B. Tech.

IN

PRODUCTION ENGINEERING

FLEXIBLE CURRICULUM
(For students admitted in 2015-16)

DEPARTMENT OF PRODUCTION ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620 015
TAMIL NADU, INDIA
CURRICULUM

The total minimum credits for completing the B.Tech. programme in Production Engineering is 176+15.

MINIMUM CREDIT REQUIREMENT FOR THE VARIOUS COURSE CATEGORIES

The structure of B.Tech. programmes shall have General Institute Requirements (GIR), Programme Core (PC), Elective Courses (PE, OE and MI) and Essential Programme Laboratory Requirements (ELR) as follows:

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>COURSE CATEGORY</th>
<th>Number of Courses</th>
<th>Number of Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>General Institute Requirement (GIR)</td>
<td>17</td>
<td>68</td>
</tr>
<tr>
<td>2.</td>
<td>Programme Core (PC)</td>
<td>20</td>
<td>65</td>
</tr>
<tr>
<td>3.</td>
<td>Essential Programme Laboratory Requirement (ELR)</td>
<td>06</td>
<td>13</td>
</tr>
<tr>
<td>4.</td>
<td>Elective courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Programme Electives (PE)</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>b. Open Electives (OE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Minor (MI)</td>
<td>05</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>A student should be allowed a minimum of 50% of the total electives of a programme from (b) and (c) if so desired by the student.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL**

176 + 15
## (I) GENERAL INSTITUTE REQUIREMENTS

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of the course</th>
<th>Number of Courses</th>
<th>Maximum Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mathematics</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>2.</td>
<td>Physics*</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>3.</td>
<td>Chemistry*</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>4.</td>
<td>Humanities</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>Communication</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>6.</td>
<td>Energy and Environmental Engineering</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>Professional Ethics</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td><strong>Engineering Graphics</strong></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td><strong>Engineering Practice</strong></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>10.</td>
<td>Basic Engineering</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>11.</td>
<td>Introduction to Computer Programming</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td><strong>Branch Specific Course</strong> (Introduction to Branch of Study)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>13.</td>
<td>Summer Internship</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>14.</td>
<td><strong>Project work</strong></td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>15.</td>
<td><strong>Comprehensive Viva</strong></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>Industrial lecture</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>17.</td>
<td>NSS / NCC / NSC</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>17 (Excluding Italics)</strong></td>
<td><strong>68</strong></td>
</tr>
</tbody>
</table>

* including Lab

** Commence during Orientation Programme
## I. GENERAL INSTITUTE REQUIREMENTS

### 1. MATHEMATICS

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MAIR11</td>
<td>Mathematics I</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>MAIR12</td>
<td>Mathematics II</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>MAIR35</td>
<td>Mathematics for Production Engineers</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MAIR47</td>
<td>Probability and Statistics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
</tr>
</tbody>
</table>

### 2. PHYSICS

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PHIR11</td>
<td>Physics I (Theory &amp; Lab)</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PHIR12</td>
<td>Physics II (Theory &amp; Lab)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>7</strong></td>
</tr>
</tbody>
</table>

### 3. CHEMISTRY

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CHIR11</td>
<td>Chemistry I (Theory &amp; Lab)</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CHIR12</td>
<td>Chemistry II (Theory &amp; Lab)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>7</strong></td>
</tr>
</tbody>
</table>

### 4. HUMANITIES

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HSOE13</td>
<td>Entrepreneurship Development</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>
### 5. COMMUNICATION

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HSIR11</td>
<td>English for communication</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>HSIR12</td>
<td>Professional communication</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

### 6. ENERGY AND ENVIRONMENTAL ENGINEERING

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ENIR11</td>
<td>Energy &amp; Environmental Engineering</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

### 7. PROFESSIONAL ETHICS

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HSIR14</td>
<td>Professional Ethics and Values</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>

### 8. ENGINEERING GRAPHICS

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MEIR12</td>
<td>Engineering Graphics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>

### 9. ENGINEERING PRACTICE

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRIR11</td>
<td>Engineering Practice</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>
10. BASIC ENGINEERING

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CEIR11</td>
<td>Basics of Civil Engineering</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>EEIR11</td>
<td>Basics of Electrical and Electronics Engineering</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>4</strong></td>
</tr>
</tbody>
</table>

11. INTRODUCTION TO COMPUTER PROGRAMMING

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSIR11</td>
<td>Basics of Programming</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>

12. BRANCH SPECIFIC COURSE

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRIR15</td>
<td>Introduction to Production Engineering</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

13. SUMMER INTERNSHIP

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRIR16</td>
<td>INTERNSHIP / INDUSTRIAL TRAINING / ACADEMIC ATTACHMENT (2 to 3 months duration during summer vacation)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

The student should undergo industrial training/internship for a minimum period of two months during the summer vacation of 3rd year. Attachment with an academic institution within the country (IISc/IITs/NITs/IIITs and CFTIs) or university abroad is also permitted instead of industrial training.

*To be evaluated at the beginning of VII semester by assessing the report and seminar presentations.*
14. PROJECT WORK

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRIR17</td>
<td>Project Work</td>
<td>6</td>
</tr>
</tbody>
</table>

Total 6

15. COMPREHENSIVE VIVA

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRIR18</td>
<td>Comprehensive Training</td>
<td>3</td>
</tr>
</tbody>
</table>

Total 3

16. INDUSTRIAL LECTURE

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRIR19</td>
<td>Industrial Lectures</td>
<td>1</td>
</tr>
</tbody>
</table>

Total 1

A course based on industrial lectures shall be offered for 1 credit. A minimum of five lectures of two hours duration by industry experts will be arranged by the Department. The evaluation methodology, will in general, be based on quizzes at the end of each lecture.
## (II) PROGRAMME CORE (PC)

[Note: (1) Number of programme core: 20 (2) Credits: 65]

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRPC10</td>
<td>Engineering Mechanics</td>
<td>---</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>PRPC11</td>
<td>Casting &amp; Welding Technology</td>
<td>PRIR15</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PRPC12</td>
<td>Machining Technology</td>
<td>PRIR15</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PRPC13</td>
<td>Metallurgy and Materials Engineering</td>
<td>CHIR12</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>PRPC14</td>
<td>Mechanics of Solids and Fluids</td>
<td>PRPC10</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>PRPC15</td>
<td>Thermal Engineering</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>PRPC16</td>
<td>Kinematics and Dynamics of Machines</td>
<td>PRPC10</td>
<td>4</td>
</tr>
<tr>
<td>8.</td>
<td>PRPC17</td>
<td>Forming Technology</td>
<td>PRPC13</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>PRPC18</td>
<td>Metrology (Theory and Lab)</td>
<td>PHIR12</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>PRPC19</td>
<td>Electrical and Control Systems (Theory and Lab)</td>
<td>EEIR11</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>PRPC20</td>
<td>Design of Machine Elements</td>
<td>PRPC14</td>
<td>4</td>
</tr>
<tr>
<td>12.</td>
<td>PRPC21</td>
<td>Tooling for Manufacturing</td>
<td>PRPC20</td>
<td>4</td>
</tr>
<tr>
<td>13.</td>
<td>PRPC22</td>
<td>Quality, Reliability and Safety Engineering</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>PRPC23</td>
<td>Computer Integrated Manufacturing (Theory and Lab)</td>
<td>PRPC12</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>PRPC24</td>
<td>Operations Research</td>
<td>MAIR47</td>
<td>4</td>
</tr>
<tr>
<td>16.</td>
<td>PRPC25</td>
<td>Work Design and Facilities Planning</td>
<td>PRPC22</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>PRPC26</td>
<td>Computer Aided Design and Engineering (Theory and Lab)</td>
<td>CSIR11</td>
<td>3</td>
</tr>
<tr>
<td>18.</td>
<td>PRPC27</td>
<td>Mechatronics and Industrial Automation (Theory and Lab)</td>
<td>EEIR11</td>
<td>3</td>
</tr>
<tr>
<td>19.</td>
<td>PRPC28</td>
<td>Analysis of Production Systems and IE Lab</td>
<td>PRPC25</td>
<td>3</td>
</tr>
<tr>
<td>20.</td>
<td>PRPC29</td>
<td>Manufacturing System Simulation (Theory and Lab)</td>
<td>MAIR47</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total** 65
(III) ELECTIVES

a. PROGRAMME ELECTIVE (PE)

[Note: Number of programme elective: at least 3 courses]

Students pursuing B.Tech. in Production Engineering should take at least three courses from the Programme Electives listed below.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRPE10</td>
<td>Unconventional Machining Processes</td>
<td>PRPC12</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PRPE11</td>
<td>Precision Engineering (Theory and Lab)</td>
<td>PRPC12</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PRPE12</td>
<td>Material Handling &amp; Storage</td>
<td>PRPC25</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PRPE13</td>
<td>Manufacturing of Composite Materials</td>
<td>PRPC14</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>PRPE14</td>
<td>Machine Tool Technology</td>
<td>PRPC12</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>PRPE15</td>
<td>Industrial Robotics</td>
<td>PRPC25</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>PRPE16</td>
<td>Plant Engineering</td>
<td>PRPC25</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>PRPE17</td>
<td>Non Destructive Testing</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>PRPE18</td>
<td>Micro Fabrication Processes</td>
<td>PRPC12</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>PRPE19</td>
<td>Surface Engineering</td>
<td>PRPC14</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>PRPE20</td>
<td>Processing of Friction composites</td>
<td>PRPC14</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>PRPE21</td>
<td>Processing of Polymeric Composites</td>
<td>PRPC14</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>PRPE22</td>
<td>Sustainable Manufacturing (Theory and Lab)</td>
<td>PRIR15</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>PRPE23</td>
<td>Rapid prototyping, Tooling &amp; Manufacturing</td>
<td>PRPC12</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>PRPE24</td>
<td>Finite Element Methods</td>
<td>PRPC14</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>PRPE25</td>
<td>Product Development Strategies</td>
<td>PRPC22</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>PRPE26</td>
<td>Design for Manufacture and Assembly</td>
<td>PRPC22</td>
<td>3</td>
</tr>
<tr>
<td>18.</td>
<td>PRPE27</td>
<td>Vibration and Noise Engineering</td>
<td>PRPC16</td>
<td>3</td>
</tr>
<tr>
<td>19.</td>
<td>PRPE28</td>
<td>Concepts of Engineering Design</td>
<td>PRPC20</td>
<td>3</td>
</tr>
<tr>
<td>20.</td>
<td>PRPE29</td>
<td>Engineering Optimization</td>
<td>PRPC22</td>
<td>3</td>
</tr>
<tr>
<td>21.</td>
<td>PRPE30</td>
<td>Computational Fluid Dynamics</td>
<td>PRPC14</td>
<td>3</td>
</tr>
<tr>
<td>22.</td>
<td>PRPE31</td>
<td>Experimental Stress Analysis</td>
<td>PRPC14</td>
<td>3</td>
</tr>
</tbody>
</table>
## PRPE32
**Design of Automated Manufacturing System**
Prerequisites: PRPC23
Credits: 3

## PRPE33
**Design and Analysis of Experiments**
Prerequisites: PRPC22
Credits: 3

## PRPE34
**Agile Manufacturing**
Prerequisites: PRPC22
Credits: 3

## PRPE35
**Integrated Materials Management**
Prerequisites: PRPE28
Credits: 3

## PRPE36
**Lean Manufacturing**
Prerequisites: PRPC22
Credits: 3

## PRPE37
**Total Quality Management**
Prerequisites: PRPC22
Credits: 3

## PRPE38
**Supply Chain Management**
Prerequisites: PRPC24
Credits: 3

**Total** 87

### b. OPEN ELECTIVE (OE)

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PROE10</td>
<td>Operations Management</td>
<td>MAIR11</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PROE11</td>
<td>Project Management</td>
<td>MAIR12</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PROE12</td>
<td>Value Engineering</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PROE13</td>
<td>Artificial Intelligence &amp; Expert systems</td>
<td>CSIR11</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>PROE14</td>
<td>Processing and manufacturing of semiconductors</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>PROE15</td>
<td>Automobile component manufacturing processes</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>PROE16</td>
<td>Laser Materials processing</td>
<td>PHIR12</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total** 21
c. MINOR (MI)

Students who have registered for B.Tech Minor in Production Engineering

[Note: Number of Minor: 5 courses (Minimum)]

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRMI10</td>
<td>Manufacturing Processes</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PRMI11</td>
<td>CAD, CAM and CAE</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PRMI12</td>
<td>Unconventional Manufacturing Processes</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PRMI13</td>
<td>Industrial Engineering and Management</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>PRMI14</td>
<td>Quality Engineering</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>15</strong></td>
</tr>
</tbody>
</table>

Note: Student should be allowed a minimum of 50% of the total electives of a programme from Open electives and Minor, if so desired by the student.

(IV) ESSENTIAL PROGRAMME LABORATORY REQUIREMENT (ELR)

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Co-requisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRLR10</td>
<td>Manufacturing Processes Lab-I</td>
<td>PRPC12</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>PRLR11</td>
<td>Mechanics of Solids &amp; Fluids &amp; Thermal Engineering Lab</td>
<td>PRPC14,15</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>PRLR12</td>
<td>Manufacturing Processes Lab-II</td>
<td>PRPC12</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>PRLR13</td>
<td>Weldability and Formability Testing Lab</td>
<td>PRPC11</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>PRLR14</td>
<td>Machine Drawing Practice</td>
<td>MEIR12</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>PRLR15</td>
<td>Production Drawing and Cost Estimation</td>
<td>PRLR14</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>13</strong></td>
</tr>
</tbody>
</table>

NOTE: Students can register for 2 laboratory courses during one session along with regular courses (PC / PE / OE / MI).

V. ADVANCED LEVEL COURSES FOR B.Tech. (HONOURS)

A student can obtain B.Tech. (Honours) degree provided the student has;

i. Registered at least for 12 theory courses and 2 ELRs in the second year.

ii. Consistently obtained a minimum GPA of 8.5 in the first four sessions
iii. Continue to maintain the same GPA of 8.5 in the subsequent sessions (including the Honours courses)

iv. Completed 3 additional theory courses specified for the Honors degree of the programme.

v. Completed all the courses registered, in the first attempt and in four years of study.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Co requisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRHO10</td>
<td>Tolerance Technology</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PRHO11</td>
<td>Robotics</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PRHO12</td>
<td>Intelligent Manufacturing Systems</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PRHO13</td>
<td>Total Quality Engineering</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>PRHO14</td>
<td>Product Analysis and Cost Optimization</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>PRHO15</td>
<td>Decision Support Systems</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>PRHO16</td>
<td>Knowledge Management</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>PRHO17</td>
<td>Product Life Cycle Management</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>PRHO18</td>
<td>Technology Management</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>PRHO19</td>
<td>Multi-Criteria Decision Making Techniques</td>
<td>---</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total** 30

**DESCRIPTION OF COURSE CODES FOR B.TECH. PROGRAMME**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Type of the course</th>
<th>Course Code and range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>General Institute requirements</td>
<td>xxIR10 to 99</td>
</tr>
<tr>
<td>2.</td>
<td>Programme core</td>
<td>xxPC10 to 99</td>
</tr>
<tr>
<td>3.</td>
<td>Programme Elective</td>
<td>xxPE10 to 99</td>
</tr>
<tr>
<td>4.</td>
<td>Essential Laboratory Requirement</td>
<td>xxLR10 to 99</td>
</tr>
<tr>
<td>5.</td>
<td>Open Electives</td>
<td>xxOE10 to 99</td>
</tr>
<tr>
<td>6.</td>
<td>Minors</td>
<td>xxMR10 to 99</td>
</tr>
<tr>
<td>7.</td>
<td>Honours</td>
<td>xxHO10 to 99</td>
</tr>
</tbody>
</table>

Where xx denotes the Department offering the course
DESCRIPTION OF DEPARTMENT CODES FOR B.TECH. PROGRAMME

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Department</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Architecture</td>
<td>AR</td>
</tr>
<tr>
<td>2.</td>
<td>Chemical</td>
<td>CL</td>
</tr>
<tr>
<td>3.</td>
<td>Civil Engineering</td>
<td>CE</td>
</tr>
<tr>
<td>4.</td>
<td>Computer Applications</td>
<td>CA</td>
</tr>
<tr>
<td>5.</td>
<td>Computer Science and Engineering</td>
<td>CS</td>
</tr>
<tr>
<td>6.</td>
<td>Chemistry</td>
<td>CH</td>
</tr>
<tr>
<td>7.</td>
<td>Electronics and Communication Engineering</td>
<td>EC</td>
</tr>
<tr>
<td>8.</td>
<td>Electrical and Electronics Engineering</td>
<td>EE</td>
</tr>
<tr>
<td>9.</td>
<td>Energy and Environmental Engineering</td>
<td>EN</td>
</tr>
<tr>
<td>10.</td>
<td>Humanities</td>
<td>HM</td>
</tr>
<tr>
<td>11.</td>
<td>Instrumentation and control</td>
<td>IC</td>
</tr>
<tr>
<td>12.</td>
<td>Mathematics</td>
<td>MA</td>
</tr>
<tr>
<td>13.</td>
<td>Mechanical Engineering</td>
<td>ME</td>
</tr>
<tr>
<td>14.</td>
<td>Metallurgical and Materials Engineering</td>
<td>MT</td>
</tr>
<tr>
<td>15.</td>
<td>Production Engineering</td>
<td>PR</td>
</tr>
<tr>
<td>16.</td>
<td>Physics</td>
<td>PH</td>
</tr>
<tr>
<td>17.</td>
<td>Management Studies (DoMS)</td>
<td>MB</td>
</tr>
<tr>
<td>18.</td>
<td>Office of Dean, Student Welfare (NSS/NSC/NSO)</td>
<td>SW</td>
</tr>
</tbody>
</table>

Details of the flow of courses for a particular programme should be made available to the students at the beginning of the programme (I Year). The feasible year (I to IV year of study) and session of study for each core course should also be given.

Course flow: X → Y Z Where X, Y, Z are courses
The following table should be prepared before the commencement of the programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Year of Study</th>
<th>Session/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HSIR11</td>
<td>English for Communication</td>
<td>I</td>
<td>July</td>
</tr>
<tr>
<td>2.</td>
<td>MAIR11</td>
<td>Mathematics - I</td>
<td>I</td>
<td>July</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Course Code</td>
<td>Course Title</td>
<td>Year of Study</td>
<td>Session/s</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>-----------------------------------------------------</td>
<td>---------------</td>
<td>-----------</td>
</tr>
<tr>
<td>3.</td>
<td>PHIR11</td>
<td>Physics – I (Theory &amp; Lab)</td>
<td>I</td>
<td>July</td>
</tr>
<tr>
<td>4.</td>
<td>CHIR11</td>
<td>Chemistry – I (Theory &amp; Lab)</td>
<td>I</td>
<td>July</td>
</tr>
<tr>
<td>5.</td>
<td>CSIR11</td>
<td>Basics of Programming (Theory &amp; Lab)</td>
<td>I</td>
<td>July</td>
</tr>
<tr>
<td>6.</td>
<td>PRIR15</td>
<td>Introduction to Production Engineering</td>
<td>I</td>
<td>July</td>
</tr>
<tr>
<td>7.</td>
<td>CEIR11</td>
<td>Basics of Civil Engineering</td>
<td>I</td>
<td>July</td>
</tr>
<tr>
<td>8.</td>
<td>EEIR11</td>
<td>Basics of Electrical and Electronics Engineering</td>
<td>I</td>
<td>July</td>
</tr>
<tr>
<td>9.</td>
<td>MEIR12</td>
<td>Engineering Graphics</td>
<td>I</td>
<td>July</td>
</tr>
<tr>
<td>10.</td>
<td>HSIR12</td>
<td>Professional Communication</td>
<td>I</td>
<td>January</td>
</tr>
<tr>
<td>11.</td>
<td>MAIR12</td>
<td>Mathematics – II</td>
<td>I</td>
<td>January</td>
</tr>
<tr>
<td>12.</td>
<td>PHIR12</td>
<td>Physics – II (Theory &amp; Lab)</td>
<td>I</td>
<td>January</td>
</tr>
<tr>
<td>13.</td>
<td>CHIR12</td>
<td>Chemistry – II (Theory &amp; Lab)</td>
<td>I</td>
<td>January</td>
</tr>
<tr>
<td>14.</td>
<td>ENIR11</td>
<td>Energy and Environmental Engineering</td>
<td>I</td>
<td>January</td>
</tr>
<tr>
<td>15.</td>
<td>PRPC10</td>
<td>Engineering Mechanics</td>
<td>I</td>
<td>January</td>
</tr>
<tr>
<td>16.</td>
<td>PRIR11</td>
<td>Engineering Practice</td>
<td>I</td>
<td>January</td>
</tr>
<tr>
<td>17.</td>
<td>MAIR35</td>
<td>Mathematics for Production Engineers</td>
<td>II</td>
<td>July</td>
</tr>
<tr>
<td>18.</td>
<td>PRPC11</td>
<td>Casting &amp; Welding Technology</td>
<td>II</td>
<td>July</td>
</tr>
<tr>
<td>19.</td>
<td>PRPC12</td>
<td>Machining Technology</td>
<td>II</td>
<td>July</td>
</tr>
<tr>
<td>20.</td>
<td>PRPC13</td>
<td>Metallurgy and Materials Engineering</td>
<td>II</td>
<td>July</td>
</tr>
<tr>
<td>21.</td>
<td>PRPC14</td>
<td>Mechanics of Solids &amp; Fluids</td>
<td>II</td>
<td>July</td>
</tr>
<tr>
<td>22.</td>
<td>PRPC15</td>
<td>Thermal Engineering</td>
<td>II</td>
<td>July</td>
</tr>
<tr>
<td>23.</td>
<td>PRLR10</td>
<td>Manufacturing Processes Lab-I</td>
<td>II</td>
<td>July</td>
</tr>
<tr>
<td>24.</td>
<td>PRLR11</td>
<td>Mechanics of Solids &amp; Fluids &amp; Thermal Engineering Lab</td>
<td>II</td>
<td>July</td>
</tr>
<tr>
<td>25.</td>
<td>MAIR47</td>
<td>Probability &amp; Statistics</td>
<td>II</td>
<td>January</td>
</tr>
<tr>
<td>26.</td>
<td>PRPC16</td>
<td>Kinematics and Dynamics of Machines</td>
<td>II</td>
<td>January</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Course Code</td>
<td>Course Title</td>
<td>Year of Study</td>
<td>Session/s</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------------</td>
<td>-----------</td>
</tr>
<tr>
<td>27.</td>
<td>PRPC17</td>
<td>Forming Technology</td>
<td>II</td>
<td>January</td>
</tr>
<tr>
<td>28.</td>
<td>PRPC18</td>
<td>Metrology (Theory &amp; Lab)</td>
<td>II</td>
<td>January</td>
</tr>
<tr>
<td>29.</td>
<td>PRPC19</td>
<td>Electrical and Control Systems (Theory and Lab)</td>
<td>II</td>
<td>January</td>
</tr>
<tr>
<td>30.</td>
<td>PRLR12</td>
<td>Manufacturing Processes Lab-II</td>
<td>II</td>
<td>January</td>
</tr>
<tr>
<td>31.</td>
<td>PRLR13</td>
<td>Weldability and Formability Testing Lab</td>
<td>II</td>
<td>January</td>
</tr>
<tr>
<td>32.</td>
<td>PRPC20</td>
<td>Design of Machine Elements</td>
<td>III</td>
<td>July</td>
</tr>
<tr>
<td>33.</td>
<td>PRPC21</td>
<td>Tooling for Manufacturing</td>
<td>III</td>
<td>July</td>
</tr>
<tr>
<td>34.</td>
<td>PRPC22</td>
<td>Quality, Reliability and Safety Engineering</td>
<td>III</td>
<td>July</td>
</tr>
<tr>
<td>35.</td>
<td>PRPC23</td>
<td>Computer Integrated Manufacturing (Theory and Lab)</td>
<td>III</td>
<td>July</td>
</tr>
<tr>
<td>36.</td>
<td>HSIR14</td>
<td>Professional Ethics and Psychology</td>
<td>III</td>
<td>July</td>
</tr>
<tr>
<td>37.</td>
<td>PRPE10</td>
<td>Unconventional Machining Processes (Prog. Elective 1/2) / Minor 1 &amp; 2</td>
<td>III</td>
<td>July</td>
</tr>
<tr>
<td>38.</td>
<td>PRPE15</td>
<td>Industrial Robotics (Prog. Elective 1/2) / Minor 1 &amp; 2</td>
<td>III</td>
<td>July</td>
</tr>
<tr>
<td>39.</td>
<td>PRPE25</td>
<td>Product Development Strategies (Prog. Elective 1/2) / Minor 1 &amp; 2</td>
<td>III</td>
<td>July</td>
</tr>
<tr>
<td>40.</td>
<td>PRLR14</td>
<td>Machine Drawing Practice</td>
<td>III</td>
<td>July</td>
</tr>
<tr>
<td>41.</td>
<td>PRHO10</td>
<td>Tolerance Technology (HO1)</td>
<td>III</td>
<td>July</td>
</tr>
<tr>
<td>42.</td>
<td>PRHO13</td>
<td>Total Quality Engineering (HO1)</td>
<td>III</td>
<td>July</td>
</tr>
<tr>
<td>43.</td>
<td>PRHO17</td>
<td>Product Life Cycle Management (HO1)</td>
<td>III</td>
<td>July</td>
</tr>
<tr>
<td>44.</td>
<td>PRPC24</td>
<td>Operations Research</td>
<td>III</td>
<td>January</td>
</tr>
<tr>
<td>45.</td>
<td>PRPC25</td>
<td>Work Design and Facilities Planning</td>
<td>III</td>
<td>January</td>
</tr>
<tr>
<td>46.</td>
<td>PRPC26</td>
<td>Computer Aided Design and Engineering (Theory and Lab)</td>
<td>III</td>
<td>January</td>
</tr>
<tr>
<td>47.</td>
<td>PRPC27</td>
<td>Mechatronics and Industrial Automation (Theory and Lab)</td>
<td>III</td>
<td>January</td>
</tr>
<tr>
<td>48.</td>
<td>PRPE11</td>
<td>Precision Engineering (Theory and Lab) (Prog. Elective 3/4) / Minor 3 &amp; 4</td>
<td>III</td>
<td>January</td>
</tr>
<tr>
<td>49.</td>
<td>PRPE26</td>
<td>Design for Manufacture and Assembly (Prog. Elective 3/4) / Minor 3 &amp; 4</td>
<td>III</td>
<td>January</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Course Code</td>
<td>Course Title</td>
<td>Year of Study</td>
<td>Session/s</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>-------------------------------------------------------</td>
<td>---------------</td>
<td>-----------</td>
</tr>
<tr>
<td>50.</td>
<td>PRPE33</td>
<td>Design and Analysis of Experiments (Prog. Elective 3/4) / Minor 3 &amp; 4</td>
<td>III</td>
<td>January</td>
</tr>
<tr>
<td>51.</td>
<td>PRPE36</td>
<td>Lean Manufacturing (Prog. Elective 3/4) / Minor 3 &amp; 4</td>
<td>III</td>
<td>January</td>
</tr>
<tr>
<td>52.</td>
<td>PRLR15</td>
<td>Production Drawing and Cost Estimation</td>
<td>III</td>
<td>January</td>
</tr>
<tr>
<td>53.</td>
<td>PRHO11</td>
<td>Robotics (HO2)</td>
<td>III</td>
<td>January</td>
</tr>
<tr>
<td>54.</td>
<td>PRHO12</td>
<td>Intelligent Manufacturing Systems (HO2)</td>
<td>III</td>
<td>January</td>
</tr>
<tr>
<td>55.</td>
<td>PRHO14</td>
<td>Product Analysis and Cost Optimization (HO2)</td>
<td>III</td>
<td>January</td>
</tr>
<tr>
<td>56.</td>
<td>PRIR16</td>
<td>Internship / Industrial Training / Academic Attachment</td>
<td>IV</td>
<td>July</td>
</tr>
<tr>
<td>57.</td>
<td>PRIR19</td>
<td>Industrial Lecture</td>
<td>IV</td>
<td>July</td>
</tr>
<tr>
<td>58.</td>
<td>PRPC28</td>
<td>Analysis of Production Systems and IE Lab</td>
<td>IV</td>
<td>July</td>
</tr>
<tr>
<td>59.</td>
<td>PRPC29</td>
<td>Manufacturing System Simulation (Theory and Lab)</td>
<td>IV</td>
<td>July</td>
</tr>
<tr>
<td>60.</td>
<td>PRPE22</td>
<td>Sustainable Manufacturing (Theory and Lab) (Prog. Elective 5/6/7) / Minor 5</td>
<td>IV</td>
<td>July</td>
</tr>
<tr>
<td>61.</td>
<td>PRPE38</td>
<td>Supply Chain Management (Prog. Elective 5/6/7) / Minor 5</td>
<td>IV</td>
<td>July</td>
</tr>
<tr>
<td>62.</td>
<td>PROE10</td>
<td>Operations Management (Prog. Elective 5/6/7) / Minor 5</td>
<td>IV</td>
<td>July</td>
</tr>
<tr>
<td>63.</td>
<td>PRIR18</td>
<td>Comprehensive Training</td>
<td>IV</td>
<td>July</td>
</tr>
<tr>
<td>64.</td>
<td>HSOE13</td>
<td>Entrepreneurship Development</td>
<td>IV</td>
<td>January</td>
</tr>
<tr>
<td>65.</td>
<td>PRPE13</td>
<td>Manufacturing of Composite Materials (Elective 8/9/10)</td>
<td>IV</td>
<td>January</td>
</tr>
<tr>
<td>66.</td>
<td>PRPE23</td>
<td>Rapid prototyping, Tooling &amp; Manufacturing (Elective 8/9/10)</td>
<td>IV</td>
<td>January</td>
</tr>
<tr>
<td>67.</td>
<td>PRPE24</td>
<td>Finite Element Methods (Elective 8/9/10)</td>
<td>IV</td>
<td>January</td>
</tr>
<tr>
<td>68.</td>
<td>PRPE35</td>
<td>Integrated Materials Management (Elective 8/9/10)</td>
<td>IV</td>
<td>January</td>
</tr>
<tr>
<td>69.</td>
<td>PRHO15</td>
<td>Decision Support Systems (HO3)</td>
<td>IV</td>
<td>January</td>
</tr>
<tr>
<td>70.</td>
<td>PRHO16</td>
<td>Knowledge Management (HO3)</td>
<td>IV</td>
<td>January</td>
</tr>
<tr>
<td>71.</td>
<td>PRHO18</td>
<td>Technology Management (HO3)</td>
<td>IV</td>
<td>January</td>
</tr>
<tr>
<td>72.</td>
<td>PRHO19</td>
<td>Multi-Criteria Decision Making Techniques (HO3)</td>
<td>IV</td>
<td>January</td>
</tr>
<tr>
<td>73.</td>
<td>PRIR17</td>
<td>Project Work</td>
<td>IV</td>
<td>January</td>
</tr>
</tbody>
</table>
PROGRAMME CORE (PC)

PRPC12 MACHINING TECHNOLOGY

PREREQUISITE COURSE: Basic Engineering

COURSE OBJECTIVES:

- To perform different machining operations like turning, drilling, milling and finishing.
- To predict tool life and tool failure
- To select suitable cutting fluid for respective materials


TEXT BOOKS:


REFERENCES:
3. ASM Handbook, Machining.

COURSE OUTCOMES:

- Summarize the theory of metal cutting and compute cutting forces involved from Mohr's circle.
- Recognize various parts of lathe list the accessories and explain various operations performed.
- Explain the construction of drilling, boring, reaming and milling machines and explain operations performed

PRPC13 METALLURGY AND MATERIALS ENGINEERING

PREREQUISITE COURSES: Chemistry I and Chemistry II

COURSE OBJECTIVES:

- To test materials through various testing methods to evaluate their properties
- To conduct heat treatment processes for metals

Art and science of metallurgy-structure of metals and alloys-phase and structural constitutions- Equilibrium diagrams

Ferrous metals and alloys-Fe-Fe3C diagram-Effect of alloying elements in steel, Classification of ferrous alloys and their applications

Heat treatment of steel-CCT diagram-Surface hardening process-Non Ferrous Metals Alloys- composition-properties and applications of copper, nickel, lead, tin, zinc, aluminium, Mg and Ti alloys-Heat treatment of Non Ferrous alloy-Non Metallic Metals and alloys-ceramic material- polymers-composite material – Nano-structured materials

Testing of Materials-Non-Destructive Testing, Tensile testing, compression testing - Hardness Testing

Testing of Materials-Impact testing, Fatigue testing, Creep, other related testing methods characterization of TEM, XRD, SEM
Practice:
Demonstration on SEM/XRD

TEXT BOOK:

REFERENCE BOOKS:

COURSE OUTCOMES:
- Interpret microstructure of engineering materials and explain Equilibrium diagrams.
- Classify ferrous alloys and their applications with respect to foundry and welding processes.
- Understand heat treatment processes for alloys, non alloys & summarize testing methods like TEM, XRD, SEM

PRPC14 MECHANICS OF SOLIDS AND FLUIDS

PREREQUISITE COURSES: Engineering mechanics

COURSE OBJECTIVES:
- To measure fluid flows and handle fluid machineries.
- To predict the behaviour of structures on loading and implement the concepts in suitable applications.

Stress - Strain - Elastic constants - Stress in Composite bars - Beams - Types - Shear force and bending moment diagrams for simply supported and overhanging

Columns Long column - Euler's Theory - Short column - Empirical formulae - Torsion of Circular shafts - Hollow Shafts - Power transmission
Vapour Pressure - Pressure at a point its variation - Measurement with Piezo meter, manometers and gauges

Continuity equation in one dimension - Bernoulli’s equation - Venturi meters and Orificie meters - Flow through pipes - Laminar Turbulent flow Major losses

Pumps - General principles of displacement and Centrifugal pumps - Efficiency and Performance Curves of Pumps - Cavitation in Pumps - Turbines - Efficiency - Governing of turbines

Text Book:

Reference:

COURSE OUTCOMES:
- Understand properties of fluids.
- Determine flow through hydraulics machines and pipes
- Able to perform simple stress and strain calculations.

PRPC15 THERMAL ENGINEERING

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

PREREQUISITE COURSES: Physics

COURSE OBJECTIVES:
- To design I.C.Engines, Compressors and Turbines effectively
- To perform flow analysis in nozzles used in different locations
Laws of Thermodynamics - Basic concepts - first law of thermodynamics applied to closed and open systems - simple problems.

Second law of thermodynamics - concept of reversible process

Air standard cycles - Otto, diesel and dual cycles - I.C. engines, S.I. engines and CI engines

Reciprocating compressor - effect of clearance volume, single and multistage compressor - Volumetric efficiency - calculation of power requirement - gas turbines - open and closed cycle - intercooling, reheating and regenerative cycles Wankel engine - Sonic velocity, mach no. Wave propagation - mach cone, static and stagnation property relations, isotropic flow, use of gas tables, normal shock, flow through converging and diverging nozzle


TEXT BOOKS:


REFERENCES:


COURSE OUTCOMES:

- Apply thermodynamic laws in engineering applications
- Calculation of power requirements of gas turbines and flow rates through nozzles
- Calculation of thermal efficiencies of steam turbines
PRPC16 KINEMATICS AND DYNAMICS OF MACHINES

PREREQUISITE COURSES: Engineering Mechanics

COURSE OBJECTIVES:
- To design various machines and to perform kinematic and dynamic analysis.

Kinematic pairs, diagram and inversion - Displacement, velocity and acceleration analysis of planar linkages – static and dynamic analysis of simple mechanisms
Cam profile synthesis - Gears dynamic force analysis
Flywheel – fluctuation of energy and speed, Governors
Inertia forces and their balancing for rotating and reciprocating machines. Hydrodynamic and boundary lubrication in journal and thrust bearings.
Longitudinal – Transverse – Torsional vibration – Two degrees of freedom and multi-degree of freedom systems.

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES:
- Understand the basic concepts of machines and machinery
- Understand law of gearing
- Understand the laws of dry friction
- Understand all mechanisms of machines.
- Design various mechanisms of machines
- Evaluate various mechanisms of machines
PRPC17 FORMING TECHNOLOGY

PREREQUISITE COURSES: Chemistry I, Chemistry II and Metallurgy and Materials Engineering

COURSE OBJECTIVES:
- To apply basic of metal forming processes to shape products to their desired forms without any defects.

Yield criteria for ductile metals - Flow theories – strain hardening – recrystallization

Fundamentals of metal forming- Effect of temperatures, speed and metallurgical microstructure on forming processes - Mechanics of Metal Forming

Forging Processes Forging Equipment, Forging defects - Types of Rolling mill - process variables – defects

Types of extrusion - Process variables - Wire drawing - Drawing and Deep drawing – Sheet metal working

High energy rate forming processes.

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES:
- Understand the properties of ductile metals
- Understand the effects of temperature, speed on metal forming process
- Understand the principle, procedure and applications of Bulk Metal Forming and Sheet Metal Forming
PRPC18 METROLOGY (Theory & Lab)

PREREQUISITE COURSE: Physics-I

COURSE OBJECTIVES:

- To apply various measurement techniques to inspect and test products
- To apply statistical tools for quality assurance purpose
- To test and evaluate various components using various measuring instruments


LAB EXERCISES

TEXTBOOK:

REFERENCES:
COURSE OUTCOMES:
- Describe the fundamental concepts in measurement methods, techniques.
- Apply various instruments for measurements
- Apply quality control tools to achieve defects free quality products
- Take precise measurements using various instruments.
- Develop data for engineering analysis.

PRPC19 ELECTRICAL AND CONTROL SYSTEMS
(Theory and Lab)

PREREQUISITE COURSES: Physics

COURSE OBJECTIVES:
- To apply concepts of electrical drives and control systems to various industrial applications.
- To test various electrical and electronic devices like generators, motors, semiconductor diodes, rectifiers and logic gates.

DC machines - Characteristics - Starting and speed control of DC motors. Transformers: (Single phase only)- equivalent circuit and regulation - losses and efficiency - auto transformer.

Alternators - EMF equation - regulation by synchronous impedance method - Synchronous motors starting and applications.

Three - phase induction motor - Cage and slip ring motors -torque slip characteristics –starting and speed control of induction motors - single phase induction motors and universal motors.

Electric drive for general factory, textile mill - pump, blowers, hoists, traction etc. - group and individual drives - Construction and working of dynamometer type watt meters and induction type energy meters.

Control System – open loop and closed loop systems- transfer function - time response of second order system - frequency response method - polar plot. Concept of stability - application of routh criterion for simple systems.

LAB

EXERCISE-1: No - load speed characteristics of D.C. shunt motor
EXERCISE-2: Load test on D.C. Shunt generator
EXERCISE-3: Equivalent circuit of single-phase transformer
EXERCISE-4: Swinburne's test
EXERCISE-5: Starting of 3-phase induction motors
EXERCISE-6: Semiconductor junction diode V-I characteristics
EXERCISE-7: Semiconductor zener diode V-I characteristics
EXERCISE-8: Inverting and Non-inverting Operational Amplifiers
EXERCISE-9: Uni Junction Transistor (UJT) and Silicon Controlled Rectifier (SCR) characteristics
EXERCISE-10: Logic gates

TEXT BOOK:


REFERENCES:


COURSE OUTCOMES:

- Understand the concepts of transformer and DC machines
- Understand open and closed system
- Understand the mechanics of fluids, transportation of mass, momentum and energy
- Conduct exercises to learn DC motor
- Conduct experiments for understanding VI characteristics of diodes
- Conduct experiments to learn about Logic Gates

<table>
<thead>
<tr>
<th>PRPC20 DESIGN OF MACHIN ELEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

PREREQUISITES: Engineering Mechanics, Strength of materials

COURSE OBJECTIVES:

- To understand material properties, design process and various theories of failures
- To design various basic machine components
- To design new components based on design principles
Introduction to the design process, factor influencing machine design, mechanical properties of materials, direct stress, bending stress, torsional stress and variable stress in machine parts, theories of failure, stress concentration factor, factor of safety.

Design of shafts based on bending moment, twisting moment, combined of bending and twisting moments, axial loads in addition to combined torsional and bending loads, rigidity and stiffness. Design of spring.

Belt and chain drives: selection of flat belt, V belt and chain drives. Design of couplings, keys and bearings.

Welded joints: types of joints, welding symbol and weld symbol and their representation, strength of welded joints subjected to various types of load. Riveted joints: types of joints, design of riveted joints for structure.

Design of spur and helical gears. Design of gear box: layout diagram, speed diagram, fixing number of teeth and module of gears.

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES:
- Understand the various theories of failures
- Design various machine components
- Design new components based on the design principles

PRPC21 TOOLING FOR MANUFACTURING

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>


COURSE OBJECTIVES:
- To study the various design considerations for tooling.

Design of cutting tools: Tool materials, design of single point cutting tool, form tool, drill, reamer, broach & plain milling cutter.
Theory of metal cutting – design of tool holders for single point tools – Boring bars – selection of tools for machining applications – economics of machining

Design of fixtures: standard work holding devices – principles of location and clamping – clamping methods and elements – quick-acting clamps – design & sketching of milling fixtures for simple components – Turning, Grinding, Welding fixtures. inspection fixtures and design of gauges

Design of Drill jigs: Drill bushings – types of jigs: Plate, Leaf, Turn over & Box Jigs – design & sketching of drill jigs for machining simple components


TEXT BOOKS:
1. A Bhattacharyya, Metal Cutting Theory and Practice, Central Book Agency Kolkata.

REFERENCES:

COURSE OUTCOMES
- Design single point cutting tool, form tool, drill etc
- Understand how to conduct machining economically
- Design jigs, fixtures and press tools

PRPC22 QUALITY, RELIABILITY AND SAFETY ENGINEERING [L T P C]
3 0 0 3

PREREQUISITES: Basic Engineering

COURSE OBJECTIVES
- To identify and analyze failures of components and subcomponents of mechanical and electronic items.
- To distinguish different concepts in maintenance and explore in order to increase service life of the products/machines
- To list various safety measures concerned with environment described for a safety engineer
Introduction to quality assurance and quality control – Statistical concepts in quality – Central limit theorem – Quality control tools

Control charts for variables and attributes– process capability studies – Sampling inspection-Quality System standard

Failure Rate, Mean Time Between Failures (MTBF)-Mean Time To Failure (MTTF), Bathtub distribution, Down time, Repair time, Availability, Series-Parallel Structures, Redundancy, Reliability Allocation, Mechanical Reliability, Failure Mode Analysis.


TEXT BOOKS:

1. David J Smith, Butterworth-Heinemann,Reliability Maintainability and Risk; Practical methods for engineers, New Delhi, 2001
2. B.S. Dhillon, Maintainability, Maintenance and Reliability for Engineers,CRC Press, 2006

REFERENCE:

2. B.S. Dhillon, Engineering maintenance; a modern approach,CRCPress, 2002

COURSE OUTCOMES:

- Identify and analyze the failures of the components and subcomponents of mechanical and electronic items.
- Distinguish different concepts in maintenance and explore in order to increase the service life of the products/machines
- List various safety measures concerning with environments described for a safety engineer
PRPC23 COMPUTER INTEGRATED MANUFACTURING
(Theory & Lab)

COURSE OBJECTIVES:

- To gain knowledge in Engineering product specification and CAD/CAM Integration.
- To impart knowledge in CAD software package for modeling, assembly, FEA of mechanical components and CNC programming for Milling/Turning.

CIM - evaluation, hardware and software of CIM - concurrent engineering – advance modeling techniques.


Cellular manufacturing - Group Technology – Flexible Manufacturing Systems- Configurations- Workstations - Control systems - Applications and benefits

Materials handling and Storage Systems - types of material handling systems – storage systems- – Automated storage and retrieval systems – Robotics technology - control systems – Programming-Applications– Automated inspection and testing – Coordinate measuring machines.

LAB EXERCISES

1. Plain turning and facing operations on EMCO turning machine.
2. Step turning operation on LEADWELL machine.
3. External threading operation on LEADWELL and STC 15 machines.
4. Profile milling operation on VMC machine.
5. Rectangular pocketing and drilling operations on EMCO milling machine.
6. Mirroring operation on MTAB milling machine.
7. Inspection on CMM

TEXT BOOK:


REFERENCES:

COURSE OUTCOMES:

- Assembly of mechanical components using CAD software Solid Works/CATIA/Pro-E.
- Finite Element Analysis (FEA) using Pre-processing (solid modeling, meshing, analysis setup)
- and post processing (graphical display and report) with software PATRAN/ NASTRAN/ MARC/
- ABAQUS/ LS-DYNA/ ANSYS/PAM-CRASH (Exercises include Simple Beam, Plane Stress, Strain, axi-symmetric, 3D Solids).
- CNC code generation for CNC Milling.
- CNC code generation for CNC Turning.
- Demonstration of CNC Router Machine/ CNC Lathe/ CNC Milling
  (Students have to Submit detailed reports on each demonstrations).

PRPC24 OPERATIONS RESEARCH

PREREQUISITES: Applied statistics

COURSE OBJECTIVES:

- To understand Linear programming, assignment and queuing problems
- To make decisions under uncertainty
- To prepare project network and perform project scheduling

Concept of linear programming model-Development of LP models - Graphical method. Simplex method - Big M method - Two-phase method - Special cases in Linear Programming. Introduction to duality theory.

Introduction-Mathematical model for Transportation problem –balanced and unbalanced transportation problem. Methods to solve transportation problem-
finding basic feasible solution- testing solution for optimality - Assignment problem-

Introduction-characteristics of queuing problem-terminologies of queuing problem-
applications of queuing model -single server model. Simulation-need for simulation-

Decision under uncertainty-Laplace criterion, Maximin criterion, minimax criterion,
Savage minimaxregret criterion, Hurwicz criterion. Decision making under risk-
expected value criterion- decision tree, Investment decisions –present worth method, annual equivalent method, rate of return method, Replacement Analysis-types of replacement problem. Replacement of item that fail with respect to time. Replacement of item that fail suddenly-individual replacement and group replacement.

Project network construction – Critical Path Method (CPM) - determination of critical path - Project Evaluation and Review Technique (PERT)-probability of completing a project in a scheduled date - Crashing of project network-cost considerations in project scheduling, Production scheduling- single machine scheduling, flow shop scheduling, Johnson’s algorithm

TEXT BOOK:

REFERENCES:

COURSE OUTCOMES:

- Summarize different techniques for production planning like queuing uncertainty and mathematical modeling are involved
- Apply optimization in utilization of resources
- Apply resource management techniques to industrial operations

PRPC25 WORK DESIGN AND FACILITIES PLANNING

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

PREREQUISITE: Reliability, maintenance and safety Engineering

COURSE OBJECTIVE:

- To understand method study and work management techniques

Methods study - motion and time study, and productivity - micromotion and macromotion study - Ergonomics.

Work measurement - techniques of work measurement - time study - production study. Facility layout - steps in facility location study - layout types and analysis.
Layout design process - systematic layout planning - analysis - designing the layout - Assignment model
Computerized layout planning - CRAFT, ALDEP and CORELAP

TEXTBOOKS:


REFERENCE:


COURSE OUTCOMES:

- Perform ergonomic analysis
- Perform computerized layout planning
- Perform work measurements

<table>
<thead>
<tr>
<th>PRPC26 COMPUTER AIDED DESIGN AND ENGINEERING</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Theory &amp; Lab)</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

PREREQUISITES: Physics, Applied Electronics

COURSE OBJECTIVES

- To understand various hardware and software that serve as components of CAD system
- To understand plotting, transformations techniques, geometric modeling
- To understand graphic standards, finite element modeling and DBMS

Fundamentals of computer - configurations - workstations - data communications - input/output devices, display technology, CAD software. Interactive graphics - point plotting techniques. Transformations techniques, viewing operations: window, viewport and clipping, visual realism

- Hidden line/surface removal, shading and colour models. Computer drafting through high level languages.

Geometric modeling: Wireframe modeling, Surface modeling: Representation of curves and surfaces, design of curves: cubic splines, bezier curves and B-spline, design of surfaces.

Solid modeling: Constructive solid geometry (C-rep) and Boundary representation (B-rep). Graphics standards: GKS, DXF and IGES standards - Parametric design programmes.
Finite element modeling and analysis: types of analysis, degrees of freedom, element and structure- stiffness equation, assembly procedure. Database concepts and data base management systems - SQL.

LAB EXERCISES
- Part modelling using CAD
- Assembly using CAD
- Manufacturing analysis using CAM
- Engineering analysis using CAE

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES
- Summarize the concepts and applications of CAD.
- Elaborate fundamental of computers, networks, transformations techniques, geometric modeling solid modeling and finite element modeling
- Distinguish various concepts and techniques used for Product design and to develop product design skills.

PRPC27 MECHATRONICS AND INDUSTRIAL AUTOMATION (Theory & Lab)

<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>2</td>
<td>3</td>
</tr>
</tbody>
</table>

PREREQUISITE: Fluid mechanics and Machinery, Engineering mechanics

COURSE OBJECTIVE:
- To study hydraulic and pneumatic systems, sensors and their applications

Introduction - overviews, principles and application of hydraulic, pneumatic, electric controls system.

Pneumatic system, pneumatic components - pressure-flow-direction controls valves - pneumatic components symbols- Design and application of pneumatic circuits of machine tool.

Semi automats-automats-transfer lines - automatic assembly - transfer devices and feeders- classifications and applications-job orienting and picking devices- setting of automats and transfer lines.

Introduction to mechatronics, mechatronics system, Microprocessors and their applications, Sensors and Principles, PLC system, examples of mechatronics systems.

LAB EXERCISES:
1. Design, simulate and testing of Pneumatic and Electro Pneumatic circuits for engineering applications using actuators and control valves (pressure, flow and direction).
2. Design, simulate and testing of Hydraulic and Electro Hydraulic circuits for engineering applications using actuators and control valves (pressure, flow and direction).
3. Design, simulate and testing of PLC circuits for engineering applications using sensors.
4. Using MAT Lab/ SCI lab -Study on Robot programming and operation with vision systems

TEXTBOOKS:

REFERENCES:

COURSE OUTCOMES:

- Understand hydraulic devices and their applications.
- Analyze the integrated product design
- Generate electro-hydraulic, electro-pneumatic solutions
PRPC28 ANALYSIS OF PRODUCTION SYSTEMS AND IELAB

PREREQUISITES: Operations research

COURSE OBJECTIVES:

- To understand production function, Design of Product, Planning functions, Material Planning and Layout and Scheduling

Engineering Economy and Costing: Elementary cost accounting and methods of depreciation; break-even analysis, techniques for evaluation of capital investments.

Production Planning: Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality

Capacity and aggregate production planning; master production scheduling; MRP and MRP-II Scheduling and priority dispatching

Inventory – functions, costs, classifications, deterministic and probabilistic inventory models, quantity discount; perpetual and periodic inventory control systems.

IE LAB EXERCISES

The objective of this lab is to have practical exposure on operations management and also to study on the ergonomic aspects of human evaluation.

Part-A Operations Management
1. Forecasting Models
2. Inventory Models
3. Scheduling Case studies
4. Material Requirements Planning
5. Project management

Part-B Ergonomics Study
1. Performance rating using stop watch
2. Peg board experiment
3. Time study trainer
4. Fitness study using treadmill
5. Fitness study using ergo cycle
TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES:
- Effective Forecasting of Production functions
- Enhanced Planning of Product Design and Service Operations
- Facility Planning and Project Management

PRPC29 MANUFACTURING SYSTEM SIMULATION
(Theory & Lab)

L T P C
3 0 2 4

PREREQUISITES: Applied statistics, Resource Management Techniques

COURSE OBJECTIVES:
- To study various simulation software
- To simulate various production system model

Introduction to Simulation - Components of a system, Types of models, Monte Carlo Simulation, Steps in simulation, applications - Discrete Event Simulation – components of DES - Time advance mechanism.

Introduction – probability mass function, probability density function, Statistical models – Discrete distributions – Bernoulli, Binomial, Poisson, Geometric-Continuous distributions – Normal, Uniform, Exponential Gamma, Triangular Empirical Distributions

Properties of random numbers- Random number generation techniques – midsquare, mid product Constant multiplier, linear, additive congruential. Test for random numbers- uniformity, independence- Kolmogorov simronov test, chi square Runs test, Gap test, poker test, autocorrelation test Random variate generation- Inverse transform Acceptance rejection, convolution method
Input Analysis Methods-Examples-Verification of simulation models- Validation of simulation models-Measure of performance and their estimation- Output Analysis Methods-Transient and steady state behavior – Evaluation of alternate system design – Simulation Based Optimization (SBO).

Simulation packages spreadsheet, witness, Arena etc., Simulation of queuing models, inventory models, Material handling, assembly systems, logistics and supply chains –Tutorial.

LAB EXERCISES

ARENA


SIMQUICK

Exercise 3: Simulation of supply chain Inventory System
Exercise 4: Simulation of Multiple Servers Queuing System
Exercise 5: Simulation of batch shop manufacturing process

WITNESS

Exercise 6: Simulation of multi machine assignment system
Exercise 7: Simulation of Manufacturing and material handling systems
Exercise 8: Simulation of supply chain inventory system

GPSS

Exercise 9: Simulation of Job shop System
Exercise 10: Simulation of queuing System

Demo on QUEST, UGRIP, Systat, GAMS

TEXTBOOK:

REFERENCES:

COURSE OUTCOMES:

- Understand the basics of Discrete event system simulation
- Apply several tests
- Acquire knowledge about the design/evaluation of different manufacturing systems using simulation modeling.
- Model and simulate using ARENA, SIMQUICK, WITNESS, Flexsim
- Familiarize QUEST, UGRIP, Systat
- Simulate job shop system and queuing system
PROGRAMME ELECTIVE (PE)

PRPE10 UNCONVENTIONAL MACHINING PROCESSES

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

PREREQUISITES: Machining Technology

COURSE OBJECTIVES:

- To understand several non-traditional machining process in micro and precision manufacturing field
- To select suitable machining process for materials considering their merits and demerits

Introduction - Classification - process economy - Mechanical machining - Types - Ultrasonic machining (USM) - Abrasive Jet Machining (AJM) - Abrasive Flow Machining (AFM) - Water Jet Machining (WJM) - Operating principle - Process parameters - Applications - Limitations.

Electro chemical machining - Chemical material removal - Types - Electro chemical machining (ECM) - Electro chemical drilling (ECD) - Electro chemical grinding (ECG) - Electro chemical honing (ECH) - Shaped tube electrolytic machining - Operating principle - Process parameters - Applications - Limitations.

Thermo electrical machining - Types – Electrical discharge machining (EDM) - Electrical discharge wire cutting (EDWC) - Electron beam machining (EBM) - Ion Beam Machining (IBM)-Plasma Arc Machining (PAM) - Operating principle - Process parameters - Applications – Limitations


Special processing technologies - Rapid Prototyping - Methods - Fused Deposition Modeling (FDM) - Laminated Object Manufacturing (LOM) - Selective laser sintering (SLA) - Solid Ground curing (SGC) - 3D printing (3DP) - Processing of integrated circuits - Micro and nano fabrication technologies.

TEXT BOOKS:
2. Wellar, E.J. "Non-Traditional Machining Processes", Society of Manufacturing

REFERENCES:

COURSE OUTCOMES:
- Understand the contribution of non-traditional machining process in micro and precision manufacturing field.
- Select suitable machining process for suitable materials
- Summarizes the merits and demerits of the non-traditional manufacturing process.

PRPE11 PRECISION ENGINEERING (Theory & Lab)  

PREREQUISITES: Machining technology

COURSE OBJECTIVES:
- To provide and enhance technical knowledge in precision engineering, its components and applications.

Precision machining – Concepts and significance – Classification - Top down – Bottom up approaches– Precision and micromachining - Machining of micro-sized components - Ultra precision machining grinding


Nano surface generation-Concepts and applications-Types- Ductile mode of machining- Diamond turning of parts to nanometer accuracy – ELID grinding – Chemo Mechanical Polishing- Magnetorheological finishing.
Precision metrology – In-process measurement of position of processing point - Post process and online measurement of dimensional features - Mechanical measuring systems - Optical measuring systems - Electron beam measuring systems – Scanning Tunneling – Atomic Force Microscope.

**Precision Lab exercises**
2. Exercise on Micro-milling operation on DT-110 Multi-process micro-machining center.

**TEXT BOOKS:**

**REFERENCES:**

**COURSE OUTCOMES:**
- Understand the concept of precision engineering, its principles and importance as applicable to instruments and machines.

**PRPE12 MATERIAL HANDLING & STORAGE**

**COURSE OBJECTIVES**
- To understand about material handling systems
- To understand material storage methods
- To understand automation in material transfer

Introduction to material handling- Principle of material handling equipment-layout and aerial handling systems- Types of material handling systems.

Fixed Path Equipment- flexible-path equipment - Conveyers-automated guided vehicles (AGV) - Applications of AGV Production line equipments-pick and place robots-transfer devices-feeder lines, robotic devices
Conveyors-storage equipments-Automated ware houses- types of storage systems- small containers - unit load containers - rack and shelving
Automated storage and retrieval systems-methods of protecting materials for packages - auxiliary equipments - automated identifications systems

**TEXTBOOKS:**

**REFERENCE BOOKS:**

**COURSE OUTCOMES**
- Classify various material handling and and storage systems
- Identify various fixed path equipment
- Summarize various packaging techniques

**PRPE13 MANUFACTURING OF COMPOSITE MATERIALS**

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**COURSE OBJECTIVES:**
- To understand the properties of composite materials
- To classify the composites based on properties
- To design metal matrix composite

FRP composites – Fiber types, fiber forms and properties, matrices type and properties, lamina, laminate, orthotrophy, anisotrophy, composites

Macro and micro-mechanical analysis and properties, Failure theories – Tsai – Hill, Tsai-Wu

Primary and secondary manufacturing of composites – Lay-up, Autoclave Molding filament Winding, Pultrusion, Compression Molding, RTM, RIM, SRIM, machining, drilling and routing

Metal matrix composites – Manufacturing route Design, Structural and testing, application
Ceramic matrix composites – Manufacturing routes and application
TEXTBOOKS:

REFERENCE BOOKS:

COURSE OUTCOMES:

- Define fundamentals of composite material strength and its mechanical behavior
- Classification of composites –matrix composites, metal matrix composites, Ceramic matrix composites reinforcement – particle reinforced composites, fiber reinforced composites
- Analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.

PRPE14 MACHINE TOOL TECHNOLOGY

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:

- To understand different types of machine tools
- To analyse the source of vibration in machine structure
- To apply automation in machine control

Classification of machine tools - features construction and operation of basic machine tools - different types and mechanics of transmission of machine tool motion - kinematic structure of machine tools

Mechanical drives for rotational movement - stepped and step less O/P - mechanical drives for reciprocation

Strength and rigidity of machine tool structures - design of lathe beds - design of drill columns - analysis of spindle bearings hydrodynamic bearings - stack slip motion - hydrostatic bearings-

Vibration of machine - sources of vibration

Semi automation - automatic machines with mechanic controls.
TEXTBOOK:

REFERENCE BOOKS:

COURSE OUTCOMES:

- Classify different types of machine tools
- Analyse vibration of machine structures
- Design lathe beds, drill columns

PRPE15 INDUSTRIAL ROBOTICS

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:

- To understand the components of robot
- To understand the drives and programs used to actuate the robot
- To utilize robot technology in various applications

Fundamentals of Robotics: Definition - robot classification - robot arm geometry - power sources, application areas - control techniques - path control - robot controller operation - open loop and closed loop systems.

End of arm tooling and sensors: characteristics - classification - special purpose tools - Typical designs, compliance in Wrists. End Effectors: types, mechanical and other types of griper - types of sensors and applications.

Robot Programming And Languages: Language classification - program commands, arm motion, task point diagram - on line/off line programming, sample programs, program analysis - AI and experts systems.

Recent developments: Recent developments in advanced Robotics – Modular concept - Special applications of robotics - micro robotics, Bio robotics - technologies and applications.

TEXTBOOKS:

REFERENCE BOOKS:

COURSE OUTCOMES:
- Explain the basic concepts, parts of robots and types of robots
- Identify the various drive systems for robot, sensors and their applications in robots, programming of robots
- Discuss about the various applications of robots, justification, implementation and safety of robot

PRPE16 PLANT ENGINEERING

COURSE OBJECTIVES
- To exemplify different types of plants and its functions
- To analyse the principles used in plants maintenance
- To understand the safety methods in plants

Organization of the plant engineering function-Classification of maintenance work-Electric power supply system's-Electric generators and turbines-compressors, ventilation and air-conditioning Producer Gas Plants-operation and safety aspects in P.G. Compressor and Oxygen plants Material handling system-AS and RS (Automatic Storage and Retrieval System)-AGV and robotics- piping system design and components-Pollution control and plant safety

Noise and vibration control - safety in plant operations, fire and electrical protection and prevention security equipment

Lubrication and corrosion- Synthetic and solid lubricants - lubrication systems - causes and control deterioration - paints and protective coatings.
TEXTBOOKS:

REFERENCE BOOK:

COURSE OUTCOMES

- Understand the different type of plant and material handling system AS and RS (Automatic Storage and Retrieval System)-AGV and robotics
- Define the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- Know about safety in plant operation, fire and electrical protection and prevention security equipment

PRPE17 NON-DESTRUCTIVE TESTING  

COURSE OBJECTIVES:

- To study and understand various Non Destructive Evaluation and Testing methods, theory and their industrial applications.

OVERVIEW OF NDT: NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT. Visual inspection – Unaided and aided.


THERMOGRAPHY AND EDDY CURRENT TESTING: Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing - Generation of eddy currents, Properties of eddy currents, Eddy current sensing
elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.


RADIOGRAPHY: Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES:
• Upon completion of this course, the students can able to use the various Non Destructive Testing and Testing methods understand for defects and characterization of industrial components.

PRPE18 MICRO FABRICATION PROCESSES

COURSE OBJECTIVE:
• To perform various micro fabrication processes to achieve very concise tolerances in micron level materials removal applications.


Solar cell materials and processing- Crystalline Si Cell- Amorphous Si Cell - Thin Film Cell Technologies- Space and Concentrator Cells- Organic and Dye Sensitized Cells- Recent advancement.

Self assembly - Basics - Cheerios effect - Static, dynamic, template driven self assembly - assembly via capillary forces - structured surface - assembly by folding - magnetically and mechanically driven dynamic systems - self propelled systems.

REFERENCES:


COURSE OUTCOMES:

- Students can perform various micro fabrication techniques to achieve micron level materials removal

PRPE19 SURFACE ENGINEERING

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVE:

- To apply various surface protection techniques to protect metallic materials from degradation and wear
Introduction- Significance of surface engineering- Solid surface- Surface energy- Superficial layer- Physico-chemical parameters- Properties of the superficial layer- Surface coating- Classification. Physical vapor deposition (PVD): Ion plating- Sputter deposition- Reactive deposition- Magnetron sputtering- Chemical vapor deposition (CVD)- Ion implantation- Electron beam technology- Applications.

Thermal Spraying Techniques- Flame Spraying, Atmospheric Plasma Spraying (APS), Vacuum Plasma Spraying (VPS), Detonation-Gun Spraying (D-GUN), High-Velocity Oxy-Fuel (HVOF) Spraying-Applications.


REFERENCES:


COURSE OUTCOMES:
- Perform different surface protection techniques like PVD, thermal spray techniques and laser surface modification techniques for the protection of metallic surfaces

PRPE20 - INTRODUCTION TO FRICTION COMPOSITES

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Introduction: Laws of friction- types of friction- wear- types of wear- mechanism involved in wear.

Brake system and Assembly: Basic requirements and functions of braking system, Types of brakes, hydraulic brake system, compressed air brake system, parking brakes, dual power brake system, regenerative brake system, fail-safe brake, anti-
lock braking system, electronic brake force distribution, anti-skid braking system, brake efficiency and testing, weight transfer, braking ratio.


REFERENCES:

COURSE OUTCOMES:

- Demonstrate knowledge of brake systems principles and operations.
- Identify various raw materials and different types of friction composites.
- Study industrial standard practices in testing the friction composites and brake systems

PRPE21 PROCESSING OF POLYMERIC COMPOSITES

COURSE OBJECTIVE:

- To enable students to understand the methods of preparation, properties and applications of thermoplastic materials covering commodity, engineering and high performance plastics.

Methods of manufacturing - Properties and applications of poly(vinyl chloride)- Poly(vinylidene chloride)- Poly(vinyl alcohol) - Poly(vinyl acetate)- Chlorinated poly(vinyl chloride)- Plastisols, Poly vinylpyrrolidiene, Polystyrene, HIPS, EPS, SAN, EVA, EPDM, ABS.

Methods of manufacturing - properties and applications of Acrylates - Poly (methyl methacrylate) - Polyacrylonitrile. Aliphatic polyamides –Aromatic polyamides-Polyethylene terephthalate - Polybutylene terephthalate - Polyacetals and copolymers -Polycarbonates- Thermoplastic polyurethane (TPU)

Methods of manufacturing- Properties and applications of Fluoro polymers - Polytetrafluoroethylene, Polychlorofluoroethylene, Thermoplastic polyurethanes, Biodegradable polymers - poly ξ–caprolactone and copolymers - polylactic acid-Bacterial polyhydroxy alkonates.

Preparation, properties and applications of High performance Thermoplastic materials PPS, PO, Polysulphone, Polyether Sulphone, PEEK, Polyimide. Biopolymer-cotton wool, collagen, hyaluroran.

**TEXT BOOKS:**


**REFERENCES:**


**COURSE OUTCOMES:**

- Familiarize in manufacturing process of plastic
- Acquire skills in selecting polymeric materials for specific applications
- Demonstrate basic knowledge of degradable plastics
PRPE22 SUSTAINABLE MANUFACTURING (Theory & Lab)

PREREQUISITES: Fundamentals of Manufacturing

COURSE OBJECTIVES
- To understand the importance of sustainable manufacturing
- To study various tools/techniques of sustainable manufacturing
- To perform Life Cycle Assessment and assess environmental impacts of manufacturing processes
- To develop eco friendly products/processes

Sustainable Manufacturing - Concept of Triple bottom line, Environmental, Economic and Social Dimensions of Sustainability, Relation between lean and sustainable manufacturing.


Sustainability Assessment – Concept Models and Various Approaches, Product Sustainability and Risk/Benefit assessment– Corporate Social Responsibility.


Laboratory Exercises:
Sustainability Analysis, Life Cycle Assessment, Design for Environment, Sustainable product design

Software packages used: Sustainability Xpress, GaBi, Simpro.

TEXTBOOKS:
REFERENCES:

1. P. Lawn, Sustainable Development Indicators in Ecological Economics, Edward Elgar Publishing Limited.

COURSE OUTCOMES:

- Recognize the need for sustainable manufacturing
- State-of-art tools and techniques of sustainable manufacturing
- Design Eco friendly processes/products

PRPE23 RAPID PROTOTYPING, TOOLING AND MANUFACTURING

COURSE OBJECTIVES

- To understand need of rapid prototyping process
- To understand about different Rapid prototyping process
- To understand tools used in Rapid prototyping techniques

Introduction- Need for the compression in product development, History of RP systems, Survey of applications, Growth of RP industry, Classification of RP systems.


Rapid Tooling: Indirect rapid tooling - silicone rubber tooling, aluminum filled epoxy tooling, spray metal tooling, Direct rapid tooling - direct AIM, copper polyamide, sand casting tooling, laminate tooling, soft tooling Vs hard tooling.


Allied Processes: Vacuum casting, surface digitizing, surface generation from point cloud, surface modification, data transfer to solid models.
TEXTBOOKS:

REFERENCE BOOKS:

COURSE OUTCOMES
- Understand the principle, parameters and applications of R P processes
- Recognize various types of rapid tooling
- Identify different allied processes

PRPE24 FINITE ELEMENT METHODS

COURSE OBJECTIVES
- To apply partial differential equations in element analysis
- To evaluate the element shape using FEM
- To apply numerical methods in element analysis

Introduction-Different approaches in Finite Element Method - Steps involved in FEM-
-Types Of Elements Used
Interpolation Polynomials - Linear elements Shape function - Finite Element
Formulation Of Field Problems
Classification of partial differential equations - Finite Element Formulation Of Solid
Mechanics Problems
Axial force member - element matrices for axial force members - Truss element
analysis of pinned truss - Two dimensional elasticity problems-Numerical Methods In
FEM
Evaluation of shape functions - Solution of finite element equations - Cholesky
decomposition, Skyline storage - Computer implementation.

TEXTBOOK:

REFERENCE BOOKS:
   Engineers”, John Wiley,2008

COURSE OUTCOMES
- Obtain expertise in formulating finite element models for structural
  thermal and vibrational problems.
- Obtain ability to solve FE models using numerical solutions.
PRPE25 PRODUCT DEVELOPMENT STRATEGIES

COURSE OBJECTIVES:

- To understand the complexities in product development
- To gain knowledge on tools/techniques of product development
- To recognize the need for design to suit environment

Product development versus design, types of design and redesign, modern product development process, reverse engineering and redesigning product development process, examples of product development process, scoping product development – S-curve, new product development.

Gathering customer needs, organizing and prioritizing customer needs, establishing product function, FAST method, establishing system functionality.

Tear Down and Experimentation- Tear down method, post teardown report, benchmarking and establishing engineering specifications, product portfolios.

Generating Concepts- Information gathering, brain ball, C-sketch/6-3-5 method, morphological analysis, concept selection, technical feasibility, ranking, measurement theory, DFMA, design for robustness

Design for the Environment: DFE methods, life cycle assessment, weighted sum assessment method, techniques to reduce environmental impact – disassembly, recyclability, remanufacturing regulations and standards, analytical and numerical model solutions.

TEXTBOOKS:


COURSE OUTCOMES:

- Explain modern product development process
- Design for the Environment through DFE method life cycle assessment
- Gather customer needs
PRPE26 DESIGN FOR MANUFACTURE AND ASSEMBLY

COURSE OBJECTIVES

- To identify opportunities for design.
- To address technical considerations of design and manufacturing.
- To utilize DFM and Concurrent Engineering Principles on a "real life" project.


Process capability analysis – Cumulative effect of tolerances – Centrality analysis – Compound assembly – Selective and Interchangeable assembly – Grouped Datum systems


TEXTBOOKS:

REFERENCES
2. KalandarSaheb, S.D and Prabhakar, O., Engineering Design for Manufacture, ISPE 1999. 3Boothroyd, DFMA.

COURSE OUTCOMES

- Identify opportunities for design.
- Address technical considerations of design and manufacturing.
- Utilize DFM and Concurrent Engineering Principles on a "real life" project.
PRPE27 VIBRATION AND NOISE ENGINEERING

COURSE OBJECTIVES:

- To understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components.

BASICS OF VIBRATION: Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non-linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

BASICS OF NOISE: Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.


CONTROL TECHNIQUES: Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

SOURCE OF NOISE AND CONTROL: Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.

TEXT BOOKS:

REFERENCES:
4. William T. Thomson, Marie Dillon Dahle, ChandramouliPadmanabhan, “Theory of

COURSE OUTCOMES:
- Understanding causes, source and types of vibrations in machineries
- Gaining knowledge in sources and measurement standard of noise
- Ability to design and develop vibrations and noise control systems.

PRPE28 CONCEPTS OF ENGINEERING DESIGN

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:
- To study about fundamental design standards and needs
- To learn about human and product factors involved in design concepts and rapid prototyping methods

DESIGN FUNDAMENTALS: Importance of design- The design process-
Considerations of Good Design –Morphology of Design –Organization for design–

CUSTOMER ORIENTED DESIGN & SOCIETAL CONSIDERATIONS:

Mathematical Modeling – Simulation – Geometric Modeling –Rapid prototyping-
Finite Element Analysis– Optimization – Search Methods.

MATERIAL SELECTION PROCESSING AND DESIGN: Material Selection Process – Economics – Cost Vs Performance – Weighted property Index –


**TEXT BOOK:**

**REFERENCES:**

**COURSE OUTCOMES:**
- Demonstration of fundamental design standards and customer needs
- Understand human and product factors involved in design concepts
- Application of engineering design concepts

**PRPE29 ENGINEERING OPTIMIZATION**

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**COURSE OBJECTIVE:**
- To perform different optimization techniques to solve various engineering problems

**Introduction:** Introduction to engineering optimization - General principles – Classification - Problem formulation & their classifications – Classical optimization techniques – Single variable and multivariable optimization-Single and Multi objectives-Pareto Optimal solutions.

Constrained Optimization Techniques: Optimization with equality and inequality constraints - Direct methods – Indirect methods using penalty functions.


Applications: Structural applications – Design of simple truss members - Design applications – production planning, controlling and scheduling – Facility layout applications, etc.

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES:
- Able to perform classical optimization techniques
- Able to perform constrained and unconstrained optimization techniques
- Able to perform optimization techniques for design of simple truss members, production planning and scheduling

PRPE30 COMPUTATIONAL FLUID DYNAMICS

L T P C
3 0 0 3

COURSE OBJECTIVES:
- To introduce governing equations of viscous fluid flows
• To introduce numerical modelling and its role in the field of fluid flow and heat transfer
• To enable students to understand the various discretization methods, solution procedures and turbulence modelling.
• To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.


FINITE VOLUME METHOD FOR CONVECTION DIFFUSION: Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.


TEXT BOOKS:
REFERENCES:

COURSE OUTCOMES:
- Perform numerical modelling and its role in the field of fluid flow and heat transfer
- Use various discretization methods, solution procedures and turbulence modelling to solve flow and heat transfer problems.

PRPE31 EXPERIMENTAL STRESS ANALYSIS

PREREQUISITES
- Strength of Materials.

COURSE OBJECTIVES:
To understand the basic aspects of experimental stress analysis that includes exhaustive treatment of the most versatile techniques like photo elasticity and strain gauges and also a brief introduction to the emerging techniques like digital image correlation.

Overview of Experimental Stress Analysis- Optical Methods Work as Optical Computers- Stress, Strain and Displacement Fields- Physical Principle of Strain Gauges, Photo elasticity and Moiré- Introduction to Moiré, Brittle Coatings and Holography- Hologram Interferometry, Speckle Methods- Introduction to Shearography, TSA, DIC and Caustics- Fringe Patterns – Richness of Qualitative Information

Multi-Scale Analysis in Experimental Mechanics- Selection of an Experimental Technique- Introduction to Transmission Photo elasticity- Ordinary and Extraordinary Rays- Light Ellipse, Passage of Light Through a Crystal Plate-Retardation Plates, Stress-optic Law- Plane Polariscope- Jones Calculus
Circular Polariscope-Determination of Photoelastic Parameters at an Arbitrary Point- Tardy’s Method of Compensation-Calibration of Photo elastic Materials-Fringe Thinning Methodologies Photo elasticity Ordering Fringe in Miscellaneous-Tops in Transmission Photoelasticity


Strain Gauge Alloys, Carriers and Adhesives-Performance of Strain Gauge System-Strain Gauge Selection-Bonding of a Strain Gauge-Soldering, Accounting for Transverse Sensitivity Effects-Correction Factors for Special Applications-Special Gauges

REFERENCE BOOKS:

COURSE OUTCOMES:
- Understand stress strain analysis with its relation
- Recognize materials structure and testing methods

PRPE32 DESIGN OF AUTOMATED MANUFACTURING SYSTEM

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:
- To understand pneumatic, electric, hydraulic and electronic systems in automation of mechanical operations.
FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION: Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation.


PNEUMATIC CONTROL: Components, constructional details, filter, lubricator, regulator, constructional features, types of cylinders, control valves for direction, pressure and flow, air motors, air hydraulic equipments. PNEUMATIC CONTROL SYSTEM DESIGN: General approach to control system design, symbols and drawings, schematic layout, travel step diagram, circuit, control modes, program control, sequence control, cascade method, Karnaugh-Veitch mapping.


TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES:
- Knowledge of industrial automation by transfer lines and automated assembly lines.
- Understanding of automated controls using pneumatic and hydraulic systems
- Ability to understand electronic control systems in metal machining and other manufacturing processes.

PRPE33 DESIGN AND ANALYSIS OF EXPERIMENTS

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:
- To provide an introduction to fundamental concepts of statistical Process control
- To enhance student understanding of the complexities of Statistical Analysis and control chart interpretation


Factorial Experiments-Main and interaction effects –Two and three Factor full factorial Designs, $2^K$ deigns with Two and Three factors-Unreplicated design-Yate’s Algorithm

Special Experimental Designs: Blocking in factorial design, Confounding of $2^K$ design, nested design-Response Surface Methods.
Taguchi Techniques- Fundamentals of Taguchi methods, Quality Loss function, orthogonal designs, application to Process and Parameter design.

TEXT BOOKS:


REFERENCE BOOKS:


COURSE OUTCOMES:

- Create steps, need and terminology for experiments
- Know about factorial experiments and special experimental techniques
- Apply Taguchi techniques for various design problems

PRPE34 AGILE MANUFACTURING

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:

- To enable manufacturing enterprises to be competitive by dynamically reconfiguring software, equipment and organization structures.


Implementing technology to enhance agility- Implementing new technology – reasons – guidelines preparation for technology implementation - A checklist, technology applications that enhance agility - agile technology make-or-buy decisions.

Creating the learning factory: Imperative for success, factory becoming a learning factory, building a road map for becoming a learning factory - core capabilities, guiding vision, leadership that fits, ownership and commitment, pushing the envelope, prototypes, integration, learning challenges for learning manufacturing business.

TEXTBOOKS:


REFERENCE BOOKS:

COURSE OUTCOMES
- Understanding recent trends in manufacturing
- Customization of product for manufacturing
- Implementation of new technology

PRPE35 INTEGRATED MATERIALS MANAGEMENT

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:

- To study the fundamentals of Integrated Materials Management, Inventory Management, Material Handling and to ensure that continuity of supply of materials to the users is maintained by avoiding out of stock situation.


Material Handling: layout, selection of equipment, principles of materials handling – Packaging, types of material handling equipment

Introduction to Supply Chain Management – Understanding the supply chain – Supply chain performance – Supply chain Drivers and Obstacles – Supplier selection and Supplier evaluation

TEXTBOOKS:


REFERENCE BOOKS:


COURSE OUTCOMES:

- Understand various concepts and functions of material management
- Classification of inventory management
- Summarize Material handling and Logistic
COURSE OBJECTIVES:

- To introduce the fundamentals of Lean Manufacturing and Components for Lean including: Waste identification and elimination (value stream analysis), 5S, JIT, Kaizen and Poke Yoke.


Standard work -communication of standard work to employees-standard work and flexibility - visual controls-quality at the source- 5S principles -preventative maintenance-total quality management-total productive maintenance -changeover/setup time -batch size reduction -production levelling.

Value Stream Mapping-The as-is diagram-the future state map-application to the factory simulation scenario-line balancing -Poke Yoke – overall equipment effectiveness. One Piece Flow-Process razing techniques – cells for assembly line – case studies

Introduction - elements of JIT-uniform production rate - pull versus push method-Kanban system - small lot size - quick, inexpensive set-up - continuous improvement. Optimised production technology.


TEXTBOOKS:

REFERENCE BOOKS:


COURSE OUTCOMES:

- Identify the waste and how to eliminate those waste
- Know the recent trends of manufacturing like just in time (JIT) and Pull Push system
- Implementation of some modern tool like 5S, Poke-Yoke and Kaizen in an organization

PRPE37 TOTAL QUALITY MANAGEMENT

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:

- To facilitate understanding of Quality Management principles and tools.

Understanding quality, quality, competitiveness and customers, building quality chains, managing quality, quality in all functions, models and frame works for total quality management, Early TQM frameworks – quality award models – the four Ps and three Cs of TQM - a new model for TQM.

The TQM approach – commitment and policy – creating or changing the culture – effective leadership – excellence in leadership.

Design, innovation and improvement – the design process – quality function deployment (QFD) – the house of quality – specifications and standards - design in the service sectors – failure mode effect and criticality analysis (FMECA) – The links between good design and managing the business.


**REFERENCE BOOKS:**


**COURSE OUTCOMES:**

- Apply TQM principle for continuous process improvement
- Lead teams for quality production
- Utilization of modern tool like QFD, FMECA to design and manage the business.

**PRPE38 SUPPLY CHAIN MANAGEMENT**

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**PREREQUISITES:** Operations Research, Quality, Reliability & Safety Engineering

**COURSE OBJECTIVES:**

- To provide an insight on the fundamentals of supply chain strategy, logistics, sourcing and outsourcing supply chain networks, tools and techniques.


Supply chain configuration design - factors involved - sourcing, models for strategic alliances – supplier selection, outsourcing and procurement process – facility location and capacity allocation - modeling approaches LP, MILP - network design in uncertain environment – evaluation using simulation models.
Demand forecasting-collaborative forecasting models-bullwhip effect-information sharing - aggregate planning in supply chain- strategies-multi echelon inventory planning-models- discounting- risk pooling-centralized versus decentralized systems.

Roles of transportation-tradeoffs in transportation design-modes of transportation and their design - vehicle routing and scheduling - models - packaging-pricing and revenue management.


TEXTBOOKS:

REFERENCES:


COURSE OUTCOMES:
- Define structure of supply chain
- Design supply chain configuration
- Analyze the role of Transportation in SCM
OPEN ELECTIVE (OE)

PROE10 OPERATIONS MANAGEMENT

COURSE OBJECTIVES:

• To understand various components and functions of operation management such as Aggregate Planning, process planning, production scheduling, Assembly Line Balancing.


Measures of capacity, Factors affecting capacity, Capacity planning, Systematic approach to capacity planning, Long-term and short-term capacity decisions, Tools for capacity planning, Capacity Requirement planning- Business process outsourcing

Aggregate Planning strategies and methods-Pure and mixed strategies- Transportation method- LPP method

Master Production Schedule, MRP-Lot sizing methods - Wagner and whitens algorithm, MRP II, CRP

Assembly Line Balancing – algorithms, Group technology – Production Flow analysis – Rank order clustering, Business Process Reengineering-JIT

TEXTBOOKS:


REFERENCE BOOKS:


COURSE OUTCOMES

- Perform production management tasks.
- Describe the various components and functions of production planning and control such as capacity planning, aggregate planning, process planning, production scheduling, line balancing.
- Know the recent trends like manufacturing requirement Planning (MRP II) and Master production schedule (MPS)

PROE11 PROJECT MANAGEMENT

COURSE OBJECTIVES:

- To understand the concepts of project definition, life cycle, Market and demand analysis, Financial analysis and systems approach and to handle the complex tasks of time estimation and project scheduling, including PERT and CPM


Market and demand analysis- market survey-demand forecasting methods-
Technical analysis – manufacturing process, materials-product mix, plant location-
project charts and layouts.

Financial analysis – cash flows for project appraisal- Investment evaluation using capital budgeting techniques - net present value, profitability index internal rate of return, payback period, accounting rate of return

Mathematical Techniques for project evaluation – Linear programming, goal programming, Network technique for Project Management – CPM, PERT, Multiple projects and constraints, scheduling.

Organization systems for project implementation- Work Breakdown-coordination and control- Project Management Soft wares

TEXTBOOKS:
REFERENCE BOOKS:


COURSE OUTCOMES:

- Understand the Method for Project Identification & appriasial
- Develop & Analyze quantitative models for Project selection & Scheduling.

PROE12 VALUE ENGINEERING

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:

- To give a brief account of value analysis and engineering tool for productivity improvement and removing unnecessary cost through case studies

An Overview Of Value Engineering-Concepts and approaches of value analysis and engineering -importance of value, Function - identity, clarify – analysis

Evaluation of VE-Evaluation of function, Problem setting system, problem solving system, setting and solving management - decision - type and services problem, evaluation of value

Results accelerators, Basic steps in using the systems

Understanding the decision environment, Effect of value analysis on other work in the business- Life Cycle Cost (LCC), Case studies

VE Level Of Effort-VE Team, coordinator, designer, different services, definitions, construction management contracts, value engineering case studies, Effective
organization for value work, function analysis system techniques- FAST diagram, Case studies.

**TEXTBOOKS:**

**REFERENCE BOOKS:**

**COURSE OUTCOMES:**

- Understand the concept and approaches of value analysis and engineering
- Justify the value of money and value of product
- Implementation of Value Engineering in any type of organization

**PROE13 ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS**

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**COURSE OBJECTIVES:**

- To study the concepts of Artificial Intelligence
- To understand the methods of solving problems using Artificial Intelligence
- To learn about the components of decision support system and expert systems.

Aspects of intelligence and AI - heuristic search - logic programming and reasoning - automatic programming-scope of AI-in manufacturing - components of intelligent manufacturing-

Requirements of AI languages - Languages Lisp and Prolog - simple programs

Knowledge engineering- protocol analysis - fuzzy logic - Semantic networks, learning systems - inference engine

Vision programs - factory vision systems - machine learning

Features of Experts systems - applications in manufacturing planning and control.
TEXTBOOKS:


REFERENCE BOOKS:
2. Ernest R Tello, "Mastering AI tools and techniques"

COURSE OUTCOMES:

- Describe the basic concepts, Operations and Principles of Artificial Intelligence
- Recognize the basic concepts, Operations and Principles of Fuzzy Logic
- Employ the concept of AI & fuzzy logic in Manufacturing Environments

PROE14 PROCESSING AND MANUFACTURING OF SEMICONDUCTORS

COURSE OBJECTIVE:

- To learn what is semiconductor and its classification and also various models in fabrication and manufacturing techniques of semiconductor.

Introduction to semiconductors – Energy band theory – Classification – Intrinsic and extrinsic – P-type and N-type – P-N junction diode – semiconductor device design – photo-voltaic cells, bipolar and MOSFET transistor – applications


Processing sequence – Oxidation – Growth kinetics, thin oxide growth, oxide quality – photolithography – Exposure tools, pattern transfer, deep UV sub-micron, E-beam lithography, X-Ray lithography – Etching – Wet chemical and dry etching
Doping – diffusion, Ion implantation – Physical and chemical vapour deposition – Planarization – chemical mechanical planarization – chemical-mechanical polish (CMP) – maintenance and troubleshooting

Modern semiconductor manufacturing – Process integration – Bipolar technology, CMOS technology – CMOS fabrication sequence – BiCMOS technology – Packaging – Die separation, Package types, attachment methods

REFERENCES:


COURSE OUTCOME:

• To understand semiconductor and its types.
• To understand and apply various processing techniques to fabricate semiconductors.

PROE15- AUTOMOBILE COMPONENT MANUFACTURING PROCESSES

COURSE OBJECTIVE:

• To learn the basic processes available to make an automobile part/product. It will help the students to select the best manufacturing process based on quality/time/cost/ mechanical properties.


Casting: Casting of engine block - conventional and expendable pattern, Casting for cylinder heads, connecting rod and gudgeon pins, Casting of piston, upset forging of valves, piston ring manufacturing & Engine bearing manufacturing, Manufacturing of friction plates, Manufacture of composite friction lining, Casting of gear box casing,
precision forging of gears, Continuous casting of propeller shaft, Forging of rear axles, casting of rear axle casing, wheels, brake drum.

**Metal Forming:** Basic concepts and classification of forming processes. Thermoforming, hydro forming & press forming, welding of body panels, Rolling, Extrusion, Wire drawing, Spinning. Powder metallurgy, steps involved, applications.


**Recent advances** Application of sensors and actuators – Emission control system – catalytic converter – Hydro forming of exhaust manifold and lamp housing – stretch forming of Auto body panels – MMC liners – thermal barrier coating of Engine head and valves – Selection of materials for Auto components.

**REFERENCES:**


**COURSE OUTCOME:**

- Identify and select the methods of forging – for gudgeon pin, Crankshaft, connecting rod, camshaft, rocker arm, gears, shaft & axles, material suitability for above components, casting equipment’s, forging defects
- Select the non-conventional machining like EDM, ECM, ECG,USM,PAM,LBM for manufacturing automobile components
PROE16 LASER MATERIALS PROCESSING

COURSE OBJECTIVE:

- To study the different processes of laser methods and their characteristics.
- To know various surface treatment techniques to protect degradation and wear.


Introduction to laser welding - process arrangement - process mechanisms - operating characteristics - process variations - applications.

Introduction - methods of cutting - theoretical models of cutting - practical performance - applications - process variations - drilling - applications.

Laser marking- engraving-methods and processing-applications-laser cleaning-laser shock processing-laser peening-laser engineered net shaping

REFERENCES:

MINOR (MI)

PRMI10 MANUFACTURING PROCESSES

COURSE OBJECTIVES:
- To perform different machining operations like turning, drilling, milling and finishing.
- To predict tool life and tool failure

CASTING: Types of pattern - Types of cores - Green Sand Molding - Tools and equipment - Cupola and Blast Furnaces


MACHINE TOOL: Studies on Centre Lathe – Drilling – Milling– Shaper – Grinding

MACHINING: SPCT geometry – Orthogonal Cutting – Machining cylindrical Job – Gear Cutting –Taper turning and Thread Cutting Methods

TEXT BOOKS:


REFERENCES:

COURSE OUTCOMES:

- Summarize the theory of metal cutting and compute cutting forces involved from Mohr's circle.
- Recognize various parts of a lathe list the accessories and explain various operations performed.
- Explain the construction of drilling, boring, reaming and milling machines and explain operations performed.

PRM11 CAD, CAM and CAE (Theory & Lab)  

COURSE OBJECTIVES

- To understand geometric modeling and graphic standards of CAD systems
- To understand basics of CAM
- To understand finite element modeling and DBMS

Basic concepts of CAD, CAD workstation, CAD software, application of CAD, Interactive graphics: point plotting techniques, Transformations techniques, viewing operations.


Computer aided manufacturing: NC/CNC, computer aided process monitoring - adaptive control, computer-aided process planning.

Production planning - capacity planning - shop floor control - computer integrated manufacturing systems, application.

Finite element modeling and analysis: types of analysis, degrees of freedom, element and structure-stiffness equation, assembly procedure. Database concepts and data base management systems - SQL.

LAB EXERCISES: Part modelling using CAD, Turning operation using CNC, Engineering analysis using CAE
REFERENCE BOOKS:

COURSE OUTCOMES

- Summarize the concepts and applications of CAD and modelling
- CNC code generation for CNC Turning
- Finite element analysis using software

PRMI12 UNCONVENTIONAL MACHINING PROCESSES

COURSE OBJECTIVES:

- To understand several non-traditional machining process in micro and precision manufacturing field
- To select suitable machining process for materials considering their merits and demerits


Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

TEXT BOO KS:

REFERENCES:

COURSE OUTCOMES:
- Understand the contribution of non-traditional machining process in micro and precision manufacturing field.
- Select suitable machining process for suitable materials
- Summarizes the merits and demerits of then on-traditional manufacturing process

PRMI13 INDUSTRIAL ENGINEERING AND MANAGEMENT

COURSE OBJECTIVES:
- To understand the concepts of Industrial Engineering, Operational Research Techniques, Simulation, Supply Chain Management and Quality Engineering.

Introduction to Industrial Engineering – Method study, Time study, Motion Economy, Value Analysis, Demand Forecasting, Scheduling

Production Planning and Control - Inventory Control, Material Requirement Planning, Aggregate Planning, Material Handling, Group technology, Facility planning, Design of Product and Process Layouts.
Supply Chain Management - Understanding the Supply Chain, Achieving Strategic Fit, Drivers and Metrics, Designing the Supply Chain Network - Managing Cross Functional Drivers in a Supply Chain.

Operational Research Techniques – Linear Programming, Transportation, Assignment models, Queuing Theory, Simulation.

COURSE OUTCOMES:

- Summarize different techniques for production planning and control like inventory control and Material requirement.
- Apply optimization in utilization of resources like queuing uncertainty and mathematical modeling are involved
- Perform work measurements and computerized layout planning

REFERENCES


PRMI14 QUALITY ENGINEERING

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

PREREQUISITES: Probability and Statistical Methods

COURSE OBJECTIVES:

- To impart knowledge to enable the students to design and implement Statistical Process Control in any industry
- To design and implement acceptance sampling inspection methods in industry

QUALITY FUNDAMENTALS

CONTROL CHARTS FOR VARIABLES
Process variation- preliminary decisions- control limits and their computation-
construction and application of X bar, R and S charts- warning and modified control
limits- process adjustment for trend,- Comparison of process variation with
specification limits

STATISTICAL PROCESS CONTROL
Process stability- process capability study using control charts- capability
evaluation- Cp, Cpk and Cpm – machine capability study- gauge capability study-
setting statistical tolerances for components and assemblies - individual
measurement charts- X-chart, moving average and moving range chart.

CONTROL CHARTS FOR ATTRIBUTES
Limitations of variable control charts- Control charts for fraction non-conforming- p
and np charts, variable sample size, - Control chart for nonconformities (defects)- c,
u, demerits control chart- applications.

ACCEPTANCE SAMPLING
Need- economics of sampling- sampling procedure- single and double sampling-
O.C. curves-Average outgoing quality- Average sample number- Average total
inspection- Multiple and sequential sampling- Design of sampling plans.

COURSE OUTCOMES:
- Control the quality of processes using control charts for variables in
  manufacturing industries.
- Control the occurrence of defective product and the defects in manufacturing
  companies.
- Control the occurrence of defects in services.
- Achieve savings in rupees to the companies through quality control and
  improvement programmes.

TEXT BOOK:

REFERENCES:
2. Eugene L. Grant and Richard S. Leaven Worth, “Statistical Quality Control”, TMH,
3. Dale H. Besterfield, Quality Control, Pearson Education Asia, Seventh Edition,
   2004.
Essential programme laboratory Requirement (ELR)

PRLR10 MANUFACTURING PROCESSES LAB– I

PREREQUISITE COURSES: Branch specific course and Workshop practice

COURSE OBJECTIVES:
- To perform all lathe operations to produce a component of their need.

EXERCISE-1: Step turning
EXERCISE-2: Taper turning and parting off
EXERCISE-3: Knurling
EXERCISE-4: Thread cutting
EXERCISE-5: Boring
EXERCISE-6: Eccentric turning
EXERCISE-7: Copy turning

COURSE OUTCOMES:
- Summarize the machine tool construction.
- Create work pieces by turning, boring using lathe and drilling machine.
- Utilize different machine tool attachments

PRLR12 MANUFACTURING PROCESSES LAB– II

PREREQUISITE COURSES: Workshop practical and Metallurgy and Materials Engineering

COURSE OBJECTIVES:
- To perform various operations on special machines like milling machine, drilling machine, grinding machine and slotting machine.
EXERCISE-1: Shaping rectangular block or cube
EXERCISE-2: Slot cutting/ Step-cutting/ V-lock
EXERCISE-3: Milling rectangular block or cube
EXERCISE-4: T-Slot milling
EXERCISE-5: Spur gear cutting
EXERCISE-6: Surface grinding
EXERCISE-7: Single point tool grinding
EXERCISE-8: Spur and Helical gear generation on hobbing machine
EXERCISE-9: Complex shaped component production using EDM.
EXERCISE-10: Drilling

COURSE OUTCOMES:

- Hands on Experience on lathe machine, Milling machine, drilling machine
- Hands on experience on casting methods.
- Hands on experience on welding

PRLR13 WELDABILITY AND FORMABILITY TESTING LAB

PREREQUISITE COURSES: Metallurgy and Materials Engineering

COURSE OBJECTIVES:

- To weld materials effectively and evaluate weldment properties

LAB EXERCISES
1. Arc butt welding of mild steel
2. Arc lap welding of mild steel
3. Macrostructure and microstructure evaluation of nugget zone
4. Bending testing on welded plates.
5. Hardness test on weldments
COURSE OUTCOMES:
- Application of welding knowledge to fabricate sound parts
- Application of testing knowledge to evaluate the quality of weldments.

FORMABILITY TESTING LAB

PREREQUISITE COURSES: Metallurgy and Materials Engineering

COURSE OBJECTIVES:
- To test the formability of sheet metals

LAB EXERCISES
1. Tensile testing
2. Three point bend test
3. Deep drawing test

COURSE OUTCOME:
- Able to test sheet metals and evaluate their properties

PRLR14 MACHINE DRAWING PRACTICE

PREREQUISITES: Engineering Graphics

COURSE OBJECTIVES
- To prepare the precise machine drawings for manufacture of components.
- To facilitate better product design.
- To interpret and generate suggestions about drawings.

Conventions, Abbreviations and symbols: Conventional representations of interrupted views, symmetrical objects, intersection curves, square ends and openings, adjacent parts,

Common machine elements, springs, gear drives—Abbreviations, designation and composition of ferrous materials, nonferrous materials and engineering drawing.

Limits, Fits and Tolerances, tolerance grades, fundamental deviation, indication of tolerances- classification, system, selection and indication of fits, geometrical tolerances, surface texture.

Screw threads and threaded fasteners, types of bolts and nuts, locking pins, screws.
Rivetjoints, Keys and welded joints.
Assembly Drawing: Cotter and pin joints, couplings, clutches, pulleys and pipe joints.

Assembly Drawing: Bearings, heat engine parts, valves, pumps and machine parts.

TEXTBOOK:

REFERENCES:

COURSE OUTCOMES:
- Prepare the precise machine drawings for manufacturing of components.
- Facilitate better product design.
- Interpret and give suggestions about the drawings.

PRLR15 PRODUCTION DRAWING AND COST ESTIMATION

L T P C
1 0 2 2

PREREQUISITES: Machine Drawing, Design of machine elements

COURSE OBJECTIVES
- To understand the fundamentals of manufacturing drawings
- To develop process sheets and production drawing for various assemblies
- To perform cost and time estimation

Review of Current international standards (ISO) and Indian Standards (IS) - Geometric Dimensioning and Tolerancing-Centrality Analysis-Compound Assembly.


Re-dimensioning and Tolerance Charting: Introduction to re-dimensioning to suit manufacturing requirements-manufacturing datum-functional datum. Introduction to tolerance charting

TEXTBOOK:
1.IS :10714,10715,10716,10717,11669,10719,813,919,2709,8000 pt 1 to 10721,11158 and AWS/ISO

REFERENCES:

COURSE OUTCOMES:
- Interpretation of contents of production drawing
- Development of process sheet and manufacturing drawings
- Systematic estimation of cost and time
Advanced level courses for B.Tech (HONORS)

PRHO10 TOLERANCE TECHNOLOGY

(Use of approved design data book is permitted in the examination)

PREREQUISITE COURSE: Machine drawing practice

COURSE OBJECTIVE:
- To recognize the importance of tolerances
- To perform tolerance analysis

Introduction to Geometric Dimensioning and Tolerancing, Scope, Definitions, and General Dimensioning, General Tolerancing and Related Principles, Symbology, Datum Referencing, Tolerances of Location, Tolerances of Form, Profile, Orientation, and Runout

Properties of the surface, Principles for tolerancing, Principles for geometrical tolerancing. Profile tolerancing, Tolerancing of cones, Positional tolerancing, Projected tolerance zone, Substitute elements, Maximum material requirement, Envelope requirement, Least material requirement.

Tolerancing of flexible parts, Tolerance chains (accumulation of tolerances), Statistical tolerancing.

General geometrical tolerances, Tolerancing principles, Tolerancing of edges, ISO Geometrical Product Specifications (GPS).

REFERENCES:

COURSE OUTCOMES:
- Interpretation of tolerances
- Perform tolerance analysis
PRHO11 ROBOTICS

PREREQUISITE COURSE: Computer Integrated Manufacturing

COURSE OBJECTIVE:
- To understand the fundamentals of robotics
- To perform robot programming

Fundamentals of robotics—wrists design -end effectors – actuators - modular robots.

Robot and its peripherals-sensors, machine vision-image processing & analysis-
application of artificial intelligence, voice communication-robot control units-motion controls.

Robot kinematics-homogeneous transformations-forward & inverse kinematics-
problems of dynamics-differential relationships-motion trajectories-dynamics of a
robot control of single multiple link robot-static force analysis.

Robot Programming -different languages-expert systems.

Robot applications in manufacturing-material transfer& machine loading/unloading-
processing operations—inspection-automation-robot cell design—control—recent
developments and special applications-Micro &Bio robotics.

REFERENCES:

COURSE OUTCOMES:
- Demonstration of knowledge in robotic engineering
- Develop programming for robot applications

---

PRHO12 INTELLIGENT MANUFACTURING SYSTEMS

PREREQUISITE COURSE: Mechatronics and Industrial automation

COURSE OBJECTIVE:
- To understand the basic concepts of intelligent manufacturing
- To develop knowledge base systems for various applications
Basic concepts of Artificial intelligence and expert systems-System Components-
System architecture and Data flow– System Operations
Knowledge based systems-knowledge representation– knowledge acquisition and
optimization-Knowledge based approaches to design mechanical parts and
mechanisms and design for automated assembly
Knowledge based system for material selection–Intelligent process
planning system.
Intelligent system for equipment selection-Intelligent system for project
management& factory monitoring. Scheduling in manufacturing–scheduling the
shopfloor–Diagnosis& trouble shooting
The role of Artificial Intelligence in the factory of the future–Intelligent
systems.

REFERENCES:

COURSE OUTCOMES:
• Development of knowledge based systems
• Application of Artificial Intelligence for future automated factories.

PRHO13 TOTAL QUALITYENGINEERING

PREREQUISITE COURSE: Quality, Reliability and Safety Engineering

COURSE OBJECTIVES:
• To study the quality control tools and ISO Standards
• To understand TQM applications in service sector

Principles of TQM–Quality Gurus and their contributions—Old and New Quality
Control tools-Quality Function Deployment–Failure Modes and Effect Analysis–
Vendor relations—vendor qualification process—vendor quality surveys—Vendor
quality improvement—vendor quality rating and evaluation-ISO9000 standards–
Sigma–Benchmarking-TQM in Service Sector–Application case studies on TQM.

REFERENCES:
1. DaleH.Besterfield,“TotalQualityManagement”,PearsonEducationAsia,(Indianr
eprint 2002)

COURSE OUTCOMES:
- Apply TQM principle for continuous process improvement
- Lead teams for quality production
- Utilization of modern tool like QFD, FMECA to design and manage the business

PRHO14 PRODUCT ANALYSIS AND COST OPTIMIZATION

PREREQUISITE COURSE: Production drawing and cost estimation

COURSE OBJECTIVES:
- To perform value engineering projects
- To perform cost accounting


Job plan information phase-speculation phase-analysis phase-development phase-presentation phase-implementation phase-follow up phase- fast diagramming-cost models- lifecycle costs.

Cost accounting-cost estimation

Cost calculations for machined components, welding, casting and forging components- calculation of selling price – activity based cost analysis.

REFERENCES:

COURSE OUTCOMES:
- Execute value engineering projects
- Cost computation for various fabricated products
PRHO15 DECISION SUPPORT SYSTEMS

PREREQUISITE COURSE: Work Design and Facilities planning

COURSE OBJECTIVES:
- To introduce decision support systems and show their relationship to other computer-based information systems,
- To demonstrates development approaches, and to utilize DSS capacities to support different types of decisions

DSS components- Data warehousing, access, analysis, mining and visualization-modelling and analysis-DSS development -Group support systems- enterprise DSS-supply chain and DSS-knowledge management methods, technologies and tools- Artificial intelligence and expert systems- Representation in logic and schemas, semantic networks, production rules and frames, inference techniques – DSS applications.

REFERENCES:

COURSE OUTCOMES:
- Recognize the importance of decisions in the work and use DSS Software Tools.
- Evaluation of the Success/Failure of Decision Support Systems
- Discuss the advantages/disadvantages of different Types of decision support systems and analyze practical cases from the life for different problems (technical, management)

PRHO16 KNOWLEDGE MANAGEMENT

PREREQUISITE COURSE: Work Design and Facilities planning

COURSE OBJECTIVE:
- To understand the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.

REFERENCES:

COURSE OUTCOMES:
- Appreciate the role and use of knowledge in organizations and institutions, and the typical obstacles that Knowledge Management aims to overcome.
- Understandthe core concepts, methods, techniques, and tools for computersupp ort of knowledge management.
- Understand how to apply and integrate appropriate components and functions of various knowledge management systems.

PRHO17 PRODUCT LIFECYCLE MANAGEMENT

COURSE OBJECTIVE:
- To understand product lifecycle management strategies
- To recognize PLM integration with other functions


REFERENCES:

COURSE OUTCOMES:
- Understand PLM applications
- Develop product data management tools
PRHO18 TECHNOLOGY MANAGEMENT

PREREQUISITE COURSE: Operations Research

COURSE OBJECTIVE:
- To understand technology development process
- To recognize technology management issues in the context of advanced manufacturing systems


REFERENCES:

COURSE OUTCOMES:
- Develop an awareness of the range, scope, and complexity of technological innovation, and the issues related to managing technological change.
- Understand different approaches to manage innovation, with multi-criteria decision making techniques
- Clearly identify drivers and barriers to technological innovation within an organization.

PRHO19 MULTI-CRITERIA DECISION MAKING TECHNIQUES

PREREQUISITE COURSE: Operations Research

COURSE OBJECTIVE:
- To recognize the need for Multi-criteria decision making
- To understand various MCDM methods


REFERENCES:

COURSE OUTCOMES:
- Understanding of various MCDM methods
- Apply MCDM methods for real time applications