SYLLABUS FOR UNDER GRADUATE DAIRY TECHNOLOGY

Name of the Programme: B. Tech (Dairy Technology)
Duration : 4 years

Name of Department

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Departments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dairy Chemistry</td>
</tr>
<tr>
<td>2.</td>
<td>Dairy Technology</td>
</tr>
<tr>
<td>3.</td>
<td>Dairy Engineering</td>
</tr>
<tr>
<td>4.</td>
<td>Dairy Business Management</td>
</tr>
<tr>
<td>5.</td>
<td>Dairy Microbiology</td>
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Department wise Credit Distribution

<table>
<thead>
<tr>
<th>S.N.</th>
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<tbody>
<tr>
<td>1.</td>
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</tr>
<tr>
<td>2.</td>
<td>Dairy Technology</td>
<td>41 (27+14)</td>
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<tr>
<td>3.</td>
<td>Dairy Engineering</td>
<td>38 (23+15)</td>
</tr>
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<tr>
<td>5.</td>
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<td>16 (10+6)</td>
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Student READY Programme

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<tr>
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<td>In-Plant Training</td>
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<td>2.</td>
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DEPARTMENT-WISE COURSES

Dairy Technology

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<tbody>
<tr>
<td>1.</td>
<td>DTT-211</td>
<td>Market Milk</td>
<td>4 (3+1)</td>
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<td>DTT-212</td>
<td>Traditional Indian Dairy Products</td>
<td>3 (2+1)</td>
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<td>3.</td>
<td>DTT-213</td>
<td>Fat Rich Dairy Products</td>
<td>3 (2+1)</td>
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<td>4.</td>
<td>DTT-214</td>
<td>Condensed &amp; Dried Milks</td>
<td>4 (3+1)</td>
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<td>5.</td>
<td>DTT-221</td>
<td>Cheese Technology</td>
<td>5 (3+2)</td>
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<td>6.</td>
<td>DTT-222</td>
<td>Ice-cream &amp; Frozen Deserts</td>
<td>3 (2+1)</td>
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<td>7.</td>
<td>DTT-311</td>
<td>By Products Technology</td>
<td>3 (2+1)</td>
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<td>8.</td>
<td>DTT-312</td>
<td>Packaging of Dairy Products</td>
<td>3 (2+1)</td>
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<td>9.</td>
<td>DTT-321</td>
<td>Sensory Evaluation of Dairy Products</td>
<td>3 (2+1)</td>
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<td>10.</td>
<td>DTT-322</td>
<td>Food Technology - I</td>
<td>3 (2+1)</td>
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<td>11.</td>
<td>DTT-421</td>
<td>Dairy Plant Management</td>
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<td>Waste Disposal &amp; Pollution Abatement</td>
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### Dairy Engineering

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<tr>
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<td>DTE-112</td>
<td>Fluid Mechanics</td>
<td>3 (2+1)</td>
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<td>3.</td>
<td>DTE-113</td>
<td>Engineering Drawing</td>
<td>1 (0+1)</td>
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<td>DTE-121</td>
<td>Thermodynamics</td>
<td>2 (1+1)</td>
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<td>Heat &amp; Mass Transfer</td>
<td>3 (2+1)</td>
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<td>6.</td>
<td>DTE-123</td>
<td>Boilers and Steam Generation</td>
<td>2 (1+1)</td>
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<td>7.</td>
<td>DTE-124</td>
<td>Basic Electrical Engineering</td>
<td>3 (2+1)</td>
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<td>8.</td>
<td>DTE-211</td>
<td>Refrigeration &amp; Air-conditioning</td>
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<td>Food Engineering</td>
<td>3 (2+1)</td>
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<td>13.</td>
<td>DTE-322</td>
<td>Material Strength &amp; Dairy Machine Design</td>
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<td>14.</td>
<td>DTE-323</td>
<td>Dairy Plant Design and Layout</td>
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<td>15.</td>
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### Dairy Chemistry

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<tbody>
<tr>
<td>1.</td>
<td>DTC-111</td>
<td>Physical Chemistry of Milk</td>
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<td>2.</td>
<td>DTC-121</td>
<td>Biochemistry</td>
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<td>3.</td>
<td>DTC-122</td>
<td>Human Nutrition</td>
<td>2 (1+1)</td>
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<td>4.</td>
<td>DTC-211</td>
<td>Chemistry of Milk</td>
<td>3 (2+1)</td>
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<td>5.</td>
<td>DTC-221</td>
<td>Chemistry of Dairy Products</td>
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<td>6.</td>
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### Dairy Microbiology

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<tbody>
<tr>
<td>1.</td>
<td>DTM-111</td>
<td>Fundamentals of Microbiology</td>
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<td>DTM-121</td>
<td>Microbiology of fluid milk</td>
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<td>3.</td>
<td>DTM-222</td>
<td>Microbiology of Dairy Products</td>
<td>2 (1+1)</td>
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<td>4.</td>
<td>DTM-221</td>
<td>Starter Cultures and Fermented Milk Products</td>
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<td>DTM-331</td>
<td>Quality and Safety Monitoring in Dairy Industry</td>
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### Dairy Business Management

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<tr>
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<th>Course No.</th>
<th>Title of the Course</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>1.</td>
<td>DBM-111</td>
<td>Milk Production Management and Dairy Development</td>
<td>3 (2+1)</td>
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<tr>
<td>2.</td>
<td>DBM-112</td>
<td>Computer and Application Software Packages</td>
<td>2 (1+1)</td>
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<td>3.</td>
<td>DBM-113</td>
<td>Economic Analysis</td>
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<td>4.</td>
<td>DBM-114</td>
<td>Environmental Studies</td>
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<td>5.</td>
<td>DBM-121</td>
<td>ICT in Dairy Industry and Operation Research</td>
<td>4(2+2)</td>
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<td>6.</td>
<td>DBM-221</td>
<td>Fundamentals of Dairy Extension</td>
<td>3 (2+1)</td>
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<td>7.</td>
<td>DBM-311</td>
<td>Marketing Management &amp; International Trade</td>
<td>2 (2+0)</td>
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<td>Communication Skills</td>
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<td>Industrial Statistics</td>
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<td>Entrepreneurship Development and Industrial Consultancy</td>
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<td>DBM-423</td>
<td>Financial Management and Cost Accounting</td>
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### Semester wise Distribution of Courses

#### Semester – I

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<th>Course Number</th>
<th>Course Name</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>1.</td>
<td>DTC-111</td>
<td>Biochemistry</td>
<td>2(1+1)</td>
</tr>
<tr>
<td>2.</td>
<td>DTE-111</td>
<td>Workshop Practice</td>
<td>2(1+1)</td>
</tr>
<tr>
<td>3.</td>
<td>DTE-112</td>
<td>Fluid Mechanics</td>
<td>3(2+1)</td>
</tr>
<tr>
<td>4.</td>
<td>DTE-113</td>
<td>Engineering Drawing</td>
<td>1(0+1)</td>
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<td>DBM-111</td>
<td>Milk Production Management and Dairy Development</td>
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<td>6.</td>
<td>DBM-112</td>
<td>Communications Skills</td>
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<td>Fundamentals of Microbiology</td>
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#### Semester – II

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<tr>
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<td>Physical Chemistry of Milk</td>
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<td>2.</td>
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<td>Chemistry of Milk</td>
<td>3(2+1)</td>
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<td>3.</td>
<td>DTE-121</td>
<td>Thermodynamics</td>
<td>2(1+1)</td>
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<td>Heat &amp; Mass Transfer</td>
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<td>DTE-123</td>
<td>Boiler &amp; Steam Generation</td>
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<td>6.</td>
<td>DTE-124</td>
<td>Basic Electrical Engineering</td>
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<td>DBM-121</td>
<td>Economic Analysis</td>
<td>2(2+0)</td>
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<td>S.N.</td>
<td>Course Number</td>
<td>Course Name</td>
<td>Credit Hours</td>
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<td>Microbiology of Fluid Milk</td>
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**Semester – III**

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<tbody>
<tr>
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<td>Human Nutrition</td>
<td>2(1+1)</td>
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<td>2.</td>
<td>DTT-211</td>
<td>Market Milk</td>
<td>4(3+1)</td>
</tr>
<tr>
<td>3.</td>
<td>DTT-212</td>
<td>Traditional Indian Dairy Products</td>
<td>3(2+1)</td>
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<td>DTT-213</td>
<td>Fat Rich Dairy Products</td>
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<td>5.</td>
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<td>Condensed &amp; Dried Milks</td>
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<td>Refrigeration &amp; Air-conditioning</td>
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**Semester – IV**

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<td>Chemistry of Dairy Products</td>
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<td>Cheese Technology</td>
<td>5(3+2)</td>
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<td>3.</td>
<td>DTT-222</td>
<td>Ice-cream &amp; Frozen Deserts</td>
<td>3(2+1)</td>
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<td>4.</td>
<td>DTE-221</td>
<td>Dairy Process Engineering</td>
<td>3(2+1)</td>
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<td>5.</td>
<td>DBM-221</td>
<td>Fundamental of Dairy Extension</td>
<td>3(2+1)</td>
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<td>6.</td>
<td>DTM-221</td>
<td>Starter Cultures and Fermented Milk Products</td>
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<td>7.</td>
<td>DTM-222</td>
<td>Microbiology of Dairy Products</td>
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**Semester – V**

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<td>Chemical Quality Assurance</td>
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<td>2.</td>
<td>DTT-311</td>
<td>By Products Technology</td>
<td>3(2+1)</td>
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<td>3.</td>
<td>DTT-312</td>
<td>Packaging of Dairy Products</td>
<td>3(2+1)</td>
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<tr>
<td>4.</td>
<td>DTE-311</td>
<td>Instrumentation and Process Control</td>
<td>3(2+1)</td>
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<td>5.</td>
<td>DBM-311</td>
<td>ICT in Dairy Industry and Operation Research</td>
<td>4(2+2)</td>
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<td>DBM-312</td>
<td>Marketing Management and International Trade</td>
<td>2(2+0)</td>
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<td>DTM-311</td>
<td>Quality and Safety Monitoring in Dairy Industry</td>
<td>3(2+1)</td>
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Semester – VI

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<td>2.</td>
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<td>Sensory Evaluation of Dairy Products</td>
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<td>3.</td>
<td>DTT-322</td>
<td>Food Technology - I</td>
<td>3(2+1)</td>
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<tr>
<td>4.</td>
<td>DTE-321</td>
<td>Food Engineering</td>
<td>3(2+1)</td>
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<tr>
<td>5.</td>
<td>DTE-322</td>
<td>Material Strength &amp; Dairy Machine Design</td>
<td>3(2+1)</td>
</tr>
<tr>
<td>6.</td>
<td>DTE-323</td>
<td>Dairy Plant Design and Layout</td>
<td>2(1+1)</td>
</tr>
<tr>
<td>7.</td>
<td>DTE-324</td>
<td>Energy Conservation and Management</td>
<td>2(1+1)</td>
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<tr>
<td>8.</td>
<td>DTM-321</td>
<td>Food and Industrial Microbiology</td>
<td>3(2+1)</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>20 (13+7)</strong></td>
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Semester – VII

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Course Number</th>
<th>Course Name</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>1.</td>
<td>DTT-411</td>
<td>Student READY In-Plant Training</td>
<td>20 (0+20)</td>
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<td></td>
<td><strong>Total</strong></td>
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<td><strong>20 (0+20)</strong></td>
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Semester – VIII

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Course No.</th>
<th>Course Name</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>1.</td>
<td>DTT-421</td>
<td>Dairy Plant Management</td>
<td>2(1+1)</td>
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<td>2.</td>
<td>DTT-422</td>
<td>Waste Disposal and Pollution Abatement</td>
<td>2(1+1)</td>
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<td>3.</td>
<td>DTT-423</td>
<td>Food Technology - II</td>
<td>3(2+1)</td>
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<td>4.</td>
<td>DBM-421</td>
<td>Entrepreneurship Development and Industrial Consultancy</td>
<td>2(2+0)</td>
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<td>5.</td>
<td>DBM-422</td>
<td>Financial Management and Cost Accounting</td>
<td>3(2+1)</td>
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<td>6.</td>
<td>DBM-423</td>
<td>Industrial Statistics</td>
<td>2(2+0)</td>
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<td>7.</td>
<td>DTT 424</td>
<td>Student READY Experimental Learning Module</td>
<td>10 (0+10)</td>
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<td><strong>Total Credit</strong></td>
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<td><strong>24 (10+14)</strong></td>
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</table>

* Students will register for any of the 3 elective courses (one each in semester I, II & V).

* Total credit hours: 90+90=180 (including student ready) +6/7 elective credit hours

Each student to register for any three elective courses

Student READY Program

- In plant Training of six months duration (One semester): 20 (0+20) credit hours
- Rural Dairy Work Experience programme of 10 weeks (0+10) (total 10 credit hours) during summer vacation (spread over 2 or 3 Semester breaks) to be introduced starting from first year. The areas of internship maybe:
  - First year: On Milk Production & Procurement to be taken up in State Dairy Federations/ Dairy Development Departments/Private Dairies/Animal Husbandry Department/Cattle farm/Progressive dairy farmers
• Second Year: On Preliminary Dairy Operations to be taken up in Experimental Dairy/ Referral lab/Dairy Plants
• Third year: Exposure to Product manufacturing operations in Dairy & Food Industry or
• Plant visits in each Dairy Technology course to have Industrial exposure in specialized products like Ice cream, Milk Powders, Cheese, By-products etc. should be made compulsory
• Experiential Learning Module of 10 (5+5) credit hours to run concurrently in the final semester along with the regular courses. This shall include development of Detailed Project Report on setting up of enterprise in the selected areas of product manufacture and Evaluation of the Module.

Common Courses

In view of the increasing importance of climate change, market competitiveness, information technology, entrepreneurship, and graduates employability, it was a general consensus that students of all disciplines need to be taught courses on the following concerned topics:
1. Environmental Studies and Disaster Management
2. Communication Skills and Personality Development
3. Information and Communication Technology
4. Entrepreneurship Development and Business Management
5. Agricultural Informatics
6. Economics and Marketing

SYLLABUS

I. DAIRY TECHNOLOGY SYLLABUS

1. Market Milk 4(3+1)

Theory


**Practical**


2. **Traditional Indian Dairy Products 3(2+1)**

**Theory**


**Practical**


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

**Theory**

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

Practical


4. Condensed and Dried Milk  4(3+1)

Theory


Recent advances with reference to freeze concentration and membrane concentration. Dried Milks: History and status in India and abroad, Grading and quality of raw milk for dried milks, Manufacture of skim milk powder (SMP), whole milk powders and heat classified powders, Physico-chemical changes taking place during manufacture of dried milks, Physical properties of dried milks, Defects in dried milk during manufacture and storage, their causes and prevention, PFA, BIS and International Standards for dried milk, Manufacture of infant foods, malted milk foods and other formulated dried products, Cheese spread powder, ice cream powder, cream powder, butter powder, whey powder, Management of condensed and dried milk industry.

Practical

5. Cheese Technology 5(3+2)

Theory


Practical


6. Ice-Cream and Frozen Desserts 3(2+1)

Theory

History, development and status of ice cream industry, History, development and status of ice cream industry, Definition, classification and composition and standards of ice cream and other frozen desserts, Stabilizers and emulsifiers-their classification, properties and role in quality of ice cream, Technological aspects of ice cream manufacture, Thermodynamics of freezing and calculation of refrigeration loads, Types of freezers, refrigeration control / instrumentation, Types of freezers, refrigeration control / instrumentation, Hygiene, cleaning and sanitation of ice cream plant, Effect of process treatments on the physico-chemical properties of ice-cream mixes and ice cream, Processing and freezing of ice-cream mix and control of over run, Packaging, hardening, storage and shipping of ice-cream, Defects in ice cream, their causes and prevention, Recent advances in ice-cream industry (flavourings, colourings, fat replacers, bulking agents) and plant management, Nutritive value of ice-cream.

Practical


7. By Product Technology  3(2+1)

Theory

Status, availability and utilization of dairy by-products in India and Abroad. Associated economic and pollution problems, Physico-chemical characteristics of whey, butter milk and ghee residue, By-products from skim milk: Casein: types of commercial casein, their specifications, manufacturing processes with basic principles involved. b)

Practical


8. Packaging of Dairy Products 3(2+1)

Theory


Practical

9. Sensory Evaluation of Dairy Products 3(2+1)

Theory


Practical


10. Food Technology-I 3(2+1)

Theory

Status of food processing industries in India and abroad, magnitude and interdependence of dairy and food industry, prospects for future growth in India. Harvesting, transportation and storage of fruits and vegetables. Post harvest processing of fruits and vegetables: Peeling, sizing, blanching, Canning of fruits and vegetables, Drying and freezing
of fruits and vegetables. Juice processing: General steps in juice processing, role of enzymes in fruit. Juice extraction, equipments and methods of fruit juice extraction, preservation of fruit juices, fruit juice clarification, concentration of fruit juices, fruit juice powders. Fruit juice processing: Orange and tangerine, Lemon and lime juice, Apple juice, Grape juice, Nectars, pulpy juices, tropical blends, Vegetable juices. Manufacture of Jam, Jelly and Marmalade: Role played by pectin, sugar and acid in jellied fruit products. Fruits and vegetable preserves, Glazed, Crystallized fruits. Tomato based products: Juice, puree, paste, sauce, ketchup. Pickles: Principle of pickling, technology of pickles. Beverages: Classification, scope, carbonated non-alcoholic beverages and their manufacture. Fruit beverages and drinks, additives for fruit based beverages. Coffee: Production practices, structure of coffee/cherry, Coffee processing including roasting, grinding, brewing extraction, dehydration, aromatization, instant coffee. Tea: Tea leaf processing, green, red, yellow, instant tea. Technology of confectionery foods: Candies, Chewing gums and bubble gums, Toffees, Caramels, Standards of confectionery products. Chocolate products: Cocoa bean processing, chocolate liquor, Standards of confectionery products. Functional foods: Introduction, Phytochemicals, Milk ingredients as nutraceuticals, fiber-rich food products etc.

Practical


11. Food Technology-II  3(2+1)

Theory

Cereal grains, legumes and oilseeds: Structure and composition of cereals, legumes and oilseeds, Milling of paddy, quality factors of rice grains, processing of rice bran oil, Instant rice, quick cooking rice, canned rice, Milling technology of wheat, Criteria of wheat flour quality, improvers for wheat flour, Types of wheat flour, Milling technology of maize, wet milling of corn, Milling technology of barley, malting of barley and its utilization in manufacture of value added food products including malted milk foods, Dehulling and processing technology of important pulses, Dehulling and extraction of oil in major oilseed crops like soy bean, mustard, sunflower, ground nut, Vegetable protein concentrates/isolates, Utilization of oil cake in food formulation. Bakery and Snack technology: Technology of bread, biscuits, crackers and cakes, Technology of manufacturing process of Pasta foods-Macaroni, Noodles and Spaghetti, Technology of breakfast cereals: corn flakes, puffed, extruded snacks, Potato chips. Meat, fish and egg technology: Development of meat, poultry, egg and fish industry in India, Pre-slaughter care, handling and ante-mortem inspection of animal, Stunning and slaughtering techniques, Postmortem inspection, rigor mortis and conversion of muscle to meat Slaughterhouse sanitation, meat hygiene and zoonotic diseases, Processing of poultry meat, Egg and egg products – quality assessment of egg, Types, handling, transportation and marketing of fish, Preservation of fish., Manufacturing process of dehydrated fish and fish pickles. Cleaning and sanitation, Waste management of food processing plants.

Practical


12. Dairy Plant Management  2(1+1)

Theory


Practical


13. Waste Disposal and Pollution Abatement  2(1+1)

Theory


Practical


II. DAIRY ENGINEERING

1. Workshop Practice  2(1+1)

Theory

Electric arc and Gas welding. Smithy and forging operations: tools and equipments. Bench work: The bench, flat surface filing, chipping, scrapping, marking out, drilling and screwing. Introduction to following tool machines: (a) Lathe Machine (b) Milling Machine (C) Shaper and Planner (d) Drilling and Boring machines (e) Grinder (f) CNC Machines etc.

**Practical**

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

2. **Fluid Mechanics** 3(2+1)

**Theory**


**Practical**


3. **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.

4. Thermodynamics 2(1+1)

Theory


Practical


5. Heat & Mass Transfer 3(2+1)

Theory

Practical


6. Boilers and Steam Generation 2(1+1)

Theory


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 Babcock & Wilcox boiler. Study of different Boiler accessories.

7. Basic Electrical Engineering 3(2+1)

Theory

Cage and Phase wound rotors, Starting of induction motors using Direct on Line (DOL) and Star-Delta Starter. Soft starter and variable frequency drives. Single Phase Induction Motors: - Introduction, Different types of single phase induction motors such as Split Phase, Capacitor type, Shaded Pole type, Universal or AC series motors, Repulsion start induction run motor, Repulsion – induction motor. DC Machine: - Construction and operation of DC generator, types of generators and their various characteristics. DC motors: Torque speed characteristics of DC motors, Starting and speed control of DC motors by using 3-point DC Starter. Alternators: - Elementary working principles, Different parts of an Alternator, Relation between Speed and Frequency, E.M.F. equation in an Alternator. Different types of Circuit Breaker and its use. Introduction to DG set system. Electric Power Economics: - Economics of Generation of electrical energy and related important terms such as, load curve, connected load, Maximum Demand, Demand Factor, Average load or demand, Load Factor, Diversity factor and its significance, Capacity Factor or Plant factor, Utilization Factor, Plant Operating Factor and Selection of Units and related numerical, Various types of Tariff used for calculation of electricity bill. Lighting system: Introduction to industrial lighting system. Energy Management and Power Factor Corrections: - Types of energy, Energy Management, Concept of Energy Audit. Concept of Power Factor, Disadvantages of low power factor, Causes of low power factor, Various methods of improving low power factor, Location of power factor correction equipment, Advantages of power factor improvement.

**Practical**


**8. 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

**Practical**

Study of different types of Refrigeration tools generally used in installation and maintenance of a refrigeration plant/ equipment including charging and leakage-detection tools. Study of specifications, components, operation, control, maintenance and precautions taken during working of a Domestic refrigerator. Study of specifications, components, operation, control, maintenance and precautions taken during working of a Water cooler. Study of specifications, components, operation, control, maintenance and precautions taken during working of a Bulk milk cooler. Study of specifications, components, operation, control, maintenance and precautions taken during working of a Walk-in-cooler. Study of different parts and learn the operation of a refrigeration plant/ice plant using ammonia refrigerant. Estimation of installed cooling capacity with the help of observed working pressures. Study of specifications, components, operation, control and maintenance of Ice Bank Tank (IBT). Study of specifications, components, operation, control and maintenance of a Cold Storage. Study of the Evaporative Cooling Devices like Cooling Tower, Spray Pond, Air-Washer or Room air-cooler etc. Study of the parts and components of different types of refrigerant compressors used in various refrigeration applications. Study of different types of capacity control devices used with compressors in a refrigeration plant. Experimental study of a simple refrigeration system on refrigeration tutor or an experimental set-up. (comparison of actual and theoretical performance). Experimental study of an year-round air-conditioning system on an air-conditioning tutor or an experimental set-up. Determination of SHF and Bypass 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.

**9. 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.


Practical


10. Dairy Process Engineering 3(2+1)

Theory


Practical

Constructional details, operation and maintenance of Vacuum pan. Constructional details, operation and maintenance of multiple effect evaporator. Constructional details,

11. Instrumentation and Process Control 3(2+1)

**Theory**


Automation: Introduction to plant automation, automation hierarchy, PLC, SCADA

**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 sensors/ instruments. Study of LVDT. Study of level/flow controller. Study of PLC. Visit to an automatic controlled dairy plant.

12. Food Engineering 3(2+1)

**Theory**

drying, freeze drying, spin flash. Freeze dehydration: Heat and mass transfer, Calculation of drying time, Industrial freeze drying. Other food processing operations and equipments: Equipment for pulping, fruit juice extraction, blanching, dehulling, size reduction, milling, extrusion and distillation.

**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 drying 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.


**Theory**


**Practical**


**14. Dairy Plant Design and Layout 2(1+1)**

**Theory**


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 layout of ghee plant. To draw layout of composite dairy plant.

15. Energy Conservation and Management 2(1+1)

Theory


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.


**Practical**


**III. DAIRY CHEMISTRY SYLLABUS**

1. **Physical Chemistry of Milk 3(2+1)**

**Theory**


**Practical**


2. **Biochemistry 2(1+1)**

**Theory**


**Practical**


3. **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**


4. Chemistry of Milk 3(2+1)

**Theory**


**Practical**

5. Chemistry of Dairy Products 3(2+1)

Theory


Practical


6. 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.

Practical

Calibration of dairy glassware such as pipette, burette, volumetric flasks, hydrometer, butyrometers. Preparation and standardization of dairy reagents such as acids, alkalies, sodium thiosulfate, silver nitrate, Fehlings, EDTA solutions etc. Preparation and testing of Gerber sulfuric acid used in fat determination. Testing the amyl alcohol used for fat determination. Chemical analysis of permissible additives used in milk and milk products.

7. Food Chemistry 3(2+1)

Theory


Practical

Determination of the order of hydrolysis of an ester/carbohydrate and measurement of activation energy; determination of the progress curve obtained during the hydrolysis of P-nitrophenyl phosphate by milk alkaline phosphatase; determination of the Michaelis constant for the digestion of casein by trypsin; Measurement of pH and buffering capacity of different types of milk; To study the gel formation and gel stability of milk proteins; preparation of a Tris/ phosphate/citrate buffer of a given molarity/ionic strength and pH; determination of pH of the buffer; measuring the stability of an oil-in-water emulsion stabilised by milk proteins; foaming capacity and foam stability of caseins/whey proteins; drawing of an adsorption isotherm of water on casein.

IV. DAIRY MICROBIOLOGY SYLLABUS

1. 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 procaryotic cells; Differences between procaryotes 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. Basics of Microbial Genetics and Host-Microbe interactions: DNA as the genetic material, Structure of DNA/ RNA, DNA replication, transcription and translation; Basic concepts of immunology; Role of immune system in governing host-microbe interactions, Microbial Commensalism, Colonization, Infection, Disease and Vaccines.

Practical


2. Microbiology of Fluid Milk 2(1+1)

Theory

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


3 Microbiology of Dairy Products 2(1+1)

Theory

Microbiology of Cream and Butter - Micro-environment and impact of critical process factors on entry of spoilage and pathogenic organisms in cream and butter; Microbiological aspects including defects in pasteurized (ripened/unripened cream), sterilized and UHT cream; Factors influencing the microbial growth during batch/continuous butter making process; Microbial Defects in butter - Bacterial/mold discoloration, enzymatic deterioration and their control measures; Regulatory microbiological standards. 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, kulfi etc.; 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.

4. Starter Cultures and Fermented Milk Products  3(2+1)

Theory

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

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.

Practical


5. Quality and Safety Monitoring in Dairy Industry 3(2+1)

Theory


Practical


6. 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 microorganisms 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 (B12), antibiotics and bacteriocins; and fermented whey beverages.

**Practical**

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

**V. DAIRY BUSINESS MANAGEMENT SYLLABUS**

1. **Milk Production Management and Dairy Development 3(2+1)**

**Theory**


**Practical**

Handling and restraining of dairy animals. External body parts and judging of cows and buffaloes. Feeding and management practices of calves. 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.

2. 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

Windows Operating System, Word Processing software operations, Presentation Graphics software operations, Internet Surfing/Email usage, RDBMS software package basic operations, Spreadsheet software package basic operations.

3. Economic Analysis  2(2+0)

Theory

Basic concepts-wants, goods, wealth, utility, consumption, demand and supply, Consumer behaviour-law of diminishing marginal utility and equi-marginal utility, cardinal and ordinal utility approach for consumer’s behaviors. Theory of demand-law of demand, demand schedule, demand function, determinates of demand, individual consumer demand and market demand, demand forecasting, elasticity of demand, price elasticity, income elasticity and cross elasticity, Consumer’s surplus. Theory of production- concepts of firm and industry, basic factors of production and their role, production function for a single product, nature of production function, laws of returns. Concepts of costs-fixed and variable costs, short run and long run costs, average and marginal costs, economics and diseconomies of scale. Concept of market- types of market, pricing and output under different market situations, market price and normal price, price determination under perfect Competition, monopoly, oligopoly and monopolistic competition. National income – GDP, GNP, NNP, disposable personal Income, per capita income, inflation.

4. Environmental Studies 2(1+1)

Theory

Environmental Science: An introduction, Ecosystem: kinds, structure, characteristics, functioning, Biochemical cycles, Natural resources and their managements, Environmental pollution, Air pollution, Water pollution, Solid waste pollution, Noise pollution, Soil pollution, Radio active 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 low, 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.

5. ICT in Dairy Industry and Introduction to Operations Research 4(2+2)

Theory


Practical

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

6. Fundamentals of Dairy Extension 3(2+1)

Theory


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.

7. 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-

8. 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 vitae/resumé writing; Innovative methods to enhance vocabulary, analogy questions. Structural and Functional Grammar: Sentence structure, modifiers, connecting words and verbs; phrases and clauses; Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults.

Practical

Listening and note taking; Writing skills, 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.

9. Industrial Statistics 2(1+1)

Theory

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

Practical


10. Entrepreneurship Development and Industrial Consultancy 2(2+0)

Theory


11. Financial Management and Cost Accounting 3(2+1)

Theory


Practical
ELECTIVES / NON CREDIT COURSES
(Each student to register for any three elective courses)

1. Organic Chemistry 3(2+1)

Theory


Practical


2. Nutraceuticals and Functional Foods 2(2+0)

Theory

Introduction The definition of Functional Foods will be outlined. Students will explore both the industry and the consumer roles involved in this growing field. Antioxidants Students will learn the chemical makeup, free radicals and biochemical functions of antioxidants. Foods explored in this unit will include cranberries, tomatoes, garlic, pomegranate and different iced teas. Dietary Fiber Students will learn about soluble and insoluble fiber, resistant starch, and how important these are to human health. The biochemical functions of dietary fiber will be explored, and oats and oats products will be the main example used in the classroom. Prebiotics and Probiotics Students will learn the definition of both pre-and probiotics, and their biological functions. How to develop prebiotics and probiotics. Pre- and probiotics will be used together as symbiotics. Lipids and health Students will learn the structure and function of essential fatty acids. Chemistry and health benefits of W-3 fatty acids, phytosterols, and CLA, Olive oil. Functions and sources of vitamins and minerals with proposed functional claims. Sports Drink - functional qualities of sports drinks. Electrolytes and sugar level will be a large part of the discussion. Infant Formula - ingredients and formulation techniques of infant formula, and all aspects of the product that make it a functional food. Consumer trends surrounding infant formula will also be outlined.
3. Food Safety Regulations  2(2+0)

Theory


4. Technology Management 2(2+0)

Theory

Introduction to Technology Management: Concept and Meaning of Technology and Technology Management- Technology; Technology management, Evolution and Growth of Technology, Role and Significance of Technology Management, Impact of Technology on Society and Business- Technology and competition; Key issues in managing technological innovation, Forms of Technology- Process technology; Product technology. Technology Forecasting Process, Need and Role of Technology Forecasting, Forecasting Methods and Techniques, Planning and Forecasting. Technology Adoption, Technology Diffusion- of technology diffusion; Perspectives of innovation diffusion process; Activities necessary for diffusion process, Technology Absorption- Role of technology absorption; Benefits of technology absorption; Constraints in technology absorption. Integration of People and Technology, Factors Considered in Technology Management- Organisational factors; Psychological factors, Organizational Structure and Technology.

5. Emerging Dairy Processing Technologies  2(2+0)

Theory

High Pressure Processing: Principles of high pressure processing, use of high pressure to improve food safety and stability. Effects of high pressure on food quality: Pressure effects on microorganisms, enzyme, texture and nutrients of food. Modelling HP processes. Other applications of high pressure processing. Pulsed electric fields processing: Historical background, PEF treatment systems, main processing parameters. Mechanisms of action: mechanisms of microbial and enzyme inactivation. PEF for processing of liquid foods and beverages, PEF Processing for solid foods. Food safety aspects of pulsed electric fields. Pulsed electric field and high pressure processing.

A thermal membrane concentration of liquid foods and colours: osmotic membrane distillation, direct osmosis, membrane modules, Applications of membrane concentration. Processing by radio frequency electric fields: radio frequency electric fields equipments, RFEF non-thermal inactivation of yeasts, bacteria and spores, electrical costs. Ultrasound processing: fundamentals of ultrasound, ultrasound as a food preservation and processing aid, effects of ultrasound on food properties. Alternate thermal processing: Microwave heating: dielectric properties of foods, heat and mass transfer in microwave processing, application of microwave processing for foods; Radio frequency processing: dielectric heating, material properties, radio-frequency heating and drying applications; Ohmic heating: Fundamentals of ohmic heating, electrical conductivity, modeling, treatment of products. Hybrid drying technologies: combined microwave vacuum drying, combining microwave vacuum drying with other processes, equipment for microwave vacuum drying, product quality degradation during dehydration.

Common Courses

It was a general consensus that students of all disciplines need to be taught the following courses:
1. Environmental Studies and Disaster Management (as per UGC guidelines - core module for undergraduate courses of all branches of higher education)

Theory

Unit 1: Multidisciplinary nature of environmental studies: definition, scope and importance

Unit 2: Natural Resources: Renewable and non-renewable resources. Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual and communities in conservation of natural resources. • Equitable use of resources for sustainable lifestyles.

Unit 3: Ecosystems • Concept of an ecosystem. • Structure and function of an ecosystem. • Producers, consumers and decomposers. • Energy flow in the ecosystem. • Ecological succession. • Food chains, food webs and ecological pyramids. • Introduction, types, characteristic features, structure and function of the following ecosystems:

a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 4: Biodiversity and its conservation:- Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India.

Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, national and local levels, India as a mega-diversity nation.

Hot-spots of biodiversity

Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India.


Unit 5: Environmental Pollution: definition, cause, effects and control measures of :-

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards.

**Solid Waste Management:** causes, effects and control measures of urban and industrial wastes.

Role of an individual and communities in prevention of pollution.

**Pollution case studies.**

**Unit 6:** Social Issues and the Environment:

From Unsustainable to Sustainable Development

Urban problems related to energy

Water conservation, rain water harvesting, watershed management

Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. dyes.

Wasteland reclamation.

Consumerism, wastage and waste products.

Environment Protection Act.

Air (Prevention and Control of Pollution) Act.

Water (Prevention and control of Pollution) Act

Wildlife Protection Act

Forest Conservation Act

Issues involved in enforcement of environmental legislation.

Public awareness.

**Unit 7:** Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Demographic patterns and impact on Agriculture.

Environment and Human Health: Human Rights, Value Education, HIV/AIDS.

Women and Child Welfare.

Role of Information Technology in Environment and Human Health.

Case Studies.

**Unit 8:** Field work: Visit to a local area to document environmental assets river/forest/grassland/hill/mountain, visit to a local polluted site-Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.

**Disaster Management Theory**

**UNIT-1:** Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.

**UNIT-2:** Man made disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, field fires-burning of straw, stables and residues oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

**UNIT-3:** Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community –based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.
II. Communication Skills and Personality Development

Theory

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations.

III. Information and Communication Technology

Theory

IT and its importance. IT tools, IT-enabled services and their impact on society; computer fundamentals; hardware and software; input and output devices; word and character representation; features of machine language, assembly language, high-level language and their advantages and disadvantages; principles of programming- algorithms and flowcharts; Operating systems (OS) - definition, basic concepts, introduction to WINDOWS and LINUX Operating Systems; Local area network (LAN), Wide area network(WAN), Internet and World Wide Web, HTML and IP; Introduction to MS Office - Word, Excel, Power Point. Audio visual aids - definition, advantages, classification and choice of A.V aids; cone of experience and criteria for selection and evaluation of A.V aids; video conferencing. Communication process, Berlo’s model, feedback and barriers to communication.

Practical

Exercises on binary number system, algorithm and flow chart; MS Word; MS Excel; MS Power Point; Internet applications: Web Browsing, Creation and operation of Email account; Analysis of fisheries data using MS Excel. Handling of audio visual equipments. Planning, preparation, presentation of posters, charts, overhead transparencies and slides. Organization of an audio visual programme.

IV. Entrepreneurship Development and Business Management

Theory

Concept of Entrepreneur, Entrepreneurship Development, Assessment of entrepreneurship skills, SWOT Analysis & achievement motivation, Entrepreneurial behavior, Government policy and plan for entrepreneurship development, Developing Leadership Skills, Encoding and decoding communication skills; Communication skills for entrepreneurship development, Developing Speaking Skills, Developing Listening Skills, Developing organizational skill, Developing Managerial skills, Problem solving skill. Supply chain management and Total quality management, Project Planning Formulation and report preparation.
V. Agri-Informatics

Theory


Practical

Study of Computer Components, accessories, practice of important DOS Commands. Introduction of different operating systems such as windows, Unix/ Linux, Creating, Files & Folders, File Management. Use of MS-WORD and MS Power-point for creating, editing and presenting a scientific Document. MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data. MS-ACCESS: Creating Database, preparing queries and reports, demonstration of Agri-information system. Introduction to World Wide Web (WWW). Introduction of programming languages. Hands on Crop Simulation Models (CSM) such as DSSAT/Crop-Info/CropSyst/ Wofost; Computation of water and nutrient requirements of crop using CSM and IT tools. Introduction of Geospatial Technology for generating valuable information for Agriculture. Hands on Decision Support System. Preparation of contingent crop planning. Forecasting and early warning.

VI. Economics and Marketing

Theory


Practical


The contents given above are suggestive. It was decided by the Committee these contents be adjusted in courses and credit hours as per their relevance to the concerned.