1. **Program Educational Objectives (PEOs)**
   1. To prepare students for prosperous spectrum of career avenues in academia, advanced research, industries of pharmaceutical technology, biomedicine, biotechnology, law, business and government and other pharmaceutical pursuits through dissemination of knowledge and proficiency in engineering and technology fundamentals related to pharmaceutical technology and the ability to solve problems.
   2. To transfuse in students the sense of confidence in professional endeavours application of the derived knowledge and appreciation of economic impact in a societal context.
   3. To provide collegial and nurturing environment for the students to realize the professional, ethical obligations and their concern to protect the health and welfare of the public and to be accountable for the social and environmental impact of their practice.
   4. To create an enjoyable educational environment in which students participate in multidisciplinary, team oriented, open-ended curricular and co-curricular activities that prepare them to work either individually and as an integrated team member.
   5. To facilitate the students to gain the wisdom of fundamentals and advances to practice Pharmaceutical technology and interdisciplinary research as career of constructive service to society and higher learning.

2. **Program Outcomes (POs)**
   After completion of graduation in Pharmaceutical Technology, the students will be able to demonstrate the ability to:
   a. apply knowledge of mathematics, science and technology in the discipline
   b. identify, formulate, research literature, and analyse complex engineering problems for its solution
   c. design and develop system processes that meet the specified needs with appropriate consideration for public health, safety, cultural, societal, and environmental.
   d. design the experiments, its analysis and interpretation of data, synthesis of the information using research-based knowledge for complex problems.
   e. use modern engineering tools, software and equipment to meet the needs in the area of Pharmaceutical Technology
   f. apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues relevant to the professional engineering practices.
   g. apply knowledge of the impact of pharmaceutical technology solutions in a societal and global context
   h. demonstrate ethical principles and commitment to responsibilities and norms of the Pharmaceutical technology practices
   i. work effectively as an individual and as well as member in teams of diversified professionals
   j. communicate effectively
   k. understand the philosophies of project management principles in Pharmaceutical technology
   l. showcase urge for self-education and life-long learning
3. Establish the correlation between the POs and the PEOs

<table>
<thead>
<tr>
<th>PEOs</th>
<th>Programme Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td>1</td>
<td>✔</td>
</tr>
<tr>
<td>2</td>
<td>✔</td>
</tr>
<tr>
<td>3</td>
<td>✔</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>✔</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Subjects</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
<th>i</th>
<th>j</th>
<th>k</th>
<th>l</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Semester – I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communicative English</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering Mathematics I</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering Physics</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering Chemistry</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem Solving and Python Programming</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering Graphics</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem Solving and Python Programming</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics and Chemistry Laboratory</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Semester II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical English</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering Mathematics II</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Physics of Materials</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Human Physiology</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic Civil and Mechanical Engineering</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biochemistry</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Engineering Practices Laboratory</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biochemistry Laboratory</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Semester – III</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transform Techniques and Partial Differential Equations</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Thermodynamics</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Microbiology</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmaceutical Chemistry</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Physical Pharmaceutics</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Environmental science and Engineering</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester – IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probability and Statistics</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stoichiometry and Chemical Process Calculations</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid Flow Operations</td>
<td>✔ ✔ ✔ ✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit Operations in Pharma Industries</td>
<td>✔ ✔ ✔ ✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molecular Biology and Genetic Engineering</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmaceutical Analysis</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analytical Methods and Instrumentation Laboratory</td>
<td>✔ ✔ ✔ ✔ ✔ ✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molecular Biology and Genetic Engineering Laboratory</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Reading and Writing</td>
<td>✔ ✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester – V</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Chemical Reaction Engineering</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>Medicinal Chemistry</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>Pharmacology and Chemotherapy</td>
<td>✔ ✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>Fundamentals of Heat and Mass Transfer</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>Professional Communication</td>
<td></td>
</tr>
<tr>
<td>Physiology and Pharmacology Laboratory</td>
<td>✔ ✔ ✔</td>
</tr>
<tr>
<td>Medicinal Chemistry Laboratory</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester – VI</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Quality Management</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>Bioprocess Engineering</td>
<td>✔ ✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>Technology of Solid Dosage forms</td>
<td>✔ ✔ ✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>Bioprocess Engineering Laboratory</td>
<td>✔ ✔ ✔</td>
</tr>
<tr>
<td>Technology of Dosage Forms Laboratory</td>
<td>✔ ✔ ✔</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester – VII</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Biopharmaceutics and Pharmacokinetics</td>
<td>✔ ✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>Regulatory requirements in Pharmaceutical Industries</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>Chemistry of Natural Products</td>
<td>✔ ✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>Biopharmaceutics and Pharmacokinetics Laboratory</td>
<td>✔ ✔</td>
</tr>
<tr>
<td>Chemistry of Natural Products Laboratory</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester VIII</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Work</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
</tr>
</tbody>
</table>
### SEMESTER I

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>HS8151</td>
<td>Communicative English</td>
<td>HS</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>MA8151</td>
<td>Engineering Mathematics – I</td>
<td>BS</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>PH8151</td>
<td>Engineering Physics</td>
<td>BS</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>CY8151</td>
<td>Engineering Chemistry</td>
<td>BS</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>GE8151</td>
<td>Problem Solving and Python Programming</td>
<td>ES</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>GE8152</td>
<td>Engineering Graphics</td>
<td>ES</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>GE8161</td>
<td>Problem Solving and Python Programming Laboratory</td>
<td>ES</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>BS8161</td>
<td>Physics and Chemistry Laboratory</td>
<td>BS</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>31</td>
<td>19</td>
<td>0</td>
<td>12</td>
</tr>
</tbody>
</table>

### SEMESTER II

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>HS8251</td>
<td>Technical English</td>
<td>HS</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>MA8251</td>
<td>Engineering Mathematics – II</td>
<td>BS</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>PH8254</td>
<td>Physics of Materials</td>
<td>BS</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>PY8201</td>
<td>Human Physiology</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>BE8252</td>
<td>Basic Civil and Mechanical Engineering</td>
<td>ES</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>PY8202</td>
<td>Biochemistry</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>GE8261</td>
<td>Engineering Practices Laboratory</td>
<td>ES</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>PY8211</td>
<td>Biochemistry Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>29</td>
<td>21</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>
### SEMESTER III

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>MA8353</td>
<td>Transforms and Partial Differential Equations</td>
<td>BS</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>PE8491</td>
<td>Chemical Engineering Thermodynamics</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>BT8291</td>
<td>Microbiology</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>PY8301</td>
<td>Pharmaceutical Chemistry</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>PY8302</td>
<td>Physical Pharmaceutics</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>GE8291</td>
<td>Environmental Science and Engineering</td>
<td>HS</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>PY8311</td>
<td>Physical Pharmaceutics Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>BT8361</td>
<td>Microbiology Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>HS8381</td>
<td>Interpersonal Skills/Listening and Speaking</td>
<td>EEC</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>29</td>
<td>19</td>
<td>0</td>
<td>10</td>
<td>24</td>
</tr>
</tbody>
</table>

### SEMESTER IV

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>MA8391</td>
<td>Probability and Statistics</td>
<td>BS</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>PY8401</td>
<td>Stoichiometry and Chemical Process Calculations</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>PY8402</td>
<td>Fluid Flow Operations</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>PY8403</td>
<td>Unit Operations in Pharma Industries</td>
<td>PC</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>PY8404</td>
<td>Molecular Biology and Genetic Engineering</td>
<td>PC</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>PY8405</td>
<td>Pharmaceutical Analysis</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>PY8411</td>
<td>Analytical Methods and Instrumentation Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>PY8412</td>
<td>Molecular Biology and Genetic Engineering Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>HS8461</td>
<td>Advanced Reading and Writing</td>
<td>EEC</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>32</td>
<td>20</td>
<td>2</td>
<td>10</td>
<td>26</td>
</tr>
</tbody>
</table>

### SEMESTER V

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>BT8691</td>
<td>Applied Chemical Reaction Engineering</td>
<td>ES</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PY8501</td>
<td>Medicinal Chemistry</td>
<td>PC</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>PY8502</td>
<td>Pharmacology and Chemotherapy</td>
<td>PC</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>FD8491</td>
<td>Fundamentals of Heat and Mass Transfer</td>
<td>PC</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Professional Elective I</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Open Elective I*</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>PY8511</td>
<td>Physiology and Pharmacology Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>PY8512</td>
<td>Medicinal Chemistry Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>HS8581</td>
<td>Professional Communication</td>
<td>EEC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>32</td>
<td>20</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

* - Course from the curriculum of the other UG Programmes

### SEMESTER VI

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>GE8077</td>
<td>Total Quality Management</td>
<td>HS</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>BT8591</td>
<td>Bioprocess Engineering</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PY8601</td>
<td>Technology of Solid Dosage forms</td>
<td>PC</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Professional Elective II</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Professional Elective III</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Professional Elective IV</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>PY8611</td>
<td>Bioprocess Engineering Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>PY8612</td>
<td>Technology of Dosage Forms Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>27</td>
<td>19</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>
### SEMESTER VII

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>PY8701</td>
<td>Biopharmaceutics and Pharmacokinetics</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>PY8702</td>
<td>Regulatory Requirements in Pharmaceutical Industries</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>PY8703</td>
<td>Chemistry of Natural Products</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Professional Elective V</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Professional Elective VI</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Open Elective II</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>PY8711</td>
<td>Biopharmaceutics and Pharmacokinetics Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>PY8712</td>
<td>Chemistry of Natural Products Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>26</td>
<td>18</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

* - Course from the curriculum of the other UG Programmes

### SEMESTER VIII

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>PY8811</td>
<td>Project Work</td>
<td>EEC</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>

**TOTAL CREDITS: 181**

### PROFESSIONAL ELECTIVES (PE)

#### PROFESSIONAL ELECTIVE I, SEMESTER V

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PY8001</td>
<td>Basic Laboratory Animal Science</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PY8002</td>
<td>Fundamentals of Material Science and Engineering</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>GE8071</td>
<td>Disaster Management</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### PROFESSIONAL ELECTIVE II, SEMESTER VI

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PY8003</td>
<td>Technology of Semisolid Dosage Forms</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>BT8071</td>
<td>Biological Spectroscopy</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PY8004</td>
<td>Fundamentals of Polymer Science and Engineering</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>S. No.</td>
<td>COURSE CODE</td>
<td>COURSE TITLE</td>
<td>CATEGORY</td>
<td>CONTACT PERIODS</td>
<td>L</td>
<td>T</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>-------------------------------------</td>
<td>----------</td>
<td>----------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>1.</td>
<td>PY8006</td>
<td>Herbal Technology</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PY8007</td>
<td>Regulatory Toxicology</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>BT8791</td>
<td>Immunology</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>BT8091</td>
<td>Instrumentation and Process Control</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>GE8076</td>
<td>Professional Ethics in Engineering</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>BT8651</td>
<td>Bioinformatics</td>
<td>PE</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

PROFESSIONAL ELECTIVE IV, SEMESTER VI

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PY8008</td>
<td>Vaccine Technology</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PY8009</td>
<td>Technology of Fine Chemicals and Bulk Drugs</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PY8010</td>
<td>Advanced Medicinal Chemistry</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PY8011</td>
<td>Nutraceuticals</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>PY8012</td>
<td>Pharmacogenomics</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

PROFESSIONAL ELECTIVE V, SEMESTER VII

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PY8013</td>
<td>Technology of Sterile Products</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PY8014</td>
<td>Introduction to Biomaterials and Tissue Engineering</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PY8015</td>
<td>IPR for Pharma Industry</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PY8016</td>
<td>Computer Aided Drug Design</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>PY8071</td>
<td>Clinical Trials</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>PY8017</td>
<td>Pharmacovigilance</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>GE8074</td>
<td>Human Rights</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

PROFESSIONAL ELECTIVE VI, SEMESTER VII

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PY8018</td>
<td>Pharmaceutical Nanotechnology</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PY8019</td>
<td>Protein Structure, Function and Proteomics</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PY8020</td>
<td>Pharmaceutical Packaging Technology</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PY8021</td>
<td>Experimental Design and Analysis</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>PY8022</td>
<td>Safety and Health Evaluation</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>GE8072</td>
<td>Foundation Skills in Integrated Product Development</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>
### SUBJECT AREAWISE DETAILS

#### HUMANITIES AND SOCIAL SCIENCES (HS)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HS8151</td>
<td>Communicative English</td>
<td>HS</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>HS8251</td>
<td>Technical English</td>
<td>HS</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>GE8291</td>
<td>Environmental Science and Engineering</td>
<td>HS</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>GE8077</td>
<td>Total Quality Management</td>
<td>HS</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### BASIC SCIENCES (BS)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MA8151</td>
<td>Engineering Mathematics I</td>
<td>BS</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>PH8151</td>
<td>Engineering Physics</td>
<td>BS</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CY8151</td>
<td>Engineering Chemistry</td>
<td>BS</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>BS8161</td>
<td>Physics and Chemistry Laboratory</td>
<td>BS</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>MA8251</td>
<td>Engineering Mathematics II</td>
<td>BS</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>PH8254</td>
<td>Physics of Materials</td>
<td>BS</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>MA8353</td>
<td>Transform and Partial Differential Equations</td>
<td>BS</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>8.</td>
<td>MA8391</td>
<td>Probability and Statistics</td>
<td>BS</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

#### ENGINEERING SCIENCES (ES)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>GE8151</td>
<td>Problem Solving and Python Programming</td>
<td>ES</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>GE8152</td>
<td>Engineering Graphics</td>
<td>ES</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>GE8161</td>
<td>Problem Solving and Python Programming Laboratory</td>
<td>ES</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>BE8252</td>
<td>Basic Civil and Mechanical Engineering</td>
<td>ES</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>GE8261</td>
<td>Engineering Practices Laboratory</td>
<td>ES</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>BT8691</td>
<td>Applied Chemical Reaction Engineering</td>
<td>ES</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### PROFESSIONAL CORE (PC)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PY8201</td>
<td>Human Physiology</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PY8202</td>
<td>Biochemistry</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PY8211</td>
<td>Biochemistry Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>PE8491</td>
<td>Chemical Engineering</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Type</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------------------------</td>
<td>-------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BT8291</td>
<td>Microbiology</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8301</td>
<td>Pharmaceutical Chemistry</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8302</td>
<td>Physical Pharmaceutics</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8311</td>
<td>Physical Pharmaceutics Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BT8361</td>
<td>Microbiology Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8401</td>
<td>Stoichiometry and Chemical Process Calculations</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8402</td>
<td>Fluid Flow Operations</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8403</td>
<td>Unit Operations in Pharma Industries</td>
<td>PC</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8404</td>
<td>Molecular Biology and Genetic Engineering</td>
<td>PC</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8405</td>
<td>Pharmaceutical Analysis</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8411</td>
<td>Analytical Methods and Instrumentation Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8412</td>
<td>Molecular Biology and Genetic Engineering Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8501</td>
<td>Medicinal Chemistry</td>
<td>PC</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8502</td>
<td>Pharmacology and Chemotherapy</td>
<td>PC</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FD8491</td>
<td>Fundamentals of Heat and Mass Transfer</td>
<td>PC</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8511</td>
<td>Physiology and Pharmacology Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8512</td>
<td>Medicinal Chemistry Lab</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BT8591</td>
<td>Bioprocess Engineering</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8601</td>
<td>Technology of Solid Dosage forms</td>
<td>PC</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8611</td>
<td>Bioprocess Engineering Lab</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8612</td>
<td>Technology of Dosage Forms Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8701</td>
<td>Biopharmaceutics and Pharmacokinetics</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8702</td>
<td>Regulatory Requirements in Pharmaceutical Industries</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8703</td>
<td>Chemistry of Natural Products</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8711</td>
<td>Biopharmaceutics and Pharmacokinetics Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY8712</td>
<td>Chemistry of Natural Products Laboratory</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### EMPLOYABILITY ENHANCEMENT COURSES (EEC)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HS8381</td>
<td>Interpersonal Skills/Listening and Speaking</td>
<td>EEC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>HS8461</td>
<td>Advanced Reading and Writing</td>
<td>EEC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3.</td>
<td>HS8581</td>
<td>Professional Communication</td>
<td>EEC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4.</td>
<td>PY8811</td>
<td>Project Work</td>
<td>EEC</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>

### SUMMARY

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Subject Area</th>
<th>Credits Per Semester</th>
<th>Total Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HS</td>
<td>4 4 3 - - 3 - -</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>BS</td>
<td>12 7 4 4 - - - -</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>ES</td>
<td>9 6 - - - - - -</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>PC</td>
<td>- 8 16 21 16 11 13 -</td>
<td>85</td>
</tr>
<tr>
<td>5</td>
<td>PE</td>
<td>- - - - 3 9 6 -</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>OE</td>
<td>- - - - 3 - 3 -</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>EEC</td>
<td>- - 1 1 1 - -</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>25 25 24 26 26 23 22 10</td>
<td>181</td>
</tr>
</tbody>
</table>
OBJECTIVES:
- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I   SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS   12

UNIT II   GENERAL READING AND FREE WRITING   12
Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and/or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –Listening- telephonic conversations. Speaking – sharing information of a personal kind—greeting – taking leave-
Language development – prepositions, conjunctions Vocabulary development- guessing meanings of words in context.

UNIT III  GRAMMAR AND LANGUAGE DEVELOPMENT   12
Reading- short texts and longer passages (close reading) Writing- understanding text structure-use of reference words and discourse markers-coherence-jumbled sentences Listening – listening to longer texts and filling up the table- product description- narratives from different sources. Speaking- asking about routine actions and expressing opinions. Language development – degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs.

UNIT IV  READING AND LANGUAGE DEVELOPMENT   12
Reading- comprehension-reading longer texts- reading different types of texts- magazines Writing- letter writing, informal or personal letters-e-mails-conventions of personal email-Listening- listening to dialogues or conversations and completing exercises based on them. Speaking- speaking about oneself- speaking about one’s friend- Language development- Tenses- simple present-simple past- present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs

UNIT V   EXTENDED WRITING   12
Reading- longer texts- close reading –Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-Listening – listening to talks-conversations- Speaking – participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense - Vocabulary development-collocations-fixed and semi-fixed expressions
OUTCOMES:
At the end of the course, learners will be able to:
- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

REFERENCES

MA8151 ENGINEERING MATHEMATICS-I L T P C
4 0 0 4

OBJECTIVES:
- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I DIFFERENTIAL CALCULUS 12
Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES 12
UNIT III INTEGRAL CALCULUS 12
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT IV MULTIPLE INTEGRALS 12

UNIT V DIFFERENTIAL EQUATIONS 12

TOTAL : 60 PERIODS

OUTCOMES:
After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

TEXT BOOKS:
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units I & III - Sections 1.1, 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES:
OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I PROPERTIES OF MATTER


UNIT II WAVES AND FIBER OPTICS


UNIT III THERMAL PHYSICS


UNIT IV QUANTUM PHYSICS


UNIT V CRYSTAL PHYSICS

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

OUTCOMES:

Upon completion of this course,

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices
and their applications in fibre optics,
• the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
• the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
• the students will understand the basics of crystals, their structures and different crystal growth techniques.

TEXT BOOKS:

REFERENCES:

CY8151 ENGINEERING CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:
• To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
• To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
• Preparation, properties and applications of engineering materials.
• Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
• Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

UNIT I WATER AND ITS TREATMENT

UNIT II SURFACE CHEMISTRY AND CATALYSIS
UNIT III ALLOYS AND PHASE RULE 9

UNIT IV FUELS AND COMBUSTION 9

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9
Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H₂-O₂ fuel cell.

TOTAL: 45 PERIODS

OUTCOMES:
- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

REFERENCES:

GE8151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:
- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
• To define Python functions and call them.
• To use Python data structures — lists, tuples, dictionaries.
• To do input/output with files in Python.

UNIT I  ALGORITHMIC PROBLEM SOLVING
Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II  DATA, EXPRESSIONS, STATEMENTS
Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III  CONTROL FLOW, FUNCTIONS
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV  LISTS, TUPLES, DICTIONARIES
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V  FILES, MODULES, PACKAGES
Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

OUTCOMES:
Upon completion of the course, students will be able to
• Develop algorithmic solutions to simple computational problems.
• Read, write, execute by hand simple Python programs.
• Structure simple Python programs for solving problems.
• Decompose a Python program into functions.
• Represent compound data using Python lists, tuples, dictionaries.
• Read and write data from/to files in Python Programs.

TEXT BOOKS:

TOTAL: 45 PERIODS

REFERENCES:

GE8152 ENGINEERING GRAPHICS L T P C
2 0 4 4

OBJECTIVES:
- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANЕ CURVES AND FREEHAND SKETCHING 7+12

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 5+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.
UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+12
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12
Principles of isometric projection – isometric scale – Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

OUTCOMES:
On successful completion of this course, the student will be able to
- familiarize with the fundamentals and standards of Engineering graphics
- perform freehand sketching of basic geometrical constructions and multiple views of objects.
- project orthographic projections of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- visualize and to project isometric and perspective sections of simple solids.

TEXT BOOK:

REFERENCES:

Publication of Bureau of Indian Standards:

Special points applicable to University Examinations on Engineering Graphics:
1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The
   students will be permitted to use appropriate scale to fit solution within A3 size.
   The examination will be conducted in appropriate sessions on the same day

<table>
<thead>
<tr>
<th>GE8161</th>
<th>PROBLEM SOLVING AND PYTHON PROGRAMMING</th>
<th>L T P C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LABORATORY</td>
<td>0 0 4 2</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:
- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

LIST OF PROGRAMS
1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

PLATFORM NEEDED
Python 3 interpreter for Windows/Linux

OUTCOMES:
Upon completion of the course, students will be able to
- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

TOTAL :60 PERIODS

<table>
<thead>
<tr>
<th>BS8161</th>
<th>PHYSICS AND CHEMISTRY LABORATORY</th>
<th>L T P C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Common to all branches of B.E. / B.Tech Programmes)</td>
<td>0 0 4 2</td>
</tr>
</tbody>
</table>

OBJECTIVES:
- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.
LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)
1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young’s modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to
1. apply principles of elasticity, optics and thermal properties for engineering applications.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

OBJECTIVES:
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometry.

1. Estimation of HCl using Na$_2$CO$_3$ as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler’s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
12. Pseudo first order kinetics-ester hydrolysis.
14. Determination of CMC.
15. Phase change in a solid.
16. Conductometric titration of strong acid vs strong base.

OUTCOMES:
- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

TOTAL: 30 PERIODS

TEXTBOOKS:
1. Vogel’s Textbook of Quantitative Chemical Analysis (8$^{th}$ edition, 2014)
OBJECTIVES:
The Course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

UNIT I  INTRODUCTION TECHNICAL ENGLISH  12
Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises - Speaking –Asking for and giving directions - Reading – reading short technical texts from journals- newspapers- Writing- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations -Vocabulary Development- technical vocabulary
Language Development –subject verb agreement - compound words.

UNIT II  READING AND STUDY SKILLS  12
Listening- Listening to longer technical talks and completing exercises based on them- Speaking – describing a process- Reading – reading longer technical texts- identifying the various transitions in a text- paragrapohing- Writing- interpreting cgrts, graphs- Vocabulary Development-vocabulary used in formal letters/emails and reports Language Development- impersonal passive voice, numerical adjectives.

UNIT III  TECHNICAL WRITING AND GRAMMAR  12
Listening- Listening to classroom lectures/ talks on engineering/technology - Speaking – introduction to technical presentations- Reading – longer texts both general and technical, practice in speed reading; Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words. Language Development- embedded sentences

UNIT IV  REPORT WRITING  12

UNIT V  GROUP DISCUSSION AND JOB APPLICATIONS  12
Listening- TED/Ink talks; Speaking –participating in a group discussion -Reading– reading and understanding technical articles Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- verbal analogies Language Development- reported speech .

OUTCOMES: At the end of the course learners will be able to:
- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.

TOTAL :60 PERIODS
• Speak appropriately and effectively in varied formal and informal contexts.
• Write reports and winning job applications.

TEXT BOOKS:

REFERENCES
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007

Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.

MA8251 ENGINEERING MATHEMATICS – II L T P C
4 0 0 4

OBJECTIVES:
• This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT I MATRICES

UNIT II VECTOR CALCULUS
Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green’s, Gauss divergence and Stoke’s theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTIONS
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions w = z + c, cz, $\frac{1}{z}$, $z^2$ - Bilinear transformation.
UNIT IV   COMPLEX INTEGRATION  

UNIT V   LAPLACE TRANSFORMS  

TOTAL: 60 PERIODS

OUTCOMES:
After successfully completing the course, the student will have a good understanding of the following topics and their applications:

- Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green’s theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

TEXT BOOKS:

REFERENCES:

PH8254   PHYSICS OF MATERIALS  
(Common to courses offered in Faculty of Technology except Fashion Technology)  
L  T  P  C  
3  0  0  3

OBJECTIVES:
- To introduce the physics of various materials relevant to different branches of technology
UNIT I  PREPARATION OF MATERIALS  9
Phases - phase rule – binary systems – tie line rule – lever rule – phase diagram – invariant
reactions - nucleation – homogeneous and heterogeneous nucleation – free energy of formation of
chemical, solvothermal, sol-gel method.

UNIT II  CONDUCTING MATERIALS  9
Classical free electron theory - expression for electrical conductivity – thermal conductivity, -
Wiedemann-Franz law – electrons in metals: particle in a three-dimensional box- degenerate
states – Fermi-Dirac statistics – density of energy states – electron in periodic potential (concept
only) – electron effective mass – concept of hole. Superconducting phenomena, properties of
superconductors – Meissner effect and isotope effect. Type I and Type II superconductors, High
Tc superconductors – Magnetic levitation and SQUIDS.

UNIT III  SEMICONDUCTING MATERIALS  9
Elemental Semiconductors - Compound semiconductors - Origin of band gap in solids (qualitative)
- carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – variation of Fermi
level with temperature – electrical conductivity – band gap determination – carrier concentration in
n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and
impurity concentration – Hall effect – determination of Hall coefficient – LED - Solar cells.

UNIT IV  DIELECTRIC AND MAGNETIC MATERIALS  9
Dielectric, Paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space
charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric loss –
different types of dielectric breakdown – classification of insulating materials and their applications
- Ferroelectric materials - Introduction to magnetic materials - Domain theory of ferromagnetism,
Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites,
magnetoresistance materials.

UNIT V  NEW MATERIALS AND APPLICATIONS  9
Metallic glasses – Shape memory alloys: Copper, Nickel and Titanium based alloys – graphene
and its properties - Ceramics: types and applications – Composites: classification, role of matrix
and reinforcement – processing of fibre reinforced plastics and fibre reinforced metals –
Biomaterials: hydroxyapatite – PMMA – Silicone - Sensors: Chemical Sensors - Bio-sensors –
conducting, semiconducting and photoresponsive polymers.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the students will able to
• gain knowledge on phase diagrams and various material processing methods,
• acquire knowledge on basics of conducting materials, superconductors and their
  applications
• get knowledge on the functioning of semiconducting materials and their applications in
  LED and solar cells,
• understand the functioning of various dielectric and magnetic materials ,
• have the necessary understanding on various advanced materials.

TEXT BOOKS:
   Ltd. 2014.

REFERENCES

PY8201 HUMAN PHYSIOLOGY L T P C
3 0 0 3

OBJECTIVES:
• To explain physiological mechanism of various organ systems and to explain the pathophysiology of underlying common diseases.

UNIT I  HEAMATOLOGY 9
Composition and functions of blood, functions of plasma proteins, reaction of blood, coagulation of blood, coagulation factors, functions of bone marrow, erythropoiesis, functions of hemoglobin, blood groups.

UNIT II  PHYSIOLOGY OF MUSCLES 9
Physiology and properties of skeletal muscle,, smooth muscle, cardiac muscle, Physiology of muscular contraction, excitability and contractibility, isotonic and isometric contractions, refractory period, tonicity, electromyography.

UNIT III  RESPIRATORY SYSTEM 9
Functions of respiratory system, role of ciliated epithelium, pleural cavity and intra pleural pressure, mechanism of breathing, resistance to breathing, pulmonary volumes, mechanism of gaseous exchange, control of respiration.

UNIT IV  CARDIOVASCULAR SYSTEM 9
Introduction to circulation, functions of circulation, anatomical considerations of heart, cardiac impulse, cardiac cycle, heart sounds, electrocardiogram, heart rate, cardiac output, blood pressure, factors influencing blood pressure, blood velocity, functions of pulmonary circulation, coronary circulation, nervous control and reflex control of blood flow.

UNIT V  ENDOCRINE AND REPRODUCTIVE SYSTEM 9
Physiology of Pituitary, thyroid, parathyroid, adrenal and pancreatic hormones and disorders of these glands, endocrine control of growth and metabolism; pineal, thymus, testes, ovaries, physiology of reproductive systems, sex hormones, physiology of fertilization, menstruation, menopause, spermatogenesis and oogenesis, pregnancy and parturition and clinical disorders

TOTAL: 45 PERIODS

OUTCOMES:
• The student should be able to locate, identify and functionally describe the organ systems of human body. Must be able to utilize appropriate reference resources to clarify and expand knowledge of physiology and pathophysiology.
TEXT BOOKS

REFERENCES

BE8252 BASIC CIVIL AND MECHANICAL ENGINEERING L T P C
4 0 0 4

OBJECTIVES:
To impart basic knowledge on Civil and Mechanical Engineering.
- To familiarize the materials and measurements used in Civil Engineering.
- To provide the exposure on the fundamental elements of civil engineering structures.
- To enable the students to distinguish the components and working principle of power plant units, IC engines, and R & AC system.

A – OVER VIEW

UNIT I SCOPE OF CIVIL AND MECHANICAL ENGINEERING 10
Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering


B – CIVIL ENGINEERING

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS 10


UNIT III BUILDING COMPONENTS AND STRUCTURES 15

C – MECHANICAL ENGINEERING

UNIT IV  INTERNAL COMBUSTION ENGINES AND POWER PLANTS  15
Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants — working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

UNIT V  REFRIGERATION AND AIR CONDITIONING SYSTEM  10

OUTCOMES:
On successful completion of this course, the student will be able to
- appreciate the Civil and Mechanical Engineering components of Projects.
- explain the usage of construction material and proper selection of construction materials.
- measure distances and area by surveying
- identify the components used in power plant cycle.
- demonstrate working principles of petrol and diesel engine.
- elaborate the components of refrigeration and Air conditioning cycle.

TOTAL: 60PERIODS

TEXTBOOKS:

REFERENCES:

PY8202  BIOCHEMISTRY  3 0 0 3

OBJECTIVE
- To enable students learn the fundamentals of Biochemical Processes and Biomolecules.
UNIT I  BIOCHEMICAL ORGANIZATION AND BIOENERGETICS  8
Scope of clinical biochemistry, component of the cell, structure and biochemical functions, membrane structure and functions, transport through biological cell membrane, transport mechanism, the concept of free energy.

UNIT II  BIOMOLECULES  12

UNIT III  BIOENERGETICS  7
High energy compounds, respiratory chain, ATP cycle, Calculation of ATP during oxidation of glucose and fatty acids. General concept of oxidation and reduction, electron transport chain, oxidative phosphorylation, uncouplers and theories of biological oxidation, chemiosmotic hypothesis.

UNIT IV  MACROMOLECULES, VITAMINS, HORMONES, ENZYMES  10
Structure of haemoglobin, immunoglobulins and nucleoprotein, classification and their properties, occurrence, functions, requirements, deficiency manifestations and role of vitamins as coenzyme, chemical nature and properties, hormones, Enzyme classification and their properties, mechanism of action, enzyme induction and inhibition, coenzyme significance and enzymes of clinical importance.

UNIT V  BIOCHEMISTRY OF CLINICAL DISEASES  8
Diabetes mellitus, atherosclerosis, Renal failure and obesity, hormonal disorders, aging, inborn errors of metabolism organ function tests

TOTAL: 45 PERIODS

TEXTBOOKS

REFERENCES
OBJECTIVES:
- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 13

Buildings:
(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:
(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:
   Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:
(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
   Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 18

Welding:
(a) Preparation of butt joints, lap joints and T-joints by Shielded metal arc welding.
   (b) Gas welding practice

Basic Machining:
(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:
(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:
(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:
(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V-fitting models.
GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13
1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
5. Measurement of energy using single phase energy meter.

IV ELECTRONICS ENGINEERING PRACTICE 16
1. Study of Electronic components and equipments – Resistor, colour coding
   measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations.
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundary and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL
1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets.
2. Carpentry vice (fitted to work bench) 15 Nos.
4. Models of industrial trusses, door joints, furniture joints 5 each
5. Power Tools: (a) Rotary Hammer 2 Nos
   (b) Demolition Hammer 2 Nos
   (c) Circular Saw 2 Nos
   (d) Planer 2 Nos
   (e) Hand Drilling Machine 2 Nos
   (f) Jigsaw 2 Nos

MECHANICAL
1. Arc welding transformer with cables and holders 5 Nos.
2. Welding booth with exhaust facility 5 Nos.
3. Welding accessories like welding shield, chipping hammer,
wire brush, etc. 5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos.

5. Centre lathe 2 Nos.
6. Hearth furnace, anvil and smithy tools 2 Sets.
7. Moulding table, foundry tools 2 Sets.
8. Power Tool: Angle Grinder 2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner One each.

**ELECTRICAL**

1. Assorted electrical components for house wiring 15 Sets
2. Electrical measuring instruments 10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each
4. Megger (250V/500V) 1 No.
5. Power Tools: (a) Range Finder 2 Nos
   (b) Digital Live-wire detector 2 Nos

**ELECTRONICS**

1. Soldering guns 10 Nos.
2. Assorted electronic components for making circuits 50 Nos.
3. Small PCBs 10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply

**PY8211 BIOCHEMISTRY LABORATORY**

**L T P C**

0 0 4 2

**AIM**

- To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,) and laboratory analysis of the same in the body fluids.

**EXPERIMENTS**

1. Preparation and measurement of pH of standard buffers (phosphate, carbonate, borate, TRIS etc.).
2. Qualitative analysis of carbohydrates (monosaccharides, disaccharides, polysaccharides etc.).
3. Enzymatic hydrolysis of glycogen by a and b amylase
4. Qualitative analysis of proteins
5. Qualitative analysis of lipids (triglycerides, cholesterol, phospholipids etc.)
6. Quantitative analysis of proteins (Lowry’s method, Bradford, UV)
7. Quantitative analysis of carbohydrates (Benedict’s method etc.) lipids
8. Quantitative analysis of lipids (Benedict’s method etc.)
9. Quantitative estimation of blood glucose
10. Acid hydrolysis and action of salivary amylase on starch
11. Estimation of chloride, glucose, ammonia and creatinine in urine.
12. Quantitative estimation of serum cholesterol by Libermann Burchard’s method

**Equipment needed for 20 students:**

Equipment Needed for 20 Students
Autoclave – 1
Hot Air Oven – 1
Incubators – 2
Light Microscopes – 4
Incubator Shaker – 1
Colorimeter – 2
Laminar Flow Chamber - 2

Glassware:
Test tubes (atleast 10 per student)
Beakers – 50 ml, 100 ml, 250 ml one each per student, 500 ml and 1000 ml atleast 5 per batch of 20 students
Watch glasses one per student
Petridishes as required, glass cuvettes as needed
Burette – one per student
Glass pipette – one each in 0.5 ml, 1 ml, 5 ml and 10 ml with suitable pipette aid.
TLC plate as required for the experiment.

Chemicals: glucose, fructose, galactose, maltose, starch, amino acids, DNA, RNA, lipids and commercial enzymes as required. Other chemicals as per the requirement of the standard protocol and commercial kit procured from the vendor followed/ utilised by the deparment

TOTAL: 60 PERIODS

TEXT BOOKS
1. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
2. Introduction of Practical Biochemistry by David T. Phummer. (II Edition)

REFERENCES

MA8353 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
4 0 0 4

OBJECTIVE:
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS
equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II  FOURIER SERIES 12

UNIT III  APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12
Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT IV  FOURIER TRANSFORMS 12

UNIT V  Z - TRANSFORMS AND DIFFERENCE EQUATIONS 12

OUTCOMES:
Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
- Students will learn PVT behaviour of fluids, laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.

UNIT I

UNIT II

UNIT III
Refrigeration and liquefaction process, Thermodynamic Potentials, thermodynamic correlation, Maxwell relations, criteria for Equilibria and stability. Clapeyron equation

UNIT IV
Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, activity and property change of mixing, excess properties of mixtures.

UNIT V
Activity coefficient-composition models, thermodynamic consistency of phase equilibria, Chemical Reaction equilibria, Extent of reaction, equilibrium constant and standard free energy change

OUTCOME:
- The course will help the students to know about engineering thermodynamics and understand the practical implications of thermodynamic law in engineering design.

TEXT BOOKS:
REFERENCES:

BT8291 MICROBIOLOGY

OBJECTIVES
- To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.
- To solve the problems in microbial infection and their control.

UNIT I INTRODUCTION 6
Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

UNIT II MICROBES- STRUCTURE AND MULTIPLICATION 12
Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages.

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 12
Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT IV CONTROL OF MICROORGANISMS 6
Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY 9
Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors

TOTAL: 45 PERIODS

TEXT BOOKS
OBJECTIVES:

- To inculcate understanding of the properties and principles of medicinal agents that originates from organic and inorganic sources and their application in pharmaceutical industry.
- To provide the basic functional group identification, molecular rearrangement, chemical bonding with their reaction mechanism.
- To provide the fundamental principles involved in the identification, preparation of pharmaceutical aids and to apply the principle of coordination compounds in pharmaceutical substances.

UNIT I  STRUCTURE AND PROPERTIES  9
Molecular orbital theory, hybrid orbitals, polarity of bonds and molecules, dipole moment, resonance, inductive, mesomeric and electromeric effects, intramolecular and intermolecular hydrogen bonding.

UNIT II  CHEMISTRY OF ALIPHATIC, AROMATIC AND HETEROAROMATIC COMPOUNDS  9

UNIT III  PRINCIPLES OF TEST FOR PURITY IN PHARMACEUTICAL SUBSTANCES  9
Identification and characterization of impurities in Pharmaceutical substances, Limit tests: Definition, importance, general procedure for limit test for chlorides, sulphates, iron, arsenic, heavy metals and lead with suitable examples.

UNIT IV  STUDY OF ORGANIC REACTIONS AND MOLECULAR REARRANGEMENTS  9

UNIT V  PHARMACEUTICAL AIDS AND CO-ORDINATION COMPOUNDS  9
Preparation and properties of various agents such as – Sodium bisulphate, Sodium metabisulphate, Sulphur dioxide, Bentonite, Magnesium stearate, Zinc stearate, Aluminium sulphate, Sodium carboxy methyl cellulose, Sodium methylparaben- Theory of co-ordination compounds with special reference to application in Pharmacy such as – EDTA, Dimercaprol, Penicillamine, 1, 10-Phenanthroline.

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
- Identify the functional groups in pharmaceutical substances and make predictions of chemical bonding along with their reaction mechanism.
- Identify and estimate the purity of drugs and its application.
- Apply the knowledge in the development and synthesis of new drug molecule with special reference to organic, inorganic and coordination chemistry.

**TEXT BOOKS:**

**REFERENCES:**

**PY8302 PHYSICAL PHARMACEUTICS**

**OBJECTIVES:**
- To acquire the fundamental principles and concepts involved in pharmaceutical powders, liquid flow, dispersions, drug diffusion, dissolution, complexation and protein binding.
- To provide the knowledge about kinetics and drug stability

**UNIT I MICROMERITICS AND POWDER RHEOLOGY**
Particle size and distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, Dynamic light scattering (DLS) technique, measurement of particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties.

**UNIT II SURFACE AND INTERFACIAL PHENOMENON, VISCOSITY AND RHEOLOGY**
Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tensions, free energy, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interface, solid gas and solid-liquid interface, complex films, electrical properties of interface. Newtonian system, Law of flow, kinematic viscosity, effect of temperature on viscosity, non-Newtonian systems, plastic, pseudoplastic, dilatant, thixotropy, thixotropy in formulation, determination of viscosity: capillary, falling ball, rotational viscometers.

**UNIT III DISPERSION SYSTEMS**
Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy. Suspensions and Emulsions: Interfacial properties of suspended particles, settling in suspension, theory of sedimentation, effect of Brownian movement, sedimentation of
flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicle, rheological considerations, emulsions; types, theories, physical stability.

UNIT IV  DIFFUSION, DISSOLUTION, COMPLEXATION & PROTEIN BINDING  9

UNIT V  KINETICS AND DRUG STABILITY  9
General considerations and concepts of drug reaction kinetics; zero order, first order and pseudo first order, half-life determination, Influence of temperature, light, catalytic species, solvent and other factors, Stabilization of drugs, Accelerated stability study, expiration dating.

OUTCOMES:
- To know the fundamental properties of pharmaceutical solids
- To understand the surface, interfacial phenomena and the rheology of liquids
- Ability to understand the principles, characters and applications of pharmaceutical dispersions.
- To acquire the knowledge about drug diffusion, dissolution, complexation and protein binding.
- To be familiar with the degradation pathways, stabilization of drugs and their expiry date calculation.

TEXT BOOKS:

REFERENCES:

GE8291       ENVIRONMENTAL SCIENCE AND ENGINEERING       L   T   P   C
3   0   0   3

OBJECTIVES:
- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
• To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
• To study the dynamic processes and understand the features of the earth’s interior and surface.
• To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I       ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY
Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II      ENVIRONMENTAL POLLUTION
Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III     NATURAL RESOURCES
Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV      SOCIAL ISSUES AND THE ENVIRONMENT
From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization-environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

TOTAL: 45 PERIODS

OUTCOMES:
- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS:

REFERENCES:

PY8311 PHYSICAL PHARMACEUTICS LABORATORY 0 0 4 2

OBJECTIVES:
- To practice the determination of fundamental properties of dosage forms of powders and dispersions.
- To study the kinetics and stability aspects of pharmaceuticals.

LIST OF EXPERIMENTS:
1. Studies on polymorphs, their identification and properties.
2. Determination of particle size, particle size distribution and surface area using various methods of particle size analysis.
3. Determination of derived properties of powders like density, porosity, compressibility, angle of repose, etc.
4. Determination of surface/interfacial tension, HLB value and critical micellar concentration (CMC) of surfactants.
5. Study of rheological properties of various types of systems using different viscometers.
6. Study of different types of colloids and their properties.
7. Preparation of various types of suspensions and determination of their sedimentation parameters.
8. Preparation and stability studies of emulsions.
9. Studies on different types of complexes and determination of their stability constants.
10. Studies on protein binding of drugs
11. Determination of half-life, rate constant and order of reaction.
12. Preparation of pharmaceutical buffers and determination of buffer capacity.
13. Determination of shelf life of a product based on Arrhenius principle

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS FOR BATCH OF 30 STUDENTS
- Optical Microscope-5nos
- Stage Micrometer-5nos
- Eye piece micrometer-5nos
- Stalagmometer-10Nos
- Ostwald’s Viscometer-10nos
- Brookfield viscometer-1no
- Tapped density apparatus-3nos
- Andreasen pipette-3nos
- Sieve shaker with sieve sets of different sizes-1no

GLASSWARES REQUIRED
- Pycnometer, Funnel, Beakers, Measuring cylinders, Dessicator, Mortar and pestle

OUTCOMES:
On completion of the course the students will able to
- Characterize and evaluate the properties of powders by using suitable methods.
- Plan and carryout the stability studies and determine the stability of various dosage forms.
- Calculate the rate constants and determine the various order of reactions involved in pharmaceutical systems and process.

TEXT BOOKS:

REFERENCES:

BT8361 MICROBIOLOGY LABORATORY L T P C
0 0 4 2

OBJECTIVE:
- To demonstrate various techniques to learn the morphology, identification and propagation of microbes
Experiments

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
2. Culture Media-Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs
5. Microscopic Methods in the Study of Microorganisms., Microscopic identification of yeast/mould
6. Staining Techniques Simple, Differential- Gram’s Staining, spore /capsule staining
7. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
8. Effect of Disinfectants- Phenol Coefficient
9. Antibiotic Sensitivity Assay
10. Growth Curve in Bacteria and Yeast
11. Effect of pH, Temperature, UV radiation on Growth Bacteria

TOTAL: 60 PERIODS

OUTCOMES:
Students will be able to
- Understand the advanced technical information pertaining to laboratory bio-safety and preventive measures from pathogenic microorganism.
- Know the various aseptic techniques and sterilization methods.
- Develop the minimum skills to work on several important techniques for the study of microorganisms in the laboratory.

Equipment Needed for 30 Students
Autoclave 1
Hot Air Oven 1
Incubators 2
Light Microscopes 4
Incubator Shaker 1
Colorimeter 2
Lamina Flow Chamber 2
Glassware
Petridish, Test tubes
Microscopic slides
Inoculation loop
Gas burner

Chemicals and media
Bacterial culture media
Yeast culture media
70% ethanol
antibiotics
Crystal violet
Iodine
Safranin
India ink (capsule staining)
Immersion oil

TEXT BOOKS
HS8381 INTERPERSONAL SKILLS/LISTENING&SPEAKING

OBJECTIVES: The Course will enable learners to:

• Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
• Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
• Improve general and academic listening skills
• Make effective presentations.

UNIT I
Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

UNIT II
Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

UNIT III
Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail

UNIT IV
Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.

UNIT V
Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

TOTAL: 30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:

• Listen and respond appropriately.
• Participate in group discussions
• Make effective presentations
• Participate confidently and appropriately in conversations both formal and informal
TEXT BOOKS:

REFERENCES:

MA8391 PROBABILITY AND STATISTICS L T P C
4 0 0 4

OBJECTIVES:
- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 12
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 12
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 12
One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT V STATISTICAL QUALITY CONTROL 12
Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 60 PERIODS

OUTCOMES:
Upon successful completion of the course, students will be able to:

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS:

REFERENCES:

PY8401 STOICHIOMETRY AND CHEMICAL PROCESS CALCULATIONS

OBJECTIVE:
This course will enable students

- To introduce the basic calculation techniques, laws about the behaviour of gases, liquids and solids, for analysing and designing chemical processing equipment with the help of data sources containing relevant physical and chemical properties.

UNIT I UNITS AND DIMENSIONS

47
Fundamental and derived units, conversion, dimensional consistency of equations, conversions of equations, Dimensional and dimensionless constants, mass and volume relations, Stoichiometric and composition relations.

UNIT II IDEAL GASES AND VAPOUR PRESSURE
Ideal gas law, Dalton’s Law, Amagat’s Law and Average molecular weight of gaseous mixtures. Effect of temperature on vapour pressure, Vapour pressure plot (Cox chart), Vapour pressures of miscible and immiscible liquids and solutions, Raoult’s Law and Henry’s Law.

UNIT III HUMIDITY AND SOLUBILITY
Partial saturation, Humidity- Absolute Humidity, Vaporization process, Molal humidity, Relative and percentage saturation, dew point, humid heat, wet bulb and dry bulb temperatures, use of humidity charts, adiabatic vaporization and adiabatic saturation temperature.

UNIT IV MATERIAL BALANCE

UNIT V ENERGY BALANCE

OUTCOMES:
On completion of this course the student will

• Have clear idea of various types of unit systems and they will be able to convert units from one form of the unit to other.
• Have sound strategy for solving and developing mathematical relations for material and energy balance calculations for reaction and separation processes.
• Analyze the behaviour of recycle processes, performing approximate material balances by hand and setting up calculations for rigorous solution by computer.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To provide the basic fundamental knowledge about the flow properties of different types of fluids and its momentum balance.
- To provide the knowledge about the various transporting and metering devices of fluid flow in bulk pharmaceutical manufacturing and in chemical process.

UNIT I   PROPERTIES OF FLUIDS AND CONCEPT OF PRESSURE

UNIT II  MOMENTUM BALANCE AND ITS APPLICATIONS

UNIT III  FLOW OF INCOMPRESSIBLE FLUIDS THROUGH DUCTS
Flow of incompressible fluids in pipes–Laminar and turbulent flow through closed conduits–Velocity profile and friction act or for smooth and rough pipes–Heat loss due to friction in pipes and Fittings.

UNIT IV  FLOW OF FLUIDS THROUGH SOLIDS

UNIT V  TRANSPORTATION AND METERING

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
- Understand fundamental concepts in fluids, such as density, viscosity, pressure and temperature.
- Apply the mass, energy and momentum balance equations in fluid flow problems.
- Analyse and solve the problems involving laminar and turbulent frictional flow, fluid dragon particles, packed beds and pumps involving Newtonian and non-Newtonian fluid flow in chemical engineering equipment’s.

TEXT BOOKS:

REFERENCES:

PY8403 UNIT OPERATIONS IN PHARMA INDUSTRIES L T P C
3 2 0 4

OBJECTIVE:
- To provide the basic fundamentals and various unit operations such as size reduction, separation, filtration, centrifugation, crystallization and evaporation.

UNIT I MATERIALS OF PHARMACEUTICAL PLANT CONSTRUCTION 15
Overview of composition, corrosion, resistance, properties and applications of the materials of construction with special reference to stainless steel and glass- Industrial Hazards and Safety Precautions – Mechanical, Chemical, Electrical, Fire and Dust hazards, etc.

UNIT II SIZE REDUCTION & SEPARATION 15
Properties and characterization of particulate solids — Introduction to storage and conveying of solids - Analysis and technical methods for size determination of powders - Size reduction equipment – Screening equipment

UNIT III CRYSTALLIZATION 15

UNIT IV FILTRATION AND CENTRIFUGATION 15

UNIT V MIXING 15
Mixing of powdered materials – Mechanism of random mixing and interactive mixing. Sampling techniques, size and mixing indices. Factors affecting the mixing process. Types, characteristics and operation of mixers.

TOTAL (L:45 + T:30):75 PERIODS

OUTCOMES:
The student will be able to
- Recognise the various categories of materials used in pharmaceutical industry.
- Apprehend the fundamental concepts of Size reduction, separation, filtration, centrifugation in Pharmaceutical industry.
- Comprehend the fundamental concepts of crystallization and evaporation

TEXT BOOKS:
REFERENCES:

OBJECTIVES:
• To expose students to application of recombinant DNA technology in biotechnological research.
• To train students in strategizing research methodologies employing cloning, construction of DNA libraries
• To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.

UNIT I MOLECULAR GENETICS 12
Bacterial conjugation, transduction and transformation, prokaryotic and eukaryotic genome organization; Introduction to nucleic acids, Nucleic acids as genetic material, Structure and function of DNA and RNA, DNA replication, Overview of differences in prokaryotic and eukaryotic DNA replication, Telomere replication in eukaryotes. Mutagens, DNA mutations and their mechanism, various types of repair mechanisms.

UNIT II TRANSCRIPTION AND TRANSLATION 12

UNIT III RECOMBINANT DNA TECHNOLOGY 12

UNIT IV SEQUENCING AND AMPLIFICATION OF DNA 12
UNIT V  GENOME ANALYSIS AND GENOMICS  12
Gene therapy and Transgenic technology, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Web resources for Genomics, Regulation of Eukaryotic Gene Expression by Small RNAs (RNA Interference, RNAi).

TOTAL: 60 PERIODS

OUTCOMES:
By the end of this course, students will be able to
• Describe the basic structure of nucleic acids, identify the principles of DNA replication, transcription and translation of proteins
• To produce the commercially important recombinant proteins
• Understand about gene expression and genome sequencing techniques

TEXT BOOKS:

REFERENCES:

PY8405  PHARMACEUTICAL ANALYSIS  L T P C 3 0 0 3

OBJECTIVE:
• To facilitate students to acquire knowledge about the principles and operations of various modern analytical instruments.

UNIT I  UV-VISIBLE SPECTROSCOPY  9
Theory of atomic and molecular spectra, Electronic transitions, Beer and Lambert’s law, Derivation and deviations, Chromophores, Auxochromes, Spectral shifts, Solvent effect on absorption spectra. Instrumentation - Sources of radiation, wavelength selectors, sample cells, Detectors-Barrier layer cell, Photo tube, PMT, PDA detectors; Applications in pharmaceuticals.

UNIT II  ATOMIC ABSORPTION SPECTROSCOPY  9
Principles, Instrumentation, Operation – single and double beam spectroscopy; sampling technique – Detection limit, Difference between Atomic absorption spectroscopy and Flame spectroscopy; Applications in pharmaceuticals.

UNIT III  INFRARED AND NMR SPECTROSCOPY  9
Principles of vibrational spectroscopy – Instrumentation and sampling techniques – Applications in pharmaceutical sciences – NMR principles – Instrumentation – Applications in pharmaceuticals.

UNIT IV MASS SPECTROMETRY
Basic principles, instrumentation and ionization methods; atmospheric pressure ionization (API), chemical ionization (CI), electron impact ionization (EI), fast atom bombardment (FAB), matrix assisted laser desorption ionization (MALDI), time of flight (TOF); Applications in pharmaceuticals.

UNIT V CHROMATOGRAPHIC METHODS
History, origin and classification of chromatography: Column Chromatography: principle, theory, column operations, instrumentation, derivatisation methods and applications; High Performance Liquid Chromatography: Principle, instrumentation, solvents system, packing materials and applications; Thin Layer Chromatography: Principle, instrumentation, solvents, packing materials and applications in pharmaceuticals.

TOTAL: 45 PERIODS

OUTCOMES:
- Develops ability to handle the modern analytical instruments like UV/Vis, IR, NMR, Mass spectroscopy and HPLC.
- Develops ability to involve in Qualitative and Quantitative analysis of various pharmaceutical agents.
- Develops ability to involve in phytochemical and biological standardization of pharmaceutical products.

TEXT BOOKS:

REFERENCES:

PY8411 ANALYTICAL METHODS AND INSTRUMENTATION LABORATORY L T P C
0 0 4 2

OBJECTIVE:
- To carry out analytical experiments related to spectroscopic and chromatographic techniques.

LIST OF EXPERIMENTS
1. Calibration of volumetric glasswares.
2. Establishing standard operating procedure (SOP) and Calibration records for analytical balance, pH meter and UV/Vis spectroscopy.
3. Determination of $\lambda_{\text{max}}$
4. Effect of change in physio-chemical parameters on absorbance spectrum of a drug molecule.
5. Quantitative and qualitative analysis of drug molecule using standard comparison method by UV/Vis spectroscopy and HPLC.
6. Quantitative analysis of drug molecule using E1%1cm method by UV/Vis spectroscopy.
7. Quantitative analysis of drug molecule using calibration graph method by UV/Vis spectroscopy and HPLC.
8. Separation and identification of mixtures of drugs by TLC.
10. Identification of functional group of a drug molecule by IR spectroscopy.
11. Determination of impurities by limit test.
12. Quantitative analysis by titrimetric methods.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

- Digital balance-5nos
- Digital pH meter-5nos
- UV chamber-1no
- TLC chamber-1no
- UV-Visible spectroscopy-1no
- Colorimeter-5nos
- HPLC-1no
- IR spectroscopy-1no

GLASSWARES REQUIRED
Nessler’s cylinder, Burette, Conical flask, Beakers and standard volumetric flasks

OUTCOMES:
Student will be able to perform,
- Preparation and standardization of various assay reagents with respect to chemical and drug analysis.
- Separation and quantification of drugs molecules by chromatographic and spectral techniques.

REFERENCES:

OBJECTIVES:
- To understand the principle of nucleic acid isolation.
- To understand the principles of PCR and their uses in genetic engineering.
• To gain a thorough knowledge about nucleic acid hybridization.
• To learn history of DNA sequencing and current methods and gene synthesis

LIST OF EXPERIMENTS:
1. Preparation of Genomic DNA
2. PCR amplification of gene from the genomic DNA
3. Preparation of plasmid DNA
4. Detection of Plasmid DNA by Agarose gel electrophoresis
5. Restriction Digestion of the vector and Insert
6. Ligation and Transformation of \textit{E. coli}
7. Lysate PCR confirmation.
8. Restriction & gel elution of DNA fragments
9. Electroporation of Yeast
10. SDS-PAGE analysis of purified protein
11. Western blot confirmation of expressed protein (anti his)
12. ELISA– Quantification of proteins.
13. RNA Isolation
14. cDNA preparation from RNA
15. Site directed mutagenesis
16. Southern hybridization experiment

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS REQUIRED FOR 30 STUDENTS
• PCR machine
• Electrophoretic assemblies for DNA and protein separations
• ELISA reader
• Ultracentrifuge
• Laminar air flow cabinets
• Cooling centrifuge

OUTCOMES:
By the end of this course, students will be able to:
• Describe the main principles, methods for preparation and cloning of DNA in various organisms.
• Express clearly about the gene amplification and methods for analysis of DNA, such as hybridization, restriction analysis and gene expressions.
• Express clearly about the analysis of protein expressions.

REFERENCES:
• Strengthen the reading skills of students of engineering.
• Enhance their writing skills with specific reference to technical writing.
• Develop students’ critical thinking skills.
• Provide more opportunities to develop their project and proposal writing skills.

UNIT I
Reading - Strategies for effective reading- Use glosses and footnotes to aid reading comprehension- Read and recognize different text types- Predicting content using photos and title
Writing- Plan before writing- Develop a paragraph: topic sentence, supporting sentences, concluding sentence – Write a descriptive paragraph

UNIT II
Reading- Read for details- Use of graphic organizers to review and aid comprehension Writing- State reasons and examples to support ideas in writing- Write a paragraph with reasons and examples- Write an opinion paragraph

UNIT III
Reading- Understanding pronoun reference and use of connectors in a passage- Speed reading techniques- Writing- Elements of a good essay- Types of essays- descriptive-narrative- issue-based-argumentative-analytical.

UNIT IV
Reading- Genre and Organization of Ideas- Writing- Email writing- visumes – Job application- project writing-writing convincing proposals.

UNIT V
Reading- Critical reading and thinking- understanding how the text positions the reader- identify Writing- Statement of Purpose- letter of recommendation- Vision statement

TOTAL: 30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:
• Write different types of essays.
• Write winning job applications.
• Read and evaluate texts critically.
• Display critical thinking in various professional contexts.

TEXT BOOKS:

REFERENCES:
3. Withrow, Jeans and et al. Inspired to Write. Readings and Tasks to develop writing
skills. Cambridge University Press: Cambridge, 2004


BT8691        APPLIED CHEMICAL REACTION ENGINEERING     L T P C

3  0 0 3

**OBJECTIVES:**

- To provide the basic concepts of types of reactions, variable affecting the rate of reaction, predicting the rate equations for different types of reactions.
- To provide the information about different reactor systems, deriving the performance equations and predicting the rate equations in chemical reaction engineering system.

**UNIT I  SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING   9**

Broad outline of chemical reactors; rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions. Industrial scale reactors.

**UNIT II  IDEAL REACTORS           9**

Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.

**UNIT III NON IDEAL REACTORS         9**

RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

**UNIT IV GAS-SOLID, GAS-LIQUID REACTIONS        9**

Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

**UNIT V FIXED BED AND FLUID BED REACTORS        9**

G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The student will be able to

- Write the rate equation for any type of reaction.
- Design reactors for heterogeneous reactions and optimize operating conditions.
- Relate and calculate the conversions, concentrations and rates in a reaction and identify, formulate and solve chemical engineering problems.

**TEXT BOOKS:**


**REFERENCES:**


PY8501 MEDICINAL CHEMISTRY L T P C
4 0 0 4

OBJECTIVES:
• To impart comprehensive understanding of the chemical basis of drug action including physicochemical and steric properties of drug.
• To study the classification, chemical nomenclature, generic names and synthesis of various medicinal agents.
• To understand the structure activity relationship, biochemical/molecular basis of mechanism of action and uses of drug.

UNIT I PRINCIPLES OF MEDICINAL CHEMISTRY 12

UNIT II DRUGS ACTING ON SYNAPTIC AND NEURO-EFFECTOR JUNCTION SITES 12
Classification, biochemical/molecular basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties and synthesis of selected drugs belonging to the class of Cholinergics, Anticholinergics, Anticholinesterases and Adrenergics.

UNIT III DRUGS ACTING ON THE CENTRAL NERVOUS SYSTEM 12
Classification, molecular basis of mechanism of action, structure activity relationship and synthesis of Hypnotics and Sedatives, Opioid analgesics, Anticonvulsants and Psychopharmacological agents (neuroleptics, antidepressants, anxiolytics).

UNIT IV DRUGS ACTING ON CARDIOVASCULAR SYSTEM 12
Structural basis of mechanism of action, structure activity relationship including physiochemical properties, and synthesis of selected drugs belonging to the class of anti-anginal, vasodilators, calcium channel blockers and cardiac glycosides.

UNIT V AUTOECIDS 12
Synthetic procedures, uses, structure activity relationship including physicochemical properties of the following classes of drugs Antihistamines, Eicosanoids, Analgesic-antipyretics, Anti -inflammatory (non-steroidal) agents.

TOTAL: 60 PERIODS

OUTCOMES:
The student will be able to
• Gain an appreciation of importance of the physical properties of drugs with respect to the ionization, solubility and efficacy of drugs, understand how changes in the chemical structure of drugs affect efficacy.
• Obtain a working knowledge of chemical structures and nomenclature, to develop the ability to suggest suitable techniques to synthesis different drug molecules.
• Understand how current drugs were developed and demonstrate the importance of chemistry in the development and application of therapeutic drugs.
TEXT BOOKS:

REFERENCES:

PY8502 PHARMACOLOGY AND CHEMOTHERAPY

OBJECTIVES:
- To provide the general pharmacological principles.
- To make understand the pharmacology of different types of drugs acting on various physiological systems.

UNIT I GENERAL PHARMACOLOGY 12
Routes of administration, Pharmacokinetics, Pharmacodynamics, Factors modifying drug action, adverse drug reaction, drug interactions, Bioassay of drugs, drug discovery and development.

UNIT II PERIPHERAL AND CENTRAL NERVOUS SYSTEM 12
Mechanism of action, Pharmacology of parasympathomimetics, parasympatholytics, sympathomimetics, sympatholytics, neuromuscular blocking agents, general anaesthetics, antipsychotics, antidepressants, antiepileptic, analgesics, antipyretic, anti-inflammatory (NSAIDS) and CNS stimulants.

UNIT III CARDIOVASCULAR PHARMACOLOGY 12
Classification, Mechanism of action, Pharmacology of cardiac glycosides, antianginal, antihypertensive agents, vasodilators including calcium channel blockers, antiarrhythmic and anti-hyperlipidemic agents.

UNIT IV GASTROINTESTINAL PHARMACOLOGY 10
Classification, Mechanism of action, Antacids, antulcer drugs, laxatives, antidiarrhoeal, emetics, antiemetics, appetite stimulants and suppressants.

UNIT V CHEMOTHERAPY AND ANTIMICROBIAL AGENTS 14
General principles of chemotherapy, sulphonamides, antibiotics – penicillins, cephalosporins, chloramphenicol, macrolides, fluoroquinolones. Chemotherapy of tuberculosis, leprosy, fungal, viral diseases, malignancy and immunosuppressive agents.

TOTAL: 60 PERIODS

OUTCOMES:
The student will be able to
• Understand the various principles of general pharmacology.
• Understand the pharmacology of various categories of drugs acting on nervous, cardiovascular and gastrointestinal systems.
• Understand the principles of chemotherapy and pharmacology of antimicrobial agents.

TEXT BOOKS:

REFERENCES:

FD8491 FUNDAMENTALS OF HEAT AND MASS TRANSFER L T P C 3 2 0 4

OBJECTIVE:
• To understand the principles and applications of heat and mass transfer operations.

UNIT I HEAT TRANSFER – CONDUCTION 9+6

UNIT II HEAT TRANSFER - CONVECTION 9+6

UNIT III HEAT TRANSFER – HEAT EXCHANGER 9+6

UNIT IV HEAT TRANSFER: RADIATION 9+6
Radiation heat transfer – concept of black and grey body - monochromatic total emissive power – Kirchoff’s law – Planck’s law - Stefan-Boltzman’s law – heat exchange through non-absorbing media - solving problems in heat transfer by radiation.

UNIT V  MASS TRANSFER  9+6

TOTAL: 75 PERIODS

OUTCOME:
- To understand and apply the principles in heat transfer phenomena
- To understand and apply the principles in mass transfer phenomena
- To design heat and mass transfer equipments.

TEXT BOOKS:

REFERENCES:

PY8511  PHYSIOLOGY AND PHARMACOLOGY LABORATORY  L T P C
0 0 4 2

OBJECTIVES:
- To learn the gross histology, structure and functions of various organs of the human body
- To perform the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body.
- Communicate clearly and in a way that reflects knowledge and understanding of the human body and demonstrates the ability to adapt information to different audiences and applications.

PHYSIOLOGY EXPERIMENTS
1. Microscopical examination of tissue samples and endocrine glands.
2. Measurements of enzyme activity (Glucose, amino acids, cholesterol, etc in biological specimens)
3. Determination of bleeding time and clotting time
5. RBC estimation, WBC total count and differential count
7. Determination of pulse, heart rate, BP and recording of ECG.
8. Determination of vital capacity.
9. Study of nervous system through reflex arcs and jerks.

PHARMACOLOGY EXPERIMENTS
1. Practical &/ Online demonstration of laboratory animals handling and various routes of drug administration.
2. Virtual study of use of anaesthetics in various laboratory animals.
3. Virtual demonstration of determination of toxicity. LD 50.
4. To demonstrate the bioassay of Ach using isolated ileum /rectus abdominis muscle preparation using online videos.
5. Bioassay of 5-HT using rat fundus strip or Bioassay of oxytocin using rat uterus using simulation software’s / online gadgets.
7. Study of alternative methods for drug evaluation.

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS FOR BATCH OF 30 STUDENTS
- Microscopes-5nos
- Haemocytometer with Micropipettes-10nos
- Hutchinson’s spirometer-1no
- Spygmomanometer-5nos
- Stethoscope-5nos
- Haemoglobinometer-5nos
- Sherrington’s Kymograph Machine / Polyrite-5nos
- Sherrington Drum-5nos
- Computer with LCD-1no
- Software packages for experiment-1no
- Convulsiometer-1no
- Plethysmograph-1no
- Permanent Slides for various tissues-one pair for each tissues

Models for various organs

OUTCOMES:
The students will be able to
- Perform basic physiological and pharmacological experiments and to record and interpret the results for its clinical significance.
- Demonstrate laboratory procedures used to examine anatomical structures and evaluate physiological functions of each organ system.
- Interpret graphs of anatomical and physiological data.

REFERENCE BOOKS:
OBJECTIVES:
- To provide students with the practical laboratory skills of medicinal chemistry
- To demonstrate the effect of the different synthetic methodology.
- To clarify theoretical concepts of chemical synthesis of drug molecules.

LIST OF EXPERIMENTS: (Minimum of 10 experiments shall be conducted)
1. Determination of melting point.
3. Determination of partition coefficient of any medicinal compound by shake flask method.
4. Synthesis and characterization of the following drugs:
   a. Phenacetin
   b. Antipyrin
   c. Benzocaine
   d. Uramil
   e. Tolbutamide
   f. Phenothiazine
   g. Isoniazid
   h. Sulphasalazine
   i. Aspirin from salicylic acid
   j. Paracetamol from p-aminophenol
   k. Benzotriazole
   l. 2-Phenyl Indole
   m. 7-hydroxy-4methyl coumarin
5. Any other relevant experiments based on theory.

LIST OF EQUIPMENTS REQUIRED FOR 30 STUDENTS
- Hot plates-10
- Hot air Oven-2
- Suction pumps-2
- Muffle Furnace-1
- Mechanical Stirrers-10
- Magnetic Stirrers with Thermostat-10
- Vacuum Pump-2
- Digital pH meter-1
- Distillation Unit-1
- Buchner Funnel-5nos
- Reflux condenser-3nos

OUTCOMES:
The students will be able to
- develop the ability to suggest suitable techniques to synthesis different drug molecules
- master a variety of synthetic techniques including purification methods and should gain the ability to design a synthetic scheme for a proposed drug molecule.
- Demonstrate how to conduct chemical reactions within medicinal chemistry context and scientific report.

REFERENCES:

HS8581 PROFESSIONAL COMMUNICATION L T P C
0 0 2 1

OBJECTIVES:
The course aims to:
- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully

UNIT I
Introduction to Soft Skills—Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II
Self-Introduction—organizing the material —Introducing oneself to the audience —introducing the topic — answering questions — individual presentation practice — presenting the visuals effectively — 5 minute presentations

UNIT III
Introduction to Group Discussion—Participating in group discussions —understanding group dynamics —brainstorming the topic —questioning and clarifying—GD strategies-activities to improve GD skills

UNIT IV
Interview etiquette —dress code —body language —attending job interviews—telephone/skype interview—one to one interview & panel interview —FAQs related to job interviews

UNIT V
Recognizing differences between groups and teams—managing time—managing stress—networking professionally—respecting social protocols—understanding career management—developing a long-term career plan—making career changes

TOTLA: 30 PERIODS

OUTCOMES:
At the end of the course Learners will be able to:
- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

Recommended Software
1. Open Source Software
2. Win English

REFERENCES:

GE8077 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:
- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION

UNIT II TQM PRINCIPLES
Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II
Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY MANAGEMENT SYSTEM

TOTAL: 45 PERIODS

OUTCOME:
- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

REFERENCES:
4. ISO9001-2015 standards

BT8591       BIOPROCESS ENGINEERING      L T P C
            3 0 0 3

OBJECTIVES:
• To provide the students with the basics of bioreactor engineering.
• To develop bioengineering skills for the production of biochemical product using integrated biochemical processes.

UNIT I  CONFIGURATION OF BIOREACTORS
Ideal reactors and its characteristicsFed batch cultivation, Cell recycle cultivation, Cell recycle cultivation in waste water treatment, two stage cultivation Packed bed reactor, airlift reactor, introduction to fluidized bed reactor bubble column reactors

UNIT II  BIOREACTOR SCALE – UP
Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors – microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed.

UNIT III  BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS
Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors

UNIT IV  MODELLING AND SIMULATION OF BIOPROCESSES
Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

UNIT V  RECOMBINANT CELL CULTIVATION
Different host vector system for recombinant cell cultivation strategies and advantages. E.coli, yeast Pichia pastoris / Saccharomyces cerevisae, Animal cell cultivation, plant cell cultivation, Insect cell cultivation. High cell density cultivation, process strategies, reactor considerations in the above system

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of Bioprocess Engineering course graduates will be able to
• Select appropriate bioreactor configurations and operation modes based upon the nature of bioproducts and cell lines and other process criteria.
• Apply modeling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems.
Plan a research career or to work in the biotechnology industry with strong foundation about bioreactor design and scale-up.

Integrate research lab and Industry; identify problems and seek practical solutions for large scale implementation of Biotechnology.

TEXT BOOKS:
2. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications

REFERENCES
3. James M. Lee, Biochemical Engineering, PHI, USA.
5. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc

PY8601 TECHNOLOGY OF SOLID DOSAGE FORMS L T P C
4 0 0 4

OBJECTIVE:
- To provide the concepts of various parameters involved in the formulation and development of various solid dosage forms.

UNIT I POWDERS AND GRANULES
Advantages and disadvantages of powdered and granulated products, Mixing and dividing of powders, Problems in manufacturing powders, Effervescent granules, Reasons for granulation, Granulation mechanisms, Pharmaceutical granulation equipments.

UNIT II TABLETS AND COATING
Types of tablets, Formulation, Manufacturing of tablets, Tableting problems, Evaluation of Tablets, Tablet coating, Film coating, Sugar Coating, Enteric coating, Evaluation of coated tablets, Applications, Large Scale Manufacture.

UNIT III CAPSULES

UNIT IV MICROENCAPSULATION
Types of microcapsules, Application of microencapsulation in pharmaceutical sciences, Microencapsulation by coacervation, Phase separation, Multi-orifice centrifugation, Spray congealing, Polymerization, Air suspension technique, Pan coating and other techniques, Evaluation of microcapsules.

UNIT V ADVANCES IN TABLETING TECHNIQUES
Sustained release dosage forms, controlled release dosage forms - Compression coating – Inlay tablets, Layer tablets, Mouth dissolving tablet, Tablets in tablets.
OUTCOMES:
The student will be able to
- Comprehend the factors influencing the development of various solid dosage forms.
- Recognize the formulation concepts and evaluate different dosage forms to meet out the compendial requirements.
- Apprehend the advances in solid dosage forms

TEXT BOOKS:
2. Indian Pharmacopoeia, Indian Pharmacopoeia commission, Ghaziabad, 2016

REFERENCES:

OBJECTIVES:
- The course provides the basics of bioprocess engineering.
- To offer a thorough foundation for more advanced studies in microbiology, biotechnology and environmental engineering.
- To introduce the engineering principles of bioprocesses including characteristics of different microbial cells, enzymes, microbial kinetics, and design considerations.

EXPERIMENTS:
1. Batch sterilization kinetics.
2. Medium optimization of growth conditions – Physical and Chemical parameters
   (a) Placket burman design. (b) Response surface methodology
4. Residence time distribution.
8. Immobilized Enzyme Kinetics in batch reactor - matrix entrapment, ionic and cross linking.

TOTAL: 60 PERIODS

TOTAL: 60 PERIODS
LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
- Bioreactor (Fermentor lab scale)
- Microbial shaker incubator
- Cooling centrifuge
- Refrigerator
- Incubator

OUTCOMES:
After completing this course, the student will be able to
- Describe the fundamental concepts of bioprocessing, understand the difference between bioprocesses and chemical processes, bioprocess design and operation and would be able to select the bioreactor
- Demonstrate bioprocesses in a bacterium, fungi or yeast, and their energy metabolism and carbon sources through various parameters.
- Evaluate and optimize the nutritional requirements.

REFERENCES:

PY8612 TECHNOLOGY OF DOSAGE FORMS LABORATORY

OBJECTIVE:
- To study the basic principles in formulating liquid, semisolid, solid and parenteral dosage forms and their evaluations.

LIST OF EXPERIMENTS
1. Preparation of solutions
2. Preparation of creams
3. Evaluation of creams
4. Preparation of ointments
5. Evaluation of ointments
6. Preformulation studies on prepared granules
7. Manufacture and evaluation of granules - wet granulation and dry granulation methods
8. Preparation of tablets
   a. Tablets prepared from wet and dry granules
   b. Tablets prepared by direct compression
9. Formulation and filling of hard gelatin capsules
10. Preparation and evaluation of parenterals
    a. Ascorbic acid injection
    b. Calcium gluconate injection
    c. Sodium chloride injection

TOTAL: 60 PERIODS

OUTCOMES:
The students will be able to
• Acquire knowledge to prepare and evaluate various liquid, semi solid dosage forms
• Acquire knowledge to prepare and evaluate solid dosage forms and parenteral dosage forms
• Apply the knowledge to formulate new dosage forms.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Mechanical stirrers-10
2. Homogenizer-5
3. Tray dryer-1
4. Propeller type mechanical agitator-10
5. Capsule filling machine-2
6. Ampoule washing machine-1
7. Ampoule filling and sealing machine-1
8. Tablet punching machine-1
9. Tablet disintegration test apparatus -1
10. Tablet dissolution test apparatus -1
11. Monsanto’s hardness tester-3
12. Friability test apparatus 1
13. Clarity test apparatus-1
14. Ointment filling machine-1
15. Collapsible tube crimping machine-1
16. Bulk Density Apparatus-2nos
17. Liquid Filling Machine-1

TEXT BOOKS:
2. Indian Pharmacopoeia, Indian Pharmacopoeia commission, Ghaziabad, 2016.

REFERENCES:

PY8701 BIOPHARMACEUTICS AND PHARMACOKINETICS L T P C
3 0 0 3

OBJECTIVES:
• To learn important parameters involved in drug disposition and its principles in living systems.
• To make the students to understand how the drug disposition takes place in the in vitro and in vivo conditions.
• To understand the concepts of bioavailability and bioequivalence of drug products and their significance
UNIT I DRUG ABSORPTION AND DISTRIBUTION

UNIT II ELIMINATION

UNIT III BIOAVAILABILITY AND BIOEQUIVALENCE
Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, in-vitro drug dissolution models, in-vitro-in-vivo correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

UNIT IV PHARMACOKINETICS
Introduction to Pharmacokinetics, Pharmacokinetic models, One compartment open model- Intravenous Bolus Injection – Intravenous infusion - Extra vascular administrations. Determination of pharmacokinetics parameters and their significance - Absorption Rate Constant (ka), Elimination Rate Constant (K) & Elimination Hal- life (t½), AUC, C max, and t max. Apparent Volume of Distribution (V d) & Renal Clearance (Q).

UNIT V MULTIPLE DOSAGE REGIMENS AND NONLINEAR PHARMACOKINETICS

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
- Explain the various factors influencing the drug disposition, various pharmacokinetic parameters.
- Design and interpret the bioavailability and bioequivalence of dosage forms.
- Identify the factors affecting the rate of drug absorption.

TEXT BOOKS:

REFERENCES:

PY8702 REGULATORY REQUIREMENTS IN PHARMACEUTICAL INDUSTRIES L T P C
3 0 0 3

OBJECTIVE:
- To acquire the knowledge of pharmaceutical industry regulations and research

UNIT I REGULATORY CONCEPTS
Quality assurance – Quality control – Practice of cGMP – Schedule M – USFDA.

UNIT II REGULATORY ASPECTS
Pharmaceuticals: Bulk drug manufacture; Personnel, Buildings and Facilities, Process Equipment, Documentation and Records, Materials Management, Production and In-Process Controls, Packaging and Identification Labelling of API’s and Intermediates, Storage and distribution; Biotechnology derived products; Principles, Personnel, Premises and equipments, Animal quarters and care, production, labelling, Lot processing records and distribution records, quality assurance and quality control.

UNIT III INTELLECTUAL PROPERTY RIGHTS

UNIT IV ICH GUIDELINES
Quality guidelines – Impurities in new drug substances (Q3A(R2)) – Impurities in new drug products (Q3B(R2)) – Validation of analytical procedures text and methodology (Q2 (R1)).

UNIT V QUALITY AUDIT AND SELF INSPECTIONS
SOPs – Documentation – Loan license auditing – Common technical documentation (CTD) – Drug master file (DMF).

TOTAL: 45 PERIODS

OUTCOMES:
- To be familiarise with the pharmaceutical industry manufacturing practices and regulatory aspects of pharmacy products.
- To know the process of patenting activities.
- To know the quality guidelines followed for pharmaceutical products and few of the aspects involved in document preparation for pharmaceutical product registration.

TEXT BOOKS:

REFERENCES:
1. Ira R. Berry, The Pharmaceutical Regulatory Process, marcel dekker Series: Drugs and the

PY8703 CHEMISTRY OF NATURAL PRODUCTS L T P C 3 0 0 3

OBJECTIVE:
- To provide knowledge on isolation, characterization and biological significance of natural products and their active substances.

UNIT I STRUCTURAL CHARACTERISATION OF NATURAL PRODUCTS 9

UNIT II GLYCOSIDES 9
Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, medicinal properties and structural elucidation of sennosides, cardenolides and bufadienolides, digoxin and digitoxin, scillaren A and ouabain.

UNIT III ALKALOIDS 9
Classification, chemistry, general methods of extraction, isolation, chemical tests, and structural elucidation of pyridine alkaloids, tropane alkaloids, quinoline and iso-quinoline alkaloids, phenanthrene alkaloids, indole alkaloids, imidazole alkaloids, alkaloid amines, glycoalkaloids and xanthene alkaloids.

UNIT IV TERPENES AND FLAVONOIDS 9
Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, medicinal properties and structural elucidation of flavonoids, quercetin; Terpenes–special isoprene rule, mono, diterpenes, triterpenoids and sesquiterpenes and structural elucidation of citral, carvone, menthol and camphor; Steroids – cholesterol, colour reactions of steroids, stigmasterol, β-sitosterol, bile acids, ergosterol, diosgenin, solasodine and hecogenin.

UNIT V PHARMACEUTICALLY IMPORTANT NATURAL PRODUCTS 9
Structure, stereochemistry, synthesis, biogenesis and biological activity of azadirachtin, forskolin, taxanes, camptothecin, artemisinin, podophyllotoxin, estrone and mifepristone.

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able
- To understand and apply the concept of extraction, isolation and characterization of the natural products.
- To explain the classification, metabolic pathways, metabolites and structural elucidation of plant secondary metabolites.
- To acquire knowledge on structure, synthesis, biogenesis and biological activity of some of the pharmaceutically important natural products.
TEXT BOOKS:
1. O.P. Agarwal, Chemistry of Natural Products (Vol.-1 & 2), 41\textsuperscript{st} edition, GoelpublishingHouse, 2014.
3. I.L.Finar, "Organic chemistry" Volume 2, 5\textsuperscript{th} edition, Published by Pearson India, 2012.

REFERENCES:

PY8711 BIOPHARMACEUTICS AND PHARMACOKINETICS LABORATORY

OBJECTIVE:
- To impart the knowledge of the rate and extent of drug absorption and distribution.

LIST OF EXPERIMENTS
1. \textit{In-vitro} dissolution study of the given sustained release dosage form using various dissolution media.
2. Study the effect of formulation on drug release (Tablet, Solution, suspension etc.).
3. Determination of effect of pH on the partition co-efficient of drug(s)
4. Determination of protein binding of the given drug(s) and the effect of protein binding on drug bioavailability.
5. \textit{In-vitro} drug absorption study using everted small intestine sac technique.
6. To calculate the various Pharmacokinetic parameters from the given blood data of I.Vbolus injection (one compartment model).
7. To calculate various Pharmacokinetic parameters from the given urinary excretion data of I.V bolus injection using both methods (Rate of elimination & sigma minus method one compartment model).
8. To determine the various Pharmacokinetic parameters from the given blood data of oral dosage form.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
- UV-Visible spectrophotometer
- HPLC
- Dissolution apparatus
- pH meter
- Digital balance

OUTCOMES:
On completion of the course the students able to
- Perform dissolution studies for the modified dosage forms.
- Estimate various pharmacokinetic parameters using plasma and urine drug level data.
- Predict the effects of dosage form design and routes of drug administration on drug levels in body.
REFERENCES:

PY8712 CHEMISTRY OF NATURAL PRODUCTS LABORATORY L T P C 0 0 4 2

OBJECTIVE:
- The lab course is to make the students learn, understand and perform various standardisation techniques of natural products as per WHO guidelines.

LIST OF EXPERIMENTS
Standardisation techniques of medicinal plants as per WHO guidelines.
1. Morphology, microscopy and quantitative microscopy of medicinal plants: Macroscopic and microscopic identification of 4-5 commonly used medicinal plants.
2. Physical constants like: specific gravity, swelling factor, ash values, extractive values, refractive index, optical rotation of selected plant materials.
3. Phytochemical methods, identification tests for various classes of phytoconstituents.
4. Extraction and isolation of active principles such as alkaloids, flavonoids, glycosides, tannins, carbohydrates, essential oils and terpenes from natural drugs (5-6 drugs).
5. Quantification of phytochemicals in plant extracts by chromatography and spectroscopy.

TOTAL: 60 PERIODS

EQUIPMENTS REQUIRED
- Microscope-5nos
- Digital Balance-1
- Rotary vacuum evaporator -2nos
- Hot air oven -1
- Refrigerator-1
- Colony counter -1
- Sterility testing unit -1
- Camera Lucida-5
- Heating mantle -5
- Flourimeter-1
- Vacuum pump -2
- Micropipettes (Single and multi channeled) - 2
- Micro Centrifuge -1
- Projection Microscope - 1
- Clavengers apparatus -5
- Soxhlet apparatus-5
- TLC chamber and sprayer-3
- Distillation unit-1
OUTCOMES:
The students will be able to
- Perform standardisation of medicinal plant products.
- Identify different types of medicinal plants and its products by morphology, physical and chemical characteristics.
- Carry out chromatographic and spectroscopic analysis of medicinal plant products.

REFERENCES:

PY8811 PROJECT WORK L T P C
0 0 20 10

OBJECTIVE:
- To objective of the project work is to make use of the knowledge gained by the student at various stages of the degree programme.

The students are assigned project work related to product / process development, solution to the technical problems in industry and current research at national and international level. The student is required to submit a report at the end of semester based on the findings. The evaluation is made as per the Regulations of University.

PY8001 BASIC LABORATORY ANIMAL SCIENCE L T P C
3 0 0 3

OBJECTIVES:
- The objective of this course is to present basic facts and principles that are essential for the humane use and care of laboratory animals and for the quality of research.
• The objective of these courses is to present basic and appropriate biology, care, health and management of animals, recognition of pain, suffering and distress in these animals and minimally invasive procedures without anaesthesia to be applied on these animals.

• This course meets the standards for the species-specific education and training requirements for persons designing projects and procedures for these specific animals.

UNIT I FUNDAMENTALS OF LABORATORY ANIMAL SCIENCE 9
Contribution of Laboratory animals to Medical Progress: Past, Present and Future. Overview of ethics of animal research.

UNIT II LABORATORY ANIMAL CARE 9
Animal accommodation, animal care routines, animal health and hygiene, diets, feeding and drinking, reproduction, breeding and heredity.

UNIT III GLOBAL REGULATIONS 9
An overview of global and Indian legislation, regulation and policies about experimentation on laboratory animals.

UNIT IV PRE-CLINICAL RESEARCH 9
Animal models, concepts, classification of animal models and disease models, extrapolation from animals to humans, model body size and scaling.

UNIT V ALTERNATIVES TO ANIMAL TESTING 9
Alternatives to animal models, refinement, reduction, and replacement of animal uses in the life sciences.

TOTAL: 45 PERIODS

OUTCOMES:
The student would able to
• Describe the requirements of various legislation concerning scientific use of animals.
• Identify ethical issues in human-animal interaction, including replacement, reduction and refinement.
• Describe normal behaviour of rodents and lagomorphs, handling, husbandry needs, and enrichment and also could be able to describe the need for hygiene in animal housing and experimental work.

TEXT BOOKS:
1. Introduction to Laboratory Animal Science and Technology J. K. INGLIS. Pergamon Press, Elsevier; 2013.

REFERENCES:
PY8002    FUNDAMENTALS OF MATERIAL SCIENCE AND ENGINEERING    L T P C
3 0 0 3

OBJECTIVE:

- To provide a comprehensive understanding of various material, its properties and their application.

UNIT I   STRUCTURE OF SOLIDS    9

UNIT II  PHASE DIAGRAMS    9

UNIT III  MECHANICAL PROPERTIES    9

UNIT IV  ELECTRICAL AND ELECTRONIC PROPERTIES    9

UNIT V  MAGNETIC, THERMAL AND OPTICAL PROPERTIES    9

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to

- Understand basic and the mechanical behaviour of the materials.
- Understand phase diagrams and phase transformations of materials.
- Understand the basic concepts of nano- materials

TEXT BOOKS:

REFERENCES:

GE8071 DISASTER MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:
- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don’ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

TEXT BOOKS:

REFERENCES:
1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005

PY8003 TECHNOLOGY OF SEMISOLID DOSAGE FORMS

OBJECTIVE:
- To impart the knowledge of the various semisolid dosage forms and its implications in pharmaceutical technology.

UNIT I INTRODUCTION
Ideal properties of semisolid dosage forms - various types - advantages and disadvantages. Semi solid bases and their selection – preservatives - drug penetration through skin – mechanism - penetration enhancers.

UNIT II OINTMENTS

UNIT III PASTES AND GELS

UNIT IV SUPPOSITORY AND PESSARIES
UNIT V    COSMETOLOGY AND COSMETIC PREPARATIONS


TOTAL: 45 PERIODS

OUTCOMES:
- Understands the principles of various semisolid dosage forms
- Understands basic process used in different preparation of semisolid formulation
- Able to know formulation, labeling, and packing of different types semisolid products.

TEXT BOOKS:

REFERENCES:

BT8071    BIOLOGICAL SPECTROSCOPY

OBJECTIVES:
- To deliver the knowledge of spectroscopic techniques and its functions
- To provide the technical information of spectroscopy for biological applications

UNIT I    OPTICAL ROTATORY DISPERSION


UNIT II    TYPES OF NUCLEAR MAGNETIC RESONANCE


UNIT III    TYPES OF MASS SPECTROMETRY

Ion sources sample introduction – mass analyzers and ion detectors – bimolecular mass spectrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications.

UNIT IV    X-RAY DIFFRACTION

9

UNIT V SPECIAL TOPICS AND APPLICATIONS
Electron microscopy – transmission and scanning electron microscopy – scanning tunnelling and atomic force microscopy – combinatorial chemistry and high throughput screening methods.

OUTCOMES:
Upon completion of this course, the student would be able to understand and apply
• Basics of optical rotary dispersion methods and nuclear magnetic resonance
• Principles and applications of mass spectrometry and X-ray diffraction
• Microscopic techniques and its applications
• Spectroscopic techniques for various biological applications

TEXT BOOKS:

REFERENCES:

PY8004 FUNDAMENTALS OF POLYMER SCIENCE AND ENGINEERING L T P C 3 0 0 3

OBJECTIVES:
• To provide the basic knowledge of polymers and its classification.
• To make aware of characterization of polymers and its application.

UNIT I BASICS OF POLYMERS

UNIT II WATER SOLUBLE POLYMERS
UNIT III  BIO AND INORGANIC POLYMERS

UNIT IV  TESTING OF POLYMERS
Elemental and Chemical Analysis, Compositional Analysis, Thermal Analysis, Physical Properties

UNIT V  APPLICATION OF POLYMERS

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
- Understand the basic of polymers.
- Acquire knowledge on different classification of polymers.
- Develop capacity to characterize polymers and its applications.

TEXT BOOKS:

REFERENCES:

PY8005  VALIDATION IN PHARMACEUTICAL INDUSTRIES

OBJECTIVES:
- To provide the information on GMP/GLP regulation involved in the manufacturing Of API and biological products.
- To provide the importance of impurity profile and stability testing of drugs.

UNITI  DRUGS AND COSMETICS ACT AND GMP FOR API

UNITII  IMPURITIES IN DRUG SUBSTANCES AND DRUG PRODUCTS
Definition of impurities–Validation and impurity issue related to manufacturing –Processing of drug substances –Enantiomers as impurities –Polymorphs as unwanted components.

UNIT III CLEANING PROCEDURE IN API MANUFACTURING FACILITIES 9
Regulatory requirements–Multiple vs dedicated equipment– Unique nature of API–Multiple level approach to cleaning–Nature of contaminants–Selection of a worst case–Cleaning techniques – Sampling – Analytical methods – Limits and acceptance criteria, documentation.

UNIT IV STABILITY TESTING 9
Reasons for stability testing–Modes of degradation –Shelflives and expiration dates– Possible strategies to improve shelflives–Stability testing of new drug substances andproducts(Q1A)–Photostability testing of new substances and products(Q1B)–Validation on analytical procedures(Q2A).

UNIT V PROCESS VALIDATION 9
Process validation as a quality assurance tool-General QA tools, purpose of process validation, Qualification activities, Process validation activities. Prospective process validation-Organization, documentation, product development, development of manufacturing capability, full scale production development, defining experimental programs, experimental design and analysis.

OUTCOMES:
The students will be able to
- Understand regulatory practices and administrative functions adopted in the Pharmaceutical organizations.
- Understand the importance of impurity and the procedure for determination of expiry date.
- Understand the role of cleanliness in manufacturing high purity products and reducing adverse products

TEXT BOOKS:

REFERENCES:

CH8791 TRANSPORT PHENOMENA

OBJECTIVE:
• To develop a fundamental knowledge of the physical principles that govern the transport of momentum, energy and mass, with emphasis on the mathematical formulation of the conservation principles.

UNIT I  TRANSPORT PHENOMENA BY MOLECULAR MOTION  9
Vectors/Tensors, Newton’s law of viscosity, Newtonian & Non-Newtonian fluids, rheological models, Temperature, pressure and composition dependence of viscosity, Kinetic theory of viscosity, Fourier’s law of heat conduction, Temperature, pressure and composition dependence of thermal conductivity, Kinetic theory of thermal conductivity, Fick’s law of diffusion, Temperature, pressure and composition dependence of diffusivity, Kinetic theory of diffusivity.

UNIT II  ONE DIMENSIONAL MOMENTUM TRANSPORT  9
Shell Momentum balances, boundary conditions, velocity profiles, average velocity, momentum flux at the surfaces, of Newtonian and non-Newtonian for flow of a falling film, flow through circular tube, slits, flow through an Annulus, Adjacent flow of two Immiscible fluids. Equations of Change (Isothermal), equation of continuity, equation of motion, equation of energy (isothermal) their applications in fluid flow problems.

UNIT III  ONE DIMENSIONAL HEAT TRANSPORT  9
Shell energy balances, boundary conditions, temperature profiles, average temperature, energy fluxes at surfaces for different types of heat sources such as electrical, nuclear viscous and chemical, Equations of change (non-isothermal), equation of motion for forced and free convection, equation of energy (non-isothermal).

UNIT IV  ONE DIMENSIONAL MASS TRANSPORT  9
Shell mass balances, boundary conditions, concentration profiles, average concentration, mass flux at surfaces for Diffusion through stagnant gas film, Diffusion with homogeneous and heterogeneous chemical reaction, Diffusion in to a falling liquid film, Diffusion and chemical reaction in porous catalystand the effectiveness factor, equation of continuity for binary mixtures, equation of change to set up diffusion problems for simultaneous heat and mass transfer.

UNIT V  TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW  9
Turbulence phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow over flat surface. Introduction to macroscopic balances for isothermal flow systems, non-isothermal systems and multicomponent systems.

TOTAL: 45 PERIODS

OUTCOMES:
• Students would gain the knowledge of fundamental connections between the conservation laws in heat, mass, and momentum in terms of vector and tensor fluxes.
• The students would be able to understand the mechanism of fluids in motion under different conditions.

TEXT BOOKS:
REFERENCES:

GE8073 FUNDAMENTALS OF NANOSCIENCE

OBJECTIVE:
- To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS

UNIT IV CHARACTERIZATION TECHNIQUES

UNIT V APPLICATIONS

TOTAL: 45 PERIODS

OUTCOMES:
- Will familiarize about the science of nanomaterials
• Will demonstrate the preparation of nanomaterials
• Will develop knowledge in characteristic nanomaterial

TEXT BOOKS:

REFERENCES:

PY8006 HERBAL TECHNOLOGY

OBJECTIVES:
• To acquire the basic knowledge of Indian system of medicines and to know the fundamentals, standardisation procedure and screening methodology for herbal drugs.
• To enable the students to know about the plant tissue culture techniques and also learn about the sophisticated instruments used in the extraction, isolation, purification and identification of herbal drugs.

UNIT I INDIAN SYSTEMS OF MEDICINE

UNIT II In-vitro CULTURE OF MEDICINAL PLANTS
Requirements – Setting up a tissue culture lab – Basic laboratory procedure – Processing of plant tissue culture – Growth profile – Growth measurement – Plant tissue culture methods – Callus culture – Types of tissue culture – Tissue culture of medicinal plants – Applications of plant tissue culture.

UNIT III EXTRACTION, ISOLATION AND ANALYSIS OF PHYTO PHARMACEUTICALS
Traditional and modern extraction techniques: Successive solvent extraction- Super critical fluid extraction – Steam distillation – Head space techniques – Sepbox –General extraction process: Carbohydrates – Proteins – Alkaloids –Glycosides. Isolation and purification of phytochemicals: Quinine from cinchona, vincristine from Vinca, sennoside from senna, Eugenol from clove oil.

UNIT IV SCREENING METHODS FOR HERBAL DRUGS

UNIT V STANDARDIZATION AND CONSERVATION OF HERBAL DRUGS
Importance of standardization – Problems involved in the standardization of herbs-Standardization of single drugs and compound formulations – WHO guidelines for the quality
assessment herbal drugs– Estimation of parameter limits used for standardization – Conservation strategies of medicinal plants – Conservation types – Government policies for protecting the traditional knowledge.

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
- Understand the basic principle, design, control and processing techniques of medicinal plants and their derivatives. They also able to know the identification and isolation of medicinally important phytochemicals.
- Describe the biological effects of medicinal plants with legislation and governmental policies for conserving medicinal plants.
- Gather and interpret data for the solution of problems, including social, scientific and ethical issues connected with the use of medicinal plants in the different field of applications.

TEXT BOOKS:
3. Indian System of Medicine and Homeopathy in India, Planning and Evaluation Cell, Govt.of India, New Delhi, 2001.

REFERENCES:

PY8007 REGULATORY TOXICOLOGY

OBJECTIVES:
- The objective of the course is to provide up-to-date information of the international, and national regulatory processes concerning chemical risk assessment in humans, biomaterials and medical devices.
- Also to develop awareness of how toxicology is applied in real world regulatory situations and to develop knowledge of the complexities and competing interests that are part of the regulatory decision making
- Overview of the methods used to evaluate risk and produce safety guidelines, including laboratory testing, epidemiological studies and evaluation of the literature and of the online resources available to gather this information.

UNIT I INTRODUCTION
Regulatory aspects and strategy in medical device and biomaterials safety evaluation. Regulations affecting cosmetic and over-the-counter drug products.

UNIT II REGULATIONS GOVERNING TOXICOLOGY
Aim and mission, working areas, regulatory process in toxicology, quality assurance in regulatory toxicology, toxicological risk assessment.

UNIT III TOXICOLOGY AND DRUG PRODUCT REGULATIONS
Introduction, aspects of the IND / NDA process, toxicology and other issues, paediatric drug products, drug combinations, excipients and reformulations, conclusions.

UNIT IV TOXICOGENEOMICS, GENETIC TOXICOLOGY AND REGULATORY POLICY
Microarrays in toxicology, proteomics and metabolomics, case examples, toxicogenomics in regulatory environment. Initiation of genetic toxicology testing, EPA GENE TOX (Phase I and II), ICPEMC, NTP. Genetic toxicology technologies and concepts. Influence of genetic toxicology research on regulatory policy, future role in safety testing strategies.

UNIT V ALTERNATIVES IN TOXICOLOGY
Introduction, Societal need for information about toxic chemicals, evolution of alternatives in toxicology, humane science and animal welfare, assessing alternatives, challenges and future.

TOTAL: 45 PERIODS

OUTCOMES:
The student can be able to
- Describe the general principles in toxicological risk assessment, both ecotoxicology and human toxicology, legal regulations and alternative options in toxicology.
- Understand the basic principles of and have current, cutting-edge knowledge in environmental and human health toxicology.
- Demonstrate an understanding of legal, regulatory, and ethical considerations relating to toxicology within the broader societal context

TEXT BOOKS:
2. Regulatory Toxicology in the European Union, Ian Dewhurst, Royal Society of Chemistry, 2017

REFERENCES:

OBJECTIVES:
- To discuss the structure, functions and integration of immune system.
- To explain the antigen-antibody interactions and how the immune system is protecting the body from foreign pathogens/germs.
To explain various techniques of monoclonal and engineered antibodies (important therapeutic molecules) production, for treating most of the human diseases.

UNIT I  INTRODUCTION TO IMMUNE SYSTEM  9
Organisation and classification of immune system – immune cells and organs; innate and acquired immunity; Toll receptors and responses, classification of antigens – chemical and molecular nature; haptens, adjuvants; cytokines; complement pathway, antigen presenting cells; major histocompatibility complex

UNIT II  HUMORAL AND CELLULAR IMMUNITY  9
Development, maturation, activation, regulation, differentiation and classification of T-cells and B-cells, antigen processing and presentation, theory of clonal selection, TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions

UNIT III  IMMUNITY AGAINST PATHOGENS AND TUMORS  9
Inflammation; protective immune responses to virus, bacteria, fungi and parasites; tumor antigens, tumor immune response, tumor diagnosis, tumor immunotherapy

UNIT IV  IMMUNE TOLERANCE AND HYPERSENSITIVITY  9
Immune tolerance, Immuno deficiencies; Transplantation – genetics of transplantation; laws of transplantation; Allergy and hypersensitivity – Types of hypersensitivity, Autoimmunity, Auto immune disorders and diagnosis

UNIT V  APPLIED IMMUNOLOGY  9
Monoclonal antibodies, engineering of antibodies; Classification of Vaccines, methods of vaccine development, immunodiagnostic methods (Immuno diffusion ELISA, FACS), immune modulatory drugs

TOTAL: 45 PERIODS

OUTCOMES:

- The students after completing the course would be aware of immune system structure and functions.
- The students would be aware of immunity to various pathogens
- The students would be aware of the principles behind the production of therapeutic/diagnostic molecules.
- The students would be aware of the concepts and mechanism behind tumour development, allergy and hypersensitivity reactions.

TEXT BOOKS:

REFERENCES:
AIM:
- To familiarize the students with concepts of process dynamics and control leading to control system design.

OBJECTIVE:
- To introduce dynamic response of open and closed loop systems, control loop components and stability of control systems along with instrumentation.

UNIT I INSTRUMENTATION
Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

UNIT II OPEN LOOP SYSTEMS
Laplace transformation, application to solve ODEs. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.

UNIT III CLOSED LOOP SYSTEMS
Closed loop control systems, development of block diagram for feed-back control systems servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability

UNIT IV FREQUENCY RESPONSE
Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controller settings

UNIT V ADVANCED CONTROL SYSTEMS
Introduction to advanced control systems, cascade control, feed forward control, Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
- Understand the response of various control systems

TEXT BOOKS:

REFERENCES:
GE8076 PROFESSIONAL ETHICS IN ENGINEERING L T P C 3 0 0 3

OBJECTIVES:
- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10

UNIT II ENGINEERING ETHICS 9

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

UNIT V GLOBAL ISSUES 8

TOTAL: 45 PERIODS

OUTCOMES:
- Upon completion of the course, the student should be able to apply ethics in society,
- Discuss the ethical issues related to engineering
- The students will be able to realize the responsibilities and rights in the society.

TEXT BOOKS:

REFERENCES:

Web sources:
1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

BT8651 BIOINFORMATICS L T P C
3 2 0 4

OBJECTIVES:
- To improve the programming skills of the student
- To let the students know the recent evolution in biological science

UNIT I INTRODUCTION
Introduction to Operating systems, Linux commands, File transfer protocols ftp and telnet, Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Database management system models, Basics of Structured Query Language (SQL).

UNIT II SEQUENCE ALIGNMENT
Sequence Analysis, Pair wise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment. Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms.

UNIT III PHYLOGENETIC METHODS
Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping. Protein Secondary structure and tertiary structure prediction methods, Homology modeling, abinitio approaches, Threading, Critical Assessment of Structure Prediction, Structural genomics.

UNIT IV PROTEIN STRUCTURE ANALYSIS
UNIT V PERL PROGRAMMING (9 + 6)
Basics of PERL programming for Bioinformatics: Data types: scalars and collections, operators, Program control flow constructs, Library Functions: String specific functions, User defined functions, File handling.

OUTCOMES:
Upon completion of this course, students will be able to
- Develop bioinformatics tools with programming skills.
- Apply computational based solutions for biological perspectives.
- Pursue higher education in this field.
- Practice life-long learning of applied biological science.

TEXT BOOKS:
1. Introduction to Bioinformatics by Arthur K. Lesk, Oxford University Press.
5. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O'Reilley Media

REFERENCE:

PY8008 VACCINE TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:
- To provide the knowledge on conventional to recent technology of vaccine production.
- To learn the types of vaccines, its immunological effects and regulatory guidelines.

UNIT I IMMUNOLOGICAL CONCEPTS IN VACCINOLOGY 9
Short history of vaccination, requirements for induction of immunity, Epitopes, linear and conformational epitopes, characterisation and location of APC, MHC and immunogenicity, Rationale vaccine design based on clinical requirements: Hypersensitivity, Immunity to Infection, Autoimmunity, immunodeficiency, mechanism of adjuvant action, Scope of future vaccine strategies.

UNIT II CLASSIFICATION OF VACCINES AND ITS PREPARATIONS 10
Active and passive immunization; Viral/bacterial/parasite vaccine differences, methods of vaccine preparation – Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, edible vaccines, reverse vaccinology, combination vaccines, therapeutic vaccines; Peptide vaccines, conjugate vaccines; Cell based vaccines.

UNIT III VACCINE RESEARCH AND DESIGN 9
Fundamental research to rational vaccine design. Antigen identification and delivery, T-Cell expression cloning for identification of vaccine targets for intracellular pathogens, Fundamentals of Immune recognition, implications for manipulating the T-Cell repertoire, Targeting Dendritic cells; a rational approach for Vaccine development, Cellular basis of T-Cell memory, Rational design of new vectors, CpG adjuvant activity, Transcutaneous immunisation, Vaccination studies and recent advances in Malaria, Tuberculosis, HIV.

UNIT IV  COMPUTATIONAL TOOLS FOR VACCINE DESIGN 8
Antigen Sequence analysis, Epitope Mapping, Predictions of Immunogenic peptides of T-Cell and B-Cells. Prediction of HLA binding peptides, Comparative Genomics as a tool for vaccine design, introduction to online epitope databases.

UNIT V  ANIMAL TESTING, COMMERCIALISATION, QUALITY CONTROL 9
Quality control and regulations in vaccine research, In-vitro experimental validations for predictions of vaccines by software, Animal testing, Rational design to clinical trials, Large scale production, Commercialisation, ethics.

TOTAL: 45 PERIODS

OUTCOMES:
The students after completing the course

- Aware of the strategies available for developing an innovative vaccine technology with different mode of vaccine delivery.
- Able to explain the significance of critical antigens, immunogens and adjuvants in developing effective vaccines.
- Aware of the regulatory issues, guidelines for the management of production of vaccine.

TEXT BOOKS:

REFERENCES:

PY8009 TECHNOLOGY OF FINE CHEMICALS AND BULK DRUGS L T P C
3 0 0 3

OBJECTIVE:
- To study about the plant design, production techniques and process chemistry involved in the fine chemicals and bulk drug industry.

UNIT I  INTRODUCTION OF FINE CHEMICALS AND BULK DRUGS 9
Concept of fine and Bulk drugs and their salient features – Evolution of process – Process chemistry – Research and development strategies in pharmaceutical industries, Chemical process life cycle, Legislative requirements for safe process development and scale up.
UNIT II  PRODUCTION, PLANNING AND CONTROL  

UNIT III  PROCESS DEVELOPMENT AND HAZARDS  
Developing the best synthetic route; Selection of the best route for scale-up, Choice of raw materials and reagents, Development techniques for safe process design, Unit operations posing particular hazards during development, Strategies for chemical hazards assessment, Hazards of gas and vapor generation, Identification of highly-energetic materials.

UNIT IV  BASE CHEMICALS, DRUG INTERMEDIATES AND FINE CHEMICAL PRODUCTION  

UNIT V  BULK DRUGS PRODUCTION  

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
  • Apply the knowledge of the production techniques of fine chemicals and bulk drugs.
  • Acquire the knowledge on plant design, process development and chemical hazards in fine chemical and bulk drug industry.
  • Understand kinetics, thermodynamics and plant construction materials for the production of bulk drugs and fine chemicals.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
The content of this syllabus is designed
- To understand the role of enzyme induction and inhibition for drug biotransformation
- To cater essential features of pharmacophores to enable a ligand molecule to interact with a specific target receptor.
- To understand the mode of action and structure activity relationship of Chemotherapeutic agents, Amino acids, peptide, nucleotides and related drugs and Steroids and related drugs

UNIT I  BIOTRANSFORMATION OF DRUGS  9
Protein Binding, Prodrug approach, Soft Drug approach, enzymes responsible for biotransformation, microsomal and non-microsomal mechanisms. Factors influencing enzyme induction and inhibition.

UNIT II  PHARMACOPHORE CONCEPT  9
Methods of conformational search used in pharmacophore mapping. Comparison between the popular pharmacophore methods like Catalyst/HipHop, DiscoTech, GASP with practical examples. De Novo drug design techniques: Receptor/enzyme cavity size prediction. Predicting the functional components of cavities, designing drugs fitting into cavity.

UNIT III  CHEMOTHERAPEUTIC AGENTS  9
Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship including Physico-Chemical properties of Antitubercular, Antimalarial, Antifungal, and Antiamoebic drugs.

UNIT IV  PEPTIDES, NUCLEOTIDES AND RELATED DRUGS  9
Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship including Physico-Chemical properties of the following classes of drugs Thyroid and Anti thyroid drugs, Insulin and oral hypoglycaemic agents.

UNIT V  STEROIDS AND RELATED DRUGS  9
Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship including Physico-Chemical properties of the following classes of drugs Steroidal nomenclature and stereochemistry, androgens and anabolic agents, estrogens, and progestational agents, adrenocorticoids.

TOTAL: 45 PERIODS

OUTCOMES:
- The student would be equipped with the advanced knowledge of identification of different targets in different diseases.
- The student will be able to involve in drug discovery programmes including lead identification, design of pro drug and their metabolic pathways.
- The student will be able to interpret structure-activity relationships and fundamental principles governing the molecular interactions of a drug with its target.

TEXT BOOKS:

REFERENCES:

PY8011 NUTRACEUTICALS L T P C
3 0 0 3

OBJECTIVES:
- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease.

UNIT I INTRODUCTION AND SIGNIFICANCE
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes.

UNIT II PHYTOCHEMICALS AS NUTRACEUTICALS
Phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, lycopene, chitin, carotenoids. Manufacturing practice of selected nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals – stability, analytical and labelling issues.

UNIT III ASSESSMENT OF ANTIOXIDANT ACTIVITY
In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different in vitro methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV ROLE IN HEALTH AND DISEASE
The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V SAFETY ISSUES
6
Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues-
International and national.

TOTAL: 45 PERIODS

OUTCOMES:

- Students will develop a good insight in the concepts of functional foods and their nutraceutical importance.
- The mechanism of action of some important phytochemicals and zoochemicals as nutraceuticals and their role in health and diseases.
- Describe pharmacological, toxicological properties and regulatory requirements of nutraceuticals.

TEXT BOOKS:

3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006

REFERENCES:

1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007

PY8012 PHARMACOGENOMICS L T P C 3 0 0 3

OBJECTIVES:

- The course intends to provide knowledge about pharmacogenomics and drug design using genomic applications for drug action and toxicity.
- To understand how individualization of drug therapy can be achieved based on a person’s genetic makeup while reducing unwanted drug effects.

UNIT I PHARMACOGENOMICS AND PERSONALIZED MEDICINE 9
Pharmacogenetics- Roots of pharmacogenomics and it is not just pharmacogenomics, Genetic drug response profiles, the effect of drugs on Gene expression, pharmacogenomics in drug discovery and drug development. Concept of individualized drug therapy, Drivers and the promise of personalized medicine, Strategies for application of pharmacogenomics to customize therapy, Barriers.

UNIT II HUMAN GENOME 9
Expressed sequence Tags (EST) and computational biology, Microbial genomics, computational analysis of whole genomes, computational genome analysis, Genomic differences that affect the outcome of host pathogen interactions, Protein coding genes, repeat elements, genome duplication, analysis of proteome, DNA variation, Biological complexity. Single nucleotide polymorphisms (SNP’s) in Pharmacogenomics - approaches, number and types of SNPs, Study design for analysis, Analytical issues, Development of markers.

UNIT III ASSOCIATION STUDIES IN PHARMACOGENOMICS
Viability and Adverse drug reaction in drug response, Multiple inherited genetic factors influence the outcome of drug treatments, Association studies in pharmacogenomics, Strategies for pharmacogenomics Association studies, Benefits of Pharmacogenomics in Drug R & D.

UNIT IV GENOMICS APPLICATIONS FOR DRUG ACTION, TOXICITY AND DESIGN
Platform technologies and Pharmaceutical process, its applications to the pharmaceutical industry, Understanding biology and diseases, Target identification and validation, Drug candidate identification and optimization, safety and toxicology studies. The need of protein structure information, protein structure and variation in drug targets-the scale of problem, Mutation of drug targets leading to change in the ligand binding pocket.

UNIT V PHARMACOGENOMICS – CASE STUDIES

TOTAL: 45 PERIODS

OUTCOMES:
At the completion of course, the student will be able to

- Distinguish the effect of genetic differences between individuals in the outcome of drug therapy and in drug efficacy and toxicity.
- Describe the role of single nucleotide polymorphism as a biomarker for the prediction of risk, therapeutic response and prognosis of malignancies.
- Utilize and manage the new genomics based tools as they become available as well as make best treatment choices.

TEXT BOOKS:

REFERENCES:
OBJECTIVE:

- To impart the knowledge of the various types and stages of process of sterile pharmaceutical products.

UNIT I  PARENTERALS

Introduction, historical perspective - parenteral routes of administration - formulation additives. Small volume parenterals - large volume parenterals.

UNIT II  STERILIZATION


UNIT III  INJECTIONS


UNIT IV  PARENTERAL SUSPENSION AND EMULSION


UNIT V  OPHTHALMIC PRODUCTS

Absorption of drugs in the eye - raw materials - ocular penetration enhancers - general safety consideration. Formulation of various ophthalmic products with their characterization.

TOTAL: 45 PERIODS

OUTCOMES:

- Able to understand the concepts of different types of sterile pharmaceutical formulations.
- Able to understand the sterilisation process for the sterile products.
- Understand the technology used for formulations of various sterile products.

TEXT BOOKS:


REFERENCES:

The objective of this course is to enable the students to learn the fundamentals of tissue engineering and tissue repairing and to acquire knowledge on biomaterials and its applications

UNIT I      INTRODUCTION 10
Introduction to tissue engineering: Basic definition-current scope - cell numbers and growth rates- measurement of cell characteristics –morphology- number viability- motility and functions. Measurement of tissue characteristics - appearance- cellular component-ECM component- physical properties.

UNIT II     TISSUE ARCHITECTURE 8
Tissue types and Tissue components, Tissue repair and Engineering -wound healing and sequence of events - Cell-Matrix- Cell-Cell Interactions - telomeres and Self renewal- Control of cell migration in tissue engineering.

UNIT III    BIOMATERIALS 9
Biomaterials: Properties of biomaterials-Surface, bulk, mechanical and biological- Scaffolds & tissue engineering - Types of biomaterials-biological and synthetic materials- Biopolymers- Applications – Modifications - Role of Nanotechnology.

UNIT IV     BASIC BIOLOGY OF STEM CELLS 9

UNIT V      CLINICAL APPLICATIONS 9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students would get
- Ability to understand the components of the tissue architecture
- Opportunity to get familiarized with the stem cell characteristics and their relevance in medicine
- Awareness about the properties and broad applications of biomaterials
- Overall exposure to the role of tissue engineering and stem cell therapy in organogenesis

TEXT BOOKS:

REFERENCES:

PY8015 IPR FOR PHARMA INDUSTRY L T P C
3 0 0 3

OBJECTIVES:
- To provide the basic fundamental knowledge of different forms of Intellectual Property Rights in national and international level.
- To provide the significance of the Intellectual Property Rights about the patents, copyrights, industrial design, plant and geographical indications.
- This paper is to study significance of the amended patent act on pharma industry.

UNIT I INTRODUCTION- INTELLECTUAL PROPERTY RIGHTS 9
Introduction, Types of Intellectual Property Rights - patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.

UNIT II PATENTS 9
Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Non-obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.

UNIT III PLANT VARIETY-TRADITIONAL KNOWLEDGE –GEOGRAPHICAL INDICATIONS 9
Plant variety- Justification, criteria for protection of plant variety and protection in India. Traditional knowledge- Concept of traditional knowledge, protection of traditional knowledge under Intellectual Property frame works in national level and Traditional knowledge digital library (TKDL). Geographical Indications – Justification for protection, National and International position.

UNIT IV ENFORCEMENT AND PRACTICAL ASPECTS OF IPR 9

UNIT V INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY 9

TOTAL:45 PERIODS

OUTCOMES:
The student will be able to
- Understand the basic fundamental of Intellectual Property Rights.
- Assess and critique some basic theoretical justifications for Patents, Copyrights and Plant varieties.
- Analyse the effects of intellectual property rights on International society.

TEXT BOOKS:

REFERENCES:
2. Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005

OBJECTIVES:
The objective of this course is
- to find a chemical compound that can fit to a specific cavity on a protein target both geometrically and chemically.
- to know the informatics approaches to the prediction of chemical properties of new drugs
- to present the appropriate tools for such a modelling, ranging from electronic Structure methods, Molecular modelling, Structure Activity Relationships in drug design, QSAR, Molecular docking and Molecular dynamics

UNIT I ELECTRONIC STRUCTURE METHODS
Quantum chemical methods semi-empirical and ab initio methods. Conformational analysis, energy minimization, predicting the mechanism of organic reactions using electronic structure methods.

UNIT II MOLECULAR MODELING

UNIT III STRUCTURE ACTIVITY RELATIONSHIPS IN DRUG DESIGN

UNIT IV QSAR: ELECTRONIC EFFECTS
Hammett equation, lipophilicity effects. Hansch equation, steric effects. Taft equation. Experimental and theoretical approaches for the determination of physicochemical parameters, parameter inter-dependence: Regression analysis, Descriptor calculation. The importance of biological data in the correct form; 2D QSAR; 3D-QSAR examples of CoMFA and CoMSIA.
UNIT V  MOLECULAR DOCKING

Rigid docking, flexible docking, manual docking. Advantages and disadvantages of Flex-X, Flex-S, Autodock and Dock softwares, with successful examples. Dynamics of drugs, biomolecules, drug-receptor complexes, Monte Carlo simulations and Molecular dynamics in performing conformational search and docking.

TOTAL:45 PERIODS

OUTCOMES:

The student able

- To gain knowledge about fundamental concepts, challenges, and rich opportunities in developing and applying algorithms for structural bioinformatics and healthcare.
- To interpret and practice the fundamental concepts of Molecular Modeling and Computer-aided Drug Design.
- To develop practical skills in computational approaches to analyze, predict, and engineer biomolecules and biomolecular systems.

TEXT BOOKS:


REFERENCES:


PY8071                                 CLINICAL TRIALS                                 L T P C
                                          3 0 0 3

OBJECTIVES:

- To highlight the epidemiologic methods, study design, protocol preparation
- To gain knowledge in the basic bio-statistical techniques involved in clinical research.
- To describe the principles involved in ethical, legal and regulatory issues in clinical trials.

UNIT I  ROLE OF CLINICAL TRIALS IN NEW DRUG DEVELOPMENT

Drug Discovery, regulatory guidance and governance, pharmaceutical manufacturing, nonclinical research, clinical trials, post-marketing surveillance, ethical conduct during clinical trials.
UNIT II     FUNDAMENTALS OF TRIAL DESIGN       9
Randomised clinical trials, uncontrolled trials. Protocol development, endpoints, patient selection, source and control of bias, randomization, blinding, sample size and power.

UNIT III     ALTERNATE TRIAL DESIGNS         9
Crossover design, factorial design, equivalence trials, bioequivalence trials, non-inferiority trials, cluster randomized trials, multi-center trials.

UNIT IV     BASICS OF STATISTICAL ANALYSIS       9
Types of data and normal distribution, significance tests and confidence intervals, comparison of means, comparison of proportions, analysis of survival data, subgroup analysis, regression analysis, missing data.

UNIT V      REPORTING OF TRIALS              9
Overview of reporting, trial profile, presenting baseline data, use of tables, figures, critical appraisal of report, meta-analysis.

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
● Explain key concepts in the design of clinical trials.
● Describe study designs used, identify key issues in data management for clinical trials.
● Describe the roles of regulatory affairs in clinical trials.

TEXT BOOKS:

REFERENCES:

PY8017             PHARMACOVIGILANCE             L T P C
                                3 0 0 3

OBJECTIVES:
● The course intends to provide knowledge about development and global scenario of pharmacovigilance and establishment of pharmacovigilance programme in an organization
● To develops the skills of classifying drugs, diseases and adverse drug reactions.
UNIT I  INTRODUCTION TO PHARMACOVIGILANCE
Scope and development of Pharmacovigilance - Importance of safety monitoring of Medicine - WHO international drug monitoring programme - Pharmacovigilance Program of India (PvPI) - Definitions and classification of adverse drug reactions - Detection and reporting - Methods in Causality assessment - Severity and seriousness assessment - Predictability and preventability assessment - Management of adverse drug reactions - Terminologies used in pharmacovigilance, adverse medication related events and Regulatory terminologies.

UNIT II  SOURCES OF DATA
Anatomical, therapeutic and chemical classification of drugs - International classification of diseases - Daily defined doses - International Nonproprietary Names for drugs - Drug dictionaries and coding in pharmacovigilance - WHO adverse reaction terminologies - MedDRA and StandardisedMedDRA queries - WHO drug dictionary - Eudravigilance medicinal product dictionary Information resources in pharmacovigilance - Basic drug information resources - Specialised resources for ADRs Establihing pharmacovigilance programme - Pre-clinical studies - Human volunteer studies - Clinical trials - Post-marketing surveillance - Systematic reviews and meta-analysis -

UNIT III  PHARMACOVIGILANCE METHODS

UNIT IV  STATISTICAL METHODS FOR EVALUATING MEDICATION SAFETY DATA
Safety data generation - Pre clinical phase - Clinical phase - Post approval phase. ICH Guidelines for Pharmacovigilance - Organization and objectives of ICH - Expedited reporting - Individual case safety reports - Periodic safety update reports - Post approval expedited reporting - Pharmacovigilance planning - Good clinical practice in pharmacovigilance studies.

UNIT V  PHARMACOGENOMICS OF ADVERSE DRUG REACTIONS
Drug safety evaluation in special population - Pediatrics - Pregnancy and lactation – Geriatrics. CIOMS - CIOMS Working Groups - CIOMS Form. CDSCO (India) and Pharmacovigilance - D&C Act and Schedule Y - Differences in Indian and global pharmacovigilance requirements

TOTAL: 45 PERIODS

OUTCOME:
At the completion of course, the student will be able
- To report adverse drug reaction in proper format.
- To analyze and compare the data generated during pharmacovigilance study
- To manage and adhere with regulatory requirements of different country.

TEXT BOOKS:

REFERENCES:

GE8074                HUMAN RIGHTS                L T P C
3 0 0 3

OBJECTIVES:
• To sensitize the Engineering students to various aspects of Human Rights.

UNIT I        INTRODUCTION 9

UNIT II     THEORIES 9

UNIT III    UNITED NATIONS PERSPECTIVE 9
Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV    NATIONAL REGULATIONS 9
Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V     CONCERNING THE DIFFERENTIALLY ABLED SECTION OF THE SOCIETY 9

TOTAL: 45 PERIODS

OUTCOME:
• Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

PY8018       PHARMACEUTICAL NANOTECHNOLOGY    L T P C
3 0 0 3

OBJECTIVE:
The goal of this course is to provide an insight into the fundamentals of nanotechnology in biomedical and Pharmaceutical research. It will also guide the students to understand how nanomaterials can be used for a diversity of analytical and medicinal rationales.

UNIT I  NANOSTRUCTURES 9
Preparation, properties and characterization - Self-assembling nanostructure - vesicular and micellar polymerization-nanofilms - Metal Nanoparticles- lipid nanoparticles- nanoemulsion - Molecular nanomaterials: dendrimers, etc.,

UNIT II  NANOTECHNOLOGY IN BIOMEDICAL INDUSTRY 9

UNIT III  NANOTECHNOLOGY IN CANCER THERAPY 9

UNIT IV  NANOTECHNOLOGY IN COSMETICS 9

UNIT V  NANOTOXICITY 9
NanoToxicology- introduction, dose relationship- Hazard Classification-Risk assessment and management - factors affecting nano toxicity- Dermal Effects of Nanomaterials, Pulmonary, Neuro and Cardiovascular effects of Nanoparticles - Gene–Cellular and molecular Interactions of Nanomaterials

TOTAL:45 PERIODS

OUTCOMES:
The students will be able to
- Comprehend the structural and functional principles of Pharmaceutical nanotechnology
- Recognize nanomaterials for analysis and sensing techniques
- Apprehend the biomedical applications of nanotechnology

TEXT BOOKS:

REFERENCES:

109
OBJECTIVES:
To enable the students
- To identify the importance of protein biomolecules to access, use and evaluate the information available in protein databases to find about a protein of interest.
- To realize and explain key concepts in protein function such as affinity and specificity, allosteric regulation.

UNIT I  BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS
Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction of electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure. Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups).

UNIT II  PROTEIN ARCHITECTURE

UNIT III  TERTIARY STRUCTURE
Prediction of substrate binding sites, Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures. Quaternary structure: Modular nature, formation of complexes, protein-protein interactions and methods to study it.

UNIT IV  STRUCTURE-FUNCTION RELATIONSHIP
DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins: General characteristics, Trans-membrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light chain and heavy chain architecture and Enzymes: Serine proteases.

UNIT V  PROTEOMICS
Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays. It needs Virtual labs and E-learning proteomics tools for the above said syllabus.

OUTCOMES:

TOTAL: 45 PERIODS
Upon completion of this course, students will be able:

- To analyze various interactions in protein makeup and be familiar with different levels of protein structure.
- To know the role of functional proteins in various field of study and to practice the latest application of protein science in their research.
- To introduce the concept of proteome, components of proteomics and proteomic analysis.

**TEXT BOOKS:**

**REFERENCES:**

**PY8020 PHARMACEUTICAL PACKAGING TECHNOLOGY**  L T P C
3  0  0  3

**OBJECTIVE:**
- To provide the importance of packaging technology and its requirements in pharmaceutical products.

**UNIT I PHARMACEUTICAL PACKAGING**  9

**UNIT II PRIMARY PACKAGING MATERIAL**  9

**UNIT III SOLID DOSAGE FORM PACKAGING**  9

**UNIT IV LIQUID FORMULATION AND STERILE PRODUCT PACKAGING**  9
Liquid Formulation - Factors influencing selection of liquid filling machinery - balanced and unbalanced constant level filling - volumetric – gravimetric - level sensing - time fill - peristaltic and overflow liquid filling machinery. Sterile product packaging- various types of containers used for sterile products like ampoules – vials - bottles for I.V. fluid, etc. Types of closures used for the sterile products. Sterile product filling and sealing machinery i.e. ampoule filling and sealing machine.
UNIT V QUALITY CONTROL AND REGULATIONS OF PACKAGING MATERIALS

TOTAL: 45 PERIODS

OUTCOMES:
- Understand the various categories of packaging materials used in pharmaceutical industry.
- Choose proper packaging materials for different pharmaceutical dosage forms.
- Understand the regulations of the packaging materials.

TEXT BOOKS:

REFERENCES:

PY8021 EXPERIMENTAL DESIGN AND ANALYSIS

OBJECTIVES:
- To define, learn, and understand the principles of experimental design;
- To plan and select statistical tools; To execute effectively and analyze results of experimental data

UNIT I FUNDAMENTALS OF STATISTICS
Define Statistics, intuitive biostatistics, relevance to research, preparation of data, analysis of data, frequency tables, graphical techniques, measuring variability, identify measures of central tendency and variability, probability, tools in statistics, selection of various statistics tools

UNIT II PRINCIPLES OF EXPERIMENTAL DESIGN
Designing an experiment, controlled experiments, natural and quasi-experiments, population definitions, sampling unit, types of variables, treatment structure, design structure, collecting and analyzing data, types of effects, randomization, replication, blocking, orthogonality, factorial design, completely randomized design, randomized complete block design

UNIT III CORRELATION AND REGRESSION
Correlation and regression: Graphical presentation of two continuous variables; Pearson's product moment correlation coefficient; its statistical significance; Multiple and partial correlations; Linear regression; Regression line; Coefficient of determination; Interval estimation and
hypothesis testing for population slope; Introduction to multiple linear regression models; Probit and logit transformations.

UNIT IV  PARAMETRIC TESTS  9
Estimation and Hypothesis testing: Point and interval estimation including fiducial limits; Concepts of hypothesis testing and types of errors; Student-t and Chi square tests; Sample size and power; Experimental design and analysis of variance: Completely randomized, randomized blocks; Latin square and factorial designs; Post-hoc procedures.

UNIT V  NON-PARAMETRIC TESTS  9
Non-parametric tests: Sign; Mann-Whitney U; Wilcoxon matched pair; Kruskal-Wallis and Friedman two-way anova tests. Spearman rank correlation; Statistical techniques in pharmaceutics: Experimental design in clinical trials; Parallel and crossover designs; Statistical test for bioequivalence; Dose response studies; Statistical quality control.

TOTAL: 45 PERIODS

OUTCOMES:
After completing this course, students should demonstrate competency in the following topics:
- Basic probability axioms and rules and the moments of discrete and continuous random variables.
- They will be able to utilize Joint distributions, correlation, regression and various parametric and non-parametric tests in their research analyses.

TEXT BOOKS:

REFERENCES:
3. Intuitive Biostatistics by Harvey Motulsky. Copyright © 1995 by Oxford University Press Inc.

PY8022  SAFETY AND HEALTH EVALUATION  L T P C
3 0 0 3

OBJECTIVE:
- To instill basics of various hazards and their effects. To create awareness among the students about the importance of safety and health evaluation.

UNIT I  INDUSTRIAL HYGIENE  9
Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.

UNIT II  CHEMICAL HAZARDS  9
Introduction to chemical hazards, dangerous properties of chemical, dust, gases, fumes, mist, Vapours, Smoke and aerosols. Route of entry to human system, recognition, evaluation and
control of basic hazards, concepts of dose response relationship, bio-chemical action of toxic substances. Concept of threshold, limit values.

**UNIT III PERSONAL PROTECTIVE EQUIPMENTS**

Need, selection, supply, use, care and maintenance, Personal protective devices for head, ear, face, eye, foot, knee and body protection, Respiratory personal protective devices.

**UNIT IV HAZARDOUS WASTE MANAGEMENT**


**UNIT V MONITORING FOR SAFETY, HEALTH**


**OUTCOMES:**

- Identify major types of hazards to health and safety.
- Able to apply and practice the protective equipments and monitor safety and health.
- Able to apply the knowledge of waste management.

**TEXT BOOKS:**


**REFERENCES:**


**GE8072 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT**

**OBJECTIVES:**

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them into design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to
validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

UNIT III DESIGN AND TESTING 9

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:
- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

TEXTBOOKS:
1. Book specially prepared by NASSCOM as per the MoU.

REFERENCES: