# Teaching Scheme and Syllabi of B.E. (Food Technology) [2020-2021]

## Fifth Semester

<table>
<thead>
<tr>
<th>S No.</th>
<th>Course code</th>
<th>Subject</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credits</th>
<th>Practic al</th>
<th>Mid term</th>
<th>End term</th>
<th>Total marks</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CHE 204</td>
<td>Heat Transfer</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>25</td>
<td>50</td>
<td>50</td>
<td>125</td>
<td>CHE</td>
</tr>
<tr>
<td>2</td>
<td>CHE 304</td>
<td>Mass Transfer -I</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>CHE</td>
</tr>
<tr>
<td>3</td>
<td>FT 301</td>
<td>Processing of Cereals &amp; Pulses</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>25</td>
<td>50</td>
<td>50</td>
<td>125</td>
<td>FT</td>
</tr>
<tr>
<td>4</td>
<td>FT 302</td>
<td>Processing of Fruits and Vegetables</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>4</td>
<td>25</td>
<td>35</td>
<td>40</td>
<td>100</td>
<td>FT</td>
</tr>
<tr>
<td>5</td>
<td>FT 303</td>
<td>Beverage Technology</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>35</td>
<td>40</td>
<td>75</td>
<td>FT</td>
</tr>
<tr>
<td>6</td>
<td>FT 304</td>
<td>Confectionery Technology</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>35</td>
<td>40</td>
<td>75</td>
<td>FT</td>
</tr>
<tr>
<td>7</td>
<td>FT 305</td>
<td>Beverage &amp; Confectionary Technology</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>FT</td>
</tr>
<tr>
<td>8</td>
<td>CHE 306</td>
<td>Process Plant Design-I</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>CHE</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td>18</td>
<td>3</td>
<td>12</td>
<td>26</td>
<td>125</td>
<td>255</td>
<td>270</td>
<td><strong>650</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Total contact hours/week** 33

**Note:**
- Sports proficiency/Community services/ Professional society activities/ Technical activities related to the field of Engineering (1st to 3rd year---2 credits to be earned in 7th semester)
- Discipline (1st to 4th year, 1 credit to be earned in 8th semester)
Sixth Semester

<table>
<thead>
<tr>
<th>S No.</th>
<th>Course code</th>
<th>Subject</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credits</th>
<th>Practic</th>
<th>Mid term</th>
<th>End term</th>
<th>Total marks</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CHE 301</td>
<td>Numerical Methods in Chemical Engineering</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>CHE</td>
</tr>
<tr>
<td>2</td>
<td>CHE 309</td>
<td>Mass Transfer-II</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>25</td>
<td>50</td>
<td>50</td>
<td>125</td>
<td>CHE</td>
</tr>
<tr>
<td>3</td>
<td>CHE 303</td>
<td>Chemical Reaction Engineering-I</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>25</td>
<td>50</td>
<td>50</td>
<td>125</td>
<td>CHE</td>
</tr>
<tr>
<td>4</td>
<td>FT 306</td>
<td>Processing of Oil Seeds, Oils and Fats</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>4</td>
<td>25</td>
<td>35</td>
<td>40</td>
<td>100</td>
<td>FT</td>
</tr>
<tr>
<td>5</td>
<td>FT 307</td>
<td>Processing of Milk and Milk products</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>4</td>
<td>25</td>
<td>35</td>
<td>40</td>
<td>100</td>
<td>FT</td>
</tr>
<tr>
<td>6</td>
<td>CHE 307</td>
<td>Chemical Engineering Computation Lab</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>CHE</td>
</tr>
<tr>
<td>7</td>
<td>CHE 405</td>
<td>Process Plant Design-II Lab</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>CHE</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>15</td>
<td>3</td>
<td>16</td>
<td>24</td>
<td>150</td>
<td>220</td>
<td>230</td>
<td>600</td>
<td></td>
</tr>
</tbody>
</table>

Total Contact hours/week: 34

Note:
- Sports proficiency/Community services/ Professional society activities/ Technical activities related to the field of Engineering (1st to 3rd year---2 credits to be earned in 7th semester)
- Discipline (1st to 4th year, 1 credit to be earned in 8th semester)
## Seventh Semester

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course code</th>
<th>Subject</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credits</th>
<th>Practical</th>
<th>Mid term</th>
<th>End term</th>
<th>Total marks</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CHE 310</td>
<td>Process Dynamics and Control</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>25</td>
<td>50</td>
<td>50</td>
<td>125</td>
<td>CHE</td>
</tr>
<tr>
<td>2</td>
<td>FTO401</td>
<td>Open Elective- I</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>35</td>
<td>40</td>
<td>75</td>
<td>FTO</td>
</tr>
<tr>
<td>3</td>
<td>CHE 408</td>
<td>Process Engineering Economics</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>CHE</td>
</tr>
<tr>
<td>4</td>
<td>FTD 401</td>
<td>Departmental Elective- I</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>4</td>
<td>25</td>
<td>35</td>
<td>40</td>
<td>100</td>
<td>FTD</td>
</tr>
<tr>
<td>5</td>
<td>FT 401</td>
<td>Project Work</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>FT</td>
</tr>
<tr>
<td>6</td>
<td>FT 402</td>
<td>Literature Survey, Report Writing and Seminar</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>NC</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>FT</td>
</tr>
<tr>
<td>7</td>
<td>FT 403</td>
<td>Industrial Training</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>25</td>
<td>FT</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>12</td>
<td>2</td>
<td>10</td>
<td>17</td>
<td>50</td>
<td>195</td>
<td>180</td>
<td>425</td>
<td></td>
</tr>
</tbody>
</table>

### Note:
- Sports proficiency/Community services/ Professional society activities/ Technical activities related to the field of Engineering (1st to 3rd year---2 credits to be earned in 7th semester)
- Discipline (1st to 4th year, 1 credit to be earned in 8th semester)
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course code</th>
<th>Subject</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
<th>Practical</th>
<th>Mid Term</th>
<th>End Term</th>
<th>Total Marks</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CHE 402</td>
<td>Environmental Engineering</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>25</td>
<td>50</td>
<td>50</td>
<td>125</td>
<td>CHE</td>
</tr>
<tr>
<td>2</td>
<td>FTD 402</td>
<td>Department Elective- II</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>FTD</td>
</tr>
<tr>
<td>3</td>
<td>FTO 402</td>
<td>Open Elective- II</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>4</td>
<td>25</td>
<td>35</td>
<td>40</td>
<td>100</td>
<td>FTO</td>
</tr>
<tr>
<td>4</td>
<td>FTO 403</td>
<td>Open Elective- III</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>35</td>
<td>40</td>
<td>75</td>
<td>FTO</td>
</tr>
<tr>
<td>5</td>
<td>FTD 403</td>
<td>Departmental Elective- III</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>FTD</td>
</tr>
<tr>
<td>6</td>
<td>FT 401</td>
<td>Project work</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>FT</td>
</tr>
<tr>
<td>7</td>
<td>CHE 403</td>
<td>Process Modelling and Simulation Lab</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>FT</td>
</tr>
<tr>
<td>8</td>
<td>FT 404</td>
<td>Comprehensive Viva</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>25</td>
<td>25</td>
<td>50</td>
<td>FT</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>15</td>
<td>3</td>
<td>10</td>
<td>24</td>
<td>75</td>
<td>220</td>
<td>255</td>
<td>550</td>
<td></td>
</tr>
</tbody>
</table>

Total Contact hours/week 28

**S' (Satisfactory) or ‘X’ (Repeat)

Note:

- Discipline (1st to 4th year, 1 credit to be earned in 8th semester)
List of Departmental Electives

A) Meat Fish & Poultry Technology
B) Packaging Technology
C) Biochemical Engineering
D) Food Biotechnology
E) Functional Food
F) Industrial Safety and Hazards
G) Plant Utilities

List of Open Electives

A) Process Instrumentation
B) Food Regulation & Quality Control
C) Food Rheology and Texture
D) Nano Technology
E) Supply Chain and Logistics Management
F) Operations Research
G) Project Management & Entrepreneurship
Title: HEAT TRANSFER  
Credits: 05

<table>
<thead>
<tr>
<th>Code</th>
<th>CHE 204</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester:</td>
<td>5th</td>
</tr>
<tr>
<td>L T P</td>
<td>3 1 3</td>
</tr>
<tr>
<td>Max.Marks</td>
<td>End term-50</td>
</tr>
<tr>
<td>Mid term- 50</td>
<td>Practical -- 25</td>
</tr>
<tr>
<td>Elective</td>
<td>N</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>42 (Theory) 14 (Practical Sessions)</td>
</tr>
</tbody>
</table>

THEORY | Time | 4 Hours

Note for the Examiner: The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.

SECTION- A
Conduction: Steady state conduction in one dimensional system, general conduction equation, effect of variable thermal conductivity, steady state conduction involving internal heat generation, lagging on pipes, the critical thickness of insulation on pipes, extended surfaces of uniform thickness and fin effectiveness, fin efficiency. Convection: Free and forced convection, concept of heat transfer coefficient, dimensionless numbers in free and forced convection, Dimensional analysis, Determination of Heat transfer coefficient using heat and momentum transfer analogies, experimental determination of heat transfer coefficient and common working correlations. Radiation Heat Transfer: Black Body radiation, and grey body radiation, physical mechanism, radiation properties and shape factor, heat exchange between non-black bodies, radiation shields, pyrometry and effect of radiation on temperature measurement.

SECTION- B
Condensation and Boiling: Condensation heat transfer phenomenon, film condensation on vertical plates and cylinders as well as on horizontal cylinders. Effects of non-condensable gases and vapor velocity on condensation, pool boiling, forced convection boiling, working correlations for pool boiling. Evaporation: Types of Evaporators, single and multiple effects, single and multiple effects calculations, evaporator capacity, economy, effect of liquid head and boiling point elevation, methods of feeding. Heat Exchangers: Various types of heat exchangers, overall heat transfer coefficients, heat exchanger mean temperature differences, heat exchanger effectiveness and the number of transfer units.

5. 6. 7.

Paper Title : HEAT TRANSFER (Practical)
Paper Code CHE 204 Max. Marks 25 Credits : 1
1. Determination of heat transfer coefficient for different types of heat transfer equipment.
   Wilson plots.
2. Unsteady state heat transfer in jacketed vessels. (Open pan evaporator)
3. Correlation of instantaneous heat transfer coefficients with time study deposition of scale on a
   heating surface.
4. Determination of heat losses for insulated pipes
5. Study of double pipe heat exchanger and to determine overall heat transfer coefficient
6. Study the performance characteristics of a 1,2 - shell and tube heat exchanger
7. Study and operation of long tube, forced circulation and multiple effect evaporators.
8. Duhring plot for solutions involving nonvolatile solutes.

<table>
<thead>
<tr>
<th>Title</th>
<th>MASS TRANSFER-I (Theory)</th>
<th>Credits</th>
<th>04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>CHE 304</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Marks</td>
<td>End term- 50</td>
<td>Mid term- 50</td>
<td>Elective</td>
</tr>
<tr>
<td>Pre requisites</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact Hours</td>
<td></td>
<td></td>
<td>42 (Theory)</td>
</tr>
</tbody>
</table>

THEORY Time 4 Hours

Note for the Examiner

The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.

SECTION- A

Mass transfer operations, classification of mass transfer operations, choice of separation methods,
methods of conducting mass transfer operations, design principles. Introduction to mass transfer
and diffusion, molecular diffusion in gases and liquids, diffusion coefficients for gases and liquids,
diffusion in solids, types of solid diffusion. Mass transfer coefficients, types of mass transfer
coefficients, mass transfer coefficients in laminar flow, theories of mass transfer. Interphase mass
transfer, concept of overall mass transfer coefficient.

SECTION- B

Working principle, construction and industrial applications of various gas liquid contacting
equipments like sparged vessels, mechanically agitated vessels, tray towers, packed towers, spray
chambers, venturi scrubbers. Humidification operations, psychometric chart, adiabatic saturation
temperatures, wet bulb temperature, adiabatic operations, types of cooling towers. Principle of
drying, batch drying, drying curve, constructional details and working of different dryers.

Books Recommended:

PROCESSING OF CEREALS & PULSES

<table>
<thead>
<tr>
<th>Title</th>
<th>PROCESSING OF CEREALS &amp; PULSES</th>
<th>Credits</th>
<th>05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>FT 301</td>
<td>L T P</td>
<td>3 1 2</td>
</tr>
<tr>
<td>Max. Marks</td>
<td>End term- 50 Mid term- 50 Practical- -25 Elective</td>
<td>Contact</td>
<td>N</td>
</tr>
<tr>
<td>Pre requisites</td>
<td></td>
<td>Hours</td>
<td>42 (Theory) 14 (Practical Sessions)</td>
</tr>
<tr>
<td>THEORY</td>
<td>Time</td>
<td>3 Hours</td>
<td></td>
</tr>
<tr>
<td>Note for the Examiner</td>
<td>The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SECTION- A


SECTION- B

Corn Milling: Dry and wet milling of corn, corn based ready to eat breakfast cereals. Corn oil processing and utilization, Corn starch modification and uses, Corn sweeteners such as glucose syrup, high fructose corn syrups, dextrose, maltodextrin. Milling of Pulses: Different methods of pulse milling. Pulse milling machinery. Application of enzymes in processing of cereals and pulses processing. Sanitation in the processing plant. Design of equipment used in milling of wheat, rice, corn and pulses. Plant layout.

Books Recommended:
1. Kent, N.L. : Technology of Cereals, CBS Publisher
2. Pomeranz, Y. : Wheat Chemistry and Technology, CHIPS Book, USA.
3. Tanley A. Watson & Paul E. Ramstad : Corn Chemistry and Technology, ADCC, USA.
4. Julliano, B.O. : Rice Chemistry and Technology, AACC, USA.

Paper Title : CEREALS & PULSES PROCESSING LAB. (Practical)

Paper Code FT 301 Max. Marks : 25 Credits : 1

1. Milling of wheat. Evaluation of properties of wheat and milled products
2. Physical, chemical and rheological.
3. Baking of bread, biscuit, cake, pastries. - Evaluation of baked bread. –
5. Milling of pulses. –
6. Visit to flour mill, rice mill and pulse mill industries.
### PROCESSING OF FRUITS & VEGETABLES

**Title**

**Credits**

<table>
<thead>
<tr>
<th>Code</th>
<th>PROCESSING OF FRUITS &amp; VEGETABLES</th>
<th>04</th>
</tr>
</thead>
</table>

**Max.Marks**

<table>
<thead>
<tr>
<th>End term-40</th>
<th>Mid term-35</th>
<th>Practical --25</th>
<th>Elective</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>35</td>
<td>25</td>
<td>N</td>
<td>42 (Theory) 14 (Practical Sessions)</td>
</tr>
</tbody>
</table>

**Pre requisite**

**THEORY Time**

<table>
<thead>
<tr>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Hours</td>
</tr>
</tbody>
</table>

**Note for the Examiner**

The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.

**SECTION- A**

Physiology of ripening. Effect of physical and chemical treatments on post harvest life of fruits and vegetables. Role of plant growth regulators in post harvest storage, Storage and handling of fresh fruits and vegetables. Preservation of fruits and vegetables by heat treatment, Canning Processing and preservation of fruits and vegetable juices. Preparation of jams, jelly, marmalade, preserves, pickles and vegetable products.

**SECTION- B**


**Books Recommended:**

3. Luh & Woodroof : Commercial Vegetable Processing, AVI Publishing, USA
4. Woodroof & Luh : Commercial Fruit Processing, AVI Publishing, USA

**Paper Title : FRUITS & VEGETABLES PROCESSING LAB (Practical)**

**Paper Code FT 302**

**Max. Marks : 25**

**Credits : 1.**

1. Blanching of fruits and vegetables: Effect of temperature, time and selected compounds on blanching.
3. Preparation of jam, marmalade preserve, candy.
4. Preparation of fruit juice concentrate and powder.
5. Preparation of tomato products.
6. Preparation of pickles, chutneys, sauces.
10. Can seaming operation and canning of fruits and vegetables.
1. Visit to a fruit and vegetable processing plant.

<table>
<thead>
<tr>
<th>Title</th>
<th>BEVERAGE TECHNOLOGY</th>
<th>Credits</th>
<th>03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>FT 303</td>
<td>Semester: 5th</td>
<td>L T P</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 - -</td>
</tr>
<tr>
<td>Max. Marks</td>
<td>End term- 50</td>
<td>Mid term- 50</td>
<td>Practical- 25</td>
</tr>
<tr>
<td></td>
<td>Contact Hours</td>
<td>42 (Theory) 14 (Practical Sessions)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THEORY</th>
<th>Time</th>
<th>3 Hours</th>
</tr>
</thead>
</table>

1. **Note for the Examiner**

The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.

**SECTION- A**

Status of the beverage industry in India. Its future prospects. Technology of manufacture of mineral water. Technology of manufacture of non-alcoholic beverages: fruits & vegetable juices, soft drinks, dairy beverages, etc.

**SECTION- B**

Technology of manufacture of alcoholic beverages: Beer, wine, whiskey, rum etc. Technology of manufacture of tea and coffee drinks. Design of equipments used in manufacturing of beverages. Plant layout.

**Books Recommended:**

1. Woordroof & Phillips : Beverages, AVI Publication, USA
3. Ranganna : Handbook of Analysis of Fruit and Vegetable Products.

<table>
<thead>
<tr>
<th>Title</th>
<th>CONFECTIONARY TECHNOLOGY</th>
<th>Credits</th>
<th>03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>FT 304</td>
<td>Semester: 5th</td>
<td>L T P</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 - -</td>
</tr>
<tr>
<td>Max. Marks</td>
<td>End term- 40</td>
<td>Mid term- 35</td>
<td>Practical- 25</td>
</tr>
<tr>
<td></td>
<td>Contact Hours</td>
<td>42 (Theory)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THEORY</th>
<th>Time</th>
<th>3 Hours</th>
</tr>
</thead>
</table>

2. **Note for the Examiner**

The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.
### SECTION- A
Types of confectionary goods. Characteristics and processing of raw materials. Technology of manufacture of toffee, chocolate, fruit drops, hard-boiled candies, bars, chewing gums, bubble gums and special confectionary goods.

### SECTION- B

**Books Recommended:**

**Paper Title : BEVERAGE & CONFECTIONARY Technology (Practical)**
**Paper Code FT 305**  
**Max. Marks: 25**  
**Credits : 1.**
1. Water hardness, acidity, basicity, chlorination, total dissolved solids, chlorides, iron, phosphorus in water.
2. Determination of alcoholic content in beer and wine using the distillation method.
3. Sulphur dioxide content in juices, squash, wine etc.
4. Acidity and total soluble solids determination in different beverages.
5. Manufacture of whey.
7. Determination of extract in tea leaves.
8. Sensory evaluation techniques and their uses.

**Paper Title: PROCESS PLANT DESIGN -I (Practical)**
**Paper Code CHE 306**  
**Max. Marks : 25**  
**Credits : 1.**
2. Selection, specification & power requirements of process pumps, fans and blowers.
3. Design of settling equipment like Dor thickners, dust chambers, cyclone separator & centrifuges.
4. Design of agitated vessels using various types of impellers.
5. Design of conveyor system for solids.

**Books Recommended**
### SIXTH SEMESTER

<table>
<thead>
<tr>
<th>Title</th>
<th>Numerical Methods in Chemical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>CHE 301</td>
</tr>
<tr>
<td>Semester:</td>
<td>6th</td>
</tr>
<tr>
<td>L T P</td>
<td>3 1 -</td>
</tr>
<tr>
<td>Max.Marks End term- Mid term-</td>
<td>50 50</td>
</tr>
<tr>
<td>Max.Marks Elective</td>
<td>N</td>
</tr>
<tr>
<td>Pre requisites</td>
<td>Contact Hours</td>
</tr>
<tr>
<td>Credits</td>
<td>04</td>
</tr>
<tr>
<td>Note for the Examiner</td>
<td>Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.</td>
</tr>
<tr>
<td>Theory Time</td>
<td>3 Hours</td>
</tr>
</tbody>
</table>

#### SECTION- A


#### SECTION- B


Numerical Solution of Partial Differential Equations: Finite-Difference Approximation to Laplace’s Equation, Parabolic Equations and Hyperbolic Equations

#### Books Recommended:

<table>
<thead>
<tr>
<th>Title</th>
<th>Mass Transfer-II</th>
<th>Credits</th>
<th>05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>CHE 309</td>
<td>Semester:</td>
<td>6th</td>
</tr>
<tr>
<td>Max. Marks</td>
<td>End term - 50</td>
<td>Mid term- 50</td>
<td>Practical- - 25</td>
</tr>
<tr>
<td>Pre requisites</td>
<td>Contact Hours</td>
<td>42 (Theory) 14 (Practical Sessions)</td>
<td></td>
</tr>
<tr>
<td>Note for the Examiner</td>
<td>Time</td>
<td>3 Hours</td>
<td></td>
</tr>
</tbody>
</table>

Note for the Examiner: The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.

SECTION- A

SECTION- B

**Book Recommended**


**Paper Title :** Mass Transfer II (Practical)
**No. of Practicals: 08**

**Paper Code** CHE 309 **Max. Marks : 25 Credits : 1**
1. Determination of mass transfer coefficients for naphthalene-air system.
2. To determine drying rate curves for different wet solids in a batch drier under constant drying conditions.
3. Fractional approach to equilibrium for liquid-liquid extraction from single drop.
4. Verification of Rayleigh’s equation for differential distillation.
5. Determination of flooding velocities in packed columns.
6. Determination of HETP for packed distillation columns.
7. Study and operation of a pilot sized distillation column under total reflux.
8. Study of different mass transfer equipments.

<table>
<thead>
<tr>
<th>Title</th>
<th>CHEMICAL REACTION ENGINEERING I</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>CHE 303</td>
<td>05</td>
</tr>
<tr>
<td>Max.Marks</td>
<td>End term- 50</td>
<td>Mid term- 50</td>
</tr>
<tr>
<td>Pre requisites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>END TERM</td>
<td>3 Hours</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**THEORY Time** 3 Hours

**Note for the Examiner**
The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting at least two questions from each Section.

**SECTION- A**
Introduction and a brief review of the kinetics of homogeneous reactions. Interpretation of rate data from constant volume and constant pressure systems. Single Ideal reactors. Design for single reactions.

**SECTION- B**
Design for multiple reactions. Thermal characteristics of reactors: temperature and pressure effects. Non-ideality in reactors and its effects on chemical conversion. One parameter models to represent the behaviour of chemical reactors.

**Books Recommended:**
Paper Title : REACTION ENGINEERING LAB. (Practical)

No. of Practicals: 08

Paper Code CHE 303    Max. Marks 50    Credits : 1

1. Kinetic studies in a batch reactor.
2. Kinetic studies in a plug flow reactor.
3. Kinetic studies in a CSTR.
4. Kinetic studies in a semi batch reactor.
5. RTD studies in CSTR.
6. Dispersion number for packed bed reactor.
7. Adiabatic batch reactor.

<table>
<thead>
<tr>
<th>Title</th>
<th>Processing of Oil Seeds, Oils and Fats</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>FT 306</td>
<td>04</td>
</tr>
<tr>
<td>Max. Marks</td>
<td>End term 40</td>
<td>Mid term 35</td>
</tr>
<tr>
<td>Pre requisites</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>THEORY</td>
<td>Time</td>
<td>3 Hours</td>
</tr>
</tbody>
</table>

熍Note for the Examiner熍
The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.

SECTION- A

SECTION- B

Books Recommended:
1. Bailey : Fats and Oil, Wiley, USA.


<table>
<thead>
<tr>
<th>Title</th>
<th>Processing of Milk and Milk Products</th>
<th>Credits</th>
<th>04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>FT 307</td>
<td>L T P</td>
<td></td>
</tr>
<tr>
<td>Semester:-6th</td>
<td></td>
<td>3 - 2</td>
<td></td>
</tr>
<tr>
<td>Max. Marks</td>
<td>End term-40</td>
<td>Mid term-35</td>
<td>Practical-25</td>
</tr>
<tr>
<td>Pre requisites</td>
<td></td>
<td>Elective</td>
<td></td>
</tr>
<tr>
<td>Contact Hours</td>
<td></td>
<td>42 Theory</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td></td>
<td>14 (Practical Sessions)</td>
<td></td>
</tr>
<tr>
<td>THEORY</td>
<td></td>
<td>3 Hours</td>
<td></td>
</tr>
<tr>
<td>Note for the Examineer</td>
<td>The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SECTION- A**

Present status of milk & milk products in India and Abroad; market milk Composition of milk of various species, quality evaluation and testing of milk, procurement, transportation and processing of market milk, cleaning & sanitization of dairy equipments. Special milks such as flavoured, sterilized, recombined & reconstituted toned & double toned.

Condensed milk- Definition, methods of manufacture, evaluation of condensed & evaporated milk; dried milk- Definition, methods of manufacture of skim & whole milk powder, instantiation, physiochemical properties, evaluation, defects in dried milk powder.

Cream- Definition, classification, composition, cream separation, sampling, neutralization, sterilization, pasteurization & cooling of cream, evaluation, defects in cream; Butter- Definition, composition, classification, methods of manufacture, theories of churning, evaluation, defects in butter.

**SECTION- B**

Ice cream- Definition, composition and standards, nutritive value, classification, methods of manufacture, evaluation, defects in ice cream, and technology aspects of softy manufacture.

Cheese: Definition, composition, classification, methods of manufacture, cheddar, Gouda, cottage and processed cheese, evaluation, defects in cheese.

Indigenous milk products - Present status, method of manufacture of yoghurt, dahi, khoa, burfi, kalakand, gulabjamun, rosogolla, srikhand, chhana, paneer, ghee, lassi etc; probiotic milk products. Practical Study on basics of reception of milk at the plant; platform tests in milk; estimation and fat and SNF in milk; Operation of LTLT & HTST Pasteurization; Preparation of special milks; Cream separation & standardization of milk; Preparation and evaluation of table butter, icecream, cheese and indigenous milk product such as khoa, chhana, paneer, ghee, rosogolla, gulab.
jamun, shrikhand, lassi, burfi etc.; Visit to dairy plants.

**Books Recommended:**


**Paper Title:** Processing of Milk and Milk Products (Practical)

**No. of Practicals:** 08

1. Physical and chemical analysis of milk & milk products.
2. Testing the adulteration in milk & milk products.
3. Preparation of cream, butter, ghee, ice-cream, milk powder and condensed milk.

**Title**  | **Chemical Engineering Computation Lab**  | **Credits**  | 01
---|---|---|---
**Code**  | **CHE 307**  | Semester:-6th  | L T P  | - - 3
**Max. Marks**  | End term-Mid term-Practical-25 | Elective | N  | 14 (Practical Sessions)
**Pre requisites**  | Contact Hours |  |  |
1. Errors analysis, solution of linear and non-linear algebraic equations.
4. Development of computer programs based on the above topics using Matlab and their applications in chemical process computations.

**Books Recommended:**


**Title**  | **Process Plant Design-II Lab**  | **Credits**  | 01
---|---|---|---
**Code**  | **CHE 405**  | Semester:-6th  | L T P  | - - 3
**Max.Marks**  | End term-Mid term-Practical:25 | Elective | N  | 14 (Practical Sessions)
**Pre requisites**  | Contact Hours |  |  |
1. Errors analysis, solution of linear and non-linear algebraic equations.
4. Development of computer programs based on the above topics using Matlab and their applications in chemical process computations.
## Practical

1. Process design and specifications of double pipe heat exchanger, shell and tube heat exchanger, plate type heat exchanger, condenser and reboiler.
2. Design of distillation column, calculation of number of plates, height and design of fractionator internals- sieve tray.
3. Absorber/Stripper design of stage-wise and continuous contact equipment (packed column), height of column and diameter calculations. HTU and NTU.
4. Design aspects of fixed bed reactors and fluidized bed reactors.

### Books Recommended:

5. Shell and Tube Type Heat Exchangers, Indian Standards:
### Seventh Semester

<table>
<thead>
<tr>
<th>Title</th>
<th>PROCESS DYNAMICS &amp; CONTROL</th>
<th>Credits</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>CHE 310</td>
<td>L T P</td>
<td>3 1 3</td>
</tr>
<tr>
<td>Semester:</td>
<td>7th</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max.Marks</td>
<td>End term: 50</td>
<td>Mid term: 50</td>
<td>Practical:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Pre requisites</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Theory

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

#### SECTION- A

Incentives for chemical process control, design aspects of a process control system. Difference between feedback and feed forward control configuration. Hardware elements of a control system, Block Diagrams.

Laplace transform and transfer functions. Difference between lumped and distributed parameter systems, Dynamic behaviour of first and higher order systems, interacting and non-interacting systems, dead time.

Different modes of control actions and their basic characteristics, controllers and their characteristics, control valve.

#### SECTION- B

Closed-loop transfer functions, transient response of simple control systems, Routh stability criterion, Root Locus.

Introduction to frequency response: Bode diagrams, control system design by frequency response: Ziegler-Nichols controller settings, stability using frequency response, gain margin and phase margin.

Introduction to advanced control techniques such as cascade control, feed forward control, ratio control, inferential control.

### Practicals

1. **U-Tube manometer**
   - (a) To plot the response curve for a given input to a U-tube manometer.
   - (b) To determine the transfer function from the response curve obtained in part (a).

2. **Time constant of a mercury thermometer**
   - To study the dynamics of the given thermometer and compare the theoretical value of its time constant with the experimental value.

3. **Analysis of valve**
   - Develop a block diagram representing the dynamic behavior of the given globe valve.

4. **(a) Liquid level measurement**
   - With the given Bubbler System for Liquid Level Measurement, evaluate liquid height in the tank and compare it with actual values.
   - (b) Calibration of Pressure Gauge
   - Calibrate a pressure gauge in the range 0 psi to 60 psi.

5. **Temperature control system**
To maintain the temperature of the fluid at the set point value.

6. Time constant of liquid level tank
   To study the dynamics of liquid level in a tank and compare the analytical value of the time constant with the experimental value.

7. Liquid level control
   (a) To carry out the closed loop experiment on the given liquid level control system and record its response for step change in the inlet flow.
   (b) To plot the experimental response curve and comment on the response obtained.

8. Compurec
   Pressure control simulation with step input and sinusoidal input.

**Recommended Books**


<table>
<thead>
<tr>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Engineering Economics</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Semester: 7th</th>
<th>L T P</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 408</td>
<td></td>
<td>3 1 -</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max.Marks</th>
<th>Pre requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>End term 50</td>
<td>-</td>
</tr>
<tr>
<td>Mid term 50</td>
<td>Contact Hours 42</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SECTION-A</strong></td>
</tr>
<tr>
<td>Interest and Investment Costs: Simple and compound interest. Nominal and effective rates of interest. Continuous interest ordinary annuity. Perpetuities and capitalized costs.</td>
</tr>
<tr>
<td>Taxes and Insurance: Types of taxes and tax returns, types of insurance and legal responsibility.</td>
</tr>
<tr>
<td>Depreciation: Types of depreciation. service life salvage value, present value and methods of determining depreciation, single unit and group depreciation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SECTION-B</strong></td>
</tr>
<tr>
<td>Optimum Design: Procedure with one variable, optimum reflux ratio in distillation and other</td>
</tr>
</tbody>
</table>
**Examples.**

**Preliminary Steps in Plant Design:** Plant design factors. project organization, plant location, preliminary data collection, process engineering

**Books Recommended:**


<table>
<thead>
<tr>
<th>Title</th>
<th>Literature Survey, Report Writing &amp; Seminar</th>
<th>Credits</th>
<th>Pre requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>Semester: 7th</td>
<td>L T P</td>
<td>Contact Hours</td>
</tr>
<tr>
<td>Max.Marks</td>
<td>End term</td>
<td>Mid term</td>
<td>Practical:</td>
</tr>
<tr>
<td>Pre requisites</td>
<td>-</td>
<td>-</td>
<td>x</td>
</tr>
</tbody>
</table>

**Practicals**

Forms of technical reports: aims and forms according to type of readership and extent of circulation. Abstracts, extended abstracts, tables, graphs. Visual representation of data: slides, microfilms, others techniques including those of audio-visual representation. Correct use of audio equipment. Research papers and their presentation and publication. Information retrieve direct and through abstracts. Practical training in writing and presentation of technical reports through audio-visual means. Technique of effective public speaking organized and imprompt discussions. Preparation of technical report on an assigned topic after survey of scientific, technical and commercial literature, using card indexes, microfilms and other information retrieval methods. Use of Computer softwares for report writing.

**Books Recommended:**

2. Sottle, R.T. : The Use of Chemical Literature, Butter Worths.
Eight Semester

<table>
<thead>
<tr>
<th>Title</th>
<th>Environmental Engineering</th>
<th>Credits</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>CHE 402</td>
<td>Semester: 8th</td>
<td>L T P</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 1 3</td>
</tr>
<tr>
<td>Max. Marks</td>
<td>End term 50</td>
<td>Mid term 50</td>
<td>Practical: 25</td>
</tr>
<tr>
<td>Pre requisites</td>
<td></td>
<td>Contact Hours</td>
<td>42 (Theory)</td>
</tr>
</tbody>
</table>

THEORY

Note for the Examiner

Note for the Paper setter: The question paper should be divided into Section A and Section B. Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

SECTION-A

Ambient air and water standards. Principal sources of pollution.
Inter-relationship between energy and environment pollution. Prevention of environmental pollution through conservation, raw material substitutions, process and equipment modifications. A case study on the concept of zero discharge.

Air Pollution:
- Principal air pollutants and their usual sources.
- Effect of air pollutants on human health, animals, vegetation and materials.
- Atmospheric dispersion of air pollutants, temperature inversions, Estimation of pollutants by Gaussian plume model.
- Process and equipments used for the control of particulate pollutants.

SECTION-B

Water Pollution:
- Types of water pollutants, their sources and effects.
- BOD and COD
- Waste water treatment techniques and equipments, flocculation, skimming, floatation, etc.
- Primary Treatment-through settling.
- Secondary Treatment-Aerobic and anaerobic digestion, activated sludge process, trickle filter and oxidation ponds.

Solid wastes: Control and disposal, sanitary landfill, incineration, pyrolysis gasification and recycling.

Books Recommended:


Environment Engineering Laboratory (PRACTICALS)

1. To find BOD of water sample.
2. To find COD of waste sample.
3. To find the total dissolved solids (TDS) and its volatile and non-volatile components.
4. To find the total suspended solids (TSS) and its volatile and non-volatile components.
5. To do the chromium separation by different techniques from electroplating wastes.
6. To find the phenol content of water sample and evolution of parameters.
7. To operate the electrodialysis apparatus.
8. To find the biodegradation constant (K) and the effect of timing on it.
9. To use the membrane separation techniques for salt brine and reverse osmosis process for sugar.
10. To use stack monitoring kit to find:
    a. Efficiency of a cyclone.
    b. Dust sampling.

Note: Any six of the above mentioned experiments are to be conducted.

**Paper Title : PROJECT WORK**

**Paper Code FT 401**

Each student is required to submit a project report on the design of a chemical plant, selecting the best process with optimum equipment size and operating conditions. The object is to test the ability of the student to apply his entire knowledge of Chemical Engineering principles to conceptualize, analyze and solve the problems. To judge his knowledge and originality and capacity for application of laboratory data in designing chemical plants and to determine the level of his proficiency at the end of the course.

<table>
<thead>
<tr>
<th>Title</th>
<th>Process Modelling &amp; Simulation</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>CHE 403</td>
<td>1</td>
</tr>
<tr>
<td>Max. Marks</td>
<td>End term</td>
<td>Mid term</td>
</tr>
<tr>
<td>Pre requisite</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Practical**

Functional design, property estimate as inputs for design. System concepts for computer aided design, computer aided flow sheet design. Process analysis. Process variables selection, equipment design through the selection of free parameters subject to constraints and other parameters, modular design. Simulation optimality. Dynamic design including control stability.

Typical equipments to be considered: heat exchangers, distillations columns, reactor and process equipments.

**Books Recommended:**


<table>
<thead>
<tr>
<th>Title</th>
<th>COMPREHENSIVE VIVA</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>FT 404</td>
<td>01</td>
</tr>
<tr>
<td>Max. Marks</td>
<td>End term--25</td>
<td>Mid term-</td>
</tr>
<tr>
<td>Pre requisite</td>
<td>Contact Hours</td>
<td></td>
</tr>
</tbody>
</table>

The viva-voce examinations will be comprehensive and covering mainly chemical engineering and technology subjects covered during all the semester including the Eight Semester.
Paper Title: Departmental Elective (Theory)

Course Duration: 45 Lectures of one hour each.

<table>
<thead>
<tr>
<th>THEORY</th>
<th>Time</th>
<th>3 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note for the Examiner</td>
<td>The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.</td>
<td></td>
</tr>
</tbody>
</table>

SECTION-A


SECTION-B


Books Recommended:

5. Roberts, R.J. : Fish Technology.

PROCESSING OF MEAT, FISH & POULTRY (Practical)

(a) Fish & Meat: Cutting and handling.
(b) Dressing of poultry.
(c) Evaluation of quality of meat, fish & poultry.
(d) Canning, freezing, dehydration & curing of meat & fish.
(e) Quality of egg & egg powder, egg preservation.
(f) Preparation of pettie, emulsion etc.
(g) Visit to meat, fish & poultry processing industries.
PACKAGING TECHNOLOGY (Theory)

<table>
<thead>
<tr>
<th>Note for the Examiner</th>
<th>The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THEORY</strong></td>
<td><strong>Time</strong></td>
</tr>
</tbody>
</table>

SECTION-A
Basic concepts, function of food package, packaging materials, cellulosic, glass, metal, polymeric composite, rigid, semi-rigid and flexible package forms, adhesive, band and closure, coatings and labels, packaging, product characteristics and packaging requirements, selection of material, form, machinery and method of packaging, package printing, standards and regulations. Active Smart packaging and Edible packaging

SECTION-B

Books Recommended:

BIOCHEMICAL ENGINEERING (Theory)

<table>
<thead>
<tr>
<th>Note for the Examiner</th>
<th>The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THEORY</strong></td>
<td><strong>Time</strong></td>
</tr>
</tbody>
</table>

SECTION-A

SECTION-B
Transport Phenomena in Microbial Systems: Gas-liquid mass transfer, determination of oxygen transfer rates, mass transfer, surface-area correlations for mechanically agitated vessels, scaling of mass transfer equipment, particulate mass transfer, heat transfer.  

Design and Analysis of Biological Reactors: The ideal continuous-flow stirred-tank reactor (CSTR), residence time distribution, different types of reactors, relationship between batch and continuous biological reactors. Fermentation technology, product manufacture by fermentation, reactors for biomass production.

Books Recommended:


FOOD BIOTECHNOLOGY (Theory)

<table>
<thead>
<tr>
<th>THEORY</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note for the Examiner</td>
<td>3 Hours</td>
</tr>
</tbody>
</table>

The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

Section A

Introduction to food biotechnology, genetic engineering and its importance in food Technology. Advantages and disadvantages of genetically modified foods.


Section B


Reference Books:


**FUNCTIONAL FOOD (Theory)**

<table>
<thead>
<tr>
<th>THEOREY</th>
<th>Time</th>
<th>3 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note for the Examiner</td>
<td>The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.</td>
<td></td>
</tr>
</tbody>
</table>

**Section A**

Definition of Nutraceuticals/ Functional foods and related terms, rationale to claim a compound as a nutraceutical, regulatory issues of nutraceuticals based on CODEX/FSSAI. Concept of angiogenesis and health foods vs. disease. Role of functional food on age related macular degeneration, endurance performance and mood disorders-compounds and their mechanisms of action, dosage levels, contradictions if any.

**Section B**

Extraction of selected nutraceuticals. Formulation of functional foods containing nutraceuticals-stability and analytical issues, labelling issues. Identification testing of nutraceuticals and health foods, interactions of prescription drugs and nutraceuticals, adverse effects and toxicity of nutraceuticals, Nutrigenomics-an introduction and its relation to nutraceuticals.

**References Books**


**INDUSTRIAL SAFETY & HAZARDS (Theory)**

<table>
<thead>
<tr>
<th>THEOREY</th>
<th>Time</th>
<th>3 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note for the Examiner</td>
<td>The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.</td>
<td></td>
</tr>
</tbody>
</table>

**SECTION-A**

Definition, identification, classification and assessment of various types of hazards in work-place environment, protective and preventive measures in hazard control.

*Toxic Chemicals*: maximum allowable concentrations and other standards. Biological threshold limit values.

SECTION-B
Case Studies of typical hazardous industries.

BooksRecommended:

PLANT UTILITIES (Theory)

<table>
<thead>
<tr>
<th>THEORY</th>
<th>Time</th>
<th>3 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note for the Examiner</td>
<td>The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.</td>
<td></td>
</tr>
</tbody>
</table>

SECTION-A
Importance of Process utilities in Chemical Plant.
Compressed air and Vacuum: Reciprocating air compressors, vacuum pumps, air receivers, piping systems.
Steam: Boiler, steam handling and distribution steam nozzles.

SECTION-B
Refrigeration: Air refrigeration cycle, vapour compression cycle, liquification processes.
Power Generation: Internal Combustion engines. Gas turbines, steam power plants.

BooksRecommended:
Paper Title: Open Elective (Theory)

Course Duration: 45 Lectures of one hour each.

<table>
<thead>
<tr>
<th>THEORY</th>
<th>Time</th>
<th>3 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note for the Examiners</td>
<td>The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.</td>
<td></td>
</tr>
</tbody>
</table>

SECTION-A


Temperature measurement: Bimetallic thermometers, filled-in system thermometers. Thermocouples, metal resistance thermometers and thermistors, optical and radiation pyrometers, radiation receiving elements.

Pressure measurement: Bourdon gauge, Bellows type gauge. Vacuum measurement– McLeod gauge, thermoionic type ionization gauge, pirani vacuum gauge. Measurement of pressure in corrosive fluids: Diaphragm seal, liquid seal and purge system.

SECTION-B

Liquid level measurement: Direct measurement of liquid level– Float & tape liquid level gauge, float and shaft liquid level unit, hydraulic remote transmission of liquid level. Level measurement in open vessels: Bubbler system, diaphragm box system, air trap system. Level measurement in pressure vessels– Differential pressure manometer, use of liquid seals with a manometer, displacement float liquid level gauge. Measurement of viscosity, conductivity, humidity and pH.

Density measurement: Liquid level method, displacement meter and hydrometer.

Weight measurement: Spring scale, pneumatic force meter and hydrostatic force meter.

Process Instrumentation: Recording instruments, indicating and signaling instruments, control centre, transmission of instrument reading, instrumentation diagrams.

Books Recommended:
2. Eckman, Donald P. : Industrial Instrumentation, CBS Publisher and Distributors
FOOD REGULATION & QUALITY CONTROL (Theory)

**Note for the Examiner**
The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

**SECTION-A**
*General Principles of Quality Control, Quality Attributes*: Colour, gloss, viscosity and consistency, size, shape and texture, flavour, taste, sensory evaluation techniques. Microbiological methods of quality evaluation. Application of Biosensors to check the quality of packaged food products

**SECTION-B**
Government and trade standards for quality. 
*Food Laws and Regulations*: PFA, FPO, BIS, AGMARK, ISO, etc.
*Quality of Different Food Products*: Cereals, fruits, vegetables, milk, egg, meat, fish etc.

**Books Recommended:**

FOOD QUALITY CONTROL & PACKAGING LAB. (Practical)
Estimation of product quality with respect to the color, size, shape. Viscosity, texture, flavour, taste, sensor evaluation, market testing of products. Evaluation of food standards.

**Packaging:**
1. Strength properties of packaging materials.
2. Water vapour and gas transmission rates of flexible packaging materials.
4. Pre-packaging of vegetables.
5. Shrink packaging of poultry.
7. Vacuum and gauge packaging.

FOOD RHEOLOGY & TEXTURE (Theory)

**Note for the Examiner**
The question paper should be divided into Section A and Section B Total of 8 questions.
Examiner questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

Section A


Section B

Pipeline Design Calculations for Non-Newtonian Fluids, Fanning Friction Factors: Power Law and Bingham Plastic Fluids, Laminar and Turbulent Friction Losses in Valves and Fittings, Velocity Profiles in Laminar and Turbulent Flows Rheology as structural analysis tool for a) Solid food materials b) Fluid and semi-solid food materials Description and measurement of solid food rheology: Dough, cheese, fruits and vegetables, extrudates Classification, description and measurement of fluid and semi-solid food rheology. Rheology of food hydrocolloids dispersions, food suspensions, pastes, gels, emulsion. Method of measurement (objective/instrumental) of texture of food material. Correlation with sensory method. Food products specific textural attributes, TPA etc.

References Books


NANO TECHNOLOGY (Theory)

<table>
<thead>
<tr>
<th>THEORY</th>
<th>Time</th>
<th>3 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note for the Examiner</td>
<td>The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.</td>
<td></td>
</tr>
</tbody>
</table>

SECTION-A

Introduction: Plenty of room at the bottom-Feynman’s concept, evolution of ultra-fine materials, the missing link between conventional laws in physics and chemistry and new theories.

Building Blocks of Nanotechnology: covalent architecture, coordinated architecture and weakly bound aggregates, Interactions and topology
**Chemical Properties:** The effect of nanoscale metals on chemical reactivity, effect of nanostructure on mass transport, metal nanocrystallites support on oxides, supported nanoscale catalysts.

**General principles for synthesis** of monodispersed nanoparticles, metals and intermetallics, Ceramics, composites, nanoparticles, colloids/Micelles-vesicles/Polymer/glasses, Crystalline, and zeolite hosts.

**Review of fundamental behaviour** of 0-D(nanoclusters), 1-D(nanowires), 2-D(thin film multilayers), and 3-D(bulk nanostructures) materials. Introduction to size dependent phenomenon in nanostructure for various applications, specific production techniques like chemical vapor deposition, arc ignition etc. Formation of clusters and nanoparticles from supersaturated vapor and selected properties, sputtering and thermal evaporation and laser methods. Synthesis of nanoparticles by chemical routes.

**SECTION-B**

**Approaches to production:** Top down and bottom up, Mechanical attrition, high energy ball milling, and mechanical attrition, nanocomposites by mechano-chemistry, mechanism of grain size reduction, property of microstructure relationships.

**Characterization techniques:** Tools in nanotechnology: Scanning electron microscopy(SEM), Transmission electron microscopy and high resolution(TEM), energy dispersive spectroscopy (EDX), Atomic force microscopy(AFM), Magnetic force microscopy(MFM), Chemical Force Microscopy(CFM), Focused ion beam, nanolithography, powder x-ray diffractometry, UV visible.

**Nanomaterials:** CNTs, Polymer Nanocomposites nanoceramics, nanometals, nanopolymers, structures-properties-applications, Quantum dots. Concepts Bio-Nanotechnology.

**Applications:** Nanotherapeutics, Molecular diagnostics, tissue engineering, nanopumps, nanorobotics cells, molecular motors, nanomembranes, Organic molecular based computers, bionanodevices (sensors & actuators).

**Books Recommended**
2. *Nanotechnology – An introduction to nanostructure of technique* by Michel Kohler and Wolfgang Frittsche 2004- Wiley VCH
3. *Springer Handbook of Nanotechnology* by Bharat Bhushan
5. *Nanostructures and Nanomaterials* by G. Cao, Imperial College Press, 2004
6. *Introduction to Nanotechnology* by Owen and Poole, Wiley
7. *Nano-materials* by A. K. Bandopadhyay, New Age International

### SUPPLY CHAIN & LOGISTICS MANAGEMENT (Theory)

<table>
<thead>
<tr>
<th>THEORY</th>
<th>Time</th>
<th>3 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note for the Examiner</td>
<td>The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.</td>
<td></td>
</tr>
</tbody>
</table>

**SECTION – A**

**Introduction to Supply Chain Management:** Definition; Scope & Importance of Supply Chain Management; Key Drivers Of the SCM; Features of Supply Chain Management; Supply Chain
Network – 1st Tier, 2nd Tier; Network decisions in SCM; Suppliers and Customers; Customer Service Dimension (Seven “R” Principles, Service after sale, Customer delight)

**Role of Logistics in Supply Chains:** Definition of Logistics Management; Scope and role of Transportation, Traffic & transportation; Relationship between transportation and other business functions, Transport Economics: Distance – volume-density, Freight Cost, Handling, Liability, market factors; Third party logistics (3 PL) & fourth party logistics service provider (4 PL), Logistics equipment; Reverse Logistics, Government rule & regulations related to Logistics; Purchase Cycle, Make or Buy, Price analysis, Negotiations.

**SECTION – B**

**Inventory Management:** Inventory Control, Planning & Managing Inventories; Warehouse Management (Receipt, issue, storage and preservation, stock verification, In bound and out bound distribution operations); Order Management; Competitive advantage through logistics and supply chain management; Responsive Supply Chain; Supply chain process integration, performance measurement; Value Chain, Value System and Supply Chain.

Planning demand and supply: Planning & Sourcing in Supply Chain, Demand forecasting, Type and Time horizon of forecast and category of forecasting, aggregate planning; Financial issues in Supply Chain - Macro and micro view, Asset management, Du Pont Model, Supply Chain Costing; Decision environment in SCM; Global supply chain perspectives - New business models, role of IT in SCM.

**Suggested Readings:**
4. RP Mohanty: Supply Chain Management-Theories and Practice, Biztantra.
5. Robert B. Handfield, Ernest L. Nicholas, Jr.: Introduction to Supply Chain Management, Pearson Education.

**OPERATIONS RESEARCH (Theory)**

<table>
<thead>
<tr>
<th>THEORY</th>
<th>Time</th>
<th>3 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Note for the Examiner</strong></td>
<td></td>
<td>The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.</td>
</tr>
</tbody>
</table>

**SECTION-A**

Linear Programming: problem formulation, graphical method, simplex method, duality sensitivity analysis.
Transportation model, Transhipment problem, traveling salesman problem, Assignment models, Sequencing model, Replacement model.

**SECTION-B**
Theory of Games: Pure strategy games, principle of dominance; mixed strategy games (Algebraic, Graphical & Linear programming method), 2-person, non-zero-sum games.

Queuing Theory: Introduction, elementary queuing system; single channel queuing model, queuing cost behaviour, multiple channel queuing model, Poisson arrivals and Erlang service distribution; benefits and limitations of queuing theory.

Books Recommended:

PROJECT MANAGEMENT AND ENTREPRENEURSHIP (Theory)

<table>
<thead>
<tr>
<th>THEORY</th>
<th>Time</th>
<th>3 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note for the Examiner</td>
<td>The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.</td>
<td></td>
</tr>
</tbody>
</table>

SECTION-A

Introduction to Projects: Meaning & Definition of Project, Attributes of a Project, Difference among Projects, Routine Activities and Programs; Project Life Cycle

Project Planning: Work Breakdown Structure, Types of Work Breakdown Structure, Planning Framework and Its Importance

Project Feasibility: Marketing, Technical & Financial Feasibility

Social Cost Benefit Analysis: Rationale, UNIDO and Little Mirrlees Approaches

Project Schedule Planning; Network Analysis Techniques; Project Implementation; Project Monitoring & Control

SECTION-B


Entrepreneurship: Concept, Policies Governing Entrepreneurs, Entrepreneurial Development Programmes, Contribution of Entrepreneurship to Economic Development

Institutions for Entrepreneurial Development; Role of Various Commercial Banks and Development financial Institutions.

Books Recommended
4. IMD little and J.A. Mirrlees: Project Apraisal and Planning in Developing Countries, 1975.
5. Prasanna Chandra: Projects: Preparation, Appraisal Budgeting and Control, 7th edition, TMH.
8. Peter F. Drucker: Innovation and development.