	30	1,000
7.	Conical flask 50ml (Titration flask)	60	4,000
8.	Standard (Measuring) flask (to prepare standard solution) 250ml/100ml	30	6,000
9.	Able's Flash Point apparatus	2	10,000
10.	(1/10)°C thermometer	06	6,000
11.	Candles	20	100
12.	Crucible with lid	06	2,000
13.	Muffle furnace	1	18,000
14.	Decicators	06	8,000
15.	Pair of tongue (small and big)	24 (small) 2 (big)	2,000

16.	Chemicals - EDTA-1 kg - Eriochrome Black-T(solochrome black T)-200g - Buffer solution (NH ₃ - 2.5 ltr, NH ₄ Cl – 1 kg) - Zinc sulphate- 500g - H ₂ SO ₄ - 2.5 ltr - Phenolphthalein indicator (as per requirement) - Methyl orange indicator (as per requirement) - Charcoal (as per requirement) - Kerosene- 1 ltr	LS	20,000
17.	Miscellaneous	LS	2,000
ENGINEERING DRAWING			
1.	Drawing Boards (700 x 500mm)	60	25,000
2.	Draughtsman Tables	60	1,80,000
3.	Draughtsman Stools	60	40,000
4.	Computer Aided Drawing (CAD) Software	30 User	5,00,000
5.	Model of different wooder joints	1	1,000
6.	Model of different screw threads	1	1,000
7.	Model of various locking devices	1	1,000
8.	Model of various joints	1	1,000
9.	Cut section Model of various couplings	1	3,000
10.	Miscellaneous	LS	5,000
BASICS OF IT LABORATORY/COMPUTER LABORATORY			
1.	Computer System with latest configuration	30	8,00,000
2.	Printer (MFP)	1	25,000
3.	Printer (Laser)	1	35,000
4.	Plotter	1	75,000
5.	Digitiser	1	50,000
6.	Antivirus Software	LS	10,000
7.	Internet Facility on Computers	LS	2,00,000
8.	AutoCAD/Solid Works/Unigraphics/Pro-C (any one software)	30 user	5,00,000
9.	LCD Projector	1	35,000
10.	UPS	60	1,20,000
11.	Software (latest windows, latest MS Office)	1	1,00,000
12.	Scanner	1	10,000
13.	Miscellaneous	LS	5,000
CARPENTRY SHOP			
1	Work benches fitted with carpenter vices	5	20,000
2.	Circular saw grinder	1	6,000
3.	Wood cutting band saw-vertical	1	10,000

4.	Bench grinder	1	5,000
5.	Drilling machine	1	8,000
6.	Wood turning lathe	1	40,000
7.	Wood Planner	1	20,000
8.	Tool accessories measuring and marking Instruments	25	25,000
9.	Band saw blade brazing unit	1	10,000
10.	Miscellaneous	LS	1,500
PAINTING AND POLISHING SHOP			
1.	Spray gun with hose pipe	1	1,000
2.	Paint brushes	20	2,000
3.	Paint/Varnish	LS	2,000
4.	Air Compressor with 2 hp motor	1 set	10,000
5.	Miscellaneous	LS	2,000
ELECTRICAL SHOP			
1.	Tool kit (Plier, Screw driver, Knife, Steel rule, hammer, sciber, pincer steel tape etc.)	20	20,000
2.	Fuses, Switches, Plugs, Sockets, Ceiling rose, Wires, cleats, Clamps, Test lamp, Tester.(as per requirement)		8,000
3.	Electric Iron	1	1,500
4.	Electric kettle	1	1,500
5.	Ceiling fan/table fan	1	2,500
6.	Desert cooler	1	5,000
7.	Lead acid battery	2	8,000
8.	Battery Charger	1	6,000
9.	Miscellaneous		3,000
Sr. No.	Description	Qty	Total Price (Rs)
SMITHY SHOP			
1.	Black smithy forge (with open hearths, accessories to match the forge)	20	40,000
2.	Wrought iron anvils	20	20,000
3.	Swage blocks	4	8,000
4.	Blower with accessories, motor switch etc	1	6,000
5.	Work benches with vices	2	6,000
6.	Power hammer	1	20,000
7.	Tools and accessories – hammers, swages, tongs, pokers, pullers etc	20	10,000
8.	Miscellaneous	LS	1,500
FITTING AND PLUMBING SHOP			
1.	Work benches with vices (4 vices on each bench)	5	30,000
2.	Marking tables with scribes	4	24,000
3.	Surface plates	5	20,000

4.	Accessories like calipers, V blocks, height, gauges steel rules and scribes	25	50,000
5.	Tool kits – taps, dies, drills	25	40,000
6.	Tool kits – chisels, hammers, files, hacksaw	25	25,000
7.	Drilling machine	2	12,000
8.	Pipe vice	4	1,000
9.	Chain wrenches	5	1,250
10.	Ring spanner set	5	600
11.	Pipe die set 2"	2 set	1,000
12.	Pipe bending device	1	5,000
13.	Various plumbing fittings	LS	2,000
14.	Miscellaneous	LS	1,500
SHEET METAL			
1.	Hammers	8	3,000
2.	Mallets (Hard & Soft)	5	2,000
3.	Sheet and wire Ganges	LS	8,00
4.	Shearing Machine	1	20,000
5.	Bar folding Machine	1	20,000
6.	Burring machine	1	10,000
7.	Various sheet (black plain, galvanized iron, corrugated, Aluminium)	1 Each	1,000
8.	Hand Shears/Snippers	4	2,000
9.	Nuts, Bolts, Rivets, Screw	LS	5,00
10.	Miscellaneous	LS	1,000
WELDING SHOP			
1.	Electrical welding transformer set with accessories	3	30,000
2.	Gas Cutting Unit	1	3,000
3.	Work benches with vices	3	5,000
4.	Welding generator set	1	10,000
5.	Oxy acetylene welding set with accessories	1	7,000
6.	Acetylene generating set	1	6,000
7.	Electric welder tool kit	10	10,000
8.	Projection welding machine	1	15,000
9.	Brazing equipment with accessories	1	10,000
10.	Soldering irons	3	1,000
11.	Pedestal grinder	1	10,000
12.	Metal spraying gun	1	10,000
13.	Spot welder	1	25,000
14.	TIG welding set	1	1,00,000
15.	MIG welding set	1	1,00,000
16.	Welding Partition Screen	5	2,500
17.	Miscellaneous	LS	3,000

FOUNDRY SHOP			
1.	Moulding boxes	40	8,000
2.	Ladles	5	2,000
3.	Tool Kits	10 set	5,000
4.	Quenching tanks	2	5,000
5.	Portable grinder	1	3,000
6.	Pit furnace with blower	1	10,000
7.	Miscellaneous	LS	1,000
MACHINE SHOP			
1.	Centre lathes	10	6,00,000
2.	Grinder	1	10,000
3.	Universal milling machine	1	1,25,000
4.	Shaper	2	1,20,000
5.	Plainer	2	1,20,000
6.	Work bench	3	10,000
7.	Precision instruments	1	10,000
8.	Hand tools and accessories	2	8,000
9.	CNC trainer lathe	1	4,00,000
10.	Miscellaneous	LS	5,000
APPLIED MECHANICS & MACHINE COMPONENT LABORATORY			
1.	Polygon of Forces Apparatus	4	60,000
2.	Universal Force Table	2	5,000
3.	Principle of Moment Apparatus Bell Crank lever	4	6,000
4.	Combined Inclined plane & Friction apparatus	4	6,000
5.	Simple wheel and axle	2	5,000
6.	Differential wheel and axle	2	7,000
7.	Double sleeve Pulley Block	1	8,00
8.	Centre lathe	8	8,00,000
9.	Allgerared head Lathe	2	4,00,000
10.	C.N.C. Trainer Lathe Center height 100 mm, swing over carriage 60mm, distance between center 200 mm, Max. machining diameter-50 mm, Max. lengitndial travem-300 mm, Spindle speed 40-2000 RPM, Automatic lubrication paints provided.	2	1,20,0000
12.	Planing Machine	1	1,00,000
13.	Shaping Machine	3	2,40,000
14.	Slotting Machine	1	50,000
15.	Universal Milling Machine 3 Axis, Travel X-300mm, Y-250 mm Z-125 capable of milling acrylic, Al., Wood, etc. Compatible with FM5/DNC	1	4,00,000
16.	Universal Tool Cutter and Grinder	1	2,50,000
17.	Two Wheel bench Grinder (Wheel size 150x16x12 mm) (Wheel standard Accessories single pahse motor .25 HP high speed)	1	10,000

18	Bench Drilling Machine 13 mm capacity, 5 HP, AC 230 Volt Single Phase 1400 rpm motor with starter switch 30 mm capacity drill chuck V belt 100 mm machine vice	1	20,000
19	Power Hacksaw motorized with coolant pump, vice, length gauge, machine drive belt guard, 1 H.P. A.C. 440/3/50/1440 rpm electric motor with starter. Capacity to cut 175 mm. round and 150x150 mm. square rod, Blade size 350x25 mm.	1	20,000
20	Marking off Table Black granite Surface, flat nonmagnetic, non glaring, Planning Accuracy as per I.S. size 1000mm x 630mm x 150mm of grade B with slab carbide scriber.	1	10,000
21	Surface Plates size 450 x 450 mm cast iron surface plate planed and hand swapped and seasoned, Brown & sharp type ribbing, complete with lifting handles & wooden surface cover. Conforming to I.S. 2285-1963	1	10,000
22	Surface Plates size 450 x 600 mm cast iron surface plate planed and hand swapped and seasoned, Brown & sharp type ribbing, complete with lifting handles & wooden surface cover. Conforming to I.S. 2285-1963	1	10,000
23	Cylindrical grinding machine (Plain)	1	1,50,000
24	Surface grinder table size 12"x8". (Planer type)	1	20,000
25	Turret/Capstan lathe	1	3,00,000
26	Tools & Instruments-Cutters drill set, taps, dies, drill chucks, milling machine cutters taper, reamers, micrometers verniers, gear tooth verniers, dial gauges, calipers, steel rules and Hand Tools Such as hammers, chisels etc.	LS	40,000

HYDRAULICS & PNEUMATIC LABORATORY			
1.	Piezometer tube	2	100
2.	U tube differential manometer	2	2,000
3.	Bourdon's Tube pressure gauge	1	1,000
5.	Hydraulic jack	1	4,000
6.	Hydraulic press Working Model	1	5,000
7.	Bernoulli's apparatus	1	15,000
8.	Venturi meter apparatus with differential manometer	1	10,000
9.	Pipe friction apparatus	1	15,000
10.	Reciprocating pump- Cut Section Model	1	20,000
11.	Centrifugal pump	1	25,000
12.	Working Model of Pelton Wheel Turbine	1	20,000
13.	Working Model of Francis Turbine	1	20,000
14.	Working Model of Kaplan Turbine	1	20,000
15.	Hydraulic Circuit Trainer Kit	1	50,000
16.	Pneumatic Circuit Trainer Kit	1	50,000

17.	Working Model of Hydraulic Brake system	1	50,000
18.	Working Model of Hydraulic Ram	1	5,000
THERMAL ENGINEERING LABORATORY			
1.	Throttling Calorimeter	2	10,000
2.	Testing for Determination of Dryness fraction of steam	1	50,000
3.	Cut section model of 4-stroke single cylinder Petrol and Diesel engine	1	30,000
4.	Gravimetric Analysis	1 each	20,000 each
5.	Model of Various Boiler Mounting and Accessories -Steam Stop Valve, Safety Valves, Blow off Cock, Water Level Indicator, Low Water High Pressure Safety Valve, Pressure Gauge, Economiser, Pre Heater (Air), Super Heater Model only.	1 each	10,000
6.	Exhaust Analyser for Petrol and Diesel engine	1 each	25,000 each
7.	Single Stage Reciprocating Air Compressor	1	50,000
8.	Rotary Compressor, Air Compressor	1	25,000
9.	Flash Point Apparatus	1	10,000
10.	Pyrometer, Infrared, Thermocouple	2	5,000 each
11.	Lancashire boiler model	1	10,000
12.	Model of impulse turbine	1	5,000
13.	Model of reaction turbine	1	5,000
14.	Model of surface condenser	1	5,000
15.	Bab Cox & Wilcox Boiler Model	1	10,000
16.	Single cylinder 2 stroke petrol engine test rig	1	45,000
17.	Single cylinder 4 stroke petrol engine test rig	1	50,000
18.	Multicylinder petrol engine test rig (Morse test rig)	1	2,00,000

DAIRY CHEMISTRY & DAIRY MICROBIOLOGY LABORATORY			
A- DAIRY CHEMISTRY			
1.	Westphal balance	2	16,000
2.	Lactometers	15	3,000
3.	Lactometer Jars.	15	4,500
4.	Burette (50 ml)	15	2,250
5.	Pipettes (10 ml)	3 x 12	1,800
6.	Pipettes (11 ml)	3 x 12	1,800
7.	Pipettes (1 ml)	3 x 12	1,800
8.	Gerber centrifuge for 12 tests electric and manually operated	1	7,500
9.	Cream Butyrometer	10	45,000
10.	Butter Butyrometer	10	40,000
11.	Cheese Butyrometer	10	55,000
12.	Skim milk Butyrometer	20	10,000
13.	Lock stoppers	3 Gross	9,00
14.	Lock stopper keys	15	3,00

15.	All glass apparatus (micro type)	2	5,000
16.	Kjeldel flasks (150 ml)	50	20,000
17.	Kjeldel flasks (300 ml)	50	30,000
18.	Digestion heater unit for protein estimation(6 sets)	2	30,000
19.	Phosphatase Kit for Measuring the efficiency for pasteurization	1	25,000
20.	Impaired moisture balance	1	22,000
21.	Hot air oven thermostatically controlled temp rang 60-120 °C	1	24,000
22.	Moisture dishes with lids aluminum 70 mm diam 70 ml. capacity	30	1,500
23.	Thermostatic Cryoscope for freezing point of milk	1	30,000
24.	Other glass wares	LS	10,000
25.	Automatic Milk Analyser	2	80,000
26.	Milk Adulteration Kit Del Strips	4	20,000
27.	Miscellaneous	LS	25,000

B-DAIRY MICROBIOLOGY LABORATORY

1.	Serological Water bath	1	12,000
2.	Colony Counter	1	7,000
3.	Ph-meter for Lab	1	8,000
4.	SSAutoclave	1	20,000
5.	Microscope, Compound type	10	2,50,000
6.	Dilution bottles glass	100	1,000
7.	Petri dishes	5 x 12	1,800
8.	Copper case for petri dishes	2	8,000
9.	Copper case for pipettes (Microbiological)	1	8,000
10.	Incubator (165 Litres capacity)	1	30,000
11.	Laminar Air Flow Cabinet	1	60,000
12.	Glass Mercury Thermometer (300mm long)	10	1200
13.	Digital Thermometer	3	1500
14.	Micropipette	10	7000
15.	Refrigerator thermostatic	2	30,000
16.	Beakers, test tubes, measuring flasks cylinder etc	LS	10,000
17.	Miscellaneous	LS	20,000

DAIRY ENGINEERING & DAIRY TECHNOLOGY LABORATORY

1.	Cream separator (Capacity 100 lts. per hour, hand operated)	1	30,000
2.	Cream separator (capacity 100 lts per hour electrically operated)	1	40,000
3.	Plate Heat Exchanger (Capacity 100 lts. per hour)	1	90,000
4.	Pasteurizer with temperature controller recorder with FDV and other control units - capacity 200 lph	1	3,00,000
5.	Straight through Can Washer- capacity 3 cans per minutes.	1	4,00,000
6.	Rotary can washer 3 cans per minutes	1	3,00,000
7.	Butter Churner (Roller type) 20 Kg. butter per batch for Lab	1	80,000
8.	Stainless steel centrifugal pump (capacity 50 lts, per	2	40,000

	hour).		
9.	Sanitary stainless steel rotary pump (capacity 100 lts. per hour)	1	50,000
10.	Jacketed Rectangular cheese vat (capacity 50 lts.)	1	1,00,000
11.	Jacketed storage tank (vertical) with agitator (capacity 50 lts.)	1	1,00,000
12.	Refrigerated Bulk Milk cooler with all accessories (Capacity 50 lts.)	1	1,50,000
13.	Jacketed ghee pan without agitator vertical capacity 50 litre	1	75,000
14.	Pipe expander 1" and 1-1/2" size	2 Set	5,000
15.	Stainless steel pipes 1/2" to 1-1/2" sizes, fillings (union, nut, coupling yoke type clamp type) valves 1/2", 1" (two way & three way type).	1 Set	20,000
16.	Homogeniser 50 lts/hour capacity	1	2,50,000
17.	Spray dryer with all accessories capacity 100 Kg/day	1	10,00,000
18.	Ice-cream freezer - Batch type capacity 25 Kg./hr	1	1,00,000
19.	Ice-cream freezer -Continuous type capacity 50 Kg./hour	1	2,50,000
20.	Casein making equipment 50 Kg./batch cap	1	1,00,000
	<u>NOTE:</u> Since equipments listed at Sl. 4,5,6,12,16,17,19,20 are costly, hence efforts may be made that students should study these items in some Dairy Plant during In Plant Training-I and II. i.e. After 4th and 5th Semester respectively. <u>SPECIAL RECOMMENDATION:(Optional)</u> All the above equipments are costly and there is no meaning of separate units for practical purposes. So, it is strongly recommended that--- In place of the items 3,4,5,6,12,13,16,17,18,19,20, a small capacity actual working Milk Plant (Pilot Plant) of minimum capacity 100 litre per day to 500 litre per day should be installed in the institute. Plant will be included with manufacturing equipment of market milk (with packaging unit), Butter, Ghee, Cheese, Casein, Dried milk, etc with its all operative accessories. This plant will be more effective for the student Training at institute level, So highly recommended by committee.	One unit	Rs 30.00 Lakh
21.	Miscellaneous	LS	40,000

Sr.	Description	Qty	Total Price
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No.			(Rs)
REFRIGERATION LAB-I LABORATORY			
1.	Sealed unit refrigeration service kits containing all sort of tools	5	4,000
2.	Refrigeration unit open type service kits containing all sorts of tools	10	6,000
3.	Gage manifold (various sizes)	3	6,00
4.	Pressure gages (low & high)	3	2,000
5.	Vacuum pump/4 H.P. with motor trolley type	2	6,000
6.	Gas charging clamp	1	3,000
7.	Gas cylinders Freon 12, 5Kg capacity	2	2,00
8.	Gas cylinders Freon 22, 5Kg capacity	1	2,00
9.	Gas cylinders for Ammonia 5 Kg.	2	8,00
10.	General tech. tools viz. Bench Vices spanners (open ring, box) Allenkey pliers, adjustable and pipe wrenches etc.	10 Set	10,000
11.	Charging Noses	30 Set	3,600
12.	Moisture indicators for Freons	10	1,000
13.	Liquid indicators for Freons.	10 Set	1,000
14.	Moisture indicators for Ammonia	2	1,50
15.	Copper tubing (Annealed) 1/4 dia	100 M	2,500
16.	Copper tubing (Annealed) 3/8 dia	50 M	1,500
17.	Copper tubing (Annealed) 1/2 dia	50 M	2,000
18.	Copper tubing (Harddrawn) 1" dia	50 M	3,000
19.	Ammonia Black Iron pipe tubing 1/2" dia	50 M	4,00
20.	Ammonia Black Iron pipe tubing 1" dia	50 M	6,00
21.	Ammonia Black Iron pipe tubing 1-1/2" dia	50 M	8,00
22.	Tube fitting copper & brass different sizes & types	-	4,000
23.	Tube fitting ammonia iron different sizes & types	-	2,000
24.	Line shut off valves (Freon) different sizes	50	2,000
25.	Line shut off valves (Ammonia) 1/4	20	1,000
26.	Gauge Freon-12	50 KG	1,500
27.	Gauge Ammonia	50 KG	1,000
28.	Leak detector halide.	10	1,000
29.	Leak detector electronics	2	4,000
30.	Capacitors different capacities	10	5,00
31.	Insulation Glass Wool	20 KG	2,00
32.	Insulation Thermocol Sheets	50 Sheet	5,00
33.	Insulation Plaster of Paris	20 KG	2,00
34.	Insulation Slag wool	40 KG	2,00
35.	Electronic Motor I.H.P.A.C.	1	1,600
36.	Starting relays- Voltage type	4	2,00
37.	Starting relays- Current type	4	2,00
38.	Starting relays- Box type	5	3,00
39.	Overload relays.	10	4,00
REFRIGERATION LAB-II- Air Conditions LABORATORY			
1.	Air conditioner 1 ton without reversibly single phase	1	2,000
2.	Expansion valves- Low side float valve 5	1	3,00

	TY(Ammonia)		
3.	Expansion valves- High side float valve 5TY(Ammonia)	1	3,00
4.	Expansion valves- Ammonia Expansion valve 5 TY	2	2,000
5.	Thermostaic Switches- For air conditioner ITY	2	3,00
6.	Thermostaic Switches- For ammonia systems 5 TR	1	5,00
7.	Pressure stats for air conditioner(ITR)	1	3,00
8.	Pressure state for ammonia plant (5TR)	1	5,00
9.	Solenoid valves different capacities For freon system	3	1,600
10.	Solenoid valves different capacities For ammonia systems	1	5,00
11.	Stop watches	2	4,00
12.	Siling psychormeters	15	7,50
13.	Aspiration psychrometers	1	2,500
14.	Bellos types psychrometers	1	5,00
16.	Dry and Wet bulb wall hygrometer	2	2,00
17.	Fortins Barometer	1	1,000
18.	Hair Hygrometer	2	5,00
19.	Humidistats	2	2,000
20.	Kata thermometer	6	1,500
21.	Dial type hygrometer	6	9,00
22.	Pannel Board showing temp pressure at different stages	6	10,000
23.	Device for measuring flow of refrigerant	6	9,00
24.	Pannel Board for making electric connections	2	2,000
25.	Evaporator Cooler- Pannel Board for determining its performance	2	1,000
26.	Pocket type thermometers	6	3,00
27.	Voltage stabilizer (Automatic) 3 Phase	6	1,500
28.	Exhaust fans	6	1,000
29.	Electric oven fitted with temperature control experimental types	1	5,000
30.	Electric Heaters	5	2,50
31.	Work Benches	10	3,000

ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY			
1.	Wattmeter	5	10,000
2.	Ammeter	5	10,000
3.	Voltmeter	5	7,500
4.	DC shunt motor	1	5,000
5.	Single phase variac	1	2,500
6.	Single phase transformer	1	5,000
7.	Resistive load	1	4,000
8.	Multimeter	1	4,000
9.	CRO	1	15,000
10.	Regulated supply	1	8,000
11.	Signal generator	1	5,000
12.	3-phase inductor motor	1	5,000

13.	3-phase variac	1	8,000
14.	DC shunt generator coupled with motor and starter	1	25,000
15.	Rheostat	2	2,500
16.	Tachometer	1	5,000

NOTE:

1. The specifications and price of equipment mentioned above used as broad guidelines for purchase of equipment.
2. Any other items not mentioned in the list of equipment can be purchased as provision has been made for purchase under the item miscellaneous for each lab/shop.
3. Any additional equipment, already available in the institute, may be used for demonstration to the students.

NOTE:

In addition to the above, laboratories in respect of physics, chemistry, Computer Centre etc will be required for effective implementation of the course. Provision for photocopiers, PC facilities along with LCD Projection System etc. has also to be made.

(C) Furniture Requirement

Norms and standards laid down by AICTE be followed for working out furniture requirement for this course.

10.2 Human Resources Development:

Weekly work schedule, annual work schedule, student teacher ratio for various group and class size, staffing pattern, work load norms, qualifications, experience and job description of teaching staff workshop staff and other administrative and supporting staff be worked out as per norms and standards laid down by the AICTE.

EVALUATION STRATEGY

INTRODUCTION

Evaluation plays an important role in the teaching-learning process. The major objective of any teaching-learning endeavor is to ensure the quality of the product which can be accessed through learner's evaluation.

The purpose of student evaluation is to determine the extent to which the general and the specific objectives of curriculum have been achieved. Student evaluation is also important from the point of view of ascertaining the quality of instructional processes and to get feedback for curriculum improvement. It helps the teachers in determining the level of appropriateness of teaching experiences provided to learners to meet their individual and professional needs. Evaluation also helps in diagnosing learning difficulties of the students. Evaluation is of two types: Formative and Summative (Internal and External Evaluation)

Formative Evaluation

It is an on-going evaluation process. Its purpose is to provide continuous and comprehensive feedback to students and teachers concerning teaching-learning process. It provides corrective steps to be taken to account for curricular as well as co-curricular aspects.

Summative Evaluation

It is carried out at the end of a unit of instruction like topic, subject, semester or year. The main purpose of summative evaluation is to measure achievement for assigning course grades, certification of students and ascertaining accountability of instructional process. The student evaluation has to be done in a comprehensive and systematic manner since any mistake or lacuna is likely to affect the future of students.

In the present educational scenario in India, where summative evaluation plays an important role in educational process, there is a need to improve the standard of summative evaluation with a view to bring validity and reliability in the end-term examination system for achieving objectivity and efficiency in evaluation.

STUDENTS' EVALUATION AREAS

The student evaluation is carried out for the following areas:

Theory

Practical Work (Laboratory, Workshop, Field Exercises) Project Work

Professional Industrial Training

A. Theory

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems. The formative evaluation for theory subjects may be caused through sessional /class-tests, home-assignments, tutorial-work, seminars, and group discussions etc. For end-term evaluation of theory, the question paper may comprise of three sections.

Section-I

It should contain objective type items e.g. multiple choice, matching and completion type. Total weightage to Section- 1 should be of the order of 20 percent of the total marks and no choice should be given in this section. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.

Section-II

It should contain short answer/completion items. The weightage to this section should be of the order of 40 percent of the total marks. Again, no choice should be given in section-II

Section-III

It may contain two to three essay type questions. Total weightage to this section should be of the order of 40 percent of the total marks. Some built-in, internal choice of about 50 percent of the questions set, can be given in this section

Table II : Suggested Weightage to be given to different ability levels

Abilities	Weightage to be assigned
Knowledge	10-30 percent
Comprehension	40-60 percent
Application	20-30 percent

Higher than application i.e. Analysis, Synthesis and Evaluation	Upto 10 percent
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B. Practical Work

Evaluation of students performance in practical work (Laboratory experiments, Workshop practicals/field exercises) aims at assessing students ability to apply or practice learnt concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work related attitudes. Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behaviour and it should be followed by viva-voce.

C. Project Work

The purpose of evaluation of project work is to assess students ability to apply, in an integrated manner, learnt knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The formative and summative evaluation may comprise of weightage to nature of project, quality of product, quality of report and quality of presentation followed by viva-voce.

D. Professional Industrial Training

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of materials, industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. The formative and summative evaluation may comprise of weightages to performance in testing, general behaviour, quality of report and presentation during viva-voce.

ASPECTS OF QUESTION PAPER SETTING

Validity and reliability are the most important considerations in the selection and construction of evaluation procedures. First and foremost are the evaluation tools to measure the specific outcomes for which they are intended to measure. Next in importance is reliability, and following that is a host of practical features that can be classified under the heading of usability.

For weightage of marks assigned to formative (internal) and summative (external) evaluation and duration of evaluation has been given in the study and evaluation scheme of the curriculum document. Teachers/Paper-setters/Examiners may use Manual for Students' Evaluation developed by IRDT U.P. Kanpur to bring objectivity in the evaluation system. The working group found it very difficult to detail out precisely the contents of subject on languages and therefore teachers may send guidelines to respective examiners for paper setting to maintain objectivity in evaluation.

10. RECOMMENDATIONS FOR EFFECTIVE CURRICULUM IMPLEMENTATION

This curriculum document is a Plan of Action (POA) and has been prepared based on exhaustive exercise of curriculum planning and design. The representative sample comprising selected senior personnel (lecturers and HODs) from various institutions and experts from industry/field have been involved in curriculum design process.

The document so prepared is now ready for its implementation. It is the faculty of polytechnics who have to play a vital role in planning instructional experiences for the courses in four different environments viz. class-room, laboratory, library and field and execute them in right perspective. It is emphasized that a proper mix of different teaching methods in all these places of instruction only can bring the changes in stipulated students behaviour as in the curriculum document. It is important for the teachers to understand curriculum document holistically and further be aware of intricacies of teaching-learning process (T-L) for achieving curriculum objectives. Given below are certain suggestions which may help the teachers in planning and designing learning experiences effectively. These are indicative in nature and teachers using their creativity can further develop/refine them. The designers of the programme suggest every course teacher to read them carefully, comprehend and start using them.

(A) Broad Suggestions:

1. Curriculum implementation takes place at programme, course and class-room level respectively and synchronization among them is required for its success. The first step towards achieving synchronization is to read curriculum document holistically and understand its rationale and philosophy.
2. State Board of Technical Education (BTE) may make the academic plan available to all polytechnics well in advance. The Principals have a great role to play in its dissemination and percolation upto grass-root level. Polytechnics in turn are supposed to prepare institutional academic plan by referring state level BTE plan.
3. HOD of every Programme Department along with HODs and in charges of other departments viz. English, Maths, Physics, Chemistry etc. are required to prepare academic plan at department level referring institutional academic plan.
4. All lecturers/Senior lecturers are required to prepare course level and class level lesson plans referring departmental academic plan.

(B) Course Level Suggestions

Teachers are educational managers at class room level and their success in achieving course level objectives lies in using course plan and their judicious execution which is very important for the success of programme by achieving its objectives.

Polytechnic teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/workshop practicals, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practicals and field experiences. Teachers are also required to do all these activities within a stipulated period of 16 weeks which is made available to them in the academic plan at BTE level.

With the amount of time to their credit, it is essential for them to use it judiciously by planning all above activities properly and ensure execution of the plan effectively.

Following is the gist of suggestions for subject teachers to carry out T-L process effectively:

1. Teachers are required to prepare a course plan, taking into account departmental academic plan, number of weeks available, course to be taught, different learning experiences required to be developed etc.
2. Teachers are required to prepare lesson plan for every theory class. This plan may comprise of content to be covered, learning material (transparencies, VCDs, Models etc.) for execution of a lesson plan. They may follow steps for preparing lesson plan e.g. drawing attention, state instructional objectives, help in recalling pre-requisite knowledge, deliver planned subject content, check desired learning outcome and reinforce learning etc.
3. Teachers are required to plan for expert lectures from field/industry. Necessary steps are to plan in advance, identify field experts, make correspondence to invite them, take necessary budgetary approval etc.
4. Teachers are required to plan for guided library exercises by identification of course specific experience requirement, setting time, assessment, etc. The tutorial, assignment and seminar can be thought of as terminal outcome of library experiences.
5. Concept and content-based field visits with appropriate releases (day-block) may be planned and executed for such content of course which otherwise is abstract in nature and no other requisite resources are readily available in institute to impart them effectively.
6. There is a dire need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem-based learning/activity learning/ experiential learning approach effectively. The development of lab instruction sheets for the course is a good beginning to provide lab experiences effectively.
7. Planning of progressive assessment encompasses periodical assessment in semester, preparation of proper quality question paper, assessment of answer sheets immediately and giving constructive explicit feedback to every student. It has to be planned properly; otherwise very purpose of the same is lost.
8. The co-curricular activities like camp, social gathering, study tour, hobby club etc. may be used to develop generic skills like task management, problem solving, managing self, collaborating with others etc.
9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time.
10. While imparting instructions, emphasis may be laid on the development of cognitive, psychomotor, reactive and interactive skills in the students.
11. Teachers may take working drawings from the industry/field and provide practices in reading these drawings.
12. Considerable emphasis should be laid in discipline specific contracting and repair and maintenance of machines, tools and installations.
13. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.
14. Case studies and assignments may be given to students for understanding of Enterprise Resource Management (ERM).

15. Students be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.
16. Students may be given relevant and well thought out minor and major project assignments, which are purposeful and develop practical skills. This will help students in developing creativity and confidence for their gainful employment (wage and self).
17. A Project bank may be developed by the concerned department of the polytechnics in consultation with related Industry, Research Institutes and other relevant field organizations in the state.

List of Participants:

The following experts have participated in the workshop for Developing the Curricula Structure and Contents of Three-year Diploma Programme in Dairy Engineering for UP State, workshop held on 8th, 21st and 22nd April 2025 at Institute of Research Development & Training U.P. Kanpur:

1. Shri Chandrabhan, Senior Lecturer Dairy Engineering, JLN Polytechnic, Mahmudabad, Sitapur.
2. Shri Gaurav Kumar Gaur, Lecturer-Dairy Engineering, Government Polytechnic Kotana Baghpat.
3. Shri Jitendra Kumar, Lecturer, Dairy Engineering, Government Polytechnic Etawah.
4. Shri Devender Singh, Lecturer, Dairy Engineering, Government Polytechnic Kotana Baghpat.
5. Shri Gaurav Kishor Kanaujiya, Assistant Professor/Coordinator, IRDT Kanpur

We extend our sincere gratitude to the management and employees of Banas Dairy (Amul), Mati, Kanpur Dehat, for their warm cooperation and support during the plant visit:

- Anjal Katiyar, Executive GCMMF, Kanpur Dehat
- Jitendra sharma, Banas Dairy,(Amul) Mati Kanpur Dehat
- Amarjeet Sharma, Banas Dairy,(Amul) Mati Kanpur Dehat
- Bhuvnesh Khandait, Banas Dairy,(Amul) Mati Kanpur Dehat

Annexure: 1

Proposed Courses by TATA Technology (Advance Skill Certification)

S. No.	Course Name
1	Fundamentals of Innovation and Design Thinking
2	Product Design and Development
3	Product Verification and Analysis
4	Advanced Automobile
5	Electric Vehicle
6	Internet of Things
7	Advanced Manufacturing
8	Advanced Welding & Painting using Simulator
9	Industrial Automation and MES
10	Industrial Robotics
11	Inspection and Quality Control
12	Advanced Plumbing
13	AI and ML