[Acce] Item No. 46.9

ANAND AGRICULTURAL UNIVERSITY
ANAND-388 110, GUJARAT, INDIA

Read: Resolution of 46th Meeting of Academic Council of Anand Agricultural University held on 21.07.2017, vide Item No. 46.9.

Implementation of Revised 5th Deans' Committee Report for B.Tech. (D.T.) programme from Academic Year 2017-18.

## NOTIFICATION

It is hereby notified to all concerned that 46th Meeting of the Academic Council of Anand Agricultural University, Anand held on 21.07.2017, vide Item No. **46.9** has resolved as under:

"It is resolved that under graduate syllabus as per recommendation of 5th Deans' Committee of ICAR for B. Tech. (D.T.) course as appended in **"Annexure-I"** is approved after incorporating suggestions of the Deans meeting with ICAR held on June 2 – 3, 2017 for implementation in Anand Agricultural University from the academic year 2017-18.

Academic Council also approved the recommendation for the implementation of other regulations governing examination pattern, marking system, grading, etc. as per the 5th Deans' Committee Report and common academic regulations of Anand Agricultural University."

No. AAU/DSC/Academic (UG)/ 1516 /2017
Date: 2-08-2017

(J.B. PRAJAPATI)
PRINCIPAL& DEAN
FACULTY OF DAIRY SCIENCE

**Copy F.W. Cs. to:**

1. All the Members of the Academic Council of this University.
2. All officers of this University.

**Annexure-I**

# UG Syllabus for

# B.TECH. (DAIRY TECHNOLOGY)

FOUR YEAR DEGREE PROGRAM

**to be adopted at**

**SMC COLLEGE OF DAIRY SCIENCE**

**ANAND AGRICULTURAL UNIVERSITY,**

**ANAND- 388110 (GUJARAT)**

**As per the recommendations of**

# CREDIT SUMMARY

| Department | Proposed credit by ICAR | To be implemented at Dairy Science College | Difference |
|---|---|---|---|
| *Dairy Engineering* | 38 (23+15) | 38 (23+15) | 0 |
| *Dairy Microbiology* | 16 (10+6) | 20 (13+7) | +4 |
| *Dairy Business Management* | 27 (18+9) | 23 (17+6) | -4 |
| *Dairy Chemistry* | 18 (11+7) | 23 (14+9) | +5 |
| *Dairy Technology* | 81 (27+54) | 80 (26+54) | -1 |
| *Total Credit* | 180 | 184 | +4 |

# partment Wise Distribution of Courses

| Department of Dairy Engineering | | | | | | |
|---|---|---|---|---|---|---|
| | To be implemented at SMC College of Dairy Science | | | | Proposed changes if any or no change | Justification/ Remarks |
| Credit Hours | Semester | Course Number | Title of the Course | Credit Hours | | |
| 2 (1+1) | 1 | DE-1101 | Workshop Practice | 2 (1+1) | No Change | |
| 3 (2+1) | | DE-1102 | Fluid Mechanics | 3 (2+1) | No Change | |
| 1 (0+1) | | DE-1103 | Engineering Drawing | 1 (0+1) | No Change | |
| **6(3+3)** | **Total Credit** | | | **6(3+3)** | | |
| 2 (1+1) | 2 | DE-1204 | Thermodynamics | 2 (1+1) | No Change | |
| 3 (2+1) | | DE-1205 | Heat & Mass Transfer | 3 (2+1) | Modification in syllabus | *Modifications are included in syllabus |
| 2 (1+1) | | DE-1206 | Boilers and Steam Generation | 2 (1+1) | No Change | |
| 3 (2+1) | | - | | | Semester transfer to third | |
| **10(6+4)** | **Total Credit** | | | **7(4+3)** | | |
| 3 (2+1) | 3 | DE-2107 | Refrigeration & Air-conditioning | 3 (2+1) | No Change | |
| 3 (2+1) | | - | | | Semester transfer to fourth | |
| | | DE-2108 | Basic Electrical Engineering | 3 (2+1) | Semester transfer from second | |
| **6(4+2)** | **Total Credit** | | | **6(4+2)** | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 4 | DE-2209 | Instrumentation and Process Control | 3(2+1) | Semester transfer from fifth<br><br>Modification in syllabus | *Modifications are included in syllabus |
| 3 (2+1) | | - | | | Semester transfer to fifth | |
| | | DE-2210 | Dairy Engineering | 3 (2+1) | Semester transfer from third | |
| 3(2+1) | **Total Credit** | | | **6(4+2)** | | |
| | 5 | DE-3111 | Material Strength & Dairy Machine Design | 3 (2+1) | Semester transfer from sixth<br><br>Modification in syllabus | *Modifications are included in syllabus |
| - | | DE-3112 | Dairy Process Engineering | 3 (2+1) | Semester transfer from fourth<br><br>Modification in syllabus | *Modifications are included in syllabus. |
| 3 (2+1) | | - | | | Semester transfer to fourth | |
| **3(2+1)** | **Total Credit** | | | **6(4+2)** | | |
| 3 (2+1) | 6 | DE-3213 | Food Engineering | 3 (2+1) | Modification in syllabus | *Modifications are included in syllabus |
| 3 (2+1) | | - | | | Semester transfer to fifth | |
| 2 (1+1) | | DE-3214 | Dairy Plant Design and Layout | 2 (1+1) | No Change | |
| 2(1+1) | | DE-3215 | Energy Conservation and Management | 2(1+1) | No Change | |
| **10(6+4)** | **Total Credit** | | | **7(4+3)** | | |
| **38(23+15)** | | | | **38(23+15)** | | |

| Department of Dairy Microbiology | | | | | | |
|---|---|---|---|---|---|---|
| | To be implemented at SMC College of Dairy Science | | | | Proposed changes if any or no change | Justification |
| **Credit hours** | **Semester** | **Course Number** | **Title of the Course** | **Credit hours** | | |
| 3 (2+1) | **1** | DM-1101 | Fundamentals of Microbiology | 3 (2+1) | Modification in syllabus | *Modifications are included in syllabus |
| **3 (2+1)** | **Total Credit** | | | **3 (2+1)** | | |
| 2 (1+1) | **2** | DM-1202 | Microbiology of Fluid Milk | 3 (2+1) | Increase one theory credit<br>Modification in syllabus | One more theory credit needed<br>*Modifications are included in syllabus |
| **2 (1+1)** | **Total Credit** | | | **3 (2+1)** | | |
| | **3** | DM-2103 | Microbiology of Dairy Products | 3 (2+1) | Increase in one theory credit<br>Semester transfer from fourth | One more theory credit needed |
| | **Total Credit** | | | **3 (2+1)** | | |
| 3 (2+1) | **4** | DM-2204 | Starter Cultures and Fermented Milk Products | 3(2+1) | Modification in syllabus | *Modifications are included in syllabus. |
| 2 (1+1) | | - | | | Semester transfer to third | |
| | | DM-2205 | Dairy Biotechnology | 2 (1+1) | New Course Proposed | |
| **5(3+2)** | **Total Credit** | | | **5(3+2)** | | |
| 3 (2+1) | **5** | DM-3106 | Quality and Safety Monitoring in Dairy Industry | 3 (2+1) | Modification in syllabus | *Modifications are included in syllabus |
| 3 (2+1) | **Total Credit** | | | **3 (2+1)** | | |
| 3 (2+1) | **6** | DM-3207 | Food and Industrial Microbiology | 3 (2+1) | Modification in syllabus | *Modifications are included in syllabus. |
| 3 (2+1) | **Total Credit** | | | **3 (2+1)** | | |
| **16(10+6)** | **Total Credits** | | | **20(13+7)** | | |

| Department of Dairy Business Management | | | | | | |
|---|---|---|---|---|---|---|
| | To be implemented at SMC College of Dairy Science | | | | Proposed changes if any or no change | Justification |
| Credit Hours | Semester | Course Number | Title of the Course | Credit Hours | | |
| 3 (2+1) | 1 | DBM-1101 | Milk Production Management | 2(1+1) | Split in to two separate courses | This course needs split into<br>a. Milk Production Management<br>b. Dairy Development<br>Syllabus is totally different. As a combined course, it will be difficult to be taught by a single teacher. |
| | | DBM-1102 | Dairy Development | 1(1+0) | New course based upon split course of Milk Production Management & Dairy Development | Course content of Dairy Development is added. |
| 2 (1+1) | | DBM-1103 | Communication Skills | 2 (1+1) | No Change | |
| 2 (1+1) | | DBM-1104 | Computer and Application Software Packages | 2 (1+1) | No Change | The common course entitled *Information Communication Technology* has almost same course content. |
| 2 (1+1) | | - | | | Department transfer from DBM to DC Dept. | To be shifted to Dairy Chemistry Department as the course content is related to Dairy Chemistry Department. |

| | | | | | | |
|---|---|---|---|---|---|---|
| **9(5+4)** | **Total Credit** | | | **7(4+3)** | | |
| 2 (2+0) | **2** | DBM-1205 | Economic Analysis | 2 (2+0) | No Change | |
| | | DBM-1206 | Fundamentals of Dairy Extension | 2 (1+1) | Reduce one practical credit<br><br>Semester transfer from fourth | |
| 2 (2+0) | **Total Credit** | | | **4(3+1)** | | |
| | **3** | DBM-2107 | Financial Management | 2 (1+1) | Semester transfer from eighth<br><br>One of the splitted course of Financial Management & Cost Accounting | |
| | **Total Credit** | | | **2 (1+1)** | | |
| 3 (2+1) | **4** | - | | | Semester transfer to second | |
| | | DBM-2208 | Cost Accounting | 1 (1+0) | Semester transfer from eighth<br><br>One of the splitted course of Financial Management & Cost Accounting | |
| | | DBM-2209 | Industrial Statistics | 3 (2+1) | Semester transfer from eighth | |
| 3 (2+1) | **Total Credit** | | | **4(3+1)** | | |
| 4(2+2) | **5** | - | | | Semester transfer to sixth<br><br>Title change to "Operation Research" and decrease in credit | No where ICT application in dairy industry mentioned in this course. So deleted from title. |
| 2 (2+0) | | DBM-3110 | Marketing Management and International Trade | 2(2+0) | No Change | |
| **6(4+2)** | **Total Credit** | | | **2(2+0)** | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **6** | DBM-3211 | Operation Research | 2 (2+0) | Title change to "Operation Research" and decrease in credit<br><br>Semester transfer from fifth | |
| | **Total Credit** | | | **2 (2+0)** | | |
| | 7 | DBM-4112 | Entrepreneurship Development | 1 (1+0) | Semester transfer from eighth | |
| | **Total Credit** | | | **1 (1+0)** | | |
| 2 (2+0) | **8** | - | | | Semester transfer from eighth to seventh semester<br><br>Change in title "Entrepreneurship Development" | The industrial consultancy syllabus is already covered in other courses |
| 3 (2+1) | | - | | | Split into two separate courses Financial Management 2 (1+1), and 1(1+0)<br><br>Semester transfer: Financial Management transferred to third semester and Cost Accounting transferred to fourth semester | Split is required as Financial Management and cost Accounting are two different subjects. |
| 2 (1+1) | | - | | | Semester transfer to sixth | |
| | | DBM-4213 | Dairy Informatics | 1(1+0) | Common course | Common Course: Agricultural Informatics |
| **7(5+2)** | **Total Credit** | | | **1(1+0)** | | |
| **27(18+9)** | **Total Credit** | | | **23(17+6)** | | |

**Department of Dairy Chemistry**

| | To be implemented at SMC College of Dairy Science | | | | Proposed changes if any or no change | Justification |
|---|---|---|---|---|---|---|
| **Credit Hours** | **Sem** | **Course Number** | **Title of the Course** | **Credit Hours** | | |
| 2 (1+1) | 1 | - | | | Semester Transfer to third | |
| | | DC-1101 | Organic Chemistry | 3 (2+1) | Consider as creditable course | To be taught in 1st semester as a creditable course as it is one of the elective/non creditable course. To make a strong foundation for understanding major constituents of milk. |
| | | DC-1102 | Environmental Studies | 2 (1+1) | Transferred to DC Dept. from DBM Dept. | Content of the syllabus is related to DC Department. |
| 2 (1+1) | **Total Credit** | | | **5 (3+2)** | | |
| 3 (2+1) | **2** | - | | | Semester transfer to third | |
| 3 (2+1) | | DC-1203 | Chemistry of Milk | 3 (2+1) | Modification in syllabus | *Modifications are included in syllabus |
| 6(4+2) | **Total Credit** | | | **3 (2+1)** | | |
| 2 (1+1) | **3** | - | | | Semester transfer to sixth | |
| | | DC-2104 | Physical Chemistry of Milk | 3 (2+1) | Semester transfer from second<br><br>Modification in syllabus | *Modifications are included in syllabus. |
| | | DC-2105 | Biochemistry | 2 (1+1) | Semester transfer from first<br><br>Modification in syllabus | *Modifications are included in syllabus. |
| 2 (1+1) | **Total Credit** | | | **5(3+2)** | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 (2+1) | **4** | DC-2206 | Chemistry of Dairy Products | 3 (2+1) | Modification in syllabus | *Modifications are included in syllabus. |
| **3 (2+1)** | **Total Credit** | | | **3 (2+1)** | | |
| 2 (1+1) | **5** | DC-3107 | Chemical Quality Assurance | 2 (1+1) | Modification in syllabus | *Modifications are included in syllabus. |
| **2 (1+1)** | **Total Credit** | | | **2(1+1)** | | |
| 3 (2+1) | **6** | DC-3208 | Food Chemistry | 3 (2+1) | Modification in syllabus<br><br>Incorporated correct practical syllabus | *Modifications are included in syllabus.<br><br>Practical syllabus given is of a PG course (DC-511 Physico-Chemical Aspects of Milk Constituents and Milk Products) |
| | | DC-3209 | Human Nutrition | 2 (1+1) | Semester Transfer from third | |
| 3 (2+1) | **Total Credit** | | | **5(3+2)** | | |
| **18(11+7)** | **Total Credit** | | | **23(14+9)** | | |

**Department of Dairy Technology**

| | To be implemented at SMC College of Dairy Science | | | | Proposed changes if any or no change | Justification |
|---|---|---|---|---|---|---|
| Credit Hours | Semester | Course Number | Title of the Course | Credit Hours | | |
| | 1 | | | | | |
| | **Total Credit** | | | | | |
| | 2 | DT-1201 | Market Milk | 5 (3+2) | Semester transfer from third<br>Increase in one practical credit<br>Modification in syllabus | *Modifications are included in syllabus.<br>Manufacturing protocol i.e. plant sanitization, product manufacturing and CIP everything cannot be covered in 3 hrs. hence two credits for practical is required. |
| | | DT-1202 | Traditional Indian Dairy Products | 3 (2+1) | Semester transfer from third<br>Modification in syllabus | *Modifications are included in syllabus. |
| | **Total Credit** | | | **8(5+3)** | | |
| (3+1) | 3 | - | | | Semester transfer to second | |
| (2+1) | | - | | | Semester transfer to second | |
| | | DT-2103 | Cheese Technology | 5 (3+2) | Semester transfer from fourth<br>Modifications in syllabus | *Modifications are included in syllabus. |
| | | DT-2104 | Ice-cream & | 3 (2+1) | Semester transfer from | *Modifications are |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Frozen Deserts | | fourth Modification in syllabus | included in syllabus. |
| 3 (2+1) | | - | | | Semester transfer from third to fourth semester | |
| 4 (3+1) | | - | | | Semester transfer from third to fourth semester | |
| 14(10+4) | **Total Credit** | | | **8(5+3)** | | |
| 5 (3+2) | **4** | - | | | Semester transfer to third | |
| 3 (2+1) | | - | | | Semester transfer to third | |
| | | DT-2205 | Fat Rich Dairy Products | 3 (2+1) | Modification in syllabus | *Modifications are included in syllabus. |
| | | DT-2206 | Condensed & Dried Milks | 4 (3+1) | Modification in syllabus | *Modifications are included in syllabus. |
| 8(5+3) | **Total Credit** | | | **7(5+2)** | | |
| 3 (2+1) | **5** | DT-3107 | By Products Technology | 3 (2+1) | Modification in syllabus | *Modifications are included in syllabus. |
| | | DT-3108 | Sensory Evaluation of Dairy Products | 3 (2+1) | Semester transfer from sixth<br>Modification in syllabus | *Modifications are included in syllabus. |
| 3 (2+1) | | - | | | Semester transfer to sixth | |
| | | DT-3109 | Food Technology- I | 3(2+1) | Semester transfer from sixth<br>Modification in syllabus | *Modifications are included in syllabus. |
| 6(4+2) | **Total Credit** | | | **9(6+3)** | | |
| 3 (2+1) | **6** | | | | Semester transfer to fifth | |
| 3 (2+1) | | - | | | Semester transfer to fifth | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | DT-3210 | Packaging of Dairy Products | 3 (2+1) | Semester transfer from fifth<br><br>Modification in syllabus | *Modifications are included in syllabus. |
| | | | DT-3211 | Food Technology-II | 2 (1+1) | Semester transfer from eighth to sixth semester<br><br>Reduce one credit. | - |
| | | | DT-3212 | Dairy Plant Management & Pollution control | 3(2+1) | Semester transfer from eighth<br><br>Two courses merged with Dairy Plant Management course under new title " Dairy Plant Management and pollution control" | |
| | 6(4+2) | **Total Credit** | | | **8(5+3)** | | |
| Y In- | 20 (0+20) | 7 | DP-4101 | Student READY-I (In- Plant Training) | 20 (0+20) | **No Change** | |
| | 20 (0+20) | **Total Credit** | | | 20 (0+20) | | |
| | 2(1+1) | **8** | - | | | Semester transfer to sixth<br><br>Two courses merged with Dairy Plant Management course under new title " Dairy Plant Management and pollution control" with 3(2+1) credits | |
| and | 2 (1+1) | | - | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| gy - | 3 (2+1) | | - | | | Semester transfer to sixth | |
| Y<br>ile | 10(0+10) | | DP-4202 | Student READY-II (Hands on Training) | 10 (0+10) | | |
| Y<br>ork<br>\ | 5 (0+5) | | DP-4203 | Student READY-III (Skill Development Training) | 5 (0+5) | Semester transfer from summer break after second semester to eighth semester | |
| Y<br>ork<br>\ | 5 (0+5) | | DP-4204 | Student READY-IV (Skill Development Training) | 5 (0+5) | Semester transfer from summer break after fourth semester to eighth semester | |
| | 27(4+23) | **Total Credit** | | | 20(0+20) | | |
| | **81(27+54)** | **Total Credit** | | | **80(26+54)** | | |
| | **180** | **Total Credit** | | | **184** | | |

## Semester Wise Distribution of Courses

| nittee | | To be implemented at SMC College of Dairy Science | | | | Proposed changes if any or no change |
|---|---|---|---|---|---|---|
| rse | **Credit Hours** | **S.N.** | Course Number | **Title of the Course** | **Credit Hours** | |
| ce | 2 (1+1) | 1 | DE-1101 | Workshop Practice | 2 (1+1) | No Change |
| s | 3 (2+1) | 2 | DE-1102 | Fluid Mechanics | 3 (2+1) | No Change |
| ing | 1 (0+1) | 3 | DE-1103 | Engineering Drawing | 1 (0+1) | No change |
| f | 3 (2+1) | 4 | DM-1101 | Fundamentals of Microbiology | 3 (2+1) | No change |
| Dairy | 3 (2+1) | 5 | DBM-1101 | Milk Production Management | 2(1+1) | Split in to two separate courses |
| | | 6 | DBM-1102 | Dairy Development | 1(1+0) | |
| kills | 2 (1+1) | 7 | DBM-1103 | Communication Skills | 2 (1+1) | No Change |
| cation es | 2 (1+1) | 8 | DBM-1104 | Computer and Application Software Packages | 2 (1+1) | No Change |
| | 2 (1+1) | | | | | Semester Transfer to third |
| | | 9 | DC-1101 | Organic Chemistry | 3 (2+1) | Elective made compulsory |
| lies | 2 (1+1) | 10 | DC-1102 | Environmental Studies | 2 (1+1) | Transferred to DC Dept from DBM Dept. |
| | | | NSS | | 1(0+1) | |
| | **20(11+9)** | | | | **21(12+09)** | |

| nittee | | To be implemented at SMC College of Dairy Science | | | | Proposed changes if any or no change |
|---|---|---|---|---|---|---|
| se | Credit hours | S.N | Discipline | Title of the Course | Credit hours | |
| s | 2 (1+1) | 1 | DE-1204 | Thermodynamics | 2 (1+1) | No Change |
| f Milk | 3 (2+1) | | | | | Semester transfer to third |
| sfer | 3 (2+1) | 2 | DE-1205 | Heat & Mass Transfer | 3 (2+1) | No change |
| m | 2 (1+1) | 3 | DE-1206 | Boilers and Steam Generation | 2 (1+1) | No Change |
| | 3 (2+1) | | | | | Semester transfer to third |
| l milk | 2 (1+1) | 4 | DM-1202 | Microbiology of Fluid Milk | 3 (2+1) | Increase one theory credit |
| sis | 2 (2+0) | 5 | DBM-1205 | Economic Analysis | 2 (2+0) | No Change |
| | | 6 | DBM-1206 | Fundamentals of Dairy Extension | 2 (1+1) | Reduce one practical credit Semester transfer from fourth |
| lk | 3 (2+1) | 7 | DC-1203 | Chemistry of Milk | 3 (2+1) | |
| | | 8 | DT-1201 | Market Milk | 5 (3+2) | Semester Transfer from third |
| | | 9 | DT-1202 | Traditional Indian Dairy Products | 3 (2+1) | Semester Transfer from third |
| | | | NSS | | 1(0+1) | |
| | **20(13+7)** | | | | **25(16+9)** | |

| ittee | | To be implemented at SMC College of Dairy Science | | | | Proposed changes if any or no change |
|---|---|---|---|---|---|---|
| se | Credit Hours | S.N | Discipline | Title of the Course | Credit Hours | |
| | 4 (3+1) | | | | | Semester transfer to second |
| airy | 3 (2+1) | | | | | Semester transfer to second |
| r- | 3 (2+1) | 1 | DE-2107 | Refrigeration & Air-conditioning | 3 (2+1) | No Change |
| g | 3 (2+1) | | | | | Semester transfer to fourth |
| | | 2 | DE-2108 | Basic Electrical Engineering | 3 (2+1) | Semester transfer from second |
| | | 3 | DT-2103 | Cheese Technology | 5 (3+2) | Semester transfer from fourth |
| | | 4 | DT-2104 | Ice-cream & Frozen Deserts | 3 (2+1) | Semester transfer from fourth |
| ucts | 3 (2+1) | | | | | Semester transfer to fourth |
| Milks | 4 (3+1) | | | | | Semester transfer to fourth |
| | 2 (1+1) | | | | | Semester transfer to sixth |
| | | 5 | DBM-2107 | Financial Management | 2 (1+1) | Semester transfer from eighth |
| | | 6 | DM-2103 | Microbiology of Dairy Products | 3 (2+1) | Semester transfer from fourth |
| | | 7 | DC-2104 | Physical Chemistry of Milk | 3 (2+1) | Semester transfer from second |
| | | 8 | DC-2105 | Biochemistry | 2 (1+1) | Semester transfer from 1st Sem. |
| | | | NSS | | 1(0+1) | |
| | **22(15+7)** | | | **Total** | **24(15+09)** | |

| nittee | | To be implemented at SMC College of Dairy Science | | | | Proposed changes if any or no change |
|---|---|---|---|---|---|---|
| se | Credit Hours | S.N | Discipline | Title of the Course | Credit Hours | |
| | | 1 | DE-2209 | Instrumentation and Process Control | 3(2+1) | Semester transfer from fifth |
| | | 2 | DE-2210 | Dairy Engineering | 3 (2+1) | Semester transfer from third |
| eering | 3 (2+1) | | | | | Semester transfer to fifth |
| nd ducts | 3 (2+1) | 3 | DM-2204 | Starter Cultures and Fermented Milk Products | 3 (2+1) | No change |
| airy | 2 (1+1) | | | | | Semester transfer to third |
| | | 4 | DM-2205 | Dairy Biotechnology | 2 (1+1) | NEW COURSE PROPOSED |
| gy | 5 (3+2) | | | | | Semester transfer to third |
| en | 3 (2+1) | | | | | Semester transfer to third |
| | | 5 | DT-2205 | Fat Rich Dairy Products | 3 (2+1) | |
| | | 6 | DT-2206 | Condensed & Dried Milks | 4 (3+1) | |
| ry | 3 (2+1) | 7 | DC-2206 | Chemistry of Dairy Products | 3 (2+1) | |
| airy | 3 (2+1) | | | | | Semester transfer to second |
| | | 8 | DBM-2208 | Cost Accounting | 1 (1+0) | Semester transfer from eighth |
| | | 9 | DBM-2209 | Industrial Statistics | 3 (2+1) | Semester transfer from eighth |
| | | | NSS | | 1(0+1) | |
| | **22(14+8)** | | | **Total** | **25(17+8)** | |

| ıittee | | To be implemented at SMC College of Dairy Science | | | | Proposed changes if any or no change |
|---|---|---|---|---|---|---|
| se | Credit Hours | S.N. | Discipline | Title of the Course | Credit Hours | |
| | | 1 | DE-3111 | Material Strength & Dairy Machine Design | 3 (2+1) | Semester transfer from sixth |
| | | 2 | DE-3112 | Dairy Process Engineering | 3 (2+1) | Semester transfer from fourth |
| ıd | 3 (2+1) | | | | | Semester transfer to fourth |
| y<br>ry | 3 (2+1) | 3 | DM-3106 | Quality and Safety Monitoring in Dairy Industry | 3 (2+1) | Modification in syllabus |
| logy | 3 (2+1) | 4 | DT-3107 | By Products Technology | 3 (2+1) | Modification in syllabus |
| | | 5 | DT-3108 | Sensory Evaluation of Dairy Products | 3 (2+1) | Semester transfer from sixth<br>Modification in syllabus |
| | | 6 | DT-3109 | Food Technology - I | 3(2+1) | Semester transfer from sixth |
| y | 3 (2+1) | | | | | Semester transfer to sixth |
| / | 2 (1+1) | 7 | DC-3107 | Chemical Quality Assurance | 2 (1+1) | Modification in syllabus |
| try<br>ırch | 4(2+2) | | | | | Semester transfer to sixth |
| ıent<br>ade | 2 (2+0) | 8 | DBM-3110 | Marketing Management and International Trade | 2(2+0) | No Change |
| | **20(13+7)** | | | **Total** | **22(15+7)** | |

| nittee | | To be implemented at SMC College of Dairy Science | | | | Proposed changes if any or no change |
|---|---|---|---|---|---|---|
| rse | Credit Hours | S.N. | Discipline | Title of the Course | Credit Hours | |
| ig | 3 (2+1) | 1 | DE-3213 | Food Engineering | 3 (2+1) | Modification in syllabus |
| & sign | 3 (2+1) | | | | | Semester transfer to fifth |
| and | 2 (1+1) | 2 | DE-3214 | Dairy Plant Design and Layout | 2 (1+1) | No Change |
| n and | 2(1+1) | 3 | DE-3215 | Energy Conservation and Management | 2(1+1) | No Change |
| ial | 3 (2+1) | 4 | DM-3207 | Food and Industrial Microbiology | 3 (2+1) | Modification in syllabus |
| n of | 3 (2+1) | | | | | Semester transfer to fifth |
| - I | 3 (2+1) | | | | | Semester transfer to fifth |
| | | 5 | DT-3210 | Packaging of Dairy Products | 3 (2+1) | Semester transfer from fifth |
| | | 6 | DT-3211 | Food Technology -II | 2 (1+1) | Semester transfer from eighth |
| | | 7 | DT-3212 | Dairy Plant Management & Pollution control | 3(2+1) | Semester transfer from eighth<br>Two courses merged with Dairy Plant Management. |
| | 3 (2+1) | 8 | DC-3208 | Food Chemistry | 3 (2+1) | Change in practical syllabus |
| | | 9 | DC-3209 | Human Nutrition | 2 (1+1) | Semester transfer from third |
| | | 10 | DBM-3211 | Operation Research | 2 (2+0) | Title change<br>semester transfer from fifth |
| | **22(14+8)** | | | **Total** | **25(16+9)** | |

| tee | | To be implemented at SMC College of Dairy Science | | | | Proposed changes if any or no change | Justification |
|---|---|---|---|---|---|---|---|
| | **Credit Hours** | **S.N.** | **Discipline** | **Title of the Course** | **Credit Hours** | | |
| | | 1 | DBM-4112 | Entrepreneurship Development | 1 (1+0) | Semester transfer from eighth<br><br>Change in title "Entrepreneurship Development" | The industrial consultancy syllabus is already covered in other courses |
| | 20 (0+20) | **2** | DP-4101 | Student READY-I (In- Plant Training) | 20 (0+20) | | |
| | **20 (0+20)** | | | **Total** | **21 (1+20)** | | |

| Committee | | To be implemented at SMC College of Dairy Science | | | | Proposed changes if any or no change | Justification |
|---|---|---|---|---|---|---|---|
| urse | Credit Hours | S.N. | Discipline | Title of the Course | Credit Hours | | |
| gement | 2(1+1) | | | | | Semester Transfer to sixth Merged two courses Dairy Plant Management and Waste Disposal and Pollution Abatement | |
| Pollution | 2 (1+1) | | | | | | |
| y -II | 3 (2+1) | | | | | Semester transfer to sixth | |
| velopment sultancy | 2 (2+0) | | | | | Semester transfer to seventh | |
| | | 1 | DBM-4213 | Dairy Informatics | 1(1+0) | Common course | Common Course: Agricultural Informatics |
| nt & Cost | 3 (2+1) | | | | | Split in to two separate coursesFinancial Management 2 (1+1). and cost accounting 1(1+0) | |
| tics | 2 (1+1) | | | | | Semester transfer to sixth | |
| eriential ale | 10(0+10) | 2 | DP-4202 | Student READY-II (Hands on Training) | 10 (0+10) | No Change | |
| | | 3 | DP-4203 | Student READY-III - (Skill Development Training) | 5 (0+5) | Semester transfer from summer break after second semester | |
| | | 4 | DP-4204 | Student READY-IV (Skill Development Training) | 5 (0+5) | Semester transfer from summer break after fourth semester | |
| | **24(10+14)** | | | **Total** | **21(1+20)** | | |

# DAIRY TECHNOLOGY SYLLABUS

**DT-1201 Market Milk** **5 (3+2)**

**Theory:**

Market milk industry in India and abroad: Distinctive features of tropical dairying as compared to those of the tropical climate of developed countries. Collection and transportation of milk; a) Organization of milk collection routes b) Practices for collection of milk, preservation at farm, refrigeration, natural microbial inhibitors, lactoperoxidase system. Reception and treatment (pre-processing steps) of milk in the dairy plant: a) Reception, chilling, clarification and storage: General practices. b) Homogenisation: 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) 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. c) Definition and description of processes: Pasteurization, thermisation, sterilization, UHT Processing. d) Defects in market milk. e) Manufacture of special milks: toned, doubled toned, reconstituted, recombined, flavoured, homogenized, vitaminised and f) Preparation of sterilized milk. g) 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. ESL milk employing Microfiltration and Bactofugation with UHT treatment. Fortified milk (with minerals like Ca, Fe). Pricing policies for purchase of milk

**Practical:**

Familiarization with equipments for reception of milk in plant. Pretreatments: Chilling, clarification, filtration. Platform tests. Standardization and computation relating to it. Cream separation: parts of separator and the process. Operation of LTLT, HTST pasteurizer, laboratory, sterilizer, Assessment of pasteurization

sweets: Burfi, Peda, Milkcake, Kalakand, Gulabjamun and their compositional profile and manufacturing 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. Recovery of milk solids and per cent yield. 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 milks. Preparation of Burfi, Peda, Kalakand, Milkcake 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, Basundi, Misti Dahi, Chhaka and Shrikhand. Visit to industry.

**DT-2103 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; Physical and chemical characteristics of milk for cheese making. Additives and preservatives for cheese. Rennet preparation and properties, rennet substitutes. Action of rennet on milk in relation to cheese making. Manufacture of different varieties of cheese: Cheddar, Gouda, Swiss, Mozzarella, Cottage. 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

**DT-2104 Ice-Cream and Frozen Desserts** **3 (2+1)**

**Theory:**

History, development and status of ice cream industry. Definition, classification and composition and standards of ice cream and 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, 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. Preparation of Sorbet, Gelato, Soft serve ice cream, Candies/Ice lolly.

**Practical:**

Calculation of standardization of ice-cream mixes. Preparation of ice cream mix. Manufacture of plain and fruit flavoured ice-cream. Manufacture of chocolate, fruit and nut ice cream. Preparation of sherbets/ices. Preparation of Soft serve 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. Factory visit.

**DT-2205 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 c) neutralization, standardization, pasteurization and cooling of cream d) Preparation and

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, Functional foods: Introduction, Phytochemicals, Dietary fibers, complex carbohydrates and protein as a functional food ingredient, fiber-rich food products, etc. Importance and scope of food preservation. Objectives, principles and methods of food preservation.

**Practical:**

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

**DT-3210 Packaging of Dairy Products** **3 (2+1)**

**Theory:**

Introduction, Importance of Packaging, History of Package Development, Packaging materials, a) 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, aseptic packaging, fat rich products-ghee and butter, coagulated and desiccated indigenous dairy products and their sweetmeats, concentrated and dried milks including baby foods. Packaging of functional dairy/food products. 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 equipments (including aseptic tank) and machines - Micro-processor controlled systems employed for AP, Package conditions and quality assurance aspects of AP, 'Active and Intelligent' packaging. Microwaveable packages. Microbiological aspects of packaging materials. Disposal of waste package

**DT-3211 Food Technology-II** **2 (1+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. Peanut and its value added products. Peanut butter – technology. 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 cake. Preparation of noodles.Manufacture of potato chips. Manufacture of malted milk foods, Manufacture of soy beverage and tofu, Preparation of peanut butter.

**DT-3212 Dairy Plant Management and Pollution Control** **3 (2+1)**

**Theory:**

Production Management: Definition, Function and structure of Production Management, Production planning & 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: Energy conservation and Auditing, Product and process control, Control charts, Process Sigma, Efficiency factors losses, Financial and Managerial

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 equipments, safety and precautions. Identification and uses of common lubricants. 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.

of U tube Manometer. Study of inclined tube Manometer. Study of Venturimeter. Determination of frictional coefficient 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-1103 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 vivet 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

**DE-1204 Thermodynamics** **2 (1+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 cycles on 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.

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

**Practical:**

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 Babcok & Wilcox boiler. Study of different Boiler accessories.

**DE-2107 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 Equipments 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-

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 an 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.

**DE-2108 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 an Single Auto-transformer, Different parts of a 11/0.4 KV, Distribution Transformer.

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 a 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.

**DE-2209 Instrumentation and Process Control** **3 (2+1)**

**Theory:**

Instrumentation scheme & characteristics: Measurands. Some basic discussion about electric field, potential, capacitance, resistance etc. Definition, Application and types of measurements, instrument classification, Functional elements of an instrument, standards, calibration, introduction to static characteristics and dynamics characteristics, selection of instruments, loading effects. Dynamic characteristics of measurement systems. Introduction to various types of sensors: Definition, principle

**Practical:**

Strain gauge characteristics and weight measurement. Measurement of pressure using bellows and diaphragm. Preparation and calibration of thermocouple. Study the construction and working of Bourden pressure gauge. Test and calibration of pressure gauges using dead weight tester. Study the mechanism of pH meter and its electrodes. Study a Proximity sensor. Study the different parts and working of pressure switch. Study the different parts of an indicating instrument. Study of RTD and Thermister. Study of different speed measurement sensor/ instruments. Study of LVDT. Study of level/flow controller. Study of PLC.Visit to a automatic controlled dairy plant. Recent advances in process control, instrumentation and automation.

**DE-2210 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 & 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. 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

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-3111 Material Strength & 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.Corrosion, principle mechanisam, classification, methods of prevention and preventive measures.

**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

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 power, spray dryer controls, Theory of solid gas separation, cyclone separators, Bag Filters, Care and Maintenance of drum and spray dryers. Recent advances in drying technologies.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 equipments: Mechanization and equipment used in manufacture of indigenous dairy products, Ice-cream and Cheese making equipments. Packaging equipments: Packaging machines for milk & 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

**DE-3213 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

**Practical:** To determine physical properties of food product. To determine viscosity of food product. To study food freezers. To study freeze drier. To determine drying characteristics of food product. To compare various dying methods. To determination juice yield. To compare hot water and steam blanching. To study construction and working of distillation system. To study various size reduction equipments. Visit to cold storage. Visit to food processing plant.

**DE-3214 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 equipments. 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

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 & 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 equipments: Improving efficiency and energy conservation opportunities in few important food processing operations like Thermal processes, Evaporation, Drying & 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 recuparator 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:**

# DAIRY CHEMISTRY SYLLABUS

**DC-1101 Organic Chemistry** **3 (2+1)**

**Theory:**

*Hydrogen bonding:* Concepts of hydrogen bonding inter and intra molecular hydrogen bonding in alcohol, carboxylic acids and other molecule. Hydrophobic interactions: Elementary idea of hydrophobicity and its importance in the structure of proteins. *Alcohols:* Important properties of mono, di and trihydric alcohols (Glycol and Glycerol). *Aldehydes and Ketone:* Reactions of aldehydes and ketones. Importance of carbonyl compounds in food flavors. *Carboxylic acids:* Ionization constant and strength of carboxylic acids. Important reactions of carboxylic acid, Derivatives: Esters, Amides, Lactones their preparation and reactions. *Amines:* Basic character of amines, important reactions. *Phenols:* Acidic character of phenols and effect of nuclear subsituents on it. Reactions in phenols. *Substituted carboxylic acid:* important reactions of halogen substituted, Keto and Hydroxy acids. Zwilter-ion forms, its properties viz. melting point and volatility. *Amino Acids and Peptides:* Synthetic and natural amino acids General properties of amino acids. Definition and classification of proteins. Primary, secondary, tertiary and quaternary structure of Proteins. *Carbohydrates:* Definition, Classification and isomerism. Derivation of structure of Glucose, open chain and ring structure, evidences for ring structure stereochemistry and stability of anomers. Reactions of monosaccharides. *Fatty acids and Lipids:* Definition and classification. Important reaction of fatty acids (saturated and unsaturated) Structure and properties of Neutral lipids, phospholipids and cholesterol.

**Practical:**

Systematic identification of Organic Compounds: Aliphatic and Aromatic character, Instauration, Detection of elements (Nitrogen, Sulphur and Halogens), Detection of functional groups (Alcoholic, Phenolic, Carboxylic, Carbonyl, Aldehyde, Ketonic esters, Amino, Amide, Nitro etc.). Preparation of derivatives: Dinitrophenylhydrazone, Oxime and Osazone. Qualitative test for Amino Acids and

pollution, Soil pollution, Radioactive pollution, Food processing industry waste and its management, Management of urban waste water, Recycling of organic waste, Recycling of factory effluent, Control of environmental pollution through law, Composting of biological waste and Sewage, uses of water disposal effluent treatment, microbial examination.

**Practical:**

Environment and its analysis, Water quality parameters, collection of sample for pollution study, Determination of pH/acidity/alkalinity from sample, Estimation of dissolved oxygen, Estimation of BOD, Estimation of COD, Estimation of nitrates, Estimation of phosphates, Estimation of pollutant elements, Estimation of heavy/toxic elements, Estimation of lead/ mercury, Visit to industrial sewage disposal unit.

**DC-1203 Chemistry of Milk** **3 (2+1)**

**Theory:**

Definition and structure of milk, Constituents and gross composition 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: α-Lactalbumin and β-Lactoglobulin. Properties of α-Lactalbumin and β-lactoglobulin, Immmunoglobulin and other minor milk proteins and non-protein 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, phosphatases, 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

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.

**DC-2104 Physical Chemistry of Milk** **3 (2+1)**

**Theory:**

Constituents and gross composition of milk of different species and breeds of milch animals, *Colloidal State:* Distinction between true and colloidal solution, lyophilic & lyophobic 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. *Liquid State:* Surface tension, surface energy interfacial tension. Surface tension of mixtures. Surface tension of milk and the factors affecting it. 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. Refractive index. Colligative Properties of Dilute Solution: Vapour pressure, Raoult's Law, Depression of freezing point, Elevation of boiling point. Freezing point and boiling point of milk. Osmosis and Osmotic pressure. Inter-relation of colligative properties. Aqueous solution of Electrolytes: Electrolytes; non-electrolytes, ionic mobility, electrical conductance, Ostwald Dilution Law, Kohlrausch Law, Electrical conductance of milk. Ionic Equilibria: Dissociation of water, ionic product of water, concept of pH and pOH and their scale. Acids and bases: Bronsted Lewis concepts of acids and bases, dissociation constants of acids and bases. Salt-their hydrolysis. Buffer solutions. Derivation of Henderson – Hasselbalch equation and it application, buffer capacity and buffer index, milk as a buffer system. Equilibrium of electrolytes. pH indicators. Oxidation- Reduction: Redox potential, Nernst equation, electrochemical cells. Hydrogen, glass and calomel electrodes. Redox system of milk. Nuclear Chemistry: The nature of isotopes, radio isotopes. Half life period of radio

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 pI. Verification of Lambert Beer Law.

**DC-2105 Biochemistry** **2 (1+1)**

**Theory:**

*Bio-Molecules:* General structures, classification and functions of bio molecules-Amino acids, Protein Structure, Carbohydrates, Fats, Lipids, DNA and RNA. *Enzymes:* Activation energy /Transition state & Enzyme Classification, Coenzymes/Co-factors & Enzyme kinetics, Mechanism of enzyme action, Factors effecting enzyme activity, Enzyme inhibition, isozymes & Regulatory Enzymes, Immobilization of enzyme, Ribozymes & Zymogens. *Metabolism :* Glycolysis, Gluconeogenesis, TCA cycle, Glycogen synthesis and degradation, Pentose phosphate pathway, Fatty acid oxidation, Urea cycle and transamination reactions, ATP and Electron transport chain.

**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. Measurement of proteolysis and lipolysis. Estimation of Vitamin A in Ghee. Estimation of Ascorbic acid in plasma.

**DC-2206 Chemistry of Dairy Products** **3 (2+1)**

**Theory:**

**Practical:**

Cream: estimation of fat and acidity. Butter: estimation of fat, moisture, curd and salt content. Ghee: estimation of moisture, acid value, Butyro refractometer reading/ refractive index and Reichert Meissl value /Polenske 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.

**DC-3107 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., Application of food safety management system (ISO: 22000). Hazard analysis and critical control points (HACCP) system and its application in dairy industry with respect to chemical quality. Setting up of testing facilities and analytical laboratories; concept of mobile testing laboratories. Accreditation of analytical laboratories. Preparation and standardization of reagents required in the analysis of milk and milk products. Sampling procedures; labeling 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

water. Estimation of available chlorine from bleaching powder. Visit to Food Analysis Laboratory.

**DC-3208 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, Reactions involved during deep fat frying. *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. *Beverages:* Classification, Coffee, Tea and Cocoa gradation, composition, chemical changes during processing, volatile compounds.

**Practical:**

Determination of moisture, acidity and gluten content in flour. Determination of total

**DC-3209 Human Nutrition** **2 (1+1)**

**Theory:**

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, Safety aspects of food additives, toxic elements, antibiotics, radionuclides in milk and milk products. Nutraceutical, antioxidants, food toxins, anti-nutritional factors, probiotics and cultured dairy products. Biochemical aspect of post-harvest storage specifically food spoilage.

**Practical:**

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 programmes (survey based result). (b) Hospitals to observe nutritional deficiencies. Identification of Mono, Di and Polysaccharides. Identification of Proteins (albumin, gelatin, peptone). Planning and preparation of high protein, low fat and specialized diets. Detection of antibiotic/toxin in food products.

# DAIRY MICROBIOLOGY SYLLABUS

**DM-1101 Fundamentals of Microbiology** **3 (2+1)**

**Theory:**

*Overview of history and scope of microbiology:* Discovery of Microorganisms and Microscopy (types, working principles and applications); Theories of Biogenesis and abiogenesis; Contributions of Leeuwenhoek,Pasteur, Tyndal, Joseph Lister, Robert Koch, Edward Jenner and Alexander Fleming; Scope and application of microbiology in fields like Dairy, Food, Pharmaceutical, Industrial, Medical and agriculture. *Classification of Microbes:* Microbial classification systems, numerical taxonomy, General properties and principles of microbial classification, Whittaker's five kingdom and Carl Woese's three domain classification system; Systematics of bacteria and Bergey's manual of systematic bacteriology, Phylogenetic tree. *Procaryotic and Eucaryotic microorganisms:* Structure and functions of prokaryotic cells; Differences between prokaryotes and eukaryotes; Differences between cell wall of Gram positive and Gram negative bacteria; Structure of Archeal cell wall. *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. *Diversity of Microorganisms:* Viruses: Structure and Classification; Bacteriophages; Differences between viruses and bacteria; Fungi: Classification of Fungi; Reproduction in Fungi; Protozoa and algae. *Microbial Ecology and Environmental Microbiology:* Microflora of air, soil and water and Microbes of Extreme environment like Archea. Basic concepts of immunology; Role of immune system in governing host-microbe interactions, Microbial Commensalism, Colonization, Infection, Disease and Vaccines.

**Practical:**

General instruction for microbiological laboratory. Microscope- simple and compound; Microbiological equipments; 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). Motility of microorganisms - hanging drop technique. Measurement of size of microorganisms by micrometry (ocular and stage). Preparation of commonly used growth media liquid and solid: simple and differential media. Isolation

milk. *Sources of contamination and microbial spoilage of raw milk:* Microbial contaminants of raw milk supplies,their sources during various stages of production i.e. milking, chilling, storage and transportation with special reference to psychrotrophic microorganisms and preventive measures.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. *Concept of clean milk production:* Hygienic milk production system; Cleaning and sanitation of udder, animal, utensils, equipments 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. *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 total viable count, 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:

microbiological standards. *Microbiology of Condensed, Evaporated and Dried products:* Type of microorganisms associated with condensed, evaporated and dried products, 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; Effect of reconstitution on microbial quality of milk powder including baby foods and survivability of pathogens; Regulatory microbiological standards.*Microbiology of Ice Cream and Frozen desserts:* Microenvironment 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, gulabjamun, etc., paneer, Chhanna and Chhanna based sweets – rasogulla; kheer, shrikhand, dahi, kulfietc.; Factors affecting the microbiological quality in reference to production, processing, storage and distribution; Microbial safety in relation to potential pathogens and their public health significance; Microbial defects, control measures and legal standards; Active packaging concepts and role in bio-preservation.

**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 packaging materials for SPC, Spores and Yeast and mold counts.

*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. *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. *Chesse 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, Host-Microbe interactions and LAB in gut homeostasis.

**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 & 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, 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).

**DM-2205 Dairy Biotechnology** **2(1+1)**

treatment. Dairy enzymes and whole cell immobilization. - Ethical issues related to use of genetically modified foods.

**Practical:**

General introduction to biotechnology laboratory. Equipment Centrifuge, UV illuminator/Gel doc, Electrophoresis, Spectophotometer, ELISA, Aseptic cabinets etc. Preparation of buffers and adjustments of pH. Demonstration of PCR machine and ELISA. Isolation of genomic DNA from E.coli and LAB by traditional and commercial methods. Isolation of plasmid DNA from E.coli and LAB by traditional and commercial methods. Application of target DNA by PCR reaction. Characterization of chromosomal DNA and plasmid DNA in gel electrophoresis. Restriction analysis of DNA. Curing of plasmids. Preparation of competent cell. Conjugal transfer in E. coli cells. Transformation of E. coli by calcium chloride treatment/ electroporation. Detection of A1 and A2 milk by PCR method.

**DM-3106 Quality and Safety Monitoring in Dairy Industry** **3 (2+1)**

**Theory:**

*Consumer Awareness about Microbiological Quality and Safety of Dairy Foods:* Changing scenario; Concepts of quality control, quality assurance and food safety; Global quality and food safety standards, Integrated food law, its main features and functions. *Introduction to Food Safety Management System:* Concepts of Quality Management System (QMS)–ISO: 9000:2000; Principles of QMS; Standard requirements for QMS; HACCP concept and principle with special reference to biological hazards in dairy foods, TQM tools and techniques. *Microbiological Risk Analysis Concepts:* Risk assessment, risk management and risk communication; risk profiling of dairy products; Microbiological criteria and 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. *Rapid Enumeration Techniques:* Enumeration principles and procedure for rapid detection of predominant hygiene indicator organisms and pathogens like *E. coli* (*E. coli* 0157:H7), *Salmonella, Shigella, Staphylococcus aureus, Bacillus cereus* and *Listeria monocytogenes*. *Role of Biosensors for monitoring hygiene and safety of dairy foods:* Detection of antibiotic residues in milk –Delvo SP, MDR test, penzyme test, charm assay, lateral flow assay (ROSA test) etc. Detection of aflatoxins, pesticides other inhibitors etc. and their public health importance in dairy foods. *Plant and equipment hygiene:* Concepts of

capacity test. Microbiological tests for assessing Environmental, equipment and personnel hygiene by swab and rinse methods, Determination of BOD in dairy waste water. Quality evaluation by HACCP in the preparation of dairy products.

**DM- 3207 Food and Industrial Microbiology** **3 (2+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; 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.

# DAIRY BUSINESS MANAGEMENT SYLLABUS

**DBM 1101 Milk Production Management** **2 (1+1)**

**Theory:**

Introduction to Animal Husbandry. Distinguishing characteristics of India and exotic breeds of dairy animals and their performance. Systems of breeding and methods of selection of dairy animals. General dairy farm practices - Identification, dehorning, castration, exercising, grooming, weighing. Care of animals at calving and management of neonates. Management of lactating and dry cows and buffaloes.

Methods of milking, milking procedure and practices for quality milk production. Dairy farm records and their maintenance. Systems of housing dairy animals and maintenance of hygiene and sanitation at dairy farm premises. Common disease problems in dairy animals, their prevention and control. Feed nutrients required by animal body. Feed resources for milk production and their nutritive values. Digestive system of ruminants and measures of feed energy. Nutrients requirements for growth and milk production. Feeding standards, Structure and function of mammary system. Milk secretion and milk let-down. Male and female reproductive system. Estrus and reproductive cycle, Ovulation, fertilization, gestation, parturition, pregnancy diagnosis. Artificial insemination and embryo transfer and their role in animal improvement introduction to biotechniques in dairy animal production.

**Practical:**

Handling and restraining of dairy animals. External body parts and judging of cows and buffaloes. Feeding and management practices of claves. Identification of common feeds and fodders. Preparation of rations for adult animals. Milking of dairy animals and cleaning and sanitation of milking equipments. Identification of reproductive and digestive organs. Demonstration of semen collection, processing and artificial insemination.

**DBM 1102 : Dairy Development** **1(1+0)**

**Theory:**

**DBM 1103 Communication Skills** **2 (1+1)**

**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; Précis writing /Abstracting/Summarizing; Style of technical communication Curriculum vitaé/resumé writing; Innovative methods to enhance vocabulary, analogy questions.

**Practical:**

Listening and note taking; Writing skills, précis 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 1104 Computer and Application Software Packages** **2 (1 + 1)**

**Theory:**

History, features, classification and organization and I/O peripheral devices for computers; Features of modern operating systems; number systems and coding schemes; Basics of networking and communications; Internet, email concepts and application, Word-processing and desktop publishing, Electronic spreadsheet basics and operations, Database management system basics and operations; Fundamental of presentation-graphic packages. Recent strides in computing.

**Practical:**

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.

**DBM 1206 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 programmes. 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 2107 Financial Management** **2 (1+1)**

**Theory:**

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 & retained earning, 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 & duration Investment decisions under inflation, Investment decisions under capital rationing. Project Report; Feasibility Report Valuation. Working capital management-Concept & determinants of working capital, Estimating working capital needs. Depreciation – Concept and method. Introduction, Definition, Objectives, Common terms.

**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

**DBM 2208 Cost Accounting** **1 (1+0)**

**Theory:**

Costing: Essentials of sound costing system. Different methods of costing, elements of cost: Labour- recording of time, idle time, methods of remunerating labour, Premium & Bonus Plans, Materials, Overheads. Cost classification: Direct and Indirect expenses, fixed and variable costs. Various methods of apportioning indirect expenses. Inventory Management: Planning, control and costing. Stores & storekeeping, scope & importance, purchase procedure, types of purchase, location of stores & materials, procedure for the movement of stores, different methods of pricing materials, store records. 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.

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 & attributes

**DBM 3110 Marketing Management and International Trade 2 (2+0)**

**Theory:**

Concept of marketing; Functions of marketing; concepts of marketing management; scope of marketing management; marketing management. Process; concepts of marketing- mix, elements of marketing- mix. Market Structure and Consumer Buying Behaviour: Concept of market structure, marketing environment, micro and macro environments. Consumers buying behaviour, consumerism. Marketing Opportunities Analysis: Marketing research and marketing information systems; Market measurement- present and future demand; Market forecasting; market segmentation, targeting and positioning. Allocation and marketing resources. Marketing Planning Process. Product policy and planning: Product-mix; product line; product life cycle. New product development process. Product brand, packaging, services decisions. Marketing channel decisions. Retailing, wholesaling and distribution. Pricing Decisions. Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry. Promotion-mix decisions. Advertising; How advertising works; Deciding advertising objectives, advertising budget and advertising message; Media Planning; Personal Selling, Publicity; Sales Promotion. Food and Dairy Products Marketing. International Marketing and International Trade. Salient features of International Marketing. Composition & direction of Indian exports; Trends ion International Dairy Trade, International marketing environment; Deciding which & how to enter international market; Exports- Direct exports, indirect exports, Licensing, Joint Ventures, Direct investment & internationalization process, Deciding marketing Programme; Product, Promotion, Price, Distribution Channels. Deciding the Market Organization; World Trade Organization (WTO)

– 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.

**DBM 4112 Entrepreneurship Development** **1 (1+0)**

**Theory:**

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalisation and the emerging business/ entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs)/SSIs. Export and Import. Policies relevant to dairy sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of dairy inputs industry. Characteristics of Indian dairy processing and export industry. Social Responsibility of Business.

**DBM 4213 Dairy Informatics** **1(1+0)**

**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 Dairy Internet and World Wide Web (WWW), Concepts, components and creation of web, HTML, XML coding. Computer