Teaching Scheme and Syllabi of B.E. (Food Technology) [2019-23]

First Year

1st SEMESTER

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course code</th>
<th>Courses</th>
<th>Contact hrs per week</th>
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<th>Mid Term</th>
<th>End Term</th>
<th>Total Marks</th>
<th>Credits</th>
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<td>BS101</td>
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<td>Material &amp; Energy Balance</td>
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Note:
- NSS/NCC/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)

L: Lectures/Week, T: Tutorials/Week, P: Practical Hours/Week

Assessment will consist of the following components

1. Mid-Term
   a. One best of two minor tests (50% of Mid-term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance (10% of Mid-term marks)
2. End -Term
### 2nd Semester

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<th>S. No.</th>
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**Note:**
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   d. Attendance (10% of Mid-term marks)
2. **End Term**
### Teaching Scheme and Syllabi of B.E. (Food Technology) [2019-2023]

#### SCHEME OF TEACHING AND EXAMINATION

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<th>End Term</th>
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2. End -Term
# Teaching Scheme and Syllabi of B.E. (Food Technology) [2019-2023]

## SCHEME OF TEACHING AND EXAMINATION

### SEMESTER-4th

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2. **End -Term**
### Teaching Scheme and Syllabi of B.E. (Food Technology) [2019-2023]

#### Fifth Semester

<table>
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**Total** 15 2 10 405 335 220 555 22

**Note:**
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2. **End-Term**
# Teaching Scheme and Syllabi of B.E. (Food Technology) [2019-2023]

## Sixth Semester

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<td>Chemical Engineering Computation Lab</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>45</td>
<td>40</td>
<td></td>
<td>40</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>15</td>
<td>2</td>
<td>11</td>
<td>420</td>
<td>350</td>
<td>220</td>
<td>570</td>
<td>22.5</td>
</tr>
</tbody>
</table>

**Note:**

- NSS/NCC/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)

L: Lectures/Week, T: Tutorials/Week, P: Practical Hours/Week

Assessment will consist of the following components

1. Mid-Term
   a. One best of two minor tests (50% of Mid-term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance (10% of Mid-term marks)
2. End-Term
### Teaching Scheme and Syllabi of B.E. (Food Technology) [2019-2023]

#### 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>Total Contact hour</th>
<th>Mid term</th>
<th>End term</th>
<th>Total marks</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PCC-CS112</td>
<td>Process Dynamics and Control</td>
<td>3</td>
<td>1</td>
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<td>60</td>
<td>50</td>
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<td>100</td>
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</tr>
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<td>2</td>
<td>FTOL401</td>
<td>Open Elective- I</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>45</td>
<td>35</td>
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<td>3</td>
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<tr>
<td>3</td>
<td>HSMC-HASS102</td>
<td>Process Engineering Economics</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>60</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>4</td>
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<tr>
<td>4</td>
<td>FT-EL 401</td>
<td>Departmental Elective- I</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>45</td>
<td>35</td>
<td>40</td>
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<td>3</td>
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<tr>
<td>5</td>
<td>Proj</td>
<td>Project Work</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>45</td>
<td>-</td>
<td>-</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>SI</td>
<td>Industrial Training</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>OEC-OL155</td>
<td>Process Modelling and Simulation Lab</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>45</td>
<td>40</td>
<td>-</td>
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<td>2</td>
</tr>
<tr>
<td>8</td>
<td>PCC-CS162</td>
<td>Process Dynamics and Control Lab</td>
<td>3</td>
<td>45</td>
<td>-</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>40</td>
<td>1.5</td>
</tr>
<tr>
<td>9</td>
<td>FT-EL 451</td>
<td>Departmental Elective- I Lab</td>
<td>2</td>
<td>30</td>
<td>-</td>
<td>25</td>
<td>-</td>
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<tr>
<td></td>
<td>Total</td>
<td></td>
<td>12</td>
<td>2</td>
<td>11</td>
<td>375</td>
<td>275</td>
<td>180</td>
<td>455</td>
<td>20</td>
</tr>
</tbody>
</table>

**Note:**
- NSS/NCC/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)

L: Lectures/Week, T: Tutorials/Week, P: Practical Hours/Week

Assessment will consist of the following components

1. **Mid-Term**
   - a. One best of two minor tests (50% of Mid-term marks)
   - b. Assignments (20% of Mid-term marks)
   - c. Class Surprise Tests/Quizzes/Presentations/Term paper (20% of Mid-term marks)
   - d. Attendance (10% of Mid-term marks)

2. **End-Term**

*The project work marks and credits to be collectively given in 8th Semester.*
### Teaching Scheme and Syllabi of B.E. (Food Technology) [2019-2023]

#### SEMESTER-8th

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course code</th>
<th>Subject</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Total Contact hour</th>
<th>Mid Term</th>
<th>End Term</th>
<th>Total Marks</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PEC-CSEL 102</td>
<td>Process Instrumentation</td>
<td>3</td>
<td>1</td>
<td></td>
<td>60</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>FT-EL 102</td>
<td>Department Elective- II</td>
<td>3</td>
<td></td>
<td></td>
<td>45</td>
<td>35</td>
<td>40</td>
<td>75</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>FT-OL 102</td>
<td>Open Elective- II</td>
<td>3</td>
<td></td>
<td></td>
<td>45</td>
<td>35</td>
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<td>75</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>FT-EL 103</td>
<td>Departmental Elective- III</td>
<td>3</td>
<td></td>
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<td>35</td>
<td>40</td>
<td>75</td>
<td>3</td>
</tr>
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<td>5</td>
<td>Proj</td>
<td>Project work</td>
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<td>-</td>
<td></td>
<td>3</td>
<td>45</td>
<td>50</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>Proj</td>
<td>Literature Survey, Report Writing and Seminar</td>
<td>-</td>
<td>-</td>
<td></td>
<td>3</td>
<td>45</td>
<td>40</td>
<td>-</td>
<td>40</td>
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<tr>
<td>7</td>
<td>FT-OL-152</td>
<td>Open Elective- II Lab</td>
<td>2</td>
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<td></td>
<td>30</td>
<td>25</td>
<td>25</td>
<td>40</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total** | 12 | 1 | 8 | 315 | 270 | 170 | **440** | 17.5 |

#### Note:
- Discipline (1st to 4th year, 1 credit to be earned in 8th semester)
- L: Lectures/Week, T: Tutorials/Week, P: Practical Hours/Week
- Assessment will consist of the following components:
  1. **Mid-Term**
     - a. One best of two minor tests (50% of Mid-term marks)
     - b. Assignments (20% of Mid-term marks)
     - c. Class Surprise Tests/Quizzes/Presentations/Term paper (20% of Mid-term marks)
     - d. Attendance (10% of Mid-term marks)
  2. **End-Term**

*Project work marks and credits collectively earned for 7th and 8th semester.*
<table>
<thead>
<tr>
<th>List of Departmental Electives</th>
<th>List of Open Electives</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) Meat Fish &amp; Poultry Technology</td>
<td>A) Food Regulation &amp; Quality Control</td>
</tr>
<tr>
<td>B) Packaging Technology</td>
<td>B) Food Rheology and Texture</td>
</tr>
<tr>
<td>C) Biochemical Engineering</td>
<td>C) Nano Technology</td>
</tr>
<tr>
<td>D) Food Biotechnology</td>
<td>D) Supply Chain and Logistics Management</td>
</tr>
<tr>
<td>E) Functional Food</td>
<td>E) Operations Research</td>
</tr>
<tr>
<td>F) Industrial Safety and Hazards</td>
<td>F) Project Management &amp; Entrepreneurship</td>
</tr>
<tr>
<td>G) Plant Utilities</td>
<td></td>
</tr>
</tbody>
</table>
SYLLABUS OF B.E. (FOOD TECHNOLOGY) 2019-2023
FIRST YEAR

1st SEMESTER

<table>
<thead>
<tr>
<th>Title</th>
<th>MATHEMATICS-I</th>
<th>Credits</th>
<th>04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>BS101</td>
<td>Semester:</td>
<td>1st</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>Contact Hours</td>
<td>60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Objectives</th>
<th>The make the students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Understand the behaviour of infinite series and their use.</td>
</tr>
<tr>
<td></td>
<td>2. Learn the concepts related to functions of several variables and their applications.</td>
</tr>
<tr>
<td></td>
<td>3. Understand the concept of Vectors and its applications.</td>
</tr>
<tr>
<td></td>
<td>4. Learn the methods of evaluating multiple integrals and their applications to various problems.</td>
</tr>
<tr>
<td></td>
<td>5. Learn the methods to formulate and solve linear differential equations and apply them to solve engineering problems.</td>
</tr>
</tbody>
</table>

| 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 atleast two questions from each Section. The duration of End Term exam will be 3 hrs. |

SECTION- A

Infinite Series:
Infinite series and convergence, alternating series, power series and convergence. Taylor’s and Maclaurin’s Series.

Multivariable Functions:
Limit, Continuity and Partial Derivatives; Euler’s Theorem for Homogeneous functions; Differentiability, Linearization and Differentials; Chain rule; Extreme values and Saddle Points; Lagrange multipliers; Taylor’s Formula.

Vector Differential Calculus and Integral Theorems:
Gradient, Divergence, Curl, Statement of Green’s, Gauss and Stoke’s Theorem and their simple applications.

SECTION- B

Solid Geometry:
Cylinders and Cones, Cylindrical and Spherical Polar Coordinates

Integral Calculus:
Area between plane curves; Volumes of solids of revolution; Lengths of plane curves; Areas of surfaces of revolution. Double integrals in rectangular and Polar form, Triple integrals in Rectangular, Cylindrical and Spherical coordinates, Substitutions in Multiple Integrals.

Ordinary Differential Equations:
First order exact differential equations, Integrating factor, Orthogonal trajectories, Second and Higher order Linear Differential Equations with constant coefficients, Differential Operators, Methods of Variation of Parameters and Undetermined Coefficients, Euler Cauchy Equation, Wronskian.


Assessment will consist of the following components

3. Mid-Term
3. One best of two minor tests (50% of Mid-term marks)
4. Assignments (20% of Mid-term marks)
5. Class Surprise Tests/Quizzes/Presentations/Term paper (20% of Mid-term marks)
6. Attendance. (10% of Mid-term marks)
4. End-Term

The students are able to
1. test the behaviour of infinite series.
2. analyze functions of several variables and their applications.
3. operate vectors and convert line integral to surface integral to volume integral.
4. evaluate multiple integrals and apply them to practical problems.
5. solve linear differential equations.

<table>
<thead>
<tr>
<th>Title</th>
<th>CHEMISTRY (ORGANIC)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>BS105</td>
<td>3</td>
</tr>
<tr>
<td>Semester:</td>
<td>1st</td>
<td>L T P</td>
</tr>
<tr>
<td>Max marks</td>
<td>End term- 40</td>
<td>Mid term- 35</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pre-requisites                | Contact hours               |
                              | 45                           |

SECTION A

Reactivity of organic molecules: Shapes and Molecular orbital structures of compounds containing C, N and O. Conformations of cyclic and acyclic systems, structures of dienes, pyridine, pyrrole, aromatic compounds. Factors affecting acidity, basicity and nucleophilicity of molecules (Kinetic as well as thermodynamic aspects) 08 hrs

Delocalisation: Concept of aromaticity, stability of cycloalkanes, resonance concept, inductive and mesomeric effects, directive effects, activating and deactivating groups. 06 hrs

Stereochemistry: Enantiomers, Diastereomers, Meso-and Racemic compounds, Resolution of racemic mixture. Asymmetric synthesis, Walden Inversion, Configuration (D and L nomenclature), Absolute configuration (R, S, E and Z nomenclature) 08 hrs

SECTION B

Organic Reagents and Reaction Intermediates: free radicals, carbonium and carbanions and the mechanism of important substitution, elimination as well as important rearrangement reactions-- : House synthesis, halogenation of alkanes, free radical mechanism, orientation, reactivity and selectivity; catalytic hydrogenation, dehydration of alcohols, dehydrohalogenation, Saytzeff rule, electrophilic addition reactions, peroxide effect, mechanism of allylic substitution, acidity of 1-alkynes, conjugated dienes, 1,2-and 1,4- additions, free radical and ionic mechanisms of addition polymerisation reactions, ringopening reactions of cyclopropane and cyclobutane, chemistry of benzene and alkylbenzenes, aromatic electrophilic substitution reactions, nucleophilic substitution Friedel-Crafts reactions, Anisole nucleophilic addition, Aldol condensation 18 hrs

Synthetic utility of diazonium salts, synthetic utility of Grignard reagents and alkyl lithiums, basicity of amines, multistep synthesis, 05 hrs

Books Recommended:
5. Mukherji & Singh: Reaction mechanism in organic chemistry, Macmillan India Ltd.,
<table>
<thead>
<tr>
<th>Title</th>
<th>ELECTRICAL AND ELECTRONICS ENGINEERING</th>
<th>Credits</th>
<th>4</th>
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<tbody>
<tr>
<td>Code</td>
<td>ESC-GES103</td>
<td>Semester:- 1st</td>
<td>L T P</td>
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<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>Contact hours</td>
<td>60</td>
</tr>
<tr>
<td>Objectives</td>
<td>To provide students about basic knowledge of A.C and D.C circuits, theorems, laws.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Introduce to the students about difference between single phase and three phase system.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To teach the students basic principle of operation of transformers and other electrical machines.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To make them aware of the difference between analog and digital system and study diodes, rectifiers, digital circuits.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Note for 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 atleast two questions from each Section. The duration of End Term exam will be 3 hrs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SECTION A**

**DC Circuits and Single Phase A.C. Fundamentals**
General introduction to Electrical Engineering, Kirchoff’s Laws, Mesh and Node analysis, Superposition theorem, Thevenin Theorem, Norton Theorem, Maximum power transfer theorem. Generation of alternating voltages and currents, Equations for AC quantities, cycle, time period, frequency, amplitude, calculation of R.M.S values, Average values for different waveforms, solution and phasor diagram of single phase AC circuit with sinusoidal source of excitation, series and parallel combination of R-L-C circuits.

**Three Phase AC Fundamentals**
Disadvantages of single phase system, star and delta connection in three phase circuits, relation between line and phasor quantities, power in three phase system, solution of three phase balanced circuits, power and power factor measurement by two wattmeter method.

**Electrical Machines**

**SECTION B**

**Semiconductor Diodes and Transistors**
General introduction to Electronics. Concept of stiff Voltage and Current Source. PN Junction, Depletion layer, Barrier Potential, Forward and Reverse Bias, Breakdown voltage, V-I characteristics, Half wave and full wave rectifiers, Zener diode. Introduction to junction transistors, Transistor amplifying action, CB, CE, CC-configuration characteristics.

**Digital Electronics**
Binary and Hexadecimal number system, conversion of numbers from one system to other, OR, Relations: Commutative, Associative and Distributive Laws. Concept of flip-flops, RS,JK flip flops, shift register.

**Text Books**

**Reference**
### Books

|-------|-------------------------------------------------------------|

### Course Assessment Methods

<table>
<thead>
<tr>
<th>Assessment will consist of the following components</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mid-Term</td>
</tr>
<tr>
<td>a. One best of two minor tests (50% of Mid-term marks)</td>
</tr>
<tr>
<td>b. Assignments (20% of Mid-term marks)</td>
</tr>
<tr>
<td>c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)</td>
</tr>
<tr>
<td>d. Attendance. (10% of Mid-term marks)</td>
</tr>
<tr>
<td>2. End Term</td>
</tr>
</tbody>
</table>

### Course Outcomes

<table>
<thead>
<tr>
<th>1. The student will understand how various loads are connected in circuits and difference between single and three phase system.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. The students will know the principles and working of different types of electrical machines used in industry</td>
</tr>
<tr>
<td>3. The students will have the basic knowledge of digitalization and conversion of physical quantity to digital quantity.</td>
</tr>
</tbody>
</table>

### Title MATERIAL AND ENERGY BALANCE

<table>
<thead>
<tr>
<th>Code</th>
<th>PCC-CS101</th>
<th>Semester: 2nd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Marks</td>
<td>End term- 50</td>
<td>Mid term- 50</td>
</tr>
<tr>
<td>Pre requisites</td>
<td>Contact Hours</td>
<td>60</td>
</tr>
</tbody>
</table>

| Credits | 04 |

### Note for examiner

**SECTION-A**
Review: Stoichiometric and composition relationship gas laws; Gaseous mixtures, vapor pressure, humidity, etc.
Material Balances for Non-reaction systems including balances involving recycle and by-pass streams.

**SECTION-B**
Material Balances for Reacting systems including balances involving recycle and purge streams.
Combustion Calculations.
Energy balances on nonreactive and reactive systems.

#### Books Recommended:


### Title COMPUTER PROGRAMMING FOR PROBLEM SOLVING

<table>
<thead>
<tr>
<th>Code</th>
<th>ESC-GES 104</th>
<th>Semester: 1st</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Marks</td>
<td>End term- 25</td>
<td>Mid term- 25</td>
</tr>
<tr>
<td>Pre requisites</td>
<td>Contact Hours</td>
<td>30</td>
</tr>
</tbody>
</table>
| Objectives | 1. To develop logical skills so that students should be able to solve basic computing problems.  
2. To learn the syntax and usage of C++ programming constructs. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<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. The duration of End Term exam will be 3 hrs.</td>
</tr>
<tr>
<td><strong>SECTION- A</strong></td>
<td><strong>Hrs</strong></td>
</tr>
<tr>
<td><strong>Introduction To Programming:</strong></td>
<td>04</td>
</tr>
<tr>
<td><strong>Programming In C++:</strong></td>
<td>04</td>
</tr>
<tr>
<td>Data types in C++, Formatted input-output for printing integer, floating point numbers, characters and strings.</td>
<td></td>
</tr>
<tr>
<td><strong>Operators And Expression:</strong></td>
<td>04</td>
</tr>
<tr>
<td><strong>Statements:</strong></td>
<td>03</td>
</tr>
<tr>
<td>Decision making structures: if, if-else, nested if and if-else, switch-Case. Loop control structures: for, while, do-while. Role of statements like break, continue, go to.</td>
<td></td>
</tr>
<tr>
<td><strong>SECTION- B</strong></td>
<td><strong>Hrs</strong></td>
</tr>
<tr>
<td><strong>Arrays:</strong></td>
<td>04</td>
</tr>
<tr>
<td>Concept and use of arrays, declaration and usage of 1-dimensional arrays and 2-dimensional arrays.</td>
<td></td>
</tr>
<tr>
<td><strong>Functions:</strong></td>
<td>04</td>
</tr>
<tr>
<td>Advantage of modularizing C++ program into functions, function definition and function invocation. Methods of passing parameters to a function: call-by-value, call-by-reference; Passing arrays to functions, Recursion, Library functions.</td>
<td></td>
</tr>
<tr>
<td><strong>Introduction To User-Defined Data Types:</strong></td>
<td>04</td>
</tr>
<tr>
<td>Structures- definition, declaration, use. Unions: definition, declaration, use, introduction to classes and Properties of object oriented programming</td>
<td></td>
</tr>
<tr>
<td><strong>Introduction to Numerical Methods And Spreadsheet Calculations:</strong></td>
<td>03</td>
</tr>
<tr>
<td>Developing programs to solve engineering computation problems and working with spreadsheets.</td>
<td></td>
</tr>
</tbody>
</table>
| **Text books:** | 1. Arora, Sumita “Computer Science with C++” Dhanpat Rai & Co.  
2. Lafore, Robert “Object Orients Programming in C++” | |
| **Course Assessment Methods** | Assessment will consist of the following components  
1. Mid-Term  
a. One best of two minor tests (50% of Mid-term marks)  
b. Assignments (20% of Mid-term marks)  
c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)  
d. Attendance (10% of Mid-term marks)  
2. End -Term | |
| **Course Outcomes** | 1. The student will demonstrate proficiency in C++ programming language. |
2. The student will be able to solve basic engineering computation problems using C++

<table>
<thead>
<tr>
<th>Title</th>
<th>ELECTRICAL AND ELECTRONICS ENGINEERING LAB.</th>
<th>Credits</th>
<th>1.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>ESC-GES 153</td>
<td>Semester: 1st</td>
<td>L T P</td>
</tr>
<tr>
<td>Max. Marks</td>
<td>Practical - 40</td>
<td>Elective</td>
<td>N</td>
</tr>
<tr>
<td>Pre requisites</td>
<td></td>
<td>Contact Hours</td>
<td>45</td>
</tr>
<tr>
<td>Objectives</td>
<td>Students will be able</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>to design electric circuits.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To use voltmeter, ammeter and wattmeter</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perform open circuit test and short circuit test on a single phase transformer and draw equivalent circuit</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>To identify diode characteristics and transistor characteristics and perform experiments related to rectifiers (half-wave and full-wave)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To verify various logical gates and networking theorems through experiments</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Overview of the equipments, instruments and procedure to be used, safety precautions and report writing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. To study resonance in R-L-C series and parallel circuit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Measurement of power and power factor by three voltmeter method.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Measurement of power and power factor by three ammeter method.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. To measure power and power factor using a single wattmeter in a single phase circuit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Measurement of power and power factor of three phase balanced load by two wattmeter method.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. To perform open circuit test and short circuit test on a single phase transformer and draw equivalent circuit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. To obtain magnetization characteristics of DC Machine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9. Study the forward and reverse biased diode characteristics.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10. Study the CB, CE, CC transistor characteristics.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11. To obtain the waveforms of half wave rectifier circuit on CRO.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12. To obtain the waveforms of full wave rectifier circuit on CRO.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13. Verification of basic and universal gates.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14. To verify the thevenin theorem, nortan theorem, Maximum power transfer theorem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Outcomes</td>
<td>Students will</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>have hands on knowledge about the design, purpose and working of R-L-C and parallel circuits</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>become confident in taking accurate readings of voltmeter, ammeter and wattmeter</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>have in depth knowledge about transformers, transistors, diodes and rectifiers and will be able to understand their applications in industry.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>have knowledge about networking theorems and their utility in industry.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title</th>
<th>CHEMISTRY (ORGANIC) LAB.</th>
<th>Credits</th>
<th>1.5</th>
</tr>
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<tbody>
<tr>
<td>Code</td>
<td>BS155</td>
<td>Semester: 1st</td>
<td>L T P</td>
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<tr>
<td>Max. Marks</td>
<td>Practical - 40</td>
<td>Elective</td>
<td>N</td>
</tr>
<tr>
<td>Pre requisites</td>
<td></td>
<td>Contact Hours</td>
<td>45</td>
</tr>
</tbody>
</table>
2. Identification of unknown organic compounds through group detection, physical constants and preparation of derivatives – Hydrocarbons, Phenols, Aldehydes, Ketones, Carboxylic acids, Amides and Amines.

Course outcomes:
List steps for identifying simple organic compounds
Use different analytical procedures

<table>
<thead>
<tr>
<th>Title</th>
<th>COMPUTER LAB.</th>
<th>Credits</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>ESC-GES 154</td>
<td>Semester: 1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>L T P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elective</td>
<td>N</td>
</tr>
<tr>
<td>Max. Marks</td>
<td>Practical 25</td>
<td>Contact Hours</td>
<td>30</td>
</tr>
<tr>
<td>Pre requisites</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Objectives
1. To develop programs using C++
2. To make the students design programs by using logic and become confident in handling numerical problems.

1. Programs based on input & output in C++
2. Programs using Decision Statements if-else, CASE
3. Programs using while statements, do-while and for Loops
4. Array based programs
5. Developing user defined Functions with and without recursion
6. How to create and access user defined data types
7. Implementation of engineering computation programs using MATLAB and EXCEL spreadsheet.

Course Assessment Methods
The students will be assessed based upon the practical assignments and viva voce

Course Outcomes
1. The students will be able to demonstrate proficiency in C++
2. The student will become confident in solving any computation problem using his programming skills.
<table>
<thead>
<tr>
<th>Title</th>
<th>PHYSICS</th>
<th>Credits</th>
<th>04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>BS102</td>
<td>Semester: 2nd</td>
<td>L  T  P</td>
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<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>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objectives</td>
<td>Basic concepts of optics and its applications, electromagnetism and magnetism properties, and Structural characterizations.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Note for the Examiner</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SECTION A

1. **Optics and Fibre Optics** (12L + 4T)
   - Diffraction: Introduction to interference and example; concept of diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits; diffraction grating, characteristics of diffraction grating and its applications.
   - Polarisation: Introduction, polarisation by reflection, polarisation by double refraction, scattering of light, circular and elliptical polarisation, optical activity.
   - Fibre Optics: Introduction, optical fibre as a dielectric wave guide: total internal reflection, numerical aperture and various fibre parameters, losses associated with optical fibres, step and graded index fibres, application of optical fibres.

2. **Structural Characterization**: (16 hours+5T)
   - Crystal Lattice, points groups, Bravais lattices, crystal systems, X-ray diffraction Symmetry
   - X-ray generation, Bragg Law, factors influencing intensity, Techniques, Indexing, precise lattice parameter determination, residual stress measurement

### SECTION B

3. **Electromagnetism and Magnetic Properties of Materials** (17L + 6T)
   - **Dielectric Materials**: Review of basic formulas, dielectric constant and polarizability, sources of polarizability, classical treatment of dipolar, ionic and electronic polarizability, piezoelectricity, ferroelectricity. (4)
   - **Magnetic Materials**: Review of basic formulas, magnetic susceptibility, classification of materials, Langevin diamagnetism, paramagnetism (only classical treatment), magnetism in metals, ferromagnetism in insulators, anti-ferromagnetism and ferrimagnetism, ferromagnetism in metals, ferromagnetic domains, hysteresis (8)
   - **Superconductivity**: Zero resistance, occurrence of superconductivity, Meissner effect, critical field, thermodynamics of superconducting transitions, electrodynamics of superconductors, qualitative idea of BCS theory. (3)
   - **Nanotechnology**: Nanomaterials and its applications, chemical and physical synthesis techniques of nano-powder and thin films. (2)

### Text Books

1. Introduction to Solid State Physics: Charles Kittle 8th Ed.

### Reference Books


<table>
<thead>
<tr>
<th>Course Assessment Methods</th>
<th>Assessment will consist of the following components</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mid-Term</td>
<td>a. One best of two minor tests (50% of Mid-term marks)</td>
</tr>
<tr>
<td></td>
<td>b. Assignments (20% of Mid-term marks)</td>
</tr>
<tr>
<td></td>
<td>c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)</td>
</tr>
<tr>
<td></td>
<td>d. Attendance (10% of Mid-term marks)</td>
</tr>
<tr>
<td>2. End – Term</td>
<td>Course outcomes Students will be familiar with</td>
</tr>
<tr>
<td></td>
<td>• Bragg’s Law and introduced to the principles of lasers, types of lasers and applications</td>
</tr>
<tr>
<td></td>
<td>• Various terms related to properties of materials such as, permeability, polarization, etc.</td>
</tr>
<tr>
<td></td>
<td>• Some of the basic knowledge of structural properties, crystal structure as well as magnetic and dielectric properties of materials</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title</th>
<th>CHEMISTRY (INORGANIC)</th>
<th>Credits</th>
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<tr>
<td>Code</td>
<td>BS103</td>
<td>03</td>
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<td>L T P</td>
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<td>Max.Marks</td>
<td>End term- 40</td>
<td>Mid term- 35</td>
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<td>Elective</td>
<td>N</td>
</tr>
<tr>
<td>Contact Hours</td>
<td></td>
<td>45</td>
</tr>
</tbody>
</table>

**Objectives**

**Note for the Examiner**

**Section A**

**Introduction to quantum theory for chemical systems**: Quantum theory and atomic structure: Introduction to wave mechanics, the Schrödinger equation, as applied to hydrogen atom, the origin of quantum numbers and shapes of orbitals from the Schrödinger equation. 06 hrs

**Chemical Bonding and structure Part I**: Molecular orbital and valence bond theories of bond formation and application of molecular orbital theory to the formation of homonuclear and heteronuclear diatomic molecules. Bonding in Coordination Compounds: Theories of bonding i.e., Werner’s theory, effective atomic number, valence bond theory, crystal field theory, crystal fields splitting in tetrahedral, octahedral and distorted octahedral (square planar) crystal fields. Kinetic and Thermodynamic aspects of coordination compounds (crystal field stabilization energies of octahedral and tetrahedral complexes, spectrochemical series). Electronic spectra and magnetic properties of complexes. 10 hrs

**Homogeneous catalysis/mechanism of industrially important reactions**: Organometallic Compounds: Nomenclature, types of ligands and bonding in organometallic compounds, The catalytic properties of the organometallic compounds and the mechanism of homogeneous catalysis for important industrial processes like hydrogenation, polymerisation and hydroformylation etc. 06 hrs

**SECTION B**

**Chemical Bonding and structure Part II**: Ligand Substitution reactions in complexes with coordination numbers 4 and 6 and their mechanism. Kinetic aspects of substitution in coordination compounds; Magnetic behaviour of complexes – Paramagnetism, diamagnetism, ferromagnetism and antiferromagnetism and measurement of magnetic susceptibility of complexes by Guoy’s method. 09 hrs

**Inorganic polymers**: Types of inorganic polymers, polyphosphazenes, polysiloxanes –their structures and properties. 05 hrs

**Bio-inorganic Chemistry of Iron and cobalt**: Heme proteins, Non-Heme iron proteins, Iron Sulphur proteins and coenzyme B_{12}. 05 hrs
**Metal Toxicology**: Toxic effects of heavy metals with special reference to Cd, Pb, Hg and As.

04hrs

**Recommended Books:**

<table>
<thead>
<tr>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MATHEMATICS-II</td>
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<table>
<thead>
<tr>
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<th>Semester: - 2nd</th>
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<tbody>
<tr>
<td>BS104</td>
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</table>

<table>
<thead>
<tr>
<th>Max marks</th>
<th>Contact hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>End term- 50</td>
<td>60</td>
</tr>
<tr>
<td>Mid term- 50</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-requisites</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To students shall</td>
</tr>
<tr>
<td></td>
<td>• Learn to expand various functions in terms of Fourier series.</td>
</tr>
<tr>
<td></td>
<td>• Learn the methods to formulate and solve partial differential equations.</td>
</tr>
<tr>
<td></td>
<td>• Be taught to apply the method of separation of variables to solve partial differential equations of engineering interest.</td>
</tr>
<tr>
<td></td>
<td>• Learn to find Laplace transforms and inverse transforms and apply these to solve differential equations.</td>
</tr>
<tr>
<td></td>
<td>• Understand the concept of Complex functions and their applications to various problems.</td>
</tr>
</tbody>
</table>

**Note for 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. The duration of End Term exam will be 3 hrs.

**SECTION A**

**Fourier Series**
Euler’s Formulae, Dirchiet’s Conditions for Expansion, Change of interval, Odd and Even Functions, Expansion of Odd and Even Periodic Functions, Introduction to Harmonic Analysis.

**Partial Differential Equations (Pde’s)**
Formation and classification of partial differential equations, first order linear equations, standard forms of non linear equations, Charpit’s method, homogeneous linear equations with constant coefficients.

**Engineering Applications Of Pde’s**
Method of separation of variables, Solution of partial differential equations of engineering interest by the method of separation of variables.

**SECTION B**

**Laplace Transforms**
Definition, Transforms of Elementary functions, Properties of Transforms, Inverse Transforms,
Transforms of Derivatives, Unit Step Function, Dirac’s Delta Function & Unit Impulse function. Periodic Functions, Application of Transform to the solution of ordinary Differential equations

**Calculus Of Complex Functions**
Functions of complex variables, analytic functions, Cauchy-Riemann equations, Cauchy’s theorem, Cauchy’s integral formula, introduction to Tailor’s series and Laurent’s series, Residues, Residue theorem and its simple applications.

<table>
<thead>
<tr>
<th>Text Books</th>
<th></th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Reference Books</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Differential Equations, Frank Ayers, TMH</td>
<td></td>
</tr>
</tbody>
</table>

**Course Assessment Methods**
Assessment will consist of the following components
1. Mid-Term
   a. One best of two minor tests (50% of Mid-term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance. (10% of Mid-term marks)
2. End-Term

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The students are able to:</td>
<td></td>
</tr>
<tr>
<td>• expand functions in terms of Fourier series.</td>
<td></td>
</tr>
<tr>
<td>• formulate and solve partial differential equations.</td>
<td></td>
</tr>
<tr>
<td>• solve partial differential equations of engineering interest.</td>
<td></td>
</tr>
<tr>
<td>• find Lapalace transforms, inverse transforms and apply these to solve various differential equations.</td>
<td></td>
</tr>
<tr>
<td>• evaluate complex integrals and apply these to various problems.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title</th>
<th>COMMUNICATION SKILLS</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Code</td>
<td>HSMC-HASS 101</td>
<td>Semester: 2nd</td>
<td>L T P</td>
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<td></td>
<td></td>
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<td>1 - -</td>
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<tr>
<td>Max. marks</td>
<td>End term- 15</td>
<td>Mid term- 10</td>
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</tr>
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<td>Pre-requisites</td>
<td></td>
<td>Contact hours</td>
<td>15</td>
</tr>
<tr>
<td>Objectives</td>
<td>1. To inculcate effective communication skills in students for better performance in professional as well as personal life</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. To improve personality of students with advanced techniques in verbal, non verbal and para verbal communication.</td>
<td></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 atleast two questions from each Section. The duration of End Term exam will be 3 hrs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SECTION A**

**Advanced Communication Skills**

**Speaking Skills**
Interpersonal Communication, Presentation Skills, Voice Modulation, Persuasion, Negotiation and Linguistic Programming, Public Speaking, Group Discussions, Interviews and Case Studies,
**Conducting Meetings and Conferences**

**Personality Development**
Body Language and importance of Non Verbal communication, Social and Professional etiquettes.

---

### SECTION B

**Communication and Media**
Social and Political Context of Communication, Recent Developments in Media

**Advanced Techniques in Speaking Skills**
Importance of Listening/Responding to native and global accents, Telephonic Interviews and Video Conferencing

**Advanced Techniques in Technical Writing**
Job Application, CV Writing, Business Letters, Memos, Minutes, Reports and Report Writing

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<table>
<thead>
<tr>
<th>Text Books</th>
<th>Reference Books</th>
</tr>
</thead>
</table>

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<table>
<thead>
<tr>
<th>Course Assessment Methods</th>
<th>Assessment will consist of the following components</th>
</tr>
</thead>
</table>
| 1. Mid-Term             | a. One best of two minor tests (50% of Mid-term marks)  
                         b. Assignments (20% of Mid-term marks)  
                         c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)  
                         d. Attendance. (10% of Mid-term marks) |

---

| Course Outcomes | 1. Gain proficiency in English language as medium for communication in both professional and personal life  
2. Increase in employment prospective of students by developing technical aspects of communication.  
3. Personality development of students by thorough knowledge of effective and enhanced communication skills |

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**Engineering Graphics (Practical)**

<table>
<thead>
<tr>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>ENGINEERING GRAPHICS (PRACTICAL)</td>
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<table>
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<tr>
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<th>Semester</th>
<th>L T P</th>
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<tbody>
<tr>
<td>ESC-GES 151</td>
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<td>- - 3</td>
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<table>
<thead>
<tr>
<th>Max. Marks</th>
<th>Elective</th>
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<tbody>
<tr>
<td>Practical</td>
<td>N</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre requisites</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45</td>
</tr>
</tbody>
</table>

**PRACTICAL**

**Objectives**
Objectives of the Engineering Drawing course is
1. To introduce the students to visual science in the form of technical graphics.  
2. To give general instructions related to Theory of Orthographic Projection of points, lines, planes and solids as per the BIS codes prevalent to drawing.
practices.

3. To upgrade the basic understanding and visualization of geometric objects and machine parts by introducing the students to section of solids, intersection and development of surfaces, isometric projection and orthographic projection of simple solids/blocks.

4. To introduce the students to Computer graphics to enhance understanding of the subject.

1. Introduction to engineering drawing, instruments, symbols and conventions in drawing practice.
2. Types of lines and BIS codes for lines, dimensioning
3. Introduction to methods of projections: Orthographic projection, Isometric projection
4. Projection of points, lines, planes and solids on principal and auxiliary planes.
5. Sectioning of solids, Intersection of solids
6. Development of surfaces
7. Drawing of threaded fasteners and assembly drawing
8. Introduction to CAD software.

Recommended Books:
1. P.S. Gill: Engineering Drawing
4. Sham Tickoo : Understanding AutoCAD 2006, Wiley Publication
5. James D. Bethune : AutoCAD, Pearson Publishers

Course Assessment Methods
The students will be assessed based upon the practical assignments and viva voce.

Course Outcomes
Student will be able to
1. understand the basics of engineering drawing.
2. visualize the different types of geometrical objects and the assembly drawing of machine parts.

<table>
<thead>
<tr>
<th>Title</th>
<th>ENGINEERING WORKSHOP (PRACTICAL)</th>
<th>Credits</th>
<th>1.5</th>
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</thead>
<tbody>
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<td>Semester: - 2nd</td>
<td>L. T. P</td>
</tr>
<tr>
<td>Max. marks</td>
<td>Practical – 40</td>
<td>Elective</td>
<td>N</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>Contact hours</td>
<td></td>
<td>45</td>
</tr>
</tbody>
</table>

PRACTICAL

Objectives
- To make the students understand the need and importance of different manufacturing techniques.
- To introduce the different tools and equipments used in mechanical workshops and develop the skill to use the same.

Carpentry Shop: Description and use of carpenter's tools, Wood and timber, defects found in wood, seasoning of wood. Different types of timber in common use, making of lap joint, Bridle joint, dovetail joint and Mitre joint.

Electric Tools: Exercise of wiring in link clip and casting and causing wiring of lights with switches in parallels, series and with 2 ways switches, Connecting energy meter, main switch and distribution board, testing a wiring installation for insulation resistance, Relevant Indian Electricity Rules.

Machine Shop: Classification of fabrication processes, machine tools and materials, introduction to working of lathe, shapper, milling and drilling machines, power hacksaw, shearing machine and grinding wheel. Simple turning, threading, drilling board and knurling operations on a lathe.

Welding: Introduction to electric arc welding, gas welding and their use in making different types of joints e.g. lap joint, butt joint and T joint.

Recommended Books

Course Outcomes
Students will be able to
• understand the theory of different manufacturing techniques and tools.
• do practices by hand

<table>
<thead>
<tr>
<th>Title</th>
<th>PHYSICS LAB</th>
<th>Credits</th>
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<tbody>
<tr>
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<tr>
<td>Pre-requisites</td>
<td>Contact hours</td>
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Objectives
Physics lab provides students the firsthand experience of verifying various theoretical concepts learnt in theory courses.
In a semester at least 10 experiments to illustrate the concepts learnt in Physics (Number of lab. Hrs. 2 per experiment)

1. To find the energy band gap of the given semiconductor by four probe method.
2. To study the Hall Effect of a given semiconductor
3. To determine the dielectric constant of the given materials.
4. To study the B-H curve of the ferromagnetic materials.
5. To determine the value of e/m for electron by long solenoid (helical) method.
6. To study the variation of magnetic field with distance along the axis of a circular coil carrying current by plotting a graph
7. To determine the velocity of ultrasonics waves in a given liquid.
8. To determine the frequency of A.C. mains using a sonometer and an electro-magnet.
9. To find the capacitance of a capacitor using flashing and quenching of a neon lamp.
10. To plot graph between current and frequency in a series LCR circuit and to find the resonant frequency.
11. To find the wavelength of sodium light using Fresnel’s biprism. (3)
12. (i) To determine the wavelength of He-Ne laser using transmission grating.
    (ii) To determine the slit width using the diffraction pattern.
13. To determine the wave length of sodium light by Newton’s rings method.
14. To determine the wave length of sodium light using a diffraction grating.
15. To find the specific rotation of sugar solution using a Bi-quartz Polarimeter.
16. To design a hollow prism and used it find the refractive index of a given liquid
17. To synthesize the nanoparticles by chemical methods and structural characterization through X-ray diffraction.
18. To investigate the optical band gap of nanomaterial using UV-vis spectroscopy.
19. Fabrication of thin films by spray pyrolysis technique.
20. Fabrication of thin films using spin coater technique.

Text Books
1. Practical Physics by CL Arora, S Chand & Co.
2. Engineering physics by S.K. Srivastva

Reference Books
A text book of practical physics by William & Watson

Course Assessment Methods
One *project out of 6 carries 40% marks, 20% for respective viva and 20% for external exams and 10% for attendance.

Course outcomes
The student will gain
• Proficiency in technical aspects of performing the experiments.
• Proficiency in designing scientific projects

<table>
<thead>
<tr>
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<tr>
<td>Pre-requisites</td>
<td></td>
<td>Contact hours</td>
</tr>
</tbody>
</table>
| Text Books                   | 1. Practical Physics by CL Arora, S Chand & Co.


**Practical session wise break-up**

**No. of sessions**

I. **Volumetric Analysis** :
   (i) Redox Titrations :- Titrations involving
      a) KMnO4 (Estimation of C2O4 -2 ) 02
      b) K2Cr2O7 (Estimation of Fe+2/Fe+3) 02
      c) Iodine [Iodometry & Iodimetry] (Standardisation with Sodium Thiosulphate, Estimation of Cu+2, AsO3 -3 and Sb+3) 04
   (ii) Complexometric Titrations- Determination of Zn+2 by EDTA titration. 02

II. **Gravimetric Analysis**
   a) Estimation of Ba+2/SO4 -2 as BaSO4
   b) Estimation of Fe+2/Fe+3 as Fe2O3 04

**Text Book**: Vogel’s Qualitative Inorganic Analysis, 7th Ed. By G. Svehla, Pearson Education.

**Course Outcomes**

The student will be able to

- apply the concept of normality, molarity and oxidation and reduction and apply redox titrations involving potassium dichromate and Iodine
- Use Complexometric Titrations to determine metal ions by EDTA method.
- Use gravimetric procedures for estimation (Estimate Ba^{2+}/SO4^{2-}, and Fe^{3+})
### SYLLABUS OF B.E. (Food Tech.) 2019-2023
#### SECOND YEAR

#### 3rd SEMESTER

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### THEOREY

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<td>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.</td>
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### SECTION- A


### SECTION- B

Sanitation facilities and procedures in food processing plants. Application of mathematical techniques to describe food processing operations such as drying, rheology, degradation of nutrients and pigments during processing and storage. Use of semi-log and log-log paper.

1. Potter, N.N : Food Science, CBS publication, New Delhi, 2005
2. Desrosier and Desrosier : Technology of Food Preservation CBS publication, New Delhi, 2006
3. Frazier : Food Microbiology, Tata McGraw Hill, New Delhi

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### FLUID FLOW

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**Max. Marks**
- End term: 50
- Mid term: 50
- Practical: Elective

**THEORY Time**
- Contact Hours: 60
- 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**

**Fluid Statics:** Normal forces in fluids, Pressure Measurements, Forces on Submerged bodies, Buoyancy and Stability.


**Flow of Incompressible Fluids:** Laminar and Turbulent flow in pipes, Velocity Distribution in Pipes, Frictional Losses in Pipes and Fittings, Fanning equation, Estimation of economic pipe diameter. Derivation of HAGEN-POISEULLI and f=16/Re equations.

**SECTION - B**

**Dimensional analysis and its Applications to Fluid Flow.**

**Flow of compressible fluids:** Compressible flow and flow through nozzles.

**Flow Measurements:** Pilot tube, Orifice, Venturi, Rotameter and Notches, wet gas metre etc.

**Fluid Machinery:** Classification and Performance of Pumps, Turbines, Compressors, and Blowers, Selection and Specification, Net positive Suction Head.

**Books Recommended:**


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### BIOCHEMISTRY & NUTRITION

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**Max. Marks**
- End term: 40
- Mid term: 35
- Practical: Elective

**Pre requisite**
THEORY Time 3 Hours

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

Introduction to biochemical science, Enzymes and coenzymes. Introduction, definition, nomenclature, classification, numbering structure and functions of water-soluble enzymes, energy-rich compounds, active sites, mechanism of enzymes action, effect of temperature, pH, enzyme concentration and substrate concentration on the rate of enzyme reaction, specificity of enzymes, enzyme inhibition, kinetics of enzymes action, activation of enzymes, nature and functions of enzymes involved in digestion.

Metabolism of Carbohydrates: Respiratory quotient, Embden-Meyerhoff pathway, Cori and Cori Cycle, Kreb's Cycle, electron transport chain, oxidative phosphorylation.

Metabolisms of Lipids: Digestion and absorption of lipids, fatty liver, lipotropic agent, oxidation pathway, methylmalonyl Co- pathway metabolism of ketone bodies, energy balance.


SECTION- B

Nucleic Acids and their Components: Bases, nucleotides and nucleotides (cyclic also). Structures of different types of RNA and DNA. Physiochemical properties of DNA and RNA. Nucleoproteins. Replication, Transcription and Translation. Biotechnological Concepts: Vectors used for recombinant DNA technology. Application of cloned DNA, Screening of newly synthesized DNA.


Books Recommended:
1. Lehninger : Biochemistry, Mac Millan Publisher.
2. Stryer : Biochemistry, Freeman Publisher
5. Gopalan, Rama Sastri & Balasubramaniam : Nutritive Value of Indian Food
### CHEMICAL ENGINEERING THERMODYNAMICS

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<td>SECTION- A</td>
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**Books Recommended:**

THEORY

<table>
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<td>The semester question paper of the subject will be of 60 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>
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</table>

SECTION- A


- Motion of particle through a fluid: Stoke’s Newton’s law. Free and hindered setting.
- Setting tank and double cone classifiers
- Batch and continuous thickeners
- Settling chamber, cyclone, filter bag and electrostatic precipitators.

SECTION- B

**Filtration:** Plate and frame filter press, continuous rotary vacuum filter, filter aids, theory of filtration for non-compressible cakes.

**Centrifugation:** Tubular bowl centrifuge, disk centrifuge and batch basket centrifuge.

**Fluidization:** Conditions for fluidization: Aggregate and particulate fluidization. Ergun’s and Carman-Kozeny equations.

**Mixing and Agitation:** Basic ideas and characteristics of mixing equipment power consumptions scale-up.

**Conveying:** Mechanical and pneumatic conveying systems, storage & handling of materials.

Books Recommended:


Paper Title: Elements of Bio & Food Science Lab.
Paper Code FT 151   Max. Marks : 25   Credits : 1
Use of microscopic technique for identification of microorganisms on the basis of cell morphology and specific staining technique.
Isolation of pure cultures of bacteria, yeasts, moulds and taxonomic identification on the basis of morphology and physiology.
Preparation of nutrient broth and media with agar, gelatin and specific media for culture of microorganisms.

Paper Title: BIOCHEMISTRY & NUTRITION Lab.
Paper Code FT 152   Max. Marks : 25   Credits : 1

Paper Title: FLUID Flow Lab.
Paper Code PCC-CS 152   Max. Marks 40   Credits: 1.5
1. General study of pipe fittings, valves and other equipments in the unit operations laboratory.
2. Pressure drop for flow through pipelines, valves & fittings.
3. Characteristics of pumps.
4. Flow measurement by the use of orifice meter, venturimeter, rotameter & pitot tube.
5. Flow over weirs and notches.
6. Flow measurement of compressible fluids.

Paper Title: MECHANICAL OPERATIONS Lab.
Paper Code PCC-CS 155   Max. Marks 40   Credits: 1.5
1. Pressure drop and two phase flow characteristics in packed and fluidized beds.
4. Constant pressure filtration.
5. Mixing, crushing, grinding, screening and particle size analysis (Anderson Pipette)
SYLLABUS OF B.E. (Food Tech.) 2019-2023
SECOND YEAR

4th SEMESTER

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<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 atleast two questions from each Section.</td>
</tr>
</tbody>
</table>

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 co-efficient, 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.

**Books Recommended:**

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**

Moisture in foods: Hydrogen bonding, bound water, water activity.


**SECTION- B**

Lipids: Classification. Occurrence in foods and composition, identification of natural fats and oils in foods. Physical (melting point, softening point, slipping point, short melting point, specific gravity, refractive index, smoke-flash and fire point, turbidity point) and chemical properties. Flavor changes in fats and oils.


Vitamins: Occurrence and chemistry of various vitamins: A, B, C, D, E, K. Losses during processing and storage.

Food Additives: Types; Methods for safety level analysis, color additive legislation.

**Recommended Books.**

2. Fenamma: Food chemistry
3. de Man: Food Chemistry
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**

Contamination of foods by microorganisms from natural sources, spoilage of different foods: general principles, causes and spoilage and growth of microorganisms in foods. Preservation of foods by different preservation methods, contamination, preservation and spoilage of different food products. Food poisoning and food infections – investigation of food borne disease outbreak. Microbiology of individual food products. Dairy products, bread.

**SECTION- B**


**Books Recommended:**
2. Stain : General Microbiology.
5. Casida : Industrial Microbiology, John Wiley.
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.

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THEORY Time 3 Hours

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

Stresses and Strains: Concept of simple stress and simple strain, mechanical properties of solids, types of load, Tensile stress, compressive stress, shear stress, complementary shear stress, thermal stresses, tensile test, stress strain curve, Hooke’s law, modulus of elasticity, modulus of rigidity, Principle of St. Venant strain, factor of safety, compound bars, Compound Stresses and Compound Strains in two-dimensional stress system, Stresses on oblique plane due to pure shear, principle planes and principle stresses, maximum shear stress, Mohr’s circle of stress, Poisson’s ratio, volumetric strain, elastic constants and relations between them.

Shearing Force and Bending Moments in Beams: Shearing force, bending moment, types of beams, types of load on beams, types of supports, sign-conventions for shearing force and bending moment, point of inflection, relations between bending moment and shearing force shearing force and bending moment diagrams for beam under different loads. Concentrated loads, uniformly distributed loads, numerical problems.

Bending Stresses and Shearing Stresses in Beams: Pure bending, graphical determination of moments of inertia, bending stress, composite beams, reinforced concrete beams, General eccentric loading, combined direct and bending stresses, eccentric longitudinal loads, Shear stress distribution in rectangular section and circular section, numerical problems.

Deflection of Beam: Introduction, Macaulay’s integration method, simply supported beam with load at mid span and beam with eccentric load, moment area method, deflection due to shear, numerical problems.

SECTION-B
**Torsion of Shafts**: Torsion of thin circular shaft, composite shaft, combined bending and torsion. Equivalent torque, equivalent bending moment, numerical problems.

**Struts and Columns**: Definition of strut and column, Euler’s Column theory and assumptions made, Strut with both ends pinned, strut with one end fixed and one end free, strut with both ends free, Slenderness ratio, limitations of Euler theory, Rankine’s Empirical formula, strut with eccentric loading, numerical problems.

**Stresses and Strains in Thin Shells**: Thin cylinder under internal pressure, thin spherical shell under internal pressure, volumetric strain, modifications for built-up shells, numerical problems.

**Stresses and Strains in Springs**: Types of Springs, stresses in Close coiled helical springs, open coiled helical springs, leaf springs, springs in parallel and in series, numerical problems.

**Strain Energy and Theories of Elastic Failure**: Strain energy and resilience, Strain energy in tension and compression due to suddenly applied load and impact loads, strain energy due to shear, strain energy due to bending, strain energy due to torsion, theories of elastic failure and their graphical representation, numerical problems.

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**Books Recommended**:


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**Title** | **PROCESS EQUIPMENT DESIGN** | **Credits** | 1.5
---|---|---|---
**Code** | ESS-GES 157 | **Semester**: 4th | L T P
**Max. Marks** | End term- | Mid term- | Practical- 40 | Elective | N
**Pre requisites** | | | | Contact Hours | 45

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**PRACTICAL**

**LIST OF PRACTICALS**

1. Study of factors influencing the design of vessels; classification of pressure vessels, applications, method of fabrications, fundamental principles and equations.
2. Study of pressure vessel codes specifications and standards; Review of code and its development, ASME codes, API-ASME code, Section VIII of ASME codes.
3. General design considerations for pressure vessels; Design pressure, design temperature, materials, design stress (nominal design strength), corrosion allowance, design loads, minimum practical wall thickness.
4. Design of thin-walled vessels under internal pressure; Cylinders and spherical shells, heads and closures, design of flat ends, design of domes ends, conical sections and end closures.
5. Design of vessels subject to external pressure; Cylindrical shells, design of stiffening rings, vessels heads.
6. Design of vessels subject to combined loading: Weight loads, wind loads (tall vessels), torque.
7. Design of welded joints and Bolted flanged joints.
8. Design of Foundation and supports.

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**Books Recommended**:

1. Battacharyya, B.C. : Introduction to Chemical Equipment Design Mechanical aspects, Chemical Engineering Education Development Centre.
Paper Title: HEAT TRANSFER Lab.

Paper Code: PCC-CS 154  Max. Marks: 40  Credits: 1.5

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

Paper Title: PROCESSING OF CEREALS & PULSES LAB.

Paper Code: FT 155  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.

Paper Title: FOOD CHEMISTRY Lab.

Paper Code: FT 153  Max. Marks: 25  Credits: 1

1. Preparation of samples for analyses.
2. Determination of moisture content (wet basis and dry basis).
3. Ash: total, acid soluble, alkali soluble and water soluble.
4. Lipids, protein, crude fibre, reducing and non-reducing sugar.
5. Estimation of ascorbic acid, vitamin-A, chlorophyll, carotenoids etc.
6. Estimation of iron, copper, lead, tin etc.

Paper Title: FOOD MICROBIOLOGY Lab.

Paper Code: FT 154  Max. Marks: 25  Credits: 1

Bacteriological examination of foods: General protocol taking the examples of different foods. Presumptive coliform test of milk, butter, cream, ice-cream and dahi. Standard plate count for pasteurized milk and ice-cream. Yeast and mold count for butter, dahi and bread. To access bacteriological quality of milk by methylene blue reduction test and resazurin reduction test.
SYLLABUS OF B.E. (FOOD TECH.) 2019-2023
THIRD YEAR

5th SEMESTER

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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

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

Recommended Books

<table>
<thead>
<tr>
<th>Title</th>
<th>Processing of Oil Seeds, Oils and Fats</th>
<th>Credits</th>
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<tr>
<td>Code</td>
<td>FT 106</td>
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<td>L T P</td>
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<td>Mid term 35</td>
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<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>
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</tbody>
</table>

**SECTION- A**


**SECTION- B**


### Books Recommended:

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

<table>
<thead>
<tr>
<th>Title</th>
<th>PROCESSING OF FRUITS &amp; VEGETABLES</th>
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<td>Note for the</td>
<td>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.</td>
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</tbody>
</table>
Examiner 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


Books Recommended:

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

Title Environmental Engineering Credits 3
Code OCE-OL 104 Semester: 5th LT P 3 1 -
Max.Marks End term 40 Mid term 35 Practical: Elective N
Pre requisites - Contact Hours 45

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


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:

<table>
<thead>
<tr>
<th>Title</th>
<th>NUMERICAL METHODS IN CHEMICAL ENGINEERING</th>
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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


SECTION- B

### Recommended Books


### Title

**PROCESS PLANT DESIGN – I**

<table>
<thead>
<tr>
<th>Code</th>
<th>PEC-CSEL 151</th>
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<th>Credits</th>
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<td>N</td>
<td>45</td>
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</tbody>
</table>

### Practical

2. Selection, specification & power requirements of process pumps, fans and blowers.
3. Design of settling equipments like Dor thickeners, dust chambers, cyclone separators and centrifuges.
4. Design of agitated vessels using various types of impellers.
5. Design of Conveyor system for solids.

### Recommended Books


### Processing of Oil Seeds, Oils & Fat Lab.

**FT 156**

Marks: 25  
Credit: 1

1. Determination of oil content of foods by Soxhlet method
2. Determination of specific gravity of oils and fats
3. Determination of refractive index of oils and fats by Abbe’s refractometer
4. Determination of free fatty acids and acid values of fats and oils
5. Determination of peroxide value of fats and oils
6. Determination of iodine value of fats and oils
7. Determination of melting points and smoke points of fats and oils
8. Determination of saponification value of fats and oils
9. Determination of adulteration of fats and oils
10. Determination of Reichert missile and Polenski value of fats and oils
11. Determination of oil absorption during deep fat frying of foods
Paper Title : PROCESSING OF FRUITS & VEGETABLES LAB  
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.  
11. Visit to a fruit and vegetable processing plant.  

Environmental Engineering Lab.  
OEC-OL 154              Marks: 40                              Credit: 1.5  
To find BOD of water sample.  
1. To find COD of waste sample.  
2. To find the total dissolved solids (TDS) and its volatile and non-volatile components. 
3. To find the total suspended solids (TSS) and its volatile and non-volatile components.  
4. To do the chromium separation by different techniques from electroplating wastes.  
5. To find the phenol content of water sample and evolution of parameters.  
6. To operate the electrodialysis apparatus.  
7. To find the biodegradation constant (K) and the effect of timing on it.  
8. To use the membrane separation techniques for salt brine and reverse osmosis process for sugar.  
9. 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.
# SYLLABUS OF B.E. (FOOD TECH.) 2019-2023

## THIRD YEAR

### 6th SEMESTER

<table>
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<tr>
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<td>Contact Hours</td>
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### 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

**Absorption:** Equilibrium for absorption systems – use of Raoult’s law, Henry’s law for solubility predictions, Selection of absorbent, limiting liquid gas ratios, absorption factor use in design of plate absorbers. Kremser equation for ideal plates and translation of ideal plates to real plates using various efficiencies. Concept of transfer units for the design of packed absorbers.


#### SECTION- B

**Liquid-Liquid Extraction:** Ternary Equilibria and its representation on various plots. Selection criteria for solvent, Multistage extraction using partially miscible & immiscible solvents. Stagewise contact for countercurrent and crosscurrent extraction. Constructional details of equipment like mixer-settler, packed columns, pulsed extractor, sieve-tray extractor and centrifugal extractor.

**Leaching:** Preparation of solid, countercurrent and crosscurrent multistage contact Shank’s system. Constructional details of equipment like Rotocel extractor, Hildebrandt extractor, Bollman extractor, Kennedy Extractor & Beet-Sugar Diffusion battery extractor.

**Adsorption:** Types of adsorption, nature of adsorbents, equilibria for adsorption systems. Brief manufacture and commercial applications and characteristics for common adsorbents. Stagewise & continuous contacting of fluid and solid phase. Description of contact filtration adsorption system. Hypersorber Ion-exchange system.


### Recommended Books

Title | CHEMICAL REACTION ENGINEERING–I | Credits | 4
---|---|---|---
Code | PCC-CS 107 | Semester:-6th | L T P | 3 - 1
Max.Marks | End term 50 | Mid term 50 | Practical : - | Elective | N
Pre requisites | - | Contact Hours | 60

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

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.

Recommended Books


Title | Processing of Milk and Milk Products | Credits | 3
---|---|---|---
Code | FT 108 | Semester:-6th | L T P | 3 - -
Max. Marks | End term 40 | Mid term 35 | Practical- | Elective | N
Pre requisites | | | Contact Hours | 45

THEORY | Time | 3 Hours

Note for the Examiner

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**

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, 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:**

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.

Title | CONFECTIONARY TECHNOLOGY | Credits |
------|-----------------------------|---------|
Code  | FT 110                      | 03      |
Semester: 5th | L T P | 3 - - |
Max. Marks | End term-40 | Mid term-35 | Practical- | Elective | Contact Hours | 45 |
Prerequisites | | | | |
THEORY | Time | 3 Hours |

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:

Mass Transfer Lab.
PCC-CS 158
Practical
Marks: 40
Credit: 1.5
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.

CHEMICAL REACTION ENGG.-I LAB.
PCC-CS 157 Marks: 40 Credit: 1.5

Practical
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.

Paper Title: Processing of Milk and Milk Products Lab.
No. of Practicals: 08
Paper Code FT 158 Max. Marks: 25 Credits: 1
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 | 1.5
---|---|---|---
Code | ESC-GES 158 | Semester: 6th | L T P | - - 3
Max.Marks | End term | Mid term | Practical: 40 | Elective | N
Pre requisites | - | | | Contact Hours | 45
Practical
Errors analysis, Solution of linear and non-linear algebric equations.
Numerical differential & integration.
Interpolation.
Least squares approximation.
Ordinary and partial differential equations.
Development of computer programs based on the above topics using Matlab and their applications in chemical process computations.

Recommended Books:
# SYLLABUS OF B.E. (FOOD TECH.) 2019-2023
## FOURTH YEAR
### 7th SEMESTER
<table>
<thead>
<tr>
<th>Title</th>
<th>PROCESS DYNAMICS &amp; CONTROL</th>
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#### THEOREY

**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**
- 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.

**Recommended Books**

<table>
<thead>
<tr>
<th>Title</th>
<th>Process Engineering Economics</th>
<th>Credits</th>
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**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**


*Interest and Investment Costs:* Simple and compound interest. Nominal and effective rates of interest. Continuous interest ordinary annuity. Perpetuities and capitalized costs.

*Taxes and Insurance:* Types of taxes and tax returns, types of insurance and legal responsibility.

*Depreciation:* Types of depreciation. Service life salvage value, present value and methods of determining depreciation, single unit and group depreciation.

**SECTION-B**


*Optimum Design:* Procedure with one variable, optimum reflux ratio in distillation and other examples.

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

**Books Recommended:**


**Title** | **Process Modelling & Simulation** | **Credits**
--- | --- | ---
**Code** | OEC-OL 155 | 1.5
**Semester:** 7th | L T P | - - 3
**Max.Marks** | End term | Mid term | Practical:40 | Elective | N
**Pre requisites** | - | | | | Contact Hours | 45

**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:

Process Dynamics & Control Lab.
PCC-CS 162 Marks: 40 Credit: 1.5
Practical
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 behaviour 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.
SYLLABUS OF B.E. (FOOD TECH.) 2019-2023
FOURTH YEAR

8th SEMESTER

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</table>

**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 Concept:** Need and classification of measurements and instruments, Basic and auxiliary functional elements of a measurement system. Static and Dynamic Characteristics of Instruments: Static Characteristics: Range and span, accuracy and static error, reproducibility and drift, sensitivity and dead zone. Dynamic Characteristics: Speed of response and lag, fidelity and dynamic error, dead time.

**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

**PROJECT WORK**

Proj. Marks: 50 Credit: 2

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>
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<tr>
<td>Pre requisites</td>
<td>-</td>
<td>Contact Hours</td>
<td>45</td>
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**Practical**

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.
Paper Title: Departmental Elective (Theory)

Course Duration: 45 Lectures of one hour each.

MEAT, FISH & POULTRY TECHNOLOGY (Theory)

<table>
<thead>
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<th>THEOREY</th>
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<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)

**THEORY** | **Time** | **3 Hours**
---|---|---
**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**
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)

**THEORY** | **Time** | **3 Hours**
---|---|---
**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**
*Isolation and Utilization of Enzymes*: Purification, immobilization, application of enzyme technology.  
*Kinetics of Enzyme-Catalyzed Reactions*: The substrate, enzyme kinetics, factors affecting enzymatic activity and enzymatic reactions in heterogeneous reactions.  
*Metabolic Pathways and Energetics of the Cell*: The concept of energy coupling, aerobic and anaerobic metabolism, photosynthesis and biosynthesis, transport across cell membranes.  
*Cellular Genetics and Control*: Growth and reproduction of a single cell, alteration of cellular DNA, commercial applications.

**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)

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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)

**THEORY** | **Time** | **3 Hours**
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**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**

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**


**References Books**


INDUSTRIAL SAFETY & HAZARDS (Theory)

**THEORY** | **Time** | **3 Hours**
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**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**

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

Books Recommended:

PLANT UTILITIES (Theory)

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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.

Books Recommended:
Paper Title: Open Elective (Theory)

FOOD REGULATION & QUALITY CONTROL (Theory)

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**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)

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**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.  
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


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<th>NANO TECHNOLOGY (Theory)</th>
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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/Polymers/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 diffraclometry, UV visible.

Nanomaterials: CNTs, Polymer Nanocomposites nanoceramics, nanomeals, 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

SUPPLY CHAIN & LOGISTICS MANAGEMENT (Theory)

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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)**

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**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)

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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

5. Prasanna Chandra: Projects: Preparation, Appraisal Budgeting and Control, 7th edition, TMH.
8. Peter F. Drucker: Innovation and development.