Bansilal Ramnath Agarwal Charitable Trust’s
Vishwakarma Institute of Technology, Pune – 411 037
Department of Industrial & Production Engineering

Bansilal Ramnath Agarwal Charitable Trust’s
Vishwakarma Institute of Technology
(An Autonomous Institute affiliated to University of Pune)

Structure & Syllabus of
B.Tech. (Production Engineering)

Pattern ‘F-11’
Effective from Academic Year 2014-15

Prepared by: - Board of Studies in Industrial & Production Engineering
Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune
Signed by

Chairman – BOS       Chairman – Academic Board
## Contents

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Program Educational Objectives of B. Tech. (Production Engineering)</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Course Structure &amp; Syllabi for Courses - Module I &amp; Module II</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Course Structure - Module III</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Course Syllabi for Courses - Module III</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>4.1 IP20151 Manufacturing Processes (Theory Course)</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>4.2 IP21155 Theory of Machines (Theory Course)</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>4.3 IP20153 Material Science (Theory Course)</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>4.4 IP21161 Analysis of Machine Elements (Theory Course)</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>4.5 IP26101 Electrical &amp; Electronics Engineering (Theory Course)</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>4.6 IP20351 Manufacturing Practices 1 (Workshop) (Laboratory Course)</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>4.7 IP21355 Theory of Machines (Laboratory Course)</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>4.8 IP20353 Material Science (Laboratory Course)</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>4.9 IP24351 Machine Drawing &amp; GDT (Skills Development Course)</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>4.10 IP27451 Mini Project</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>4.11 IP20451 $ Comprehensive Viva Voce (Based on IP20351, IP21355, IP20353)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>4.12 HS20108 Technical Writing (Communication Skills)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>4.13 @General Proficiency</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Course Structure - Module IV</td>
<td>28</td>
</tr>
<tr>
<td>6</td>
<td>Course Syllabi for courses - Module IV</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>6.1 IP20154 Metal Cutting, Finishing &amp; NCM Processes (Theory Course)</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>6.2 IP21154 Thermal &amp; Fluid Energy Conversion (Theory Course)</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>6.3 IP20158 Engineering Metrology (Theory Course)</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>6.4 IP21152 Mathematics for Engineering Applications (Theory Course)</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>6.5 IP26102 Mechanical Measurements (Theory Course)</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>6.6 IP20354 Manufacturing Practices 2 (Workshop) (Laboratory Course)</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>6.7 IP21354 Thermal &amp; Fluid Energy Conversion (Laboratory Course)</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>6.8 IP20358 Engineering Metrology (Laboratory Course)</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>6.9 IP24352 Computer Graphics (Skills Development Course)</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>6.10 IP27452 Mini Project</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>6.11 IP20452 $ Comprehensive Viva Voce (Based on IP20354,IP21354,IP20358)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>6.12 HS27302 General Seminar - II</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>6.13 @General Proficiency</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Course Structure - Module V</td>
<td>50</td>
</tr>
<tr>
<td>8</td>
<td>Course Syllabi for courses - Module V</td>
<td>51</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Course Type</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>8.1 IP30161</td>
<td>Statistical Methods &amp; Research Methodology</td>
<td>Theory Course</td>
</tr>
<tr>
<td>8.2 IP31161</td>
<td>Design of Machine Elements</td>
<td>Theory Course</td>
</tr>
<tr>
<td>8.3 IP30171</td>
<td>Metal Cutting &amp; Tool Design</td>
<td>Theory Course</td>
</tr>
<tr>
<td>8.4 IP30157</td>
<td>Quality Management</td>
<td>Theory Course</td>
</tr>
<tr>
<td>8.5 IP30163</td>
<td>Production Planning &amp; Control</td>
<td>Theory Course</td>
</tr>
<tr>
<td>8.6 IP30361</td>
<td>Statistical Methods &amp; Research Methodology</td>
<td>Laboratory Course</td>
</tr>
<tr>
<td>8.7 IP31361</td>
<td>Design of Machine Elements</td>
<td>Laboratory Course</td>
</tr>
<tr>
<td>8.8 IP30371</td>
<td>Metal Cutting &amp; Tool Design</td>
<td>Laboratory Course</td>
</tr>
<tr>
<td>8.9 IP30451</td>
<td>Comprehensive Viva Voce</td>
<td>Theory Course</td>
</tr>
<tr>
<td>8.10 IP37351</td>
<td>Seminar</td>
<td>Theory Course</td>
</tr>
<tr>
<td>8.11 IP37451</td>
<td>Mini Project</td>
<td>Theory Course</td>
</tr>
<tr>
<td>9 Course Structure - Module VI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Course Syllabi for courses - Module VI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.1 IP30156</td>
<td>Production Metallurgy</td>
<td>Theory Course</td>
</tr>
<tr>
<td>10.2 IP30158</td>
<td>Industrial Fluid Power</td>
<td>Theory Course</td>
</tr>
<tr>
<td>10.3 IP30160</td>
<td>Work Study &amp; Ergonomics</td>
<td>Theory Course</td>
</tr>
<tr>
<td>10.4 IP30162</td>
<td>Material Forming</td>
<td>Theory Course</td>
</tr>
<tr>
<td>10.5 IP30164</td>
<td>Design for Manufacturing</td>
<td>Theory Course</td>
</tr>
<tr>
<td>10.6 IP30356</td>
<td>Production Metallurgy</td>
<td>Laboratory Course</td>
</tr>
<tr>
<td>10.7 IP30358</td>
<td>Industrial Fluid Power</td>
<td>Laboratory Course</td>
</tr>
<tr>
<td>10.8 IP30360</td>
<td>Work Study &amp; Ergonomics</td>
<td>Laboratory Course</td>
</tr>
<tr>
<td>10.9 IP30452</td>
<td>Comprehensive Viva Voce</td>
<td>Theory Course</td>
</tr>
<tr>
<td>10.10 IP37352</td>
<td>Major Project</td>
<td>Theory Course</td>
</tr>
<tr>
<td>11 Course Structure - Module VII</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Course Syllabi for courses - Module VII</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.1</td>
<td>*Elective Group A (Theory Course)</td>
<td></td>
</tr>
<tr>
<td>IP42151</td>
<td>Materials &amp; Operations Management</td>
<td>92</td>
</tr>
<tr>
<td>IP42153</td>
<td>Finite Element Method &amp; CAD</td>
<td>95</td>
</tr>
<tr>
<td>IP42171</td>
<td>Industrial Robotics</td>
<td>99</td>
</tr>
<tr>
<td>12.2</td>
<td>*Elective Group B (Theory Course)</td>
<td></td>
</tr>
<tr>
<td>IP42159</td>
<td>Logistics &amp; Supply Chain Management</td>
<td>102</td>
</tr>
<tr>
<td>IP42161</td>
<td>Plant Engineering</td>
<td>105</td>
</tr>
<tr>
<td>IP42167</td>
<td>Modern Manufacturing Processes</td>
<td>108</td>
</tr>
<tr>
<td>12.3 IP40163</td>
<td>Machine Tool Design</td>
<td>Theory Course</td>
</tr>
<tr>
<td>12.4 IP40165</td>
<td>Manufacturing Systems</td>
<td>Theory Course</td>
</tr>
<tr>
<td>12.5 IP40363</td>
<td>Machine Tool Design</td>
<td>Laboratory Course</td>
</tr>
<tr>
<td>12.6 IP40365</td>
<td>Manufacturing Systems</td>
<td>Laboratory Course</td>
</tr>
<tr>
<td>12.7 IP47351</td>
<td>Major Project</td>
<td>Theory Course</td>
</tr>
</tbody>
</table>
### Course Structure - Module VIII

<table>
<thead>
<tr>
<th>14</th>
<th>Course Syllabi for courses - Module VIII</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.1</td>
<td><em>Elective Group A (Theory Course)</em></td>
</tr>
<tr>
<td>IP42152</td>
<td>Financial Management &amp; Costing</td>
</tr>
<tr>
<td>IP42154</td>
<td>Reliability Engineering</td>
</tr>
<tr>
<td>IP42156</td>
<td>World Class Manufacturing</td>
</tr>
<tr>
<td>IP42174</td>
<td>Tribology</td>
</tr>
</tbody>
</table>

| 14.2 | *Elective Group B (Theory Course)* |
| IP42158 | Operations Research |
| IP42160 | Surface Engineering |
| IP42162 | Product Design & New Product Development |
| IP42164 | Entrepreneurship Development |
| IP42176 | Powder Metallurgy |

| 14.3 | IP40172 | Die & Mould Technology (Theory Course) |
| 14.4 | IP40168 | Process Engineering (Theory Course) |
| 14.5 | IP40372 | Die & Mould Technology (Laboratory Course) |
| 14.6 | IP40368 | Process Engineering (Laboratory Course) |
| 14.7 | IP47352 | $ Major Project |

$ Please Refer Academic Information Booklet
! Please Refer F. Y. B. TECH. Structure & Syllabi Booklet
@ Please Refer GP-PD-OE Structure & Syllabi Booklet
# Program Educational Objectives (PEO) for B. Tech. (Production Engineering) Program

<table>
<thead>
<tr>
<th>PEO No.</th>
<th>Description of the Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Preparation:</strong> To prepare students to excel in postgraduate programmes / be successful in industry / technical profession.</td>
</tr>
<tr>
<td>II</td>
<td><strong>Core Competence:</strong> To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies.</td>
</tr>
<tr>
<td>III</td>
<td><strong>Breadth:</strong> To train students with good scientific and engineering breadth so as to comprehend, analyze, design, and create novel products and solutions for the real life problems.</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Professionalism:</strong> To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context.</td>
</tr>
<tr>
<td>V</td>
<td><strong>Learning Environment:</strong> To provide student with an academic environment aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career.</td>
</tr>
</tbody>
</table>

## 2. Program and Course Outcomes,

### Programme Outcomes:
- a. Graduates will demonstrate basic knowledge in mathematics, science and engineering.
- b. Graduate will be familiar with different manufacturing processes.
- c. Graduate will be familiar with different materials used in manufacturing.
- d. Graduates will demonstrate an ability to design simple mechanical components.
- e. Graduates will be familiar with industry and organizational management.
- f. Graduates will have the confidence to apply engineering solutions in global and societal contexts.
- g. Graduates will demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results.
- h. Graduates will demonstrate the ability to design a process that meets desired specifications and requirements.
- i. Graduate will demonstrate skills to use modern engineering tools, software and equipment to analyze problems.
- j. Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
- k. Graduates will be familiar with safety, product quality aspects and quality control.
- l. Graduates will be able to communicate effectively in both verbal and written forms.
- m. Graduate who can participate and succeed in competitive examinations like GATE, GRE.

### Under Graduate Program in Industrial Engineering
- p. Graduates will demonstrate the ability to identify, formulate and solve problems in materials and metal forming.
- q. Graduate will be familiar with advanced trends in manufacturing.
- r. Graduate will be familiar with machine design and tool design.
<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Lecture</th>
<th>Tutorial</th>
<th>Practical</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>S₁</td>
<td>IP20151</td>
<td>Manufacturing Processes</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>S₂</td>
<td>IP21155</td>
<td>Theory of Machines</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>S₃</td>
<td>IP20153</td>
<td>Material Science</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>S₄</td>
<td>IP21161</td>
<td>Analysis of Machine Elements</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>S₅</td>
<td>IP26101</td>
<td>Electrical &amp; Electronics Engineering</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>P₁</td>
<td>IP20351</td>
<td>Manufacturing Practices 1 (Workshop)</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>P₂</td>
<td>IP21355</td>
<td>Theory of Machines</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>P₃</td>
<td>IP20353</td>
<td>Material Science</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>SD₃</td>
<td>IP24351</td>
<td>Machine Drawing &amp; GDT</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>MP₃</td>
<td>IP27451</td>
<td>Mini Project.</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>CVV₁</td>
<td>IP20451</td>
<td>Comprehensive Viva Voce</td>
<td>Based on Courses P₁, P₂, P₃</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OE3</td>
<td>HS20108</td>
<td>Technical Writing</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>GP</td>
<td></td>
<td>General Proficiency</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

|               |               | Total                             | 14   | 2       | 14       | 26     |
IP20151: MANUFACTURING PROCESSES

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II (b)

Unit I

Casting I

A. Introduction of casting process, casting manufacturing steps, applications and advantages of castings,
Patterns: Pattern materials, allowances, types of pattern, pattern design
Sand Casting: Green and dry sand casting process, types of sand, molding sand and its properties, molding sand composition.
Classification of molding sands, core sands, molding and core additives, Cores- Functions of cores, Core making procedure, core prints, chaplets, types of Cores
Special casting Processes: Pressure and gravity Die Casting, centrifugal casting, continuous casting, investment casting, their typical applications, merits and limitations.

B. Types of foundries, Foundry mechanization and automation, Sand preparation and sand reclamation, types of core boxes

Unit II

Casting II

A. Types of molds: Green sand, dry sand mould, shell mold, plaster mould, CO2 moulds.
Hand moulding equipment, mould ramming methods, steps involved in making a mould, forces on cores and moulds.
Melting & Pouring of Metals - Solidification of casting, Progressive and directional solidification, Gating and Risering System: Elements of gating systems, types of gates, Riser design considerations
Shakeout, Cleaning & finishing of castings, Testing and inspection of castings and casting defects

B. Melting Furnaces-types, Cupola, Induction- furnace construction, operation, zones and chemistry, Moulding Methods: bench, floor, pit and Machine moulding
Unit III  
Joining Processes I  
(8 Hrs)

A. Gas Welding – processes and equipment used, types of flame, gas welding technique adjustment of flame, oxy Acetylene welding, gas cutting – merits, limitations and applications of above processes  
Brazing, braze welding and soldering processes, merits, limitations and applications of above processes.  
Fusion welding processes : Arc welding processes-Carbon arc, submerged arc, tungsten inert Gas (TIG), metal inert gas (MIG), Electro slag, plasma arc & stud welding process- theory, comparison on merits, limitations and applications  
B. Filler metals & fluxes used Electrodes and Fluxes used in arc welding

Unit IV  
Joining Processes II  
(8 Hrs)

A. Thermit welding, Laser welding, Electron beam welding.  
Solid state welding processes: Electric resistance welding - processes and equipment used, spot, seam, projection, Butt, Percussion welding. Merits, limitations and applications.  
Cold welding, Ultrasonic welding, friction welding and Inertia welding, Explosion Welding, Friction stir welding  
Adhesive bonding and Mechanical Fastening processes  
B. Resistance tube welding, Diffusion welding, Welding defects and Remedies

Unit V  
Processes related to Plastics, Rubber, Ceramic & Composites  
(8 Hrs)

A. Processing of Plastics : Introduction and typical applications of the commonly used plastic parts manufacturing processes such as extrusion, injection molding, blow molding, rotational molding, compression molding, transfer molding etc  
Rubber processing and shaping, manufacturing of rubber products  
Shaping of ceramics and composites: Fabrication, machining and joining of ceramics and composites  
Advanced Manufacturing Processes: Introduction of Free form fabrication (rapid prototyping) and net shape manufacturing processes  
B. Plastic part manufacturing - structural foam molding, thermoforming

Text Books:
1. D.K. Singh, Manufacturing Technology, 2/e, Pearson Education  
3. Foundry Technology by O.P. Khanna
4. Principles of Metal Casting by P.L. Jain

**Reference Books:**
2. Little, Welding and Welding Technology, Tata McGraw Hill
3. R. S. Parmar, Welding and Welding Processes, Khanna Publication
4. Welding Technology by O.P. Kahanna
7. Serope Kalpakjian, Steven R. Schmid, Manufacturing Processes for Engineering Materials, 5/e (New editions), Pearson Education
IP21155 :: THEORY OF MACHINES

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II (a,r)

Unit I (8 Hrs)
Kinematic Analysis of Mechanisms: (Velocity and Acceleration Analysis)

A. Introduction, Motion of a link, velocity of a point on a link by Relative velocity method, velocity in a slider crank mechanism, introduction, acceleration diagram for a link, acceleration of a point on a link by Relative velocity method, acceleration in a slider crank mechanism, Klein’s construction

B. Approximate analytical method for velocity & acceleration of piston.

Unit II (8 Hrs)
Governors

A. Introduction, Function, types of governor, centrifugal governor, terms used in governor, different types of centrifugal governors - Watt, Porter, Proell & Hartnell, sensitivities of governor, stability of governor, isochronous of governor, hunting, effort and power of governor

B. Hartung governor, Pickering governor

Unit III (8 Hrs)
Cams and Followers

A. Introduction, applications, types of cams and followers, terms used in radial cams, analysis of motion of follower, displacement, velocity, and acceleration diagrams for various types of follower motions: uniform velocity, SHM, uniform acceleration and retardation, cycloidal motion, construction of cam profile for roller, knife edge and flat faced followers. Construction of cam profile for oscillating follower.

B. Introduction to Belt drives, types of belts, types of flat belt drive.
Unit IV
Spur Gear

A. Advantages and disadvantages of gear drive, Classification of Toothed wheel, Terms used in gears, Involute and Cycloidal profile, condition for constant velocity ratio-law of gearing, Length of path of contact, Length of arc of contact, interference in involute gears, minimum number of teeth on the pinion in order to avoid interference, minimum number of teeth on the wheel in order to avoid interference.

B. Types of Gear Trains- Simple Gear Trains, Compound Gear Trains, Reverted Gear Trains, Epicyclic Gear Trains

Unit V
Introduction to Simple Mechanisms

A. Kinematic link, types of link, machine, structure, types of constrained motion, kinematic pair, classification of kinematic pairs, degrees of freedom, kinematic chain, mechanism, inversion , four bar chain and its inversion, single slider crank chain and its inversion and double slider crank chain and its inversions.

B. Steering mechanism - Ackerman steering mechanism, Davis steering mechanism, Hookes joint

Text Books:
3. Theory of Machines and Mechanisms, Ballaney P. L., Khanna Publisher Delhi, 1999,

Reference Books :
IP20153 :: MATERIAL SCIENCE

Credits: 03
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Selection of appropriate materials for various types of products
- Mapping with PEOs: I, II, III (c, p)

Unit I
Plastic Deformation
(6 Hrs)
B. Classification of Engineering Materials. Important properties of each group & some typical applications of each group.

Unit II
Material Testing
(8 Hrs)
Non-destructive tests - Visual Inspection, Magna flux test Dye penetrant test, Sonic and Ultrasonic test, Radiography.
B. Examples of selection of NDT & mechanical testing methods for selected components like crankshafts, gears, razor blades, welded joints, steel and cast iron castings, rolled products, forged products.

Unit III
(8 Hrs)
Equilibrium diagrams and Pyrometry


B. Practice of numerical based on equilibrium diagrams

Unit IV
(8 Hrs)

Strengthening Mechanisms and Powder Metallurgy

A. Strengthening Mechanisms: Refinement of grain size, Solid solution hardening, Dispersion hardening, Age hardening, Martensitic transformation, Composite materials etc.

Powder Metallurgy: Process in brief, powder characteristics, powder manufacturing, Production of sintered structural components such as self lubricated bearing, cemented carbide tools.

B. Production of cermets, refractory metals, electrical contact materials, friction materials, Diamond impregnated tools etc

Unit V
(8 Hrs)

Methods of Surface Improvements and Corrosion Prevention

A. Corrosion Prevention Methods: Design and material selection, atmosphere control, electroplating, Inhibitors, Cathodic and anodic protection, Coatings etc. Surface Modification Techniques such as Electro deposition (Conventional electroplating, Electroless plating, Anodising), Diffusion coatings (Plasma nitriding, Aluminizing, Boronising, Chromizing), Vapour deposition (conventional PVD and CVD, Diamond like coating, Electron beam PVD), Thermal Spray Coatings, Ion implantation etc.

B. Corrosion prevention of some typical engineering components. Preparation of substrate for surface engineering.

Text Books:
Reference Books:
5. Structure and properties of materials II, Willey Eastern (P) Ltd.
IP21161 :: ANALYSIS OF MACHINE ELEMENTS

Credits: 04  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites:
Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Mapping with PEOs: I, II, III (a,j,d,r)

Unit I (8 Hrs)
Simple Stresses and Strains; Principal Stresses and Strains

A. Concept of stress and strain (Linear, lateral, shear and volumetric) Hooke’s law. Poissons ratio, modulus of elasticity, modulus of rigidity, stress-strain diagrams for ductile and brittle materials, factor of safety, working stress, generalized Hooke’s law, bulk modulus, interrelation between elastic constants.
Elementary Treatment of Axial force diagram, stresses, strains and deformations in determinate, homogeneous and composite bars under concentrated loads.
Normal and Shear Stresses on any oblique plane; Concept of principal planes; Derivation of expressions for principal stresses and maximum shear stress, position of principal planes and planes of maximum shear, combined effect of axial force, bending and torsion.
B. Derivations of Various Formulae; Graphical solution using Mohr’s circle of stresses

Unit II (8 Hrs)
Pure Bending & Axially Loaded Columns

Elementary Treatment of Concept of buckling of columns. Derivation of Euler’s formula for buckling load for column with hinged ends. Concept of equivalent length for various end conditions. Limitations of Euler’s formula. Rankine’s formula;
B. Derivations of Various Formulae, Safe Load on Columns

Unit III (8 Hrs)
Shear Force and Bending Moment Diagrams
A. Elementary Treatment of Shear force and bending moment in determinate beams due to concentrated loads, uniformly distributed loads, uniformly varying loads and couples. Relation between SF and BM diagrams for cantilevers, simple and compound, cantilever beams. Construction of loading diagram and BMD from SFD and construction of loading diagram and SFD from BMD.

B. Derivations of Various Formulae, Bending of curved bars/beams (Winkler & Bach Theory) Stresses in ring, chain link and crane hooks.

**Unit IV**

*(8 Hrs)*

**Shear stresses & Deflection of Beams**

A. Elementary Treatment of Shear Stress: Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common symmetrical sections, maximum and average shear stress, shear connection between flange and web. Deflection of beam – Derivation of equation of elastic curve. Double integration method (McCauley’s method) for simply supported beams

B. Double integration method (McCauley’s method) for cantilever beams

**Unit V**

*(8 Hrs)*

**Torsion of Shafts & Thin Cylinders**

A. Pure Torsion – Theory of pure torsion with assumptions, Deformation in circular shaft, polar moment of inertia, elastic torsion formula, Torsional failure, Stresses in thin walled pressure vessels, Cylindrical pressure vessels, Spherical pressure vessels. Mohrs circle for thin walled pressure vessels

B. Thick walled pressure vessels

**Text Books**

2. Timoshenko and Young – Strength of Materials, CBS Publisher

**Reference Books**

1. U.C. Jindal, Design of Machine Elements, Pearson Education
IP21161 :: ANALYSIS OF MACHINE ELEMENTS

Teaching Scheme: - - Tutorial 1 Hr/Week

Prerequisites: : Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the Strength of Materials
- Develop conceptual framework of the course
- Mapping with PEOs: I, II (d,r)

List of Contents
Problem & Numerical solving and sketching figures for :
1. Simple Stresses and Strains
2. Principal Stresses and Strains
3. Slope and Deflection of Beams
4. Axially Loaded Columns
5. Second moment of area
6. Pure bending
7. Shear Force and Bending Moment Diagrams; Shear stresses
8. Shear stress in Beams
9. McCaulay’s Method for deflection of Beams
10. Torsion in shafts
11. Thin cylinders
12. Mohr’s Circle

Text Books :
1. Timoshenko and Young – Strength of Materials, CBS Publisher

Reference Books :
3. Mechanical Engineering Design- J.E. Shigley
IP26101 :: ELECTRICAL & ELECTRONICS ENGINEERING

Credits: 03
Teaching Scheme: - Theory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the Strength of Materials
- Develop conceptual framework of the course
- Mapping with PEOs: I, II, III (a,j,d,r)

Unit I (8 Hrs)
DC Motors
A) Construction, working principle, types of DC motors, Equations, Characteristics.
B) DC servo motors

Unit II (8 Hrs)
Three Phase Induction Motor
A) Construction, working principle, Torque equation, T-Slip Characteristic, types.
B) AC servo motors

Unit III (8 Hrs)
Selection of Motors and Drives
A) Starting/ methods of speed control, applications of DC motors, Starting/ methods of speed control, applications of 3-ph Induction motors, Drives for DC motors, Drives of Induction motors, Application and working of stepper motors, Selection of motors.
B) 3-point and 4-point starters for dc motors.

Unit IV (8 Hrs)
Switchgear and Automation
A) Switches, contactors, relays, timers, limit switches, sensors, interlocking, study of a typical electrical control panel.
B) Fuses, MCB, MCCB, ELCB, OCB, ACB.

Unit V (8 Hrs)
Unit V: Programmable Logic Controller (PLC)
A) Introduction to PLC, Ladder diagram and its components, Ladder programming exercises, Case study I, Case study II.
B) Different types of sensors and their applications.

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

<table>
<thead>
<tr>
<th>Reference Books</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Electrical machinery, S.K. Bhattacharya, T.T.I. Chandigarh</td>
<td></td>
</tr>
<tr>
<td>2. Electrical machines &amp; Power system Vol I, Syed A. Asar, McGraw hill</td>
<td></td>
</tr>
<tr>
<td>3. Fractional and sub fractional horse power electrical motors. C.E. Veinou and J.E. Martits, McGraw hill</td>
<td></td>
</tr>
<tr>
<td>4. Electrical engineering handbook, Siemens, Wiley Eastern</td>
<td></td>
</tr>
</tbody>
</table>
IP26101 :: ELECTRICAL & ELECTRONICS ENGINEERING

Teaching Scheme: - - Tutorial 1 Hr/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the Strength of Materials
- Develop conceptual framework of the course
- Mapping with PEOs: I, II (d,r)

List of Contents
Any 12 practical from the list below - out of which 12 to 17 are compulsory.

1) Speed control of DC shunt motor.
2) Load test on DC shunt motor.
3) Load test on DC series motor.
4) Load test on 3-ph induction motor.
5) Study of induction motor starters.
6) Speed control of 3-ph induction motor.
7) Study of DC motor drive
8) Study of AC motor drive
9) Study of Stepper motor
10) Study of Servo motor
11) Visit to LT substation
12) Switchgear case study - I
13) Switchgear case study - II
14) PLC Programming - I
15) PLC Programming - II
16) PLC case study - I
17) PLC case study – II

Text Books
1. Electrical Machinery and Transformer by Irvin Kosow, Prentice Hall

Reference Books
1. Electrical machinery.. S.K. Bhattacharya, T.T.T.I. Chandigarh
2. Electrical machines & Power system Vol I, Syed A. Asar , McGraw hill
3. Fractional and sub fractional horse power electrical motors. C.E. Veinou and J.E. Martits , McGraw hill
4. Electrical engineering handbook, Siemens, Wiley Eastern
IP20351 :: MANUFACTURING PRACTICES 1

Credits: 01  
Teaching Scheme: - Laboratory  2 Hrs/Week

Prerequisites: Nil

Objectives:
- To give students ‘hands on experience’ of craftsmanship, machining, maintenance and assembly.
- To make students familiar with different Work Trades.
- To develop quality & safety consciousness amongst the students.
- To develop respect towards labour work amongst the student.
- Mapping with PEOs: I, II (b)

List of Practicals
1. Sand Preparation & Testing (Compression Test, Shear Test, Mould & Core Hardness Test, Permeability & Moisture)
2. Design of Gating System
3. Pattern Making: Introduction, different types of patterns, necessity of draft and allowance, function and operation of wood turning lathe, safety precautions etc.
   Practical: one job of any one type of pattern.
4. Foundry: Introduction, uses of different foundry tools, sand preparation, mould preparation, metal pouring, safety precautions etc.
   Practical: One job of casting.

Demonstrations
1. Gas Welding, Study of Types of Flames
2. TIG & MIG Welding – Voltage & Current Characteristics

Text Books
2. H.P.Garg, Industrial Maintenance, Published by S.Chand Co.Ltd,1990

Reference Books
1. HMT, Production Technology, Published by Tata McGraw-Hill Publishing Co.Ltd, New Delhi, 1st -1987
IP21355 :: THEORY OF MACHINES

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: : Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II (r)

List of Contents

Term work consist of any six following exercises:

[A] Laboratory Experiments:
Any eight of the following shall be performed and record to be submitted in the form of journal.
1. Demonstration and explanation of configuration diagram of working models based on four bar chain, single slider crank mechanism, and double slider crank mechanism for various link positions (any two models).
2. Identifying different mechanisms used for motion conversion in sewing machine.
3. To determine the mass moment of inertia of a connecting rod using a compound pendulum method.
4. To determine the mass moment of inertia of a flat bar using bifilar suspension method.
5. To determine the mass moment of inertia of a flywheel/gear/circular disc using trifilar suspension method.
7. Study of various types of cam and follower systems and Verification of cam jump phenomenon.
8. Study of different types of brakes and dynamometer
10. Study of different types of gear trains.
11. To observe the effect of varying sleeve weight or spring force on the operation of a Porter Governor

[B] Drawing Sheets (4 sheets of ½ imperial size):
Any four of the following shall be performed and record to be submitted in the form of journal.
1. To study and draw (any four) mechanisms for practical applications such as: mechanical grippers in robot, lifting platform, foot pump, toggle clamp, folding chair etc.; straight line mechanisms such as: Peaucellier Mechanism, Scott Russell Mechanism, Grasshopper Mechanism etc., for various link positions.
2. Graphical solution of two problems on velocity analysis using relative velocity method.
3. Graphical solution of two problems on acceleration analysis using relative acceleration method.
4. Graphical solution of problems on velocity and acceleration in mechanisms by Kleins construction method.
5. To draw a cam profile for specific follower motion
6. To draw a conjugate profile for any general shape of gear tooth.

Text Books
IP20353 :: MATERIAL SCIENCE

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Application of the theory
- Understanding of fundamentals of the subject
- Mapping with PEOs: I, II, III (c,p)

List of Practical
1. Tensile test on mild steel and aluminum test pieces.
2. Compression test on cast iron and brass test pieces.
3. Brinell hardness test on different materials.
4. Poldi hardness test on different materials.
5. Vickers hardness test on different materials.
6. Rockwell test on different materials with different Scales.
7. Rockwell superficial test on different materials with different Scales.
8. Izod and Charpy impact tests.
9. Erichsen cupping test on minimum three different sheet metal samples.
10. Non-destructive testing - Magnaflux testing.
11. Non-destructive testing - Dye penetrant test.
12. Non-destructive testing - ultrasonic testing.

Text Books

Reference Books
5. Structure and properties of materials II, Willey Eastern (P) Ltd.
IP24351 :: MACHINE DRAWING & GDT LAB

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Application of the theory
- Mapping with PEOs: I, II (d, r)

List of Practicals

1. Sketches of Conventional Representation of Machine Components as per ‘IS Code SP 46’ of Screw Threads, Tapped Holes, Holes on Circular Pitch, Countersunk and Counter-bores,
2. Sketches of Conventional Representation of Machine Components as per ‘IS Code SP 46’ of Bearing, Splined Shafts, Tapers, Chamfers, Knurling, Keys
3. Sketches of Conventional Representation of Machine Components as per ‘IS Code SP 46’ of Springs, Gears, Welded Joints, Structural Sections
4. Sketches of Conventional Representation of Machine Components as per ‘IS Code SP 46’ of Types of Screws
5. Sketches of Conventional Representation of Machine Components as per ‘IS Code SP 46’ of Bolts and Nuts
6. Sketches of Conventional Representation of Machine Components as per ‘IS Code SP 46’ of Nut Locking Arrangements
7. Assembly and Details of Machine Components based on ‘Theory of Geometrical Dimensioning & Tolerancing’ (GDT) - Cotter Joint, Knuckle Joint
8. Assembly and Details of Machine Components based on ‘Theory of Geometrical Dimensioning & Tolerancing’ (GDT) - Rigid and Flexible Coupling
9. Assembly and Details of Machine Components based on ‘Theory of Geometrical Dimensioning & Tolerancing’ (GDT) - Stop Valve
10. Assembly and Details of Machine Components based on ‘Theory of Geometrical Dimensioning & Tolerancing’ (GDT) - Non Return Valve
11. Assembly and Details of Machine Components based on ‘Theory of Geometrical Dimensioning & Tolerancing’ (GDT) - Revolving Centers
12. Assembly and Details of Machine Components based on ‘Theory of Geometrical Dimensioning & Tolerancing’ (GDT) - Machine Vice, Tool Holder

Text Books:


Reference Books:
1. Shah, Rana, Engineering Drawing, 2/e, Pearson Education
4. CMTI Handbook of Machine Tools
IP27451 :: MINI PROJECT

Credits: 02

Teaching Scheme: - Laboratory 4 Hrs/Week

Prerequisites: Nil

Objectives:
- Scope for creativity
- Getting a hands on experience
- Acquire team-work, project management, and organizational skills

1. Mini Project can be an individual or a group activity depending on the depth and scope of the topic.
2. The project work can be any of the form given below (but not restricted to below mentioned topics only):
   a) Making physical working models, prototypes, scaled models, of a concept machine.
   b) Making virtual / CAD models of machines / concepts.
   c) Making study, modeling, analysis, programming and simulation of a system / machine operation / process.
   d) Making study / teaching modules of a sufficiently complex topic for pedagogy purposes.
3. A complete assembly and details drawings of the project should be submitted along with a detailed project report, where applicable.
4. A Detailed background / field / literature survey, related to the topic must be made presented in the report.
5. Entire work should be presented at the end of the Semester.

#### FF No. 653 Issue No.1, Rev No.2 dated 4/4/2013


<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Teaching Scheme (Hrs/week)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>S₆</td>
<td>IP20154</td>
<td>Metal Cutting, Finishing &amp; NCM Processes</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>S₇</td>
<td>IP21154</td>
<td>Thermal &amp; Fluid Energy Conversion</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>S₈</td>
<td>IP20158</td>
<td>Engineering Metrology</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>S₉</td>
<td>IP21152</td>
<td>Mathematics for Engineering Applications</td>
<td>3 1 0</td>
<td>4</td>
</tr>
<tr>
<td>S₁₀</td>
<td>IP26102</td>
<td>Mechanical Measurements</td>
<td>2 1 0</td>
<td>3</td>
</tr>
<tr>
<td>P₄</td>
<td>IP20354</td>
<td>Manufacturing Practices Lab 2 (Workshop)</td>
<td>0 0 2</td>
<td>1</td>
</tr>
<tr>
<td>P₅</td>
<td>IP21354</td>
<td>Thermal &amp; Fluid Energy Conversion</td>
<td>0 0 2</td>
<td>1</td>
</tr>
<tr>
<td>P₆</td>
<td>IP20358</td>
<td>Engineering Metrology</td>
<td>0 0 2</td>
<td>1</td>
</tr>
<tr>
<td>SD₄</td>
<td>IP24352</td>
<td>Computer Graphics</td>
<td>0 0 2</td>
<td>1</td>
</tr>
<tr>
<td>MP₄</td>
<td>IP27452</td>
<td>Mini Project</td>
<td>0 0 4</td>
<td>2</td>
</tr>
<tr>
<td>CVV₂</td>
<td>IP20452</td>
<td>Comprehensive Viva Voce</td>
<td>Based on Courses P₄, P₅, P₆</td>
<td>2</td>
</tr>
<tr>
<td>OE4</td>
<td>HS27302</td>
<td>General Seminar – II</td>
<td>0 0 2</td>
<td>1</td>
</tr>
<tr>
<td>GP</td>
<td></td>
<td>General Proficiency</td>
<td>0 2 0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>14 2 14</td>
<td>26</td>
</tr>
</tbody>
</table>
IP20154 : METAL CUTTING, FINISHING & NCM PROCESSES

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II (b)

Unit I  
(8 Hrs)
Lathe and turning operations and Gear Cutting:

A. Lathe and its accessories, lathe specifications, lathe cutting tools, speed, feed and depth of cut, various operations on lathe (turning, boring-taper turning, threading etc.) Geometry of single point cutting tools, tool materials and their properties, coolants and lubricants, Gear cutting -Forming & generation, gear cutting on milling, gear hobbing, gear shaping, gear shaving, lapping & grinding, various machines use for gear manufacturing.
B. Introduction to high speed machining

Unit II  
(8 Hrs)
Shaper, planer and slotting machines & Drilling Machines and Related Operations:

A. Basic Introduction to shaping and planing operations: Definition, type of shapers and planers. Quick return mechanism, cutting speed and feeds, machining time. Drilling operations, boring drills and reamers, cutting speeds and feeds, machining time. Thread cutting - internal and external chasers, dies, thread rolling thread milling, lapping and grinding.
B. Types of drilling machines, equipment, size of drilling machine,

Unit III  
(8 Hrs)
Milling Machines and operations

A. Various milling operations and types, accessories and standard and special equipment, Universal dividing head, angular milling attachment, standard index base. Types of indexing (direct simple, differential compound spiral, angular), size, shape and materials of milling cutters, cutting speeds, feed and depth of cut, machining time.
B. Vertical milling attachment, high speed milling attachment, slotting attachment, vice
Unit IV  
**Grinding and Super Finishing**  
(8 Hrs)


B. Honing, lapping, super finishing, buffing, burnishing processes.

Unit V  
**Broaching Operations and Non-conventional machining processes**  
(8 Hrs)

A. Definitions, types of broaching, machines cutters for broaching, materials for broach, cutting action, chip disposal, broaching speeds, application of broaching.

Non-conventional machining processes: comparison with conventional machining, classification, principle, working advantages, disadvantages and applications of ECM, EDM, AJM, LBM, IBM, EBM.

B. Advantages and limitations of broaching operations

---

**Text Books**

1. Workshop Technology : Chapman,

---

**Reference Books**

3. Elements of Workshop Technology, Hajara choudhary S. K., Bose S. K. : Volume I, II. Asia Publishing House:
4. Manufacturing Processes. Begeman
FF No. : 654

IP21154 :: THERMAL & FLUID ENERGY CONVERSION

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II, III (a)

Unit I
Introduction & Fluid Properties

A. Definition of fluid, Newton’s law of Viscosity, classification of fluid: Newtonian & Non-Newtonian fluids, Ideal & Real fluids, Fluid properties: viscosity, compressibility, cohesion, adhesion, surface tension, capillarity, vapour pressure, cavitations, Static’s of Fluid-Pressure head, Pascal’s law, continuity equation, total pressure, total Pressure on an immersed surface, Bernoulli’s equation, applications of Bernoulli’s equation, orifice meter, venturimeter, Pitot tube.

B. Measurements of fluid pressure- piezometer tubes, manometers, mechanical gauges, bourdon’s tube, diaphragm pressure gauge, dead weight pressure gauge, types of flow

Unit II
Fluid Machinery

A. Construction, working and applications of hydraulic turbines, Construction, working and applications of centrifugal pumps and reciprocating pumps.

B. Steam generators
Introduction, formation of a steam at a constant pressure, temperature Versus total heat graph during steam formation, steam properties, boiler performance, boiler efficiency, equivalent of evaporation and energy balance, measurement of dryness fraction of steam by throttling calorimeter.

B. Construction and working of Lancashire boiler, Babcock Wilcox boiler

Unit III
I.C. Engines.

A. Classification of I.C. Engines, construction and working of two stroke, four stroke, S.I. and C.I. Engines, terms used in air cycles, thermodynamic air cycles-Otto, Diesel
and Dual combustion cycles, Cooling and lubrication systems of I.C. engines., applications of I.C. Engines.

B. Thermodynamics - zeroth, first and second law of thermodynamics, thermodynamic system and processes.

Unit IV  
(8 Hrs)
Air Compressors:

A. Introduction, Classifications, working of single stage reciprocating air compressors, work done by a single stage reciprocating air compressors with and without clearance, multistage compression, two stage reciprocating air compressors with intercooler, intercooling of air in a two stage reciprocating air compressors, work done by a two stage reciprocating air compressors Applications of Compressed air
B. Construction and working of centrifugal compressor and axial Flow air compressors.

Unit V  
(8 Hrs)
Refrigeration and Air conditioning:

A. Air refrigeration working on Bell Coleman Cycle, Simple Vapour Compression Cycle, Vapour absorption cycle, types and properties of refrigerants, p-h and T-s diagram, window, central, and Industrial Air conditioning Systems.
B. Introduction to heat transfer-conduction, convection, radiation.

Text Books :
2. Fluid Mechanics and Hydraulic Machines, S.C. Gupta, Pearson Education

Reference Books :
IP20158 :: ENGINEERING METROLOGY

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Sensitizes the students of the importance of course in real life environment
- Know fundamentals of sensors
- Suggest suitable sensor for given applications.
- Procure and install the sensor.
- Mapping with PEOs: I, II, III (a, h, j, k)

Unit I (8 Hrs)
Introduction to Metrology
B. Manufacture of slip gauges, Sine Center, Uses of sine bars, angle gauges, Angle Dekkor, vernier bevel protractor

Unit II (8 Hrs)
Limits, Fits and Tolerances
B. Optical, Electrical, Pneumatic Comparators.

Unit III (8 Hrs)
Measurement of Surface Finish and geometric parameters & Interferometry
A. Surface Texture, Meaning of RMS and CLA values, Grades of Roughness, Specifications, surface roughness measurement methods, comparison, profile-meters, pneumatic and replica
Inspection of Geometric parameters: Straightness, Flatness, Squareness Parallelism, Circularity and Rotation, measurement of run out and concentricity
B. NPL Flatness Interferometer

Unit IV (8 Hrs)

Screw & Gear Metrology
A. Screw Thread Metrology: External Screw Thread terminology, Floating Carriage Instruments, Pitch and flank Measurement of External Screw Thread.
Gear Metrology: Spur Gear Parameters and their Inspection Methods, pitch & Tooth thickness measurement by various methods
B. Measurement of pitch – Internal Thread, Measurement of gear tooth profile, Profile projector

Unit V (8 Hrs)
A. Computer aided and laser metrology: Co-ordinate measuring machine; applications; laser micrometer, laser interferometer, laser scanning gauge, non contact and in-process inspection, vision system.
B. Length bar measuring machine, Optical projection comparator, Tool makers microscope.

Text Books
1. Jain R.K.; Engineering metrology; Khanna publishers

Reference Books
1. Practical Engineering Metrology by K.W. B. Sharp, Pitman Publication
2. ASTE; Handbook of industrial metrology; Prentice hall of india ltd
3. Galye G.N et al; Metrology for engineers; elbs
IP21152 :: MATHEMATICS FOR ENGINEERING APPLICATIONS

Credits: 04

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
1. To make the students understand the concepts & broad principles of contents of the course
2. Develop conceptual framework of the course
3. Sensitizes the students of the importance of course in real life environment
4. Mapping with PEOs: I II (a)

Unit I

Linear Differential equations of higher order


B. System of linear differential equations, Examples on Mass Spring System. Revision: Probability and Expected value, classical, relative frequency and subjective approaches to probability, Venn Diagram, Laws of probability, conditional probability and Bayes theorem.

Unit II

Fourier and Laplace Transform


B. Application of Fourier series to physical systems that are governed by Ode’s and subjected to periodic forcing functions. Application of Laplace transform for solving system of differential equations. Revision: Regression analysis (Linear only), Correlation analysis, Karl Pearson’s correlation coefficient, Spearman’s Rank correlation coefficient

Unit III

Applications of Partial Differential equations

B. d’Alembert’s solution of partial differential equations

Unit IV
Vector Calculus
A. Vector and scalar functions & fields, Derivative, Gradient of a scalar field, Directional derivative, Divergence and curl of a vector field, vector identities, Irrotational and solenoidal vectors and potential functions, line and surface integrals, Green’s, Stoke’s and Gauss theorems and applications to Engineering Problems.

B. Applications to Fluid dynamics

Unit V
Basics Statistics

B. Application to real life problem. Revision: Concept of Random Variable & Probability Distributions, Discrete random variable and its distributions – Binomial, Poisson,. Continuous random variable and its distributions - (Mean, Variance of All Distributions)

Text Books

Reference Books
3. Murray R. Spiegel, Advanced Calculus, Schaum’s out line series, ---------, --------
IP21152 :: MATHEMATICS FOR ENGINEERING APPLICATIONS

Teaching Scheme: - - Tutorial 1 Hr/Week

Pre requisites: : Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II (a)

List of Assignments
1. Linear Differential Equation – Method of Solution
2. Application of Linear Differential Equation
3. Fourier Series
4. Fourier Transform
5. Laplace Transform
6. Inverse Laplace Transform & Its Applications
7. Vector Calculus – Vector Differentiation
8. Vector Calculus – Vector Integration
9. Statistics – Data Presentation
10. Statistics – Data Analysis

Text Books

Reference Books
Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Mapping with PEOs: I, II (h, j, k)

Unit I

A. Basic Concepts of Measurement: General measurement system

Sensors & Transducers: Mechanical detector-transducers element, electrical transducers, transducer classification, transducer sensitivity, variable resistance transducer, thermoelectric transducer, variable inductance transducer, capacitive transducer, piezo electric transducer, photo electric transducer.

B. Measuring instruments: Ammeter, Voltmeter, Wattmeter, energy meter, potential transformer and current transformer, frequency meter and megger

Unit II

Pressure and Flow Measurement

A. Pressure Measurement: Definition of pressure, Units, Types of pressure measurement devices, Manometers, Dead weight tester, Bourdon tube pressure gauge, Diaphragms and bellows, Low pressure measurement, The Mcleod gauge, Pirani thermal conductivity gauge, Selection of pressure measuring devices for specific applications

Flow Measurements: Types of flow measuring devices, Constructional features, Obstruction meters like orifice, Venturi nozzle and their calibration, Flow measurement by drag effects (rotameter), Pitot tube, Hot wire anemometers, Magnetic flow Meters, Flow visualization Techniques

B. Knudsen gauge, Ionization gauge, Piezo electric transducer, Laser doppler anemometer, Ultrasonic flow meter.

Unit III

Temperature and Strain Measurement

A. Temperature Measurement: Temperature standards, Temperature scales; Thermometry based on thermal expansion: Liquid in glass thermometers, Bimetallic Thermometers; Electrical resistance thermometry: Resistance Temperature Detectors, Thermistors; Thermoelectric Temperature Measurement: Temperature measurement with thermocouples, Strain Measurement: Stress and strain, resistance strain gauges, gauge factor, strain gauge electrical circuits, multiple gauge bridge, bridge constant

B. thermocouple standards, apparent strain and temperature compensation, bending compensation.

Unit IV (8 Hrs)

Motion, Force and Torque Measurement

A. Displacement measurement: Potentiometers, Linear variable differential transformers, rotary variable differential transformer; Velocity measurement: moving coil transducers; angular velocity measurement: electromagnetic techniques Force measurement: load cells, piezoelectric load cells Torque measurement: measurement of torque on rotating shafts, Power estimation from rotational speed and torque.

B. Stroboscopic measurement

Text Books
1. Nakra and Chowdhry; Measurement and Control; TMH
2. Swahney; Metrology and Instrumentation, Dhanpat Rai & Co.(P) LTD.

Reference Books
1. Backwith and Buck; Mechanical Measurements, Addison Wesely Publishing Company
2. Figiola RS & Beasley DE; Theory and Design for Mechanical Measurements; 3e John Wiley
IP26102 :: MECHANICAL MEASUREMENTS

Teaching Scheme: - - Tutorial 1 Hr/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Mapping with PEOs: I, II (h, j, k)

List of Contents
1. Study and assignments on various transducers
2. Study of various pressure measuring devices like manometers, mercury in glass pressure gauge.
3. Study of various pressure measuring devices like Bourdon tube pressure gauge.
4. Study of temperature measuring devices; thermo couple.
5. Study of temperature measuring devices; RTD
7. Study and Measurement of velocity of fluid flow by pitot-tube.
8. Study and assignment on LVDT
9. Study and Assignment on angular velocity measurement
10. Study and assignment on apparent strain and temperature compensation, bending compensation.
11. Measuring torque and power generated by a prime mover by using pony brake dynamometer.

Text Books
1. Nakra and Chowdhry; Measurement and Control; TMH
2. Swahney; Metrology and Instrumentation, Dhanpat Rai & Co.(P) LTD.

Reference Books
1. Backwith and Buck; Mechanical Measurements, Addison Wesely Publishing Company
2. Figiola RS & Beasley DE; Theory and Design for Mechanical Measurements; 3e John Wiley
IP20354 :: MANUFACTURING PRACTICES 2

Credits: 01  

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To give students ‘hands on experience’ of craftsmanship, machining, maintenance and assembly.
- To make students familiar with different Work Trades.
- To develop quality & safety consciousness amongst the students.
- To develop respect towards labour work amongst the student.
- Mapping with PEOs: I, II (b, g, j)

List of Practical

1. Turning:
   Introduction, functions and operations of lathe parts, lathe tools and measuring instruments, demonstration of different lathe operations, such as knurling, grooving, drilling, boring, reaming, threading etc., safety precautions etc.
   Practical: One simple job involving few lathe operations.
   Practical: One composite job involving the above mentioned operations.

2. Milling:
   Introduction, demonstration of milling operations such as plain milling, end milling, gear cutting etc., safety precautions
   Practical: One job.

Demonstrations

1. Demonstration on CNC lathe machine

Assignment: Process sheet of machining component.

Text Books:
Reference Books:
IP21354 :: THERMAL & FLUID ENERGY CONVERSION LAB

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II (a)

List of Practical
1. Verification of Bernoulli’s equation
2. Determination of losses in various pipe fitting.
3. Problem on boiler to determine boiler efficiency, equivalent evaporation.
4. Study of pumps and turbines.
5. Trial on petrol engine.
6. Trial on diesel engine.
7. Study of Engine system: Air intake, exhaust, cooling, lubrication system
8. Trial on reciprocating air compressor.
9. Study of different Pressure measuring devices.
10. Study of vapour compression refrigeration system
11. Construction detail of IC engines by dismantling and assembly
12. Industrial visit

Text Books

Reference Books
1. A course in Thermodynamics and heat engines Thermal engineering with solar energy, Kothanaraman C. P., Khajuria P. P., Arora S. and Domkundawars, Dhanpat Rai & Sons
4. Textbook of Refrigeration and Air Conditioning, Khurmi R. S. and Gupta J. K.,
IP20358 :: ENGINEERING METROLOGY

Credits: 01  
Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II (a)

List of Practical

List of Contents
1. Linear measurements by precision measuring instruments
2. Angular measurements by sine bar
3. Dial Gauge calibration
4. Profile Projector for measurement of screw thread parameters and saw tooth parameter
5. Design of limit gauge
6. Measurement of roundness using Johanson’s comparator
7. Measurement of gear tooth parameters
8. Measurement of screw thread parameters using floating carriage micrometer
9. Surface finish measurement
10. Use of interferometer for study of various surfaces
12. Study of Toolmakers Microscope

Text Books
1. Jain R.K.; Engineering metrology, Khanna publishers

Reference Books
1. Practical Engineering Metrology by K.W. B. Sharp, Pitman Publication
2. ASTE; Handbook of industrial metrology; Prentice hall of india ltd
3. Galye G.N et al; Metrology for engineers; elbs
IP24352 :: COMPUTER GRAPHICS LAB

Credits: 01  
Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- Mapping with PEOs: I, II (i)

List of Practical
1) Introduction & use of basic AutoCAD commands to draw basic drawing entities – Part 1
2) Introduction & use of basic AutoCAD commands to draw basic drawing entities – Part 2
3) Introduction to modifying commands (trim, extend, offset, array etc)
4) Simple 2D drafting (orthographic projections)
5) Complex 2D drafting – Part 1 (Assembly and details of any one of Machine Components Cotter Joint, Knuckle Joint, Flange Joint, Rigid and Flexible Coupling, Stop Valve, Non Return Valve, Revolving Centers, Machine Vice, Tool Holder.)
6) Complex 2D drafting – Part 1 (Assembly and details of any one of Machine Components Cotter Joint, Knuckle Joint, Flange Joint, Rigid and Flexible Coupling, Stop Valve, Non Return Valve, Revolving Centers, Machine Vice, Tool Holder.)
7) Introduction to basic isometric commands.
8) Isometric drafting
9) Introduction to 3D commands (extrude, polyline, etc.)
10) Introduction to 3D commands (subtract, union, etc.)
11) Simple 3D drafting of simple mechanical components
12) Complex 3D drafting

Text Books
1. Ghosh, Machine Drawings with AutoCAD, Pearson Education

Reference Books
1. Junnarkar, Machine Drawing, 2/e, Pearson Education
2. CMTI Handbook of Machine Tools
3. Engineering drawing by N.D.Bhatt, V.M.Panchal
4. Engineering Drawing by N. H. Dubey
IP27452 :: MINI PROJECT

Credits: 02

Teaching Scheme: - Laboratory 4 Hrs/Week

Prerequisites: Nil

Objectives:
- Scope for creativity
- Getting a hands on experience
- Acquire team-work, project management, and organizational skills

1. Mini Project can be an individual or a group activity depending on the depth and scope of the topic.
2. The project work can be any of the form given below (but not restricted to below mentioned topics only):
   a. Making physical working models, prototypes, scaled models, of a concept machine.
   b. Making virtual / CAD models of machines / concepts.
   c. Making study, modeling, analysis, programming and simulation of a system / machine operation / process.
   d. Making study / teaching modules of a sufficiently complex topic for pedagogy purposes.
3. A complete assembly and details drawings of the project should be submitted along with a detailed project report, where applicable.
4. A Detailed background / field / literature survey, related to the topic must be made presented in the report.
5. Entire work should be presented at the end of the Semester.
MODULE V

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Teaching Scheme (Hrs/week)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>S₁</td>
<td>IP30161</td>
<td>Statistical Methods &amp; Research Methodology</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>S₂</td>
<td>IP31161</td>
<td>Design of Machine Elements</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>S₃</td>
<td>IP30171</td>
<td>Metal Cutting &amp; Tool Design</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>S₄</td>
<td>IP30157</td>
<td>Quality Management</td>
<td>3 1 0</td>
<td>4</td>
</tr>
<tr>
<td>S₅</td>
<td>IP30163</td>
<td>Production Planning &amp; Control</td>
<td>2 1 0</td>
<td>3</td>
</tr>
<tr>
<td>P₁</td>
<td>IP30253</td>
<td>Statistical Methods &amp; Research Methodology</td>
<td>0 0 2</td>
<td>1</td>
</tr>
<tr>
<td>P₂</td>
<td>IP31361</td>
<td>Design of Machine Elements</td>
<td>0 0 2</td>
<td>1</td>
</tr>
<tr>
<td>P₃</td>
<td>IP30251</td>
<td>Metal Cutting &amp; Tool Design</td>
<td>0 0 2</td>
<td>1</td>
</tr>
<tr>
<td>PD₁</td>
<td></td>
<td>*Institute Level</td>
<td>0 0 2</td>
<td>1</td>
</tr>
<tr>
<td>CVV₃</td>
<td>IP30451</td>
<td>Comprehensive Viva Voce</td>
<td>Based on Courses P₁, P₂, P₃</td>
<td>2</td>
</tr>
<tr>
<td>SM₁</td>
<td>IP37351</td>
<td>Seminar</td>
<td>0 0 4</td>
<td>2</td>
</tr>
<tr>
<td>MP₅</td>
<td>IP37451</td>
<td>Mini Project</td>
<td>0 0 4</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>14 2 16</strong></td>
<td><strong>26</strong></td>
</tr>
</tbody>
</table>
IP30161 :: STATISTICAL METHODS & RESEARCH METHODOLOGY

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Mathematics for Engineering Applications

Objectives:
- To make the students understand the concepts & broad principles of statistical techniques used in managerial decision making
- Sensitize the students of the importance of statistics in real life environment
- Mapping with PEOs: I, IV (a, g, i, n)

Unit I  (08 Hrs)
Concept of random variable & probability distributions

A. Discrete random variable and its distributions – Binomial, Poisson, Hyper-geometric.
Continuous random variable and its distributions - Uniform, Normal, Exponential (Mean, Variance of All Distributions)
B. Calculation of probabilities for the above probability distributions in MS EXCEL and developing probability curves

Unit II  (08 Hrs)
Sampling Theory & Statistical Inferences

A. Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample, sampling methods, Point estimate, Interval estimate, Chebyshev’s Theorem, Sample size determination. Practical considerations in sampling and sample size
Principles of Statistical inferences – Testing hypotheses and Inferences concerning means and proportions. Sampling distributions – Test based on Normal, t-distribution ,Chi-square distribution, Hypothesis Testing - Logic & Importance
B. Developing sampling distribution and its analysis for the specified data using MS EXCEL, Various methods of probability and Non-probability sampling

Unit III  (08 Hrs)
Hypothesis Testing for Variances and ANOVA

B. Analysis of cases and numerical problems on DOE and Taguchi method using net-based study

Unit IV
Foundations of Research

A. Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method - Understanding the language of research - Concept, Construct, Definition, Variable. Research Process
B. Designing a questionnaire for e-mail survey for the specified objective, studying cases on questionnaire design and field surveys

Unit V
Research Design

A. Concept and Importance of Research - Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs - concept, types and uses. Experimental Design: Causal relationships, Concept of Independent & Dependent variables, concomitant variable, extraneous variable, Treatment, Control group.
Types of Data: Secondary Data - Definition, Sources, Characteristics. Primary Data - Definition, Advantages and disadvantages over secondary data, Observation method, Questionnaire Construction, Personal Interviews, Telephonic Interview, Mail Survey, Email/Internet survey.
B. Collection and analysis of two questionnaires from real life field surveys

Text Books
3. Krishnaswamy, Management Research Methodology – Integration of Methods & Techniques, Pearson Education

Reference Books
4. Taguchi Methods Explained: Practical steps to robust design- Tapan Bagchi, Prentice Hall of India,1993
IP31161 :: DESIGN OF MACHINE ELEMENTS

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites (If any):

Objectives:
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: II (i, j)

Unit I (08 Hrs)
Design of Shafts, Keys and Couplings
A. Design of solid and hollow shafts based on strength, rigidity, ASME code for shaft design.
   Keys, Types of keys, Design of keys and key ways
   Couplings, Types of Couplings, Design of muff coupling, Design of rigid and flexible couplings.
B. Derivations of Various Formulae, Design of shaft for variable load and based on stiffness, Design of spline.

Unit II (08 Hrs)
Design of Spur and Helical Gears
   Helical Gears: Introduction, Terms used in Helical Gears.
B. Proportion of the Helical Gears, Strength of Helical Gears Design of Helical Gears

Unit III (08 Hrs)
Rolling Contact Bearings
Types, Static and Dynamic load Capacity, Strieberc’s Equation, Concept of equivalent load, Load life Relationship, Selection of bearing from Manufacturer’s Catalogue, Design for bearing for variable loads and Speeds, Bearings with Probability of Survival other than 90%.
B. Lubrication and Mounting of bearings, oil Seals and packing used for bearings

Unit IV (08 Hrs)
Design of Threaded, Welded Joints and Power Screw

Design of bolted joints subjected to transverse and eccentric loads. Bolted joint subjected following conditions – i) Bolted joints in shear ii) Bolted joints subjected to load perpendicular to the axis of bolt iii) Bolted joints subjected to eccentric load on circular base.

Design of Power Screw -- Types, materials used, thread forms and their applications; types of stresses induced, overhauling and self-locking properties, design of nuts.

B. Design of welded joints for various loading conditions

Unit V (08 Hrs)

Design for Fluctuating Loads and Flywheel


B. Flywheel: Introduction, Coefficient of fluctuation of speed, Fluctuation of energy, Maximum fluctuation of energy, Energy stored in flywheel, Stresses in flywheel rim, Stresses in flywheel Arms.

Text Books
6. Design of Machine Element by M.F.Spotts, Pearson Education Publication
7. PSG Design data Book

Reference Books
7. Design of Transmission Systems by P. Kannaiah, Scitech Publication

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites (If any):

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Mapping with PEOs: I, II (b, r)

Unit I  (08 Hrs)
Tool nomenclature
A. Milling cutter, broach
B. Single point cutting tool, various tool elements, Designation of cutting tools in ORS & ASA Systems, Importance of tool angles, Method of machining- orthogonal, oblique cutting, Nomenclature of drill

Unit II  (08 Hrs)
Theory of metal cutting
A. Mechanics of chips formation, types of chips, determination of shear angle, chip reduction factor, velocity relationship, merchant force circle, estimation of cutting forces, Tool dynamometer. Heat generation & tool life
B. Heat generation in cutting, Functions of cutting fluid, characteristics of cutting fluid, types of cutting fluid, Tool wear, Tool life, modified Taylor's equation, Tool dynamometers.

Unit III  (08 Hrs)
Design of cutting tools
A. Tool materials, design of single point cutting tool, form tool, drill, reamer
B. Design of broach & plain milling cutter

Unit IV  (08 Hrs)
Fundamentals of jig & fixtures
B. Types of Jigs & Fixtures.

Unit V  (08 Hrs)
Design of jig & fixtures

A. Concept of modular fixtures.
B. General guidelines & procedures for design of jig & fixtures, Bodies, bases & frame, Design of locators, Design of guiding elements, Analysis of number of clamping forces required & their magnitude

Text Books
1. P C Sharma, Production Engg., Khanna publishers.
2. M.H.A. Kempster, Introduction to Jigs and fixtures design

Reference Books
1. Tool Engg by Nagpal
2. Dolalson, Lecain and Goold, Tool design, Tata McGrawhill.
3. Hoffman, Introduction to Jigs and fixtures.
6. R. K. Jain, production technology, Khanna Publishers
7. Milton Shaw, Metal cutting principle
IP30157 :: QUALITY MANAGEMENT

Credits: 04  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites (If any):

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: II (h, j, k)

Unit I  (08 Hrs)
Introduction to Quality


B: Contribution of Quality Gurus, Juran, Crosby, Deming’s Principles of Management. Concept of TQM – Quality Circles

Unit II  (08 Hrs)
Acceptance Sampling


B. Home assignment: Case on designing of sampling plan using MIL, ASQ standards.

Unit III  (08 Hrs)
Statistical Process Control


B. Applications of Control Charts in Mass Production, Process Production
Unit IV (08 Hrs)
Quality Improvement Tools
A. Introduction to TQM & Quality Circles, Quality Improvement Tools: 7 QC Tools – Check Sheet, Histogram, Pareto Chart, Fishbone Diagram, Run Charts, Scatter Diagram, Process Flow Chart. 7 QM Tools – Program Decision Process Chart, Tree Diagram, Affinity Diagram, Prioritization Matrix, etc. Bench Marking
Quality Improvement Tools: Why-Why Analysis, Root Cause Analysis, Poka Yoke (Mistake Proofing)
B. Bench Marking: Types – Process, Product. Cases on application of 7 above concepts from reference books and web sources

Unit V (08 Hrs)
Six Sigma & Quality Management Systems
Introduction to TS16949: Technical Specifications, Major Components.

Text Books
1. Amitav Mitra, Fundamentals of Quality Control & Improvement, Pearson Education

Reference Books
1. J.M. Juran & F.M.Gryna, Quality Planning and Analysis.
IP30157 :: QUALITY MANAGEMENT

Teaching Scheme: - Tutorial 1 Hr/Week

Prerequisites:

Objectives:
- To make the students understand the concepts & broad principles of statistical techniques used in managerial decision making
- Sensitize the students of the importance of statistics in real life environment
- Mapping with PEOs: I, IV (a, g, i, n)

List of Contents

A TERM-WORK containing the record of the following:

Assignments: (Any ten of the following)
1. Case on Constructing House of Quality for any Product
2. Assignment on Operating Characteristics Curve
3. Assignment on Sampling Plans
4. Assignment on Variable Control Charts (X-bar, R)
5. Assignment on Attribute Control Charts (c, p, np, U)
6. Assignment on Process Capability
7. Assignment on Check Sheets, Run Charts
8. Assignment on Histogram, Pareto Diagram
9. Comprehensive Case Study on 7 QC Tools
10. Assignment on any two of 7 QM Tools

Text Books
1. Amitav Mitra, Fundamentals of Quality Control & Improvement, Pearson Education

Reference Books
2. J.M. Juran & F.M.Gryna, Quality Planning and Analysis.
5. Kaoru Ishikawa, Guide to Quality Control, Asian Productivity Organisation, Tokyo
IP30163 :: PRODUCTION PLANNING & CONTROL

Credits: 03

Teaching Scheme: - Theory 2 Hrs/Week

Prerequisites (If any):

Objectives:

• To make the students understand the concepts & broad principles of contents of the course
• Develop conceptual framework of the course
• Sensitizes the students of the importance of course in real life environment
• Mapping with PEOs: II (h, j, k)

Unit I (8 Hrs)

Types of Production Systems


B: Scheduling Tools: Gantt Charts, Machine Load Charts, Documentation - Production Work Order.

Unit II (8 Hrs)

Demand Forecasting:


B: Holts Model, Winters Model, Box-Jenkins Method

Unit III (8 Hrs)

Aggregate Planning(S & OP) & Quantitative Techniques in Scheduling


B. Numerical & Cases in Aggregate Planning & Scheduling

Unit III

Project Planning & Scheduling


B: Cases & Numerical on Resource Smoothening, Project Crashing

Text Books

Reference Books
IP30163 :: PRODUCTION PLANNING & CONTROL

Teaching Scheme: - Tutorial 1 Hr/Week

Prerequisites: :

Objectives:

- To make the students understand the concepts & broad principles of statistical techniques used in managerial decision making
- Sensitize the students of the importance of statistics in real life environment
- Mapping with PEOs: I, IV (a, g, i, n)

List of Contents

A TERM-WORK containing the record of the following:

1. Assignment on Production Systems
2. Case on Operations Strategy & Process Choice
3. Assignment on Demand Forecasting – Quantitative Model
4. Assignment on Demand Forecasting – Forecasting Errors
5. Assignment / Case on Aggregate Planning
6. Assignment on Job Shop Scheduling - Priority Sequencing Rules
7. Assignment on Assignment Models, Johnson’s Rule
8. Assignment on PERT / CPM – Construction of Network, Computation of Slacks
9. Assignment on PERT / CPM – Project Crashing
10. Assignment on PERT / RPM – Resource Smoothening

Text Books


Reference Books

IP30361 :: STATISTICAL METHODS & RESEARCH METHODOLOGY

Credits: 01

Teaching Scheme: - Laboratory 2 Hr/Week

Prerequisites:

Objectives:
- To make the students understand the concepts & broad principles of statistical techniques used in managerial decision making
- Sensitize the students of the importance of statistics in real life environment
- Mapping with PEOs: I, IV (a, g, i, n)

List of Contents
A TERM-WORK containing the record of the following (All assignments should be done using excel functions):
1) Numerical Problems on discrete probability distributions
2) Numerical Problems on continuous probability distributions
3) Numerical problems on statistical estimation
4) Determination of sample size
5) Characteristics of sampling distributions
6) Degrees of Freedom (DOF)
7) Hypothesis Testing for means
8) Hypothesis Testing for proportions
9) Hypothesis Testing for variances
10) ANOVA
11) Questionnaire Design
12) Taguchi Method of Design

Text Books

Reference Books
4. Taguchi Methods Explained: Practical steps to robust design- Tapan Bagchi, Prentice Hall of India,1993

IP31361 :: DESIGN OF MACHINE ELEMENTS

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites (If any):

Objectives:
- Application of the theory
- Understanding of fundamentals of the subject
- Mapping with PEOs: II (i, j)

List of Practicals

Problem & Numerical solving and sketching figures for:
1. Design of Shafts
2. Design of Keys
3. Design of Couplings
4. Design of Spur gear
5. Design of Helical gear
6. Rolling contact bearing selection
7. Rolling contact bearing selection
8. Design of Welded Joints
9. Design of Threaded Joints
10. Design for Fluctuating loads-I
11. Design for Fluctuating loads-I
12. Flywheel design.

Text Books:
6. Design of Machine Element by M.F. Spotts, Pearson Education Publication
7. PSG Design data Book

Reference Books:
2. Mechanical Analysis & Design by H. Burr & Cheatam, Prentice Hall
3. Design of Transmission Systems by P. Kannaiah, Scitech Publication
5. Fundamentals of Machine Component Design by J Marshek Willey Eastern Ltd

7. Machine Design A Basic Approach By Dr, s.s.wadhwa S s Jolly Dhanapat Rai & Sons
IP30371 :: METAL CUTTING & TOOL DESIGN

Credits: 01

Teaching Scheme: - Laboratory 2 Hr/Week

Prerequisites (If any):

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Mapping with PEOs: I, II (b, r)

List of Contents

A TERM-WORK containing the record of the following:

Any Eight of the following assignments:
1. Experiment on chip formation.
3. Study of influence of cutting parameters on surface roughness in turning.
5. Verification of metal cutting theories.
6. Tool life study on a single point turning tool.
7. Design & working drawing of one drilling jig.
8. Design & working drawing of one Fixture.
9. Design & working drawing of one Form tool.
10. Design & working drawing of any two of following cutting tools.
   11. SPCT, Reamer, Broach, Plain milling cutter
12. Industrial visit report.
13. Research paper study & presentation on metal cutting processes.

Text Books
1. P C Sharma, Production Engg., Khanna publishers.
2. M.H.A. Kempster, Introduction to Jigs and fixtures design

Reference Books
1. Tool Engg by Nagpal
2. Dolalson, Lecain and Goold, Tool design, Tata McGrawhill.
3. Hoffman, Introduction to Jigs and fixtures.
6. R. K. Jain, production technology, Khanna Publishers
7. Milton Shaw, Metal cutting principle
## IP37351 :: SEMINAR

**Credits:** 02  
**Teaching Scheme:** Practical 4 Hr/Week

### Objectives:
- To develop and test ability of student for self-study, presentation and communication skill  
- Mapping with PEOs: IV (l, o)

### Guidelines for selecting a topic
1. The topic should be the latest & related to the industrial engineering field.  
2. It should not be taken directly from Syllabus.  
3. Topic should be based on literature survey /a case study wherever applicable / possible, and approved by the staff- in- charge

### Instruction for preparing a seminar report
1. The report should be of about 15-20 (A4 size) pages including figures and plates.  
2. Use Arial 12 font with single spacing.  
3. Report should be so arranged such that text matter, figures, plates, etc. will appear on right hand side only. Left hand side should be kept blank.  
4. General sequence of the report material should be as follows: Title page, Certificate, Content, Abstract, Literature, Bibliography

### Evaluation & Assessment Scheme
- The student will be expected to a deliver a presentation using audio-visual aids on the seminar topic. Assessment will be based on the following criteria: Report Content, Depth of Knowledge, Presentation Skills, Question-Answers, Adherence to Time

*Standard certificate Proforma will be made available by the department and the same should be used.*

**Bibliography should be presented in the following sequence**

i) Research papers from National/International Journals, proceedings, conferences  
ii) Books (starting from latest)  
iii) Websites

***Two copies of report with cover page (as supplied by department) duly filled up and spiral bound to be submitted before the term end.***
IP37451 :: MINI PROJECT

Credits: 02

Teaching Scheme: - Laboratory 4 Hrs/Week

Prerequisites: Nil

Objectives:
- Scope for creativity
- Getting a hands on experience
- Acquire team-work, project management, and organizational skills

1. Mini Project can be an individual or a group activity depending on the depth and scope of the topic.
2. The project work can be any of the form given below (but not restricted to below mentioned topics only):
   a. Making physical working models, prototypes, scaled models, of a concept machine.
   b. Making virtual / CAD models of machines / concepts.
   c. Making study, modeling, analysis, programming and simulation of a system / machine operation / process.
   d. Making study / teaching modules of a sufficiently complex topic for pedagogy purposes.
3. A complete assembly and details drawings of the project should be submitted along with a detailed project report, where applicable.
4. A Detailed background / field / literature survey, related to the topic must be made presented in the report.
5. Entire work should be presented at the end of the Semester.
MODULE VI
<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Teaching Scheme (Hrs/week)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>S₆</td>
<td>IP30156</td>
<td>Production Metallurgy</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>S₇</td>
<td>IP30158</td>
<td>Industrial Fluid Power</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>S₈</td>
<td>IP30160</td>
<td>Work Study &amp; Ergonomics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>S₉</td>
<td>IP30162</td>
<td>Material Forming</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>S₁₀</td>
<td>IP30164</td>
<td>Design for Manufacturing</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>P₄</td>
<td>IP30356</td>
<td>Production Metallurgy</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>P₅</td>
<td>IP30358</td>
<td>Industrial Fluid Power</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>P₆</td>
<td>IP30360</td>
<td>Work Study &amp; Ergonomics</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PD₂</td>
<td></td>
<td>*Institute Level</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CVV₄</td>
<td>IP30452</td>
<td>Comprehensive Viva Voce</td>
<td>Based on Courses P₄, P₅, P₆</td>
<td>2</td>
</tr>
<tr>
<td>PS₁</td>
<td>IP37352</td>
<td>Major Project</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td>14</td>
<td>2</td>
</tr>
</tbody>
</table>
IP30156 :: PRODUCTION METALLURGY

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Basic Knowledge of material science

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Mapping with PEOs: III (b, c, p)

Unit I

(08 Hrs)

Stainless

A. Introduction to Metallography, micro and macro examination, metallurgical microscope, etching. Steels: iron-iron carbide equilibrium diagram, Critical temperatures, Allotropy, cooling curve and volume changes of pure iron. Microstructure, non-equilibrium cooling of steel, Widmanstatten structure, structure property relationship. Classification and applications of steels, specifications of some commonly used steels like BIS, EN, AISI, SAE.

B. Specimen preparation for micro and macro examination

Unit II

(08 Hrs)

Heat treatments of Steels


B. Defects due to heat treatment, causes and remedial measure

Unit III

(08 Hrs)

Surface Hardening & Isothermal Treatments

A. Carburising, heat treatment after carburising, Nitriding, Carbonitriding, Flame hardening and Induction hardening. Commercial heat treatment practice of gears of different sizes, tools, springs. Isothermal heat treatments such as austempering, patenting, isoforming, martempering, ausforning.

B. Modification of nitriding - Tuffride and Sursulf process and plasma nitriding
Unit IV (08 Hrs)

Alloy Steels & Cast Iron


B. Applications of cast irons for different components of machine tool, automobiles, pumps etc.

Unit V (08 Hrs)

Non-Ferrous Alloys: Composite Materials

A. Copper alloys - Brasses, Bronzes-: Tin, Aluminium, Beryllium, Silicon Copper nickel alloys, Nickel - Silver, Aluminium and aluminium alloys. Solders, Bearing materials and their applications, Precipitation hardening alloys. High Temperature materials such as Nimonics, Super alloys, Ti-alloys etc.

Composite Materials—Various types, Production techniques, applications etc.

B. Selection of Materials and Failure Prevention: Selection factors, some case studies of common engineering components. Failure prevention through design, proper material selection.

Text Books

Reference Books

Department of Industrial & Production Engineering

FF No. : 654

Bansilal Ramnath Agarwal Charitable Trust's
Vishwakarma Institute of Technology, Pune – 411 037

IP30158 :: INDUSTRIAL FLUID POWER

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Mathematics for Engineering Applications

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: II, III (j)

Unit I

Introduction to Fluid Power

A. Types of hydraulic fluids - petroleum based, synthetic and water based, selection of fluids, additives, effect of temperature and pressure on hydraulic fluid. Seals, sealing materials, compatibility of seal with fluids. Types of pipes, hoses, material, quick acting couplings, Fluid conditioning through filters, strainers, sources of contamination and contamination control. Heat exchangers. Accumulators : Types

Pumps: Types, classification, principle of working and constructional details of vane pumps, gear pumps, radial and axial plunger pumps, screw pumps, power and efficiency calculations, characteristics curves, selection of pumps for hydraulic power transmission.

B. Pressure drop in hoses/pipes, Power units and accessories, selection/design procedure, applications of accumulators.

Unit II

Actuators

A. Actuators: (v) Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads. (vi) Design considerations for cylinders.

B. Actuators: (i) Linear and Rotary. (ii) Hydraulic motors- Types- Vane, gear, piston types, radial piston. (iii) Methods of control of acceleration, deceleration. (iv) Types of cylinders and mountings.

Unit III

Fluid Power Control

A. Introduction to Cartridge valves. Manually operated, solenoid operated, pilot operated, direction control valves, check valve.
**B.** Symbols for hydraulic and pneumatic circuits. Control of fluid power: (i) Necessity of fluid control through pressure control, directional control, flow control valves. (ii) Principle of pressure control valves, direct operated and pilot operated relief valves, pressure reducing valve, sequence valve. (iii) Principle of flow control valves, pressure compensated, temperature compensated flow control valves, meter in circuit, meter out circuits, flow through restrictor. (iv) Types of directional control valves: two way two position, four way three position, four way two positions valves. Open centre, close centre, tandem centre valves

**Unit IV**

**Industrial Circuits & System Design**

A. Industrial circuits 1 - Simple reciprocating, Regenerative, Speed control (Meter in, meter out & bleed off), Sequencing, Synchronization, transverse & feed, circuit for rivetting machine

Design of hydraulic/pneumatic circuit for practical application, Selection of different components such as reservoir, various valves, actuators, filters, pumps based on design. (Students are advised to refer manufacturer’s catalogues.)


**Unit V**

**Pneumatics**


B. (viii) Air motors- radial piston, vane, axial piston (ix) Basic pneumatic circuit, selection of components(x) Application of pneumatics in low cost Automation and in industrial automation

**Text Books**

1. A. Esposito – ‘Fluid Power with application’, Pearson Education

**Reference Books**

4. Festo’s Manual on Pneumatic Principle, applications
5. ISO – 1219, Fluid Systems and components, Graphic Symbols
IP30160 :: WORK STUDY AND ERGONOMICS

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites (If Any):

Objectives:

- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: III, IV (f, k, n)

Unit I  
Introduction to Work Study  
(08 Hrs)

A. Historical background, Contribution of Taylor and Gilbreth, Definition and Scope of Work Study
Introduction to Industrial Engineering, Historical background, Contribution of Taylor and Gilbreth, Productivity – Definition, Types, Improvement, Work Content Analysis, Definition and Scope of Work Study

B. Work study historical initiatives in India, Recent developments and applications in the country. Numerical and Cases on Productivity

Unit II  
Method Study I  
(08 Hrs)


B. Various Considerations in Select Job for Method Study. Relationship between Motion Economy and Work Simplification.

Unit III  
Method Study II  
(08 Hrs)


B. Review of Cases in Method Study

Unit IV  
(08 Hrs)

Predetermined Motion Time Standards

A. Work Measurement – Time Study & Work Sampling

B. Comparison between Time Study, Work Sampling & MTM

Unit V

Ergonomics

A. Ergonomics: Definition, Scope, Historical background, Human- machine system interfaces, Basic Ergonomics, Work Physiology, Applied Anthropometry: Definition and scope, use and principles of anthropometric data, statistical analysis, Product design and work station design using anthropometric data, Work Space design - work spaces, work space envelopes for seated persons, design of work spaces such as: work surface height, seated & standing, principles of seat design, workplace design. Physical space & arrangement, principles of arrangement of components

B. Work Efficiency and Ergonomics, Effect of Light, Noise, Temperature on Human Performance

Text Books

1. ILO, “Introduction to Work study”.
3. E. Grad jean, “Fitting Task to the Man” Taylor and Francis.

Reference Books

2. R. S. Bridger, “Introduction to Ergonomics”, Taylor and Francis
5. Waldemar Karwowski, William Steven Marras, “Occupational ergonomics: design and management of work systems”, CRC Press,
FF No. : 654

IP30162 :: MATERIAL FORMING

Credits: 04  

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Manufacturing Processes 1 & 2

Objectives:
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: III (b, p, r)

Unit I  

Fundamentals of Material Forming  
(08 Hrs)

A. Concept of flow stress determination, Effect of temperature, strain rate, Mohrs circle for three dimensional state of stress, Theory of plasticity, Yield criteria - Von mises criteria and Tresca criteria. Classification of material forming processes, Concept of workability, formability and forming limit diagram

B. Engineering stress-strain and true stress-strain, Strain hardening, work done in tensile test, temperature rise in plastic deformation

Unit II  

Rolling of Metals  
(08 Hrs)

A. Scope and importance of rolling, Types of Rolling Mills- Construction and working, Roll bite, reduction, elongation and spread. Deformation in rolling and determination of forces required, Process variables, Roll flattening

B. Roll camber - its effect on rolling process, mill spring. Defects in rolling. Automatic gauge control- Lubrication in rolling

Unit III  

Wire and Tube Drawing  
(08 Hrs)


B. Forces required in wire drawing and tube drawing, Lubrication in wire drawing and tube

Unit IV  

Extrusion & Forging  
(08 Hrs)

A. Extrusion: Types - Direct, reverse, impact, hydrostatic extrusion. Dies for extrusion, stock penetration, metal flow in extrusion, defects.

Forging: Introduction, classification, Forging equipments, Basic forging operations such as drawing, fullering edging, blocking etc.

B. Role of friction and lubricants in extrusion, forging defects and their remedies.

Unit V  (08 Hrs)
Advanced Material Forming Processes
B. Stretch forming, coining, embossing, curling, spinning, flow forming -advantages, limitations and applications of the process

Text Books :
1. Dieter, Mechanical Metallurgy

Reference Books :
1. Dr. R. Narayanswamy, Metal Forming Technology, Ahuja Book Co.
2. Surender Kumar, Principles of Metal Working.
3. ASM Metal handbook Vol: 4 forming.
4. J. N. Harris, Mechanical working of metals
5. G. W. Rowe, Principles of industrial metal working process, Edward Arnold
IP30162 :: MATERIAL FORMING

Teaching Scheme: - Tutorial 1 Hr/Week

Prerequisites (If Any):

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Application of the theory
- Mapping with PEOs: III (b, p, r)

List of Contents

TERM-WORK containing the record of the following:

1. Determination of True stress –strain & Engineering stress- strain for Mild steel
2. Assignment on failure criteria
3. To draw a forming limit diagram
4. Different Roll passes for any four structural shapes
5. Assignment on rolling defects
6. Assignment on Wire drawing
7. Assignment on tube drawing
8. Assignment on Extrusion
9. Assignment on Forging
10. Assignment on High Energy Rate Forming
11. Research paper study and presentation on Forming process
12. Industry visit to study any of the above forming process

Text Books
1. Dieter, Mechanical Metallurgy
3. G.W. Rowe, Principles of industrial metal working process, Edward Arnold

Reference Books
1. Dr. R. Narayanswamy, Metal Forming Technology, Ahuja Book Co.
2. Surender Kumar, Principles of Metal Working.
3. ASM Metal handbook Vol: 4 forming.
4. Mechanical working of metals by J.N. Harris.
5. P.C. Sharma, Production Engineering, S. Chand
IP30164 :: DESIGN FOR MANUFACTURING

Credits: 03

Teaching Scheme: - Theory 2 Hrs/Week

Prerequisites:

Objectives:
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: III (b, p, r)

Unit I (08 Hrs)
Product Design Process
A. Importance, design process, steps, concept, design, product life cycle, technology development cycle, sequential vs. concurrent design approach.
Economics of Process selection – General design principles of manufacturability, material selection – Strength and Mechanical factors- Application of form design, Selection of Shapes, Review of Manufacturing Processes, Selection of Manufacturing Processes
B. Selection of Manufacturing Processes

Unit II (08 Hrs)
Design for Manufacture
A. Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for plastic processing, injection molding etc.
B. Case studies for design for manufacture

Unit III (08 Hrs)
Design for Assembly
A. Review of Assembly Processes, Design for Welding, Design for Brazing and Soldering, Design for Adhesive Bonding. Types of assembly, DFA, evaluation of assembly, assembly cost reduction
B. Case studies for design of assembly.

Unit IV (08 Hrs)
Design for Reliability and Quality
B. Failure Mode and Effect Analysis.

Text Books

Reference Books
IP30164 :: DESIGN FOR MANUFACTURING

Teaching Scheme: - Tutorial 1 Hr/Week

Prerequisites (If Any):

Objectives:
- To clearly understand the Work Study concepts
- Mapping with PEOs: III, IV (f, k, n)

List of Contents
Tutorials containing the record of the following:

Case studies & Problem solving and sketching figures for any 12 of following:
1. Selection of material
2. Selection of shapes
3. Human factors in Engineering design
4. Quality Function Deployment
5. Basic principles of DFM
6. Design for casting
7. Design for machining
8. Design for material forming
9. Design for plastic processing
10. Design for Assembly: Welding/ Brazing
11. Design for Assembly
12. Design for quality
13. Optimization of design
14. Design for reliability
15. Failure Mode Effect Analysis (FEMA)

Text Books

Reference Books
3. ASTM Design handbook.
IP30356 :: PRODUCTION METALLURGY

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites (If Any):

Objectives:

- To develop skills in the subject
- Verify the principles of the course
- Application of the theory
- Mapping with PEOs: III (b, c, p)

List of Practical

1. Specimen preparation for micro examination.
2. Study and drawing of microstructures of mild steel and medium carbon steel.
3. Study and drawing of microstructures of Eutectoid steel and hypereutectoid steel.
4. Study and drawing of microstructures of white and malleable cast iron.
5. Study and drawing of microstructures of grey and nodular cast iron.
7. Study and drawing of microstructures of Aluminum bronze, tin bronze and bearing metal.
8. Study and drawing of microstructures of hardened steel, tempered steel.
11. Study of change in microstructure on annealing and normalizing of tempered steel.
12. Jominy Hardenability test on steel sample

Text Books


Reference Books

5. A.S. M. Metals Hand Book Volume 4 ‘ Heat Treatment’
IP30358 :: INDUSTRIAL FLUID POWER

Credits: 01

Teaching Scheme: - Laboratory 2 Hr/Week

Prerequisites (If Any):

Objectives:

• To make the students understand the concepts & broad principles of contents of the course
• Aim is to provide insight of the subject
• Sensitizes the students of the importance of course in real life environment
• Mapping with PEOs: II, III (j)

List of Practical

Following assignments will be covered:
1. Study of hydraulic control valves.
2. Study of hydraulic actuators
3. Study of hydraulic accumulators
4. Study of hydraulic pumps-Rotary
5. Study of hydraulic pumps-reciprocating-In line axial
6. Study of hydraulic pumps-radial
7. Study of hydraulic circuits: -, machine tools,
8. Study of hydraulic circuits-, automobile systems
9. Study of Compressed air generation and distribution systems
10. Study of Filters, Regulator and Lubricator
11. Study of Shuttle Valve/ Quick Exhaust valve/Twin pressure valve /Pneumatic Clamp
12. Demonstration of working of Pressure/Direction/ Flow control valves on trainer.

Text Books

Reference Books
4. A. Lall – ‘Oil Hydraulics’, International Literature Association
7. Festo’s Manual on Pneumatic Principle, applications
8. ISO – 1219, Fluid Systems and components, Graphic Symbols

IP30360 :: WORK STUDY & ERGONOMICS

Credits: 01

Teaching Scheme: - Laboratory 2 Hr/Week

Prerequisites (If Any):

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: II, III (j)

List of Practicals
Practicals containing the record of the following:

Assignments :
1) Numerical on Productivity
2) Assignment on Recording Tools – Charts
3) Assignment on Recording Tools - Diagrams
4) Method Study – Bagging Exercise 1
5) Method Study – Bagging Exercise 2
6) Assignment on Time study
7) Assignment on MTM
8) Assignment on Work Sampling
9) Anthropometric data collection
10) Anthropometric data analysis
11) Assignment on Ergonomic design principles
12) Assignment on Work place design

Text Books
1. ILO, “Introduction to Work study”.
3. E. Gradjean, “Fitting Task to the Man” Taylor and Francis.

Reference Books
2. R. S. Bridger, “Introduction to Ergonomics”, Taylor and Francis

CREDITS: 02

PREREQUISITE: Nil

OBJECTIVES:
- To train the students to apply their engineering knowledge to real life problem solving.
- Mapping with PEOs: IV (e, f, g, i, n)

The project work could be of the following nature:
1. Manufacturing / Fabrication of a prototype machine' including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.
2. Improvement of existing machine / equipment / process.
3. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, inspection gauges, measuring instruments for machine tools.
4. Computer aided design, analysis of components such as stress analysis.
5. Problems related to Productivity improvements.
6. Problems related to value engineering.
7. Problems relating to material handling system.
10. Product design and development.
11. Analysis, evaluation and experimental verification of any engineering problem encountered.
13. Quality improvements, In-process Inspection, Online gauging.
15. Time and Motion study, Job evaluation.
16. Ergonomics and safety aspects under industrial environment
17. Management Information System.
18. Market Analysis in conjunction with Production Planning and Control.

OR

Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hitech systems and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system (s) and its validation or comparison with available benchmarks / results. Modelling/simulation of product(s), mechanism(s) or system(s) and its validation or comparison with available bench marks / results. Design/development and Fabrication of models, machines, and prototypes based on new ideas, robotic and automation systems, Experimental set ups, test rigs/ equipments.
The project work shall be taken up individually or in a group consisting of not more than 4 students.

A report containing maximum 30 pages shall be submitted based on the background, need and scope of the project, project specifications, activities involved in the project and activity plan, study of literature and basic theory, and work completed (if any).

**Guidelines:**

- Report shall be typed or printed.
- Figures and tables shall be on separate pages and attached at respective positions.
- Project title and approval sheets shall be attached at the beginning of the report followed by index and synopsis of the project.
- References shall be mentioned at the end followed by appendices (if any).
- When a group of students is doing a project, names of all the students shall be included on every certified report copy.

Each group of students shall submit two copies of reports to the institute and one copy shall be prepared for each individual student.
MODULE VII
<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Teaching Scheme (Hrs/week)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lect.</td>
<td>Tutorial</td>
</tr>
<tr>
<td>S₁</td>
<td>IP42151</td>
<td>*Elective Group I</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>IP42153</td>
<td>• Materials &amp; Operations Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IP42171</td>
<td>• Finite Element Method &amp; CAD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Industrial Robotics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S₂</td>
<td>IP42159</td>
<td>*Elective Group II</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>IP42161</td>
<td>• Logistics &amp; Supply Chain Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IP42167</td>
<td>• Plant Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Modern Manufacturing Processes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S₃</td>
<td>IP40163</td>
<td>Machine Tool Design</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>S₄</td>
<td>IP40165</td>
<td>Manufacturing Systems</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>P₁</td>
<td>IP40363</td>
<td>Machine Tool Design</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>P₂</td>
<td>IP40365</td>
<td>Manufacturing Systems</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PS₂</td>
<td>IP47351</td>
<td>Major Project</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>12</td>
<td>2</td>
</tr>
</tbody>
</table>
IP42151 :: MATERIALS & OPERATIONS MANAGEMENT

Credits: 04

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject.
- Mapping with PEOs: I, III, IV (f, g, i, n, o)

Unit I
Introduction to Materials Management: (8 Hrs)
A: Introduction to Materials Management: Functions of Materials Management – Sourcing/Procurement, Inventory, Stores, Vendor Development etc. Organization of Materials Management Function. Inventories –Objectives of an Inventory Control, Classification and Costs of Inventories: Types, Objective of holding inventories, Different types of Inventories, Costs Associated with Inventory - Carrying cost, Procurement cost. EOQ - Concept, Assumptions of EOQ Model, Practical Constraints – Numerical Analysis

B: Case Study on Materials Management Functions in Industry

Unit II
Replenishment Systems: (8 Hrs)
A: Replenishment Systems: Introduction, Concept of lead time and its effects on Inventory, Components of Lead Time - Internal and External. Variability in demand and lead time. Safety Stock Evaluation and ways to minimize lead time, Different types of replenishment systems like Fixed order quantity system, Fixed order interval system, Combination of fixed order interval and quantity system, Two Bin System.

B: Case Study in Inventory Control & Replenishment Systems

Unit III
Material Requirement Planning (MRP I) (8 Hrs)

B: MRP II: Manufacturing Resource Planning, Types of Buying, Methods of Buying, Legal Aspects of Buying
Unit IV  
Inventory Management & Selective Inventory Control  
(8 Hrs)

A. EOQ & Quantity Discounts, Probabilistic Replenishment System (Inventory Models). Selective Inventory Control Techniques. ABC analysis VED analysis, HML analysis, SDE analysis, SOS analysis, FSN analysis, GOLF analysis. EMQ Model - Carrying cost, Set up cost. EOQ Special Considerations – Spares, Bought-outs, etc. Symptoms of Poor Inventory management, Measuring Effectiveness of Inventory Function (Inventory Turnover Ratio, Average Inventory, etc.)

B. Cases on Selective Inventory Control, Numerical on EOQ, EMQ & Quantity Discounts

Unit V  
Procurement Management  
(8 Hrs)

A. Procurement Management: Responsibilities of Purchase Department. Procurement Procedure, Documents in Procurement, Types of Buying, Methods of Buying, Legal Aspects of Buying, Vendor Selection, Vendor Development, Vendor Rating. Import-Export Procedure – Imports & Exports


Text Books
1. Inventory management by L.C. Jhamb, Everest Publishing House

Reference Books
1. Material Management by Dobler Burt
2. Inventory management, Silver and Peterson, John Willey and sons

IP42151 :: MATERIALS & OPERATIONS MANAGEMENT

Teaching Scheme: - Tutorial 1 Hrs/Week

Prerequisites:

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Mapping with PEOs: I, III, IV (f, g, i, n, o)

List of Contents
A TERM-WORK containing the record of the following:

1. Assignment on Costs of Inventories, Assignment on EOQ
2. Assignment on Replenishment Systems – Deterministic Models
3. Assignment on Disposal of Surplus and Obsolescent stocks
4. Assignment on MRP – BOM Explosion
5. Assignment on MRP – Netting Requirements
6. Assignment on EOQ, EMQ & Quantity Discounts
7. Assignment on Replenishment Systems – Probabilistic Models
8. Assignment on Selective Inventory Control
9. Case – Purchase Management
10. Case – Vendor Selection, Vendor Rating
11. Case – Warehouse Layout Planning
12. Comprehensive Case

Text Books
1. Inventory management by L.C. Jhamb, Everest Publishing House
3. Chapman, Fundamentals of Production Planning & Control, Pearson Education

Reference Books
1. Material Management by Dobler Burt
2. Inventory management, Silver and Peterson, John Willey and sons
IP42153:: FINITE ELEMENT METHOD & CAD

Credits: 04  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:

- Introduce students to basic concepts in FEM, various elements used and steps in FEM
- Make students to understand problem formulation and solution by FEM for Single degree, Double degree of freedom problem and Axi-symmetric field problems
- Make students to understand mathematical computation when using higher order elements
- Introduce the students to few case studies for FEM analysis.
- Mapping with PEOs: II, III (b, j)

Unit I

(8 Hrs)

A: Introduction to FEA, Basic Steps in FEM, Stresses and equilibrium, boundary conditions, potential energy approach-Rayleigh Ritz method, Saint venant’s principle, von mises stresses, Stress-strain relations

B: Plane stress and plain strain, Galerkin’s method.

Unit II

(8 Hrs)

A: One Dimensional Elements: Linear element, shape function & local coordinates, solution by potential energy & Galerkin’s method, elemental stiffness and load matrices. Assembly of Global stiffness matrix and Load vector, treatment of boundary conditions – elimination & penalty approaches, multipoint constraints, quadratic shape functions, plane trusses, beams & frames

B: Application of the above concepts for Problems like truss analysis, temperature distribution analysis etc.

Unit III

(8 Hrs)

A: Two Dimensional Elements: Constant strain triangle, Isoparametric representation, shape functions, Co-ordinate systems – Local & natural, their significance, problem formulation and solutions by potential energy & Galerkin’s methods, orthotropic materials, four node quadrilateral

Introduction to three dimensional elements & axisymmetric problems

B: Application of above concepts for two dimensional and axisymmetric problems

Unit IV

(8 Hrs)

Models, Inverse Transformations. Projections - Orthographic, Isometric.

**B:-** Oblique, Perspective.

**Unit V**

**(8 Hrs)**


**B:** Introduction to different volume modelling techniques

**Text Books**

1. Chandrupatla, Belegundu, Introduction to Finite Elements in Engineering, Pearson Education

**Reference Books**

IP42153:: FINITE ELEMENT METHOD & CAD

Teaching Scheme: - Tutorial 1 Hrs/Week

Prerequisites:

Objectives:
- Introduce students to basic concepts in FEM, various elements used and steps in FEM
- Make students to understand problem formulation and solution by FEM for Single degree, Double degree of freedom problem and Axi-symmetric field problems
- Make students to understand mathematical computation when using higher order elements
- Introduce the students to few case studies for FEM analysis.
- Mapping with PEOs: II, III (b,j)

List of Contents
A TERM-WORK containing the record of the following:
1. Formulation of FEM problem by potential energy approach
2. Problems on obtaining elemental stiffness and load matrices
3. Problems on 1D elements- using elimination approach
4. Problems on 1D elements- using penalty approach
5. Evaluation of Shape function for Linear triangular elements
6. Problems on 2D elements – constant strain triangle
7. Problems on 2D elements – plates with and without temperature distribution
8. Problems on basic transformations - Translation, Rotation, Scaling, Reflection
9. Parametric representation of curves
10. Problem on synthetic curves
11. Different volume modeling techniques

Text Books
1. Chandrupatla, Belegundu, Introduction to Finite Elements in Engineering, Pearson Education
Reference Books

IP42171:: INDUSTRIAL ROBOTICS

Credits: 04

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To give students idea about principle and working of different configurations of Robot
- To understand the methods of motion analysis of manipulators
- To help students understand the role of robotics in automation
- Mapping with PEOs: I, II, III (a,j,d,r)

Unit I (8 Hrs)
Basic Concepts in Robotics

A. Automation and robotics, robot anatomy, robot specifications, Development of industrial Robots and manipulators, basic structure of robots, resolution, accuracy and repeatability. Classification, Configuration of robots, arm and body motions, wrist motions
B. Mechanical, hydraulic and pneumatic Manipulators

Unit II (8 Hrs)
Robot Arm Kinematics and Dynamics

A. The direct kinematics problem, the inverse kinematic solution, Homogeneous transformations, Denavit - Hartenberg’s representations, Global & Local Coordinates for analysis
B. Generalized D’Alembert equations of motion, Spatial mechanisms, Trajectory planning

Unit III (8 Hrs)
Robot Grippers

A. Classification, Design consideration, Materials for hostile operation. Cylindrical Cam type; Grippers using pneumatic, hydraulic and electrical motor for transmission
B. Vacuum Grippers, ultrasonic grippers

Unit IV (8 Hrs)
Sensors in Robotics

Vision system: Median filtering, thresholding, discretization, Smoothening of binary image. Recognition Procedure. CCD Camera.


Unit V  
Robot Drives, Control and Robot Programming  
(8 Hrs)
A. DC servo motors, basic control systems concepts and models, control system analysis, robot activation and feedback components. Positional and velocity actuators. Methods of Programming the robot, Languages, Robographics, Introduction to Artificial Intelligence
B. Hydraulic systems, Power transmission systems, robot joint control design.

Text Books:

Reference Books:
Prerequisites: 

Objectives:
• To give students idea about principle and working of different configurations of Robot
• To understand the methods of motion analysis of manipulators
• To help students understand the role of robotics in automation
• Mapping with PEOs: I, II, III (a,j,d,r)

List of Contents
A TERM-WORK containing the record of the following:
1. Problems on accuracy, precision and repeatability, resolution
2. Problem on forward kinematics-Cartesion
3. Problem on forward kinematics-cylindrical
4. Problem on forward kinematics-polar
5. Problem on forward kinematics-joWed arm
6. Inverse kinematic problem
7. Problems on grippers
8. Study of robot interfacing with PC
9. Robot programming
10. Robot programming-problem
11. Example on machine vision system
12. Trajectory planning

Text Books

Reference Books:
IP42159 :: LOGISTICS & SUPPLY CHAIN MANAGEMENT

Credits: 04

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:

- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Mapping with PEOs: IV (f, o)

Unit I

Logistics Management

A: Logistics Management – Definition, Logistics Function: Transportation – Significance, Modes of Transportation, Warehousing – Objectives, Warehousing Functions, Types of Warehouses, Inventory Management, Order Processing – Role of IT, Material Handling, Transportation: Modes of Transportation – Rail, Road, Pipelines, Water Air – Advantages & Disadvantages, Concept of TL, LTL, FTL. Selections of Appropriate Modes of Transportation

B: Modes of Transportation – Rail, Road, Pipelines, Water Air – Advantages & Disadvantages

Unit II

Warehouse Management:


B: Stores Documentation – Bin Cards, Stores Ledger. WMS Systems in Practice

Unit III

Concept of SCM


B: Importance of Supply Chain, Examples of Supply Chain
Unit IV (8 Hrs)

Network Design in Supply Chain

A: Network Design in Supply Chain

B: Factors Influencing Network Design Decisions – Strategic, Technological, Macroeconomic, Political, Infrastructure, Competitive

Unit V (8 Hrs)

Co-ordination & Technology in the Supply Chains

A: Co-ordination & Technology in the Supply Chains

B: Building Strategic Partnerships and Trust within a Supply Chain. Future of IT in Supply Chain. Cases on E-business and supply chains

Text Books
1. Supply Chain Management - Strategy, Planning & Operation – Sunil Chopra & Peter Meindl, Pearson Education

Reference Books
1. Logistical Management - The Integrated Supply Chain Process – Bowersox
2. Christopher, Logistics & Supply Chain Management, Pearson Education
3. Logistics & Supply Chain Management – Raghuram
4. Purchasing & Supply Management - Dobler and Burt
6. Strategic Logistics Management – Lambert
IP42159 :: LOGISTICS & SUPPLY CHAIN MANAGEMENT

Teaching Scheme: Tutorial 1 Hr/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Application of the theory
- Understanding of fundamentals of the subject
- Mapping with PEOs: IV (f, o)

List of Contents

A TERM-WORK containing the record of the following:

Assignments
1. Detailed Study of Supply Chain of any one company in an Industry of your choice
2. Study of Industry Based on ETIG SCM CD
3. Numerical & Cases on Facility Location Models- Single and Multiple Facility Location & Location - Allocation Models
4. Numericals & Caselet on Demand Forecasting
5. Caselet on Aggregate Planning
6. Caselet on Inventory Management
7. Numerical and Cases on Travelling Salesman Problem
8. Numerical and Cases on Vehicle Routing Problem
9. Comprehensive Case Study on Supply Chain Management
10. Computerized Simulation Game
11. Case Study on Logistics Modeling
12. Industrial Visit

Text Books
1. Supply Chain Management - Strategy, Planning & Operation – Sunil Chopra & Peter Meindl, Pearson Education
IP42161 :: PLANT ENGINEERING

Credits: 04  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: III (f, g, h, n)

Unit I (8 Hrs)
Scope of Plant Engineering

A: Scope of Plant Engineering – Importance & Objectives, Nature Of Location Decision, Affecting Facility Location, Single & Multiple Facility Location Models, Qualitative Considerations in Facility Location, Factors Urban v/s Rural Location, Site Selection. Plant Layout – Introduction, Types of Plant Layout: Product, Process, Fixed Postion, Hybrid – Cellular, FMS, etc. Phases of Layout Planning

B: Urban Location versus Rural Location. Case Study in Location Decisions, Location Pattern In India.

Unit II (8 Hrs)
Systematic Layout Planning


B: Need And Advantages of Planned Material Flow, Factors For Consideration, Types of Flow Patterns, Flow Patterns For Production Lines And Assembly Lines. Case Study in REL Chart.

Unit III (8 Hrs)
Systematic Layout Planning:

Concept. CORELAP, ALDEP

B: Criteria For Computerized Facility Layout, Concept Of Computerized Layout Programs Like CRAFT & PLANET.

Unit IV

Material Handling: (8 Hrs)


Unit V

Systematic Handling Analysis (8 Hrs)


Text Books
1. Systematic Layout Planning …. Richard Muther
2. Systematic Handling Analysis … Richard Muther
3. Plant Layout and Design … James More
4. Clark, Facility Planning, Pearson Education

Reference Books
1. Plant Layout and Material Handling ..By James M Apple
2. Plant Layout By Immer
3. Plant Layout By Shubin
4. Material handling By Allexander
5. Material Handling Equipment By N Rudenko
IP42161 :: PLANT ENGINEERING

Teaching Scheme: Tutorial: 1 Hr/Week

Prerequisites: NIL

Objectives:
• To develop skills in the subject
• Verify the principles of the course
• Mapping with PEOs: III (f, g, h, n)

Assignments
1. Single facility location problems – Quantitative Techniques
2. Multiple facility location problems - Quantitative Techniques
3. Case on – Facility Location
4. Assignment on Process Layout - REL Charts
5. Assignment on Product Layout - Line Balancing
6. Computerized Layout Planning
7. Assignment on Layout Evaluation Techniques
8. Comprehensive Case on – Layout Improvement 1
9. Comprehensive Case on – Layout Improvement 2
10. Comprehensive Case – Material Handling Systems Design 1
11. Comprehensive Case – Material Handling Systems Design 2
12. Industrial Visit

Text Books
1. Systematic Layout Planning …. Richard Muther
2. Systematic Handling Analysis … Richard Muther
3. Plant Layout and Design … James More

Reference Books
1. Plant Layout and Material Handling ..By James M Apple
2. Plant Layout By Immer
3. Plant Layout By Shubin
4. Material handling By Allexander
5. Material Handling Equipment By N Rudenko
FF No. : 654

IP42167:: MODERN MANUFACTURING PROCESSES

Credits: 04

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
  - Aim is to provide insight of the subject
  - Sensitizes the students of the importance of course in real life environment
  - Mapping with PEOs: II, III (g, r)

Unit I (8 Hrs)

A. INTRODUCTION: Introduction to nontraditional machining methods - Need for non-traditional machining - Sources of metal removal - Classification on the basis of energy sources - Parameters influencing selection of process.


B. Ultrasonic Machining, Operating Principle and Process characteristics

Unit II (8 Hrs)


B. EDM tool design, Machine tool selection, EDM accessories / applications, electrical discharge grinding.

Unit III (8 Hrs)

A. THERMAL ENERGY TECHNIQUES
Operating principles - Equipment and sub systems - Parameters influencing metal removal - Benefits - Applications - Advantages and limitations of Electron beam machining (EBM), Plasma ARC Machining (PAM) and laser beam machining (LBM).

B. Electron Beam Machining, EBM Principle and process characteristics.

Unit IV (8Hrs)


Unit V (8 Hrs)

A. CHEMICAL MACHINING (CHM): Introduction, Elements of process Chemical blanking process:-Preparation of workpiece. Preparation of masters, masking with photo resists, etching for blanking, applications of chemical blanking, chemical milling (Contour machining):- Process steps – masking, Etching, process characteristics of CHM :-material removal rate accuracy, surface finish, Advantages & application of CHM.

B. Electro-chemical Drilling and Deburring operations.

Text Books
2. Mishra, P. K., Non-Conventional Machining, The Institution of Engineers (India), Text Book Series, New Delhi, 1997

Reference Books
IP42167:: MODERN MANUFACTURING PROCESSES

Teaching Scheme: Tutorial: 1 Hr/Week

Prerequisites: NIL

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Mapping with PEOs: III (f, g, h, n)

Assignments
1. Exercise on Ultrasonic machining (USM)
2. Exercise on ABRASIVE JET MACHINING (AJM)
3. Case study: Mechanical Material Removal process (USM, AJM)
4. Exercise on EDM PROCESS
5. Exercise on wire-EDM process
6. Case study: thermal material Removal process (EDM, WEDM)
7. Exercise on CHEMICAL METAL REMOVAL PROCESS
8. Exercise on Electro CHEMICAL Machining
9. Case study: chemical material Removal process (CM, ECM)
10. Exercise on LASER BEAM MACHINING (LBM)
11. Exercise on PLASMA ARC MACHINING (PAM)
12. Case study: Hybrid material Removal process (ECDM, ECG, EDG etc.)

Text Books
2. Mishra, P. K., Non-Conventional Machining, The Institution of Engineers (India), Text Book Series, New Delhi, 1997

Reference Books
FF No. : 654

**IP40163:: MACHINE TOOL DESIGN**

**Credits:** 03

**Teaching Scheme:** - Theory 3 Hrs/Week

**Prerequisites:** Nil

**Objectives:**
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
  - Aim is to provide insight of the subject
  - Sensitizes the students of the importance of course in real life environment
  - Mapping with PEOs: II, III (g, r)

**Unit I**

**Design of Guide-ways & Power Screws**


**Unit II**

**Design of Machine Tool Drives**

A. 1) Selection of Electric Motor, 2)Stepped Regulation of Speed, Laws of Stepped Regulation, Why Geometric Progression is used against Arithmetic, Harmonic & Logarithmic despite shortcomings, Relation between Range ratio, Geometric Progression Ratio and No. of Speed Steps, 3)Design of Stepped Drives: Break up of Speed Steps, Structural Formulae, Structural Diagram, Selection of Best Structural Diagram, Ray Diagram, Speed Chart, General recommendations for Developing the Gearing Diagram, Determining the number of teeth of Gears. 4) Speed/ Feed Gear box : Limiting Transmission Ratio of Speed / Feed Gear Box
B. Design Case Study of - Speed Gear Box for Lathe, - Feed Gear Box for Drilling Machine. Classification of Speed / Feed Gear Boxes & their Application, Electro-Mechanical Step less Drive; Case Study of CNC Lathe with Electronic Controller for Speed & Feed Step less Regulation

Unit III  
Design of Spindle & Spindle Supports  
A. Function & Requirements of Spindle Units, their Materials, Effect of Machine Tool Compliance on Machining accuracy Design of Spindle for Bending Stiffness: Deflection of Spindle Axis due to a) Bending, b) - due to Compliance of Spindle Supports, c) - due to Compliance of the Tapered Joint. Optimum Spacing between Spindle Supports, Permissible Deflection & Design for stiffness: Additional Check for Strength like Additional Supports, Location of Bearings and Drive elements, Balancing.  

Unit IV  
Design of Machine Tool Structure  
A. Function & Requirement of Machine Tool Structure, Design Criteria from Strength & Stiffness considerations, Concept of Unit Rigidity, Unit Strength under Tension, Unit Strength under Torsion & Unit Strength under Bending for Material of Machine Tool Structures, Compare Steel & Cast Iron on the basis of Material Properties, Manufacturing Problems and Economy, Role of Static & Dynamic Stiffness in the design of elements of machine tools, Profiles of Machine Tool Structures, Factors affecting stiffness of machine tool structures & methods of improving it, Basic Design procedure of machine tool structures B. Design Case Studies of a) Bed of Lathe, b) Column & Base of Milling Machine, c) Housing of Speed Gear box

Unit V  
Design for Fluctuating Loads  
A. Stress Concentration and remedies, S.N.Diagram, Endurance limit, Factors affecting Endurance Strength, Design for Finite and Infinite life under reverse stresses, Cumulative damage, Sodberg’s and Goodman’s Diagram  
B. Design of components like shaft, bolted joints, springs etc. subjected to variable loading

Text Books  


**Reference Books**

IP40165 :: MANUFACTURING SYSTEMS

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: II, III (b, j)

Unit I
Hard and soft automation

A. Transfer lines, types, work part transfer mechanisms, control of production line, transfer line performance, CNC NC/CNC machine programming: construction, classification, various axes in NC machines, G & M code programming
B. SPMs, automats, machines, machining centers, computer aided programming

Unit II
ROBOTICS

A. ROBOTICS: Components, Configuration, Machine vision system
B. Applications, dc and ac servo driving units, encoders.

Unit III
Computer aided manufacturing, CIM and FMS

A. Computer aided manufacturing, CIM and Flexible Manufacturing Systems: Components, Types, Workstations, FMS Layout
B. DNC, cellular manufacturing, Group technology – part families formation, classification and codification systems (DCLASS, MICLASS, OPITZ), flexible manufacturing systems, computer control system. FMS planning and implementation, Elements of CIM system

Unit IV
Automatic material handling and inspection

A. Automatic material handling and inspection, Automated guided vehicles systems,
conveyor systems, automated inspection

B. Analysis, carousel storage systems, automatic gauging system

Unit V  
Factory automation , Assembly systems

A. Factory automation, Assembly systems, automated assembly, design for automated assembly, vibratory bowl feeders, hopper feeders, rotary disc feeders.
B. Synchronous and non synchronous material transfer, centrifugal, revolving feeders

Text Books

Reference Books
1. Mechanisation by pneumatic control-Werner Deport and Kurt Stool,Vol.1,2
2. Control Systems Engineering-Gopal,Willie Eastern Ltd
3. Hydraulics and Pneumatics –Andrew Parr
4. Microprocessor-Gaonkar,Penram International
IP40363 :: MACHINE TOOL DESIGN

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
• To develop skills in the subject
• Verify the principles of the course
• Application of the theory, Understanding of fundamentals of the subject
• Mapping with PEOs: II, III (j, r)

List of Practical
1. Design and Working Drawing of Speed Gear Box for Lathe
2. Design and Working Drawing of Feed Gear Box for Drilling Machine
3. Design and Working Drawing of Lathe Bed,
4. Design and Working Drawing of Milling Machine Column,
5. Design and Working Drawing of Milling Machine Base
6. Design and Working Drawing of Sliding Friction Power Screw
7. Design and Working Drawing of Rolling Friction Power Screw
8. Design and Working Drawing of Spindle for Lathe
9. Design and Working Drawing of Spindle-Support for Lathe
10. Design and Working Drawing of Guide Ways of VIT Anil Lathe
11. Study of Step-less Drives : VIT CNC Lathe
12. Study of Machine Tool Control Systems for Speed & Feed

Text Books

Reference Books
IP40365 :: MANUFACTURING SYSTEMS

Credits: 01

Teaching Scheme: - Laboratory: 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: (b, h, i, q)

List of Practical
1. Programming using linear interpolation on CNC machine.
2. Programming using circular interpolation on CNC machine.
3. Programming using automatic canned cycles on CNC machine
4. Programming using complex functions on CNC machine
5. Study of Programming on Robot application.
7. Analysis of AGVs.
8. Conveyor system analysis.
9. Problem 1 on assembly Line balancing.
10. Problem 2 on assembly Line balancing
11. FMS performance “Bottleneck Model”.
12. Analysis of transfer lines with no internal storage.

Text Books:

Reference Books:
1. Mechanization by pneumatic control-Werner Deport and Kurt Stool,Vol.1,2
3. P. Radhakrishnan , S. Subrmaniyum, V. Raju, CAD\CAM\CIM- New Age International Pvt Ltd.

IP 43751:: MAJOR PROJECT

Credits: 04
Teaching Scheme: - Practical 8 Hrs/Week

Prerequisite: Nil

Objectives:

- To train the students to apply their engineering knowledge to real life problem solving.
- Mapping with PEOs: IV (e, f, g, i, n)

The project work could be of the following nature:

1. Manufacturing / Fabrication of a prototype machine including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.
2. Improvement of existing machine / equipment / process.
3. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, inspection gauges, measuring instruments for machine tools.
4. Computer aided design, analysis of components such as stress analysis.
5. Problems related to Productivity improvements.
6. Problems related to value engineering.
7. Problems relating to material handling system.
10. Product design and development.
11. Analysis, evaluation and experimental verification of any engineering problem encountered.
13. Quality improvements, In-process Inspection, Online gauging.
15. Time and Motion study, Job evaluation.
16. Ergonomics and safety aspects under industrial environment
17. Management Information System.
18. Market Analysis in conjunction with Production Planning and Control.

OR

Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hitech systems and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system(s) and its validation or comparison with available benchmarks / results. Modelling/simulation of product(s), mechanism(s) or system(s) and its validation or comparison with available bench marks/results. Design/development and
Fabrication of models, machines, and prototypes based on new ideas, robotic and automation systems, Experimental set ups, test rigs/ equipments.

The project work shall be taken up individually or in a group consisting of not more than 4 students.

A report containing maximum 30 pages shall be submitted based on the background, need and scope of the project, project specifications, activities involved in the project and activity plan, study of literature and basic theory, and work completed (if any).

Guidelines:

- Report shall be typed or printed.
- Figures and tables shall be on separate pages and attached at respective positions.
- Project title and approval sheets shall be attached at the beginning of the report followed by index and synopsis of the project.
- References shall be mentioned at the end followed by appendices (if any).
- When a group of students is doing a project, names of all the students shall be included on every certified report copy.
- Each group of students shall submit two copies of reports to the institute and one copy shall be prepared for each individual student.
<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Teaching Scheme (Hrs/week)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>S5</td>
<td>IP42152</td>
<td>*Elective Group III</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>IP42154</td>
<td>Financial Management &amp; Costing</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IP42156</td>
<td>Reliability Engineering</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IP42174</td>
<td>World Class Manufacturing</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tribology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S6</td>
<td>IP42158</td>
<td>*Elective Group II</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>IP42160</td>
<td>Operations Research</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IP42162</td>
<td>Surface Engineering</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IP42164</td>
<td>Product Design &amp; New Product Development</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IP42176</td>
<td>Entrepreneurship Development</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Production Metallurgy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S7</td>
<td>IP40172</td>
<td>Die &amp; Mould Technology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>S8</td>
<td>IP40168</td>
<td>Process Engineering</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>P3</td>
<td>IP40372</td>
<td>Die &amp; Mould Technology</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>P4</td>
<td>IP40368</td>
<td>Process Engineering</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>PS3</td>
<td>IP47352</td>
<td>Major Project</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>12</td>
<td>22</td>
</tr>
</tbody>
</table>

IP42152 :: FINANCIAL MANAGEMENT & COSTING

Credits: 04

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Application of the theory
- Understanding of fundamentals of the subject
- To learn and understand applications of costing in engineering
- To learn and understand cost estimation, cost analysis
- Mapping with PEOs: IV (f, g)

Unit I (8 Hrs)
Financial Management

A. Nature and Scope of Finance Function; Financial goal - profit vs. wealth Maximization; Finance functions – investment.
Ratio Analysis Classification, Ratio Analysis and its limitations. Types of Ratios – Activity Turnover, Profitability, Liquidity, etc


Unit II (8 Hrs)
Capital Budgeting & Working Capital Management

A: Nature of investment decisions; Investment evaluation criteria – net present value, internal rate of return, profitability index, payback period, accounting rate of return;
Meaning, significance and types of working capital; calculating operating cycle period and estimation of working capital requirements; Financing of working capital and norms of bank finance; Sources of working capital; Commercial paper; Factoring services

B: NPV and IRR comparison; Capital rationing. B. Various committee reports on bank finance; Dimensions of working capital management.

Unit III (8 Hrs)
Cost

B. Accounting for Prime Cost.

Unit IV
Overheads


B. Accounting for Overheads. Preparation of Cost Sheet & Cost Statement

Unit V
Marginal Costing:


B. Concept of Break-Even, P/V Ratio, Margin of Safety.

Text Books

Reference Books

IP42152 :: FINANCIAL MANAGEMENT & COSTING

Teaching Scheme: - Tutorial 1 Hr/Week

Prerequisites: : Nil

Objectives:
- To give an idea about the scope of Financial Management & Costing
- Mapping with PEOs: IV (f, g)

List of Contents
Tutorials containing the record of the following:

Assignments:
1. Goals of Financial Management
2. Assignment on Ratio Analysis 1
3. Assignment on Ratio Analysis 2
4. Assignment on Investment Evaluation Criteria
5. Sources of Capital
6. Assignment on Working Capital Management
7. Assignment on Cost Sheet
8. Assignment on Material Cost
9. Assignment on Labor Cost
10. Assignment on Overheads
11. Assignment on Marginal Costing
12. Assignment on Budgeting

Text Books

Reference Books
IP42154:: RELIABILITY ENGINEERING

Credits: 04  
Teaching Scheme: Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Mapping with PEOs: III (g, h)

Unit I  
Introduction to Reliability  
(8Hrs)

A. Introduction to Reliability, Importance of reliability, trade off between cost, quality and reliability, quality and safety, bathtub concept, MTBF, MTTR, hazard rate, failure rate.
B. Probability and sampling, cumulative probability distribution function, data and distributions.

Unit II  
System Safety Analysis  
(8 Hrs)

A. Fault tree and event tree concept, construction and analysis, failure modes effects and criticality analysis, systems approach
B. Techno-physio constraints, typical failure analysis, risk priority number and its allocation.

Unit III  
System Reliability and Redundancy  
(8 Hrs)

A. System reliability and redundancy, Active and Passive Redundancy, redundancy allocation and limitations, Evaluation of overall system reliability, allocation of reliability.
B. Conditional probability

Unit IV  
Loads, Capacity, Maintainability and Availability  
(8 Hrs)

A. Preventive maintenance, Testing and repair, reliability centered maintenance, system availability and maintainability.
B. Reliability and safety factors, Repetitive loading.

Unit V  
**Reliability Testing and Failure Interactions**  
(8 Hrs)

A. Reliability testing and Failure Interactions, accelerated life testing, Markov analysis of two independent components, reliability with standby system, multicomponent systems

B. Reliability growth models, grouped and ungrouped data, censored data, DTMC and CTMS models

**Text Books**

**Reference Books**
IP42154: RELIABILITY ENGINEERING

Teaching Scheme: Tutorial 1 Hr/Week

Prerequisites: Knowledge about basic machining processes and tooling

Objectives:
• To develop the Process planning skill for the manufacturing
• Mapping with PEOs: III (g, h)

A TERM-WORK containing the record of the following:

Assignments
1. Definitions of CDF and PDF.
2. Comment with examples on trade off bet. Cost, quality and reliability.
3. Case study 1 on FMECA
4. Case study 2 on FMECA
5. Problem on allocation of reliability.
6. 6 Problem on improvement of reliability due to preventive maintenance.
7. 7 Note on reliability centered maintenance
8. 8 Note on life testing methods
9. Problems on Series systems
10. Problems on Parallel systems
11. Problems on Standby systems
12. Probability concepts-problems

Text Books:

Reference Books:
2. Stochastic Processes, Sheldon M. Ross, John Wiley and Sons
IP42156:: WORLD CLASS MANUFACTURING

Credits: 04

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To apply the concepts of lean manufacturing in industrial situations to improve productivity and eliminate the wastes.
- Mapping with PEOs: IV (f, o)

Unit I
WCM & Lean Manufacturing
(8 Hrs)


B. Hall’s, Schonberger,s framework of World Class Manufacturing, Various models of world class manufacturing

Unit II
Lean Manufacturing Tools & Techniques 2
(8 Hrs)


Unit III
Total Productive Maintenance
(8 Hrs)

A. Maintenance – Breakdown, Preventive, Predictive. TPM: Concept & Origin, Outline of TPM – 8 Pillars, TPM Performance Measures – PQCDSM & OEE, Introduction to Autonomous Maintenance (Jishu Hozen) activities, Small-Group activities of TPM. Introduction to 5S: Steps in 5S Methodology, Concept of 1S(Sciri), 2S(Seiton), 3S (Seiso), 4S (Shiketsu), 5S, (Shitsuke). Implementation of 1S & 2S

B. MBNQA, EFQM Award, RBNQA Award, JIPM TPM Award, Losses & Abnormalities in TPM, Home Assignment on 5S

Unit IV (8 Hrs)

Business Process Reengineering


B. Tools in BPR

Unit V (8 Hrs)

Theory of Constraints

A. Introduction to TOC, Concept, Constraints – Types, Concept of Throughput, Inventory & Operating Expenses, Throughput Accounting, TOC Methodology, Numerical & Cases in TOC. Application of TOC in industry


Text Books
1. Learning to See, James Womack & Daniel Jones

Reference Books
1. World Class Manufacturing -A strategic perspective by B.S. Sahay, Saxena, Macmillan, India
2. Cause and Effect Lean – The essentials of Lean Manufacturing by John Bicheno
3. World Class Manufacturing – Richard Schonberger
4. Introduction to TPM: Total Productive Maintenance by Nakajima Seiichi
5. Total Productive Maintenance by Terry Wireman (Industrial Press)
6. Management Of Industrial Maintenance By A. Kelley, M.J. Harris (Newness Butterworths)
7. Complete Handbook of Maintenance Management By J.E. Heintzelman (Prentice Hall)
8. TPM material/ books published by JIPM (Japanese Institute of Plant Maintenance)
Teaching Scheme: - Tutorial 1 Hr/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- To verify the principal of course
- Mapping with PEOs: IV (f, o)

List of Practical Assignments on the following
1. Value Stream Mapping – Current State
2. Value Stream Mapping – Future State
3. Case – Design of JIT / Kanban System
4. Case – Cellular Manufacturing
5. Case – Setup Time Reduction (SMED Philosophy)
7. Assignment on TPM Performance Measures
8. Assignment on 5S: Implementation of 1S
9. Assignment on 5S: Implementation of 2S
10. Case on BPR
11. Numerical on TOC
12. Case Study on Application of TOC

Text Books
1. Operations Management for Competitive Advantage – Chase
2. Making Common Sense Common Practice – Mooref

Reference Books
1. Managing Technology & Innovation for Competitive Advantage - Narayanan
2. Just In Time Manufacturing - M.G.Korgaonkar
3. World Class Manufacturing - B.S.Sahay
4. World Class Manufacturing - Schonberger
Credits: 04  

**Teaching Scheme:** - Theory 3 Hrs/Week

<table>
<thead>
<tr>
<th>Prerequisites:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid mechanics</td>
</tr>
<tr>
<td>Engineering Mathematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Objectives:</th>
</tr>
</thead>
<tbody>
<tr>
<td>To make the students understand the concepts &amp; broad principles of contents of the course</td>
</tr>
<tr>
<td>Develop conceptual framework of the course</td>
</tr>
<tr>
<td>Mapping with PEOs: II III (f, h, j)</td>
</tr>
</tbody>
</table>

**Unit I** (8 Hrs)

**Friction and wear**


B. Abrasive Wear Resistance of Materials, Transfer films in Adhesion

**Unit II** (8 Hrs)

**Hydrodynamic Lubrication- Pad bearings**

A. Mechanics of fluid flow, Reynold’s equation; Simplifying assumptions, Equilibrium of an element, Continuity of flow in a column, Simplifications to the Reynolds equation, Unidirectional velocity approximation, Steady film thickness approximation, Isoviscous approximation, Infinitely long bearing approximation, Narrow bearing approximation, Bearing parameters predicted from Reynolds equation. Infinitely long pad bearings, Infinite Rayleigh step bearing, Finite pad bearings

B. Pivoted pad bearing

**Unit III** (8 Hrs)

**Hydrodynamic Lubrication – Journal bearings and squeeze film bearings**


B. Hydrodynamic squeeze film bearings

---

Unit IV
Hydrostatic bearings

A. Hydrostatic bearing analysis, Flat circular hydrostatic pad bearing - Pressure distribution, Lubricant flow, Load capacity, Friction torque Friction power loss. Non-flat circular hydrostatic pad bearings - Pressure distribution, Lubricant flow, Load capacity, Friction torque, Friction power loss. Generalized approach to hydrostatic bearing analysis - Flat circular pad bearings, Flat square pad bearings. Optimization of hydrostatic bearing design -- Minimization of power (Low speed recessed bearings, High speed recessed bearings), Control of lubricant film thickness and bearing stiffness (Stiffness with constant flow method, Stiffness with capillary restrictors, Stiffness with an orifice, Stiffness with pressure sensors)

B. Gas lubricated bearings - Aerostatic bearings, Pressure distribution, Gas flow, Load capacity, Friction torque, Power loss

Unit V
Elasto-hydrodynamic lubrication

A. Hetz contact stress theory, Contact between two elastic spherical or spheroidal bodies, Geometry of contacting elastic bodies, Contact area, pressure, maximum deflection and position of the maximum shear stress - Contact between two spheres, Contact between a sphere and a plane surface, Contact between two parallel cylinders, Contact between two parallel cylinders, Elliptical contact between two elastic bodies, general case. Elastohydrodynamic lubricating films, Effects contributing to the generation of elastohydrodynamic films - Hydrodynamic film formation, Modification of film geometry by elastic deformation, Transformation of lubricant viscosity and rheology under pressure. Approximate solution of Reynolds equation with simultaneous elastic deformation and viscosity rise, Pressure distribution in elastohydrodynamic films, Elastohydrodynamic film thickness formulae

B. Elastohydrodynamic film thickness measurements

Text Books
2. Basic Lubrication Theory: A. Cameron.

Reference Books
1. The principles of lubrication: A. Cameron. Longmans Green & Co. Ltd.
5. Gas Bearings: Grassam and Powell.

IP42174 :: TRIBOLOGY

Teaching Scheme: - Tutorial 1 Hr/Week

Prerequisites: Fluid Mechanics, Material Science

Objectives:
- To make the students understand the concepts & broad principles of contents of Tribology
- Develop conceptual framework of the course
- Mapping with PEOs: I, II (d)

List of Practical

Problem & Numerical solving and sketching figures for:
1. Theories of Friction
2. Adhesive and abrasive wear
3. Infinitely long pad bearings
4. Infinite Rayleigh step bearing
5. Converging-diverging wedges
6. Evaluation of the main parameters of Journal bearings
7. Flat circular hydrostatic pad bearing
8. Conical circular hydrostatic pad bearing
9. Optimization of hydrostatic bearing design
10. Contact between two spheres
11. Contact between two parallel cylinders

Text Books
2. Basic Lubrication Theory: A. Cameron.

Reference Books
1. The principles of lubrication: A. Cameron. Longmans Green & Co. Ltd.
5. Gas Bearings: Grassam and Powell.
IP42158:: OPERATIONS RESEARCH

Credits: 04

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: IV (a, f, i, n)

Unit I (8 Hrs)
Linear Programming


Unit II (8 Hrs)
Queuing Theory & Simulation

A. Queuing Theory: Introduction, terminology, Poisson single and multi channel queuing system models: M/M/1 Model, M/M/C Model, M/Ek/1 Model. Simulation: Definition, Introduction, Application, Monte Carlo Simulation. Applications of Simulation, Generation of Random Numbers.

B. Simulation software, Building Model on Simulation Software, Running the simulation, Understanding the results.

Unit III (8 Hrs)
Replacement Model & Theory of Games

A. Replacement Model: Replacement of capital equipments that deteriorates with time, time value of money (a) remains same (b) changes with constant rates during period. group and individual replacement. Individual Replacement, Group Replacement Policies, Problems.

Game Theory: Game theory Introduction, Terminology, Two -person zero sum game, minimax, maximin principle, Saddle Point, Games with pure and mixed strategies, Dominance property, Solutions with Graphical methods. LP Method
B. Case studies on Replacement Models & Game Theory: L.P. method, approximation

Unit IV
Goal Programming & Decision Making Tools
B. Case studies based on Goal Programming & Decision Making Tools

Unit V
Integer Programming & Dynamic Programming
B. Case studies based on Integer Programming & Dynamic Programming

Text Books
2. Paneerselvam Operations Research, Prentice Hall of India

Reference Books
IP42158:: OPERATIONS RESEARCH

Teaching Scheme: - - Tutorial 1 Hr/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: III (h, j)

TERM-WORK containing the record of the following:

Assignments
1. Assignment Linear Programming methods like Dual Simplex Method.
2. Assignment Sensitivity Analysis in Linear Programming problems
3. Assignment on Integer Programming problems
4. Assignment on Dynamic Programming problems
5. Assignment on Goal Programming & Decision Making Tools
6. Assignment on Replacement Model for items that deteriorate
7. Assignment on Replacement of sudden failure items
8. Assignment on Game Theory: Graphical method
9. Assignment on Game Theory: Analytical methods
10. Assignment on Queuing Theory
11. Assignment on Simulation
12. Building Model on Simulation Software.

Text Books
2. Paneerselvam Operations Research, Prentice Hall of India

Reference Books

IP42160:: SURFACE ENGINEERING

Credits: 04

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:

• To make the students understand the concepts & broad principles of contents of the course
• Develop conceptual framework of the course
• Mapping with PEOs: III (b, c, h)

Unit I

Basic Principles & Pretreatment of Substrate

A. Introduction of Surface dependent properties Classification and scope of surface engineering in metals, ceramics, polymers and composites, tailoring of surfaces of advanced materials. Surface protection (Physical) Surface dependent engineering properties, viz., wear, friction, corrosion, fatigue, etc.; common surface initiated engineering failures; mechanism of surface degradation; importance and necessity of surface engineering. Classification & Selection of Cleaning processes. Acid & Alkaline, Salt bath, Ultrasonic, Mechanical cleaning, Pickling & de scaling etc. Process details of each, applications of each Environmental concern of each.

B. Various purposes of Surface engineering

Unit II

Surface Coatings


B. Scope and application of conventionally deposited materials.

Unit III

Thermal Spray coatings

A. Process details of all type of Thermal spray coatings like Flame, Electric, Plasma arc Detonation gun & High velocity Oxy Fuel. Advantages & limitations of each type
B. Applications of all types of Thermal spray coatings

Unit IV
Thin Film Coatings & High Energy processes
(8Hrs)
A. All Process details of Physical vapour deposition & Chemical vapour deposition. Ion implantation. Laser assisted surface modification & Electron beam treatment. Diamond & Diamond like Carbon thin film coatings
B. Applications of the above processes.

Unit V
Characterization of coatings & Recent trends in surface engineering
(8Hrs)
A. Quality Assurance, surface geometry – characterization techniques (conventional and recent trends); coating thickness measurements – laboratory techniques and special techniques for accurate routine thickness measurements; adhesion measurement – conventional methods and recent developments, Measurement of mechanical properties of engineered surface in nano scale; Evaluation of tribological characteristics of engineered surface in macro, micro and nano scale.
B. Tribological coatings for engineering components & their evaluation

Text Books
1. N.J. Persson, Sliding Friction
2. Surface Engineering Process, Fundamentals & Applications Vol 1 & 2 Lecture notes Of SERC school on Surface Engineering

Reference Books
1. The Friction and Lubrication of Solids, Frank Philip Bowden, Oxford Classic Texts
2. Engineering Tribology, Gwion Stachowiak, A W Batchelor,
3. Surface Engineering, ASM Hand Book, Vol. 5,
IP42160:: SURFACE ENGINEERING

Teaching Scheme: - Tutorial 1 Hr/Week

Prerequisites: :

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Mapping with PEOs: III (b, g, h)

List of Contents
1. Preparation of Substrate by Acid & Alkaline, Salt bath, cleaning for surface treatments.
2. Preparation of Substrate by Ultrasonic and Mechanical cleaning for surface treatments.
3. Various purposes of Surface engineering
4. Electroplating – Theory of electro plating
5. Plating of non metallic materials
6. Study of Diffusion coatings like carburising, nitriding, cyaniding, hot dipping
7. Study of Diffusion coatings like galvanizing, anodizing, Aluminising, Phosphetising
8. Study of various type of Thermal spray coatings like Flame, Electric, Plasma arc Detonation gun & High velocity Oxy Fuel.
9. Study of Thin Film Coatings & High Energy processes
10. Wear testing of Wear resistant coatings.
11. Coating thickness measurement.
12. Case depth measurements of surface hardened components.

Text Books
1. N.J. Persson, Sliding Friction
2. Surface Engineering Process , Fundamentals & Applications Vol 1 & 2
3. Lecture notes Of SERC school on Surface Engineering

Reference Books
IP42162: PRODUCT DESIGN & NEW PRODUCT DEVELOPMENT

Credits: 04

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of the contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject.
- Mapping with PEOs: I (d, h)

Unit I (8 Hrs)
B:- Function trees system functionality, augmentation, Aggregation, common basis, functional modeling methods.

Unit II (8 Hrs)
A:- Product tear down and experimentation, benchmarking and establishing engineering specification. Product portfolios and portfolio architecture. Tear down process, tear down methods, post teardown reporting, benchmarking approach, support tools, setting specifications.
B:- Portfolio architecture, types, platform, functional architecting, optimization selection. Product modularity, modular design

Unit III (8 Hrs)
A:- Concepts and Modeling, Generation of concepts, information gathering and brain storming, directed search, morphological analysis, combining solutions. Decision making, estimation of technical feasibility, concept selection process, selection charts, measurement theory, numerical concept scoring, design evaluation scheme, concept embodiment, geometry and layout, system modeling, modeling of product metrics,
B:- Selection of model by performance specifications, physical prototyping, informal and formal models.

Unit IV (8 Hrs)
A:- Design materials & human factors in product design, material properties, metals,
plastics, rubber, woods & factors considered while designing for metals, plastics, rubber, woods etc. Anthropometry factors, physiological factors, psychology factors, anatomy factors. **Economic factors influencing design**, product value, safety, reliability & environmental considerations, Economic analysis, break even analysis, profit & competitiveness, Economic of a new product design.

**B:-** Case study based upon Economic analysis, break even analysis, profit & competitiveness, Economic of a new product design.

**Unit V**

**A:- Value engineering in product design & Modern Approaches to Product Design**


**B:-** Techniques to reduce environmental impact like minimum material usage, disassembly, recycle ability, remanufacturing, high impact material reduction, energy efficiency, regulation and standards, Value analysis tests with examples in the form of case studies.

**Text Books**

1. Otto, Product Design, Pearson Education
4. Trott, Innovation Management & New Product Development, 4/e, Pearson Education

**Reference Books**

4. Product Design for manufacturing and Assembly Geoffrey Boothroyd, peter dewhurst, Winstn Knight Marcel Dekker Inc., USA.
5. Product Design: A practical guide to systematic methods of new product development, Mike Baxter, Champman and Hall.
IP42162:: PRODUCT DESIGN & NEW PRODUCT DEVELOPMENT

Teaching Scheme: Tutorial 1 Hr/Week

Prerequisites:

Objectives:
• To make the students understand the concepts & broad principles of contents of the course
• Develop conceptual framework of the course
• Aim is to provide insight of the subject
• Mapping with PEOs: I (d, h)

List of Assignments
1) Assignment On Product Development Process
2) Assignment on Modeling process
3) Assignment on product tear down
4) Assignment on Optimization Selection
5) Assignment on Numerical concept scoring & System modeling
6) Assignment on physical prototyping,
7) Assignment on Break Even Analysis
8) Assignment on Profit & Competitiveness,
9) Assignment on Economic of a new product design
10) Assignment on Quality Function Development (QFD)
11) Assignment on value analysis job plan
12) Assignment on Product Life Cycle Management

Text Books

Reference Books
1. Product design & Manufacture- Jhon R Lindbeck
4. Company 19811.Indistrial Design - Mayall
IP42164 :: ENTREPRENEURSHIP DEVELOPMENT

Credits: 04
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites:
GENERAL ENTREPRENEURSHIP TENDENCY TEST.
Students need to exhibit and possess the will to develop entrepreneurship tendencies. Students who are keen on starting their own business alone may take this course. All branch students should be permitted to take this course. 15% seats reserved for the industrial and production engineering department. Students will be required to choose a line of business and try to implement those ideas during the course of the semester as though they were actually doing business.

Objectives:
- To provide the motivational inputs to students to become entrepreneurs
- To enable students to understand the importance of national wealth generation
- To teach students the legal formalities of starting a business with a few assignments
- To teach students to make efficient business cases identify opportunities and apply for loans to become independent business persons.
- To sensitizes the students with the importance of being self employed professionals on the planet instead of slavishly working under someone else.
- Major objective is to ensure that they become entrepreneurs and actually start a business and not just become bookworms of an entrepreneurship academic subject
- Mapping with PEOs: V (j, i)

Unit I (8 Hrs)
Introduction Motivation Inputs To Entrepreneurship


B. Administration inputs to entrepreneurship – planning scheduling, time management

Unit II (8 Hrs)
Legal inputs to entrepreneurship


B: Shop ACT Business cards, venue Ambience,

Unit III (8 Hrs)
Business opportunity identification inputs to entrepreneurship


B. How to formulate a business and project plan. Project counseling to students

Unit IV (8 Hrs)
Marketing Inputs To Entrepreneurship

A. What to sell and how to sell ?: Market research and survey, overview on methods of forecasting, launching and marketing the products and services, sales and distribution, project feasibility study – market feasibility, technical feasibility, sources of finance, financial feasibility – project costing and budgeting, product costing. Where to find finance and how to get project finance for a business; Legal input to a business Marketing inputs to entrepreneurship: How to prepare a business plan and strategise. How to identify the right strategy for market development. Exploiting an attractive market. Creating competitive advantages for the market. Creating the right strategy. Inputs for strategy development

B. Vision and Strategy planning, Product / Process evaluation assignment for chosen business.

Unit V (8 Hrs)
Problem solving inputs to entrepreneurship

A. How to solve problems as and when they arrive? Business crisis and how to solve them when they arise. Review of Cash crisis Starting Crisis, Delegation crisis, Management crisis and Succession crisis. Review of methods to solve each crisis. Methods to solve new crisis which may arrive in the future. Review of luck and the business cycle.
B. Tax and relativity of moral ethics in adverse business (corrupt) environments.

Text Books
2. Class notes on entrepreneurship

Reference Books
1. Dr J. S. Juneja, Small and Medium Enterprise: Challenges and opportunities
2. Kondalah, chukka; Enterprise in the new millennium, McGraw-Hill publication
4. Gopal & Ramamurthy; Project management Handbook, Macmilan.
5. Prassanna Chandra; Preparation, Appraisal, Budgeting and Implementation.
Prerequisites: Nil

Objectives:
- To provide the motivational inputs to students to become entrepreneurs
- To enable students to understand the importance of national wealth generation
- To teach students the legal formalities of starting a business with a few assignments
- To teach students to make efficient business cases identify opportunities and apply for loans to become independent business persons.
- To sensitizes the students with the importance of being self employed professionals on the planet instead of slavishly working under someone else.
- **Major objective is to ensure that they become entrepreneurs and actually start a business and not just become bookworms of an entrepreneurship academic subject**
- Mapping with PEOs: V (j, i)

List of Contents
A TERM-WORK containing the record of the following:

Assignments:
1. Administration inputs to entrepreneurship – planning scheduling, time management
2. Preparation of Business cards
3. How to formulate a business and project plan
5. Market potential analysis of the business.
6. Tax and relativity of moral ethics in adverse business (corrupt) environments.
7. Study of Shop ACT

Text Books
2. Class notes on entrepreneurship

Reference Books
1. Dr J. S. Juneja, Small and Medium Enterprise: Challenges and opportunities
2. Kondalah, chukka; Enterprise in the new millennium, McGraw-Hill publication

5. Prassanna Chandra; Preparation, Appraisal, Budgeting and Implementation.
IP42176:: POWDER METALLURGY

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:

- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Mapping with PEOs: III (b, c, h)

Unit I

Powder Production


B. Historical development , Basic principles of Powder Metallurgy

Unit II

Compaction

A. Fundamentals of compaction, presses used, selection of presses, Automation and Handling of powder, tool clearances, Die design principles, wear reclamation, Die and punch materials selection and heat treatment, surface treatment properties, compact density variations, effect of blending powders, lubricants and lubrication in process. Pressure less powder shaping.

B. Improvement of press tool life

Unit III

Sintering


B. Sintering atmosphere and its impact on process performance
Unit IV  
(8 Hrs)

Special P.M. Processes & Secondary Operations

A. Secondary operations like sizing, coining, Oil impregnation, heat treatments, Steam treatment. Special PM processes like Hot Compaction, Iso static pressing, Hot Iso static compaction merits, demerits and typical applications. Powder metal products with polymer blends, Powder roll compaction. P.M. Forging, Powder Extrusion, Injection molding, Spray deposition forming.

B. Comparison between various special PM processes.

Unit V  
(8 Hrs)

Powder Metallurgy Applications & Economics

A. Production details of common PM structural parts like gears, levers, ratchets, etc, lamp filament and filament support, refractory metal components, electrical contact material, Cemented Carbide tools and wear parts, brakes and clutch lining material, porous bearings and filters, catalytic components etc. Advantages and limitations of powder metallurgy. Production of nano composites.

B. Economics, Quality assurance, Manufacturing Competitiveness due to conservation of energy, Materials, Operations, Durability, rigidity, near net – shape, surface finish and machining.

Text Books


Reference Books

IP42176:: POWDER METALLURGY

Credits: 01

Teaching Scheme: Tutorial 1 Hr/Week

Prerequisites:

Objectives:
- Introduce students to basic concepts in powder metallurgy
- Make students understand the applications of powder metallurgy in manufacturing applications
- Mapping with PEOs: III (b, c, h)

A TERM-WORK containing the record of the following:

2. Powder characterization & its effects on properties of sintered parts.
4. Study of various compaction presses
5. Study of methods for improvement in tool life.
6. Study of Theories of sintering mechanism
7. Study of sintering furnaces-characteristics and selection
8. Testing of sintered parts.
9. Study of protective atmospheres, their production & control.
10. Recent developments in cutting tools.
11. Special PM processes like Hot Compaction, Iso static pressing, Hot Iso static compaction
12. Applications of powder metallurgy in engineering components.

Text Books

Reference Books
1. Powder Metallurgy Handbook, ASME
FF No. 654

IP40172:: DIE & MOULD TECHNOLOGY

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: IV (f, o)

Unit I

Introduction to Press Working

A. Press working terminology, Basic operations, types of presses- mechanical, hydraulic, pneumatic and their mechanisms, elements of die sets, types of die sets, types of dies - simple, compound, progressive, combination and inverted dies, types of punches
B. Methods of reduction of shear force, types of strip layouts, types of strippers, types of pilots, types of stoppers, selection of dowel pins and allen screws

Unit II

Design of Blanking & Progressive dies

A. Shearing force, press capacity, clearances, die & punch size types of strippers, types of pilots, types of stoppers, selection of dowel pins & allen screws., center of pressure of progressive die
B. Problems on progressive and blanking die design.

Unit III

Design of Drawing & Bending Dies

A. Deep drawing mechanism, Design of deep drawing die: blank size, no of draws, drawing punch and die size, drawing force, press capacity and ironing.
B. Types of Bending dies, developed length calculation, bending force, spring back & methods used to overcome it, press brake.

Unit IV
Design of Forging Dies
A. Design of forging die for multi-impression die:- selection of parting line, drafts, fillet & corner radii, ribs & webs, stock size calculation, flash & gutter, design of fullering, edging, blocking, finishing impressions, trimming dies, Die block dimensions, die inserts.
B. Design of upset forging die: Up setters, stock size calculation, Rules for upset forging

Unit V
Design of Injection Molds
A. Determination of number of cavities, types of cooling system, design of cooling channels, heat transfer considerations, types of ejectors, determination of mould opening force & ejection force
B. Types of runners & gates, design of runners & gates

Text Books

Reference Books
2. P. C. Sharma, Production Engineering, S. Chand
3. Dr. Surender Kumar, Production Engg. Design (Tool Design), Satya Prakashan
4. R. G. W. Pye, Injection Mould Design (Design manual for plastic industry), EWP
IP40168:: PROCESS ENGINEERING

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Knowledge about basic machining processes and tooling

Objectives:

- To develop the Process planning skill for the manufacturing
- Mapping with PEOs: II (h, i)

Unit I  
Product and Process Engineering

A. Product and Process Engineering, Dimensional and tolerance analysis, Types of dimensions, Measuring geometry of form –Flatness, parallelism, straightness, Tolerance analysis-causes of work piece variations, to express limits and tolerance, tolerance stack, purpose of tolerance chart, Rules for adding and subtracting, layout of tolerance chart

B. General Manufacturing processes, Product Engineering, DFM, DFMA, Process Engineering, communications, squareness, angularity, roundness, concentricity and eccentricity, symmetry surface quality and surface integrity, surface finish affecting product properties and product cost, base lines, direction of specific dimensions

Unit II  
Work piece Control & Classifying operations

A. Work piece Control & Classifying operations, concept of location, geometrical control, dimensional control, mechanical control, alternate location, Classifying operations, qualifying and requalifying operations

B. Equilibrium theories, Basic process operations, principal process operations, major operations, auxiliary process operations.

Unit III  
Selection of Equipment and toolings


B. General purpose, special purpose machines, jigs fixtures moulds, pattern, core boxes, dies, templates, gauges.
Unit IV

Selecting and planning the process

A. Selecting and planning the process, Function, Economy and appearance, fundamental rules for manufacturing process, eliminating operations, combined operations, selecting proper tooling, availability of equipment, effect of operations speed on performance of economy, make or buy decision. Computer aided process planning.
B. Engineering approach, basic design of product, influence of process engineering on product design, specifications, materials and its cost analysis.

Unit V

Process sheet design

A. Process sheet design, Determining manufacturing sequence, Factors for operation sequence, major process sequence, Operation routing, process picture, process picture sheet, processing dimensions and views
B. combining operations, routing uses routing description.

Text Books
2. Computer aided process planning, P. W. Wang, J. Kelly
3. System approach to computer integrated design and manufacturing, Nanu singh

Reference Books
2. Manufacturing catalogues for cutting tools and inspection equipments
3. CAD\CAM\CIM- P. Radhakrishnan , S. Subrmaniyum, V. Raju, New Age International Pvt Ltd
IP40372:: DIE & MOULD TECHNOLOGY

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Application of the theory
- Mapping with PEOs: III (b, p, r)

List of Practical
1. Basic sheet metal working operations and their applications
2. Types of presses and their mechanisms and its selection.
3. Types of dies and die sets and its selection
4. To determine the center of pressure for simple blanking die and progressive die.
5. To design the strip layout, % utilization and scrap development for the given component.
6. To design Punch and die for simple blank with selection of hardware, stripper & stopper
7. To design Punch and die for progressive die with selection of pilot, hardware, stripper & stopper
8. Deep drawing die design: Blank size, no of draws, drawing force and punch and die design.
9. To determine the developed length of bend components, bending force and die
10. Forging die design for closed die forging
11. Upsetting die design for upset forging
12. Injection mould design for the given component.

Text Books
2. Computer aided process planning, P. W. Wang, J. Kelly
3. System approach to computer integrated design and manufacturing, Nanua singh
Reference Books
2. Manufacturing catalogues for cutting tools and inspection equipments
3. CAD\CAM\CIM- P. Radhakrishnan, S. Subrmaniyum, V. Raju, New Age International Pvt Ltd
4. Manufacturing Systems Engg, K. Hitomi, John Willey Groover Mikell, P.
IP40368:: PROCESS ENGINEERING

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Mapping with PEOs: II (h, i)

List of Practicals
1. Process parameters and machining time determination of lathe operations.
2. Process parameters and machining time determination of milling operations.
3. Process picture conventions
4. Process sheet format
5. Dimensional and tolerance analysis of part print.
7. Identification of locating areas on work piece.
8. Identification of clamping, holding areas on work piece
9. Process sheet design of one component for mass production
10. Process sheet design of one component CNC for batch production
11. Time estimation for assembly using flow charting techniques
12. Industrial visit to study process designing and its report

Text Books
2. Computer aided process planning, P. W. Wang, J. Kelly
3. System approach to computer integrated design and manufacturing, Nanua singh

Reference Books
2. Manufacturing catalogues for cutting tools and inspection equipments
3. CAD\CAM\CIM- P. Radhakrishnan , S. Subrmaniyum, V. Raju, New Age International Pvt Ltd
IP47352:: MAJOR PROJECT

Credits: 6

Teaching Scheme: - Practical 12 Hrs/Week

Objectives:
- To train the students to apply their engineering knowledge to real life problem solving.
- To train the students to plan, implement and execute project work so as to satisfy the stated objectives of the project.
- Mapping with PEOs: IV (e, f, g, i, n)

The project work could be of the following nature:
1. Manufacturing / Fabrication of a prototype machine including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.
2. Improvement of existing machine / equipment / process.
3. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, inspection gauges, measuring instruments for machine tools.
4. Computer aided design, analysis of components such as stress analysis.
5. Problems related to Productivity improvements.
6. Problems related to value engineering.
7. Problems relating to material handling system.
10. Product design and development.
11. Analysis, evaluation and experimental verification of any engineering problem encountered.
13. Quality improvements, In-process Inspection, Online gauging.
15. Time and Motion study, Job evaluation.
16. Ergonomics and safety aspects under industrial environment
17. Management Information System.
18. Market Analysis in conjunction with Production Planning and Control.

OR

Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hi-tech systems and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system (s) and its validation or comparison with available benchmarks / results. Modelling/simulation of product(s), mechanism(s) or system(s) and its validation or comparison with available bench marks / results. Design/development and
Fabrication of models, machines, and prototypes based on new ideas, robotic and automation systems, Experimental set ups, test rigs/ equipments.

The project work shall be taken up individually or in a group consisting of not more than 4 students.

A report containing maximum 30 pages shall be submitted based on the background, need and scope of the project, project specifications, activities involved in the project and activity plan, study of literature and basic theory, and work completed (if any).

**Guidelines:**

- Report shall be typed or printed.
- Figures and tables shall be on separate pages and attached at respective positions.
- Project title and approval sheets shall be attached at the beginning of the report followed by index and synopsis of the project.
- References shall be mentioned at the end followed by appendices (if any).
- When a group of students is doing a project, names of all the students shall be included on every certified report copy.
- Each group of students shall submit two copies of reports to the institute and one copy shall be prepared for each individual student.