# Proposed Syllabus Structure for the B.Tech Course Surface coating Engineering & Tech.

## Semester I

<table>
<thead>
<tr>
<th>No.</th>
<th>Subjects</th>
<th>Hours/week (L + T)</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inorganic Chemistry</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Organic Chemistry-I</td>
<td>3+1</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Applied Mathematics-I</td>
<td>2+2</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Applied Physics-I</td>
<td>3+1</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>15</td>
<td>350</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Engineering Graphics-I</td>
<td>8</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Physics Laboratory</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Inorganic Chemistry Laboratory</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Organic Chemistry Laboratory</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total Practicals</td>
<td>20</td>
<td>250</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>35</td>
<td>600</td>
<td>25</td>
</tr>
</tbody>
</table>

## Semester II

<table>
<thead>
<tr>
<th>No.</th>
<th>Subjects</th>
<th>Hours/week (L + T)</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Organic Chemistry-II</td>
<td>3+1</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Analytical Chemistry</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Material &amp; Energy Balance Calculations</td>
<td>2+2</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Applied Mathematics-II</td>
<td>2+2</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Applied Physics-II</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>18</td>
<td>400</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>Engineering Applications of Computers</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Organic Chemistry Laboratory</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Analytical Chemistry Laboratory</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Communication Skills</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total Practicals</td>
<td>16</td>
<td>200</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>34</td>
<td>600</td>
<td>26</td>
</tr>
</tbody>
</table>

- # where there are one special subject or practicle in special bracket it should be considered common for both Polymer & Paints students
- * where there are two special subject or practicle in special bracket first one is for Polymers & second one is for Paints students
### Semester III

<table>
<thead>
<tr>
<th>No.</th>
<th>Course code</th>
<th>Subjects</th>
<th>Hours/week (L + T)</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Engineering Mechanics and Strength of Materials</td>
<td>3+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Electrical and Electronics Engineering*</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>PST1C01</td>
<td>Physical Chemistry</td>
<td>3+1</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>PST1C02</td>
<td>Spl 1: Polymer Science &amp; Technology I</td>
<td>3+1</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>PST1C03</td>
<td>Spl 2: Polymer Science &amp; Technology II</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>PST1C03</td>
<td>Spl 3: Materials Technology</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>21</strong></td>
<td><strong>400</strong></td>
<td><strong>19</strong></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Electrical and Electronics Engineering Laboratory</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Physical Chemistry Laboratory</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>PSP1C04</td>
<td>Pr1: Analysis &amp; Characterization of raw materials &amp; polymers-I</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total Practicals</strong></td>
<td><strong>12</strong></td>
<td><strong>150</strong></td>
<td><strong>6</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>33</strong></td>
<td><strong>550</strong></td>
<td><strong>26</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Semester IV

<table>
<thead>
<tr>
<th>No.</th>
<th>Course code</th>
<th>Subjects</th>
<th>Hours/week (L + T)</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Transport Phenomena</td>
<td>3+1</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>PST1C05</td>
<td>Spl 4 Polymer Science &amp; Technology III</td>
<td>3+1</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>PST1C06</td>
<td>Spl 5 Thermoplastics Polymer Technology I</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>PST1C07</td>
<td>Spl 6 Technology of Thermoset Polymers- I</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>PST1C08</td>
<td>Spl 7 Colour Physics &amp; colour Harmony</td>
<td>3+1</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>18</strong></td>
<td><strong>400</strong></td>
<td><strong>18</strong></td>
</tr>
<tr>
<td>6</td>
<td>PSP1C09</td>
<td>Pr 2: Analysis &amp; Characterization of raw materials &amp; polymers-II</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>PSP1C10</td>
<td>Pr 3: Synthesis &amp; Characterization of resins &amp; polymers-I</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>PSP1C11</td>
<td>Pr 4: Colour Physics</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total Practicals</strong></td>
<td><strong>12</strong></td>
<td><strong>150</strong></td>
<td><strong>6</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>30</strong></td>
<td><strong>550</strong></td>
<td><strong>24</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Semester V

<table>
<thead>
<tr>
<th>No.</th>
<th>Course code</th>
<th>Subjects</th>
<th>Hours/week (L + T)</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PST1C12</td>
<td>Chemical Engineering Operations</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>PST1C13</td>
<td>Chemical Reaction Engineering</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>PST1C14</td>
<td>Spl 8: Thermoplastics Polymer Technology II</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>PST1C15</td>
<td>Spl 9: Thermoplastics Polymer Technology III</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>PST1C16</td>
<td>Spl 10: Technology of Thermoset Polymers-II</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>PST1C17</td>
<td>Spl 11: Technology of Thermoset Polymers-III</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td>18</td>
<td>300</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>PSP1C16</td>
<td>Pr 5 Analysis, Characterization of raw materials &amp; Synthesis of resins &amp; polymers</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>PSP1C17</td>
<td>Pr 6   Synthesis &amp; Characterization of resins &amp; polymers-II</td>
<td>8</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>PSP1C18</td>
<td>Pr 7   Synthesis &amp; Characterization of resins &amp; polymers-III</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td>16</td>
<td>200</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>34</td>
<td>500</td>
<td>26</td>
</tr>
</tbody>
</table>

### Semester VI

<table>
<thead>
<tr>
<th>No.</th>
<th>Course code</th>
<th>Subjects</th>
<th>Hours/week (L + T)</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PST1C19</td>
<td>Instrumentation</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>PST1S01</td>
<td>Spl 12: Pigments &amp; Additives for Polymers</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>PST1S02</td>
<td>Spl 13: Paints Technology -I</td>
<td>3+1</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>PST1S03</td>
<td>Spl 14: Paints technology II</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>PST1P04</td>
<td>Spl 15: Paints technology -III</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>TOTAL</td>
<td></td>
<td>19</td>
<td>350</td>
<td>19</td>
</tr>
<tr>
<td>7</td>
<td>PAS1P04</td>
<td>ELECTIVE-I: Structure property relationship</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>PSP1S05</td>
<td>Processing of paints-I</td>
<td>8</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>PSP1S05</td>
<td>Processing of paints-II</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td>16</td>
<td>200</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>35</td>
<td>550</td>
<td>27</td>
</tr>
</tbody>
</table>

In-Plant Training: 50 marks/2 credits
### Semester VII

<table>
<thead>
<tr>
<th>No.</th>
<th>Course code</th>
<th>Subjects</th>
<th>Hours/week (L + T)</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Project Economics</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>PST1S06</td>
<td>Industrial Psychology and Human Resource Management</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>PST1S07</td>
<td>Spl 16: Corrosion protection Tech.</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>PST1S07</td>
<td>Spl 17: Technology of Printing Inks</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Spl 18: Evaluation &amp; testing of Polymers -I</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>PST1S08</td>
<td>Elective II : Electrical Insulation Coatings</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td></td>
<td>18</td>
<td>300</td>
</tr>
<tr>
<td>7</td>
<td>PSP1S09</td>
<td>Pr 10: Processing of Paints-III</td>
<td>8</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>PST1C20</td>
<td>Seminar</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>PSP1S10</td>
<td>Pr 11: Analysis &amp; Testing of Paints</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total Practicals</td>
<td></td>
<td></td>
<td>16</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>34</td>
<td>500</td>
</tr>
</tbody>
</table>

### Semester VIII

<table>
<thead>
<tr>
<th>No.</th>
<th>Course code</th>
<th>Subjects</th>
<th>Hours/week (L + T)</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Industrial Management</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Value Education</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>PST1S12</td>
<td>Design and Analysis of Experiments</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>PST1S13</td>
<td>Spl 19: Advanced Paints technology I</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>PST1S13</td>
<td>Spl 20: Pigments &amp; additives for Paints</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>PST1S14</td>
<td>Elective III -Advanced Paints Technology II</td>
<td>2+1</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td></td>
<td>18</td>
<td>300</td>
</tr>
<tr>
<td>7</td>
<td>PSP1S15</td>
<td>Pr 12: Processing &amp; analysis of paints IV</td>
<td>4</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>PSP1C21</td>
<td>Experimental Project</td>
<td>12</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>16</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>34</td>
<td>500</td>
</tr>
</tbody>
</table>

Total credits of all semesters = 25 (Sem I) + 26 (Sem II) + 25 (Sem III) + 24 (Sem IV) + 26 (Sem V) + 27 (Sem VI) + 2 (IPT) + 27 (Sem VII) + 28 (Sem VIII) = 209

Total Marks: 600 (Sem I) + 600 (Sem II) + 550 (Sem III) + 550 (Sem IV) + 500 (Sem V) + 550 (Sem VI) + 50 (IPT) + 500 (Sem VII) + 550 (Sem VIII) = 4450

- #where there are one special subject or practicle in specials bracket it should be considered common for both Polymer & Paints students
- * where there are two special subject or practicle in specials bracket first one is for Polymers & second one is for Paints students
<table>
<thead>
<tr>
<th>Subject heads</th>
<th>AICTE Norms</th>
<th>Proposed syllabus in %</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Marks</td>
<td>% Marks</td>
<td>Credits</td>
</tr>
<tr>
<td>General</td>
<td>5 - 10 %</td>
<td>250</td>
<td>5.68</td>
</tr>
<tr>
<td>Basic Sciences</td>
<td>15 – 25 %</td>
<td>1150</td>
<td>26.14</td>
</tr>
<tr>
<td>General Engineering + Chemical Engineering</td>
<td>15 – 25 %</td>
<td>650</td>
<td>14.77</td>
</tr>
<tr>
<td>Professional courses</td>
<td>55 – 65 %</td>
<td>2350</td>
<td>53.41</td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td>--</td>
<td>4400</td>
<td>100</td>
</tr>
</tbody>
</table>

Electives to be offered by Polymer Engineering and Technology Department and their prerequisite

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Elective</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Polymer Science &amp; Technology II(SemIII) Corrosion protection Tech. (SemVII)</td>
<td>No prerequisite</td>
</tr>
<tr>
<td>2</td>
<td>Elective-I: Structure property relationship</td>
<td>No prerequisite</td>
</tr>
<tr>
<td>3</td>
<td>Elective II: Electrical Insulation Coatings (Sem. VII)</td>
<td>Polymer / Paints /Oils</td>
</tr>
<tr>
<td>4</td>
<td>Elective III- Advanced Paints Technology II</td>
<td>Polymer / Paints / Oils</td>
</tr>
</tbody>
</table>
SEMESTER I       No Special Subjects

SEMESTER II      No Special Subjects

SEMESTER III

THEORY

PST1C01 Special 1: Polymer Science & Technology I (Polymer/ Surface coating) (4 h/ week) Marks 100

Historical developments in polymeric materials, Basic concepts & definitions: monomer & functionality, oligomer, polymer, repeating units, degree of polymerization, molecular weight & molecular weight distribution. (5),

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins etc. (9),

Raw material for synthetic polymers: Manufacturing of various fractions of crude petroleum important for polymer industry for (a) Raw Materials such as ethylene, propylene, butadiene, vinyl chloride, vinylidene dichloride, styrene, acrylic monomers like acrylic acid, acrylonitrile, methacrylic acid, methacrylates, acrylamide etc. (b) Polycrystals such as phthalic acid, terephthalic acid, isomers and anhydrides etc. (c) Phenols, polyols and their modifications, (e) Isocyanates, (f) Amino Compounds, (g) Other petroleum based material (31)

(b) solvents such as alcohols, toluene, xylene, acetone, ketones, terpenes, chloromethanes etc. Evaluation of raw materials and reactants for synthesis & manufacturing of polymers. (15)

Textbooks/Sourcebooks:

PST1C02 Special 2 Polymer Science & Technology II (Polymer/ Surface coating) (2 hrs/ week) Marks 50

Classification of polymers thermoplastic/ thermost, addition/ condensation, natural/synthetic, crystalline/amorphous, step growth /chain growth, commodity...specialty, homochain/heterochain, confirmation: homo & copolymers (detailed graft, block alt, ladder etc. & nomenclature), configuration cis/trans; tacticity, branched/ crosslinked, Classification of polymers based on end use etc. (7)
Molecular weight and its distribution determination (Mn to Mz & MWD), carothers equation, states of polymers, transition temperatures such as Tg, Tc, Tm, solubility parameter, solution properties, temperature, good/ bad solvent, Surface tension/ energy & contact angle measurements of different polymeric systems & their wetability with other substances.

Textbooks/Sourcebooks:
2. Polymer Science, Gowarikar, Johan wiley and Sons 1986.
9. Polymer Science and Technology of Plastics and Rubbers, P. Ghosh,

PST1C03: Spl 3: Materials Technology: (Polymer/ Surface coating) (2 hrs/ week)
Marks 50
Crystal structure, crystal defects, atomic packing factor, study of different metals iron/steel, Al, brass, copper, nickel, chrom, titanium etc. Their different grades/ compositions of alloys. Annealing, nitriding, carburizing & other treatments etc. corrosion of metals, electrochemistry, corrosion & its prevention. Use of different grades of steel for manufacture of reactors, molds, dies & plastic processing equipments.

Textbooks/Sourcebooks:
Mechanical metullargy Dieter

Practices:
PSP1C04: Pr1: Analysis & Characterization of raw materials & polymers-I Marks 50
(Polymer/ Surface coating) 2X4
1) To Check the colour of oil & resins.
2) To Check the colour of oils & resins on heating.
3) To check the viscosity of oils & resins solution using Ford Cup or Brookfield viscometer.
4) To check the melting range of given resin by capillary tube method.
5) To find the acid value of given sample.
6) To find Aniline point of given solvent.
7) To find the distillation large of given solvent.
8) To find the evaporation rate of given solvent.
9) To find flash point of given solvent.
10) To find moisture content of solvent (qualitative analysis)
11) To find specific gravity of solvent by pycnometer.
12) To find the moisture content of pigment.
13) To find the water soluble matter of pigment.
14) To check the Acidly & Alkalinity of pigment.
15) To check bleeding of pigment.
16) To find oil absorption value of pigment.
17) To find minimum surfactant demand by Daniel flow-point method

SEMESTER IV

THEORY

PST1C05: Spl 4: Polymer Science & Technology III (Polymer) (4 hrs/ week) Marks 100
(Polymer/ Surface coating)
Techniques of polymerization: bulk, solution, suspension, emulsion, plasma etc. Different initiating systems such as free radicle polymerization, redox, cationic & anionic polymerization ( different terms such as living polymers, inifers, telechelics ). Their kinitics & control over structure of polymer.

Condensation polymerization, different catalysts used case studies of condensation polymerization, carothers equation, Comparison of these systems with advantages & disadvantages. (18)
Copolymerization, reactivity ratios & kinitics of copolymerization (copolymer composition equation). (10)

Rheological concepts of polymer solutions and melts, degradation plasticization Mixing operations: Typical agitation system, dissolution (10)

Different advanced catalyst systems: Ziegglar natta catalyst & metalloocene catylysts & their role in polyolefins, ATRP etc. (12)

Textbooks/Sourcebooks:
2. Polymer Science , Gowarikar, Johan wiley and Sons 1986.
9. Polymer Science and Technology of Plastics and Rubbers, P. Ghosh,

PST1C06: Spl 5: Thermoplastic Polymer Technology I (Polymer/ Surface coating) 
(2 hrs/week)  
Marks 50
Polyethylene; modified polyethylenes, Polypropylene and copolymer of PP, modified Polyolefins like crosslinked & filled polyolefins, Polyisobutylene & polyolefin plastomers etc.
(15)  
Engineering Polymers Polyesters such as PET, PBT, PTT, Polycarbonates, Polyacetal etc.  
(15)

PST1C07: Spl 6: Technology of Thermoset Resins-I (Polymer/ Surface coating) 
(2 hrs/ week)  
Marks 50
(12)  
Phenolics: Basic components of the polymer. Different kinds of phenols and their derivatives, different kinds of aldehydes used. Novolacs and Resol: effect of the ratio of phenol to aldehyde on the nature and the property of the polymer. Theory of resinification and effect of pH on the reaction mechanism and the reaction product. Curing of phenolics  
Modification of phenolics such as novolac-epoxy oil soluble and oil reactive. Phenolic moulding compounds, ingredients, compounding and applications.  
(9)  
Amino resins: Basic raw materials used like urea/melamine/ aniline/ formaldehyde. Synthesis of UF and MF resins. Theory of resinification and effect of pH on the reaction mechanism and
the reaction product. Properties and application of the UF, MF and AF resins Modification of resins with alcohols and phenols Moulding materials, compounding, processing and applications.

Text/ Source Books

19. Polymer Technology by Miles and Briston
20. Surface Coating, OCCA Publication.
22. Organic Coating: Science and Technology by Z. Wicks.]

PST1C08:Spl 7: Colour Physics and Colour Harmony (Polymer/ Surface coating) (2 hrs/week) Marks 50

Introduction-geometric and chromatic attributes; Radiation and illumination; SPD, CT and CCT; Sources and illuminants; Need for artificial sources – various ways of producing light
and different artificial sources; Lamp efficacy and colour rendering properties of sources


Perception of colour in eye \ brain, various colour theories

Additive – subtractive mixing, colour specification systems – Munsell colour order system, CIE system, colour spaces, colour difference formulae.

Single constant Kubelka – Munk theory of colourant formulation and recepie prediction; Modern computerised methods of colour matching; Finding the dyeing recipes, shade sorting, etc. using the CCM software

Decorative effect using pattern and design theory; Application of CAD for textiles.

Text/Reference Books:

PRACTICLES

PSP1C09: Pr 2: Analysis & Characterization of raw materials & polymers-II
(Polymer/ Surface coating) (2 hrs/ week) Marks 50
1. To find polymer content and NVM of emulsion polymer
2. Analysis of carbon black, saw dust etc.
3. To find bulk density of fillers like TiO2, Carbon black etc
4. Identification of pigment by spot test
5. To determine Acid value, amine value, iodine value

PSP1C10: Pr 3: Synthesis & Characterization of resins & polymers-I
(Polymer/ Surface coating) (2 hrs/ week) Marks 50
1) To synthesis polymer using Bulk, solution, suspension & emulsion polymerization method.
2) To study auto acceleration by solution polymerization method.
3) Synthesis of copolymers by emulsion Bulk, solution & suspension and emulsion, Polymerization.

PSP1C11: Pr4: Color Physics (Polymers) (Term Work) (Polymer/ Surface coating) (1x 4hrs/week) Marks 50
1. Determination of unknown concentration of a dye in solution by Dubosque colorimeter.
2. Verification of B-L law (dependence of absorbance on concentration) by spectrophotometer.
3. Mixture analysis using spectrophotometer.
4. Determination of gloss of various samples using gloss meter.
5. Determination of color of various textile samples in terms of Lovibond primaries and chromaticity co-ordinates using Lovibond tintometer.
7. Finding color differences (ΔE) between set of samples vis a vis dye solution concentration.
8. Finding color differences (ΔE) between set of samples vis a vis time of exposure.
9. Determination of colors of samples in terms of Munsell color system using Munsell Color Tree.
10. Recipe prediction and matching of colored samples using CCM.

Suitable number of experiments from the above list will be performed.

**SEMESTER V**

**THEORY**

**PST1C12: Spl 8: Thermoplastic Polymer Technology (Polymer) II**  
(Polymer/ Surface coating)  
Marks 50  
(2 hrs/week)

Styrenic polymers - Polystyrene, HIPS, SAN, ABS, important copolymers of styrene maleic anhydride and styrene acrylics copolymers, toughening mechanism of impact modified plastics.  
(12)

Polymamides- Nylon 6, Nylon 6,6, Nylon 11, aromatic polyamide such as Kevlar (10)

Acrylic polymers & copolymers, Polyacrylamide, PMMA, ASA, Polyacrylonitrile etc.  
(7)

**PST1C13: Spl 9: Thermoplastic Polymer Technology (Polymer) III**  
(Polymer/ Surface coating)  
Marks 50  
(2 hrs/week)

Polyvinyl chloride & its copolymers, Poly vinyl acetate, Polyvinyl alcohol etc.  
(8)

Modified cellulosics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals etc., Liquid crystalline polymers; speciality plastics- PES, PAES, PEEK, PEAK etc.  
(15)

Developments in new polymers such as dendrimers, biopolymer & biodegradable polymers, thermoplastic PU etc.  
(7)
Epoxy resins: Basic raw materials like epichlorohydrin and di hydroxy phenol. Different di hydroxy phenolic compounds which can be used. Classification of epoxy resins. Synthesis of epoxy resins. Ratios of reaction components and their effect on the properties of reaction product and molecular weight in particular. Curing of the resin: curing agents like amines, acids, anhydrides, etc. Epoxy compositions and their ingredients, like diluents, flexibilizers, etc. Epoxy adhesives along with their recipes. Novolac epoxy, epoxy acrylates, Modified epoxides & epoxy resins for advanced applications.

Polyurethanes- Thermoset: Basic components: diisocyanates and diols, different diisocyanates and diols used. Reactions of isocyanates with various other functional groups. Synthesis of polymers Polyurethane foams, polyester and polyether foams. Processes like one-shot process, Polyether pre-polymer, Quasi-pre-polymer polyether foams, etc. Difference between thermoset & thermoplastic PU. Flexible foams Polyurethanes in Coatings Polyisocyanates IPN using polyurethanes-acrylic blends


Thermosetting acrylics: Synthesis of acrylic polymers and co-polymers, different techniques. Structure property relationship application of thermosetting acrylics, like anaerobic adhesives, laminating resins, etc.

Alkyd resins: Basic components like polyfunctional alcohols, poly-basic acids, vegetable oils/fatty acids. Different types of drying oils: drying, semi-drying and non-drying with examples. Influence of all these components in the synthesis and properties of the final alkyds obtained modification of alkyds: modification with rosin, maleic anhydride, acrylics, vinyls, imides etc.

Miscellaneous thermosetting polymers: Polyimides, plasma-polymers & other thermoset polymers

Text/ Source Books
2) Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.
12) Biopolymers, Wiley, VCH Verlag, 2003
19) Polymer Technology by Miles and Briston
20) Surface Coating, OCCA Publication.
22) Organic Coating: Science and Technology by Z. Wicks.

PRACTICLES

PSP1C16: Pr 5: Analysis, Characterization of raw materials & Synthesis of resins & Polymers (Polymer/Surface coating) (2x2 hrs/ week) Marks 50

1.) Analysis of formalin, phenol, substituted phenol, epichlorohydrine, plasticizer.
2) Determination of Hydroxy value, K-Value, carboxyl value, epoxy value, ester value, sap value etc. RI of solvent and plasticizer, color and viscosity by Gardeners tube etc.

PSP1C17: Pr 6: Synthesis & Characterization of resins & polymers-II (Polymer/Surface coating) (4X4 hrs/ week) Marks 100

1.) Synthesis of novolac, Resol, epoxy, amino, unsaturated polyester resin and their analysis
2). Manufacturing of molding powder of phenolic resin & Amino resin
3.) Making paper laminate of resol resin. To find free phenol & free formaline content of phenolic resin etc.

PSP1C18: Pr 7: Synthesis & Characterization of resins & polymers-III (Polymer/Surface coating) (2x2 hrs/ week) Marks 50

1.) Aqueous polymerization of acrylamide.
2.) Synthesis of modified amino, epoxy, modified phenolic resin. etc
SEMESTER VI

THEORY

PST1C19: Spl 12: 1 Pigments & additives for Polymers (Polymer/ Surface coating)

(4 hrs/ week)
Marks 100

Properties required in a pigment and extender

Pigment dispersion basics

Inorganic pigments such as titanium dioxide, zinc oxide, carbon black, chromate pigments, molybdate orange, chrome green, ultramarine blue, iron blue, cadmium red, pearlescent and other effect pigments (15) corrosion inhibiting pigments, such as zinc phosphate, zinc and barium chromate pigments, ceramic pigments, metal flake pigments, extenders

Theory of color formation in organic compounds, effect of auxiliary groups on the shade and hue of the pigment (Bathochromic and hyper chromic shift)

Manufacture of Carbon black different grades such as furnace & channel black

Additives such as dispersion aids, UV stabilizers, antioxidants & antiozonents, processing/flow modifiers, different fillers such as calcium carbonate, mica, talc & others etc.

PST1S01: Spl 13: Paints Technology- I (Paints)

(4 hrs/ week)
Marks 100

Colloidal chemistry of coatings, surface chemistry of pigments

Pigment dispersion and wetting, flushing of pigments, effect of pigment volume concentration on paint properties

Paint additives, solvents

Basics of Paint formulations

Machinery for grinding of pigments and extenders

Paint manufacturing machinery for pigment dispersion (Ball mill, Sand mill, Attritor mills, Drais mill, basket mill, kaddy mills, twin shaft dispenser, alpine mills, horizontal V/S vertical mills

Recommended Books

(1) Paint and Surface Coatings
Lambourne and Strivens

(2) Organic Coatings Science and Technology
Zeno Wicks et al

(3) Surface Coatings Science and Technology
Swaraj Paul

(4) Introduction to Paint Chemistry
Turner

(5) Pigment Hand Book Part 1, 2,3
Patton

(6) Encyclopedic Hand book of Emulsions Technology
Sjoblom

(7) Paint Film Defects
Hess

(8) Industrial Organic Pigments
W. Herbst
PST1S02: Spl 14: Paints Technology II (Paints) (2hrs/ week) Marks 50

Special effect pigments (IR Reflective, anticorrosive, thermo chromic, pearlescent etc), Incan corrosion preventor, rheology modifiers, biosides, antisetting, antiskinning, antisagging additives, odourants, masking agentnts, Additives for water based coatings

Text Books/Source

1) High performance pigments Huge M. Smith
2) Pigment Hand Book Part 1, 2,3 Patton
3) Application properties of Pigments A. Karnik

PST1S03: Spl 15: Paints technology III (2hrs/ week) Marks 50

Manufacture of Powder Coatings, dry distempers, cement paints, oil based distempers and paints, other stiff paints, putties, Manufacturing of alkyls, emulsions and hard resins, filration of resins, paints, ultra filtration of ED resins, forming of hard resins, marking and labeling of packaged products, Utilities in paint plant (steam, hot oil, cooling water, chilled water, compressed air)
Plant layout, Inventory control, use of computers in paint industry, interphasing with R&D
Solvent emission, recovery and disposal, environmental, health and safety issues

1) Paint and Surface Coatings Lambourne and Strivens
2) Basics of Paints Technology V.C.Malshe
3) Surface Coatings Science and Technology Swaraj Paul

Elective I

PST1P04: Structure property Relationship (Polymers/ Surface coatings) (2hrs/ week) Marks 50

General structural features of polymers: Effects of atoms types of bonds, bond dissociation energy and functional groups on properties of polymers (3)
Configuration and conformation and structure properties of polymers (2)
Molecular mass heterogeneity and structure properties (1)
Polymers solutions: thermodynamics of dissolution, factors effecting dissolution and swelling of polymers, phase equilibrium of polymer-solvent systems, polymer solution, Florry-Huggins theory (6)

Polymer chain flexibility: concept of flexibility, various factors deciding flexibility of polymers with case studies, properties of polymers affected by flexibility (6)

Intermolecular orders: Amorphous, crystalline and oriented forms of polymers, crystallinity in polymers, factors affecting crystallinity, properties affected by crystallinity of polymers (6)

Thermal properties of polymers: fire retartant polymers, factors affecting glass transition (Tg) temperature, heat stability etc. with case studies (4)

Degradation and stabilization: various stresses acting on polymers and their influence, method of improving the stability of polymers with case study (6)

Text/Source Books

PRACTICLES

PSP1S04:SEM VI  Pr 8  Processing of Paints-I (Paints)  
(2x4hours/week)  
Marks100

Synthesis of pigments like
1. Iron oxide, Iron blue etc
2. Lemon chrome
3. Middle chrome
4. Zinc phosphate and Zinc Chromate
5. Para red
6. Toluidine red
7. Hansa Yellow
8. Lithol red
9. Phthalocyanine blue
10. Precipitated barium sulphate
11. Charecterisation and testing of pigments like moisture content, hiding power, yield, bulk density etc.
12.Use of Muller and Pigment Flusher for dispersion
PSP1S05: SEM VI  Pr 9  Processing of Paints-II (Paints)  
(2hrs/ week)  
Marks 50  
Qualitative analysis of Pigments & Pigment mixtures

SEMESTER VII

THEORY

PST1S06: Spl 16: Corrosion Protection Technology  
(2Hrs/week)  
Marks 50  
Theory of corrosion, action of corroding environment, mechanism of corrosion & detection of corrosion, fouling, pigments, binders & additives for corrosion prevention, recent developments in corrosion protection materials etc.

References:
Naval electrician’s text book volume 1  
William Hannum, Grubb Bullard  
Electrical Insulation Coatings

PST1S07: Spl 17 Technology of Printing Inks (Paints)  
(2 hrs / week)  
Marks 50  
Manufacture of paper: qualities and properties of paper  
Letterpress printing: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments  
Screen printing: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments  
Flexography: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments  
Gravure: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments  
Lithography: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments  
Non impact printing  
Other than above printing method: pad printing, transfer printing and latest development

Elective II
PST1S08: Paints Elective:  
(2 hrs / week)
**Insulating & Intumescent coatings:**
Various insulating resins & polymers used for heat & electrical insulations. Their additives methods of coatings & their properties & Testing

**PRACTICES**

Sem VII
PSP1S09:Pr. 10 Processing of Paints (Paints)  
(4hrs/ week)  
Marks 100

1. Evaluation of paints as per IS 1012
2. Preparation of
   a. Alkyd Resin and its evaluation (Long, medium and Short by different groups)
   b. acrylic/vinyl acetate emulsion
   c. Plastic emulsion paint and evaluation (To include determination of surfactant demand by Daniel Flow Point method and evaluation of final properties of the prepared paint. Scrub resistance, stain resistance, detergent and soap resistance to be evaluated)
   d. Polyester polyol from Aliphatic and aromatic dibasic acids, aliphatic diol, triols and its characterization (A.V. and Hydroxyl value)
   e. Suspension polymer from MMA and Butyl methacrylate
   f. Cement paint and application on exterior surface
   g. Alkyd paint for base coat and top coat at different PVC
   h. high gloss coating from the polyol and evaluation of the coating properties
   i. varnishes for wood finishing

SEM VII
PSP1S10:Pr 11 Processing & Analysis of Paint -II  
(4hrs/ week)  
Marks 100

1. Analysis Of Linseed Oil (IV, Sap Value, Colour, Refractive Index, Viscosity)
3. Analysis of Emulsion Paint (NVM, % Solids, Scrub Resistance, Stain Resistance)
4. Analysis Of Cement Primer
5. Colour Matching Of Synthetic Enamel, Plastic Emulsion Paint And Distemper
6. Analysis Of An Alkyd (Oil Length, Acid Value, Hydroxyl Value, Phthalic Content
7. Analysis Of Pigments (Solvent Bleed In About 10 Different Solvents, Resistance to acids, alkalis, light)

PSP1S11:Processing of Paints III  
(2hrs/ week)  
Marks 50
Preparation of different solvent & water based coatings powder coatings. Paints such as alkyl based, acrylic emulsion based, lacquers, PU based clear coats/ dispersions, washable distempers, preparation of inks testing & application of these coatings.

**PST1C20:3 Seminar (Term Work)**

Students will be required to prepare critical reviews of selected topics in Chemical Technology and Allied subjects and submit in the form of standard typed report. The students will also be required to make an oral presentation of the review.

**SEMESTER VIII**

**THEORY**

**PST1S12: Spl 19: Advanced Paints Technology I: (Paints)**


1. Coil coatings (2)
2. Wood Finishing (4)
3. Strippable coatings, lacquers (1)
4. Treatment of air for paint application (1)
5. Surface treatment and paint application methods (2)
6. Treatment of over sprays (1)
7. Reworking of painted products (1)
8. Paint application and curing machinery (1)
9. Formulation and application of sealants and adhesives (10)

**Text books/ References**

(1) Paint and Surface Coatings  
Lambourne and Strivens
(2) Organic Coatings Science and Technology  
Zeno Wicks et al
(3) Surface Coatings Science and Technology  
Swaraj Paul
(4) Introduction to Paint Chemistry  
Turner
(5) Pigment Hand Book Part 1, 2,3  
Patton
(6) Encyclopedic Hand book of Emulsions Technology  
Sjoblom
(7) Application properties of Pigments  
A. Karnik
(8) Paint Film Defects  
Hess
(9) Industrial Organic Pigments  
W. Herbst
(10) High performance pigments  
Huge M. Smith

(11) Printing ink Formulations principles  
Ronal Todd

PST1S13: Spl:20 Pigments & additives for paints (paints) (2hrs/ week) 
Marks 50

Organic pigments such as monoazo pigments, copper Phthalocyanine blue, green and other Phthalocyanine pigments, anthraquinone pigments, diaryllid yellows, Napthol pigments, BONA lakes, Benzimidizolone, diazo condensation pigments, azo metal complex pigments, dioxazine violet, violet 23, di keto pyrrolopyrrol pigments, rhodamine phosphotungstic acid complex pigments, quinophthalone pigments, thio indigo polycyclic pigments, perlin and iso indoline pigments, solvent soluble colors, polymeric pigments iron oxide pigments, micaceous iron oxide etc (30)

Elective III

PST1S14: Advanced Paints technology II (paints) (2hrs/ week) 
Marks 50

1. Paint industry overview, problems and prospects (1)
2. Formulation of primers, zinc rich epoxy, Micaceous iron oxide, zinc chromate and tetraoxy chromate, zinc phosphate based primers, wash primers, (8)
3. Anti fouling coatings (3)
4. Paints for marine environments, vinyl paints (1)
5. Road marking paints (2)
6. Cement paints (2)
7. Automotive protection products, paints, finishing and refinishing (4)
8. Electrodeposition coatings (2)
9. UV curable coatings (1)
10. Coatings for high temperature (2)
11. Coatings for aerospace and aircrafts (2)
12. Electrical conducting coatings (1)
13. Thermal sensitive paints (1)
14. Insulating paints (1)
15. Metallic paints (1)

PRACTICALS

PSP1S15: Pr 12: Processing of paints –IV (Paints) (Term Work)
1. Synthesis of Alkyds like Drying And Non Drying Alkyds, Long, Medium, Short oil length Alkyds, Modified alkyds (Styrenated, Acrylated)
2. Synthesis of Reduced phenolics like Phenol (M.P 120-240°C), P-Tert Butyl Phenol Bisphenol
3. Synthesis of polymers by Emulsion, Solution polymerization like S-BA, S-MMA
4. Synthesis of Water Dispersible Polyester
5. Synthesis of Cationic Polymer For Electrodeposition And Application
6. Synthesis of Water Soluble Melamine, Urea Formaldehyde, Butylated Melamine Formaldehyde
7. Paint formulation using various PVC values.
8. Paint Application & Curing, Shade matching

**PSP1C21:2 Project Work (Term Work)**

Every student will be required to submit a project report in a typed standard format on a topic set by one or more faculty members. The object of the project work is to test the ability of the student to tackle an investigational problem in his field of specialization. Every student will be orally examined in the subject incorporated in his project report.