## ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED COLLEGES
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM

### B. TECH. PLASTICS TECHNOLOGY

CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS III AND IV

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGOR Y</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1.</td>
<td>IP3151</td>
<td>Induction Programme</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>HS3151</td>
<td>Professional English - I</td>
<td>HSMC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>MA3151</td>
<td>Matrices and Calculus</td>
<td>BSC</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>PH3151</td>
<td>Engineering Physics</td>
<td>BSC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>CY3151</td>
<td>Engineering Chemistry</td>
<td>BSC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>GE3151</td>
<td>Problem Solving and Python Programming</td>
<td>ESC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>GE3152</td>
<td>தமிழர் மரபு /Heritage of Tamils</td>
<td>HSMC</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>GE3171</td>
<td>Problem Solving and Python Programming Laboratory</td>
<td>ESC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>BS3171</td>
<td>Physics and Chemistry Laboratory</td>
<td>BSC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>10.</td>
<td>GE3172</td>
<td>English Laboratory $</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

|        | **TOTAL**   |             |          | 16 | 1 | 10 | 27 | 22 |         |

$ Skill Based Course
# SEMESTER II

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>HS3251</td>
<td>Professional English - II</td>
<td>HSMC</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>MA3251</td>
<td>Statistics and Numerical Methods</td>
<td>BSC</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>PH3258</td>
<td>Physics of Materials</td>
<td>BSC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>BE3252</td>
<td>Basic Electrical, Electronics and Instrumentation Engineering</td>
<td>ESC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>CY3201</td>
<td>Physical and Organic Chemistry</td>
<td>BSC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>GE3251</td>
<td>Engineering Graphics</td>
<td>ESC</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>7.</td>
<td>GE3252</td>
<td>தமிழரும் ததொழில்நுட்பமும் / Tamils and Technology</td>
<td>HSMC</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td>NCC Credit Course Level 1#</td>
<td></td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>GE3271</td>
<td>Engineering Practices Laboratory</td>
<td>ESC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>10.</td>
<td>BE3272</td>
<td>Basic Electrical, Electronics and Instrumentation Engineering Laboratory</td>
<td>ESC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>11.</td>
<td>GE3272</td>
<td>Communication Laboratory / Foreign Language $</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>1</td>
<td>16</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>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MA3391</td>
<td>Probability and Statistics</td>
<td>BSC</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>PT3301</td>
<td>Fundamentals of Chemical Engineering</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>PT3302</td>
<td>Plastics Materials I</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>PT3303</td>
<td>Polymer Chemistry</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>PT3304</td>
<td>Polymer Physics</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>PT3305</td>
<td>Solid Mechanics for Technologists</td>
<td>ESC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>PT3311</td>
<td>Chemical Engineering Lab</td>
<td>ESC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>8.</td>
<td>PT3312</td>
<td>Polymer Chemistry Lab</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>GE3361</td>
<td>Professional Development $</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

$ Skill Based Course
## SEMESTER IV

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>THEORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>PT3401</td>
<td>Additives and Compounding</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>PT3402</td>
<td>Fluid Mechanics and Polymer Rheology</td>
<td>ESC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>PT3403</td>
<td>Plastics Materials II</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>PT3404</td>
<td>Plastics Moulds and Dies Technology</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>PT3405</td>
<td>Plastics Processing</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>GE3451</td>
<td>Environmental Sciences and Sustainability</td>
<td>BSC</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>NCC Credit Course Level 2#</td>
<td></td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PRACTICALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>PT3411</td>
<td>Polymer Science Lab</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>PT3412</td>
<td>Plastics Processing Lab</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>PT3512</td>
<td>Industrial Training/Internship I</td>
<td>EEC</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL</td>
<td></td>
<td>17</td>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>

# NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

*Four weeks industrial training/internship carries two credits. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester.

## SEMESTER V

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>THEORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>PT3501</td>
<td>Plastics Testing and Characterization</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Professional Elective I</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Professional Elective II</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Professional Elective III</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Professional Elective IV</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Mandatory Course-I*</td>
<td>MC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PRACTICALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>PT3511</td>
<td>Plastics Testing and Characterization lab</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>PT3512</td>
<td>Industrial Training/Internship I**</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL</td>
<td></td>
<td>18</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)

**Four weeks industrial training/internship carries two credits. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester.
### SEMESTER VI

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>PT3601</td>
<td>Plastics Product Testing</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Open Elective – I*</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Professional Elective V</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Professional Elective VI</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Professional Elective VII</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Professional Elective VIII</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Mandatory Course--II&amp;</td>
<td>MC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td>NCC Credit Course Level 3#</td>
<td></td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>PT3611</td>
<td>Plastics Product Testing Lab</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10.</td>
<td>PT3612</td>
<td>Seminar and Comprehension</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>11.</td>
<td>PT3712</td>
<td>Industrial Training/Internship II**</td>
<td>EEC</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>21</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

*Open Elective – I shall be chosen from the emerging technologies.
**Two weeks industrial training/internship carries one credit. Industrial training/internship during VI Semester Summer Vacation will be evaluated in VII semester.
& Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC- II)
# NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

### SEMESTER VII/VIII

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>PT3701</td>
<td>Plastics Product Design</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>PT3702</td>
<td>Plastics Recycling and Waste Management</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>GE3791</td>
<td>Human values and Ethics</td>
<td>HSMC</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Elective- Management #</td>
<td>HSMC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Open Elective – II**</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Open Elective – III***</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Open Elective – IV***</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>PT3711</td>
<td>CAD/CAM/CAE Lab</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>PT3712</td>
<td>Industrial Training / Internship II##</td>
<td>EEC</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.
**Open Elective – II shall be chosen from the emerging technologies.**

**Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes**

* Elective- Management shall be chosen from the Elective Management courses

**Two weeks industrial training/internship carries one credit. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester.**

---

**SEMESTER VIII/VII**

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>PRACTICALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>PT3811</td>
<td>Internship# Project Work</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

# If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.

**ELECTIVE – MANAGEMENT COURSES**

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>GE3751</td>
<td>Principles of Management</td>
<td>HSMC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>GE3752</td>
<td>Total Quality Management</td>
<td>HSMC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>GE3753</td>
<td>Engineering Economics and Financial Accounting</td>
<td>HSMC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>GE3754</td>
<td>Human Resource Management</td>
<td>HSMC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>GE3755</td>
<td>Knowledge Management</td>
<td>HSMC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>GE3792</td>
<td>Industrial Management</td>
<td>HSMC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**MANDATORY COURSES I**

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MX3081</td>
<td>Introduction to Women and Gender Studies</td>
<td>MC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>MX3082</td>
<td>Elements of Literature</td>
<td>MC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>MX3083</td>
<td>Film Appreciation</td>
<td>MC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>MX3084</td>
<td>Disaster Management</td>
<td>MC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
# MANDATORY COURSES II

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MX3085</td>
<td>Well Being with traditional practices (Yoga, Ayurveda and Siddha)</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>MX3086</td>
<td>History of Science and Technology in India</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>MX3087</td>
<td>Political and Economic Thought for a Humane Society</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>MX3088</td>
<td>State, Nation Building and Politics in India</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>MX3089</td>
<td>Industrial Safety</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

## PROFESSIONAL ELECTIVE COURSES: VERTICALS

<table>
<thead>
<tr>
<th>Vertical I</th>
<th>Vertical II</th>
<th>Vertical III</th>
<th>Vertical IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Polymeric Materials</td>
<td>Design and Manufacturing</td>
<td>Processing Technology</td>
<td>Management</td>
</tr>
<tr>
<td>Composite Materials</td>
<td>Advanced Mould and Die Design</td>
<td>Advanced Extrusion Processing</td>
<td>Product Design and Cost Estimation</td>
</tr>
<tr>
<td>Plastics in Electronics</td>
<td>Additive Manufacturing</td>
<td>Advanced Injection Moulding</td>
<td>Engineering Statistics and Quality Control</td>
</tr>
<tr>
<td>Biodegradable Polymers</td>
<td>Fiber technology</td>
<td>Advanced Blow Moulding</td>
<td>Circular Economy and Extended Producer Responsibility</td>
</tr>
<tr>
<td>Polymers in Biomedical Engineering</td>
<td>Plastics Packaging Technology</td>
<td>Polyurethane Technology</td>
<td>Pollution, Regulatory Norms and Control equipment</td>
</tr>
<tr>
<td>Adhesives, Paints &amp; Coatings</td>
<td>Rubber Technology</td>
<td>Instrumentation and Process Control</td>
<td>Fintech and Block Chain</td>
</tr>
<tr>
<td>Polymers in Transportation</td>
<td>Design and Manufacture of Composites</td>
<td>Automation in Polymer Processing</td>
<td>Entrepreneurship Development</td>
</tr>
<tr>
<td>Biopolymers and Green Composite</td>
<td>Finite Element Methods</td>
<td>Foam Technology</td>
<td>Intellectual Property Rights (IPR)</td>
</tr>
<tr>
<td>Polymer Blends and Alloys</td>
<td>PVC Technology</td>
<td>Machining and Joining of Plastics</td>
<td>Engineering Management</td>
</tr>
</tbody>
</table>
Registration of Professional Elective Courses from Verticals:
Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation. Students are permitted to choose all Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E./B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to Regulations 2021 Clause 4.10.

**PROFESSIONAL ELECTIVE COURSES : VERTICALS**

**VERTICAL 1: ADVANCED POLYMERIC MATERIALS**

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PT3001</td>
<td>Composite Materials</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>PT3002</td>
<td>Plastics in Electronics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>PT3003</td>
<td>Biodegradable Polymers</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>PT3004</td>
<td>Polymers in Biomedical Engineering</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>PT3005</td>
<td>Adhesives, Paints &amp; Coatings</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>PT3006</td>
<td>Polymers in Transportation</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>PT3007</td>
<td>Biopolymers and Green Composite</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>PT3008</td>
<td>Polymer Blends and Alloys</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
## VERTICAL 2: DESIGN AND MANUFACTURING

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PT3009</td>
<td>Advanced Mould and Die Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PT3010</td>
<td>Additive Manufacturing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PT3011</td>
<td>Fiber technology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PT3012</td>
<td>Plastics Packaging Technology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>PT3013</td>
<td>Rubber Technology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>PT3014</td>
<td>Design and Manufacture of Composites</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>PT3015</td>
<td>Finite Element Methods</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>PT3016</td>
<td>PVC Technology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

## VERTICAL 3: PROCESSING TECHNOLOGY

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PT3017</td>
<td>Advanced Extrusion Processing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PT3018</td>
<td>Advanced Injection Moulding</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PT3019</td>
<td>Advanced Blow Moulding</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PT3020</td>
<td>Polyurethane Technology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>PT3021</td>
<td>Instrumentation and Process Control</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>PT3022</td>
<td>Automation in Polymer Processing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>PT3023</td>
<td>Foam Technology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>PT3024</td>
<td>Machining and Joining of Plastics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
### VERTICAL 4: MANAGEMENT

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PT3025</td>
<td>Product Design and Cost Estimation</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PT3026</td>
<td>Engineering Statistics and Quality Control</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PT3027</td>
<td>Circular Economy and Extended Producer Responsibility</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PT3028</td>
<td>Pollution, Regulatory Norms and Control equipment</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>PT3029</td>
<td>Fintech and Block Chain</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>PT3030</td>
<td>Entrepreneurship Development</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>PT3031</td>
<td>Intellectual Property Rights (IPR)</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>PT3032</td>
<td>Engineering Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

**OPEN ELECTIVES**

Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories.

**OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)**

To be offered other than Faculty of Information and Communication Engineering

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>OCS351</td>
<td>Artificial Intelligence and Machine Learning Fundamentals</td>
<td>OEC</td>
<td>2 0 2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>OCS352</td>
<td>IoT Concepts and Applications</td>
<td>OEC</td>
<td>2 0 2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>OCS353</td>
<td>Data Science Fundamentals</td>
<td>OEC</td>
<td>2 0 2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>OCS354</td>
<td>Augmented and Virtual Reality</td>
<td>OEC</td>
<td>2 0 2</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>
## OPEN ELECTIVES – III

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>OHS351</td>
<td>English for Competitive Examinations</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>OCE353</td>
<td>Lean Concepts, Tools And Practices</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>OMG352</td>
<td>NGOs and Sustainable Development</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>OMG353</td>
<td>Democracy and Good Governance</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>OME353</td>
<td>Renewable Energy Technologies</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>OME354</td>
<td>Applied Design Thinking</td>
<td>OEC</td>
<td>2 0 2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>OMF351</td>
<td>Reverse Engineering</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>OMF353</td>
<td>Sustainable Manufacturing</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>OAU351</td>
<td>Electric and Hybrid Vehicle</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>OAS352</td>
<td>Space Engineering</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>OIM351</td>
<td>Industrial Management</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>OIE354</td>
<td>Quality Engineering</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>OFS351</td>
<td>Fire Safety Engineering</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>OMR351</td>
<td>Mechatronics</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>ORA351</td>
<td>Foundation of Robotics</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>OAE352</td>
<td>Fundamentals of Aeronautical engineering</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>OGI351</td>
<td>Remote Sensing Concepts</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>18.</td>
<td>OAI351</td>
<td>Urban Agriculture</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>19.</td>
<td>OEN351</td>
<td>Drinking Water Supply and Treatment</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>20.</td>
<td>OEE352</td>
<td>Electric Vehicle technology</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>21.</td>
<td>OEI353</td>
<td>Introduction to PLC Programing</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>22.</td>
<td>OBT352</td>
<td>Biomedical Instrumentation</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>23.</td>
<td>OFD352</td>
<td>Traditional Indian Foods</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>24.</td>
<td>OFD353</td>
<td>Introduction to food processing</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>25.</td>
<td>OPY352</td>
<td>IPR for Pharma</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>SL. NO.</td>
<td>COURSE CODE</td>
<td>COURSE TITLE</td>
<td>CATEGORY</td>
<td>PERIODS PER WEEK</td>
<td>TOTAL CONTACT PERIODS</td>
<td>CREDITS</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>--------------</td>
<td>----------</td>
<td>------------------</td>
<td>------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>1.</td>
<td>OHS352</td>
<td>Project Report Writing</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>OCE354</td>
<td>Basics of Integrated Water Resources Management</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>OMA355</td>
<td>Advanced Numerical Methods</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>OMA356</td>
<td>Random Processes</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>OMA357</td>
<td>Queuing and Reliability Modelling</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>OMG354</td>
<td>Production and Operations Management for Entrepreneurs</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>OMG355</td>
<td>Multivariate Data Analysis</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>OME353</td>
<td>New Product Development</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<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>
</tr>
<tr>
<td>9</td>
<td>OME355</td>
<td>Industrial Design &amp; Rapid Prototyping Techniques</td>
<td>OEC</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>OMF352</td>
<td>Micro and Precision Engineering</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>OMF354</td>
<td>Cost Management of Engineering Projects</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>OAU352</td>
<td>Batteries and Management system</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>OAS353</td>
<td>Sensors and Actuators</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>OAS353</td>
<td>Space Vehicles</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>OIM352</td>
<td>Management Science</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16</td>
<td>OIM353</td>
<td>Production Planning and Control</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>17</td>
<td>OIE353</td>
<td>Operations Management</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>18</td>
<td>OSF352</td>
<td>Industrial Hygiene</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>19</td>
<td>OSF353</td>
<td>Chemical Process Safety</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>OML352</td>
<td>Electrical, Electronic and Magnetic materials</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21</td>
<td>OML353</td>
<td>Nanomaterials and applications</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>22</td>
<td>OMR352</td>
<td>Hydraulics and Pneumatics</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>23</td>
<td>OMR353</td>
<td>Sensors</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>24</td>
<td>ORA352</td>
<td>Foundation of Automation</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>ORA353</td>
<td>Concepts in Mobile Robotics</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>26</td>
<td>OMV351</td>
<td>Marine Propulsion</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>27</td>
<td>OMV352</td>
<td>Marine Merchant Vehicles</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>28</td>
<td>OMV353</td>
<td>Elements of Marine Engineering</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>29</td>
<td>OAE353</td>
<td>Drone Technologies</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>OGI352</td>
<td>Geographical Information System</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>31</td>
<td>OAI352</td>
<td>Agriculture Entrepreneurship Development</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>32</td>
<td>OEN352</td>
<td>Biodiversity Conservation</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>33</td>
<td>OEE353</td>
<td>Introduction to control systems</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>34</td>
<td>OEL354</td>
<td>Introduction to Industrial Automation Systems</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>35</td>
<td>OBT353</td>
<td>Environment and Agriculture</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<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>
</tr>
<tr>
<td>36.</td>
<td>OFD354</td>
<td>Fundamentals of Food Engineering</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>37.</td>
<td>OFD355</td>
<td>Food safety and Quality Regulations</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>38.</td>
<td>OPY353</td>
<td>Nutraceuticals</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>39.</td>
<td>OTT354</td>
<td>Basics of Dyeing and Printing</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>40.</td>
<td>OTT355</td>
<td>Fibre Science</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>41.</td>
<td>OTT356</td>
<td>Garment Manufacturing Technology</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>42.</td>
<td>OCH353</td>
<td>Energy Technology</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>43.</td>
<td>OCH354</td>
<td>Surface Science</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>44.</td>
<td>OPE353</td>
<td>Industrial safety</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>45.</td>
<td>OPE354</td>
<td>Unit Operations in Petro Chemical Industries</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>46.</td>
<td>OEC353</td>
<td>VLSI Design</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>47.</td>
<td>OEC354</td>
<td>Industrial IoT and Industry 4.0</td>
<td>OEC</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>48.</td>
<td>OBM353</td>
<td>Wearable devices</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>49.</td>
<td>OBM354</td>
<td>Medical Informatics</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</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></td>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>1</td>
<td>HSMC</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>BSC</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>ESC</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>PCC</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>PEC</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>OEC</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>7</td>
<td>EEC</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Non-Credit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Mandatory)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>22</td>
<td>26</td>
</tr>
</tbody>
</table>
Enrollment for B.E. / B. Tech. (Honours) / Minor degree (Optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) Minor degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.

Complete details are available in clause 4.10 of Regulations 2021.

**VERTICALS FOR MINOR DEGREE (IN ADDITIONS TO ALL THE VERTICALS OF OTHER PROGRAMMES)**

<table>
<thead>
<tr>
<th>Vertical I</th>
<th>Vertical II</th>
<th>Vertical III</th>
<th>Vertical IV</th>
<th>Vertical V</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fintech and Block Chain</strong></td>
<td>Foundations of Entrepreneurship</td>
<td>Principles of Public Administration</td>
<td>Statistics For Management</td>
<td>Sustainable infrastructure Development</td>
</tr>
<tr>
<td><strong>Fundamentals of Investment</strong></td>
<td>Team Building &amp; Leadership Management for Business</td>
<td>Constitution of India</td>
<td>Datamining For Business Intelligence</td>
<td>Sustainable Agriculture and Environmental Management</td>
</tr>
<tr>
<td><strong>Banking, Financial Services and Insurance</strong></td>
<td>Creativity &amp; Innovation in Entrepreneurship</td>
<td>Public Personnel Administration</td>
<td>Human Resource Analytics</td>
<td>Sustainable Bio Materials</td>
</tr>
<tr>
<td><strong>Introduction to Blockchain and its Applications</strong></td>
<td>Principles of Marketing Management For Business</td>
<td>Administrative Theories</td>
<td>Marketing And Social Media Web Analytics</td>
<td>Materials for Energy Sustainability</td>
</tr>
<tr>
<td><strong>Fintech Personal Finance and Payments</strong></td>
<td>Human Resource Management for Entrepreneurs</td>
<td>Indian Administrative System</td>
<td>Operation And Supply Chain Analytics</td>
<td>Green Technology</td>
</tr>
<tr>
<td><strong>Introduction to Fintech</strong></td>
<td>Financing New Business Ventures</td>
<td>Public Policy Administration</td>
<td>Financial Analytics</td>
<td>Environmental Quality Monitoring and Analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Integrated Energy Planning for Sustainable Development</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Energy Efficiency for Sustainable Development</td>
</tr>
</tbody>
</table>
(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

### VERTICAL 1: FINTECH AND BLOCK CHAIN

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CMG331</td>
<td>Financial Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CMG332</td>
<td>Fundamentals of Investment</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CMG333</td>
<td>Banking, Financial Services and Insurance</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CMG334</td>
<td>Introduction to Blockchain and its Applications</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CMG335</td>
<td>Fintech Personal Finance and Payments</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CMG336</td>
<td>Introduction to Fintech</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### VERTICAL 2: ENTREPRENEURSHIP

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CMG337</td>
<td>Foundations of Entrepreneurship</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CMG338</td>
<td>Team Building &amp; Leadership Management for Business</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CMG339</td>
<td>Creativity &amp; Innovation in Entrepreneurship</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CMG340</td>
<td>Principles of Marketing Management For Business</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CMG341</td>
<td>Human Resource Management for Entrepreneurs</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CMG342</td>
<td>Financing New Business Ventures</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
# VERTICAL 3: PUBLIC ADMINISTRATION

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CMG343</td>
<td>Principles of Public Administration</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CMG344</td>
<td>Constitution of India</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CMG345</td>
<td>Public Personnel Administration</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CMG346</td>
<td>Administrative Theories</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CMG347</td>
<td>Indian Administrative System</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CMG348</td>
<td>Public Policy Administration</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

# VERTICAL 4: BUSINESS DATA ANALYTICS

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CMG349</td>
<td>Statistics For Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CMG350</td>
<td>Datamining For Business Intelligence</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CMG351</td>
<td>Human Resource Analytics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CMG352</td>
<td>Marketing And Social Media Web Analytics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CMG353</td>
<td>Operation And Supply Chain Analytics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CMG354</td>
<td>Financial Analytics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
# VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CES331</td>
<td>Sustainable infrastructure Development</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CES332</td>
<td>Sustainable Agriculture and Environmental Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CES333</td>
<td>Sustainable Bio Materials</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CES334</td>
<td>Materials for Energy Sustainability</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CES335</td>
<td>Green Technology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CES336</td>
<td>Environmental Quality Monitoring and Analysis</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>CES337</td>
<td>Integrated Energy Planning for Sustainable Development</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>CES338</td>
<td>Energy Efficiency for Sustainable Development</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
IP3151

INDUCTION PROGRAMME

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

“Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.”

“One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. “

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity
This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts
Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values
This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do’s and dont’s, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity
Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.
(v) Proficiency Modules
This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People
Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area
A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations
They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities
About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering / Technology / Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

REFERENCES:
Guide to Induction program from AICTE

---

HS3151

PROFESSIONAL ENGLISH I

OBJECTIVES:
- To improve the communicative competence of learners
- To learn to use basic grammatical structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners’ ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

UNIT I

INTRODUCTION TO EFFECTIVE COMMUNICATION

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C’s of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?
UNIT 1     INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION  
Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Wh/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II     NARRATION AND SUMMATION  
Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III     DESCRIPTION OF A PROCESS / PRODUCT  
Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

UNIT IV     CLASSIFICATION AND RECOMMENDATIONS  
Reading – Newspaper articles; Journal reports –and Non Verbal Communication ( tables, pie charts etc., ). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal ( chart , graph etc, to verbal mode) Grammar – Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.

UNIT V     EXPRESSION  
Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.

LEARNING OUTCOMES : 
At the end of the course, learners will be able
- To use appropriate words in a professional context
- To gain understanding of basic grammatic structures and use them in right context.
- To read and infer the denotative and connotative meanings of technical texts
- To write definitions, descriptions, narrations and essays on various topics

TOTAL : 45 PERIODS

TEXT BOOKS :
1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

ASSESSMENT PATTERN
Two internal assessments and an end semester examination to test students' reading and writing skills along with their grammatical and lexical competence.

MA3151 MATRICES AND CALCULUS L T P C 3 1 0 4

COURSE OBJECTIVES:
- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES
9+3

UNIT II DIFFERENTIAL CALCULUS
9+3

UNIT III FUNCTIONS OF SEVERAL VARIABLES
9+3

UNIT IV INTEGRAL CALCULUS
9+3
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 - Applications: Hydrostatic force and pressure, moments and centres of mass.

UNIT V MULTIPLE INTEGRALS
9+3

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to

CO1: Use the matrix algebra methods for solving practical problems.
CO2: Apply differential calculus tools in solving various application problems.
CO3: Able to use differential calculus ideas on several variable functions.
CO4: Apply different methods of integration in solving practical problems.
CO5: Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXT BOOKS:
3. James Stewart, "Calculus: Early Transcendentals," Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - 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:

PH3151 ENGINEERING PHYSICS

COURSE OBJECTIVES
- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to be successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I MECHANICS
9

UNIT II ELECTROMAGNETIC WAVES
9
The Maxwell’s equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone
reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS

UNIT IV BASIC QUANTUM MECHANICS
Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch’s theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

COURSE OUTCOMES
After completion of this course, the students should be able to
CO1 : Understand the importance of mechanics.
CO2 : Express their knowledge in electromagnetic waves.
CO3 : Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
CO4 : Understand the importance of quantum physics.
CO5 : Comprehend and apply quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.

REFERENCES:
5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag,

CY3151 ENGINEERING CHEMISTRY L T P C
3 0 0 3

COURSE OBJECTIVES:
• To inculcate sound understanding of water quality parameters and water treatment
techniques.

- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

**UNIT I  WATER AND ITS TREATMENT  9**


**UNIT II  NANOCHEMISTRY  9**

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

**UNIT III  PHASE RULE  AND COMPOSITES  9**

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process. Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

**UNIT IV  FUELS AND COMBUSTION  9**


**UNIT V  ENERGY SOURCES AND STORAGE DEVICES  9**

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; Electric vehicles: working principles Fuel cells: H₂-O₂ fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES**

At the end of the course, the students will be able:

- CO1 :To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2 : To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO3 : To apply the knowledge of phase rule and composites for material selection requirements.

CO4 : To recommend suitable fuels for engineering processes and applications.

CO5 : To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

REFERENCES:

GE3151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C 3 0 0 3

OBJECTIVES:
• To understand the basics of algorithmic problem solving.
• To learn to solve problems using Python conditionals and loops.
• To define Python functions and use function calls to solve problems.
• To use Python data structures - lists, tuples, dictionaries to represent complex data.
• To do input/output with files in Python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9
Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.
UNIT III CONTROL FLOW, FUNCTIONS, STRINGS
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: simple sorting, histogram, Students marks statement, Retail bill preparation.

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, Voter’s age validation, Marks range validation (0-100). TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, students will be able to
CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Write simple Python programs using conditionals and looping for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries etc.
CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:

REFERENCES:
5. https://www.python.org/
அலகு I  தமிழ் மரபு வகைப்பாட்டு 3
தமிழ் மொழிக் குடும்பங்கள் - இந்திய தமிழ்கள் - முன்னுச்சீராக இந்திய தமிழ்கள் - வெளியே இருந்து வந்துள்ள மொழிக் குடும்பங்கள் - செல்லும் தமிழ்களின் கலை - மாணுர் தமிழ்களின் பார்வை ஆரம் - திங்களின் பெருமான் கலைத்துறை - தமிழ் காப்புக்கள், தமிழ்களின் குழு போன்ற மொழிக்கலை நூற்றாண்டு - தமிழ் அடிகற்று, பெருமையான நூற்றாண்டு தமிழ் கலைத்துறை - தமிழ் தமிழ் வடிவரிசை பார்வை மூலம் பார்வைக்கக்கு அதியாரிகள் பதித்தியம்.

அலகு II  மொழி - பக்தத் தில்லியல்கள் (முதல் நூற்றாண்டு தில்லியல்கள் வகை) - சிறப்பு கலை 3
தமிழ் மொழியில் தமிழ் விளக்கம் - பொதுத் தில்லியல்கள் - மலர்சுந்திரனுக்கு பயன் மற்றும் கற்று வந்த பார்வை தொடர்புகள், போராட்டக் கலை - இந்திய தமிழ் தில்லியல்கள் - தமிழ் விளக்கம் குழுக்கள் - தமிழ் தமிழ்களின் இதென்று தில்லியல்கள் - தமிழ் பெண் தொடர்புகள் - பார்வை மற்றும் பார்வை குழுக்கள் - தமிழ் தொடர்புகள் தலை பார்வை வந்த முயற்சி கலைக் கலைகள் பதித்தியம்.

அலகு III  தமிழ் மொழி தில்லியல் வகைப்பாட்டு 3
சிறித்தற்பாலி, தாட்சி, சுகாதாரத்துறை, செல்வாந்து கலை, தமிழ் மொழி தலைக்குடியினர், தமிழ் மொழி வழியியலாளர்கள்.

அலகு IV  தமிழ் தயாரிப்பு தில்லியல் வகைப்பாட்டு 3
தமிழ் தயாரிப்புத் தலைக்குடியினர், தமிழ் மொழி தயாரிப்பு - மாணுர் தமிழ்களின் கலை தந்தொல்லியல் ஆரம் போராட்டம் எழுத்துகள் - தமிழ் தயாரிப்பு அதியாரிகள் - தமிழ் தயாரிப்பு தம்சவரிசை - தமிழ் தயாரிப்பு தமிழ்களின் கலை தந்தொல்லியல், கலைப்படுகள் - சிற்றிலகை கலை கலைத்துறை தமிழ் தயாரிப்பு தம்சவரிசை - கலை தொடர்புகள், தமிழ் தயாரிப்பு தம்சவரிசை எழுத்துகள்.

அலகு V  தமிழ் தயாரிப்பு தில்லியல் வகைப்பாட்டு 3
தமிழ் தயாரிப்பு தந்தொல்லியல் தம்சவரிசை - தமிழ் தயாரிப்பு தம்சவரிசை தமிழ் தயாரிப்பு தந்தொல்லியல் - தமிழ் தயாரிப்பு தம்சவரிசை, சிற்றிலகை கலை கலைத்துறை - கலை தொடர்புகள், தமிழ் தயாரிப்பு தம்சவரிசை எழுத்துகள்.

TEXT-CUM-REFERENCE BOOKS
1. தமிழ் கலைப்பு - மாணுர் பார்வை (தமிழில்: தமிழில் பார்வை மற்றும் கலைத்துறை கொண்டாடல்).
2. கலைத்துறை தமிழ் - பரமானுத் தந்தொல்லியல் (சிற்றிலகை பிரசுரம்).
3. தமிழ் - முன்னுச்சீராக பெருமையான நூற்றாண்டு (தமிழில்: தமிழ் பெருமையான நூற்றாண்டு).
4. போராட்டக் கலைத்துறை (சிற்றிலகை பிரசுரம்).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)
8. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

GE3152

HERITAGE OF TAMILS

UNIT I

LANGUAGE AND LITERATURE


UNIT II

HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE


UNIT III

FOLK AND MARTIAL ARTS

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV

THINAI CONCEPT OF TAMILS

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V

CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

2. கல்விக் நோகரிகம் – மேற்குற்று வரலை குறிப்பிடும். (இந்த பத்தி).
3. மாண்டு – மண்டராள் சர்பு குறிப்பிட்டு (தமிழ் பொடும் குறித் தமிழ் நோகரிகம்).
4. மாண்டு – மண்டராள் வரலை குறிப்பிடும். (இந்த பத்தி).
5. Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)


GE3171 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C

OBJECTIVES:
- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:
Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)

2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).

3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)

4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)

5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)

6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)

7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)


9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)

10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter’s age validity, student mark range validation)

12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

OUTCOMES:
On completion of the course, students will be able to:
CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Implement programs in Python using conditionals and loops for solving problems.
CO4: Deploy functions to decompose a Python program.
CO5: Process compound data using Python data structures.
CO6: Utilize Python packages in developing software applications.

TEXT BOOKS:

REFERENCES:
5. https://www.python.org/

BS3171 PHYSICS AND CHEMISTRY LABORATORY

PHYSICS LABORATORY: (Any Seven Experiments)

COURSE OBJECTIVES:
- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS
1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young’s modulus
4. Uniform bending – Determination of Young’s modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre - Determination of Numerical Aperture and acceptance angle
b) Compact disc - Determination of width of the groove using laser.
8. Acoustic grating - Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde’s string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students should be able to
CO1: Understand the functioning of various physics laboratory equipment.
CO2: Use graphical models to analyze laboratory data.
CO3: Use mathematical models as a medium for quantitative reasoning and describing physical reality.
CO4: Access, process and analyze scientific information.
CO5: Solve problems individually and collaboratively.

CHEMISTRY LABORATORY: (Any seven experiments)

OBJECTIVES:
- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)
1. Preparation of Na₂CO₃ as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in water sample.
   - Split the first experiment into two
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler’s method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
13. Preparation of nanoparticles (TiO₂/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

TOTAL: 30 PERIODS

OUT COMES:
- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To analyse and determine the composition of alloys.
- To learn simple method of synthesis of nanoparticles
- To quantitatively analyse the impurities in solution by electroanalytical techniques
TEXT BOOKS:

GE3172 ENGLISH LABORATORY

OBJECTIVES:
- To improve the communicative competence of learners
- To help learners use language effectively in academic/work contexts
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students’ English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION
Listening for general information-specific details- conversation: Introduction to classmates - Audio/video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions( filling out a bank application for example).

UNIT II NARRATION AND SUMMATION
Listening - Listening to podcasts, anecdotes/stories/event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences/events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.

UNIT III DESCRIPTION OF A PROCESS/PRODUCT
Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)-talking about precautions.

UNIT IV CLASSIFICATION AND RECOMMENDATIONS
Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation-

UNIT V EXPRESSION
Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking – making predictions- talking about a given topic-giving opinions-understanding a website-describing processes

LEARNING OUTCOMES:
At the end of the course, learners will be able
- To listen and comprehend complex academic texts
- To speak fluently and accurately in formal and informal communicative contexts
- To express their opinions effectively in both oral and written medium of communication

ASSESSMENT PATTERN
- One online/app based assessment to test listening/speaking
- End Semester ONLY listening and speaking will be conducted online.

TOTAL: 30 PERIODS
- Proficiency certification is given on successful completion of listening and speaking internal test and end semester exam.

**HS3251 PROFESSIONAL ENGLISH -II**

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

**OBJECTIVES :**
- To engage learners in meaningful language activities to improve their reading and writing skills
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

**UNIT I MAKING COMPARISONS**  
6
Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases

**UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING**  
6
Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

**UNIT III PROBLEM SOLVING**  
6
Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences

**UNIT IV REPORTING OF EVENTS AND RESEARCH**  
6

**UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY**  
6
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.

**TOTAL : 30 PERIODS**

**OUTCOMES:**
At the end of the course, learners will be able
- To compare and contrast products and ideas in technical texts.
- To identify cause and effects in events, industrial processes through technical texts
- To analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format.
- To report events and the processes of technical and industrial nature.
- To present their opinions in a planned and logical manner, and draft effective resumes in context of job search.

**TEXT BOOKS :**
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
REFERENCE BOOKS:

ASSESSMENT PATTERN
Two internal assessments and an end semester examination to test students’ reading and writing skills along with their grammatical and lexical competence.

MA3251 STATISTICS AND NUMERICAL METHODS

OBJECTIVES:
- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- 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 solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS
9+3
Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS
9+3
One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 2² factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS
9+3

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION
9+3
Lagrange’s and Newton’s divided difference interpolations – Newton’s forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson’s 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS
9+3
Single step methods: Taylor’s series method - Euler’s method - Modified Euler’s method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods:
Milne’s and Adams - Bash forth predictor corrector methods for solving first order differential equations.

TOTAL: 60 PERIODS

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

- 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.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS:

REFERENCES:

PH3258 PHYSICS OF MATERIALS
L T P C
3 0 0 3

COURSE OBJECTIVES:

- To make the students to understand the basics of phase diagrams and various materials preparation techniques
- To equip the students to have a knowledge on different types of electron theory, basics of quantum mechanics and about superconductors
- To introduce the physics of semiconducting materials and applications of semiconductors in device fabrication
- To familiarize the students with the theory and applications of magnetic and dielectric materials
- To provide the students a sound platform towards learning about advanced materials and their applications.

UNIT I PREPARATION OF MATERIALS

UNIT II ELECTRICAL PROPERTIES OF MATERIALS

UNIT III SEMICONDUCTING PROPERTIES MATERIALS

UNIT IV DIELECTRIC AND MAGNETIC MATERIALS

UNIT V NEW MATERIALS AND APPLICATIONS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the students should be able to

CO1: acquire knowledge of phase diagram, and thin film and nanomaterial preparation techniques
CO2: familiarize with conducting materials, basic quantum mechanics, and properties and applications of superconductors.
CO3: gain knowledge on semiconducting materials based on energy level diagrams, its types, temperature effect. Also, fabrication methods for semiconductor devices will be understood.
CO4: realize with theories and applications of dielectric and ferromagnetic materials
CO5: familiarize with ceramics, composites, metallic glasses, shape memory alloys, biomaterials and their important applications.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To introduce the basics of electric circuits and analysis
- To impart knowledge in domestic wiring
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To introduce the functional elements and working of sensors and transducers.

UNIT I  ELECTRICAL CIRCUITS
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm’s Law - Kirchhoff’s Laws – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)
Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only), Three phase supply – star and delta connection – power in three-phase systems

UNIT II  MAGNETIC CIRCUITS AND ELECTRICAL INSTALLATIONS
Magnetic circuits-definitions-MMF, flux, reluctance, magnetic field intensity, flux density, fringing, self and mutual inductances-simple problems.
Domestic wiring, types of wires and cables, earthing, protective devices- switch fuse unit-
Miniature circuit breaker-moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid

UNIT III  ELECTRICAL MACHINES

UNIT IV  ANALOG ELECTRONICS

UNIT V  SENSORS AND TRANSDUCERS
Sensors, solenoids, pneumatic controls with electrical actuator, mechatronics, types of valves and its applications, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors,Strain gauge, LVDT, differential pressure transducer, optical and digital transducers, Smart sensors, Thermal Imagers.

COURSE OUTCOMES:
After completing this course, the students will be able to
CO1: Compute the electric circuit parameters for simple problems
CO2: Explain the concepts of domestics wiring and protective devices
CO3: Explain the working principle and applications of electrical machines
CO4: Analyze the characteristics of analog electronic devices
CO5: Explain the types and operating principles of sensors and transducers
TEXT BOOKS:
3. S.K. Bhattacharyya, Basic Electrical Engineering, Pearson Education, 2019
4. James A Svoboda, Richard C. Dorf’s Introduction to Electric Circuits, Wiley,2018

REFERENCES:

CY3201 PHYSICAL AND ORGANIC CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:
• To understand concepts of chemical thermodynamics and partial molar quantities
• To impart thorough knowledge on rubber and plastics
• To make the student conversant with adsorption and oxidation process
• To provide comprehensive information and exposure to synthesis of monomers
• To learn and understand the structure and reactivity in organic compounds

UNIT I CHEMICAL THERMODYNAMICS
9
Introduction to thermodynamics – Need for second law of thermodynamics, third law of thermodynamics and its validity - Entropy and probability - Maxwell relations - Gibbs – Helmholtz equation - Van’t Hoff’s equation - Chemical potential - Partial molar quantities, methods of calculation Ideal and non-ideal solutions Thermodynamic criteria of polymer solubility, solubility parameter.

UNIT II RUBBER AND PLASTICS
9
Introduction to rubber - latex - processing latex - mastication - compounding of rubber - vulcanizations of rubber - engineering polymers thermoforming - degradation stability and environment- synthetic rubbers preparation and applications of SBR - butyl rubber - nitrile rubber - neoprene and silicone rubber- plastic materials - classification of plastics (or resins) - moulding constituents of a plastic – fabrication techniques used for thermoplastic resin (moulding process)-important thermoplastic resins- natural resins - celluloses – polyethylene – PVC.

UNIT III REACTION MECHANISMS
9
Free radical substitutions, Electrophilic addition, Aromatic Electrophilic substitutions, Nucleophilic additions, condensation reactions, nucleophilic substitutions in aliphatic compounds, cycloadditions, Rearrangements Beckmann, Curtius, Hofmann, cope and oxy-cope, Fries rearrangement reactions (Mechanism not required).

UNIT IV MONOMERS IN POLYMER TECHNOLOGY
9
Preparation, properties and uses of monomers: ethylene, propylene, isobutylene, butadiene, styrene, methyl methacrylate, diisocyanates, glycols, polyols, epichlorohydrin, Tetrafluoro ethylene,
acrylonitrile, vinyl chloride, vinyl acetate, Caprolactam.

UNIT V  STRUCTURE AND REACTIVITY IN ORGANIC COMPOUNDS  9
Bonding in Organic Compounds: alkane, alkene and alkyne - Structure-property relationships
Electronic effects: inductive, mesomeric, electromeric and hyperconjugation. Free radicals, carbocations, carbanions, elementary ideas about stereo chemistry RS-nomenclature and EZ-nomenclature

OUTCOMES:
- Will be able to understand chemical thermodynamics and the influence of chemical potential
- Will be familiar in rubber and plastics
- Will be conversant in the reaction mechanisms in organic chemistry
- Will have the ability to synthesize the monomers for the use of man kind
- Can investigate on the structure and reactivity of organic compounds

TOTAL: 45 PERIODS

TEXTBOOKS

REFERENCES

GE3251  ENGINEERING GRAPHICS  L T P C
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Drawing engineering curves.
- Drawing freehand sketch of simple objects.
- Drawing orthographic projection of solids and section of solids.
- Drawing development of solids
- Drawing isometric and perspective projections of simple solids.

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  PLANE CURVES  6+12
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

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 AND FREEHAND SKETCHING 6+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles — Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.
Practicing three dimensional modeling of simple objects by CAD Software(Not for examination)

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+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.
Practicing three dimensional modeling of simple objects by CAD Software(Not for examination)

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.
Practicing three dimensional modeling of isometric projection of simple objects by CAD Software(Not for examination)

TOTAL: (L=30+P=60) 90 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
• Use BIS conventions and specifications for engineering drawing.
• Construct the conic curves, involutes and cycloid.
• Solve practical problems involving projection of lines.
• Draw the orthographic, isometric and perspective projections of simple solids.
• Draw the development of simple solids.

TEXT BOOKS:

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.
4. The examination will be conducted in appropriate sessions on the same day.

GE3252  கருவிகள் தருண்ணந்தும் படவும் வருமானத்துறை:  L T P C
1  0  0 1

அலகு I படவும் படவும் படவும் வருமானத்துறை:  3
1. கருவிகளின் முக்கியமான படவும் - படவும் நூற்றாண்டுப் படவும் - கருவிகளின் ஆராய்ச்சி படவும் - படவும் நூற்றாண்டுப் படவும்.

அலகு II படவும் படவும் படவும் வருமானத்துறை:  3

TOTAL: 15 PERIODS
TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலொறு – மக்களும் பண பொடும் – மக.மக. பிளமள (தவளியீடு:தமிழ்நொடு பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முமனவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – மவமக நதிக்கமரயில் ஆங்ககொல நகரிகம் (ததொல்லியல் துமறதவளியீடு)
4. தபொருமந – ஆற்றங்கமர நொகரிகம். (ததொல்லியல் துமறதவளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

GE3252 TAMILS AND TECHNOLOGY L T P C
UNIT I WEAVING AND CERAMIC TECHNOLOGY
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple) - Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING

TOTAL : 15 PERIODS
TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலெறு – மக்களும் பண் பொடும் – தச.தக.பிள முதலை (தயாரிப்பு: துறையீடு பராமரிப்பால் கட்டியிட்டியால் புதுக்கும் கொண்டாம்).
2. தமிழில் தமிழ் – முதலையர் விளை. காரணமால். (விளக்கம் பிரசுரம்).
3. நேரடை துவாரகர்ப்பிழ் காலக் காலபிட்டு (தயாரிப்பு தொன்மை தொலைப்பிட்டு).
4. பராமரிப்பு – அத்துரைகள் காலபிட்டு. (தயாரிப்பு தொன்மை தொலைப்பிட்டு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
### NCC Credit Course Level 1*

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Description</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX3251</td>
<td>(ARMY WING) NCC Credit Course Level - I</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

#### NCC GENERAL

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCC 1</td>
<td>Aims, Objectives &amp; Organization of NCC</td>
<td>1</td>
</tr>
<tr>
<td>NCC 2</td>
<td>Incentives</td>
<td>2</td>
</tr>
<tr>
<td>NCC 3</td>
<td>Duties of NCC Cadet</td>
<td>1</td>
</tr>
<tr>
<td>NCC 4</td>
<td>NCC Camps: Types &amp; Conduct</td>
<td>2</td>
</tr>
</tbody>
</table>

#### NATIONAL INTEGRATION AND AWARENESS

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI 1</td>
<td>National Integration: Importance &amp; Necessity</td>
<td>1</td>
</tr>
<tr>
<td>NI 2</td>
<td>Factors Affecting National Integration</td>
<td>1</td>
</tr>
<tr>
<td>NI 3</td>
<td>Unity in Diversity &amp; Role of NCC in Nation Building</td>
<td>1</td>
</tr>
<tr>
<td>NI 4</td>
<td>Threats to National Security</td>
<td>1</td>
</tr>
</tbody>
</table>

#### PERSONALITY DEVELOPMENT

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD 1</td>
<td>Self-Awareness, Empathy, Critical &amp; Creative Thinking, Decision Making and Problem Solving</td>
<td>2</td>
</tr>
<tr>
<td>PD 2</td>
<td>Communication Skills</td>
<td>3</td>
</tr>
<tr>
<td>PD 3</td>
<td>Group Discussion: Stress &amp; Emotions</td>
<td>2</td>
</tr>
</tbody>
</table>

#### LEADERSHIP

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>L 1</td>
<td>Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code</td>
<td>3</td>
</tr>
<tr>
<td>L 2</td>
<td>Case Studies: Shivaji, Jhasi Ki Rani</td>
<td>2</td>
</tr>
</tbody>
</table>

#### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS 1</td>
<td>Basics, Rural Development Programmes, NGOs, Contribution of Youth</td>
<td>3</td>
</tr>
<tr>
<td>SS 4</td>
<td>Protection of Children and Women Safety</td>
<td>1</td>
</tr>
<tr>
<td>SS 5</td>
<td>Road / Rail Travel Safety</td>
<td>1</td>
</tr>
<tr>
<td>SS 6</td>
<td>New Initiatives</td>
<td>2</td>
</tr>
<tr>
<td>SS 7</td>
<td>Cyber and Mobile Security Awareness</td>
<td>1</td>
</tr>
</tbody>
</table>

**TOTAL: 30 PERIODS**
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Lecture (L)</th>
<th>Theory (T)</th>
<th>Practical (P)</th>
<th>Credits (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX3252</td>
<td>NCC Credit Course Level 1* (NAVAL WING)</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td><strong>NCC GENERAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCC 1</td>
<td>Aims, Objectives &amp; Organization of NCC</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCC 2</td>
<td>Incentives</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCC 3</td>
<td>Duties of NCC Cadet</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCC 4</td>
<td>NCC Camps: Types &amp; Conduct</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NATIONAL INTEGRATION AND AWARENESS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NI 1</td>
<td>National Integration: Importance &amp; Necessity</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NI 2</td>
<td>Factors Affecting National Integration</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NI 3</td>
<td>Unity in Diversity &amp; Role of NCC in Nation Building</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NI 4</td>
<td>Threats to National Security</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PERSONALITY DEVELOPMENT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD 1</td>
<td>Self-Awareness, Empathy, Critical &amp; Creative Thinking, Decision Making and Problem Solving</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD 2</td>
<td>Communication Skills</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD 3</td>
<td>Group Discussion: Stress &amp; Emotions</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LEADERSHIP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L 1</td>
<td>Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L 2</td>
<td>Case Studies: Shivaji, Jhasi Ki Rani</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SOCIAL SERVICE AND COMMUNITY DEVELOPMENT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS 1</td>
<td>Basics, Rural Development Programmes, NGOs, Contribution of Youth</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS 4</td>
<td>Protection of Children and Women Safety</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS 5</td>
<td>Road / Rail Travel Safety</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS 6</td>
<td>New Initiatives</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS 7</td>
<td>Cyber and Mobile Security Awareness</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL : 30 PERIODS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NCC Credit Course Level 1*

NX3253

(AIR FORCE WING)

NCC Credit Course Level - I

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

NCC GENERAL

NCC 1 Aims, Objectives & Organization of NCC 1
NCC 2 Incentives 2
NCC 3 Duties of NCC Cadet 1
NCC 4 NCC Camps: Types & Conduct 2

NATIONAL INTEGRATION AND AWARENESS

NI 1 National Integration: Importance & Necessity 1
NI 2 Factors Affecting National Integration 1
NI 3 Unity in Diversity & Role of NCC in Nation Building 1
NI 4 Threats to National Security 1

PERSONALITY DEVELOPMENT

PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving 2
PD 2 Communication Skills 3
PD 3 Group Discussion: Stress & Emotions 2

LEADERSHIP

L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code 3
L 2 Case Studies: Shivaji, Jhasi Ki Rani 2

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

SS 1 Basics, Rural Development Programmes, NGOs, Contribution of Youth 3
SS 4 Protection of Children and Women Safety 1
SS 5 Road / Rail Travel Safety 1
SS 6 New Initiatives 2
SS 7 Cyber and Mobile Security Awareness 1

TOTAL : 30 PERIODS
COURSE OBJECTIVES:
- Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
- Wiring various electrical joints in common household electrical wire work.
- Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
- Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:
- a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
- b) Preparing plumbing line sketches.
- c) Laying pipe connection to the suction side of a pump
- d) Laying pipe connection to the delivery side of a pump.
- e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:
- a) Sawing.
- b) Planing and
- c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:
- a) Studying joints in door panels and wooden furniture
- b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES 15

- a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
- b) Staircase wiring
- c) Fluorescent Lamp wiring with introduction to CFL and LED types.
- d) Energy meter wiring and related calculations/calibration
- e) Study of Iron Box wiring and assembly
- f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
- g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:
- b) Practicing gas welding.

BASIC MACHINING WORK:
a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:
   a) Assembling a centrifugal pump.
   b) Assembling a household mixer.
   c) Assembling an airconditioner.

SHEET METAL WORK:
   a) Making of a square tray

FOUNDRY WORK:
   a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:
   a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:
   a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:
   a) Study an elements of smart phone..
   b) Assembly and dismantle of LED TV.
   c) Assembly and dismantle of computer/ laptop

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

CO1 : Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.

CO2 : Wire various electrical joints in common household electrical wire work.

CO3 : Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.

CO4 : Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

TOTAL : 60 PERIODS
COURSE OBJECTIVES:
- To train the students in conducting load tests electrical machines
- To gain practical experience in experimentally obtaining the characteristics of electronic devices and rectifiers
- To train the students to measure three phase power and displacement

List of Experiments
1. Verification of ohms and Kirchhoff’s Laws.
2. Three Phase Power Measurement
3. Load test on DC Shunt Motor.
4. Load test on Self Excited DC Generator
5. Load test on Single phase Transformer
6. Load Test on Induction Motor
7. Characteristics of PN and Zener Diodes
8. Characteristics of BJT, SCR and MOSFET
9. Design and analysis of Half wave and Full Wave rectifiers
10. Measurement of displacement of LVDT

COURSE OUTCOMES:
After completing this course, the students will be able to

CO1: Use experimental methods to verify the Ohm’s law and Kirchhoff’s Law and to measure three phase power

CO2: Analyze experimentally the load characteristics of electrical machines

CO3: Analyze the characteristics of basic electronic devices

CO4: Use LVDT to measure displacement

GE3272 COMMUNICATION LABORATORY

OBJECTIVES
- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To be able to communicate effectively through writing.

UNIT I
Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition-discussing progress toward goals-talking about experiences- talking about events in life-discussing past events-Writing: writing emails ( formal & semi-formal).

UNIT II
Speaking: discussing news stories-talking about frequency-talking about travel problems-discussing travel procedures- talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.

UNIT III
Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios-talking about purchasing-discussing advantages and disadvantages- making comparisons-
discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.

UNIT IV 12
Speaking: discussing the natural environment-describing systems-describing position and movement- explaining rules-( example- discussing rental arrangements)- understanding technical instructions- Writing: writing instructions-writing a short article.

UNIT V 12
Speaking: describing things relatively-describing clothing-discussing safety issues( making recommendations) talking about electrical devices-describing controlling actions- Writing: job application( Cover letter + Curriculum vitae)-writing recommendations.

TOTAL: 60 PERIODS

LEARNING OUTCOMES

• Speak effectively in group discussions held in a formal/semi formal contexts.
• Write emails and effective job applications.

Assessment Pattern

• One online / app based assessment to test speaking and writing skills
• Proficiency certification is given on successful completion of speaking and writing.

MA3391 PROBABILITY AND STATISTICS

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 9 + 3
Axioms of probability – Conditional probability – Baye’s theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions – Functions of a random variable.

UNIT II TWO- DIMENSIONAL RANDOM VARIABLES 9 + 3
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 ESTIMATION THEORY 9 + 3

UNIT IV NON- PARAMETRIC TESTS 9 + 3
Introduction - The Sign test - The Signed - Rank test - Rank - sum tests - The U test - The H test - Tests based on Runs - Test of randomness - The Kolmogorov Tests.
UNIT V  STATISTICAL QUALITY CONTROL  

Control charts for measurements ( $\bar{X}$ and R charts ) – Control charts for attributes ( p, c and np charts) – Tolerance limits - Acceptance sampling.

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:
UNIT II MECHANICAL OPERATIONS 9
Properties of solids - Sieve analysis; Laws of crushing, Crushers and grinders. Principle of separation and selection and details of equipment for screening, cyclones and hydro cyclones (Basic principles and equipment description only. Mathematical consideration not required)

UNIT III HEAT TRANSFER 9
Modes of heat transfer; Heat transfer by conduction - Fourier's law, conduction across composite walls. Heat transfer by natural & forced convection. Co current, counter current, shell & tube heat exchangers (Basic principles and equipment description only. Mathematical consideration not required)

UNIT IV MASS TRANSFER 9
Principles of diffusion, theory of diffusion, Two film theory and mass transfer coefficients. Humidification - operation, humidity chart, equipment’s - cooling towers and spray chambers. Drying - Principles and definitions. Rate of batch drying. Equipment for drying (Basic principles and equipment description only. Mathematical consideration not required)

UNIT V UNIT OPERATIONS 9
Absorption - Principle and equipment (packed towers and plate columns). Distillation - flash distillation, and Binary distillation. Industrial equipment for distillation. Adsorption - Principle and equipment for adsorption. (Basic principles and equipment description only. Mathematical consideration not required)

TOTAL: 45 PERIODS

OUTCOMES
Upon completion of the course, the student will be able to:
- Attain the knowledge in fluid flow behaviors and mechanical separation.
- Understand the conduction and convection modes of heat transfer.
- Understand the concept of distillation equipment in the process industries.
- Understand the fundamentals of chemical engineering.
- Gain knowledge in various Unit Operations for Polymer processing.

TEXT BOOKS:

REFERENCES:

MAPPING OF CO’S WITH PO’S

<table>
<thead>
<tr>
<th>Course outcome Statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>AVg.</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>3</td>
</tr>
</tbody>
</table>

53
OBJECTIVES:
To enable the students
- To learn about the general methods of preparation of individual class of plastics Materials
- To study about the general properties, processing behavior and applications of different Class of plastics materials
- To understand about the structure- property relation of different class of plastics materials.
- To familiar about properties and end application of different plastics materials
- To gain knowledge of thermoplastics for industrial applications.

UNIT I INTRODUCTION
Basic chemistry of polymers-nomenclature of polymers sources for raw materials. Methods of manufacturing –properties and applications of Natural Polymers - Shellac resin and natural rubber- Cellulosics-Cellulose nitrate, cellulose acetate, cellulose acetate butyrate, Ethyl cellulose and others.

UNIT II COMMODITY THERMOPLASTICS-I
Preparation- properties - and applications of Polyolefin-Polyethylene- LDPE -LLDPE- HDPE, HMWHDPE- UHMWHDPE–Cross-linked polyethylene- Chlorinated polyethylene –Polypropylene – Homo & Co polymer

UNIT III COMMODITY THERMOPLASTICS-II
Preparation - properties - and applications of Vinyl plastics - Polyvinyl chloride, C-PVC, Polyvinyl Acetate, Polyvinylidene chloride, polyvinyl alcohol. Polystyrene

UNIT IV GENERAL PURPOSE THERMOSETS
Preparation - properties - and applications of: Phenol formaldehyde (PF), Amino plastics: Urea50formaldehyde (UF) - Melamine formaldehyde (MF), unsaturated polyesters, Alkyd resins

UNIT V ENGINEERING PLASTICS & ITS APPLICATIONS - I
Preparation- properties - and applications: Styrene copolymers–High Impact Polystyrene (HIPS), Acrylonitrile Butadiene Styrene (ABS), Styrene acrylonitrile (SAN), Acrylic plastics–Polymethyl Methacrylate, Polyacrylonitrile , Ethylene Vinyl Acetate (EVA).

OUTCOMES:
Upon completing this course, the student will be able to:
- Familiarize in natural polymer properties and its applications
- Acquire skills in selecting additives for plastic materials for specific applications
- Gain knowledge of manufacturing, properties and applications of poly olefins.
- Gain knowledge of manufacturing, properties and applications of vinyl halogenated olefin based plastic materials
- Gain knowledge of manufacturing, properties and applications of special purpose plastics

TEXT BOOKS:
REFERENCES:

MAPPING OF CO’S WITH PO’S

<table>
<thead>
<tr>
<th>Course outcome statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
</tr>
<tr>
<td>Avg</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘_’- no correlation

PT3303 POLYMER CHEMISTRY  L T P C

OBJECTIVES:
To make the student conversant with
- The basic concepts of polymers, classification of polymers, copolymer types and tactility.
- The kinetics & mechanism of different types addition polymerization and free radical copolymerization
- The kinetics & mechanism of two types of condensation polymerization and ring-opening polymerization
- Various types of polymerization techniques
- The molecular weight and its distribution and different methods of molecular weight determination.

UNIT I BASIC CONCEPTS OF POLYMERS

UNIT II ADDITION POLYMERISATION

UNIT III CONDENSATION POLYMERISATION
UNIT IV POLYMERISATION TECHNIQUES

UNIT V MOLECULAR WEIGHT AND ITS DISTRIBUTION
Molecular weight of polymer – number, weight and viscosity average molecular weights – molecular weight distribution (problems) – molecular weight determination: end-group analysis, colligative properties, osmometry, light scattering, gel permeation chromatography and viscometry.

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of the Course the students will be able to
- Classify polymers based on various criteria and also name the polymers using proper nomenclature.
- Derive the rate equations and explain the mechanism of addition polymerisation reactions.
- Derive the rate equations and explain the mechanism of condensation polymerisation reactions.
- Describe the various polymerisation techniques.
- Elaborate on methods of molecular weight determination and calculate molecular weight of polymers

TEXTBOOKS:
4. V.R. Gowariker, —Polymer Science – New Age International (P) Ltd, Publishers

REFERENCES:
PT3304 POLYMER PHYSICS L T P C 3 0 0 3

OBJECTIVES:
To enable the students to understand the
- To make the students understand physical and conformational properties of polymeric materials.
- To know the molecular arrangement in polymers
- To know about the transition temperatures in polymers
- To understand about the orientation in polymers under the influence of stress.
- To know the solubility behavior of polymers.

UNIT I FUNDAMENTALS OF POLYMER PHYSICS 9
Potential energy and conformational energy of molecules - conformations and configurations, Tacticity, isomeric states and isomerism in polymers, stereoisomerism, geometric isomerism - Random coils and average end to end distance - (Derivation only)

UNIT II THERMODYNAMIC PROPERTIES 9
Laws of Thermodynamics - Freely jointed and freely rotating chain models - Entropy and enthalpy Energy driven and entropy driven elasticity - Thermo elasticity -Thermodynamic treatment - entropic and energetic contributions (Derivation only).

UNIT III POLYMER CRYSTAL FORMATION 9

UNIT IV CHAIN ORIENTATION 9

UNIT V POLYMER SOLUTIONS 9
Polymer solutions - Terms and definitions, types of solutions - Hildebrand approach, Flory Huggins theory - Thermodynamic view of miscibility, upper critical solution temperature (UCST), lower
critical solution temperature (LCST) - solubility parameter, determination of solubility parameter of polymers - theta conditions.

OUTCOMES:
Upon Completion of the Course the students will be able to
- Will acquire the knowledge about the conformational properties of polymers
- Will understand molecular arrangement in polymers.
- Will understand about the transition temperatures in polymers
- Will able to demonstrate the orientation processes in polymer.
- Will acquire the knowledge in solubility behaviour of polymers

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of the Course the students will be able to
- Will acquire the knowledge about the conformational properties of polymers
- Will understand molecular arrangement in polymers.
- Will understand about the transition temperatures in polymers
- Will able to demonstrate the orientation processes in polymer.
- Will acquire the knowledge in solubility behaviour of polymers

OUTCOMES:
Upon Completion of the Course the students will be able to
- Will acquire the knowledge about the conformational properties of polymers
- Will understand molecular arrangement in polymers.
- Will understand about the transition temperatures in polymers
- Will able to demonstrate the orientation processes in polymer.
- Will acquire the knowledge in solubility behaviour of polymers

OUTCOMES:
Upon Completion of the Course the students will be able to
- Will acquire the knowledge about the conformational properties of polymers
- Will understand molecular arrangement in polymers.
- Will understand about the transition temperatures in polymers
- Will able to demonstrate the orientation processes in polymer.
- Will acquire the knowledge in solubility behaviour of polymers

OUTCOMES:
Upon Completion of the Course the students will be able to
- Will acquire the knowledge about the conformational properties of polymers
- Will understand molecular arrangement in polymers.
- Will understand about the transition temperatures in polymers
- Will able to demonstrate the orientation processes in polymer.
- Will acquire the knowledge in solubility behaviour of polymers

TEXT BOOKS:

REFERENCES:

MAPPING OF CO’S WITH PO’S

<table>
<thead>
<tr>
<th>Course outcome statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
</tr>
<tr>
<td>AVG</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘‘-’’- no correlation

PT3305 SOLID MECHANICS OF TECHNOLOGISTS L T P C
3 0 0 3

OBJECTIVES:
- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.
- To apply the mathematical knowledge to calculate the deformation behavior of beams.
- To understand the effect of torsion on shafts and springs.
- To understand thin cylinders and theories of failure
- To analyze a complete two dimensional state of stress

UNIT I STATICS OF PARTICLES

UNIT II  EQUILIBRIUM OF RIGID BODIES  9
Free body diagram – Types of supports – Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon’s theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III  DEFLECTION OF BEAMS  9

UNIT IV  TORSION  9
Torsion of Circular and Hollow Shafts – Stresses and Deflection in Circular Solid and Hollow Shafts – strain energy due to torsion – Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – Springs in series and parallel.

UNIT V  THIN CYLINDERS AND THEORIES OF FAILURE  9
Thin cylinders – Stresses in thin cylindrical shell due to internal pressure – circumferential and longitudinal stresses - Theories of failure - maximum Principal stress - maximum Principal strain - Shear stress - Total strain energy - Energy distortion theories.

TOTAL: 45 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- Illustrate the vectorial and scalar representation of forces and moments
- Analyse the rigid body in equilibrium
- Apply the mathematical knowledge in determining the deformation behavior of beams
- Thoroughly understand the effect of torsion on shafts and springs.
- Analyze a complex two dimensional state of stress and to analyze the failure mode.

TEXT BOOK

REFERENCE BOOK

MAPPING OF CO’S WITH PO’S

<table>
<thead>
<tr>
<th>Course outcome Statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
</tbody>
</table>
OBJECTIVE:
- To practically train on various techniques for reducing and separating of particles, flow properties of fluids.
- To test the performance of centrifugal and reciprocating pump.
- To estimate the HTC for heat transfer through heat exchangers.
- To study the reduction capacity of various mills in size reduction of coarse particles.

LIST OF EXPERIMENTS:
1. To determine the pipe friction using Flow through rough and smooth pipes.
2. To determine the efficiency of pump using Centrifugal pump.
3. To determine the coefficient of discharge of orifice meter.
4. To find the efficiency of Air compressor.
5. To Calibrate the rotameter.
6. To find the Pressure drop in packed bed.
7. To study the concept of Fluidization by using fluidized bed.
8. To determine the coefficient of discharge of Venturi meter.
9. To find the Thermal conductivity of solids.
10. To find overall heat transfer coefficient of the Heat exchanger.
11. To find the Stefan-Boltzman constant.
12. To find the new surface area created by Jaw crusher.
13. To find the critical speed of Ball Mill.
14. To find the Screening efficiency.
15. To separate the component by Simple distillation.
16. To separate the component by using steam distillation.
17. To find the Particle size and Surface area of filler particles.

(Any nine Experiments)  TOTAL: 60 PERIODS

OUTCOMES:
Upon completing of this course, the students will be able to:
- Apply the different technique for size reduction.
- Attain skill in operating fluid pressure apparatus.
- Estimate the HTC for heat transfer through shell and tube heat exchangers.
- Will be able to apply the different technique for size reduction.

REFERENCES:
<table>
<thead>
<tr>
<th>Course outcome Statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVg.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘-‘- no correlation

PT3312 POLYMERIC CHEMISTRY LAB

COURSE OBJECTIVES:
- To develop an understanding on various methods of polymerization and its structure property relationship.
- To equip with the fundamental knowledge of mechanism of polymerization and various process parameters affecting the polymerisation technique
- To train the student to identify plastics by preliminary methods

PRACTICALS
List of Experiments:
1. Preparation of phenol-formaldehyde (Novolac) resin.
2. Preparation of phenol-formaldehyde (Resol) resin.
3. Preparation of urea-formaldehyde resin.
4. Preparation of bisphenol–A epoxy resin.
5. Preparation of unsaturated polyester resin.
6. Preparation of polyester using diethylene glycol & adipic acid.
8. Emulsion polymerization of styrene.
10. Solution polymerization of vinyl acetate.
11. Suspension polymerization of methylnitrate.
12. Copolymerization of styrene and methylmethacrylate

(Any nine Experiments) TOTAL: 60 PERIODS

OUTCOMES:
Upon completion of the course the students will be able to
- Identify different types of plastics by their characteristics using preliminary tests
- Identify different types of rubbers by their characteristics using preliminary tests
- Identify the polymers by confirmatory tests

TEXTBOOKS:

### MAPPING OF CO’S WITH PO’S

<table>
<thead>
<tr>
<th>Course outcome Statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>AVG.</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>2</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘-’- no correlation

### GE3361 PROFESSIONAL DEVELOPMENT

<table>
<thead>
<tr>
<th>OBJECTIVES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.</td>
</tr>
<tr>
<td>- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.</td>
</tr>
<tr>
<td>- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered</td>
</tr>
<tr>
<td>- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.</td>
</tr>
</tbody>
</table>

### MS WORD: 10 Hours

- Create and format a document
- Working with tables
- Working with Bullets and Lists
- Working with styles, shapes, smart art, charts
- Inserting objects, charts and importing objects from other office tools
- Creating and Using document templates
- Inserting equations, symbols and special characters
- Working with Table of contents and References, citations
- Insert and review comments
- Create bookmarks, hyperlinks, endnotes footnote
- Viewing document in different modes
- Working with document protection and security
- Inspect document for accessibility

### MS EXCEL: 10 Hours

- Create worksheets, insert and format data
- Work with different types of data: text, currency, date, numeric etc.
- Split, validate, consolidate, Convert data
- Sort and filter data
- Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,)
- Work with Lookup and reference formulae
- Create and Work with different types of charts

62
Use pivot tables to summarize and analyze data
Perform data analysis using own formulae and functions
Combine data from multiple worksheets using own formulae and built-in functions to generate results
Export data and sheets to other file formats
Working with macros
Protecting data and Securing the workbook

**MS POWERPOINT:**
Select slide templates, layout and themes
Formatting slide content and using bullets and numbering
Insert and format images, smart art, tables, charts
Using Slide master, notes and handout master
Working with animation and transitions
Organize and Group slides
Import or create and use media objects: audio, video, animation
Perform slideshow recording and Record narration and create presentable videos

**OUTCOMES:**
On successful completion the students will be able to
- Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
- Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
- Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

**PT3401 ADDITIVES AND COMPOUNDING**

**OBJECTIVES:**
To enable the students to
- Understand various draw backs of polymer materials and suitable remedies.
- Understand various additives used in polymers
- Understand the mechanism of degradation of polymers and chemistry of stabilizing additives
- Understand various compounding methodologies for plastics materials
- Learn the house keeping and maintenance of compounding machinery.

**UNIT I FILLERS/REINFORCEMENTS, STABILIZERS, PIGMENTS**
Fillers and Reinforcement—Antioxidants-Thermal Stabilisers, Ultraviolet stabilizer—Impact Modifiers/ toughening agents. Colourants-Fire retardants-Coupling agents-blowing-agents

**UNIT II ADDITIVES FOR PROCESSING**
Plasticizers- Anti static agents-Anti blocking agents-Slip and anti slip agents-processing aids - Lubricants- mould releasing agents Additives for recycling.

**UNIT III FUNDAMENTALS OF COMPOUNDING**

**UNIT IV COMPOUNDING MECHANISMS**
Compounding Machineries specifications - temperature control system – operating characteristics and working details of continuous mixers - Single Screw extruder - Twin Screw extruder-
housekeeping and maintenance of compounding machines.

UNIT V CASE STUDIES
Case studies on preference of one plastics to other and co-relation of properties of conventional materials and blends and alloys - case studies on application of blends and alloys.

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of the Course the students will be able to
- Understand various types of additives for plastics and their merits and demerits.
- Analyse various compounding methods used in the manufacturing of compounded thermoplastics and thermosets.
- Students will have clear understanding of various drawbacks of polymer materials and remedies
- Will understand about the mechanism of degradation in polymers
- Students can learn about various compounding methods used in the manufacturing of compounded thermoplastics and thermosets.

TEXT BOOKS:

REFERENCES:

MAPPING OF CO’S WITH PO’S

<table>
<thead>
<tr>
<th>Course outcome statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>_</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>_</td>
<td>1</td>
<td>1</td>
<td>_</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>_</td>
<td>1</td>
<td>1</td>
<td>_</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>_</td>
<td>1</td>
<td>1</td>
<td>_</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>_</td>
<td>1</td>
<td>1</td>
<td>_</td>
<td>3</td>
</tr>
<tr>
<td>AVG</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>_</td>
<td>1</td>
<td>1</td>
<td>_</td>
<td>3</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, _“-"-_ no correlation
OBJECTIVES:
To enable the students to understand the basic concepts of rheology
- To analyze the flow behavior of polymer melts and to carry out the experimental techniques for measuring the rheological properties.
- To study various mechanical models in rheology
- To learn the methods of measurement of polymer viscosity
- To understand the basics of fluid mechanism and to analyze behavior of Newtonian fluids.
- To understand the types of flow measuring devices and to determine coefficient of discharge.

UNIT I     FLUID PROPERTIES
Units and dimensions-Properties of fluids-mass density, specific weight, specific volume, specific gravity, viscosity, surface tension and capillarity-Terminologies of fluid flow-Laminar and turbulent flow of Newtonian fluids-Power law-Reynolds number and its significance

UNIT II     FLUID FRICTION AND FLOW MEASUREMENT
Bernoulli’s equation–kinetic energy correction factor; head loss; friction factor; major and Minor losses- Flow measurement: Introduction; Orifice meter; Venturi meter; concept of area meters: rotameter; Local velocity measurement: Pitot tube.

UNIT III    POLYMER RHEOLOGY
Introduction and Basic concepts of Rheology, classification of fluids, Newtonian and non Newtonian fluids, shear stress, shear strain and shear rate, shear modulus, bulk modulus, Zero shear viscosity, Dependence of viscosity with temp, shear stress, Viscoelasticity - effect of rate of strain, temperature and time on mechanical behaviour of polymeric materials.

UNIT IV     RHEOLOGICAL MODELS

UNIT V     MEASUREMENT OF POLYMER MELT VISCOSITY

OUTCOMES:
On completion of the course, students
- Will have thorough knowledge on the basic concepts of rheology.
- Will able to analyze the mechanical behavior of polymers under applied load.
- Will have the knowledge on experimental techniques for measuring the rheological properties.
- Will understand the basics of fluid mechanics and to analyze the behavior of Newtonian fluids.
- Will have knowledge of the instruments such as orifice meter, venturi meter & pitot tube.
TEXT BOOKS:

REFERENCES:

MAPPING OF CO’S WITH PO’S

<table>
<thead>
<tr>
<th>Course outcome Statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>AVg.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘-‘- no correlation

PT3403
PLASTICS MATERIALS II
L T P C
3 0 0 3

OBJECTIVES:
To enable the students to
• Learn about the general methods of preparation of individual class of plastic materials
• Understand the general properties, processing behavior of plastics materials.
• Knowledge in applications of different class of plastics materials.
• Make the student familiar about specialty polymers properties and end application.
• To understand the role of polymer blends & alloys in current scenario.

UNIT I
ENGINEERING PLASTICS & ITS APPLICATIONS – II
Preparation-properties - and applications: Polyamides-Nylons 6, (6,6), (6,10), 11, 12, Polyesters–Polyethylene terephthalate, polybutylene terephthalate, Polycarbonate, Polyacetals.

UNIT II
HIGH PERFORMANCE PLASTICS - I
Preparation -properties-and applications: Aromatic ether-Polyphenylene oxide (PPO), Aromatic thioether - Polyphenylensulphide (PPS), Polysulfone, Aromatic polyamides
UNIT III HIGH PERFORMANCE PLASTICS - II
Preparation-properties-and applications: Polyimides (PI) Polyamideimide (PAI), Polyimidazoles, Fluoropolymers—Polyvinyl fluoride (PVF), Polyvinylidene fluoride (PVDF), Polytetrafluoroethylene (PTFE), Polychlorotrifluoroethylene (PCTFE).

UNIT IV WATER SOLUBLE POLYMERS AND BIO DEGRADABLE POLYMERS
Preparation- properties and applications of Biodegradable polymers-poly ε-caprolactone – polylactic acid- Bacterial polyhydroxyalkonates.—polyvinylpyrroldione—polyacrylic acid and its homolog’s – polyacrylamide –polyethylene oxide – polyethylene amine-Polyvinyl alcohol

OUTCOMES:
Upon completing this course, the students

- Will have the knowledge of manufacturing methods, properties of special purpose polymers applied in special application
- Will have knowledge of manufacturing methods and correlate the high performance polymer properties for special purpose
- Will acquire skills in selection of conducting polymer to suitable application
- Will have the knowledge of manufacturing methods, properties and applications of ionic polymers
- Will have the knowledge of manufacturing methods, properties and applications of watersoluble and bio degradable polymers

TEXT BOOKS:

REFERENCES:
### MAPPING OF CO’S WITH PO’S

<table>
<thead>
<tr>
<th>Course outcome statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>_</td>
<td>1</td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>_</td>
<td>1</td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>_</td>
<td>1</td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>_</td>
<td>1</td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>_</td>
<td>1</td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Avg</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>_</td>
<td>1</td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘-‘- no correlation

---

### PT3404  PLASTIC MOULD AND DIES TECHNOLOGY

**OBJECTIVES:** To impart knowledge on
- impart knowledge on various Molds types, Mold making and Material of mold selection.
- acquire knowledge on mold tools.
- develop the knowledge on elements of the mould and manufacturing processes.
- learn the application of additive manufacturing in mould development
- acquire skills in advanced measuring instruments for inspection of mold

#### UNIT I  BASIC MOLD TYPES, TOOL MAKING PROCESSES AND MATERIALS


#### UNIT II   INJECTION MOLDS


#### UNIT III  BLOW MOLDED AND EXTRUSION MOLDS


#### UNIT IV  COMPRESSION MOLDS

Special Design Features – Side Ram Molds.

UNIT V REACTION INJECTION AND MAINTENANCE MOLD


TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students would have knowledge on

- will have the knowledge in Molds Tools and mould manufacturing
- will acquire skills Types of molds
- will understand on different materials for mold manufacturing
- will learn the application of additive manufacturing in mold development
- will acquire skills in advanced measuring equipment for inspection of mold

TEXT BOOKS:

REFERENCES:

MAPPING OF CO’S WITH PO’S

<table>
<thead>
<tr>
<th>Course outcome statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Avg</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>_</td>
<td>1</td>
<td>2</td>
<td>_</td>
<td>_</td>
<td>3</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘-‘- no correlation
OBJECTIVES:
To enable the students
- understand the effect of polymer property on processing
- study the rheology of polymer melts
- understand the various processing techniques of plastic materials.
- learn the fundamentals and compression molding and transfer molding of thermoset plastics.
- learn the basic processing of thermoplastics by injection molding, extrusion and blow moulding.

UNIT I  **INTRODUCTION**  5
Basic principles of processing - shape and size – Effect of polymer property on processing – Newtonian and Non-Newtonian fluids - Rheology of polymer melts.

UNIT II  **COMPRESSION MOULDING & TRANSFER MOULDING**  10

UNIT III  **INJECTION MOULDING**  10
Principles processing outline - Process variables - Mould cycle - Machinery used – Parts and functions –Specifications - Construction and maintenance - Start-up and shut down procedures - Cylinder nozzles - Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables - Introduction to trouble shooting.

UNIT IV  **EXTRUSION**  10

UNIT V  **BLOW MOULDING**  10
Basic principles and definitions- Processer – viz. Injection Blow moulding, extrusion blow moulding, Accumulation blow moulding, Merits & Demerits - Development of blow moulding industry Processing Parameters-Temperature-Pressure and cycle time Components – Materials requirements related to process and product performance- Materials used-Limitations in product design presented by process characteristics- Design guide lines for optimum product performance and appearance-Equipment used- Hand and power operated equipment. Screw and Plunger Systems-Cross head and die design- Blow moulding machine features and operation including hydraulic and electrical control systems-faults, causes and remedies. Parison programming, blow mould construction, cooling methods, mould venting, blow moulding of difficult articles like fuel
tanks, odd shaped containers with handles, limitation in blow moulding, decoration of blow moulding products, hot stamping-multi colour printing-faults, causes and remedies.

TOTAL: 45 PERIODS

OUTCOMES:
On completing this course, the students would
- On completing this course, the students would acquire the knowledge on effect of polymer properties on processing
- Will understand the rheology of polymers
- Will acquire knowledge on basic principles of processing
- Will understand processing of plastic materials by injection moulding, extrusion, and blow moulding.
- Students can will understand processing techniques like compression molding and transfer moulding of thermoset plastics.

TEXT BOOKS:
4. Extrusion of Plastics By Fisher
5. Plastics Extrusion Technology By Grief

REFERENCES:
1. A Guide to Injection Molding of Plastics By Bolur, P.C.,
6. Injection Molding Technology By V.D.I.
9. Compression Molding By Iyesew, A.I.

MAPPING OF CO'S WITH PO'S

<table>
<thead>
<tr>
<th>Course outcome statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>2</td>
</tr>
<tr>
<td>Avg</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>2</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘-‘- no correlation
UNIT I: ENVIRONMENT AND BIODIVERSITY

UNIT II: ENVIRONMENTAL POLLUTION

UNIT III: RENEWABLE SOURCES OF ENERGY
Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV: SUSTAINABILITY AND MANAGEMENT
Development , GDP ,Sustainability concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V: SUSTAINABILITY PRACTICES

TEXT BOOKS:
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.

REFERENCE BOOKS:
PT3411 POLYMER SCIENCE LAB

OBJECTIVE:
• To prepare the students with Methodology for facing the Industrial and academic challenges in identifying various polymers and controlling the quality of incoming raw materials and processing
• To make the students to understand the laboratory scale synthesis process of various types of thermoplastics and thermosets
• To enable the student to carry out production, research and development in the areas of polymer synthesis, polymer nanocomposites, coating formulation development, Fiber reinforced composites, polymer processing etc.
• To make them aware of Environmental concerns of Polymer Synthesis
• To make the students to understand and do calculations observations formulations involved team work and understanding practical problems related to the experiment.

LIST OF EXPERIMENTS
1. Preparation of phenol - formaldehyde (Novalac) resin.
2. Preparation of phenol - formaldehyde (Resol) resin.
3. Preparation of Urea formaldehyde resin.
5. Bulk polymerization of styrene.
7. Solution Polymerization of acrylonitrile.
8. Bulk Polymerization of Methyl methacrylate.
9. Copolymerization of styrene and methyl methacrylate.
10. Ring opening polymerization of Caprolactone
11. Solution Polymerization of Vinyl acetate.
12. Depolymerization of waste thermoplastics such as polystyrene or polymethylmethacrylate
13. Determination of acid value in unsaturated polyester resin
14. Preparation of saturated polyester resin
15. Determination of acid value in saturated polyester resin

(Any Nine of the above) TOTAL: 60 PERIODS

OUTCOMES:
Upon completing this course, the students
• Will acquire skills in preparation of polymers using various polymerization techniques.
• Will develop the conversion of polymeric materials into product.
• Design and conduct experiments for synthesis of Resins and polymers and understand the practical problems related to the experiment.
• Interpret data, process parameters within realistic constraints of the experiment.
• Communicate effectively in team work and understanding of professional and ethical responsibility.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
• Magnetic stirrer 10 Nos.
• Thermostatic Water bath 2 Nos.
• Vacuum Pump 1 No.
• Heating Mantle 8 Nos.
• Water distillation set up 1 No.
• Bunsen burner 15 Nos.
• Electronic balance 2 Nos.
• Air oven 1 No.
• Melting point apparatus 1 No.
• Retard stands 15 Nos.
• Burette
• Pipette
• Funnel

<table>
<thead>
<tr>
<th>Course outcome statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>2</td>
</tr>
<tr>
<td>Avg</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>___</td>
<td>2</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘-‘ no correlation
OBJECTIVE:
- To practice the students in different types of moulding machines.
- To practice the students in different types of Semi automatic moulding machines.
- To practice the students in different types of Automatic moulding machines.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of M/c/ Equipment/ Mould</th>
<th>Description of Practical Exercise to be done</th>
</tr>
</thead>
</table>
| 1      | Hand operated Injection Moulding Machine | (i) Study of Machine in Idle-Run Observation (IRO), Parts & functions, operating principle, Free sketch of Machine-parts eg. Nozzle, Torpedo, Hopper, Rack & Pinion Barrel etc., shot capacity definition  
(ii) Operation practice to produce moulding on Different and injection moulds. Recording the observation and results in practical record books. |
| 2      | Injection Moulding Semi Automatic | (i) Study of Semi Automatic Injection Moulding M/cs of all types in IRO. Comparative study of Pneumatic type & Hydraulic type of M/cs, Operating Principle of M/cs. Line diagrams of M/cs with nomenclature of parts, M/cs specifications.  
(ii) Operation of Pneumatic & Hydraulic type of Semi automatic Injection moulding M/cs, to produce components in different moulds. Cycle-time analysis, observations of Process-Parameters & Procedure to be recorded |
| 3      | Extrusion Processes on Extruders | (i) Study of Extruders in IRO, Free sketch of machines, their parts and parts-function, List of products manufactured by Extrusion-Process. Study of different types of extrusion process.  
(ii) Operation-Practice by Trainees on setting up of Process parameter to produce Blown-Film on Film-plant, observations on extruder output, size of film produced and technical specifications of machines to be recorded |
(ii) Operating Principle of Hand Compression Press, mould setting procedure & parameter setting, operation practice on different compression moulds, M/c specification observations and recording |
| 5      | Blow Moulding and Recording Hand Operated | (i) Study of Hand Blow Moulding M/cs, Free-sketch of M/c with parts & study of part-function, Specification of M/c, Study of Parison-die with sketch.  
(ii) Die-centering practice by Trainees, operation of Hand Blow Machines, to produce components observations, cycle time analysis Procedure of operation and observations. |
| 6      | Scrap Grinding | (i) M/c Study in IRO, specification of M/c, study of parts & function, Line Diagram of M/c.  
(ii) Operation-practice with different materials and output study in Kg/hour for different materials. |
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of M/c/ Equipment/ Mould</th>
<th>No. of machine required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hand operated Injection Moulding Machine</td>
<td>01</td>
</tr>
<tr>
<td>2</td>
<td>Injection Moulding Semi-Automatic</td>
<td>01</td>
</tr>
<tr>
<td>3</td>
<td>Extrusion Processes on Extruders</td>
<td>01</td>
</tr>
<tr>
<td>4</td>
<td>Compression moulding–Hand Operated</td>
<td>01</td>
</tr>
<tr>
<td>5</td>
<td>Blow Moulding and recording – Hand Operated</td>
<td>01</td>
</tr>
<tr>
<td>6</td>
<td>Scrap Grinding</td>
<td>01</td>
</tr>
<tr>
<td>7</td>
<td>Injection Moulding M/c.- Automatic</td>
<td>01</td>
</tr>
<tr>
<td>8</td>
<td>Compression &amp; Transfer Moulding- Semi Automatic</td>
<td>01</td>
</tr>
<tr>
<td>9</td>
<td>Blow-Moulding Semi-Automatic</td>
<td>01</td>
</tr>
<tr>
<td>10</td>
<td>Introduction to Maintenance</td>
<td>--</td>
</tr>
<tr>
<td>11</td>
<td>Introduction to Moulds, Tool Room M/c &amp; Drawing Practice</td>
<td>--</td>
</tr>
</tbody>
</table>

**TOTAL: 60 PERIODS**

**OUTCOME:**

- Upon completing this practical course, the student will have hands on experience on different types of hand operated moulding machines.
- The student will have hands on experience on different types of semi automatic moulding machines.
- The student will have hands on experience on different types of fully automatic moulding machines.
<table>
<thead>
<tr>
<th>Course outcome statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>___</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>___</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>___</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Avg</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>___</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, '-'- no correlation