NEP-2020 Aligned Curriculum for

Three Year (Six Semester) Diploma Programme in

DAIRY ENGINEERING

For the State of Uttar Pradesh
(Effective from Session 2025-26)
Third and Fourth Semester

Prepared by:
Curriculum Development Centre
Institute of Research Development & Training
U. P. Kanpur

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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 learning 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

Director
Institute of Research Development &Training.
Kanpur

ACKNOWLEDGEMENTS

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5. Faculty/Subject Experts from U.P. Government polytechnics

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

Coordinator
Institute of Research Development & Training,
Kanpur, U.P.

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 Pradesik 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 (Go-**	Private	South and Central India

	drej)		
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 Pra-desh	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
THIRD SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/ Week			Credit	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External	Course/ Exam Type
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
3.1	Introduction To Dairy Engineering and Technology	1	-	4	3	-	60	60	-	-	40	3	40	100	Practicum/ Practical
3.2	Steam Engineering and Heat Engines	2	-	5	4	-	60	60	-	-	40	3	40	100	Practicum/ Practical
3.3	Dairy Engineering-I	2	-	3	3	40	-	40	60	3	-	-	60	100	Practicum/ Theory
3.4	Dairy Microbiology	2	-	3	3	40	-	40	60	3	-	-	60	100	Practicum/ Theory
3.5	Dairy Chemistry	3	-	2	4	40	-	40	60	3	-	-	60	100	Practicum/ Theory
3.6	Industrial Training (Summer Internship-I)	-	-	-	1	-	50	50	-	-	-	-	-	50	Practical
3.7	Open Elective-I ^	2	-	-	2	50	-	50	-	-	-	-	-	-	Qualifying
	Advance Skill Development	-	-	-		-	-	-	-	-	-	-	-	-	Certification
#Student Centred Activities (SCA)		-	-	7	-	-	50	50	-	-	-	-	-	50	-
Total		**12**	**-**	**24**	**20**	**120**	**220**	**340**	**180**	**-**	**80**	**-**	**260**	**600**	**-**

* Common with other diploma programmes

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 alloted to SCA can also be utilised to complete the syllabus of other subjects.
^ : As per the AICTE Open Elective List

OPEN ELECTIVE-1

SR. NO.	SUBJECT NAME
1.	Economic policies in India
2.	Project Management
3.	Energy Conservation & Audit
4.	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
FOURTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External	Course/ Exam Type
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
4.1	Dairy Technology-I	3	-	2	4	40	-	40	60	3	-	-	60	100	Practicum/ Theory
4.2	Hydraulics and Pneumatics	1	-	4	3	-	60	60	-	-	40	3	40	100	Practicum/ Practical
4.3	Dairy Engineering-II	2	-	2	4	40	-	40	60	3			60	100	Practicum/ Theory
4.4	Refrigeration-I	1	-	4	3	-	60	60	-	-	40	3	40	100	Practicum/ Practical
4.5	Dairy Plant Layout, Maintenance and Automation	4	-	0	4	40	-	40	60	3	-	-	60	100	Theory
4.6	Essence Of Indian Knowledge And Tradition (Q)	2	-	0	-	50	-	50	-	-	-	-	-	-	Qualifying
4.7	Open Elective-II ^	2	-	-	2	50	-	50	-	-	-	-	-	-	Qualifying
	Advance Skill Development	-	-	-		-	-	-	-	-	-	-	-	-	Certification
#Student Centred Activities (SCA)		-	-	9	-	-	50	50	-	-	-	-	-	50	-
Total		**15**	**-**	**21**	**20**	**120**	**170**	**290**	**180**	**-**	**-**	**6**	**260**	**550**	**-**

- Industrial training(summer internship-II) (After 4th Semester) (4 Weeks)

* Common with other 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.
^ : As per the AICTE Open Elective List

OPEN ELECTIVE-2

SR. NO.	SUBJECT NAME
1	Internet of Things
2	Disaster Management
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.

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

It was discussed and decided that the maximum marks for SCA should be 50 as itinvolves 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

3.1 INTRODUCTION TO DAIRY ENGINEERING AND TECHNOLOGY

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RATIONALE

This subject is essential in a dairy engineering diploma as it provides foundational knowledge of milk production, processing, and preservation. It familiarizes students with the principles of dairy equipment operation, hygiene, and quality control critical for ensuring safe and efficient dairy processing. These subject bridges theoretical concepts with practical applications in the dairy industry, preparing students for technical roles. Understanding this field is crucial to support innovations and maintain standards in the growing dairy sector.

LEARNING OUTCOMES

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

1. Understand the structure and functioning of the organized dairy industry in India, including milk procurement systems and the roles of NDDB, PM-FME, and government schemes promoting entrepreneurship.
2. Explain the composition, properties, and quality standards of milk, and carry out basic quality evaluation tests such as organoleptic tests, CLR, acidity, and MBRT.
3. Demonstrate knowledge of milk reception, handling, and transportation processes, including the use and operation of bulk milk coolers, road tankers, and weighing and pumping systems.
4. Apply sanitary engineering principles in dairy operations, including the use of appropriate fittings, materials, and CIP systems, and understand the working of various pumps used in the dairy industry.
5. Identify and describe key milk handling equipment, such as milk cans, chilling systems, and can washers, along with their construction, operation, and maintenance.

DETAILED CONTENTS

Unit No.	Content	Periods
1	**Overview of the Dairy Industry** Organised Dairy Industry in India. Structure of milk procurement and collection systems. Role of NDDB, PM-FME. Scope of entrepreneurship in dairy- Government schemes and Trading. Milk transportation: Road Tankers-Ordinary and Refrigerated, BMC. **Practicals** **1.** Study of bulk milk cooler	10
2	**Milk Reception & RMRD Operations** • Composition of milk, FSSAI Standards for Different types of milk. • Physical and Chemical properties of Milk. • Raw milk reception at plant level. • Sampling and quality tests: Organoleptic Tests-Temperature, smell, appearance and Platform tests-Lacto-meter/CLR, clot-on-boiling. Alcohol Test, Acidity, MBRT.	24

	• Milk unloading, weighing, and pumping. **Practicals** 1. Study of different components of milk 2. Performing of different types of RMRD test for milk. 3. To find out CLR for milk 4. To find out specific gravity of milk.	
3	**Essentials of Sanitary Engineering in Dairy Industry** • Sanitary fittings and pipelines: Metallic and Non-Metallic: SS 304/316, grades of rubber and plastic. • Basics of CIP (Clean-in-Place) system. • Types of pumps used in Dairy Industry: Centrifugal- single and multi-stage; positive displacement Pump-reciprocating, rotary. **Practicals** 1. Study of sanitary pipe fittings. 2. Study and dismantling and assembling of following pumps - Reciprocating Pump, Centrifugal Pump, Positive displacement pumps. **3.** Care and maintenance of different type of pumps. 4. Study, operation and control of CIP	16
4	**Milk Handling Equipment** • **Milk cans** – types, materials, uses. • **Chilling systems**: Bulk milk coolers (BMCs), PHE-chillers. • Construction, working & cleaning of Can washers: Manual, rotary, straight-through. **Practicals:** 1. Study, operation and control of different types of can washer. 2. Study and maintenance of can washers.	20

INSTRUCTIONAL STATREGY

Teacher may use various teaching aids like live models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. 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,
- Model Making,
- Actual Lab & Practical Work,
- Viva Voce

RECOMMENDED BOOKS

1- Outlines of Dairy Technology by Sukumar De.
2- Dairy Processing Handbook By Tetrapak.
3- DAIRY TECHNOLOGY Vol-1 & Vol-2 BY- Shivashraya Sing Publisher- Nipa ISBN-13 9789383305087 & 88
4- DAIRY SCIENCE & TECHNOLOGY BY-Gavin White Publisher- Callisto
5- Milk & Dairy Product Technology By -Edgar Spreer Publisher-
6- Dairy Plant Engineering And Management : By Tufail Ahmad Publisher- Kitab Mahal
7- Dairy Development and Income Distribution in India
8- Dudh Udyog ; By-Dr. Anil Kumar Kulkarni : Publisher:Continental Publication

WEBSITES FOR REFERENCE:

1- http://ecoursesonline.iasri.res.in/course/index.php?categoryid=7
2- https://milkyday.com/blog/2020/08/24/milk-processing-equipment-for-small-scale-dairy-farm/

SUGGESTED DISTRIBUTION OF MARKS

Unit No.	Time Allotted (Periods)	Marks Allotted (%)
1	10	15
2	24	35
3	16	20
4	20	30
Total	**70**	**100**

3.2 STEAM ENGINEERING AND HEAT ENGINES

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RATIONALE

The subject "Steam Engineering and Heat Engines" is vital for diploma students in dairy engineering as it builds foundational knowledge of thermal systems essential for milk processing operations such as pasteurization, sterilization, and CIP. It equips students with practical understanding of boilers, condensers, and heat transfer equipment, enabling them to operate, maintain, and troubleshoot thermal systems efficiently while emphasizing energy conservation and safety.

LEARNING OUTCOMES

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

1. Understand the construction, types, and working principles of boilers, with emphasis on those used in the dairy industry, including energy-efficient and automated systems.
2. Explain the functions of boiler mountings and accessories, and apply knowledge of boiler safety, draught systems, and routine maintenance for safe and efficient operation.
3. Analyze the role of steam condensers and heat recovery systems, and assess their applications in dairy operations such as CIP and condensate reuse.
4. Apply principles of heat transfer (conduction, convection, radiation) in the operation of dairy heat exchangers like pasteurizers and chillers, including concepts like Mean Temperature Difference (MTD).
5. Demonstrate basic understanding of internal combustion (IC) engines, their classifications, components, and use in power generation and field applications in the dairy sector.

DETAILED CONTENTS

Unit No.	Content	Periods
1	**STEAM GENERATORS & BOILERS** • Classification of boilers • Fire tube vs. water tube boilers • Boilers used in dairy industry (e.g., vertical/horizontal, electric, oil-fired, gas-fired) • Boiler components: mountings & accessories (line diagrams) • Energy-efficient and green boilers • Purpose and types of draught: natural, induced, forced • Boiler efficiency and equivalent evaporation • Boiler safety issues, accident prevention, and standard maintenance • Digital boiler monitoring and automation • Energy conservation measures in steam generation **Practicals** 1. To study and sketch a boiler installed in the laboratory. 2. To study and sketch fire tube boiler i.e. a Lancashire boiler. 3. To study the construction and working of various mountings. (a) Feed check value.	34

	(b) Safety valve, (dead weight safety valve, lever safety valve and rams bottom safety valve). (c) Stop valve. 4. To study the construction and working of various accessories of boiler. (a) Air-preheater. (b) Green's Economizer. (c) Superheater.	
2	**STEAM CONDENSERS & HEAT RECOVERY** • Types of condensers: jet and surface with simple line diagram (details not required) • Applications in dairy plants (e.g., heat recovery in CIP systems) • Condensate recovery systems and water reuse **Practicals** 1. To study and sketch steam condenser. (a) Surface condenser. (b) Jet condenser.	24
3	**HEAT TRANSFER IN DAIRY EQUIPMENT** • Modes of heat transfer: conduction, convection, radiation • Heat exchangers: plate, tubular, regenerative • Heat transfer in pasteurizers, sterilizers, and chillers • Concept of Mean Temperature Difference (MTD) • Thermal insulation and energy loss prevention	24
4	**Internal Combustion (IC) Engines. (Only basic Undertanding)** • Classification and comparison: petrol vs. diesel, 2-stroke vs. 4-stroke • Components and working of IC engines- basic • Use of engines in backup power, gensets, and field operations in dairy • Cooling and lubrication systems • Emissions, fuel efficiency, and environmental regulations **Practicals:** 1. To study and sketch a two-stroke petrol engine. 2. To study and sketch four stroke I.C. Engine: (a) Petrol Engine. (b) Diesel Engine.	16

INSTRUCTIONAL STATREGY: Teacher should mainly focus on the detailed study of boilers, heat engines and internal combustion engines. Some aids / animations should also be demonstrated.

MEANS OF ASSESSMENT:

- Theory classes.
- Practical /Viva voce
- Assignments/ quizzes.

RECOMMENDED BOOKS:

1. Heat engines volume-1 by Dr.N.C.Pandey
2. Thermal engineering by R.K.Hegde
3. Thermal engineering by M.M.L.Patel.
4. Power generation by kapil goyal.
5. 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	34	40
2	24	25
3	24	20
4	16	15
Total	**98**	**100**

3.3 DAIRY ENGINEERING - I

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RATIONALE

The subject "Dairy Engineering–I" is crucial for diploma students as it introduces them to essential milk handling, thermal processing, and packaging technologies used in modern dairy operations. It equips students with practical skills to operate, maintain, and troubleshoot equipment such as pasteurizers, separators, and packaging machines, while emphasizing hygiene, energy efficiency, and compliance with safety standards. This foundational knowledge supports their ability to ensure product quality and optimize processing workflows in the dairy industry.

LEARNING OUTCOMES

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

1. Understand the design, operation, and maintenance of milk storage and handling systems including BMCs and insulated tankers.
2. Explain the working principles of preprocessing equipment like clarifiers, separators, and homogenizers.
3. Apply thermal processing techniques such as LTLT, HTST, and UHT in milk treatment with a focus on energy efficiency.
4. Demonstrate knowledge of various milk packaging and filling systems and sustainable packaging practices.
5. Operate and maintain key dairy processing equipment following hygiene and safety standards.

Detailed Content

Unit No.	Content	Periods
1	**STORAGE EQUIPMENT AND MILK HANDLING SYSTEMS** • Insulated and refrigerated storage tanks – design, material, capacity; Bulk Milk Coolers (BMCs) • Milk transport tankers and their insulation. • Preprocessing equipment: filters, clarifiers, bactofuge separators, homogenizers– working principles and operations. • Milk separators: Cold milk and warm milk separators, Triprocessor. • CIP (Clean-in-Place) systems – principles, process, and importance **Practicals** 1. Study of constructional details, disassembling, assembling, adjustment, operation and control of different types of bulk milk cooler and storage tanks. 2. Study of constructional details, dismantling, assembling, adjustment, and maintenance, commissioning of clarifiers and separators.	20
2	**THERMAL PROCESSING OF MILK** • Fundamentals of heat transfer in dairy • Pasteurization: LTLT and HTST– design, working, applications	20

	• Regeneration efficiency and energy saving methods • Flow diversion valve (FDV) • Sterilization systems for milk and milk-based beverages • UHT – design, working, applications • Plate Heat Exchangers and Tubular Heat Exchangers • Direct vs indirect heating systems • Basic concepts of HACCP and GMP **Practicals** 1. Study of constructional details, dismantling, assembling adjustment operation, control and maintenance of:- (a) H.T.S.T. pasteurizer (b) Batch pasteurizer (c) Sterilizer 2. Study the batch type sterilizer for bottled milk.	
3	**CONVEYING AND BULK HANDLING EQUIPMENT** • Pneumatic conveying systems • vacuum conveying systems	10
4	**FILLING AND PACKAGING SYSTEMS** • Types of packaging materials: glass, plastic, Tetra Pak/aseptic, eco-friendly bioplastics • Filling systems: Gravity, volumetric, piston, and electronic fillers. • Pouch, bottle, and tetra pack filling machines • Labelling, sealing, date coding, and traceability systems • Sustainable packaging practices and waste management **Practicals** 1. Study of constructional details, dismantling, assembling adjustment, operation, control, maintenance of bottle filling and capping machine. 2. Study of constructional details, dismantling, assembling, adjustment, operation control and maintenance of fluid milk packaging machine.	20

INSTRUCTIONAL STATREGY

Teacher may use various teaching aids like live models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. 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
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
10. Outlines of Dairy Technology by Sukumar De.

WEBSITES FOR REFERENCE:

1. https://agrimoon.com/
2. 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	20	30
2	20	30
3	10	15
4	20	25
Total	**70**	**100**

3.4 DAIRY MICROBIOLOGY

L T P
2 0 3

RATIONALE

The subject Dairy Microbiology is essential for diploma students to understand the role of microorganisms in milk safety, spoilage, and product quality. It provides foundational knowledge in microbial classification, growth, and control methods, with practical skills in microbiological testing and hygiene practices. This ensures students can support quality assurance, food safety standards, and waste management in dairy operations.

LEARNING OUTCOMES

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

- Microorganism types, structure, growth in the milk and different products during processing.
- Measurement of bacterial growth nutrition milk
- Hygenic Milk production
- Microbiological test of milk and Milk products.
- Waste management for Dairy Plant

Unit No.	Content	Periods
1	**INTRODUCTION TO DAIRY MICROBIOLOGY** • Scope of Microbiology: Applications in dairy, food, pharmaceutical, industrial, medical and importance of dairy microbiology • General concept regarding Classification, nomenclature and structure of bacteria, yeasts, and Molds • Morphology, spore formation, growth and reproduction • Microbial growth and nutrition: Bacterial growth curve; factors affecting growth of bacteria and measurement of microbial growth. • Psychrophilic, mesophilic, thermoduric and thermophilic bacteria. • Effect of physical and chemical agents on microorganism growth • Basic laboratory techniques: culture media, isolation, identification preservation • Gram Staining-Positive and Negative Staining **Practicals** 1. Familiarity with equipment's used in Microbiological work and common bacteriological techniques. 2. Motility of bacteria, yeast and Molds. 3. Preparation of smears, simple staining, gram staining and study of morphology of bacteria, yeast and Molds.	25
2	**MILK HYGIENE AND QUALITY ASSURANCE** • Sources and types of microbial contamination	25

	• Hygienic milk production and handling: farm to dairy plant • Cleaning and sanitization of dairy equipment • Pasteurization, UHT, sterilization – effect on microbes • Microbiological quality standards: BIS, FSSAI, ISO, Codex • Role of microbial indicators: psychrophilic, thermoduric and coliforms • Microbial quality of water and environmental hygiene in dairy plant, chlorination of dairy water supply, quality of air, personnel hygiene. • Starter cultures and their use in fermented dairy product manufacturing-curd, butter, yoghurt, acidophilus milk. • Microbial spoilage: milk, cheese, ghee, paneer, ice cream etc. • Milk borne diseases -food infection, intoxication and toxi-infection caused *E. coli, Salmonella typhi, Staphylococcus aureus, Bacillus cereus, Listeria monocytogenes, Shigella species, Campylobacter* etc. • GMP and HACCP in microbial control **Practicals** 1. Micro-organisms in air. 2. Examination of various milk products with respect of the a. Total plate count. b. Total coliform count. c. Total yeast and Mold counts.	
3	**DAIRY WASTE MANAGEMENT** • Sources of dairy waste (solids, liquids, gases) • Environmental impact and legislative norms (CPCB, SPCB, FSSAI) • Treatment of wastewater: physical, chemical, and biological methods • Effluent Treatment Plants (ETPs) and their functioning • Sludge disposal, biogas generation, and sustainability practices **Practicals** 1. Determination of BOD and COD of ETP Water.	10
4	**MICROBIOLOGICAL TESTING & ANALYSIS (20 Periods)** • Standard Plate Count (SPC), Total Plate Count (TPC), Coliform Count, Yeast & Mold Count • Methylene Blue Reduction Test (MBRT), Resazurin Test • Phosphatase Test, Swab Test, Pathogen detection (Listeria, Salmonella, E. coli) • BOD, COD analysis of ETP water **Practicals** 1. Direct microscopic count. 2. Standard plate count technique. 3. To conduct Dye-Reduction and presumptive and utensils. 4. Examination of sterility of dairy equipment coliform tests.	10

INSTRUCTIONAL STATREGY

Teacher may use various teaching aids like live models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. 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 Microbiology Handbook; The Microbiology of Milk and Milk Products; By-R K Robinsion; Publisher-
2. Applied Dairy Microbiology; By-Elmer H Marth, James Steele ; Publisher; Taylor & Francis
3. Dairy Microbiology; A practical approach ; By- Photis Papademas ; Publisher-CRC Press
4. Dairy Microbiology; By- Pradeep Parihar :Publisher- Student Edition,2008
5. Fundamental of Micobiology; By-I Edward Alcamo; Jones and Bartlett
6. A comprehensive Dairy Microbiology; By-JS Yadav , Sunita Grover and V K Batish
7. Food and Dairy Microbiology; By- Dr M K Rao ; Publisher- Mangalam publishers & Distributors
8. Dairy Microbiology, KC Mahanta

WEBSITES FOR REFERENCE:

1- www.swayam.in
2- www.urise.up.gov.in
3- www.nptel.ac.in
4- www.agrimoon.com
5- http://ecoursesonline.iasri.res.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	25	35
2	25	35
3	10	15
4	10	15

Total	**70**	**100**

3.5 DAIRY CHEMISTRY

L T P
3 0 2

RATIONALE

A firm grasp of milk's biochemical components—fats, proteins, lactose, enzymes, vitamins—is critical for process control and product standardization. Chemistry underpins quality testing, adulteration detection and the development of value-added formulations.

LEARNING OUTCOMES

After undergoing this subject, the student will be able to;
1. Analyze gross composition and physico-chemical properties of various milks.
2. Measure milk solids (SNF), fat (Gerber), protein (Kjeldahl), acidity and freezing point.
3. Explain lipid rancidity, fat constants (RM, iodine value) and proteolysis in processing.
4. Assess enzyme activity (phosphatase) as pasteurization indicators.
5. Detect common milk adulterants and apply FSSAI quality criteria.

DETAILED CONTENTS

Unit No.	Content	Periods
1	**COMPOSITION OF MILK** • Bio-Molecules: General structures, classification and functions of bio molecules. Amino acids, Protein, Carbohydrates, Fats, Lipids and Enzymes • Average gross composition of cow, buffalo, sheep, and goat milk. • Colostrum and its significance. • Factors affecting milk composition (breed, feed, season, etc.). • Difference between cow and buffalo milk. **PHYSICAL PROPERTIES OF MILK** • Colour, specific gravity, refractive index, viscosity, surface tension, boiling and freezing points, pH, titratable acidity. • Electrical conductivity and its significance. • Importance of pH and acidity in processing and storage. **Practicals** 1. Determination of Sp. gravity of milk by lactometer. 2. Determination of percentage of S.N.F. by lactometer. 3. Common platform test of milk such as C.O.B, alcohol and sediment test. 4. Determination of acidity of milk. 5. Determination of freezing point of milk.	20
2	**MILK FAT** • Composition, physical properties • Rancidity: Hydrolytic and oxidative. • Fat constants: Reichert-Meissl (RM), Polenske value, iodine	20

	value, saponification number. **MILK PROTEINS** • Types: Casein, α-lactalbumin, β-lactoglobulin, whey proteins. • Heat stability, coagulation properties, nutritional importance. • Functional role in dairy processing (foaming, emulsification, gelling) **LACTOSE** • Properties, lactose intolerance, fermentation to lactic acid. **Practicals** 1. Determination of fat by Gerber methods and by milk tester. 2. Determination of protein content of milk by kjeldahl method.	
3	**PHYSICO-CHEMICAL CHANGES DURING PROCESSING** • Changes during heat treatment (pasteurization, UHT, sterilization). • Effect of homogenization and chilling. **ENZYMES IN MILK** • Definition, function and Types: Lipase, protease, catalase, peroxidase, alkaline phosphatase. • Importance in processing, detection of pasteurization efficiency **VITAMINS AND PIGMENTS** • Fat-soluble and water-soluble vitamins in milk. • Pigments: Riboflavin, carotene **Practicals** 1. Determination of the efficiency of pasteurization.	15
4	**MINOR CONSTITUENTS & QUALITY ISSUES** • Role of trace minerals and metals. • Detection of adulteration (urea, starch, detergent, synthetic milk, etc.). • FSSAI standards for milk and milk products • Preservatives used and their detection **FUNCTIONAL MILK COMPONENTS** • Concept of Bioactive peptides, CLA, probiotics, prebiotics, fortification and health benefits. • Concept of A1 vs A2 milk. **Practicals** 1. Detection of adulteration in milk and milk products	15

INSTRUCTIONAL STATREGY

Teacher may use various teaching aids like live models and experimental kits etc. for imparting effective instructions in the subject. 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. Outlines of Dairy Technology ; By – Sukumar De ; Publisher- Oxford University Press (Indian Branch)
2. Text book of Dairy Chemistry ; By- M P Mathur, D Datta Roy, P. Dinakar ; Publisher-ICAR New Delhi
3. Dairy Science and Technology Hand Book ; By Y .H. Hui Publisher; John Wiley
4. Dairy Engg Practical Book ; By-Seema Tanwar , V.D Mudgal, S K Jain ; Publisher- Satish Serial Publishing House.
5. Fundamentals of Dairy Chemistry; By- Webb .B. H ;Publisher-CBS Publisher
6. Dairy Process Engg (Practical Book) ; By VD Mudgal , KK Meena ; Publisher- Satish Serial Publishing House
7. A Text Book of Dairy Chemistry ; By – MP Mathur ;Publisher-ICAR
8. Dairy Chemistry ; By- Hary Synder Publisher; Nabu Press
9. Fundamentals of Dairy Chemistry; By-Webb Johnson and Alford; Publisher-CBS
10. दुग्ध रसायन एवं पशु पोषण- डॉ० तेज बहादुर सिंह
11. दुग्ध रसायन एवं पशु पोषण-विनय सिंह

WEBSITES FOR REFERENCE:

1. https://agrimoon.com/
2. 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	20	30
2	20	30
3	15	20
4	15	20
Total	70	100

3.6 INDUSTRIAL TRAINING (SUMMER INTERNSHIP-I)

Duration and Timing:
Students will undergo a **4 week in-plant training** immediately after appearing in their theory examinations of 2nd 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 primary objective of the Summer Internship-I 4 weeks' program is to provide students with practical exposure to industrial work environments in dairy and related processing industries. This initiative aims to bridge the gap between theoretical knowledge and real-world application by enabling students to gain hands-on experience under the supervision of qualified factory personnel and academic staff.

Key Components of the Internship:

1. **Industrial Exposure:**
    - Students will be trained in live factory settings to understand the day-to-day operations, challenges, and management practices.
    - Guidance will be provided jointly by industry professionals and faculty members from the polytechnic.
2. **Faculty Involvement:**
    - All faculty members from the Dairy Engineering department will be deputed to coordinate and supervise the internship program.
    - The Head of the Department (HoD) shall be responsible for organizing and overseeing the entire internship process.
3. **Industry Coordination:**
    - The HoD, with the support of the Director and the Board of Apprenticeship Training, will identify and procure suitable internship placements in reputed dairy and food processing units.
4. **Project Assignment:**
   During the internship, each student may be assigned a topic relevant to their industrial exposure. Suggested project areas topics include:
    - Material Handling Systems
    - Plant Layout and Workflow Analysis
    - Inventory Management and Control
    - Work Study and Time-Motion Analysis
    - Process Control and Automation
    - Rejection and Rework Analysis
    - Inspection Systems
    - Quality Control and Assurance
5. **Evaluation and Reporting:**
    - Students will be required to maintain a daily logbook of their activities and observations.
    - A final report, including the project findings and internship reflections, will be submitted for evaluation.

- Oral presentations or viva-voce will be conducted as part of the final assessment.

3.7 OPEN ELECTIVE-I/ Advance Skill Development

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3.7.1 ECONOMIC POLICIES IN INDIA

Course Learning Objectives:
The objective of this course is to familiarize the students of different streams with the basic concepts, structure, problems and issues concerning Indian economy.

Course Content:
UNIT-I: Basic features and problems of Indian Economy: Economic History of India; Nature of Indian Economy, demographic features and Human Development Index, Problems of Poverty, Unemployment, Inflation, income inequality, Black money in India.

UNIT-II: Sectoral composition of Indian Economy: Issues in Agriculture sector in India, land reforms Green Revolution and agriculture policies of India,

UNIT-III: Industrial development, small scale and cottage industries, industrial Policy, Public sector in India, service sector in India.

UNIT-IV: Economic Policies: Economic Planning in India, Planning commission v/s NITI Aayog, Five Year Plans, monetary policy in India, Fiscal Policy in India, Centre state Finance Relations, Finance commission in India. LPG policy in India

UNIT-V: External sector in India: - India's foreign trade value composition and direction, India Balance of payment since 1991, FDI in India, Impact of Globalization on Indian Economy, WTO and India.

Reference Books:
1. Dutt Rudder and K.P.M Sunderam (2017). Indian Economy. S Chand & Co. Ltd. New Delhi.
2. Mishra S.K & V.K Puri (2017). Indian Economy and –Its Development Experience. Himalaya Publishing House.
3. Singh, Ramesh, (2016): Indian Economy, Tata-McGraw Hill Publications, New Delhi.
4. Dhingra, I.C., (2017): March of the Indian Economy, Heed Publications Pvt. Ltd.
5. Karam Singh Gill, (1978): Evolution of the Indian Economy, NCERT, New Delhi
6. Kaushik Basu (2007): The Oxford Companion to Economics of India, Oxford University Press.

3.7.2 PROJECT MANAGEMENT

Course Learning Objectives:

• To develop the idea of project plan, from defining and confirming the project goals and objectives, identifying tasks and how goals will be achieved.

• To develop an understanding of key project management skills and strategies.

Content:

UNIT-I: Concept of a project: Classification of projects- importance of project management- The project life cycle- establishing project priorities (scope-cost-time)project priority matrix- work break down structure.

UNIT-II: Capital budgeting process: Planning- Analysis-Selection-Financing-Implementation-Review. Generation and screening of project ideas- market and demand analysis- Demand forecasting techniques. Market planning and marketing research process- Technical analysis

UNIT-III: Financial estimates and projections: Cost of projects-means of financing-estimates of sales and production-cost of production-working capital requirement and its financing-profitability projected cash flow statement and balance sheet. Break even analysis.

UNIT-IV: Basic techniques in capital budgeting: Non discounting and discounting methods-payback
period- Accounting rate of return-net present value-Benefit cost ratio-internal rate of return. Project risk. Social cost benefit analysis and economic rate of return. Non-financial justification of projects**.**

UNIT-V: Project administration: progress payments, expenditure planning, project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress, time-cost trade off. Concepts and uses of PERT cost as a function of time, Project Evaluation and Review Techniques/cost mechanisms. Determination of least cost duration. Post project evaluation. Introduction to various Project management softwares.

Reference Books:

1. Project planning, analysis, selection, implementation and review – Prasannachandra – Tata McGraw Hill
2. Project Management – the Managerial Process – Clifford F. Gray & Erik W. Larson - McGraw Hill
3. Project management - David I Cleland - Mcgraw Hill International Edition, 1999
4. Project Management – Gopala krishnan – Mcmillan India Ltd.
5. Project Management-Harry-Maylor-Peason Publication

3.7.3 Energy Conservation & Audit

Course Learning Objectives:

• To Identify demand supply gaps in present scenario.

• To understand conservations approaches to an industry.

• To draw the energy flow diagram of an industry.

• To identify energy wastage and suggest alternative methods.

• To understand the concepts energy audit.

Course Content:

UNIT-I: Introduction: General energy problem, Sector wise Energy consumption, demand supply gap, Scope for energy conservation and its benefits; Energy Efficiency Principle – Maximum energy efficiency, Maximum cost effectiveness; Mandatory provisions of EC act; Features of EC act-Standards and labeling, designated consumers, Energy Conservation Building Codes (ECBC);

Unit-II: Energy Conservation Approaches In Industries: Methods and techniques of energy conservation in ventilation and air conditioners- compressors pumps, fans and blowers - Area Sealing, Insulating the Heating / cooling fluid pipes, automatic door closing- Air curtain, Thermostat / Control;
Energy conservation in electric furnaces, ovens and boilers.

Unit-III: Energy Conservation Option: New equipment, technology, staffing, training; Calculation and costing of energy conservation project; Depreciation cost, sinking fund method. Cost evaluation by Return On Investment(ROI) and pay back method etc.

Unit-IV: Performance improvement of existing power plant: cogeneration, small hydro, DG Set;
Demand side management; Load response programmes; Types of tariff and restructuring of electric tariff Technical measures to optimize T and D losses.

Unit-V: Energy Audit: Energy audit and its benefits; Energy flow diagram; Preliminary, Detailed energy audit; Methodology of -preliminary energy audit and Detailed energy audit – Phase I, Pre audit,
Phase II- Audit and Phase III- Post audit; Energy audit report; Electrical Measuring Instruments
- Power Analyzer.

Reference Books:

1. Electric Energy Generation, Utilisation and Conservation Sivaganaraju, S Pearson, New Delhi, 2012
2. Project Management, Prasanna Chandra, Tata Mcgraw Hill, New Delhi
3. O.P. Jakhar, Energy Conservations in Buildings, Khanna Publishing House, New Delhi
4. Financial Management, Prasanna Chandra Tata Mcgraw Hill, New Delhi.

5. Energy management Handbook, Prasanna Chandra, Tata Mcgraw Hill, New Delhi.
6. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ed. 2018)

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.

4.1 DAIRY TECHNOLOGY-I

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3 0 2

RATIONALE

Focusing on indigenous and Western dairy products, this subject integrates process design with hands-on manufacturing of paneer, khoa, ghee, butter and fermented milks. It develops skills to meet BIS/FSSAI standards and manage food safety.

LEARNING OUTCOMES

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

1. Execute filtration, standardization, pasteurization, homogenization and sterilization processes.
2. Manufacture and grade butter, ghee and AMF per FSSAI norms.
3. Produce paneer, khoa, chhana, dahi and shrikhand with proper yields.
4. Operate continuous and batch separators and pasteurizers.
5. Apply HACCP/GMP principles in product lines

DETAILED CONTENTS

Unit No.	Content	Periods
1	**MILK PROCESSING OPERATIONS** • Filtration-Types of filters, strainer, clarification-clarifier and Microfiltration • Standardization: Process of standardization, Basic Numerical. • Pasteurization: Batch, HTST, and UHT • Homogenization & Aseptic Packaging • Basics of Cleaning-in-Place (CIP) **Practicals** 1. Operation of pasteurisers, cream separators with milk.	15
2	**CREAM SEPARATION AND SPECIAL MILKS** • Cream separation process. • Fat standardization and SNF balancing • Different Types of creams as per FSSAI standards (table cream, whipping cream, etc.) • Production of toned, double toned, recombined, reconstituted, Standardized and fortified milk- Vitamin A/D fortification • Flavoured, probiotic, and functional milks **Practicals** 1. Preparation of flavoured milk. 2. Preparation of standardized milk, toned and double toned milk.	20

	3. Preparation of Sterilized milk.	
3	**BUTTER, GHEE & BUTTER OIL TECHNOLOGY** • Churning and phase inversion of cream • Equipment for continuous and batch butter making • Fssai standards for Butter. • Butter oil and AMF production; • Packaging and storage of butter and butter oil **GHEE MANUFACTURING TECHNOLOGY** • Traditional and industrial methods of ghee production • Fssai standards for ghee. • Ghee clarifiers and evaporators. • Nutritional and medicinal value of ghee • Defects in ghee and their control • AGMARK certification and grading of ghee **Practicals** 1. Preparation of Butter, Butter Oil & Ghee.	20
4	**INDIGENOUS DAIRY PRODUCTS AND FOOD SAFETY** • Manufacturing of: Khoa, Channa, Paneer, Dahi, Shrikhand • FSSAI standards and BIS specifications for each product. • Overview of FSSAI regulations, Codex standards, HACCP, and ISO 22000 • Introduction to GMP and traceability systems in dairy **Practicals** 1. Preparation of Dahi. 2. Preparation of Khoa 3. Preparation of Chhana & Paneer 4. Preparation of Srikhand	15

INSTRUCTIONAL STATREGY
The teacher should focus on explaining the concepts with practical examples.

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)

WEBSITES FOR REFERENCE:

1- http://ecoursesonline.iasri.res.in/course/index.php?categoryid=7
2- https://milkyday.com/blog/2020/08/24/milk-processing-equipment-for-small-scale-dairy-farm/

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1.	15	20
2.	20	30
3.	20	30
4.	15	20
Total	70	100

4.2 HYDRAULICS AND PNEUMATICS

L T P
1 0 4

RATIONALE

Diploma holders in this course are required to deal with problems of fluid and use of hydraulics and pneumatics in power generation. For this purpose, knowledge and skills about fluid mechanics and machinery, hydraulics and pneumatics systems are required to be imparted for enabling them to perform above functions.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:
1. Calculate pressure, flow and losses using Bernoulli's theorem in dairy pipelines.
2. Select and maintain centrifugal, reciprocating and positive-displacement pumps.
3. Design and troubleshoot pneumatic circuits (compressor, FRL units, actuators).
4. Measure flow with venturi meters and manometers.
5. Apply Pascal's law in hydraulic actuators for milk-handling equipment.

DETAILED CONTENTS

Unit No.	Content	Period
1	**INTRODUCTION TO FLUID MECHANICS** • Fluids, Types of fluids; properties: mass density, viscosity-kinematic and dynamic, specific gravity, surface tension, compressibility, etc. and their units. • Relevance of fluid properties in dairy processing equipment. **PRESSURE AND ITS MEASUREMENT** • Pressure, Types of pressure: atmospheric, gauge, absolute. • Pressure measuring Devices: **digital pressure sensors**, piezometer, U-tube and differential manometers, bourdon pressure gauge, diaphragm pressure gauge. • Smart gauges and IoT-enabled sensors in fluid systems **Practicals** 1. Measurement of pressure head by employing. i) Piezometer tube ii) Single and double column manometer	20
2	**FLUID FLOW AND BERNOULLI'S APPLICATIONS** • Flow types on basis of Reynolds Number: steady/unsteady,	20

	laminar/turbulent. • Rate of flow and their units; continuity equation of flow; • Bernoulli's Theorem – derivation and applications. • Discharge Measurement: venturi meter, orifice meter, pitot tube, rotameter. **Practicals** 1- To find out the value of coefficient of discharge for a venturi meter. 2- Measurement of flow by using venturi meter. 3- Verification of Bernoulli's theorem.	
3	**PUMPS AND DAIRY APPLICATIONS** • Pumps: Classification- centrifugal, reciprocating, rotating, gear, screw, diaphragm pumps. • Operation, efficiency, priming, and cavitation. • Pump selection for CIP, chilling, and liquid milk transfer **Practicals** 1- To study a single stage centrifugal pump for constructional details and its operation to find out its normal head and discharge. 2- Direct operation of single and double acting cylinder. 3- Automatic operation of double acting cylinder in single cycle using limit switch. 4- Operation of double acting cylinder with quick exhaust wall.	20
4	**INTRODUCTION TO PNEUMATICS** • Compressed air: properties, generation, and treatment • Basic pneumatic components and their functions: compressor, air dryer, Filter, Regulator and Lubrication unit. **Practicals** 1. Study and Demonstration of Compressed Air Generation Using a Compressor 2. Demonstration of Air Treatment Using Filter, Regulator, and Lubricator (FRL) Unit 3. Identify components such as compressors, air dryers, filters, regulators, and lubricators. 4. Assemble and operate a basic pneumatic circuit.	10

INSTRUCTIONAL STRATEGY

Use computer based learning aids for effective teaching-learning

1- Expose students to real life problems

2- Plan assignments so as to promote problem solving abilities and develop continued learning skills

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS

1- Fluid Mechanics by KL Kumar; S Chand and Co Ltd., Ram Nagar, New Delhi.
2- Hydraulics and Fluid Mechanics Machine by RS Khurmi ; S.Chand & Co. Ltd., New Delhi.
3- Fluid Mechanics through Problems by RJ Garde; Wiley Eastern Ltd., New Delhi.
4- Fluid Mechanics by Dr AK Jain, Khanna Publishers, New Delhi.
5- Hydraulic and Pneumatic Control by K Shammuga Sundaram, S. Chand & Co. Ltd., New Delhi
6- Hydraulics and Hydraulic Machinery by Dr. Jagadish Lal; Metropolitan Book Company Ltd., Delhi.
7- Hydraulic and Pneumatic Power and Control Design, Performance and Application by Yeaple, McGraw Hill, New York..
8- Pneumatic Controls by Festo Didactic; Bangalore.
9- Pneumatics Control: An Introduction to the Principles by Werner Deppert and Kurt Stoll; Vogel – Verlag.
10- e-books/e-tools/relevant software to be used as recommended by AICTE/BTE/NITTTR, Chandigarh.
11- Dairy Plant Engineering And Management : By Tufail Ahmad Publisher- Kitab Mahal

WEBSITES FOR REFERENCE:

1- http://swayam.gov.in
2- http://ecoursesonline.iasri.res.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	20	25
2	20	30
3	20	25
4	10	20
Total	**70**	**100**

4.3 DAIRY ENGINEERING – II

L T P
2 0 2

RATIONALE

Advanced product lines—ice cream, cheese, casein—require specialized equipment insight. This course develops competence in continuous freezers, homogenizers, churns and packaging machinery to optimize product quality and operational uptime.

LEARNING OUTCOMES

After undergoing this subject, the student will be able to;
1. Disassemble, reassemble and maintain batch and continuous ice-cream freezers.
2. Explain homogenizer design and control lipid droplet size distribution.
3. Operate butter churns, continuous butter machines and ghee plants.
4. Select MAP/vacuum packaging systems for high-moisture dairy products.
5. Plan preventive maintenance schedules for complex dairy machinery.

DETAILED CONTENTS

Unit No.	Content	Period
1	**ICE CREAM PROCESSING EQUIPMENT** • Batch and Continuous Freezers – construction, working, design. • Refrigeration system, freezing cylinder, dasher, scrapping blades. • Overrun control, air incorporation, automation of freezing process. • Packing of ice cream – automated packaging machines. • Hardening and storage cabinets – types and operation. • Routine and preventive maintenance schedules. **Practicals** 1- Study of constructional details, dismantling, assembling, adjustment, operation, control and maintenance of: (a) Batch type ice cream freezers. (b) Continuous ice cream freezers.	15
2	**HOMOGENIZERS** • Principle of homogenization, theory of homogenization, effects on milk quality, efficiency of homogenization. • Single and two-stage homogenizers – construction, materials. • Gauges, valves, Care and Maintenance of homogenizer. **Practicals** 1- Study of constructional details, dismantling, assembling,	15

	adjustment, operation, control and maintenance of: Homogenizer.	
3	**CREAM, BUTTER & GHEE PROCESSING EQUIPMENT** • Cream ripening tanks –design, types, operation. • Traditional (butter churn- metal, speed of churn) and continuous butter making machines – design and comparison. • Ghee making pans and continuous ghee plants – construction, operation. **Practicals** 1- Study of constructional details, dismantling, assembling, adjustment, operation, control and maintenance of: (a) Different types of butter churns. (b) Continuous Butter Making machine (c) Ghee pans and continuous ghee making machine.	16
4	**PACKAGING & ANCILLARY EQUIPMENT IN DAIRY INDUSTRY** • Butter, ice cream, cheese, and ghee packaging – types and requirements. • Smart packaging systems: MAP (Modified Atmosphere Packaging), vacuum packaging, and aseptic filling. **Practicals** 1- Packaging machines and materials for butter and ice cream 2- Packaging machines and materials for ghee,	10

INSTRUCTIONAL STATREGY

Teacher may use various teaching aids like live models, and experimental kits etc. for imparting effective instructions in the subject. 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 more knowledge 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 Plant Engineering And Management : By Tufail Ahmad Publisher- Kitab
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
10- Outlines of Dairy Technology by Sukumar De.

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	15	25
2	15	25
3	16	30
4	10	20
Total	**56**	**100**

4.4 REFRIGERATION - I

L	T	P
1	0	4

RATIONALE

To avoid microbiological disintegration and ladder preparation of milk air conditioning and refrigeration are required to produce low temperature. The students are required to possess the knowledge of various methods of creating low temperature.

LEARNING OUTCOMES

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

1. Trace vapor-compression and reversed-Carnot cycles on P-V/T-S charts.
2. Identify refrigerant properties, leak-detection and charging protocols.
3. Maintain compressors (reciprocating, rotary, centrifugal) and condensers.
4. Select expansion devices (capillary, thermostatic) and evaporators for dairy applications.
5. Implement brine and ice-bank systems in chillers.

DETAILED CONTENTS

Unit No.	Content	Period
1	**FUNDAMENTALS OF THERMODYNAMICS & REFRIGERATION CYCLES** • Importance and applications of thermodynamics in Dairy/Food processing: Basic concepts- Thermodynamic systems, processes, cycles; • The Zeroth Law of Thermodynamics; • The first Law of Thermodynamics: Internal energy, enthalpy • The second Law of Thermodynamics: Carnot cycle, entropy. • Need and applications of refrigeration in dairy and food industry. • COP, refrigerating effect, units of refrigeration. • Reversed Carnot cycle – representation on T-S and P-V diagrams. • Vapor compression refrigeration cycle and its components. • P-H and T-S diagrams for VCR cycle. **Practicals** 1- To study different parts and operation of ice plant using ammonia as refrigerant. 2- To Understand different components of VCR System.	20
2	**REFRIGERANTS & ALTERNATE COOLING SYSTEMS** • Refrigerants: Primary and Secondary refrigerants; common refrigerants (Particularly Ammonia, Freon); • Desirable properties of refrigerants. • Leak Detection of refrigerants. • Introduction to air refrigeration cycle – working, pros & cons.	18

3	**COMPRESSORS AND CONDENSORS** **Compressors** • Types: Reciprocating (open, hermetic), rotary, screw, centrifugal. • Cylinder arrangements, lubrication systems, cooling mechanisms. **Condensers** • Types: Air-cooled, water-cooled, evaporative. • Cooling towers – operation and maintenance. **Practicals** 1. To dismantle an open type compressor, study its parts, assemble it again. 2. To dismantle a sealed unit compressor, study its parts and assemble it again. 3. To study different refrigerant unit at different operating condition. 4. To test the condensing unit at different operating condition. 5. To dismantle& assemble rotary type of compressor and study their parts. 6. To dismantle and assemble a centrifugal compressor and study its parts. 7. To dismantle and assemble a gear type compressor and study its part.	16
4	**REFRIGERATION EQUIPMENT & CONTROLS.** **Expansion Devices** • Automatic, thermostatic, capillary tube, float valves. **Evaporators** • Types: Bare tube, plate, shell and tube, finned tube. • Dry and flooded evaporators. **Controls and Accessories** • Thermostatic and pressure motor controls. • Solenoid valves, oil separators, accumulator. • Low and high-pressure cut-outs, crankcase heaters. • Brine systems, ice bank systems, direct and indirect cooling. **Practicals** 1. To study different types of evaporators. 2. To study different types of expansion devices	16

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
5. Dairy Plant Engineering And Management : By Tufail Ahmad Publisher- Kitab Mahal

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	20	30
2	18	30
3	16	20
4	16	20
Total	**70**	**100**

4.5 DAIRY PLANT LAYOUT, MAINTENANCE AND AUTOMATION

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4 0 0

RATIONALE

The functioning of a dairy plant is very much dependent on the layout & power maintenance schedule, followed in the plant. Energy in the form of steam & electricity is utilized in processing of milk products. Therefore safety measures are to taken for the personal employed in the plant. A student should have basic knowledge about maintenance & safety of the plant.

LEARNING OUTCOMES

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

1. Design flow-efficient dairy layouts (U-type, linear) and calculate space requirements.
2. Draft preventive, predictive and breakdown maintenance plans for pumps, heat exchangers and conveyors.
3. Specify food-grade lubricants and manage spares inventory.
4. Program basic PLC/SCADA loops for HTST control, CIP sequencing and refrigeration.
5. Integrate sensors (temp, flow, pressure) into real-time dashboards.

DETAILED CONTENTS

Unit No.	Content	Period
1	**PLANT MAINTENANCE** • Definition, objectives, and importance of plant maintenance. • Types of maintenance: Preventive, Predictive, and Breakdown maintenance (brief intro). • Wear: Mechanical wear, corrosive wear: causes and effects on equipment.	10
2	**DAIRY PLANT LAYOUT AND DESIGN** • Classification of dairy plants • Principles of plant layout and process scheduling. • Selection of location and site for dairy plants – rural vs. peri-urban considerations. • Layouts for market milk plants. Layouts for product-specific plants (butter, cheese, powder, ice cream, etc.). • Design of flow patterns (straight line, L-type, U-type, circular) for milk processing. • Arrangement of sections: reception dock, processing, packing, utility rooms, and dispatch. • Centralized vs. decentralized plants. • Area calculations and layout for workshop, admin, quality control, and storage. • Space allocation for equipment and utilities. Drainage and waste management. • Requirements for water, steam, compressed air, refrigeration, and electricity. Design and maintenance of utility systems	20
3	**REPAIR AND MAINTENANCE PLANNING** • Organization of maintenance in a dairy plant: roles and	16

	responsibilities. • Preparation for assembly and disassembly of pumps, valves, and other equipment. • Preventive maintenance planning: tools, checklists, frequency charts. • Spare parts management, maintenance audits. **LUBRICATION AND EQUIPMENT CARE** • Lubrication principles. • Types of lubricants: food-grade oils, greases. • Selection and application of lubricants for dairy machinery.	
4	**AUTOMATION IN DAIRY PLANTS** • Introduction to automation in dairy operations – definitions and scope. • Advantages and challenges of automation in milk handling and processing. • Introduction to PLCs (Programmable Logic Controllers) and SCADA (Supervisory Control and Data Acquisition) systems. • Use of IoT (Internet of Things) for real-time monitoring and control. • Application of automatic valves, sensors (temperature, flow, pressure), thermostats. • Automatic controls like thermostats for temperature control, FDV in HTST unit, Vacuum control in evaporation plant.	10

INSTRUCTIONAL STATREGY

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 Plant Engineering And Management : By Tufail Ahmad Publisher- Kitab Mahal
2. Dudh Udyog ; By-Dr. Anil Kumar Kulkarni : Publisher:Continental Publication
3. Dairy Process Engg (Practical Book) ; By VD Mudgal , KK Meena ; Publisher- Satish Serial Publishing House
4. Milk and Dairy Product Technology; By- Edgar Sprur, Taylor & Francis ; Publisher- Taylor and Francis
5. Dairy Engineering : Advanced Technologies and Their Applications; By- Murlidhar Meghwal, Megh R. Goyal, Rupesh S. Chavan Publisher-Apple Academic Press
6. Dairy Plant Design & Layout; By-Sunil M. Patel, A. G.Bhadania Publisher;Agrimoon

7. A Text Book of Dairy Plant Layout and Design; By-Prof Lalat Chander ;Publisher- ICAR

WEBSITES FOR REFERENCE:

1. https://agrimoon.com/
2. 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	10	20
2	20	35
3	16	25
4	10	20
Total	**56**	**100**

4.6 ESSENCE OF INDIAN KNOWLEDGE AND TRADITION (Q)

L	T	P
2	-	-

COURSE OBJECTIVE:
Understand the fundamental aspects of the Indian Knowledge System, its integration with modern science, principles of Yoga and holistic healthcare, and practical applications in contemporary contexts.

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

- Overview, importance, and relevance of the Indian Knowledge System, including Vedas, Upavedas, Vedangas, and Upangas.
- Relevance of science and spirituality, and contributions of ancient Indian science and technology.
- Basic principles of Yoga, benefits of holistic healthcare, and integration with modern healthcare.
- Practical applications and case studies of the Indian Knowledge System's relevance today.

COURSE CONTENTS

Unit 1: Introduction to Indian Knowledge System (16 Periods)
Overview of Indian Knowledge System

- Importance and relevance
  - Introduction to the Vedas
  - Upavedas
  - Vedangas
  - Upangas

Unit 2: Modern Science and Indian Knowledge System (06 Periods)

- Relevance of Science and Spirituality,
- Science and Technology in Ancient India,

Unit 3: Yoga and Holistic Healthcare (04 Periods)

- Basic principles of Yoga
- Benefits of holistic healthcare practices
- Integration with modern healthcare

Unit 4: Case Studies / Assignment (02 Periods)

- Practical Applications / Case studies demonstrating the relevance of Indian Knowledge System in modern times

Assessment
Viva -Voce Exam

4.7 OPEN ELECTIVE-II/ SKILL CERTIFICATION

L T P

2 0 0

4.7.1 Internet of Things

Course Content:

Unit I - Introduction to Internet of Things

• Define the term "Internet of Things"
• State the technological trends which have led to IoT.
• Describe the impact of IoT on society.

Unit II - Design consideration of IoT

• Enumerate and describe the components of an embedded system.
• Describe the interactions of embedded systems with the physical world.
• Name the core hardware components most commonly used in IoT devices.

Unit III Interfacing by IoT devices

• Describe the interaction between software and hardware in an IoT device.
• Explain the use of networking and basic networking hardware.
• Describe the structure of the Internet.

SUGGESTED LEARNING RESOURCES:

1 Internet of Things Raj Kamal McGraw Hill Education; First edition (10 March 2017) ISBN 978-9352605224
2. Internet of Things: A Hands-On Approach Arsheep Bahge and Vijay Madisetti Orient Blackswan Private Limited - New Delhi; First edition (2015) ISBN : 978-8173719547

SUGGESTED SOFTWARE/LEARNING WEBSITES:

1. https://www.raspberrypi.org/blog/getting-started-with-iot/
2. https://www.arduino.cc/en/IoT/HomePage
3. https://www.microchip.com/design-centers/internet-of-things
4. https://learn.adafruit.com/category/internet-of-things-iot
5. http://esp32.net/

4.7.2 Disaster Management

Course Learning Objectives:

Following are the objectives of this course:

- To learn about various types of natural and man-made disasters.
- To know pre- and post-disaster management for some of the disasters.
- To know about various information and organisations in disaster management in India.
- To get exposed to technological tools and their role in disaster management.

Course Content:

Unit – I: Understanding Disaster

Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.

Unit – II: Types, Trends, Causes, Consequences and Control of Disasters

Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire);
Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.

Unit- III: Disaster Management Cycle and Framework

Disaster Management Cycle – Paradigm Shift in Disaster Management.
Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness.
During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation –
Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Stretegy, Hyogo Framework of Action.

Unit– IV: Disaster Management in India

Disaster Profile of India – Mega Disasters of India and Lessons Learnt.
Disaster Management Act 2005 – Institutional and Financial Mechanism,
National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national),Non-Government and Inter Governmental Agencies

Unit– V: Applications of Science and Technology for Disaster Management

Geo-informatics in Disaster Management (RS, GIS, GPS and RS).
Disaster Communication System (Early Warning and Its Dissemination).
Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non Structural Mitigation of Disasters
S&T Institutions for Disaster Management in India

References

1. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
2. Bhandani, R. K., An overview on natural & man-made disasters and their reduction, CSIR, New Delhi
3. Srivastava, H. N., and Gupta G. D., Management of Natural Disasters in developing countries, Daya Publishers, Delhi
4. Alexander, David, Natural Disasters, Kluwer Academic London
5. Ghosh, G. K., Disaster Management, A P H Publishing Corporation
6. Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

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.

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:

1. Understand actual operational challenges
2. Experience the working environment of a functional dairy plant
3. Apply theoretical knowledge in a professional setting

Reporting Requirements:

1. 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.

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	10	3,500

	Moving coil weston-type ammeter with ebonite stand		
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)	2,000

		2 (big)	
16.	Chemicals - EDTA-1 kg - Eriochrome Black-T(solochrome black T)-200g - Buffer solution (NH_3 - 2.5 ltr, NH_4Cl – 1 kg) - Zinc sulphate- 500g - H_2SO_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, Srew 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 scribers	4	24,000
3.	Surface plates	5	20,000
4.	Accessories like calipers, V blocks, height, gauges steel rules and scribers	25	50,000
5.	Tool kits – taps, dies, drills	25	40,000
6.	Tool kits – chiesels, 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 sleave 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 cost 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 cost 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 tapper, reamers, micrometers verniers, gear tooth verniers, dial gauges, calipers, steel rules and Hand Tools Such as hammers, chiesels 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.	Buretere (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 ^{0}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 seperater (Capacity 100 lts. per hour, hand operated)	1	30,000
2.	Cream seperator (capacity 100 lts per hour	1	40,000

	electrically operated)		
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 hour).	2	40,000
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.	Homogensier 50 lts/hour capacity	1	2,50,000
17.	Spray dryer with all accessories capacity100 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
	NOTE: 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.Ie. After 4th and 5th Semester respectively. **SPECIAL RECOMMENDATION:(Optional)** All the above equipments are costly and there is no meaning of seprate 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	One unit	Rs 30.00 Lakh

	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.		
21.	Miscellaneous	LS	40,000

Sr. No.	Description	Qty	Total Price (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 lits containing all sorts of tools	10	6,000
3.	Gage mainfeld (various sizes)	3	6,00
4.	Presure gages (low & high)	3	2,000
5.	Vaccum pump/4 H.P. with motor trolley type	2	6,000
6.	Gas charging slamp	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 wrnches etc.	10 Set	10,000
11.	Chargin Noses	30 Set	3,600
12.	Moisture indicators frenons	10	1,000
13.	Liquid indicators freons.	10 Set	1,000
14.	Moisture indicators Ammonia	2	1,50
15.	Copper tubing (A nealed) 1/4 dia	100 M	2,500
16.	Copper tubing (A nealed) 3/8 dia	50 M	1,500
17.	Copper tubing (A nealed) 1/2dia	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) diferent 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 haltide.	10	1,000
29.	Leak detector electronics	2	4,000
30.	Capacitiors 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 TY(Ammonia)	1	3,00
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

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 Jitendra Kumar, Lecturer, Dairy Engineering, Government Polytechnic Etawah.
3. Shri Gaurav Kumar Gaur, Lecturer, Dairy Engineering, Government Polytechnic Kotana Baghpat.
4. Shri Devendra Singh, Lecturer, Dairy Engineering, Government Polytechnic Kotana Baghpat.
5. Shri Gaurav Kishor Kanaujiya, Assistant Professor/Coordinator, IRDT Kanpur

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- 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