ACADEMIC REGULATIONS FOR BACHELOR OF TECHNOLOGY IN DAIRY TECHNOLOGY

B. Tech. (Dairy Technology) Degree Programme

(As perMinimum Standards of Indian Council of Agricultural Research of Sixth Deans' Committee)

2025

COLLEGE OF DAIRY SCIENCE

U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan (DUVASU), Mathura - 281001 (U.P.)

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FOREWORD

I am pleased to present the Academic Regulations for the **B.Tech. (Dairy Technology)** programme of the College of Dairy Science, DUVASU, Mathura, effective from 2025-26, and prepared as per the **ICAR Sixth Deans'** Committee recommendations. The revised curriculum aligns with the **National Education Policy (NEP-2020)**, with a focus on skill development, digital integration, and multiple entry-exit options to meet emerging national and global needs.

Established in **2024**, the College of Dairy Science is an important step toward meeting the growing demand for skilled professionals in the dairy and food sectors. Located in the sacred city of Mathura, the college aims to become aleading centre for dairy education, research and extension. The B.Tech. (Dairy Technology) programme, with an annual intake of 40 students, blends rigorously theory, hands-on practical, and **In-Plant Training** to build competencies across the dairy value chain – from milk production to processing and consumer delivery.

These Academic Regulations, approved by the Academic Council, provide a clear and student-friendly framework for an enriching academic experience. I appreciate the efforts of the faculty and administration in developing this document. I am confident it will guide students and staff in fostering academic excellence, innovation, and professional integrity.

(Abhijit Mitra)



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PREFACE

The College of Dairy Science, a constituent college of U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan (DUVASU) under the aegis of Uttar Pradesh Government, marks a significant milestone in addressing the growing demand for skilled dairy professionals in India. The college, located in the holy city of Mathura, aims to provide high-quality education and training in the field of dairy science. The college currently offers a four-year B.Tech. (Dairy Technology) programme with an intake capacity of 40 students per academic year. To ensure a holistic academic framework, the college has five specialized departments, viz., Dairy Technology, Dairy Engineering. Dairy Chemistry, Dairy Microbiology and Dairy Business Management.

The Academic Regulations outlined in this document have been meticulously prepared in alignment with the recommendations of the ICAR Sixth Deans' Committee as per National Education Policy (NEP 2020). It includes modification of academic structure as degree/diploma/certificate with multiple entry-and-exit system, flexible course selection, introduction of skill enhancement courses, making internship as part of UG-certificate and UG-diploma requirements and In-Plant training as part of UG-degree requirement. A course entitled '*Deeksharambh*' has been introduced to acquaint freshers with traditional values and culture. Common courses have been added for better communication skills and personality development. On-line courses have been introduced for advanced topics to strengthen knowledge and competency of the students. Progressive assessment in form of quiz/group assignment will add in critical thinking and problem-solving attitude of the students. Compulsory courses of NCC/NSS, study tour, physical education, first aid, yoga practices and meditation have been introduced for better social awareness and health of future generation. Inputs have been taken from other dairy science institutions across the country to develop a comprehensive and student-friendly framework.

This document is structured into five parts, viz. course of the study, admission criteria, academic requirements, examination and evaluation systems, and the organization of courses. It also addresses important facets of student discipline. anti ragging policies, and the prevention of harassment, ensuring a safe and conducive environment for learning.We are confident that these regulations will establish a strong foundation for the smooth operation of the college and offer a clear pathway for the academic progression of the students. We sincerely hope this document to support students, faculty, and administration in upholding the college vision of fostering excellence in dairy education and research.

(Rashmi Singh)

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(I) Sanction is accorded to implement the complete syllabus for the B. Tech. (Dairy Technology) degree programme in accordance with the ICAR Sixth Deans' Committee Report with the recommendations and approval from Academic Council, DUVASU for the Academic year 2025-26 onwards. However, any further amendment by ICAR or new Education Policy shall be adopted with approval from the Academic Council.

(II) a) U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura Act, 2001

b) U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura Statutes, 2005.

c) Academic Regulation for B. Tech. (Dairy Technology) Degree Programme 2025 of U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura.

PART–I : PRELIMINARY

1. Short Title and Commencement

(i) These regulations may be called as **"The Academic Regulations for B. Tech. (Dairy Technology) Degree Programme (College of Dairy Science) - 2025"** of 'U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura for the award of B. Tech. (Dairy Technology) Degree'.

(ii) These Regulations are in accordance with the recommendations of Sixth Deans' Committee of Indian Council of Agricultural Research (ICAR) for B. Tech. (Dairy Technology) Degree Programme.

(iii) They shall come in force from the academic year 2025-2026 and shall be applicable to all the student's getting admission from the year 2025-2026 and onwards.

2. **Definitions:** In these regulations unless the context otherwise requires:

a. **'Act'** means the DUVASU Act, 2001 and subsequent amendment/s made time to time.

b. **'Advisor'** means an academic staff member who will help a group of students assigned to him/her in planning of their studies and foster close personal relationship.

c. **'Course'** means teaching units of a subject to be covered within a semester of academic year as prescribed by the ICAR Sixth Deans' Committee in the syllabus of a department and it includes lecture and/or practical classes.

- **'Core Courses'** are the mandatory courses to be taken by all the students for completing their degree programme.
- **'Skill Enhancement Courses (SEC)'** means courses that will help in development of skills of the students and empower them to grasp viable avenues of self-employment and entrepreneurship along with diversified career options in different facets of related domains.
- **'Elective Courses'** are a bouquet of courses offered to the student as per interest to get deeper knowledge and understanding in the subject.
- **'Common Courses'** are the courses to be taken that will help in personality development and develop better communication skills of the students as well as to have a broader view of dairy sector for future collaboration.
- **'Online Courses/MOOC (Massive Open Online Courses)'** means courses to be taken by the student (minimum 08 credits) available on online platforms like SWAYAM, edX, Coursera, NPTEL, mooKIT, Diksha etc. based on the topics like advanced sciences, computing, data sciences, AI, machine learning, humanities etc.
- **'Non-Gradial (NG) course'** means mandatory course to be taken by the student for completion of the degree programme which will be evaluated as Satisfactory or Non-Satisfactory and the marks obtained will not be taken into account for calculation of grade point.

d. **'Course Content'** means a concise outline of the subject-matter of a Course.

e. **'Credit Hour'** means the weekly unit of work recognized for any particular course as per the course catalogue issued by the University. A lecture class of one hour per week shall be counted as one credit whereas a practical class of two hours duration per week shall be counted as one credit.

f. **'Credit load'** means the quantum of credits undertaken by a student in a semester.

g. **'Dean'** means the Head of the 'College of Dairy Science'.

h. **'Deeksharambh'** means a two-week induction-cum-foundation course for newly admitted students at the start of first semester offered as 2 (0+2), Non-Gradial credit hours. This will be a part of first semester for all purposes including the calculation of net instructional days.

i. **'Department'** means a unit of teaching and/or research and/or extension education of the college/institute/ center.

j. **'DUVASU Act, 2001'** means the U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan Act of 2001 and its amendment thereof.

k. **'Grade Point (GP)'** in a course means the total marks obtained by a student in a course divided by 10.

- **'Credit Point (CP)'** in a course means the Grade Point (GP) multiplied by the credit hours.
- **'Grade Point Average (GPA)'** means the sum of total credit points scored divided by the sum of the credit hours in a respective semester.
- **'Cumulative Grade Point Average (CGPA)'** means the sum of total credit points scored divided by the sum of credit hours till a particular semester.
- **'Overall Grade Point Average (OGPA)'** means the quotient of the total credit points obtained by a student in all courses during the degree programme divided by the total number of credit hours completed.

l. **'Guidelines or Instructions'** means the guidelines or instructions issued by the ICAR from time to time for uniform implementation of these regulations.

m. **'Head of the Department' (HoD)** means the academic staff member principally responsible for teaching, research and extension education in the Department of the College of Dairy Science.

n. **'In-charge of the department'** means the academic staff member who is working as in-charge of the department and is responsible for teaching, research and extension activities of his/her department.

o. **'In-Plant training'** for experiential learning for UG degree in 4th year (Eighth semester) having 0+20 credits.

p. **'Internship'** for exit programs after 1st year/ 2nd year of 10 weeks duration having 10 (0+10) credits.

q. **'Multiple entry and exit'** means an enabling mechanism where the student can exit after any level and join back to continue in the programme and acquire higher qualifications within a specified duration.

r. **'NCC'** means National Cadet Corps

s. **'NSS'** means National Service Scheme

t. **'Programme of Study'** means a series of coherent courses and related activities assigned to a student to meet the requirements of degree.

u. **'Qualifying Examinations'** means Higher Secondary (10+2) or equivalent examination conducted by State or Central Board of Education.

v. **'Semester'** means a term consisting of a minimum of 95 instructional days excluding the period of Semester-End Examinations. Condensed semesters with less duration can be sanctioned by the Vice Chancellor based on the proposal from the Dean.

w. **'Statute'** means the statute made under the U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan Act of 2001.

x. **'Student'** means a candidate who is enrolled in College of Dairy Science for B.Tech. (Dairy Technology) degree programme.

y. **'Syllabus'** and **'curriculum'** mean the syllabus and curriculum for courses of study as specified by the ICAR Sixth Deans' Committee or any amendments thereof.

z. **'Teaching Experience'** means the experience of teaching in the subject concerned in a recognized Dairy Technology College or provisionally recognized College of Dairy Science or recognized Dairy Technology university after obtaining post graduate qualification in the concerned/ related subject.

aa. **'Transcript'** is the consolidated report of grade points indicating OGPA secured by the student, issued by the University.

ab. **'University'** means U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura.

ac. **'UG-Certificate'** in Dairy Technology means a Certificate after completing one year of study (2 semesters) in B. Tech. (Dairy Technology) and internship of 10 weeks.

ad. **'UG-Diploma'** in Dairy Technology means a Diploma awarded after two years of study (4 semesters) in B. Tech. (Dairy Technology) and internship of 10 weeks.

ae. **'UG-Degree'** in B. Tech. (Dairy Technology) means a degree awarded after four years of study (8 semesters) in B. Tech. (Dairy Technology) including In-Plant Training.

af. **'Student READY Programs'** means different activities for Rural Entrepreneurship Awareness Development Yojana (READY), including In-Plant Training, Experiential Learning, Skill-Development, Project Work and Seminar recommended by ICAR-Sixth Deans' committee recommendations to the B.Tech.(Dairy Technology) students.

ag. **'Study Tour'** means an educational tour of 10-14 days offered during fifth semester as 0+2 Non-Gradial credit hours.

Note- Words and expressions used in the Act, Statutes and Regulations and not defined in these Regulations shall have the meaning assigned to them in the Act, Statutes and Regulations as the case may be.

PART – II : COURSE OF STUDY

3. **Degree Course**

3.1 **UG-degree** programme of B.Tech. (Dairy Technology) shall comprise of a course of study consisting of curriculum and syllabus specified by ICAR Sixth Deans' Committee recommendations applied for four years B.Tech. (Dairy Technology) degree.

a. The UG degree in B. Tech. (Dairy Technology) shall be of **172 credits (course work)** and **08 credits (online) (Total 180 credits)** spread over eight semesters including one semester to be spent by each student to gain work experience in dairy industry as **'In-Plant Training'** of 20 (0+20) credits (40 contact hours per week).

b. A non-gradial course of ***'Deeksharambh'*** of 0+2 credit hours will be compulsory during the 1st semester of degree programme.

c. Skill enhancement courses in form of multiple **'SEC modules'** shall be offered in all the four semesters of the first two years.

d. **'Core courses'**, 'Common Courses' shall be spread over eight semesters of the degree, whereas **'Elective Courses'** shall be offered in the seventh semester.

e. Common Courses shall be offered as Multi- Disciplinary Course (MDC), Value Added Course (VAC), Ability Enhancement Course (AEC).

f. **NCC/NSS** shall be offered in first year as gradial course.

g. **'Online courses'** can be chosen from various online platforms available and shall be non-gradial as separate certificates would be issued by institutes offering them. They can be taken any time during the duration of UG program, but preferably during the third and fourth years. If, there is any fee for online course, the payment of that course shall be borne by the student itself.

h. A non-gradial compulsory **'Study Tour'** of 0+2 credit hours (10-14 days) has to be completed by a student admitted to B.Tech (Dairy Technology) degree programme during 3rd year. The students will preferably visit the leading industries/enterprises/institutions/organizations and other places of academic interest.

3.2 **UG-Certificate in Dairy Technology:** Student who wants to exit after successful completion of 1st Year shall be issued a UG-Certificate in Dairy Technology after completing the course requirement of 40 credits in both the semesters and compulsory 'Internship' of 10 weeks comprising of 0+10 credit hours (20 contact hours per week).

3.3 **UG-Diploma in Dairy Technology:** Student who wants to exit after successful completion of 2nd Year shall be given a UG-Diploma in Dairy Technology after completing the course requirement of 80 credits in the four semesters and compulsory **'Internship'** of 10 weeks comprising of 0+10 credit hours (20 contact hours per week).

4. **Duration of B.Tech. (Dairy Technology) degree**

4.1 The minimum duration of B.Tech. (Dairy Technology) degree programme shall be **4 years (8 semesters).** The maximum period allowed for completion of B.Tech. (Dairy Technology) degree programme shall be **7 years (14 semesters).**

4.2 For UG-Certificate in Dairy Technology requirement is 1 year (2 semesters) and Internship of 0+10 credits (10 weeks).

4.3 For UG-Diploma in Dairy Technology requirement is 2 years (4 semesters) and Internship of 0+10 credits (10 weeks).

5. **Academic Calendar and Schedule for Semester**

5.1 The Academic Calendar and schedule for semester will be notified by the Dean, College of Dairy Science as approved by the Academic Council from time to time.

5.2 All the examinations shall be conducted as per the academic calendar.

PART -III: ADMISSION TO BACHELOR OF TECHNOLOGY (DAIRY TECHNOLOGY) DEGREE PROGRAMME IN COLLEGE OF DAIRY SCIENCE

6. **Criteria for Admission -** A candidate shall not be admitted to Bachelor of Technology (Dairy Technology) degree programme unless:

6.1 He or she has fulfilled the age criteria as specified by the university from time to time.

6.2 He or she has passed the qualifying examinations as specified by the university from time to time.

6.3 Admission to B. Tech. (Dairy Technology) degree programme shall be made on the basis of Undergraduate Entrance Examination (UGEE) or by any other examination conducted as specified by the university and amendment there of.

6.4 The number of seats for admission to the B. Tech. (Dairy Technology) degree programme shall be as per university norms.

7. **Selection of Students**

7.1 The selection of students for admission to B. Tech. (Dairy Technology) degree programme in the university shall only be on the basis of merit through UGEE.

7.2 To be eligible for UGEE, a candidate has to pass any of the qualifying examinations as enumerated in the prospectus of university in respective years.

7.3 The qualifying student has to appear for the counselling as per the notification by the university and according to merit secured in UGEE.

7.4 Reservation for the seats to B. Tech. (Dairy Technology) degree programme shall be as per the criteria notified by the university from time to time.

8. **Enrollment, Registration and Continuance**

8.1 Newly admitted students to B.Tech. (Dairy Technology) Degree Programme shall be enrolled on the date of counselling as notified by the Registrar of the university and the student shall deposit the prescribed university fees and other dues prior to registration.

8.2 The date of registration, commencement of instruction/classes, Semester-wise examination shall be determined by the Dean as approved by Academic Council from time to time and notified accordingly.

8.3 Fees levied on account of enrollment, tuition, hostel, students' council, examination and other items shall be as determined by the university from time to time.

8.4 Students selected provisionally for admission to B. Tech. (Dairy Technology) degree programme shall report to Dean before the last date notified for this purpose by the Registrar of the university.

8.5 For newly admitted students, the registration is a part of admission process and if any student fails to get registered in the specified period, the admission is liable to be cancelled, and admission will be offered to the next candidate in the waiting list.

8.6 **Registration shall consist of**

(a) The student must remain present himself/herself for the registration and in absentia registration will not be permitted in any case.

(b) Obtaining and filling up of registration cards indicating the subjects/ courses offered during the semester duly signed by the student, his/her advisor and course teachers.

(c) Payment of University/ College/ Hostel fees including electricity bill, if any, and other fees/ charges by the student.

(d) Submission of Registration Forms by the student in the Office of the Dean within specified time period.

(e) The Dean may refuse / cancel registration of the student who has indulged in any act of indiscipline or gross misconduct. The registration may also be cancelled by Vice Chancellor, if allowed by mistake/any other reason, on the recommendation of Dean/DSW/Registrar. Such students have to immediately vacate the hostel and leave the campus.

(f) **Special Provision For Newly Admitted Students:** Medical examination shall be compulsory for all the students admitted during the first year from the Civil Surgeon/Medical Officer/Registered Medical Practitioner as directed by the University / Dean on the date of counseling. If a student is medically unfit, the admission shall be denied by the admission committee.

(g) At any time during the B. Tech. (Dairy Technology) degree programme, the student may be directed to get himself/herself medically examined by the competent authority(s) as and when it may deem fit.

9. **Late Registration**

(a) A student seeking registration in a semester shall be permitted for late registration by the Dean on payment of a late fee as approved by Academic Council per day up to a period of 6 working days excluding the day notified for registration.

(b) No registration shall be permitted on the expiry of this period on any ground. After the last day of registration (including the period specified for late registration), the student shall not be permitted to register for that semester.

(c) Student having late registration shall complete the prescribed required attendance without any relaxation.

10. **Award of Degree and the Residential Requirement**

(a) For the award of degree of B. Tech. (Dairy Technology) the minimum permissible time limit shall be 4 years (8 semesters), while maximum permissible time limit shall be 7 years (14 semesters).

(b) Any year washed out on account of withdrawal/dropping by the student of his own due to any reason/failure to register in time/ medical grounds/use of unfair means/ dropped for any reason whatsoever shall be counted towards the maximum permissible limit of 7 years.

11. **Exit Options**

There will be three exit options available in the UG programme.

11.1 **Exit after 1st year: A** student may opt to exit after successful completion of the 1st year of UG programme. However, he/she has to complete 10 weeks of internship (0+10 credits) to be eligible for being awarded UG-Certificate in Dairy Technology. (The students going to the higher level need not take 10-week internship at this stage). Only maximum of 10% students based on the merit of first year result shall be allowed to exit.

11.2 **Exit after 2nd year: A** student may opt to exit after successful completion of the 2nd year of UG programme. However, he/she has to complete 10 weeks of internship (0+10 credits) to be eligible for being awarded UG-diploma in Dairy Technology. (The students going to the higher level need not take 10-week internship at this stage). Only maximum of 10% students based on the merit of first and second year results shall be allowed to exit.

11.3 **Exit after 4-years programme** will lead to B. Tech. (Dairy Technology) degree.

12. **Re-Admission of the Student**

A student whose semester has been washed out for any reason whatsoever as described above shall be able to resume his/her studies in the subsequent academic year or maximum within two years of leaving the college and he/she shall be treated as continuing student for all purposes provided:

(a) He/She has completed a minimum requirement of one semester.

(b) The total period of withdrawal shall not exceed two consecutive years (4 semesters) including the year in which he/she had withdrawn.

(c) He / She has obtained permission from the University authority for withdrawal and re-admission.

(d) Student can take re-admission only in the subsequent semester of next academic year.

(e) Any student failing to pass in first year, due to any reason including dropping the semester/year will be allowed to get re-admission in next year. However, he/she will be governed by the academic regulations applicable to the academic year in which he/she seeks re-admission.

(f) Re-admission shall be allowed only if his/her re-admission semester coincides with similar regular semester and is open for registration in the college.

(g) Fees of the gap period shall be paid by the student at the time of re-registration.

(h) Such permission and re-admission shall be granted only once during the B. Tech. (Dairy Technology) Degree by the competent authorities.

(i) Students who exit with a UG- Certificate or UG- Diploma are permitted to re-enter within two academic years and complete the degree programme, provided that no disciplinary action should have been taken against such student during his/her career in the college and have not joined any course in any other institution.

(j) If the course curriculum, in which the candidate has studied, is not in existence, the case of such student shall be placed before equivalence committee to be appointed by the Dean of the college. On the basis of report of this committee, re-registration of the students who gave up the studies shall be considered.

Note: The candidates with either UG-Certificate or UG-Diploma in Dairy Technology will have to surrender their original UG-Certificate or UG-Diploma in Dairy Technology while seeking re-admission and the same shall be returned after completion of B. Tech. (Dairy Technology).

13. **Dropping from the University:**

Student would be dropped from the University due to the following reason(s):

(a) If any student has more than two years gap of the discontinuation including the year of the dropping.

(b) If his/her registration has been cancelled due to his/her indulging in any act of indiscipline or gross misconduct as University norms prescribed in student's hand book.

(c) If student has not completed all courses in prescribed maximum duration of the degree (7 years) including the dropping period.

PART - IV

CURRICULUM-STRUCTURE AND ORGANIZATION OF COURSES

14 **Academic Requirement**

14.1 To receive a UG-Degree in B. Tech. (Dairy Technology), an enrolled student must complete the prescribed course credits, and he/she has an Overall Grade Point Average (OGPA) of 5.000 or higher in prescribed period.
To receive a UG-Certificate in Dairy Technology, an enrolled student must complete the prescribed course credits, and he/she has an Overall Grade Point Average (OGPA) of 5.000 or higher in prescribed period.
To receive a UG-Diploma in Dairy Technology, an enrolled student must complete the prescribed course credits, and he/she has an Overall Grade Point Average (OGPA) of 5.000 or higher in prescribed period.

14.2 One (1) course credit means one hour of theory lecture or two hours of laboratory for regular courses. However, in Internship / In-Plant Training one credit refers to one week. For example, 10 credit refer to 10 weeks of internship or 20 credit refers to 20 weeks of In-Plant Training.

15 **System of Teaching**

15.1 There shall be eight semesters during which the student shall complete the requirements of course credits under the semester system of teaching and continuous evaluation. The same shall run in four academic year's duration.

15.2 Each academic year shall be divided into two semesters consisting of a minimum of **95 instructional** days per semester excluding the period of End-Term Examinations.

15.3 The semester shall be announced in every academic calendar year by the Dean of the college. Suitable adjustment in a semester shall be made to accommodate festival vacation; summer vacation and other holidays as may be notified by the University /State Government.

15.4 The medium of instructions shall be English.

16 **Advisory / Counselling system**

16.1 Each student shall be assigned to an advisor by the Dean during the first semester. The advisor shall help the student in carrying out the programme of his/her studies. The students are expected to keep in constant touch with their advisors. The advisor shall monitor students' progress and guide them as and when needed during B.Tech. (Dairy Technology) Degree Programme.

16.2 The advisor shall bring to the notice of the Dean in the problem cases needing special measures.

17 **Course Curriculum**

17.1 The details of the courses, credits and curriculum of the course shall be as determined by the Academic Council in consultation with the Board of Faculty, College of Dairy Science from time to time. The distribution of courses for each semester shall be such as may be decided by the university from time to time.

17.2 A student enrolled in the university for UG-Degree / UG-Diploma /UG-Certificate in Dairy Technology shall be required to pursue the prescribed course curriculum.

A. **B. Tech. (Dairy Technology)** degree includes:

a. Deeksharambh (Introduction-cum-foundation course) of 0+2 credits as Non-Gradial will be offered at the start of first semester for duration of two weeks. **This will be a part of first semester for all purposes including the calculation of Net Instructional Days (NIDs).**

b. Core Courses are the mandatory courses to be taken by all the students for completing their degree programme.

c. Students will have flexibility and choice in selection of skill enhancement courses from a bouquet of multiple 'SEC modules' offered in 1st and 2nd year as part of the course programme.

d. Elective Courses offered to the student as per interest with a minimum 8 credits in seventh semester.

e. Common Courses offered as Multi- Disciplinary Course (MDC), Value Added Course (VAC), Ability Enhancement Course (AEC).

f. Online Courses to be taken by the student of minimum 08 credits as Non-Gradial available on online platforms like SWAYAM, edX, Coursera, NPTEL, mooKIT, Diksha etc.

g. Study tour to be taken as a non-gradial compulsory course of 0+2 credit hours (10-14 days) in the 3rd year.

h. In-Plant Training of 0+20 credits in 4th year (eighth semester) is to be carried out at a Dairy Processing Plant.

Note: A student shall be required to study all the courses including Compulsory Non-gradial (NG) Course and to earn total credits (180) specified for the degree programme inclusive of the online courses (08 credits). However, the credits of NG courses will not be included in OGPA of the degree.

B. **UG-Certificate** in Dairy Technology includes

a. *Deeksharambh*
b. Core Courses
c. Common Courses
d. Skill Enhancement Courses
e. Internship of 10 weeks duration (0+10 credits)

Note: A student shall be required to study all prescribed courses including Compulsory Non-gradial (NG) Course and to earn minimum credits (40) specified for the programme inclusive of internship of 10 weeks duration. However, the credits of NG courses will not be included in OGPA of the degree.

C. **UG-Diploma** in Dairy Technology includes
   a. *Deeksharambh*
   b. Core Courses
   c. Common Courses
   d. Skill Enhancement Courses
   e. Internship of 10 weeks duration (0+10 credits)

Note: A student shall be required to study all prescribed courses including Compulsory Non-gradial (NG) Course and to earn minimum credits (80) specified for the programme inclusive of internship of 10 weeks duration. However, the credits of NG courses will not be included in OGPA of the degree.

D. **Internship** for exit programs after 1st year/ 2nd year of 10 weeks duration having 0+10 credits (20 contact hours per week). It shall be preferably arranged outside of the parent institution at any assigned organization/ industry/ research institution/ dairy enterprise, etc. Internship can be in one of the following three areas:
   a. Dairy Products Processing
   b. Dairy Plant Maintenance
   c. Milk Quality Testing

E. **In-Plant Training** of 0+20 credits in 4th year (eighth semester) is to be carried out at a Dairy Processing Plant. It shall be preferably arranged outside of the parent institution at any assigned organization/ industry/ research institution/ dairy enterprise, etc.

18 **Attendance**

18.1 The minimum percentage of attendance required to appear in the Semester-End Examination shall be 75 percent in each course separately in theory and practical classes.

18.2 Instructor(s) shall maintain a record of the students' attendance in each course taught by him/her in each semester for theory and practical separately. The students falling short of attendance be apprised of their position on monthly basis by the instructor(s) in the class and also through the notice board/university website with a copy to the class in-charge and Dean. At the end of each semester, the instructor(s) shall notify the consolidated attendance of the course(s) taught by him/her after giving benefit of attendance, if any and submit the same to the in-charge of the concerned class as well as the Dean through the HOD concerned.

18.3 A student falling short of attendance in any one or more course shall not be permitted to appear in the Semester-End Examination of course(s) registered and shall be declared fail in that/ those course(s).

18.4 **Attendance Benefit**

   a. The minimum percentage of attendance required to appear in the Semester- End Examination shall be 75 percent in each course separately in Theory and Practical classes. The maximum relaxation in attendence for NCC/NSS/NSO, Co-curricular activities and medical ground or any

other permitted leave is 25% from the competent authority. However, 75 percent attendance is essential to appear in the Semester-End Theory Examination after the relaxtion.

b. A Student whose attendance in a course falls short of the requirements shall be deemed to have dropped the course and will be declared Fail in that course. He/she will not be allowed to appear in the Semester-End Examination of the concerned course(s) and shall have to repeat the course(s).

19 **Division and Honors**

The award for UG-degree in B. Tech. (Dairy Technology) and UG-Certificate in Dairy Technology/ UG-Diploma in Dairy Technology shall be based on the OGPA score obtained by the candidates and shall be governed by the following criteria:

A student shall secure qualifying marks of 50% **separately in theory and practical in each course to pass**. To be qualified to earn UG-Degree/ UG-Certificate/UG-Diploma he/she must secure an OGPA of minimum 5.000 on 10-point scale.

OGPA	**Division**
8.000 and above	First division with distinction
7.000 – 7.999	First division
6.000 – 6.999	Second division
5.000 – 5.999	Pass
Less than 5.000	Fail

Note: The online/MOOC courses, successfully completed by the student, will be indicated in the transcript with 'Satisfactory (S)' or 'Unsatisfactory (US)' remark. 'S' or 'US' grade in non gradial courses will have no effect on GPA/OGPA.

20 **Examination and Evaluation**

20.1 The types of examinations as per the credit hour is as under:

1. Mid-term theory examination
2. Cumulative total of quiz/progressive assessment
3. Practical Examination
4. End-term theory examination
5. Examination or evaluation for the Internship and/ or In-Plant training: It shall be conducted by the constituted committee by the Dean at the end of each activity.

20.2 There shall be a uniform system of the evaluation and grading to be followed with Grade Point Average (GPA) system as given in the Table below;

	End-term theory exam (External)	Mid-term theory Exam (Internal)	Quiz/Prog-ressive Assessm-ent (Internal)	Final Practical (Internal)
For courses having both theory and practical components	40%	20%	20%	20%
For courses with theory only	50%	30%	20%	------
Courses with practical only	------	------	20%	80%

20.3 **Duration and pattern of examinations:**
The sequence of Internal and Semester-End Examination shall be as follows:

A. **Courses having Theory and Practical:** The sequence of the examinations of the courses having theory and practical shall be as under:

1. First quiz (10 minutes)/ progressive assessment (group assignment) - 10 % weightage
2. Mid-term theory examination (1 hour) - 20 % weightage
3. Second quiz (10 minutes)/ progressive assessment (group assignment) - 10 % weightage
4. Practical examination (2 hours) - 20 % weightage
5. End-term theory examination (2.5 hours)- 40 % weightage

B. **Courses having theory only:** The sequence of the examinations of the courses having theory only shall be as under:

1. First quiz (10 minutes)/ progressive assessment (group assignment) - 10 % weightage
2. Mid-term theory examination (1 hour)- 30 % weightage
3. Second quiz (10 minutes)/ progressive assessment (group assignment) - 10 % weightage
4. End-term theory examination (2.5 hours)- 50 % weightage

C. Courses having practical only:

1. First quiz (10 minutes)/ progressive assessment (group assignment) - 10 % weightage
2. Second quiz (10 minutes)/ progressive assessment (group assignment) - 10 % weightage
3. End-term practical examination (2.5 hours)- 80 % weightage

▶ Note: if a student scores less than 50 % marks in any one quiz, he/she can opt for a final third quiz within the instructional days. This is applicable only for Quiz Examination.

20.4 **The pattern of the question paper for different types of the examination is as under:**
Mid-term Theory examination (Internal):

Objective questions (Part A) shall be 40 % for 20 minutes.

Descriptive questions (Part B) shall be 60 % for 40 minutes

- The examination shall include Objective type questions (Fill in the blanks/ True or False/ Match the following /Multiple choice questions or any other types) and descriptive type questions (Definition/Abbreviations/Differentiations/short notes/Justifications/ Long/ Detailed questions or any other types)

Practical examination (Internal)

- The practical examination shall include spotting/Quiz/Laboratory working exercise/practical record/ Assignment/ Viva-voce or any other types.

End-term theory examination (External)

Objective questions (Part A) shall be 40 % for 30 minutes.
Descriptive questions (Part B) shall be 60 % for 120 minutes

- The End-term theory examination shall include Objective type questions (Fill in the blanks/ True or False/ Match the following /Multiple choice questions or any other types) and descriptive type questions (Definition/Abbreviations/ Differentiations/ short notes/ Justifications/ Long/ Detailed questions or any other types)

Internship / In-Plant Training

a. Internship / In-Plant Training shall be undertaken in the specified semesters. Consent from the parents of the respective student is required for attending in these activities. An approval is also required from the University authorities for engaging the students in these activities.

b. Examination for Internship / In-Plant Training shall be conducted by the committee constituted by the Dean at the end of each activity.

20.5 **Conduct of examination**

a. Mid-term theory examination and Final Practical examination shall be conducted as per Academic calendar / schedule decided by COE during the instructional days. However, End-term theory examination shall be conducted as per the notification from the COE according to the schedule at the end of the semester.

b. Quiz / progressive assessment shall be conducted by the instructor concerned with prior information to the students. The course instructor(s) in consultation with the HoD shall notify the schedule at least 06 working days for the information of students and others concerned.

c. The practical examination shall be conducted by the course instructor and one faculty, if available, nominated by the HoD of the concerned department.

d. The end-term theory question paper shall be obtained from external expert who shall set the paper according to the course content provided. The external examination shall cover the entire subject matter of the course.

20.6 **Moderation in question paper of Semester-end examination (Theory):** A maximum of two questions is allowed for moderation in the descriptive portion of the End-term examination maximum up to 10 %. The moderation of the question paper shall be done within the examination by the Course Instructor with consent of Dean and COE, if he/she finds any portion in question paper beyond the prescribed syllabus.

20.7 **System of Evaluation**

The evaluation of a student shall be carried out on the basis of the marks obtained in mid-term (internal), practical and end-term examination (external) including Internship / In-Plant training.

A. **Evaluation of answer books of Mid-term theory and quiz/progressive assessment:** The answer books of Mid-term theory and quiz/progressive assessment shall be evaluated by the concerned course teacher. Course teacher shall send the marks of statement in the prescribed format to the COE through HOD/ In-Charge and Dean of the College.

B. **Evaluation of answer books of End-Term theory examination:** The answer books of End-term theory examination shall be evaluated by the internal examiner(s) as appointed by the COE and the result shall be submitted in the prescribed format to the COE.

C. **Evaluation of answer books of Practical and quiz/progressive assessment:** The answer books of Practical and quiz/progressive assessment shall be evaluated by the instructor(s)/committee, as the case may be and the marks shall be submitted to the COE through HoD/ In-Charge and Dean of the College.

D. **Evaluation of SEC:** The evaluation of the skill enhancement courses (SEC) shall be done as courses with practical only.

E. **Evaluation of Internship/ In-Plant Training:** The evaluation of internship / In-Plant Training shall be done by the committee constituted by the Dean. The student shall submit a report to the committee and present the learnings before the other students and faculty after the Internship / In-Plant Training programme. The format of evaluation may be developed by the constituted committee.

Internship/ In-plant training	
Evaluation criteria	**Distribution of Marks (%)**
Viva - Voce	25
Written examination	25
Documentation of Report & Presentation	50
Total	**100**

Activity Instructor shall submit the result to the COE through HOD or In-Charge and Dean of the college.

F. **Evaluation of online/MOOC** courses shall be non-gradial as separate certificates would be issued by institutes offering them. The confirmation and compilation of details pertaining to online/MOOC courses, successfully completed by the student, shall be submitted by course instructor to the COE through Dean of the college.

G. COE office of the university shall compile the result and declare it. Strict confidentiality shall be maintained for evaluation and submission of marks.

21 **Scrutiny of End-term theory examination results**

a. There shall be a provision of scrutiny of marked answer book(s) of End-term theory examination only.
b. A student may apply for scrutiny as per the notification of the COE and after the prescribed fee.
c. Scrutiny will be done only for totaling of marks and for unchecked questions only for end-term theory examination.

22 **Credits and Grade Point**

22.1 Grading and Evaluation will be in "Ten-point scale".

22.2 The grade point for a course is obtained by dividing the combined marks of all examinations by ten and correcting it to the third decimal.

22.3 The minimum grade point required for passing a course shall be 5.000. A student getting less than 5.000 shall be deemed to have failed in that course and actual grade shall be indicated in the grade report against the credit point obtained.

22.4 **The calculation for GPA/CGPA/OGPA shall be as follows:**

The percentage-marks obtained by the student in each course is converted to Grade Points by dividing the total marks with ten.

To calculate the Grade Point Average (GPA) of a semester, the grade points of respective course is multiplied by its credit hours to obtain the credit points. The sum of the total credit points divided by the total number of credit hours of all the courses shall be the GPA.

To calculate the Cumulative Grade Point Average (CGPA) till the current semester, the sum of the credit points secured by the student in all the courses registered up to the current semester is divided by the total number of credit hours of all the courses registered up to the current semester.

To calculate the Overall Grade Point Average (OGPA) at the end of last semester, the sum of the credit points secured by the student in all the courses registered in all the semesters is divided by the total number of credit hours of all the courses registered in all the semesters.

23 **Promotion of students**

23.1 **Pass**

a. A student obtaining 50% and above marks in theory (cumulative total of quiz/progressive assessment + mid-term theory + end-term theory) and

practical examination separately shall be declared pass in the relevant course(s).

b. If a student is unable to maintain 5.000 OGPA at the end of any academic year, he/she will be declared fail in that class and shall be re-admitted in the same academic year.
c. A student who is not able to full fill the attendance in a course shall be declared fail in that course.
d. Withdrawal/ absence for any reason from the semester practical examination and or semester-end examination of any course(s) shall be counted as failure in the said course/ courses.
e. It is mandatory to score satisfactory in all the Non-Gradial (NG) courses for the award of the degree. If, he/ she does not score satisfactory in NG course/courses then he/she has to re-register same course/courses as and when offered.

23.2 **Repeat examination**

a. The student failing in a course shall have to register that course as a regular teaching course when offered in routine.
b. Repeat course(s) can be taken by the student any number of times subject to not exceeding the maximum permissible residential requirements.
c. A student shall not be permitted to register more than 27 credits (with a margin adjustment of one credit only) in a semester including course/course registered as repeat course. For registration of repeat course(s), the final recommendation made by Dean shall be final.
d. Maximum permissible time limit shall be 7 years (14 semesters).

23.3 **Registration for In-plant training**

a. To be eligible for registering for the In-plant training, the students should have passed all the courses successfully up to 7th semester. No student should be allowed to take up the In-plant training with backlog/repeat courses.
b. If a student fails to register for In-Plant training due to any reasons, he/she shall be offered another chance only in the next session.

Note: A student with backlog/repeat courses of any semester will be given an opportunity to register in eighth semester and clear the backlog/repeat courses before undergoing In-plant training. This will not be applicable for those students who have backlog courses due to shortage of attendance.

24 **Eligibility for the degree**

24.1 A student is deemed to have completed the requirement for graduation and shall be eligible for the award of B.Tech. (Dairy Technology) Degree from university provided, if

(i) He/she has satisfied all the rules of evaluation as prescribed by the university.
(ii) He/she has earned credits specified for the different creditable courses of the degree programme inclusive of In-Plant training.

(iii) He/she has obtained satisfactory grades specified for the degree programme in on-line courses.

(iv) He/she has undertaken Deeksharambh and study tour.

(v) He/she has paid all fees as prescribed by the University.

(vi) There is no case of indiscipline pending against him/her.

(vii) He/she has completed the minimum residential requirement of eight semesters excluding any dropped semester.

24.2 A student is deemed to have completed the requirement for UG-Certificate and shall be eligible for the award of UG-Certificate (Dairy Technology) from university provided, if

(i) He/she has satisfied all the rules of evaluation as prescribed by the university.

(ii) He/she has earned credits specified for the different creditable courses of the degree programme inclusive of Internship.

(iii) He/she has undertaken Deeksharambh.

(iv) He/she has paid all fees as prescribed by the University.

(v) There is no case of indiscipline pending against him/her.

(vi) He/she has completed the minimum residential requirement of two semesters excluding any dropped semester.

24.3 A student is deemed to have completed the requirement for UG-Diploma and shall be eligible for the award of UG-Diploma (Dairy Technology) from university provided, if

(i) He/she has satisfied all the rules of evaluation as prescribed by the university.

(ii) He/she has earned credits specified for the different creditable courses of the degree programme inclusive of Internship.

(iii) He/she has undertaken Deeksharambh.

(iv) He/she has paid all fees as prescribed by the University.

(v) There is no case of indiscipline pending against him/her.

(vi) He/she has completed the minimum residential requirement of four semesters excluding any dropped semester.

25 **Medals and Awards**

S. No.	Medals	Qualifications
1	**Gold Medal**	Student who has secured first highest OGPA during B.Tech. (Dairy Technology) degree in first attempt without any conduct of probation or any disciplinary action.
2	**Silver Medal**	Student who has secured second highest OGPA during B.Tech. (Dairy Technology) degree in first attempt without any conduct of probation or any disciplinary action.

3	**Bronze Medal**	Student who has secured Third highest OGPA during B.Tech. (Dairy Technology) degree in first attempt without any conduct of probation or any disciplinary action.

Book Prize: As per University Student's Handbook and its amendments thereof

26 **Disqualification for Award of the Degree**
Students who have been convicted in any cognizable offence(s) as per the University rules, shall be debarred from receiving degree.

27 **Student's Discipline:** As per University Student's Handbook

28 **Unfair Means:** As per University Student's Handbook

29 **Students' Responsibilities:** As per University Student's Handbook

30 **Maintenance of the Discipline Among the Students:**
As per University Student's Handbook

31 **Prohibition and Prevention of Ragging:** As per University Student's Handbook

32 **Protection Against Harassment to Girl's Student:** As per University Student's Handbook

33 **Amendment to the Regulation**
This regulation is based on the minimum standard of education and recommendations of the ICAR-Sixth Deans' committee and any other amendments made by the Academic Council, DUVASU from time to time shall be incorporated in this regulation.

34 **Repeal and Savings**
The regulations, for the award of B.Tech. (Dairy Technology) Degree as amended from time to time and in existence on the date on which this regulation comes into force, shall hereby repealed.

PART V:
COURSES AND COURSE CONTENTS

35. DEPARTMENTS

I. Department of Dairy Technology
II. Department of Dairy Engineering
III. Department of Dairy Chemistry
IV. Department of Dairy Microbiology
V. Department of Dairy Business Management

36. CREDITS ALLOCATION SCHEME OF B.TECH. (DAIRY TECHNOLOGY)

(Credit Hours)

Table: Credits Allocation Scheme of B.Tech. (Dairy Technology) Program (Credit Hours)

Sem-ester	Core Courses	Common courses			Skill Enhancement Course (SEC)	In-Plant Training	Total Credits	Non-Gradial	Internship	Online Courses/ MOOC
		Multi-Disciplinary Course (MDC)	Value Added Course (VAC)	Ability Enhancement Course (AEC)						
I	09	$_3(2)$	$_3(10)$	$_1(3) + _2(4)$	4	-	22	$_2(1)$		08
II	15	-	$_3(6)$	$_1(3) + _2(7)$	4	-	25	-	$_{10}(12)$	
III	14	$_3(9)$	-	$_2(8)$	2	-	21			
IV	17	$_3(5)$	-	----	2	-	22	-	$_{10}(13)$	
V	22	-	-	-	-	-	22	$_2(11)$		
VI	20	-	-	-	-	-	20	-		
VII	20	-	-	-	-	-	20	-		
VIII	-	-	-	-	-	20	20	-		
Total	117	9	6	8	12	20	172	4		08

Note: The credit hours mentioned in the table includes both theory and practical.

(1) *Deeksharambh* (Induction-cum-Foundation Course) of 2 credits (2 weeks' duration).
(2) Farming Based Livelihood Systems
(3) NCC/NSS (I& II)
(4) Communication Skills
(5) Entrepreneurship Development and Business Management
(6) Environmental Studies and Disaster Management
(7) Personality Development
(8) Physical Education, First Aid and Yoga Practices
(9) Agriculture Marketing & Trade
(10) Agricultural Informatics and Artificial Intelligence
(11) Study tour (10-14 days)
(12) Only for those opting for an exit with UG-Certificate
(13) Only for those opting for an exit with UG-Diploma

37. SUMMARY OF CREDIT DISTRIBUTIONS

Type of courses		Credits
Core courses (Major and Minor/s)	:	117
Common courses (MDC+VAC+AEC)	:	23
Skill Enhancement Courses (SEC)	:	12
In-Plant Training	:	20
**MOOCS/Online courses	:	08
Total	**:**	**172 + 08****

The credits of Deeksharambh (0+2) and Study tour (0+2) have not been included in the total 180 credit hours.

38. DEPARTMENT-WISE COURSES

I. Department of Dairy Technology

Course category	Course title	Credit Hours
Core Courses	Market milk	4 (3+1)
	Traditional Indian Dairy Products	3 (2+1)
	Fat Rich Dairy Products	3 (2+1)
	Condensed and Dried Milks	4 (3+1)
	Cheese Technology	5 (3+2)
	Ice Cream and Frozen Desserts	3 (2+1)
	Dairy By Product Technology	3 (2+1)
	Packaging of Dairy Products	2 (1+1)
	Sensory Evaluation of Dairy Products	2 (1+1)
	Dairy Plant Management and Pollution Control	2 (1+1)
	Food Technology I	3 (2+1)
	Food Technology II	3 (2+1)
SEC modules	Operation of dairy evaporators and dryers	2 (0+2)
	Operation of liquid milk processing system	2 (0+2)
	Operation of ice cream freezers, ice candy making unit and their packaging	2 (0+2)
	Packaging of milk and milk products	2 (0+2)
	Technology of heat and acid coagulated milk products	2 (0+2)
	Canning and Sterilization systems for Dairy and Food Applications	2 (0+2)
	Extrusion Processing in Dairy and Food Industry	2 (0+2)
	Calibration of Dairy Equipments/Instrument	2 (0+2)

II. Department of Dairy Engineering

Course category	Course title	Credit Hours
Core Course	Workshop Practice	2 (1+1)
	Fluid Mechanics	2 (1+1)
	Engineering Drawing	1 (0+1)
	Thermodynamics	3 (2+1)
	Heat and Mass Transfer	3 (2+1)
	Basic Electrical Engineering	3 (2+1)
	Refrigeration and Air conditioning	3 (2+1)
	Dairy Engineering	3 (2+1)
	Dairy Process Engineering	3 (2+1)
	Instrumentation and Process Control	3 (2+1)
	Food Engineering	3 (2+1)
	Strength of Materials and Dairy Machine Design	3 (2+1)
	Dairy Plant Design and Layout	2 (1+1)
	Energy Conservation and Management	2 (1+1)
SEC modules	Electrical Power Supply and Distribution in Dairy plant	2 (0+2)
	Introduction to AutoCAD/Solids works, Ansys, CFD for Design of Dairy machines and Layout	2 (0+2)
	Electrical and Control Systems in Dairy Plant	2 (0+2)
	Design, Operation and Maintenance of Cold Storage, Ice Bank tanks, Ice silo and refrigeration plant in Dairy plant	2 (0+2)

III. Department of Dairy Chemistry

Course category	Course title	Credit Hours
Core Courses	Biochemistry and Human Nutrition	2 (1+1)
	Physical Chemistry of Milk	2 (1+1)
	Chemistry of Milk	3 (2+1)
	Chemistry of Dairy Products	2 (1+1)
	Chemical Quality Assurance	2 (1+1)
	Food Chemistry	3 (2+1)
SEC modules	Basic aspects of milk and milk products testing	2 (0+2)
	Nutritional evaluation of milk and milk products	2 (0+2)
	Malpractices in dairy industry: detection & control	2 (0+2)
	NABL Accreditation of laboratory	2 (0+2)

IV. Department of Dairy Microbiology

Course category	Course title	Credit Hours
Core Courses	Fundamentals of Microbiology	2 (1+1)
	Microbiology of Fluid Milk	2 (1+1)
	Microbiology of Dairy Products	2 (1+1)
	Quality and Safety Monitoring in Dairy Industry	3 (2+1)
	Starter Culture and Fermented Dairy Products	2 (1+1)
	Food and Industrial Microbiology	2 (1+1)
	Food safety and hygiene	2 (0+2)
	Preparation and management of starter cultures for fermented milk products	2 (0+2)
SEC modules	Basic microbiological tests for quality of milk and milk products	2 (0+2)
	ISO 22000: Food Safety Management System	2 (0+2)
	FSSAI rules and regulations	2 (0+2)
	NABL Accreditation of laboratory	2 (0+2)
	BIS certifications for the dairy industry	2 (0+2)

V. Department of Dairy Business Management

Course category	Course title	Credit Hours
Core Courses	Farming based Livelihood System	3 (2+1)
	Agricultural Informatics and Artificial Intelligence	3 (2+1)
	Environmental Science and Disaster Management	3 (2+1)
	Communication Skills	2 (1+1)
	Personality Development	2 (1+1)
	ICT in Dairy Industry	2 (1+1)
	Operations Research	2 (1+1)
	Economic Analysis	2 (2+0)
	Agriculture Marketing and Trade	3 (2+1)
	Entrepreneurship and Business Management	3 (2+1)
	Financial Management and Cost Accounting	3 (2+1)
SEC modules	International dairy trade	2 (0+2)
	Brand awareness: Major dairy companies and their brands	2 (0+2)
	Understanding operations of a sweet shop	2 (0+2)
	Market Survey on dairy and related aspects	2 (0+2)
	Market research: tools and techniques	2 (0+2)

39. Elective courses

(Total 8 credits of electives are to be taken out of the following indicative courses)

Elective courses	Credit Hours	Course Code
Fundamentals of Dairy Extension	2 (1+1)	DBM-411
Industrial Statistics	2 (1+1)	DBM-412
Dairy Biotechnology	2 (1+1)	DM-411
Instrumental Technique in Food Analysis	2 (1+1)	DC-412
Food Additives and Preservatives	2 (1+1)	DC-413
Design and Formulation of Foods	3 (2+1)	DT-413

40. SEMESTER-WISE DISTRIBUTION OF COURSES

First Year (Semester-I)				
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Total Credit hours**
1.	NG-1	*Deeksharambh* (Foundational two-week orientation course)	2 (0+2) NG	22 (9+13) + 2 (Non Gradial)
2.	DE-111	Workshop Practice	2 (1+1)	
3.	DE-112	Fluid Mechanics	2 (1+1)	
4.	DE-113	Engineering Drawing	1 (0+1)	
5.	DM-111	Fundamentals of Microbiology	2 (1+1)	
6.	DC-111	Physical Chemistry of Milk	2 (1+1)	
7.	DBM-111 (VAC-1)	Agricultural Informatics and Artificial Intelligence	3 (2+1)	
8.	DBM-112 (AEC-1)	Communication Skills	2 (1+1))	
9.	DBM-113 (MDC-1)	Farming Based Livelihood System	3 (2+1)	
10.	NCC-111 / NSS-111 (AEC-2)	NCC-I / NSS-I	1 (0+1)	
11.	SEC-111	Skill Enhancement Course*	2 (0+2)	
12.	SEC-112	Skill Enhancement Course*	2 (0+2)	

- 09 Credit for Core (Basic) Courses (2,3,4,5,6)
- 09 Credit for Common Courses: (7,8,9,10)
- 04 Credit for Skill Enhancement Course (SEC) (11& 12)
- *SEC courses will be decided by the Dean from the list of SEC modules.

Semester - II				
1.	DT-121	Market Milk	4 (3+1)	
2.	DE-121	Heat & Mass Transfer	3 (2+1)	
3.	DE-122	Basic Electrical Engineering	3 (2+1)	
4.	DM-121	Microbiology of Fluid milk	2 (1+1)	
5.	DC-121	Chemistry of Milk	3 (2+1)	**25 (13+12)**
6.	DBM-121 (VAC-2)	Environmental Studies and Disaster Management	3 (2+1)	
7.	DBM-122 (AEC-3)	Personality Development	2 (1+1)	
8.	NCC-121/ NSS-121 (AEC-4)	NCC-II / NSS-II	1 (0+1)	
9.	SEC-121	Skill Enhancement Course*	2 (0+2)	
10.	SEC-122	Skill Enhancement Course*	2 (0+2)	

- 15 Credit for Core (Basic) Courses (1,2,3,4,5)
- 6 Credit for Common Courses (6,7,8)
- 4 Credit for Skill Enhancement Course (SEC) (9& 10)
- *SEC courses will be decided by the Dean from the list of SEC modules.

INT-1 Internship (10 weeks) 10 (0+10)* **10 (0+10)***
*Compulsory Internship for students exercising exit option (UG-Certificate) after I Year

Second year (Semester-III)				
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Total Credit hours**
1.	DT-211	Traditional Indian Dairy Products	3 (2+1)	
2.	DE-211	Thermodynamics	3 (2+1)	
3.	DE-212	Dairy Engineering	3 (2+1)	
4.	DE-213	Refrigeration & Air-conditioning	3 (2+1)	
5.	DM-211	Starter Culture and Fermented Dairy Products	2 (1+1)	**21 (11+10)**
6.	AEC-5	Physical Education, First Aid and Yoga Practices and Meditation	2 (0+2)	
7.	DBM-211 (MDC-2)	Agriculture Marketing and Trade	3 (2+1)	
8.	SEC-211	Skill Enhancement Course*	2 (0+2)	
9.	NSS-211	NSS-III	1 (0+1)	Non-Gradial

- 14 Credit for Core (Basic) Courses (1,2,3,4,5)
- 05 Credits for Common Courses (6 & 7)
- 02 Credit for Skill Enhancement Course (SEC) (8)
- *SEC courses will be decided by the Dean from the list of SEC modules.

Semester - IV				
1.	DT-221	Cheese Technology	5 (3+2)	
2.	DT-222	Fat Rich Dairy Products	3 (2+1)	
3.	DT-223	Ice-cream & Frozen Desserts	3 (2+1)	
4.	DC-221	Chemistry of Dairy Products	2 (1+1)	
5.	DM-221	Microbiology of Dairy Products	2 (1+1)	**22 (12+10)**
6.	DBM-221	ICT in Dairy Industry	2 (1+1)	
7.	DBM-222 (MDC-3)	Entrepreneurship Development and Business Management	3 (2+1)	
8.	SEC-221	Skill Enhancement Course*	2 (0+2)	
9.	NSS-221	NSS - IV	1 (0+1)	Non Gradial

- 18 Credit for Core (Basic) Courses (1, 2, 3, 4, 5, 6)
- 3 Credits for Common Course (7)
- 2 Credit for Skill Enhancement Course (SEC) (8)
- *SEC courses will be decided by the Dean from the list of SEC modules.

INT-2 Internship (10 weeks) 10 (0+10)** **10 (0+10)****

**Compulsory Internship for students exercising exit option (UG-Diploma) after 2nd Year Student taking various modules will get a Certificates with Nomenclature as follows-

- Milk and Milk Products Processing
- Dairy Plant Maintenance
- Milk Quality Testing

Semester-V				
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Total Credit hours**
1.	DT-311	Condensed & Dried Milks	4 (3+1)	
2.	DT-312	Dairy By-products Technology	3 (2+1)	
3.	DM-311	Quality and Safety Monitoring in Dairy Industry	3 (2+1)	**22 (15+7)**
4.	DC-311	Chemical Quality Assurance	2 (1+1)	+
5.	DE-311	Instrumentation and Process Control	3 (2+1)	**2 (Non Gradial)**
6.	DE-312	Dairy Process Engineering	3 (2+1)	
7.	DBM-311	Operations Research	2 (1+1)	
8.	DBM-312	Economic Analysis	2 (2+0)	
9.	NG-2	Study Tour*	2 (0+2) NG	
10.		Online Course**		

- 22 Credit for Core (Basic) Courses (1, 2, 3, 4, 5, 6, 7, 8)
- *2 credit (Non-gradial) for Study tour (10-14 days during semester break)
- ** Courses listed under Online Courses may be offered as per the availability.

Semester-VI				
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Total Credit Hours**
1.	DT-321	Dairy Plant Management and Pollution Control	2 (1+1)	
2.	DE-321	Strength of Materials & Dairy Machine Design	3 (2+1)	
3.	DBM-321	Financial Management & Cost Accounting	3 (2+1)	
4.	DM-321	Food and Industrial Microbiology	2 (1+1)	**20 (12+8)**
5.	DT-322	Packaging of Dairy Products	2 (1+1)	
6.	DT-323	Food Technology - I	3 (2+1)	
7.	DC-321	Food Chemistry	3 (2+1)	
8.	DE-322	Energy Conservation and Management	2 (1+1)	
9.		Online course*		

- 20 Credit for Core (Basic) Courses (1, 2, 3, 4, 5, 6, 7, 8)
- *Courses listed under Online Courses may be offered as per the availability.

Fourth Year (Semester-VII)				
1.	DE-411	Food Engineering	3 (2+1)	
2.	DE-412	Dairy Plant Design and Layout	2 (1+1)	
3.	DT-411	Food Technology-II	3 (2+1)	
4.	DT-412	Sensory Evaluation of Dairy Products	2 (1+1)	**20**
5.	DC-411	Biochemistry and Human Nutrition	2 (1+1)	
6.		Elective Courses*	8	
7.		Online course**	2	

- Student has to complete 20 credits in 7th Semester (Courses 1 to 5 (12 credits) are compulsory)
- *Courses listed under Elective Courses (minimum of 8 credit hours from the elective courses should be opted to complete total 20 credits)
- **Courses listed under Online Courses may be offered as per the availability.

Semester - VIII				
1.	SRP-421	Student Ready In-Plant Training	One Semester (0+20)	**20(0+20)**

41. COURSE CONTENT (Semester-wise in detail)

SEMESTER - I

NG-1 Deeksharambh (NG 02 week) 2 (0+2)

The newly inducted students should be acclimatized with the campus and be given an orientation of the degree programme. The Deeksharambh will be a week-long foundation course.

The foundation course should be a primer for the new comer students about the nature of the degree program, processes and procedures of academic activities and orientation to various facets of the university. The outline of the foundation course is to be decided by the university or constituent college and can broadly include:

- Help for cultural Integration of students from different backgrounds,
- Know about the operational framework of academic process in university
- Instilling life and social skills
- Social Awareness, Ethics and Values, Team Work, Leadership, Creativity, etc.
- Identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.

The details of activities will be decided by the parent universities. The structure shall include, but not restricted to:

1. Discussions on operational framework of academic process in university, as well as interactions with academic and research managers of the University.
2. Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences
3. Group activities to identify the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other's life experiences
4. Activities to enhance cultural Integration of students from different backgrounds
5. Field visits to related fields/ establishments
6. Sessions on personality development (instilling life and social skills, social awareness, ethics leadership, etc.) and communication skills.

DE-111 Workshop Practice 2 (1+1)

Theory

Introduction: workshop practice, safety, care and precautions in workshop. Wood working tools and their use, Carpentry. Heat treatment process: Hardening, tempering, annealing and normalizing etc.

Metal work: Metal cutting. Soldering, Brazing. Welding: Electric arc and Gas welding. Smithy and forging operations: tools and equipment.

Bench work: The bench, flat surface filing, chipping, scrapping, marking out, drilling and screwing.

Introduction to following tool machines: (a) Lathe Machine, (b) Milling Machine, (C) Shaper and Planner, (d) Drilling and Boring machines, (e) Grinder, (f) CNC Machines etc.

Practical

To study different types of measuring tools used in metrology and determine least counts of vernier calipers, micrometers and vernier height gauges. Job work on filing and chipping. To study different types of fitting tools and marking tools used in fitting practice. To study various types of carpentry tools and prepare simple types of at least two wooden joints. Job work on hand hack and power hack saw. Job work on metal sheet working. Job work on butt and lap welding. To study different types of machine tools (lathe, milling, drilling machines etc). To prepare for a job on a lathe involving facing, outside turning, taper turning, step turning, radius making, threading etc.

DE-112 Fluid Mechanics 2 (1+1)

Theory

Units and dimensions, Properties of fluids. Compressible and non-compressible fluids. Surface tension, capillarity. Pressure measuring devices, simple, differential, micro, inclined manometer, mechanical gauges, Piezometer.

Fluid flow: Classification, steady uniform and non-uniform flow, Laminar and turbulent, continuity equation, Bernolli's theorem and its applications. Flow through pipes: Loss of head, determination of pipe diameter. Determination of discharge, friction factor, critical velocity.

Flow through mouthpieces, Vena contracta, hydraulic coefficients, discharge losses, Time for emptying a tank. Loss of head due to contraction, enlargement at entrance and exit of pipe. External and internal mouthpieces, types of notches, rectangular and triangular notches, rectangular weirs. Venturimeters, pitot tube, Rota meter. Water level point gauge, hook gauge.

Dimensional analysis: Buckingham's theorem application to fluid flow phenomena. Froude Number, Reynolds number. Weber number and hydraulic similitude.
Pumps: Classification, reciprocating, centrifugal pump. Pressure variation, work efficiency.
Pump selection and sizing.

Practical

Study of various types of pipes and pipe fittings. Study of different types of valves. Study of reciprocating pump. Study of rotary gear pump. Study of piezometer. Study of U tube Manometer. Study of inclined tube Manometer. Study of Venturimeter. Determination of frictional co-efficient of given pipe. Determination of minor head loss. Study of Pitot tube. Study the construction and working principle of centrifugal pump. Study of Reciprocating pump. Study and measurement of flow of liquid by V- notch.

DE-113 **Engineering Drawing** **1 (0+1)**

Practical

Drawing of lines, lettering and dimensioning types of lines, types, types of lettering, types of dimensioning. Drawing of scales. Plain scale, diagonal scale, comparative scale and Vernier scale.

Drawing of projections; Orthographic projections, methods of projections. Drawing of screw threads; Types of threads and terminologies used in lit. Screw fastening: Types of nuts, types of bolts, stud, locking arrangements for nuts and Foundation bolt. Drawing of rivets and riveted joints forms of rivet heads, types of riveted; joints, failure of riveted joints. Drawing of welded joints: Forms of welds, location and dimensions of welds. Drawing of keys, cotter joint, pin joints types of keys, types of cotter joints, pin joints. Drawing of shaft couplings: Rigid couplings, loose couplings, flexible couplings universal coupling. Drawing of shaft bearings. Journal bearings, pivot bearings, collar bearings.

DM-111 **Fundamentals of Microbiology** **2 (1+1)**

Theory

History of Microbiology: Discovery of microorganisms and microscopy (types, principles, and applications). Early Microbiologists: Contributions of Leeuwenhoek, Pasteur, Tyndall, Lister, Koch, Jenner, and Fleming. Scope of Microbiology: Applications in dairy, food, pharmaceutical, industrial, medical, and agricultural fields.

Classification of Microbes: Microbial Classification Systems: Traditional and numerical taxonomy. Classification Schemes: Whittaker›s five kingdoms and Woese›s three-domain system. Bacterial Classification: Berge's Manual of Systematic Bacteriology, phylogenetic trees. Prokaryotic vs. Eukaryotic Cells: Structure and function of prokaryotic cells. Cell Wall Differences: Gram- positive vs. Gram-negative bacteria; Archaeal cell walls.

Microbial growth and nutrition: Bacterial growth curve; factors affecting growth of bacteria, direct and indirect methods of measurement of bacterial growth; Bacteriostatic and bactericidal agents; Common nutrient requirements and nutritional types of microorganisms.

Microbial Ecology: Micro flora of air, soil, and water; extremophiles (archaea). Basics of Microbial Genetics and Host-Microbe interactions: DNA as the genetic material, Structure of DNA/ RNA, Genetic code, Central Dogma, DNA replication, transcription and translation.

Practical

General instruction for microbiological laboratory. Microscope -- simple and compound; Microbiological equipment; autoclave, hot air oven, incubator, centrifuge, colorimeter, laminar airflow, membrane filter.

Simple staining- methylene blue; crystal violet; negative staining. Differential staining (Gram, spore, acid fast). Preparation of commonly used growth media (liquid and solid): simple and differential media. Isolation techniques for microorganisms – Streak, spread and pour plate. Enumeration of microorganisms in air and soil. Enumeration of microorganisms in water: total viable count, coliform (MPN). Visit to Microbiology Laboratory of Dairy/Food Industry.

DC-111 Physical Chemistry of Milk 2 (1+1)

Theory

Constituents and gross composition of milk of different species and breeds of milch animals, Colloidal State: Distinction between true and colloidal solution, lypophilic and lypophobic solution, properties of colloidal system. Gels-their formation and properties, Milk as a colloidal system and its stability, Elementary idea about emulsion.

Density: Density and specific gravity, pyknometer method, hydrometer lactometer, Density and specific gravity of milk, effect of various processing variables on the density and specific gravity of milk, viscosity- Definition of viscosity, Newtonian and Non-Newtonian liquids, Stokes Law, influence of temperature and concentration of solute on viscosity. Viscosity of milk, evaporated milk and condensed milk. Liquid State: Surface tension, surface energy interfacial tension, Surface tension of milk and the factors affecting it.

Refractive index, Colligative Properties of Dilute Solution: Vapour pressure, Raoults Law, Depression of freezing point, Elevation of boiling point. Freezing point and boiling point of milk, Osmosis and Osmotic pressure, Inter-relation of colligative properties, Electrical conductance of milk, Buffer solutions. Derivation of Henderson – Hasselbach equation and its application, buffer capacity and buffer index, milk as a buffer system, Equilibrium of electrolytes. pH indicators.

Oxidation- Reduction: Redox potential, Nernst equation, Redox system of milk, Occurrence of radio nuclide in milk and milk products, Molecular Spectroscopy: The spectrum of electro- magnetic radiation, the laws of Lambert and Beer, visible, and ultra-violet Spectroscope.

Practical

Determinati on of density and specific gravity of milk using pyknometer, hydrometer and lactometer. Determination of viscosity of milk using Ostwald viscometer. Determination of surface tension of milk using Stalagmometer. Interfacial tension between water-oil phase. Determination of freezing point of milk. Preparation of a buffer solution. Determination pH of buffer solution and milk electrometrically. Determination of acidity of milk electrometrically. Determination of electrical conductance of milk. Determination of redox potential of milk. Coagulation of milk using electrolytes. Determination of refractive index of skim milk and whey. Titration of amino acid in the presence and absence of formaldehyde. Determination of PKa1 PKa2 and PL. Verification of Lambert Beer Law.

DBM-111 Agricultural Informatics and Artificial Intelligence
(VAC-1) 3 (2+1)

Theory

Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System: Definition and types, Applications of MS-Office for creating, Editing and Formatting a document, Data presentation, Tabulation and graph creation, Statistical analysis, Mathematical expressions, Database, concepts and types, creating database, Uses of DBMS in Agriculture, Internet and World Wide Web (WWW): Concepts and components.

Computer programming: General concepts, Introduction to Visual Basic, Java, Fortran, C/ C++, etc. concepts and standard input/output operations. e-Agriculture, Concepts, design and development, Application of innovative ways to use information and communication technologies (IT) in Agriculture, Computer Models in Agriculture: Statistical, weather analysis and crop simulation models, concepts, structure, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation, IT applications for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone mobile apps in agriculture for farm advice: Market price, postharvest management etc., Geospatial technology: Concepts, techniques, components and uses for generating valuable agri-information, Decision support systems: Concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting farm decisions. Preparation of contingent crop-planning and crop calendars using IT tools, Digital India and schemes to promote digitalization of agriculture in India.

Introduction to artificial intelligence, background and applications, Turing test. Control strategies, Breadth-first search, Depth-first search, Heuristics search techniques: Best-first search, A* algorithm, IoT and Big Data; Use of AI in agriculture for autonomous crop management, and health, monitoring livestock health, intelligent pesticide application, yield mapping and predictive analysis automatic weeding and harvesting, sorting of produce, and other food processing applications; Concepts of smart agriculture, use of AI in food and nutrition science etc.

Practical

Study of computer components, accessories, practice of important DoS Commands, Introduction of different operating systems such as Windows, Unix/ Linux, creating files and folders, File Management. Use of MS-WoRD and MS Power-point for creating, editing and presenting a scientific document, MS- EXCEL - Creating a spreadsheet, Use of statistical tools, writing expressions, Creating graphs, Analysis of scientific data, Handling macros. MS-ACCESS: Creating Database,

preparing queries and reports, Demonstration of Agri- information system, Introduction to World Wide Web (WWW) and its components, Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++, Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/Crop Syst/ Wofost, Preparation of inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools, Use of smart phones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial Technology, Hands on practice on preparation of Decision Support System, Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA).

DBM-112 (AEC-1) **2 (1+1)**

Communication Skills

Theory

Communication Process: The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication.

Basic Communication Skills: Listening, Speaking, Reading and Writing Skills; Precis writing/ Abstracting/Summarizing; Style of technical communication Curriculum vitae/resume writing; Innovative methods to enhance vocabulary, analogy questions.

Structural and Functional Grammar: Sentence structure, modifiers, connecting words and verbals; phrases and clauses; Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults.

Practical

Listening and note taking; Writing skills: precis writing, summarizing and abstracting; Reading and comprehension (written and oral) of general and technical articles; Micro-presentations and Impromptu Presentations: Feedback on presentations; Stage manners: grooming, body language, voice modulation, speed; Group discussions; Public speaking exercises; vocabulary building exercises; Interview Techniques; organization of events.

DBM-113 (MDC-1) **3 (2+1)**

Farming Based Livelihood System

Theory

Status of agriculture in India and different states, Income of farmers and rural people in India, Livelihood-Definition, concept and livelihood pattern in urban and rural areas, Different indicators to study livelihood systems.

Agricultural livelihood systems (ALS): Meaning, approach, approaches and framework, Definition of farming systems and farming based livelihood systems Prevalent Farming systems in India contributing to livelihood.

Types of traditional and modern farming systems. Components of farming system/ farming- based livelihood systems- Crops and cropping systems, Livestock (dairy, piggery, goatry, poultry duckry etc.), Horticultural crops, Agro-forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc., Small-, medium- and large-enterprises including value chains and secondary enterprises as livelihood components for farmers.

Factors affecting integration of various enterprises of farming for livelihood. Feasibility of different farming systems for different agro-climatic zones, Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country, Case studies on different livelihood enterprises associated with the farming. Risk and success factors in farming-based livelihood systems, Schemes and program by Central and State Government.

Public and Private organizations involved in promotion of farming-based livelihood opportunities. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style.

Practical

Survey of farming systems and agricultural based livelihood enterprises; Study of components of important farming based livelihood models/ systems in different agro-climatic zones; Study of production and profitability of crop based, livestock based, processing based and integrated farming based livelihood models; Field visit
of innovative farming system models; Visit of Agri-based enterprises and their functional aspects for integration of production, processing and distribution sectors and Study of agri-enterprises involved in industry and service sectors(Value Chain Models); Learning about concept of project formulation on farming based livelihood systems along with cost and profit analysis; Case study of Start-Ups in agri-sectors.

NCC-111 (AEC-2) **1 (0+1)**

Practical/ Awareness Program

Aims, objectives, organization of NCC and NCC song. DG's cardinals of discipline; Drill- aim, general words of command, attention, stands at ease, stand easy and turning; Sizing, numbering, forming in three ranks, open and close order march, and dressing; Saluting at the halt, getting on parade, dismissing, and falling out.

Marching, length of pace, and time of marching in quick/slow time and halt. Side pace, pace forward and to the rear. Turning on the march and wheeling. Saluting on the march; Marking time, forward march, and halt. Changing step, formation of squad and squad drill; Command and control, organization, badges of rank, honors, and awards.

Nation Building- cultural heritage, religions, traditions, and customs of India. National integration. Values and ethics, perception, communication, motivation, decision making, discipline and duties of good citizens. Leadership traits, types of leadership. Character/personality development. Civil defense organization, types of emergencies, firefighting, protection. Maintenance of essential services, disaster management, aid during development projects.

Basics of social service, weaker sections of society and their needs, NGO's and their contribution, contribution of youth towards social welfare and family planning.

Structure and function of human body, diet and exercise, hygiene and sanitation. Preventable diseases including AIDS, safe blood donation, first aid, physical and mental health. Adventure activities. Basic principles of ecology, environmental conservation, pollution and its control.

NSS-111 (AEC-2) **1 (0+1)**

Practical/ Awareness Program

Orientation: history, objectives, principles, symbol, badge; regular programs under NSS;

Organizational structure of NSS, Code of conduct for NSS volunteers, points to be considered by NSS volunteers' awareness about health.

NSS program activities. Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analyzing guiding financial patterns of scheme, youth program/ schemes of GOI, coordination with different agencies and maintenance of diary. Understanding youth. Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change.

Community mobilization. Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilization involving youth-adult partnership. Social harmony and national integration.

Indian history and culture, role of youth in nation building, conflict resolution and peace- building. Volunteerism and shramdaan. Indian tradition of volunteerism, its need, importance, motivation, and constraints; shaman as part of volunteerism.

Citizenship, constitution, and human rights. Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information. Family and society. Concept of family, community (PRIs and other community-based organizations) and society.

Skill Enhancement Course **2 (0+2)**

Basic Microbiological Tests for Quality of Milk and Milk Products

Basic concepts of laboratory practices and aseptic techniques. Familiarization with different microbiological laboratory equipment. Dilution preparation. Preparation of culture media. Sterilization of glass wares and media. Study of Microscope. Microscopic examination of bacterial smears-Gram staining, simple staining, etc. General microbiological tests. Direct Microscopic Count (DMC), Standard Plate Count (SPC), Dye reduction Methods, Coliform Test, Detection of Pathogens in Milk and milk products, Yeast and Mould Count.

Skill Enhancement Course
Basic Aspects of Milk and Milk Products Testing **2 (0+2)**

Handling of chemical substances and safety measures in lab. Handling of dairy glassware (Buretter, pipettes, measuring cylinders, volumetric flasks, separating funnel, tilt measures, butyrometer, hydrometer). Handling of dairy chemistry laboratory equipment (Hot air oven, Weighing Balance, Muffle furnace, Kjeldahl assembly, Water bath etc.). Washing, Drying and sterilization of glassware. Weighing and preparation of solution of different strength and dilution. Preparation of milk sample. Platform tests (Organoleptic test, Sediment test, COB, alcohol Alizarine, Acidity). Detection of adulteration in milk. Chemical examination of market milk samples (Fat, SNF, Turbidity Test, Creaming Index, Alkaline phosphatase test). Estimation of Fat content in cream and butter. Estimation of Acidity of cream, butter and ghee. Estimation of fat content in cheese paneer and khoa, Ice-cream. Estimation of fat content in milk products. Estimation of moisture/TS content in cheese and butter. Estimation of moisture/TS content in milk powder and Ice-cream. Visit to quality control laboratory of dairy industry.

SEMESTER-II

DT-121 **Market Milk** **4 (3+1)**

Theory

Dairy industry in India and abroad: Salient features. Collection and transportation of milk:(a) Organization of milk collection routes, (b) Practices for collection of milk, preservation at farm, refrigeration and natural microbial inhibitors.

Reception and treatment (pre-processing steps) of milk in the dairy plant: (a) Reception, chilling, clarification and storage: General practices, (b) Homogenization: Definition, pretreatments, theories, synchronization of homogenizer with operation of pasteurizer (HTST) (c) Effect of homogenization on physical properties of milk, (d) Bactofugation: Theory and microbiology.

Thermal processing of milk: (a) Definition and description of processes: Pasteurization, thermisation, sterilization, UHT Processing, (b) Product control in market milk plant, (c) Defects in market milk, (d) Manufacture of special milks: toned, doubled toned, reconstituted, recombined, flavoured, homogenized, vitaminised and sweet acidophilus milk, (e) Manufacture of sterilized milk, (f) Distribution systems for market milk.

UHT processing of milk: (a) Relevance of UHT processing in the tropical climate, (b) UHT plants: Description. Direct, Indirect, with upstream and downstream homogenization, third generation UHT plants, (c) Aseptic packaging, types and systems of packaging, sterilizing packages, filling systems, (d) Technical control in the UHT plant, (e) Shelf life of UHT milk and tests for UHT milk.

Nutritive value of milk. Effect of heat processing on nutritive value. Cleaning and sanitization of dairy equipment.

Practical

Familiarization with equipment for reception of milk in plant; Pretreatments: Chilling, clarification, filtration; Standardization and numericals relating to it; Cream separation: parts of separator and the process; Operation of LTLT, HTST pasteurizer, laboratory steriliser; Preparation of special milks, toned, double toned, standardised, flavoured, sterilised; Cleaning of storage tanks, cream separators, HTST plants; manual cleaning and CIP; Detection of adulterants and preservatives in milk; Assessment of homogenisation efficiency in milk; Strength of common detergents and sanitizers used in market milk plant.

DE-121 **Heat and Mass Transfer** **3 (2+1)**

Theory

Basic heat transfer process: thermal conductivity, convective film co-efficient, Stefan Boltzman's constant and equivalent radiation co-efficient, Overall heat transfer co-efficient, physical properties related to heat transfer. Working principles and application of various instruments for measuring temperature.

One-dimensional steady state conduction: Theory of heat conduction, Fourier's law, Derivation of Fourier's equation in Cartesian coordinates, Linear heat flow through slab, cylinder and sphere. Heat flow through slab, cylinder and sphere with non-uniform thermal conductivity. Concept of electrical analogy and its application for thermal circuits, Heat transfer through composite walls and insulated pipelines.

Steady-state heat conduction with heat dissipation to environment: Introduction to extended surfaces (FINS) of uniform area of cross-section. Equation of temperature distribution with different boundary conditions. Effectiveness and efficiency of the FINS. Introduction to unsteady state heat conduction.

Convection: Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer, Concept of Nusselt number. Prandtl number, Reynolds number, Grashoff number, some important empirical relations used for determination of heat transfer coefficient.

Heat Exchangers: General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, Shell and tube and plate heat exchangers, Heat exchanger design. Application of different types of heat exchangers in dairy and food industry. Mass transfer: Fick's Law of diffusion, steady state diffusion of gases and liquids through solids. Equimolal diffusion. Mass transfer co-efficient and problems on mass transfer.

Practical

Determination of thermal conductivity: milk, solid dairy and food products. Determination of overall heat transfer co-efficient of: Shell and tube, plate heat exchangers and Jacketted kettle used in Dairy and Food Industry. Studies on heat transfer through extended surfaces. Studies on temperature distribution and heat transfer in HTST pasteurizer. Design problems on heat exchangers. Study of various types of heat exchangers. Design problems on Mass Transfer. Heat transfer in tubular heat exchanger: co current/ counter flow. Heat transfer through composite wall. Heat transfer through legged pipes. Heat transfer through natural and forced convection.

DE-122 **Basic Electrical Engineering** **3 (2+1)**

Theory

Alternating current fundamentals: Generation of alternating current or voltage, magnitude of induced E.M.F. Alternating current, R.M.S value and average value of an alternating current. Phase relation and vector representation. Cycle, Time period, Frequency, Amplitude, Phase and Phase Difference, Root – Mean Square Value, Average value, Form Factor, Crest or Amplitude Factor. Poly- phase Circuit: - Generation of Poly-phase Voltage, Phase Sequence, Interconnection of Three Phases such as Star Connection and Delta Connection and their respective value of current and voltages, Energy Measurement by using Single and Two Watt-meters.

Transformers: Working Principle of Transformer, Construction features of Core and Shell type transformer, Elementary theory of an Ideal Transformer, E.M.F. Equation of a Transformer, Vector diagram of transformer with and without load, Transformer losses, voltage regulation and efficiency of transformer, Construction and working on a Single Auto-transformer, Different parts of a 11/0.4 KV, Distribution Transformer.

Three Phase Induction Motor: Fundamental working principles, Production of rotating magnetic fields, construction, Different types of Rotor such as Squirrel Cage and Phase wound rotors, starting of induction motors using Direct on Line (DOL) and Star-Delta Starter. Soft starter and variable frequency drives.

Single Phase Induction Motors: Introduction, Different types of single phase induction motors such as Split Phase, Capacitor type, Shaded Pole type, Universal or AC series motors, Repulsion start induction run motor, Repulsion – induction motor.

DC Machine: Construction and operation of DC generator, types of generators and their various characteristics. DC motors: Torque speed characteristics of DC motors, Starting and speed control of DC motors by using 3-point DC Starter.

Alternators: Elementary working principles, Different parts of an Alternators, Relation between Speed and Frequency, E.M.F. equation in an Alternators. Different types of Circuit Breaker and its use. Introduction to DG set system.

Electric Power Economics: Economics of Generation of electrical energy and related important terms such as, load curve, connected load, Maximum Demand, Demand Factor, Average load or demand, Load Factor, Diversity factor and its significance, Capacity Factor or Plant factor, Utilization Factor, Plant Operating Factor and Selection of Units and related numerical, Various types of Tariff used for calculation of electricity bill.

Lighting system: Introduction to industrial lighting system. Energy Management and Power Factor Corrections: Types of energy, Energy Management, Concept of Energy Audit. Concept of Power Factor, Disadvantages of low power factor, causes of low power factor, Various methods of improving low power factor, Location of power factor correction equipment, Advantages of power factor improvement.

Practical

Introduction to various basic circuits of parallel wiring, stair case wiring, fluorescent light fitting; Study of voltage and current relationship in case of Star connected load; Study of voltage and current relationship in case of Delta connected load; Measurement of power in 3-phase circuit; for a balanced load, using watt meters. Measurement of power in 3-phase circuit; for an unbalanced load, using watt meters. Measurement of iron losses of Single Phase transformer by conducting open circuit test; Measurement of Copper losses of Single Phase transformer by conducting short circuit test. Starting and reversing the speed of a single phase induction motor; Starting and reversing the speed of a three phase induction motor using Direct on Line (DOL) Starter; Starting and reversing the speed of a three phase induction motor using manual Star Delta Starter; Starting and reversing the speed of a DC shunt motor using 3-point DC Starter; Starting of slip-ring induction motor by manual and automatic Slip-ring Induction Motor Starter; To determine the relation between induced armature voltage and speed of separately /self excited DC Shunt Generator.

DM-121 **Microbiology of Fluid Milk** **2 (1+1)**

Theory

Microbes associated with raw milk: Significance of specific groups of microorganisms in milk i.e. psychrotrophic, mesophilic, thermoduric and thermophillic bacteria - their morphological and biochemical characteristics and classification. Significance of spore and spore-forming bacteria in milk, Microbial contaminants in raw milk, their sources during various stages of production - milking, chilling, storage and transportation with special reference to psychrotrophic microorganisms; Microbiological changes in bulk refrigerated raw milk.

Concept of clean milk production: Hygienic milk production system; Cleaning and sanitation of udder, animal, utensils, equipment and dairy farm environment; Microbiological quality of milk produced in organized and un-organized sector in India and comparative information in developed world; Microflora of aseptically drawn milk and its natural antimicrobial systems - immunoglobulins, lactoferrin, lysozyme and lactoproxidase (LP) system. Somatic cells in raw milk: Significance and measurement.

Types of microbial spoilage - souring, curdling, bitty cream, proteolysis, lipolysis, abnormal flavors and discolouration. Mastitis milk - types of mastitis, causative micro-flora of mastitis, compositional and microbiological changes during mastitis infection, their processing and public health.

Microbiological aspects of fluid milk: Pasteurization, boiling, sterilization, ultra high temperature (UHT), non thermal (pulsed field) micro-filteration, bactofugation, standardization and homogenization. Significance of heat resistant and post processing contaminants in fluid milk with special reference to proteases and lipase enzymes and their role in spoilage of processed milk. Bio-film formation during processing and their control measures.

Public health aspects of fluid milk: Microbial zoonotic diseases transmitted through fluid milk; Milk borne diseases -food infection, intoxication and toxi- infection caused E. coli, Salmonella typhi, Staphylococcus aureus, Bacillus cereus, Listeria monocytogenes, Shigella species, Campylobacter etc. Microbiological grading and legal standards of raw and processed milk.

Practical

Morphological examination of common dairy microorganisms (size and shape, arrangement and sporulation); Estimation of microbial load in raw milk by standard plate count (SPC) and dye reduction tests (MBRT, RRT); Grading of processed/ market milk by Aerobic plate count (APC), coliform and methylene blue reduction time; Enumeration of psychrotrophic, thermophillic, thermoduric and spore forming bacteria in raw and market milk; Detection of sources of contamination: Air, water, utensils, equipment and personnel, line testing; Spoilage of milk caused by microorganisms: souring, sweet curdling, gassiness, lipolysis, ropiness, proteolysis and discolouration; Detection of mastitis milks: pH, SLST, somatic cell count, chloride content, Hotis test and CAMP test. Detection and estimation of coliforms: presumptive, rapid coliform and IMViC Test.

DC-121 Chemistry of Milk 3 (2+1)

Theory

Definition and structure of milk, factors affecting composition of milk, Nomenclature and classification of milk proteins Casein: Isolation, fractionation and chemical composition, physico- chemical properties of casein, Whey proteins: Preparation of total whey proteins: á-Lactalbumin and β-Lactoglobulin. Properties of á-Lactalbumin and β-lactoglobulin, Immmunoglobulin and other minor milk proteins and non proteins nitrogen constituents of milk, Hydrolysis and denaturation of milk proteins under different physical and chemical environments, Estimation of milk proteins using different physical and chemical methods, Importance of genetic polymorphism of milk proteins.

Milk enzymes with special reference to lipases, Xanthine Oxidase, phosphates, proteases and lactoperoxidase. Milk carbohydrates their status and importance. Physical and chemical properties of lactose, Sugar amine condensation, amadori re-arrangement, production of hydroxyl methyl furfural (HMF), Processing related degradation of lactose.

Definition, general composition and classification of milk lipids. Nomenclature and general structure of glycerides, factors affecting the fatty acid composition. Milk phospholipids and their role in milk products, Unsaponifiable matter and fat soluble vitamins.

Milk Salts: Mineral in milk (a) major mineral (b) Trace elements, physical equilibria among the milk salts and Milk contact surfaces and metallic contamination.

Practical

Sampling techniques of chemical examination of milk; Determination of pH and titratable acidity of milk; Determination of fat in milk by different methods; Determination of total solids and solids not fat in milk; Determination of total milk proteins by Kjeldahal method; Determination of casein, whey proteins and NPN in milk; Estimation of alkaline phosphatase and lipase in milk; Determination of lactose in milk; Determination of ash in milk; Determination of phosphorus and calcium in milk; Determination of chloride in milk; Determination of temporary and permanent hardness of water; Estimation of available chlorine from bleaching powder.

DBM-121 (VAC-2) Environmental Studies and Disaster Management 3 (2+1)

Theory

Multidisciplinary nature of environmental studies; definition, scope and importance; Natural resources: renewable and non-renewable resources, natural resources and associated problems; Forest resources: use and over-exploitation, deforestation, case studies; Timber extraction, mining, dams and their effects on forest and tribal people; Water resources: use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems;

Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, case studies; Food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies; Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies; Land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles; Ecosystems: concept of an

ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of ecosystems as forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries).

Biodiversity and its conservation: introduction, definition, genetic, species and ecosystem diversity and biogeographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, national and local levels; India as a mega-diversity nation; Hot-spots of biodiversity; Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Environmental pollution: definition, cause, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards; Solid waste management: causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution.

Social issues and the environment: from unsustainable to sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management.

Environmental ethics: issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust; Dies, wasteland reclamation; Consumerism and waste products; Environment protection act; Air (prevention and control of pollution) act; Water (prevention and control of pollution) act; Wildlife protection act. Forest conservation act; Issues involved in enforcement of environmental legislation; Public awareness.

Human population and the environment: population growth, variation among nations, population explosion, family welfare programme; Environment and human health: human rights, value education, HIV/ aids; Women and child welfare; Role of IT in environment and human health.

Natural disasters- meaning and nature of natural disasters, their types and effects; Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves; Climatic change: global warming, sea level rise, ozone depletion.

Man-made disasters- nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

Disaster management- effect to migrate natural disaster at national and global levels; International strategy for disaster reduction; Concept of

disaster management, national disaster management framework; financial arrangements; role of NGOs, community based organizations and media, Central, state, district and local administration; armed forces in disaster response; disaster response; police and other organizations.

Practical

Pollution case studies; Case studies- visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain; Visit to a local polluted siteurban/rural/industrial/agricultural; Study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.; Collection of polluted water/ effluent sample, sampling of polluted water/ effluents; Estimation of solids, pH, EC, DO, COD, BOD, Cl^-, F^-, CO^{2-} & HCO^-, Ca^{2+} & Mg^{2+}, K^+ and Na^+.

DBM-122 (AEC-3) **Personality Development** **2 (1+1)**

Theory

Personality Definition, Nature of personality, theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality, Myers-Briggs Typology Indicator, Locus of control and performance, Type A and Type B Behaviours, personality and Organizational Behaviour.

Foundations of individual behavior and factors influencing individual behavior, Models of individual behavior, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution.

Learning: Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback. Attitude and values, Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence. Motivation- theories and principles, Teamwork and group dynamics.

Practical

MBTI personality analysis, Learning Styles and Strategies, Motivational needs, Firo-B, Interpersonal Communication, Teamwork and team building, Group Dynamics, Win-win game, Conflict Management, Leadership styles, Case studies on Personality and Organizational Behavior.

NCC-121 (AEC-4) 1 (0+1)

Practical/ Awareness Program

Arms Drill- Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out. Ground/take up arms, examine arms.

Shoulder from the order and vice-versa, present from the order and vice-versa. Saluting at the shoulder at the halt and on the march. Short/long trail from the order and vice- versa. Guard mounting, guard of honor, Platoon/Coy Drill.

Characteristics of rifle (.22/.303/SLR), ammunition, fire power, stripping, assembling, care, cleaning, and sight setting. Loading, cocking, and unloading. The lying position and holding:

Trigger control and firing a shot. Range Procedure and safety precautions. Aiming and alteration of sight. Theory of groups and snap shooting. Firing at moving targets. Miniature range firing. Characteristics of Carbine and LMG.

Introduction to map, scales, and conventional signs. Topographical forms and technical terms.

The grid system. Relief, contours, and gradients. Cardinal points and finding north. Types of bearings and use of service protractor. Prismatic compass and its use. Setting a map, finding north and own position. Map to ground and ground to map. Knots and lashings, Camouflage and concealment, Explosives and IEDs.

Field defenses obstacles, mines and mine lying. Bridging, waterman ship. Field water supplies, tracks and their construction. Judging distance. Description of ground and indication of landmarks.

Recognition and description of target. Observation and concealment. Field signals. Section formations. Fire control orders. Fire and movement. Movement with/without arms. Section battle drill. Types of communication, media, latest trends and developments.

NSS- 121 (AEC-4) **1 (0+1)**

Practical/ Awareness Program

Importance and role of youth leadership; Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership, Life competencies; Definition and importance of life competencies, problem-solving and decision-making, interpersonal communication. Youth development programs; Development of youth programs and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations;

Health, hygiene and sanitation. Definition needs and scope of health education; role of food, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programs and reproductive health. Youth health, lifestyle, HIV AIDS and first aid. Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid. Youth and yoga. History, philosophy, concept, myths, and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method.

Skill Enhancement Course

Operation of Liquid Milk Processing System

2 (0+2)

Familiarization with the various milk sampling equipment's and platform tests. Study of various types of storage tanks used in a milk processing unit. Study the operations of Raw Milk Reception Dock. Study the operation of can/crate/bottle washer. Familiarization with various parts of a milk pasteurizer-Float control balance tank (FCBT), heat exchanger, Flow Diversion Valve (FDV) and various monitoring systems and alarms. Study of milk pasteurization process in batch and continuous units. Cream separation of milk-determine the skimming efficiency. Standardization of milk. Homogenization of milk-single and double stage. Operation and maintenance of packing machine. Familiarization with the various equipment's in refrigeration unit. Operation and maintenance of hot water generator. Familiarization with the Ice Bank Tank (IBT). Cleaning and sanitization in milk processing unit. Familiarization with an Effluent Treatment Plant (ETP). Study of common repairs and maintenance in milk processing unit- milk pasteurizer, cream separator, packaging machines etc. Industrial visit to Dairy Plant.

Skill Enhancement Course

Electric Power Supply and Distribution in Dairy Plant

2 (0+2)

General concepts: Introduction to distribution systems, Load modelling and characteristics. Classification of loads (Residential and Dairy Industry) and their characteristics. Electric-Substation and Primary Feeders. Distribution System Analysis. Voltage drops and Power -loss calculations. Electrical distribution system in Dairy Plant. Electric Power Economics in Dairy Plant: Maximum demand charge, Billing of electricity in industry, Need for electrical load management, Step by step approach for maximum demand control, Electrical energy conservation in dairy plant. Load factor and load factor correction.

SEMESTER-III

DT-211 **Traditional Indian Dairy Products** **3 (2+1)**

Theory

Status and significance of traditional Indian milk products in India. Khoa: Classification of types, standards methods of manufacture and preservation, factors affecting yield of khoa. Mechanization in manufacture of khoa. Khoa based sweets: Burfi, Peda, Milk-cake, Kalakhand, Gulabjaman and their compositional profile and manufacture practices. Rabri and Basundi: Product identification, process description, factors affecting yield, physico-chemical changes during manufacture.

Channa: Product description, standards method of manufacture, packaging and preservation. Chhana-based sweets: Rasogolla, Sandesh, Rasomalai. Mechanization of manufacturing process, advances in preservation and packaging. Paneer: Product description, standards, method of manufacture, packaging and preservation. Mechanization of Paneer manufacturing/packaging process.

Chakka/Maska and Shrikhand: Product description, standards, method of manufacture, small scale and industrial process of production, packaging and preservation aspects. Misti Dahi: Product description method of manufacture and packaging process.

Kheer and Payasam: Product description methods of manufacture, innovations in manufacturing and packaging processes. Biopreservative principles in enhancing the shelf-life of indigenous milk products including active packaging.

Practical

Preparation of Khoa from cow, buffalo and concentrated milk; Preparation of Burfi, Peda, Kalakand, Milk cake and Gulabjamun; Preparation of Paneer from cow, buffalo and mixed milk; Preparation of Chhana from cow and buffalo milk and mixed milk; Preparation of Sandesh and Rasogolla; Preparation of kheer; Preparation of Rabri, Misti Dahi, Chhana and Shrikhand; Visit to industry.

DE-211 **Thermodynamics** **3 (2+1)**

Theory

Importance and applications of thermodynamics in Dairy/Food processing. Basic concepts: Thermodynamic systems, properties, state, processes, cycles, energy, The Zeroth Law of Thermodynamics.

Ideal gases: Equation of state, Compression and expansion of gases. The first Law of Thermodynamics: Internal energy, enthalpy. Analysis of non-flow and flow processes. The second Law of Thermodynamics: Thermodynamic temperature scale, Carnot cycle, heat engine, entropy, reversibility, availability.

Air Cycles: Otto, Diesel, dual cycles and their efficiencies, Plotting the air cycleson p-V, T-S, p-h diagram etc. I.C. Engines: Concepts,

Classification, Working of two stroke and four stroke cycle S.I. engines and C.I. engines. Parts of I.C. engine, Performance of IC engines. Fuels.

Chemical properties, Calorific value and its determination, Fuel Burners, Fuel combustion analysis. Properties of steam: Properties of wet, dry saturated, superheated steam, Use of steam tables and Mollier charts, Analysis of energy input in steam generation and heat gain in steam consumption.

Steam generators: Definition, classification, fire tube boilers, water tube boilers, Boiler performance parameters, Boiler mountings and Boiler accessories. Layout of steam pipe-line and expansion joints. Introduction to Indian Boiler Regulation Act. Boiler Draught: Definition, importance and classification of draught, Natural and artificial draught, Calculation of Height of chimney, Draught analysis.

Air Compressors: Definition, classification, Reciprocating, Single and multi-stage reciprocating compressors and their theoretical analysis.

Practical

A visit to dairy/ food processing plant showing the thermodynamics applications/ devices; Study of 2-stroke and 4-strokes IC engines working; Study of S.I. and C.I. engines working; Study of modern fuel injection systems of I.C. engines; Study of diesel fuel supply system (pump and fuel injector) of I.C. engine; Study of fuel supply system of a petrol engine; Study of cooling system of an I.C. engine (air cooling and water cooling); Study of lubrication system of I.C. engine; Study of Solar water heater and biogas plants and appliances; To study different types of boilers with the help of Lab models; To study Boiler mountings and steam-line layout and steam traps; Industrial exposure visit to plant with steam utilization; Study of Fire tube low pressure boiler installed in a dairy processing plant; Study of water softening plant installed with boiler in a dairy processing plant; Study the construction and working of Cochran boiler. Study of Babcock and Wilcox boiler. Study of different Boiler accessories.

DE-212 Dairy Engineering 3 (2+1)

Theory

Sanitization: Materials and sanitary features of the dairy equipment. Sanitary pipes and fittings, standard glass piping, plastic tubing, fittings and gaskets, installation, care and maintenance of pipes and fittings. Description, working and maintenance of can washers, bottle washers. Factors affecting washing operations, power requirements of can the bottle washers, CIP cleaning and designing of system.

Mechanical Separation: Fundamentals involved in separation. Sedimentation, Principles involved in filtration, Types, rates of filtration, pressure drop calculations. Gravity setting, principles of centrifugal separation, different types of centrifuges. Application in Dairy Industry, clarifiers, tri processors, cream separator, self-desludging centrifuge, cold and hot separators, Bactofuge, in-line standardization system, care and maintenance of separators and clarifiers.

Homogenization: Classification, single stage and two stage homogenizer pumps, power requirement, care and maintenance of homogenizers, aseptic homogenizers.

Thermal Processing: (a) Principles of thermal processing: kinetics of microbial destruction, thermal death curve, Arrhenius equation, D value, Z value, F value, Q_{10} value. (b) Factors affecting thermal destruction of microorganisms.

Pasteurization: Batch, flash and continuous (HTST) pasteurizers, Flow diversion valve, Pasteurizer control, Care and maintenance of pasteurizers.

Sterilization: Different type of sterilizers, in bottle sterilizers, autoclaves, continuous sterilization plant, UHT sterilization, Aseptic packaging and equipment. Care and maintenance of Sterilizers.

Packaging machines: Pouch filling machine pre-pack and aseptic filling bulk handling system Principles and working of different types of bottle filters and capping machine, Blow molding machines, Aseptic PET bottle filling machine. Cup filling system. Care and maintenance.

Mixing and agitation: Theory and purpose of mixing. Equipment used for mixing solids, liquids and gases. Different types of stirrers, paddles and agitators. Power consumption of mixer- impeller, selection of mixing equipment in dairy industry, mixing pumps.

Practical

Study of S. S. pipes, fitting and gaskets; Study and selection of pump; Study of different types of milk filter; Study of equipment at raw milk reception dock; Constructional details, operation and maintenance of straight through can washer; Constructional details, operation and maintenance of C.I.P. system; Constructional details, operation and maintenance of homogenizers; Constructional details, operation and maintenance of batch pasteurizer; Constructional details, operation and maintenance of HTST pasteurizer; Comparison of conventional and modern pasteurizer; Constructional details, operation and maintenance of cream separators; Constructional details, operation and maintenance of sterilization systems; Constructional details, operation and maintenance of pouch filling machine; Constructional details, operation and maintenance of different types of agitators; Constructional details, operation and maintenance of bottle filling and capping machine; Visit to a dairy processing plant.

DE-213 Refrigeration and Air Conditioning 3 (2+1)

Theory

Basic refrigeration cycles and concepts: Standard rating refrigerating machines; Elementary vapour compression refrigeration cycle with reciprocating, rotary and centrifugal compressors; Theoretical vapour compression cycle; Departure from theoretical vapour compression cycle, representation on T-S and P-h diagrams; Mathematical analysis of vapour compression refrigeration system.

Refrigerants: Primary and secondary refrigerants; common refrigerants (Ammonia, Freon, HFC, HCFC etc.); Brine, their properties and comparison. Multi-Pressure Refrigeration Systems: Applications; Multi-evaporators with single stage and multi-stage compression and expansion systems; Working, Control and mathematical analysis of above systems.

Refrigeration Equipment and Controls: Introduction to the types, construction, operation and maintenance of Refrigeration Components, Controls and Safety Devices as used in different refrigeration applications. Capacity control methods, Refrigeration Piping: Purpose, Types, Materials, Fittings and Insulation.

Design and Balancing of Refrigeration System: Basic elements of design of individual components and a complete refrigeration system. Input and Output design parameters, Balancing of components of refrigeration system for optimum performance. Absorption Refrigeration Systems: Simple vapour absorption refrigeration systems, Actual Vapour absorption refrigeration system, Refrigerant absorbent pairs, Absorption cycle analysis.

Cryogenic Freezing: Cryogenics, cryogens, properties, applications, cryogenic freezers. Psychrometry: Definition, properties of moist air, psychrometric charts, psychrometric processes; Cooling/ Heating coils, humidifiers and dehumidifiers, Temperature and humidity measurements and controls.

Air-conditioning Systems: Types of cooling loads and their calculation, Design conditions for Human and Industrial air conditioning systems, Analysis of different air-conditioning systems with the help of psychrometric chart. Cold Storage: Types of cold storages, Types of cooling loads in cold storages used for food/ dairy products;

Construction and operation of cold storage. Insulating materials and vapour barriers.

Practical

Study of different types of Refrigeration tools generally used in installation and maintenance of a refrigeration plant/ equipment including charging and leakage-detection tools; Study of specification, components, operation, control, maintenance and precautions taken during working of a Domestic refrigerator; Study of specifications, components, operation, control, maintenance and precautions taken during working of a Water cooler; Study of specifications, components, operation, control, maintenance and precautions taken during working of a Bulk milk cooler; Study of specifications, components, operation, control, maintenance and precautions taken during working of a Walk-in-cooler; Study of different parts and learn the operation of a refrigeration plant/ice plant using ammonia refrigerant; Estimation of installed cooling capacity with the help of observed working pressures; Study of specifications, components, operation, control and maintenance of Ice

Bank Tank (IBT); Study of specifications, components, operation, control and maintenance of a Cold Storage; Study of the Evaporative Cooling Devices like Cooling Tower, Spray Pond, Air- Washer or Room air-cooler etc.; Study of the parts and components of different types of refrigerant compressors used in various refrigeration applications; Study of different types of capacity control devices used with compressors in a refrigeration plant; Experimental study of a simple refrigeration system on refrigeration tutor or an experimental set-up (Comparison of actual and theoretical performance); Experimental study of a year-round air-conditioning system on an air-conditioning tutor or an experimental set-up; Determination of SHF and By-pass factor etc; Study and plotting of psychrometric processes using refrigeration/air-conditioning tutor; Measurement of psychrometric properties using psychrometric meters/gadgets; Industrial exposure visit to refrigeration/air- conditioning plant.

DM-211 Starter Culture and Fermented Dairy Products 2 (1+1)

Theory

Types, metabolism and propagation of starter cultures: History, classification and importance of starter Cultures in dairy industry; Single, multiple, defined and mixed strain starters; Probiotics and special cultures like exopolysaccharide, vitamin and low calorie sugar producing cultures; Propagation of starter cultures-concentrates - direct bulk and direct vat starter cultures, factors affecting propagation; Metabolism of starter cultures (carbohydrate, protein, citrate) and production of metabolites and antibacterial substances; methods of starter distillates their merits/demerits. Prebiotic, postbiotic and symbiotic concepts.

Activity, Purity, Preservation of Starters and Starter Failure: Quality and activity tests for dairy starters and their preservation- methods (liquid, spray drying, vacuum drying, freeze-drying, frozen concentrate, concentrated dried cultures), merits and demerits; factors affecting the survival of cultures during preservation; Defects in starters and their control; Starter failures- effect of antibiotic residues, sanitizers and bacteriophages. Phages-life cycle, sources, prevention, chemical and mechanically protected systems for starter culture production.

Role of Starters in fermented milks: Role of starters in the preparation of various fermented milks; Types of fermented milks - dahi, yoghurt, acidophilus milk; different types of dahi and yoghurt; preparation; defects and their control. Kefir and koumiss: origin and characteristics; microbiology of kefir grains; Other fermented milks such as Bulgarian milk, cultured buttermilk, Leben, Villi and Yakult; Microbiology of fermented milk products; their nutritional and therapeutic significance.

Cheese Starters: Classification, desirable properties, Artisanal and adjunct cheese cultures, primary and secondary flora of cheese; biochemical changes during ripening, bacterial and mold ripened cheeses: soft, semi-soft, semi-hard, hard, Brick and Brie cheese, Camembert and Roquefort cheese; Rennet: rennet substitutes, microbial rennet and recombinant chymosin

Practical

Testing purity of starter cultures by gram's staining, catalase test; creatine test; Testing starter activity by dye reduction tests, Horrall-Elliker, White Head and Cox test; Preparation of single and mixed starter cultures; Evaluation of homo-fermentation and hetero-fermentation separately and in combination; Preservation of starter cultures by freeze-drying techniques; Preparation of concentrated starter (DVS); Effect of physical factors (temperature, pH, Salt and Sugar) on dairy starters; Testing milk for presence of inhibitory substances using B. stearothermophilus and S. thermophilus as indicator organisms; Effect of presence of antibiotic residues in milk on starter activity; Evaluation of associative growth of Starter cultures in milk; Detection of Bacteriophages in cheese whey by plaque assay method; Preparation and microbial examination of dahi, lassi, shrikhand, yoghurt, cultured butter milk, acidophilus milk and kefir; Analysis of cheese for total spore and anaerobic spore count; Microbiological analysis of cheddar cheese at different stages of manufacture of (storage and ripening).

AEC-5 Physical Education, First Aid, Yoga Practice and Meditation

2 (0+2)

Practical

Physical education; Training and Coaching - Meaning and Concept; Methods of Training; aerobic and aerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory,

Circulatory and Digestive systems; Balanced Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing and role of regular exercise on ageing process; Personality, its dimensions and types; Role of sports in personality development; Motivation and Achievements in Sports; Learning and Theories of learning; Adolescent Problems and its Management; Posture; Postural Deformities; Exercises for good posture.

Yoga; History of Yoga, Types of Yoga, Introduction to Yoga:

- Asanas: Definition and Importance, Padmasan, Gaumukhasan, Bhadrasan, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan– left legright leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Sawasan
- Suryanamskar Pranayama (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari
- Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh
- Mudras (Definition and Importance) Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra

- Role of yoga in sports
- Teaching of Asanas – demonstration, practice, correction and practice.

History of sports and ancient games, Governance of sports in India; Important national sporting events; Awards in Sports; History, latest rules, measurements of playfield, specifications of equipment, skill, technique, style and coaching of major games (Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics

Need and requirement of first aid. First Aid equipment and upkeep. First AID Techniques, First aid related with respiratory system. First aid related with Heart, Blood and Circulation. First aid related with Wounds and Injuries. First aid related with Bones, Joints Muscle related injuries.

First aid related with Nervous system and Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs, Handling and transport of injured traumatized persons. Sports injuries and their treatments.

DBM-211 (MDC-2) **Agriculture Marketing and Trade** **3 (2+1)**

Theory

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets; demand, supply and producer's surplus of agri commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits and demerits.

Marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labeling (Agmark).

Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs.

Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP and DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation and hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; GATT and WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR. Role of government in agricultural marketing. Role of APMC and its relevance in the present day context.

Practical

Plotting and study of demand and supply curves and calculation of elasticities; Study of relationship between market arrivals and prices of some selected commodities; Computation of marketable and marketed surplus of important commodities; Study of price behaviour over time for some selected commodities; Construction of index numbers; Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class; Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning; Application of principles of comparative advantage of international trade.

Skill Enhancement Course

Market Research: Tools and Techniques **2 (0+2)**

Introduction: Market Research and Techniques, Types of Data, Sampling, Survey, Activities: Designing a questionnaire for milk/dairy product preferences, Conducting a mini-survey in a local market (Consumer Need and Preferences, Market trends, Competitors, product and service performance), Market mapping of agri-products/dairy products, Analyzing secondary data from NSSO/NDDB/Agmarknet etc., Pricing analysis of local vs branded products, Branding and Advertisement of dairy based products, Group project on consumer satisfaction survey.

SEMESTER - IV

DT-221 **Cheese Technology**

5 (3+2)

Theory

Origin and history of development of cheese manufacture, status and scope in India and abroad. Definition, standards and classification of cheese.

Milk quality in relation to cheese making. Pre-treatment of milk for cheese making; Physical and chemical additives and preservatives for cheese making. Rennet preparation and properties, milk clotting enzymes as rennet substitutes: plant, animal and microbial origin. Action of rennet on milk in relation to cheese making. Biochemical changes during ripening, bacterial and mold ripened cheeses: soft, semi soft, semi hard, hard, acid coagulated cheese.

Cheese starters: Classification, desirable properties, Artisanal and adjunct cheese cultures, primary and secondary flora of cheese; Manufacture of different choice-based varieties of cheese: Cheddar, Gouda, Swiss Mozzarella, Cottage, Cream and Quarg. Enzyme modified cheese (EMC), flavourings, Application of membrane processing in cheese manufacture. Factors affecting yield of cheese. Packaging, storage and distribution of cheese. Accelerated ripening of cheese. Manufacture of processed cheese, cheese spread and processed cheese foods. Mechanization and automation in cheese processing.

Application of membrane processing in cheese manufacture. Factors affecting yield of cheese. Packaging, storage and distribution of cheese. Accelerated ripening of cheese. Manufacture of processed cheese, cheese spread and processed cheese foods. Mechanization and automation in cheese processing.

Practical

Effect of physical factors (temperature, pH, Salt and Sugar) on dairy starters; Testing milk for presence of inhibitory substances using B. stearothermophilus and S. thermophilus as indicator organisms; Effect of presence of antibiotic residues in milk on cheese starter activity; Evaluation of associative growth of Starter cultures in milk; Detection of Bacteriophages in cheese whey by plaque assay method; Familiarization with equipments, accessories and standardization numerical; Study of factors affecting rennet action; Determination of Rennet Coagulation Time (RCT) of milk, Manufacture of Cheddar cheese; Manufacture of Gouda cheese; Manufacture of Mozzarella cheese; Manufacture of Swiss cheese; Manufacture of Cottage cheese; Manufacture of Processed cheese; Manufacture of Processed cheese spread; Manufacture of Processed cheese food.

DT-222 **Fat-Rich Dairy Products** **3 (2+1)**

Theory

Status of fat-rich dairy products in India and abroad. Cream: (a) Definition and Legal standards, efficiency of cream separation and factors affecting it; control of fat concentration in cream. (b) Planning and operating a cream production unit) neutralization, standardization, pasteurization and cooling of cream. (c) Preparation and properties of different types of cream; table cream, sterilized cream, whipped cream, plastic cream, frozen cream and chip-dips (cultured cream), UHT processing of cream. (d) factors affecting the quality of cream; ripening of cream. (e) Packaging, storage and distribution, defects (non-microbial) in cream and their prevention.

Butter: (a) Introduction to the butter making process; theory of churning, Legal standards. (b) Technology of Butter manufacture, Batch and continuous methods. Over-run in butter; control of fat loses in butter-milk; packaging and storage; transportation; defects in butter; rheology of butter; uses of butter. Butter making equipment: Construction, operation, care and maintenance of cream separators, coolers and vacreator, factory butter churn and continuous butter making machine.

Special butters and related products: (a) Manufacture, packaging, storage and properties of whey butter, flavoured butter, whipped butter, renovated butter/fractionated and polyunsaturated milk fat products, vegetable oil-blended products and low-fat spreads. (b) Manufacture, packaging, storage and characteristics of margarine of different types.

Ghee and butter oil: (a) Methods of ghee making-batch and industrial processes, innovations in ghee production, procedure, packaging and preservation of ghee; utilization of substandard milk. (b) Ghee: Composition and changes during manufacture fat constants. (c) Butteroil: Manufacture of butteroil, packaging and storage.

Practical

Standardization, neutralization, pasteurization and cooling of cream. Preparation of sterilized cream. Study of construction and cooperation of the power operated butter churn and butter packaging machine. Preparation of cooking butter by the hand operated churn. Preparation of desi butter. Manufacture of table butter using the power-driven churn. Preparation of ghee from cream and butter. Study and operation of continuous ghee plant.

DT-223 **Ice-Cream and Frozen Desserts** **3 (2+1)**

Theory

History, development and status of ice cream industry, History, development and status of ice cream industry, Definition, classification and composition and standards of ice cream and other frozen desserts.

Stabilizers and emulsifiers-their classification, properties and role in quality of ice cream, Technological aspects of ice cream manufacture.

Thermodynamics of freezing and calculation of refrigeration loads, Types of freezers, refrigeration control / instrumentation, Hygiene, cleaning and sanitation of ice cream plant.

Effect of process treatments on the physico-chemical properties of ice-cream mixes and ice cream, Processing and freezing of ice-cream mix and control of over run, Packaging, hardening, storage and shipping of ice-cream, Defects in ice cream, their causes and prevention.

Recent advances in ice-cream industry (flavourings, colourings, fat replacers, bulking agents) and plant management, Nutritive value of ice-cream.

Practical

Calculation of standardization of ice-cream mixes; Manufacture of plain and fruit flavoured ice- cream; Manufacture of chocolate, fruit and nut ice cream; Preparation of sherbets/ices; Preparation of soft served and filled ice-cream; Manufacture of kulfi. Study of continuous and batch type freezers; Manufacture of ice-cream by continuous process; Determination of overrun in ice cream; Visit to an Ice Cream Plant.

DC-221 Chemistry of Dairy Products 2 (1+1)

Theory

Chemical composition and legal standards of milk products. Chemistry of creaming and factors affecting the same. Ripening and neutralization of cream. Theories of churning and factors affecting the same. Butter colour. Ghee: Physico-chemical changes during manufacture. Hydrolytic and oxidative deterioration, their causes, prevention and role of antioxidants.

Physico-chemical changes in milk constituents during manufacture and storage of traditional dairy products: Khoa, Paneer, Dahi, Channa, Lassi, Chakka, Shrikhand.

Chemistry of cheese: milk clotting enzymes, enzymatic coagulation of milk, biochemical changes during ripening. Physico-chemical changes during preparation and storage of concentrated and dried milk products.

Physico-chemical changes during processing and storage of ice cream and frozen desserts.

Role and mechanism of stabilizers and emulsifiers in ice cream.

Practical

Cream: estimation of fat and acidity; Butter: estimation of fat, moisture, curd and salt content; Ghee: estimation of moisture, acid value, Butyro refractive reading and Reichert Meissl value / Polanske value; Determination of lactose and sucrose in sweetened condensed milk; Milk powder: moisture, fat, ash, solubility, acidity and bulk density; Ice cream: estimation of fat and total solids; Estimation of moisture, fat and salt content in cheese; Khoa/paneer: estimation of moisture and fat; Estimation of protein content in milk products and protein rich dairy products using Kjeldahl method.

DM-221 Microbiology of Dairy Products 2 (1+1)

Theory

Microbiology of Cream and Butter - Micro-environment and impact of critical process factors on entry of spoilage and pathogenic organisms in cream and butter; Microbiological aspects including defects in pasteurized (ripened/un-ripened cream), sterilized and UHT cream; Factors influencing the microbial growth during batch/continuous butter making process; Microbial Defects in butter

- Bacterial/mold discoloration, enzymatic deterioration and their control measures;

Regulatory microbiological standards. Fungal spoilage of Ghee.

Microbiology of Condensed, Evaporated and Dried products: Type of microorganisms associated with condensed and evaporated milk, their growth/ survival during manufacture and storage; Microbial defects - Bacterial thickening / Mold button formation in SCM; Gassiness/ bloating, Bacterial coagulation (Sour and sweet), Bitterness, Fishy flavor in evaporated milk; pre- heating/DSI temperature and their impact on microflora of dried products.

Microbiological aspects of milk powder with respect to manufacturing steps and types of powder (heat classification of powders), Effect of reconstitution on microbial quality of milk powder including baby foods and survivability of pathogens; Regulatory microbiological standards. Microbiology of Infant Milk Formula (IMF).

Microbiology of Ice Cream and Frozen desserts: Micro environment in ice cream, microbiological quality of ingredients, critical process factors and their impact on entry of pathogens in ice cream and frozen desserts, their survival during storage, food poisoning out breaks and legal standards.

Microbiology of Indigenous Milk Products: Predominance of spoilage and pathogenic organisms in khoa and khoa based sweets – burfi, peda, gulab jamun, etc., paneer, Chhanna and Chhanna based sweets – rasogulla; kheer, shrikhand, dahi, kulfi etc.; Factors affecting the microbiological quality in reference to production, processing, storage and distribution; Comparison of dairy sweets made at sweet shops vs. commercially manufactured sweets. Microbial safety in relation to potential pathogens and their public health significance; Microbial defects, control measures and legal standards.

Practical

Microbiological examination of raw, pasteurized, sterilized and UHT cream for Standard plate count (SPC) as well as lipolytic and coliform counts, direct microscopic count (DMC), dye reduction tests and sterility test ; Microbiological examination of salted and unsalted butter for SPC, psychrotrophic, lipolytic, coliforms and yeast and mold count; K.Q test; Microbiological examination of concentrated milk for SPC, coliforms,

spores, yeast and mold, thermoduric and thermophilic counts; Microbiological examination of dried milks for SPC, coliforms, Staph. aureus, B. cereus, E. coli, Salmonella, Sulphite reducing clostridia and Staphylococcal enterotoxins; Microbiological examination of ice-cream and other frozen desserts for SPC, coliforms and Staphylococcal counts; Detection of Salmonella spp./E. coli; Microbiological examination of khoa for SPC, coliforms and staphylococcal counts besides yeast and mold counts; Microbiological examination of paneer and shrikhand for SPC, Spores, coliforms, yeast and molds and Staphylococcal counts;

Microbiological examination of Kheer for SPC, Spores, coliforms, yeast and molds and Staphylococcal counts.

DBM-221 **ICT in Dairy Industry** **2 (1+1)**

Theory

Importance of Computerization and IT in dairy industries. Computers, Operating. Environments and Information Systems for various types of dairy Industries. Principles of communication. Role of Computer in Optimization; Introduction to Operation. Research A Computer Oriented Algorithmic approach: Queuing systems and waiting models, PERT CPS and CPM. Dairy Process Modelling and Simulation. Introduction to SCADA and INTELUTION. CAD and CAM in Dairy Industries: Instrumentation, Process control, Inventory control, Automation, Robotics, Expert Systems and Artificial Intelligence, Instrumentation.

Practical

Applications of MS Excel to solve the problems of dairy technology: Statistical quality control, Sensory evaluation of food. Chemical kinetics in dairy processing. Use of word processing software for creating reports and presentation. Familiarization with the application of computer in dairy industries: Milk plant, Dairy units, Fruit and Vegetable processing unit. Familiarization with software related to dairy industry

DBM-222 **3 (2+1)**

(MDC-3) Entrepreneurship Development and Business Management

Theory

Development of entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial attributes/competencies. Concept, need for and importance of entrepreneurial development.

Evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs, importance of entrepreneurial development, and process of entrepreneurship development. Environment scanning and opportunity identification need for scanning–spotting of opportunity-scanning of environment–identification of product / service – starting a project; factors influencing sensing the opportunities.

Infrastructure and support systems- good policies, schemes for entrepreneurship development; role of financial institutions, and other agencies in entrepreneurship development. Steps involved in functioning of an enterprise. Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution.

Planning of an enterprise, project identification, selection, and formulation of project; project report preparation, Enterprise Management. Production management – product, levels of products, product mix, quality control, cost of production, production

controls, Material management. Production management – raw material costing, inventory control. Personal management – manpower planning, labour turn over, wages / salaries. Financial management /accounting – funds, fixed capital and working capital, costing and pricing, long term planning and short-term planning, book keeping, journal, ledger, subsidiary books, annual financial statement, taxation. Marketing management- market, types, marketing assistance, market strategies. Crisis management- raw material, production, leadership, market, finance, natural etc.

Practical

Visit to small scale industries/agro-industries, Interaction with successful entrepreneurs/ agric- entrepreneurs; Visit to financial institutions and support agencies; Preparation of project proposal for funding by different agencies.

Skill Enhancement Course **2 (0+2)**

Operation of Ice-cream Freezers, Ice-candy making unit and their packaging

Introduction to ice cream and frozen desserts: Ice cream, kulfi, ice candy etc. Familiarization with equipment in ice cream unit. Study of ice cream freezers. Preparation and formulation of ice cream mix. Ice candy formulation. Preparation of Kulfi. Preparation of low calorie, dietetic, diabetic and low-fat ice cream and frozen desserts. Cleaning and sanitization practices during ice cream production. Operation and maintenance of ice cream freezers. Hardening and storage of ice cream and frozen desserts. Packaging of ice cream and frozen desserts. Evaluation of quality parameters of ice cream and frozen desserts: Overrun, body & texture, and melting resistance. Industrial Visit to Ice-cream unit.

SEMESTER - V

DT-311 Condensed and Dried Milk 4 (3+1)

Theory

Condensed milks: History, status and scope in India and abroad, Definition and legal standards: Condensed milk, sweetened condensed milk and evaporated milk, manufacturing techniques; (a) Manufacture of evaporated milk including pilot sterilization test, (b) Manufacture of sweetened condensed milk, (c) Recombined sweetened condensed milk.

Grading and quality of raw milk for condensed and evaporated milk, Physico-chemical changes taking place during manufacture of condensed milk, Heat stability of milk and condensed milk and role of stabilizers in the stability of condensed milk, Chemical defects in condensed milk, their causes and prevention. Recent advances with reference to freeze concentration and membrane concentration.

Dried milks: History and status in India and abroad, Grading and quality of raw milk for dried milks, Manufacture of skim milk powder (SMP), whole milk powders and heat classified powders.

Physico-chemical changes taking place during manufacture of dried milks, Physical properties of dried milks, Defects in dried milk during manufacture and storage, their causes and prevention, PFA, BIS and International Standards for dried milk.

Manufacture of infant foods, malted milk foods and other formulated dried products, Cheese spread powder, ice cream powder, cream powder, butter powder, whey powder, Management of condensed and dried milk industry.

Practical

Manufacture of plain skim concentrated milk; Manufacture of Sweetened Condensed Milk; Manufacture of Evaporated Milk; Concentration of milk by membrane processing; Manufacturing of Skim Milk Powder by spray drying/roller drying; Manufacture of instant milk powder.

DT-312 Dairy By-Products Technology 3 (2+1)

Theory

Status, availability and utilization of dairy by-products in India and Abroad. Associated economic and pollution problems, Physico-chemical characteristics of whey, butter milk and ghee residue

By-products from skim milk: (a)Casein: types of commercial casein, their specifications, manufacturing processes with basic principles involved. (b) Industrial and food uses of caseins (c) Manufacture of sodium and calcium caseinates their physico-chemical and functional properties and food applications. (d) Manufacture of casein hydrolysates and its industrial application. (e) Co-precipitates: types, their specifications, manufacturing processes with basic principles involved, functional properties and food applications.

Whey processing: (a) Fermented products from whey, (b) Beverages from whey, (c) Deproteinized and demineralized whey, (d) Condensed whey, (e)

Dried whey, types and their specification, manufacturing techniques, (f) Utilization of whey products. Application of membrane processing for whey processing.

Whey protein concentrates: (a) Methods of isolation with basic principles involved, physico- chemical properties of whey proteins concentrates, (b) Functional properties and food applications of WPC.

Lactose: methods for the industrial production of lactose, refining of lactose, uses of lactose and hydrolysis of lactose. Butter milk processing: (a) Condensed butter milk, (b) Dried butter milk, (c) Utilization of butter milk products.

Ghee residue: Composition, processing and utilization. Nutritional characteristics of by- products.

Practical

Manufacture of edible casein from cow and buffalo milk; Manufacture of rennet casein; Manufacture of sodium caseinate; Manufacture of calcium caseinate; Manufacture of co-precipitate; Isolation of whey proteins by cold precipitation technique; Manufacture of whey proteins, concentration by ultra filtration process; Manufacture of whey drinks; Manufacture of dried whey; Manufacture of lactose; Incorporation of whey protein concentrates in processed cheese foods; Manufacture of coffee whitener.

DM-311 Quality and Safety Monitoring in Dairy Industry 3 (2+1)

Theory

Concepts of Quality: Quality as defined by various authors and organizations, History of Quality, Seven tools of quality, Quality Assurance vs. Quality Control, Total Quality Management (TQM); Concepts of Quality Management System (QMS)–ISO: 9001:2015; Principles of QMS; Standard requirements for QMS. Concept of Six sigma and lean sigma. Kaizen; Toyota Production System (TPS).

Global quality and food safety standards, Role and activities of International organizations involved in food regulation (CAC, WHO, FAO, INFOSAN, FDA, EFSA, ICMSF, GFSI, ISO etc.). Codex Alimentarius Commission (CAC): Working, History of CAC- GATT-Uruguay Round, WTO Regime, Sanitary and Phytosanitary (SPS) Standards, CAC in International food trade. National Organizations involved in food safety and quality (FSSAI, BIS, Agmark), FSSAI: Mandate, Role, Activities, Online services (FLRS, InFOLeT), Integrated food law, its main features and functions. Integrated food law of India (FSS 2006).

Food Safety: Good Manufacturing Practices (GMPs and cGMPs) and Good Hygienic Practices (GHPs); Pre-requisite programs (PRPs); HACCP: history, concept, principles and steps, with special reference to biological hazards in dairy foods, Concept of Food safety management system (FSMS)-ISO 22000:2018, principles and requirements; FSSC 22000; Comparison of ISO 22000 and FSSC 22000. Food safety auditing.

Microbiological Risk Analysis Concepts: Risk assessment, risk management and risk communication; risk profiling of dairy products; Microbiological criteria (Standards, Guidelines and Specifications), ICMSF two and three class sampling plan / guidelines; Bio-safety concepts in handling of dairy pathogens and setting up of a microbiological/ pathogen lab in a dairy plant.

Tests and Microorganisms in process hygiene criteria and food safety criteria for dairy products as per FSSAI. Enumeration principles and procedure for conventional and rapid detection of predominant hygiene indicator organisms; Conventional and rapid techniques for isolation and identification of safety indicator organisms like E. coli (E.coli0157:H7), Salmonella, Shigella, Bacillus cereus, Sulphite reducing Clostridium and Listeria monocytogenes.

Plant and equipment hygiene: Concepts of hygiene and sanitation, microbial quality of water and environmental hygiene in dairy plant, chlorination of dairy water supply, quality of air, personnel hygiene, treatment and disposal of waste water and effluents.

Practical

Conventional techniques for evaluation of milk and milk products for Hygiene and safety. Rapid detection of pathogenic bacteria based on antigen antibody principle: Staphylococcal enterotoxins, E. coli O157:H7, Listeria monocytogenes and Salmonella using VIDAS system; Rapid detection of total plate count, yeast and mold counts, Coliform, E. coli, Enterococci, Enterobacteriacae count using D-count and 3M Petrifilm kits; Preparation of GMP/GHP report; Designing of HACCP plan for milk products; Making of Decision Tree for Critical Control Point (CCP) determination; Prepration of audit report for ISO 9001 and ISO 22000; Evaluation of common sanitizing agents used in dairy plants by (a) suspension, (b) capacity test; Microbiological tests for assessing Environmental, equipment and personnel hygiene by swab and rinse methods; Determination of BOD in dairy waste water.

DC-311 Chemical Quality Assurance 2 (1+1)

Theory

Importance of chemical quality control, quality assurance and total quality management in dairy industry. Role of national and international food regulatory systems and standards with respect to quality and safety of milk and milk products: FSSAI, PFA, AGMARK, BIS ISO, IDF, Codex, etc.

Setting up of testing facilities and analytical laboratories; concept of mobile testing laboratories. Accreditation of analytical laboratories. Preparation and standardization of reagents required in the analysis of milk and milk products.

Sampling procedures; labelling of samples for analysis; choice of analytical tests for milk and milk products for chemical analysis and instrumental methods of analysis. Calibration of dairy glassware; including butyrometer, pipettes, burettes, hydrometers, lactometers and thermometer.

Testing methods for the detection of adulterants, preservatives and neutralizers in milk and milk products. Environmental contaminates such as pesticides, antibiotics, heavy metals in milk and milk products and their chemical testing methods.

Importance of milk contact surfaces, metallic contamination in dairy industry. Chemical quality of water in dairy industry. Prediction of shelf-life behavior of milk and milk products.

Practical

Calibration of dairy glassware such as pipette, burette, volumetric flasks, hydrometer, butyrometers. Preparation and standardization of dairy reagents such as acids, alkalies, sodium thiosulfate, silver nitrate, Fehlings, EDTA solutions etc. Preparation and testing of Gerber sulfuric acid used in fat determination. Testing the amyl alcohol used for fat determination. Chemical analysis of permissible additives used in milk and milk products. Chemical analysis of detergents and sanitizers. Detection of adulterants, preservatives, and neutralizers in milk and milk products. Detection of vegetable oils and animal body fat adulteration in ghee. Analysis of market samples of milk and milk products. Determination of temporary and permanent hardness of water. Estimation of available chlorine from bleaching powder.

DE-311 Instrumentation and Process Control 3 (2+1)

Theory

Importance of instrumentation and process automation in Dairy process control, Instrumentation scheme and characteristics: Introduction to static characteristics and dynamics characteristics, selection of instruments, loading effects. Dynamic characteristics of measurement systems.

Sensors: Definition, principle of sensing and transduction, classification, selection and applications of Sensors. Types of Sensors, Measurement of parameters Proximity sensors: applications in Dairy processing operations, Digital and analogue signals, handling and processing, Piezo electric sensor: construction- working and applications, Micro, Nano sensors and smart sensors: Construction, characteristics and applications. Switches: Relays, solid state relay, Contactors etc, Micro and Limit switches: Types, construction, working and applications.

Electric Power Monitoring and control: Measurement and control of electric Power, digital AC/ DC Volt, current, frequency PF meters. Voltage protection, Earth leakage, current protection, Phase reversal, phases monitoring relays. PF control relays, Smart Energy meters: Role and importance. Solid state alarm: working and application in dairy processing. Valve automation: Different types of automation valves and their application, Variable frequency drives (INVERTER): Importance, types, Construction, working and their application in Dairy process automation.

Speed control of DC motors. Digital Process timers: On-delay, Interval, cyclic, sequential, reverse-forward, star delta, totaliser and counter types of timers, their applications in control of dairy process operation. Micro-processor and Micro-controllers: Introduction and application.

Data acquisition and data loggers: Importance- and applications, Programmable logic controller: Introduction, importance, working-selection and applications, Communication Interfaces: RS-485, Rs-232, modbusetc, their role and applications, Programmable touch screen and HMI: Introduction, importance, working- selection and usage, SCADA: Introduction, importance, working- selection and usage.

Electronic Instruments: Role and importance of general purpose test instruments, Electronic Millimeter, Cathode Ray Oscilloscope, Measurement of amplitude, frequency and phase using CRO Advantages of digital meter over analog meters, Digital voltmeter, Resolution and sensitivity of digital meters, Digital multimeter, Digital frequency meter, Signal generator. Display devices and recorders like X-Y and X-T recorders. Automation: Introduction to plant automation, automation hierarchy, PLC, SCADA.

Practical

Strain gauge characteristics and weight measurement; Measurement of pressure using bellows and diaphragm; Fabrication and calibration of thermocouples; Study the construction and working of Bourdon pressure gauge; Testing and calibration of pressure gauges using dead weight tester; Study the mechanism of pH meter and calibration; Study of proximity sensor; Study of different parts and working of pressure switch.

Study of RTD and Thermistor; Study of different speed measurement sensor/ instruments; Study of LVDT; Measurement of level and flow using controllers; Temperature control using PID and On/Off controllers; Generation of wave signals using CRO, Data acquisition to PC from instruments using RS232/485 and USB interfaces, Fabrication of micro sensors and Study of PLC systems and Demonstration of PLC systems in Dairy Plant.

DE-312 Dairy Process Engineering 3 (2+1)

Theory

Evaporation: Basic principles of evaporators, construction and operation, Different types of evaporators used in dairy industry, Calculation of heat transfer area and water requirement of condensers, Basic concepts of multiple effect evaporators, Operations and various feeding systems, Economy of operation, Thermo processor and MVR system, Care and maintenance of evaporators.

Drying: Introduction to principle of drying, Equilibrium moisture constant, bound and unbound moisture, Rate of drying- constant and falling rate, Effect of Shrinkage, Classification of dryers-spray and drum dryers, spray drying, etc., air heating systems, Atomization and feeding systems; Factors affecting bulk density of powder, spray dryer controls, Theory of solid gas separation, cyclone separators, Bag Filters, Care and Maintenance of drum and spray dryers.

Fluidization: Mechanisms of fluidization characteristics of gas-fluidization

systems, Minimum Porosity, Bed Weight, Pressure drop in fluidized bed, Application of fluidization in drying, Batch fluidization, Fluidized bed dryers.

Processing equipment: Mechanization and equipment used in manufacture of indigenous dairy products, Ice-cream and Cheese making equipment; Packaging equipment: Packaging machines for milk and milk products.

Membrane Processing: Ultra filtration, Reverse Osmosis and electro dialysis, Materials for membrane construction, Ultra filtration of milk, Effect of milk constituents on operation, membranes for electro-dialysis.

Practical

Constructional details, operation and maintenance of Vacuum pan; Constructional details, operation and maintenance of multiple effect evaporator; Constructional details, operation and maintenance of spray drier; Constructional details, operation and maintenance of butter making equipment; Constructional details, operation and maintenance of equipment related to ghee production; Constructional details, operation and maintenance of ice-cream making equipment; Constructional details, operation and maintenance of cheese making equipment; Constructional details, operation and maintenance of reverse osmosis and ultra filtration system; Design problems on double effect evaporator and vacuum pan; Visit to a milk product plant.

DBM-311 **Operations Research** **2 (1+1)**

Theory

Introduction–Elementary concepts, objectives of operations research, Applications of OR in decision-making; Modelling in Operation Research; Linear Programming: Introduction, mathematical formulation of the problem, Graphical solution, Simplex technique for solving simple LP problems.

Inventory Control – Introduction and general notations, Economic lot size models with known demand; Replacement – Introduction, Replacement of items whose efficiency deteriorates with time.

Queuing – Introduction and general notions, Classification of queues and their problems, Probability distribution of queues; Various models in the queuing system; Sequencing – Statement of the problem, notations and assumptions, Problems with 'n' jobs and two machines; Generalization to 'm' machines.

Transportation model – Definition and application of transportation model, Formulation of transportation problems and their solutions; Assignment problems and their solutions.

Framework of PERT and CPM, Activities, events and network, PERT and activity time estimates, probability of project completion critical path analysis.

Practical

LP problems; Inventory Control problems; Replacement model problems; Problems on queuing theory, sequencing, transportation, assignment; PERT/CPM.

DBM-312 **Economic Analysis** **2 (2+0)**

Theory

Basic concepts-wants, goods, wealth, utility, consumption, demand and supply, Consumer behaviour-law of diminishing marginal utility and equi-marginal utility, cardinal and ordinal utility approach for consumer's behaviors.

Theory of demand-law of demand, demand schedule, demand function, determinates of demand, individual consumer demand and market demand, demand forecasting, elasticity of demand, price elasticity, income elasticity and cross elasticity, Consumer's surplus.

Theory of production- concepts of firm and industry, basic factors of production and their role, production function for a single product, nature of production function, laws of returns.

Concepts of costs-fixed and variable costs, short run and long run costs, average and marginal costs, economics and diseconomies of scale.

Concept of market- types of market, pricing and output under different market situations, market price and normal price, price determination under perfect Competition, monopoly, oligopoly and monopolistic competition; National income – GDP, GNP, NNP, disposable personal Income, per capita income, inflation.

SEMESTER - VI

DT-321 Dairy Plant Management and Pollution Control 2 (1+1)

Theory

Production Management: Definition, Function and structure of Production Management, Production planning and Control, Work study and measurement motion and time study; Efficiency of plant operation: product accounting, setting up norms for operational and processing losses for quantity, fat and SNF, monitoring efficiency.

Plant Operations Product and process control, Control charts, Process Sigma, Efficiency factors losses, Financial and Managerial efficiency; Provision for Industrial Legislation in India, particularly in dairy industry, Factory Act and Regulations.

Human Resource Management: Personnel Management, Manpower planning, recruitment, training, transfer, promotions policies, Job specifications, Job evaluation, Job enhancement, Job enrichment, MBO, working conditions.

Safety hazards: hazards prevention, security for plant machinery and the employees, Plant Maintenance; Prevention and Break-down maintenance: Spare parts inventory, tools and lubricants, etc; Food hygiene: personnel hygiene, plant hygiene, water quality, etc.

Wastes discharged from dairy plants: An overview; Wastewater discharged from (a) Milk reception dock, (b) Liquid milk processing section, (c) Butter and ghee manufacturing, (d) Ice- cream and condensed milk manufacturing, e) Milk powder manufacturing, (f) Cheese and paneer manufacturing; Packaging wastes; CIP cleaning, Environmental issues in effluent discharge: (a) Effects on waterways, (b) Effects on land, (c) Effects on the atmosphere (d) Solid waste.

Waste treatment process in a dairy processing plant: Wastewater treatment options for A Dairy Processing Plant; Calculation of wastes discharged and the economics thereof.

Practical

Flow process charts of different milk products; Identification of steps of material losses on dairy plants; Identification of hazardous processes and equipment, (HACCPT plan) safety and precautions; Identification and uses of common lubricants; Waste characterization and Waste Utilization processes; Various treatments in waste disposal; Analysis of cleaning agents and sanitizers; Reports and records maintenance of dairy plant; Operational precautions; CIP cleaning.

DE-321 Strength of Materials and Dairy Machine Design 3 (2+1)

Theory

Strength of Materials: Basic concepts in Statics and Dynamics; Force Systems; Equilibrium condition, friction, Law of friction, Second moments of inertia, Parallel axis theorem; Dynamics: Equation of motion.

Translation and rotation of a Rigid body, work and mechanics of materials: Stress-Axial Load Classification Strain-Hooke's law, stress-strain diagram, Poisson's Ratio: Shearing Stresses; Torsion, Torsion formula, Angle to Twist of circular members; Power transmission shear force and bending moments, Shear in Beams, Bending Moment in beams; Pure bending of beams, Flexural stress shearing stresses in beams relations between centre, Torsional and flexural loads.

Dairy Machine Design: Procedures, Specification, strength, design factor, factor of safety selection of factor of safety; Materials and properties; Static strength, ductility, hardness, fatigue, designing for fatigue conditions; Theories of failure, Stresses in elementary machine parts, Design of a drive system; Design of length and thickness of belt.

Bearing: Journal and Anti-friction bearings; Selection of ball, tapered roller and thrust bearing; Springs, helical and leaf springs; Energy stored in springs; Design and selection of springs.

Practical

Design problems on applications of engineering statics and dynamics; Design problems on applications of work and energy; Design problems on applications of linear and angular momentum; Design problems on stress-strain diagram evaluation of elastic constants; Study on shear force and bending moment diagrams and its applications; Design problems on applications of flexural stresses; Design problems on applications of shearing stresses in beams; Study on system of limits, fits and tolerances and their applications; Design stresses in elementary machine parts; Design features and applications of shafts; Design features and applications of axles; Design features and applications of keys; Design features and applications of couplings.

Design problems on various types of power transmission systems; Design features and applications of bearings; Design features and applications of springs; Design problems on agitator/ stirrer; Design features of milk silo.

DBM-321 Financial Management and Cost Accounting 3 (2+1)

Theory

Introduction: Definition, scope and objectives of financial management; Different Systems of Accounting: Financial Accounting, Cost accounting, Management Accounting; Doubles entry system of Book-Keeping; Preparation of Accounting Records: Journal, Purchases and Sales Book and Posting in Ledger, Cash Book; Preparation of Final Accounts and adjustments at the end of trading period; Preparation of Trial Balance Banking Transactions and Bank reconciliation statements; Statements of Financial Information: Accounting system: A source of financial statements, Classification of capital and revenue expenditure, Balance Sheet, Profit and Loss Account, Statement of changes in the financial position, funds flow statements, cash flow statement, uses of funds flow and cash flow statements in financial decision making.

Financial Analysis: Nature and uses of financial analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Utility of Ratio analysis; Cost Volume – Profit analysis and operating leverage, Break-even analysis, Profit analysis and operating analysis, Utility of CVP analysis; Capital Structure: C;S Planning, risk return trade off, financial leverage; Cost of capital: Management of cost of capital, cost of debt, debentures, preference share capital, equity share capital and retained earnings, overall cost of capital.

Investment decision: Time value of money, Net present value, Investment evaluation criteria, NPV method, Internal rate of return method, Profitability index method, Pay-back period method, Accounting rate of return method; Capital budgeting: Complex Investment Decisions: Investment timing and duration Investment decisions under inflation, Investment decisions under capital rationing.

Project Report; Feasibility Report Valuation; Working capital management- Concept and determinants of working capital, Estimating working capital needs; Depreciation – Concept and method; Introduction, Definition, Objectives, Common terms.

Costing: Essentials of sound costing system; Different methods of costing, elements of cost: Labour- recording of time, idle time, methods of remunerating labour, Premium and Bonus Plans, Materials, Overheads.

Cost classification: Direct and Indirect expenses, fixed and variable costs; Various methods of apportioning indirect expenses; Inventory Management: Planning, control and costing; Stores and storekeeping, scope and importance, purchase procedure, types of purchase, location of stores and materials, procedure for the movement of stores,

different methods of pricing materials, store records; Cost Sheets- Different methods, Statement of cost and statement of profit estimates, Tenders or Quotations; Contract or Terminal costing; Process Costing: Process losses and inter- process profits, joint products and by products costing; Ascertainment of cost of milk production; Preparation of Cost Account Information for managerial decisions.

Practical

Preparation of Profit and Loss account; Preparation of Balance Sheet; Preparation of Cash flow statements; Preparation of Funds flow statements; Problems on Ratio analysis; Problems on Break-Even Analysis; Problems on Profit analysis; Problems on Operating Analysis; Problems on Financial leverage; Problems on Cost of Capital; Problems on Investment decisions; Problems on Capital budgeting.

DM-321 Food and Industrial Microbiology 2 (1+1)

Theory

Scope of food microbiology: Basic aspects, history and scope of food microbiology; Intrinsic and extrinsic factors that affect microbial growth

in different foods; Microbial Spoilage of foods: Microbial spoilage of fruits, fruit juices, vegetables, cereals, meat, poultry, sea foods, carbonated soft drinks, canned foods; Sources of contamination; Control of spoilage.

Food preservation: Principles of food preservation: physical methods, viz. low temperature and high temperature preservation (D, Z and F Values); Drying Methods; Chemical preservatives, Natural antimicrobial compounds and bio- preservation; Alternate methods of food preservation; Mode of action of various preservation methods on microbes.

Fermentation processes: Fermentation processes: Historical development, the range, components and types (i.e., submerged, surface and solid-state fermentation); criteria for selection of industrially important microorganisms; preservation and improvement of industrially important micro-organisms using metabolic engineering/genetic engineering; media for industrial process; upstream and downstream processing.

Types of fermenters: Fermenters: types (batch, fed batch and continuous), functions, design and control; sterilization; growth rate analysis, estimation of biomass; difference in chemostat and turbidostat.

Microbial production of industrial products: Immobilization of enzymes/cells; Microorganisms and processes involved in the production of single cell protein and industrial alcohol, beer and wine; organic acids (citric and lactic), enzymes (protease, lipase and rennet), vitamin (B_{12}), antibiotics and bacteriocins; and fermented whey beverages.

Practical

Microbiological examination of: (1) fresh and canned fruits, vegetables and juices; (2) flour and bread; and (3) eggs and meat; Isolation of psychrophilic, salt and sugar tolerant microorganisms from foods; Isolation of industrially important microorganisms from environment; Determination of Z, D and F values; Production and assaying of microbial enzymes (protease/ lipase); Production of lactic acid from whey; Production of nisin and assaying the antimicrobial activity of the culture; Design and control of a table-top and 10 liter lab fermenter (Demonstration); Production of ethyl alcohol from molasses and whey by yeasts; Production of fermented whey beverages; Educational tour to food processing/ fermentation industries.

DT-322 Packaging of Dairy Products 2 (1+1)

Theory

Introduction, Importance of Packaging, History of Package Development, packaging materials, Characteristics of basic packaging materials: Paper (paper board, corrugated paper, fibre board), Glass, Metal, Plastics, Foils and laminates, retort pouches, Package forms, Legal requirements of packaging materials and product information.

Packaging of milk and dairy products such as pasteurized milk, UHT-sterilized milk, fat rich products-ghee and butter, coagulated and desiccated indigenous dairy products and their sweetmeats, concentrated and dried milks including baby foods; Packaging of functional dairy/food products.

Modern Packaging Techniques; Vacuum Packaging, Modified atmosphere packaging (MAP), Eco-friendly packaging, Principles and methods of package sterilization, Coding and Labelling of Food packages.

Aseptic Packaging (AP), Scope of AP and pre-requisite conditions for AP, Description of equipment (including aseptic tank) and machines- Micro-processor controlled systems employed for AP, Package conditions and quality assurance aspects of AP, Microbiological aspects of packaging materials.

Disposal of waste package materials, Packaging Systems; Hazards from packaging materials in food.

Practical

Identification of packaging materials, Flame Hot wire test, Testing of papers/paperboards: Percentage moisture, Grease resistance, Water absorptiveness, Grammage, Tearing resistance, Bursting strength; Testing of glass bottle – resistance to thermal shock; Testing of plastics and laminates – Thickness, Water vapour transmission rate (WVTR), Grease resistance; Packaging of different dairy products by using prepack and vacuum packaging machines.

DT-323 Food Technology-I 3 (2+1)

Theory

Harvesting, transportation and storage of fruits and vegetables; Post harvest processing of fruits and vegetables: Peeling, sizing, blanching, Canning of fruits and vegetables, Drying and freezing of fruits and vegetables.

Juice processing: General steps in juice processing, role of enzymes in fruit; Juice extraction, equipment and methods of fruit juice extraction, preservation of fruit juices, fruit juice clarification, concentration of fruit juices, fruit juice powders; Fruit juice processing; Orange and tangerine, Lemon and lime juice, Apple juice, Grape juice, Nectars, pulpy juices, tropical blends, Vegetable juices.

Manufacture of Jam, Jelly and Marmalade: Role played by pectin, sugar and acid in jellied fruit products; Fruits and vegetable preserves, Glazed, Crystallized fruits; Tomato based products: Juice, puree, paste, sauce, ketchup; Pickles: Principle of pickling, technology of pickles.

Beverages: Classification, scope, carbonated non-alcoholic beverages and their manufacture; Fruit beverages and drinks, additives for fruit based beverages; Coffee: Production practices, structure of coffee/cherry, Coffee processing including roasting, grinding, brewing extraction, dehydration, aromatization, instant coffee; Tea: Tea leaf processing, green, red, yellow, instant tea.

Technology of confectionery foods: Candies, Chewing gums and bubble gums, Toffees, Caramels, Standards of confectionery products; Chocolate products: Cocoa bean processing, chocolate liquor, Standards of confectionery products; Functional foods: Introduction, Phytochemicals, Milk ingredients as nutraceuticals, fiber-rich food products etc.

Practical

Manufacture of toffees and caramels, Testing the efficacy of blanching process; Drying of fruits and vegetables; Preparation of fruit-based drinks and beverages: Ready-to-serve drink, Nectar, Squash, Whey-fruit based beverages; Manufacture of fruit jam; Manufacture of fruit jelly; Manufacture of chocolate confections; Manufacture of tomato ketchup/tomato sauce; Manufacture of soups; Manufacture of fruit preserve; Manufacture of candied fruits; Manufacture of fruit bar; Manufacture of pickles.

DC-321 **Food Chemistry** **3 (2+1)**

Theory

Water: Water binding and chemical reaction mediated by water; Food proteins: Classification and physico-chemical and structural properties; Lipids: Definition, classification of lipids, Unsaponifiable matter contents in various fats and oils, classification and chemical composition.

Carbohydrates: Classification of carbohydrates, polysaccharides, viz. linear, branched and modified; Properties and utilization of common polysaccharides, viz. cellulose, glycogen, hemicelluloses, pectin; Food Enzymes: Hydrolases and lipases, utilization in food chemistry; Minerals in foods: Main elements, trace elements in eggs, cereals and cereal products, vegetables and fruits; Aroma compounds in foods: Threshold value, off-flavours.

Food additives: Vitamins and Amino acids, Minerals, Aroma Substances/flavour enhancers- Monosodium glutamate, 5-nucleotides sugar substitutes, sorbitol sweeteners- saccharin, and cyclamate, Food colours and food preservatives.

Antinutritional factors and Food contaminants: Toxic trace elements, radio nucleotides; Cereal and cereal products: Individual constituents like proteins, lipids, carbohydrates and vitamins in cereals flour and their relationship in dough making, influence of additives /minor ingredients on baking properties: physico-chemical changes during baking; Legumes: Classification, general composition and physico-chemical properties.

Vegetables and Fruits: Classification, general composition, chemical changes during ripening and storage; Jams, Jellies and Pickles: Classification, composition and preservation; Preservation of foods, general principles of food preservation.

Practical

Determination of moisture, acidity and gluten content in flour; Determination of total ash and acid insoluble ash in flour; Determination of starch in flour; Determination of total nitrogen in cereal products; Determination of acidity and vitamin C in citrus fruits; Analysis of tomato ketchup for total solids, acidity, ash and salt; Determination of total sugar in tomato ketchup; Determination of total ash and alkalinity of soluble ash in tea; Determination of water extractive in tea leaves. Determination of presence of Chicory in coffee powder; Determination of reducing sugars in Jam; Determination of iron in infant foods.

DE-322 Energy Conservation and Management 2 (1+1)

Theory

Introduction: Potential and Importance of industrial energy conservation in dairy and food processing; Energy conservation Act 2001 and its important features, Schemes of Bureau of Energy Efficiency (BEE); Electricity Act 2003, Integrated energy policy; Energy management and audit: Definition, energy audit, need, types of energy audit; Energy audit approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution.

Energy balances and computation of efficiencies of equipment; Role of Energy inspectors and Auditors in energy management; Electrical load management: Demand management, energy management information systems, Energy saving controllers and cost saving techniques; Quality of power, Power factor and its improvement;

Transformers, losses in transformers; Energy savings in transformers; Electric motor-selection and application, Energy efficient motors; Variable Speed Drives and Variable Frequency Drives (VFD) and their role in saving electric energy; Bureau of Energy Efficiency (BEE): Power saving guide with "Star Ratings" of electrical appliances: Induction Motors, Air conditioners, Refrigerators and Water Heaters; Industrial Lighting: Quality of light, types of light sources, energy efficiency, Light controls.

Energy efficiency and conservation in utilities: High efficiency boilers, improved combustion techniques for energy conservation, Fluidized Bed Combustion and multi fuel capabilities; Energy conservation in steam distribution systems, efficient piping layouts, protective and insulation coverings in utility pipes; Steam conservation opportunities; Upkeep and maintenance of steam auxiliaries and fittings.

Energy conservation in Refrigeration and AC systems (HVAC), Cooling towers, Pumps and pumping systems, Fans, Blowers, Air compressors; Maintenance and upkeep of Vacuum lines and Compressed air pipe lines; Conservation and reuse of water, water auditing; Energy conservation opportunities in Wastewater treatment.

Processing equipment: Improving efficiency and energy conservation opportunities in few important food processing operations like Thermal processes, Evaporation, Drying and Freezing; Role of steam traps in energy saving; Energy Savings methods in hot air generator, Thermic fluid heater, Steam radiator.

Energy conservation in buildings: Concepts of Green Buildings; Waste-heat recovery and thermal energy storage in food processing facilities; Condensate recovery and reuse; Application of recuperator to recover energy from flue gases from boiler, DG exhaust, hot air from spray dryer, FBD etc; Diesel generating sets (stand by AC Gen sets): Energy saving opportunities in DG sets, Fuel and Oil conservation; important regular maintenance aspects; Carbon credits and carbon trade: Concepts of CDM, economic and societal benefits.

Cleaner energy sources: Introduction to Solar, and Bio-mass Energy; Solar thermal and photo- voltaic energy options for food processing industries; Role of automation in conservation of energy in dairy and food processing: Incorporation of enhanced PLC based computer controls and SCADA.

Practical

Study of Energy Conservation Act 2001; Study of schemes of BEE; Study of concepts of Energy Balance in Unit Operations and System boundaries; Solving examples on energy balances; Solving problems on electrical energy use and management: Connected load, Maximum demand, Demand factor and Load curve.

Determination of Load factor of an installation; Study of use of power factor meter and determination of true power and wattles power by using PF meters, Watt meter, Ammeter and Volt meter; Study of performances of a general type of induction motor and an energy efficient induction motor; Study of use of VSD; Study of various types of electrical appliances classified under different BEE Star Ratings; Drawing Energy Balance on a boiler: Collection of data, Analysis of results and determination of efficiency; Exercise on energy audit of a Dairy plant.

SEMESTER - VII

DE-411 **Food Engineering** **3 (2+1)**

Theory

Rheology: Rheology of processed food, properties of fluid foods, Rheological method, Measurement of rheological parameters, properties of granular food and powders, Properties of solids foods, Viscoelastic models; Measurement of food texture; Food Freezing: Thermal properties of frozen foods; Predication of freezing rates; Plank's equation, Design of food freezing equipment, Air blast freezers, Plate freezers, spiral freezers, and immersion freezers, IQF, storage of frozen foods.

Food dehydration: Estimation of drying time for food products, constant rate period and falling rate period dehydration; Diffusion controlled falling rate period; Use of heat and mass balances in analysis of continuous dryers, Principle, construction working of vacuum drier, ring dryer, Flash dryer, fluid bed granulator, tunnel, Rotary dryer, solar dryer; Freeze concentration and dehydration: Heat and mass transfer, Calculation of drying time, Industrial freeze drying.

Other advance food processing operations and equipment: Equipment for fruit washing, pulping, fruit juice extraction, blanching, de-hulling, milling, Juice concentration, aroma recovery and distillation; Handling and storage of fresh produce like fruits and vegetables: Pre-cooling (Field heat removal), cleaning, grading, sorting, packaging and storage; Study of Stability chambers: Principle, construction and working.

Unit operations in Fruit and vegetable: Processing for production of puree and paste : Washing (Hydraulic flume Rotary washer, sorting and grading, size reduction, blanching, hot/cold break system, De-aerators, Pulpers, turbo extractors, forced circulation evaporators, Tube- in tube type sterilizer- Aseptic filler; Size reduction: Theory and principle, Different size reductions equipment; Unit operations and equipment for production of bakery products: Planetary mixer, sigma mixer, Rotary oven, etc. Unit operations in production of Coffee powder production: Mixer, roaster, size reduction plant, Extraction, concentration and spray drying unit; Rewet method of production of granulated coffee.

Meat and fish processing: Meat mincer, Marinator, sausage maker; Food extruder: Principle, construction and working of Single and double screw extruder, Hot and cold extrude for production of ready eat and ready to cook foods.

Practical

To determine physical properties of food product; To determine rheological properties of food product; Determination of rheological parameters of solid and liquid foods by graphical solutions; To study food freezers; To study freeze drier; To determine drying characteristics of food product; To compare various dying methods; To determine juice

yield; To compare hot water, steam and vacuum blanching; To study construction and working of aroma /distillation system; To study various size reduction equipment; Study of sifter for size separation; Study of planetary mixer/sigma mixer/ whisker etc; Study of grain mill; Study of microniser/colloid mill for homogenisation, emulsification of viscous products like tomato paste, mayonnaise etc; Visit to cold storage; Visit to food processing plant (bakery, coffee processing, meat processing, cereal processing).

DE-412 Dairy Plant Design and Layout 2 (1+1)

Theory

Introduction of Dairy Plant design and layout: Type of dairies, perishable nature of milk, reception flexibility; Classification of dairy plants, Location of plant, location problems, selection of site; Hygienic design considerations for dairy processing plants;

Planning: Dairy building planning, Process schedule, basis of dairy layout, importance of planning, principles of dairy layout; Space requirements for dairy plants, estimation of service requirements including peak load consideration.

Dairy plant design aspects: General points of considerations for designing dairy plant, floor plant types of layouts, service accommodation, single or multilevel design; Arrangement of different sections in dairy, sitting the process sections, utility/service sections, offices and workshop; Arrangement of equipment, milk piping, material handling in dairies, Common problems, office layouts-flexibility; Development and presentation of layout, model planning, use of planning table in developing plot plant and detailed layout.

Building construction materials: Floors, general requirement of dairy floor finishes, floors for different section of dairy; Foundations, walls doors and windows.

Other design aspects: Drains and drain layout for small and large dairies; Ventilation, fly control, mold prevention, illumination in dairy plants; Computer aided Design: Introduction to CAD software.

Practical

Building symbols and convention; Symbols for equipment; Study of process schedule; To draw layout of collection/chilling centre; Visit to dairy processing plant for understanding of layout of different sections.

To draw layout of small dairy plant; To draw layout of small dairy plant using CAD; To draw layout of medium dairy plant; To draw layout of large dairy plant; To draw layout of cheese plant; To draw layout of ice-cream plant; To draw layout of butter manufacturing unit; To draw layout of ghee plant; To draw layout of composite dairy plant.

DT-411 **Food Technology-II** **3 (2+1)**

Theory

Cereal grains, legumes and oilseeds: Structure and composition of cereals, legumes and oilseeds, milling of paddy, quality factors of rice grains, processing of rice bran oil, Instant rice, quick cooking rice, canned rice, Milling technology of wheat, Criteria of wheat flour quality, improvers for wheat flour, Types of wheat flour.

Milling technology of maize, wet milling of corn, Milling technology of barley, malting of barley and its utilization in manufacture of value added food products including malted milk foods.

Dehulling and processing technology of important pulses, Dehulling and extraction of oil in major oilseed crops like soy bean, mustard, sunflower, ground nut, Vegetable protein concentrates/ isolates, Utilization of oil cake in food formulation.

Bakery and Snack technology: Technology of bread, biscuits, crackers and cakes, Technology of manufacturing process of Pasta foods-Macaroni, Noodles and Spaghetti, Technology of breakfast cereals: corn flakes, puffed, extruded snacks, Potato chips.

Meat, fish and egg technology: Development of meat, poultry, egg and fish industry in India, Pre-slaughter care, handling and ante-mortem inspection of animal, Stunning and slaughtering techniques, Postmortem inspection, rigor mortis and conversion of muscle to meat Slaughterhouse sanitation, meat hygiene and zoonotic diseases, Processing of poultry meat, Egg and egg products – quality assessment of egg, Types, handling, transportation and marketing of fish, Preservation of fish;, Manufacturing process of dehydrated fish and fish pickles; Cleaning and sanitation, Waste management of food processing plants.

Practical

Manufacture of barley malt; Determination of cooking quality of rice; Manufacture of bread and bun; Manufacture of biscuits; Preparation of noodles; Preparation of cake; Manufacture of potato chips; Preparation of malt based food products; Manufacture of malted milk foods, Manufacture of soy beverage and tofu, Preparation of salami; Preparation of chicken soup; Manufacture of chicken pickle.

DT-412 **Sensory Evaluation of Dairy Products** **2 (1+1)**

Theory

Introduction, definition and importance of sensory evaluation in relation to consumer acceptability and economic aspects; Terminology related to sensory evaluation; Design and requirements of a sensory evaluation laboratory; Basic principles: senses and sensory perception; Physiology of sensory organs; Classification of tastes and odours, threshold value; Factors affecting senses, visual, auditory, tactile and other responses.

Fundamental rules for scoring and grading of milk and milk products; Procedure and types of tests – difference tests (Paired comparison, due-trio, triangle) ranking, scoring, hedonic scale and descriptive tests; Panel selection, screening and training of judges; Requirements of sensory evaluation, sampling procedures; Factors influencing sensory measurements.

Milk: score card and its use; Judging and grading of milk, defects associated with milk; Cream: desirable attributes and defects in cream, Score card for cream, sensory evaluation of different types of cream; Butter: Specific requirements of high grade butter, undesirable attributes of butter, butter score-card, sensory evaluation of butter; Ghee: grades of ghee, special requirements of quality ghee, defects in ghee, sensory evaluation of ghee.

Fermented milks: desirable and undesirable characteristics of fermented milks, sensory evaluation of dahi, yoghurt, chakka, srikhand, lassi and other fermented drinks; Frozen dairy products: desirable and undesirable characteristics of frozen dairy products; Sensory evaluation of ice cream, kulfi and milk sherbets; Cheese: sensory attributes of some common cheese varieties and their defects, score card for cheese; Sensory evaluation and grading for cheddar, cottage and other varieties of cheeses; Dried dairy products: desirable and undesirable characteristic of dried milks; Sensory evaluation and grading of dry milk products; Concentrated milks: desirable attributes and defects; Sensory evaluation and grading of evaporated and condensed milk; Heat desiccated Indian milk products: desirable and undesirable characteristics.

Sensory evaluation of khoa and khoa based sweets; Acid coagulated Indian milk products: desirable arid undesirable characteristics; Sensory evaluation of paneer, chhana and chhana based sweets; Consumer acceptance studies: Objectives, methods, types or questionnaires, development of questionnaires, comparison of laboratory testing and consumers studies, limitations; Interrelationship between sensory properties of dairy products and various instrumental and physico-chemical tests.

Practical

Determination of threshold value for basic tastes; Determination of threshold value for various odours; Selection of sensory evaluation panel; Training of judges, for recognition of certain common flavour and texture defects using different types of sensory tests; Sensory evaluation of milk and cream; Sensory evaluation of butter and ghee; Sensory evaluation of condensed and evaporated milk; Sensory evaluation of milk powders; Sensory evaluation of cheese and related products; Sensory evaluation of frozen products; Sensory evaluation of khoa and khoa-based sweets; Sensory evaluation of chhana and chhana based sweets; Sensory evaluation of dahi and fermented dairy products; Preparation of milk and milk products with defects, techniques for simulation; Novel techniques of sensory evaluation.

DC-411 Biochemistry and Human Nutrition 2 (1+1)

Theory

Bio-Molecules: General structures, classification and functions of Biomolecules-Amino acids, Protein Structure, Carbohydrates, Fats, Lipids, DNA and RNA.

Enzymes: Activation energy /Transition state and Enzyme Classification, Coenzymes/Co- factors and Enzyme kinetics, Mechanism of enzyme action, Factors effecting enzyme activity, Enzyme inhibition, isozymes and Regulatory Enzymes, Immobilization of enzyme, Ribozymes and Zymogens.

Metabolism: Glycolysis, Gluconeogenesis, TCA cycle, Glycogen synthesis and degradation, Pentose phosphate pathway, Fatty acid oxidation, Urea cycle and transaminase reactions, ATP and Electron transport chain.

Fundamentals of human nutrition, concept of balanced diet, nutrient requirements of different age groups; Methods of evaluation of nutritive value of food and nutritional value of cow, buffalo and human milk, biochemical composition and energy value of foods with special reference to milk and dairy products.

Nutrition, digestion and absorption, Vitamins (structure and function), Hormones (structure and function), Milk intolerance and hypersensitivity, Concept of functional foods and Nutraceutical, Milk based functional foods.

Practical

Estimation of alkaline phosphatase by conversion of a non-chromogenic substrate to a chromogenic substrate; Effect of temperature, pH and enzyme inhibitors on the activity of the enzyme; Estimation of catalase by spectrophotometric method; Determination of the Michaelis Menten constant of an enzyme; Estimation of RNA by colorimetric method; Estimation of DNA by colorimetric method; Estimation of Ascorbic acid in plasma; Estimation of serum Protein (Biuret method /Lowry method); Estimation of Blood Glucose (Folin Wu method); Estimation of Serum inorganic phosphorus (Fiske and Subba Row method);Estimation of blood creatinine, triglyceride and cholesterol levels; Estimation of calorific value of food items; Diet and nutrition surveys: (a) Identification of vulnerable and risk groups; (b) Diet survey for breast-feeding and weaning practices of specific groups; (c) Use of anthropometric measurement in children; Preparation of visual aids for nutritional disorders; Field visit to (a) Observe the working of nutrition and health oriented program (survey based result); (b) Hospitals to observe nutritional deficiencies; Identification of Mono, Di and Polysaccharides; Identification of Proteins (albumin, gelatin, peptone).

ELECTIVE COURSES

(Total 8 credits of electives are to be taken out of the following indicative courses)

DBM-411 Fundamentals of Dairy Extension 2 (1+1)

Theory

History, need, definition, philosophy, principles, approaches and objectives of extension education; Present status of dairy and animal husbandry development programme launched in pre and post-independence era; Teaching and learning process, Extension Teaching Methods, classification and selection of teaching methods; Importance of Audio-Visual-Aids; Identification of rural leaders, their characteristics, role and function in rural development, training of rural leaders; Principle of working with group and their mobilisation; Need, principle and step of programme planning; Evaluation of extension program; Diffusion of innovations and categories of farmers; Problems of different stake holders, Conceptual orientation about different terms, like- RRA, PRA, IVLP/TAR, ATMA, ATIC, PTD, etc.

Practical

Acquiring skill in use of audio-visual and other aids: Hands-on training on use of LCD projector, PA system, camera; Skills in preparation of documents including script writing; Preparation and use of audio-visual aids including animation for dairy stakeholders Group discussion technique, Hands on learning of field problems in dairy and animal husbandry.

DBM-412 Industrial Statistics 2 (1+1)

Theory

Definition and scope; sources of animal husbandry and dairy statistics; Measures of central tendency, Measures of dispersion, Moments, skewness and kurtosis; Elementary notions of probability, Laws of addition and multiplication probability.

Theoretical frequency distributions: Binomial, Poisson and Normal distribution and their application; Concepts of sampling methods, Introduction to testing of hypotheses, Tests of Significance-Z, t, F tests, and their application in the field of dairying.

Analysis of variance- One-Way and two-way classification; Simple correlation coefficient and its test of significance, Linear regression, rank correlation.

Basic concepts of statistical quality control, Control charts for variables and attributes, Fundamental concepts of acceptance sampling plan.

Practical

Measures of central tendency, Measures of dispersion, Moments, Skewness and Kurtosis Fitting of binomial and Poisson distribution; Application of 'Z' test for one and two sample problems; Application of 't' test for one and two sample problems; Application of Chi-square test and

F-test; Correlation and regression; Rank correlation coefficient; Control chart for variables and attributes.

DM-411 Dairy Biotechnology 2 (1+1)

Theory

Definition, scope and historical development of biotechnology, achievement and future application. Structure of DNA and RNA; DNA replication, protein synthesis, genetic code, mutations. Vectors, cloning strategies in bacteria and animals, rDNA technology and Protoplast fusion; Application of biotechnology in food and dairy industry, dairy effluents; Genetic manipulation of dairy starters for improved attributes of commercial value; Dairy enzymes and whole cell immobilization;

Ethical issues related to use of genetically modified foods; Ethical issues related to use of genetically modified foods.

Practical

Isolation of plasmid and genomic DNA from bacteria (E; coli, lactic acid bacteria); Agarose gel electrophoresis of DNA fragments); Restriction analysis of DNA; Curing of plasmids; Preparation of competent cell; Transformation of E; coli by calcium chloride treatment/ electro oration; Conjugal transfer in E; coli cells; Preparation of protoplasts and protoplast fusion; PCR technique demonstration; Visit to a biotechnology lab.

DC-412 Instrumental Techniques in Food Analysis 2 (1+1)

Theory

Concepts of food analysis; Rules and regulations of food analysis.

Principles and methodology involved in analysis of foods: Rheological analysis, textural profile analysis of foods. Methods of analysis: Proximate constituents: Total fat, crude fiber, protein, moisture, minerals analysis; adulterations. Principles and methodology involved in analytical techniques: spectroscopy, ultraviolet visible, infrared spectroscopy atomic absorption and emission, florescence mass spectroscopy. Food compositional analysis and applications in the food industry. Chromatography: Principle of chromatography, classifications, (Adsorption, column, partition, gel-filtration, affinity, ion-exchange, size-exclusion method) gas-liquid, high performance liquid chromatography; Ion chromatography and others. Separation techniques: Dialysis, electrophoresis, sedimentation, ultra-filtration, ultracentrifugation, iso-electric focusing, chemically sensitive semiconductor devices: Solid-state sensors for pH, acidity, amperometric, potentiometric and; Acoustic sensors, rapid microbiological methods: Overview, Conductance/impedance techniques for microbial assay; chemosensors, biosensors, immunosensors.

Practical

Sampling plan; Sample collection and preparation for analysis; Quality evaluation of raw materials: Fruits products; Quality evaluation of raw materials: vegetables products; Quality evaluation of raw materials: cereals products; Quality evaluation of raw materials: dairy products; Quality evaluation of food products for color and taste of marketed products (sweet); Quality evaluation of food products for color and taste of marketed products (carbonated drinks; Quality evaluation of food products for color and taste of marketed products (Processed food); Quality evaluation of food products for color and taste of marketed products (Chili powder); Estimation of phytic acid using spectrophotometer; Separation of amino acids by two-dimensional paper chromatography; Analysis of heavy metals using atomic absorption spectrophotometer (mercury/ lead/arsenic/tin); Identification of organic acids by paper electrophoresis; Estimation of vitamins (A) using HPLC; Estimation of vitamins (thiamine) using HPLC; Estimation of vitamins (riboflavin) using HPLC; Estimation of vitamins (nicotinamide) using HPLC; Estimation of lycopene using HPLC; Estimation of betacarotein using HPLC; Estimation of vitamins A using HPLC; Analysis of foods for drug residues in milk/milk products; Analysis of foods for pesticide residues in fruit; Analysis of foods for pesticide residues in vegetable; Analysis of foods for pesticide residues in spices; Spectrophotometric method of total chlorophyll (A and B); Gel-electrophoresis for analytic techniques; Quantitative determination of sugars and fatty acid profile by GLE; Fatty acid profiling using gas chromatograph.

DC-413 Food Additives and Preservatives 2 (1+1)

Theory

Intentional and unintentional food additives, their toxicology and safety evaluation; Naturally occurring food additives; Food colors and dyes: Regulatory aspects of dyes, food color (natural and artificial), pigments and their importance and utilization as food color; Processing of natural and artificial food colorants; Food preservatives and their chemical action; Role and mode of action of salts, chelating agents, stabilizers and thickeners; Humectants/polyhydric alcohol, anti-caking agent, firming agent, flour bleaching and maturing agents, antioxidants, nutritional and non-nutritional sweeteners; Production of enzymes, leavening agents, fat substitutes, flavor and taste enhancers in food processing; Acidity regulators; Emulsifiers.

Practical

Evaluation of GRAS aspect of food additives; Estimation of chemical preservatives by TLC (organic and inorganic);Identification of food colour by TLC (organic and inorganic);Quantitative estimation of added dyes; Isolation and identification of naturally occurring food pigments by paper and TLC; Role and mode of action of chelating agent in fruit juice;

Role and mode of action of stabilizer and thickener in frozen dairy products (ice-cream); Role and mode of clarifying agent in fruit juices; Role and mode of antioxidant in foods; Role of leavening agent in baked food product; Preservation of food samples using humectants.

DT-413 Design and Formulation of Foods 3 (2+1)

Theory

Nutrients and their function, food classification and their nutritive value, anti-nutritional factors present in food; Concept of different food groups, recommended dietary allowances (RDA) for Indians; nutrition for infant, pre-school and school children, adult, pregnant and lactating women, old age people; Production and formulation of Indian traditional sweet and snack food products, steps for quality improvement and value addition; Therapeutic diets – Principles and objectives of diet therapy, diet for patient suffering from Diabetes mellitus, osteoporosis, cardiac problem, gastrointestinal disorder, Diet planning and use of exchange list in nutrient calculation; Functional foods - definition and concepts; design of functional foods; Nutraceuticals food - definition and concepts, design of nutraceutical foods; Recent trends in food formulation; antioxidant rich food products; concepts for formulation of foods for drought and disaster afflicted; defence services, sportsmen, space food.

Practical

To study the principles and planning menu; Develop diet plan using food exchange list and nutrient calculation for school children, adult, pregnant; Preparation and formulation of Indian Traditional Snack, Traditional Sweet; Preparation and development of food for pregnant and lactating women, foods for infants; Preparation and formulation of food and energy drinks for diabetic person (sugar free food products); sports person and osteoporosis; preparation of prebiotic and pro biotic food product; Preparation of functional food using millets; whey beverage probiotic beverage; Production of functional beverage and antioxidant determination; Visit to Food Processing Industries/ Expos.

SEMESTER-VIII

SRP-421 Student Ready In-Plant Training (0+20)

- In eighth semester of the degree program students will be offered In-plant training of 20 credits.
- The training will be carried out at a commercial dairy plant.
- The students will be exposed to processing, production, testing and quality assurance and marketing of dairy products at commercial scale.
- The students would be required to submit a certificate of completion of the training from the concerned authorities of the company.

42. ONLINE COURSES

Indicative List of Online Courses on SWAYAM/MOOCs/Others

Course Title	Duration	Credit
Digital Media	16 weeks	1
Basics of Photography	12 weeks	1
Design, Technology and Innovation	8 weeks	1
Visual Communication Design for Digital Media	4 weeks	1
Certificate Course in Environmental Sustainability	8 weeks	1
Consumer Protection Legislation	8 weeks	1
Visual Communication Design for Digital Media	4 weeks	1
Certificate Course in Environmental Sustainability	8 weeks	1
Consumer Protection Legislation	8 weeks	1
Communication and Extension for Sustainable Development	15 weeks	1
Intellectual Property	12 weeks	1
Biopsychology	15 weeks	1
NGO'S and Sustainable Development	15 weeks	1
Counselling Psychology	12 weeks	1
Gender Sensitization: Society Culture and Change	16 weeks	1
Basics of Health Promotion and Education Intervention	8 weeks	1
Psychology of Stress, Health and Well-being	12 weeks	1
Diet Management in Health & Disease	12 weeks	1
Dairy and Food Process and Products Technology	12 weeks	1
Thermal Processing of Foods	12 weeks	1
Nano-technology, Science and Applications	8 weeks	1
Food Science & Processing	12 weeks	1
Diet Management in Health & Disease	8 weeks	1
Human Nutrition and Biochemistry	12 weeks	1
Personality Development and Communication Skills	8 weeks	1
Public Speaking	8 weeks	1
Personality Development	8 weeks	1
Personality Development	8 weeks	1
Yoga Practices 1	12 weeks	1
Yoga Practices 2	12 weeks	1
Ethics: Theories and Applications	12 weeks	1
Information Sources and Library Services	6 weeks	1
Qualitative Research Methods and Research Writing	12 weeks	1
Food Science & Processing	12 weeks	1
Food Safety & Quality Control	8 weeks	1
Communication Skills and Computer Operations	24 weeks	1
Human Resource Management	24 weeks	1
Business Plan and Finance Management	24 weeks	1

Annexure -I

U.P. PANDIT DEEN DAYAL UPADHYAYA PASHU CHIKITSA VIGYAN VISHWAVIDYALAYA EVAM GO-ANUSANDHAN SANSTHAN, MATHURA

GRADE SHEET OF---------- SEMESTER

COLLEGE OF DAIRY SCIENCE

Enrolment No.: XYZ — Father's Name: XYZ

Name of the student: XZY — Programme: xxxxxxxx

Mother's Name: XYZ — Session: xxxxxx

S. No.	Course Title	Course Code	Credit Hours	Marks Obtained				Grade Point (10 Point Basis)	Credit Points
				Theory		Practical	Total		
				Internal	External				
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
Total									
GPA									
CGPA (till this semester)									
Result									

Note: Calculation of Grade Point (GP), Credit Point (CP), Grade Point Average (GPA) & Cumulative Grade Point Average (CGPA)

- Grading of marks shall be done on 10 point scale. The minimum marks are 50% including theory and practical.
- The divisions are determined on the basis of aggregate of marks of all the courses prescribed as under-First Division with distinction: 8.000 and above, First Division: 7.000-7.999, Second Division: 6.000-6.999, Pass: 5.000-5.999.
- In case of any discrepancy the marks entered in the university tabulation chart shall be final.
- The credit points earned will be 0 if the marks obtained in theory or practical are less than 50%.
- The credit point (CP) in a course shall be equal to the total marks obtained in theory and practical multiplied by number of credit hours and divided by 10.
- The Grade Point Average (GPA) is sum of the total credit points earned divided by the sum of credit hours.
- The Cumulative Grade Point Average (CGPA) is equal to the total credit points divided by total number of course credit hours in all the semesters.

Date : — Prepared by :

Chacked by : — Controller of Examinations

Serial No. : **Annexure -II**

Enrollment No.: _____

U.P. PANDIT DEEN DAYAL UPADHYAYA PASHU CHIKITSA VIGYAN VISHWAVIDYALAYA EVAM GO-ANUSANDHAN SANSTHAN, MATHURA 281001

Photo

TRANSCRIPT

Name of the Student : Father's Name Mother's Name
Name of the College :
Degree Programme UG Certificate/UG Diploma:
Admitted in : Completed in:

Academic Year and Semester	Course Title	Course Code	Credit Hours	Marks Obtained	Grade Point	Credit points	GPA
20….-…. 1st Semester							
20….-…. 2nd Semester							
20….-…. 1st Semester							
20….-…. 2nd Semester							

20….-…. 1st Semester							
20….-…. 2nd Semester							
20….-…. 1st Semester							
20….-…. 2nd Semester							

Grand Total of Credit Hours: ……... **Grand**

Total of Credit Points: ……...

Overall Grade Point Average (OGPA): ……

Percentage of Marks: ……...

Result: ……...

DIVISION AND HONORS

First division with distinction	8.000 and above
First division	7.000 – 7.999
Second division	6.000 – 6.999
Pass	5.000 – 5.999
Fail	Less than 5.000

Abbreviation Used

S- Satisfactory QR Code

US – Unsatisfactory

r- Repeat Courses

GPA- Grade Point Average

OGPA- Overall Grade Point Average

Calculation of Grade Point (GP), Credit Point (CP), Grade Point Average (GPA) & Overall Grade Point Average (OGPA)

- Grading of marks shall be done on 10 point scale. The minimum marks are 50% including theory and practical.
- The divisions are determined on the basis of aggregate of marks of all the courses prescribed as under-First Division with distinction: 8.000 and above, First Division: 7.000-7.999, Second Division: 6.000-6.999, Pass: 5.000-5.999.
- In case of any discrepancy the marks entered in the university tabulation chart shall be final.
- The credit points earned will be 0 if the marks obtained in theory or practical are less than 50%.
- The credit point (CP) in a course shall be equal to the total marks obtained in theory and practical multiplied by number of credit hours and divided by 10.
- The Grade Point Average **(**GPA) is sum of the total credit points earned divided by the sum of credit hours.
- The Overall Grade Point Average (OGPA) is equal to the total credit points divided by total number of course credit hours in degree programme.

Date: Prepared by:

Checked by:

Controller of Examinations