# DIPLOMA IN MECHANICAL ENGINEERING
## SCHEME OF INSTRUCTIONS AND EXAMINATIONS
### (FIRST YEAR)

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Name of the Subject</th>
<th>Instruction period / week</th>
<th>Total Period / year</th>
<th>Scheme of Examination</th>
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<tr>
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**THEORY:**

**PRACTICAL:**

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<td>Basic Workshop practice</td>
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<td>109-A Physics Lab</td>
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<td>ME-110</td>
<td>Comp. fundamentals practice</td>
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**TOTAL**

1260

1000
ENGINEERING MECHANICS

Subject Title : Engineering Mechanics  
Subject Code : M-105
Periods/Week : 04
Periods per year : 120

TIME SCHEDULE

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OBJECTIVES

Up on completion of the course the student shall be able to

1.0 Understand the concept of Statics
   1.1 Explain the meaning of mechanics in engineering.
   1.2 Understand the importance of mechanics in engineering.
   1.3 Review the system of units used.
   1.4 Understand the concept of force, types of forces and force systems
   1.5 Understand the concept of equilibrium
   1.6 Explain the parallelogram law of forces, triangle law of forces, polygon law of forces and Lamé's theorem.
   1.7 Understand the concept of free body diagram
   1.8 Solve the problems involving concurrent coplanar forces
   1.9 State the term couple and moment of couple with legible sketch.
   1.10 State the condition of equilibrium of a body acted upon by co-planar forces.
   1.11 Solve simple problems involving non-concurrent coplanar forces

2.0 Understand the concept of Friction
   2.1 Understand the concept of friction
   2.2 State the laws of friction
   2.3 Identify the machine members in which friction exists and desirable
   2.4 Resolve the forces acting on bodies moving on horizontal plane.
   2.5 Resolve the forces acting on bodies moving along the inclined planes.
   2.6 Solve the related numerical problems
3.0 **Understand the Geometric Properties of Sections**

3.1 Define the terms Centre of Gravity, Centre of Mass and Centroid.
3.2 Locate the C.G. of a given section.
3.3 Explain the meaning of the term moment of Inertia.
3.4 State perpendicular axis theorem
3.5 State Parallel axis theorem
3.6 Prove perpendicular axis theorem
3.7 Prove Parallel axis theorem
3.8 Calculate the moment of Inertia of composite sections.
3.9 Explain the term radius of gyration.

4.0 **Understand the concept of Dynamics**

4.1 Define the terms Kinematics and Kinetics
4.2 Classification of motion
4.3 Define the terms displacement, velocity and acceleration
4.4 State the Newton's Laws of motion (without derivation)
4.5 Solve the problems related to the rectilinear motion of a particle
4.6 Explain the Motion of projectile
4.7 Solve the numerical problems
4.8 D'Alembert's principle
4.9 Define Law of conservation of energy
4.10 Explain the Work-Energy principle
4.11 Define the Law of conservation of momentum
4.12 Explain the Impulse –momentum equation
4.13 Solve the problems using the above principles
4.14 Explain the Rotary motion of particle
4.15 Define Centripetal force.
4.16 Define Centrifugal force.
4.17 Differentiate Centripetal and Centrifugal forces
4.18 Describe simple harmonic motion.
4.19 Explain the application of simple harmonic motion in engineering.

5.0 **Comprehend the Principles involved in Simple Machines**

5.1 Define the terms Machine, Mechanical Advantage, Velocity Ratio and Efficiency.
5.2 Illustrate the use of three classes of simple lever.
5.3 Show that an inclined plane is a simple machine to reduce the effort in lifting loads.
5.4 Derive expression for VR in cases of wheel & axle, Weston Differential pulley blocks, pulleys, Worm & Worm wheel crabs, screw jack, rack & pinion.
5.5 Compute the efficiency of a given machine.
5.6 Compute effort required to raise or lower the load under given conditions.
5.7 Interpret the law of machine.
5.8 State the conditions for self-locking and reversibility.
5.9 Calculate effort lost in friction and load equivalent of friction.
5.10 Evaluate the conditions for maximum M.A.& Maximum efficiency.
6.0 Understand the concept of Basic Link mechanism
6.1 Define terms like link, kinematics pair, kinematic chain, Mechanism & machine
6.2 Explain kinematic pair and kinematic chain with the help of legible sketch
6.2 List examples for Lower and Higher pairs.
6.3 List examples of inversion.

COURSE CONTENT

1.0 Statics
1.1 The meaning of word mechanics.
1.2 Application of Mechanics to Engineering.
1.3 System of Units.
1.4 Definition and specification of force
1.5 System of forces
1.6 Resolution of force
1.7 Equilibrium and Equilibrant.
1.8 Statement of Parallelogram law of forces, triangle law of forces, polygon law of forces and Lami’s theorem
1.9 Drawing the free body diagram
1.10 Numerical problems related to concurrent coplanar forces
1.11 Couple and moment of a couple
1.12 Condition for equilibrium of a rigid body subjected to number of coplanar non-concurrent forces.
1.13 Related Numerical problems

2.0 Friction
2.1 Definition of static friction, dynamic friction and impending friction
2.2 laws of solid and liquid friction
2.3 Derivation of limiting angle of friction and angle of repose
2.4 Resolution of Forces considering Friction when a body moves on horizontal plane.
2.5 Resolution of Forces considering Friction when a body moves on inclined plane.
2.6 Numerical examples on the above cases

3.0 Geometric Properties of Sections
3.1 Definition and explanation of the terms Centre of Gravity, Centre of Mass and centroid
3.2 Centroid of square, rectangle, triangle, semi-circle and trapezium (formulae only without derivations)
3.3 Centre of gravity of composite sections by analytical method only (T-Section, L-Section I-section and channel section).
3.4 Moment of Inertia.
   a) Definition and Explanation.
   b) Theorems of Moment of Inertia.
      i) Parallel axes theorem.
      ii) Perpendicular axes theorem.
   c) Moment of Inertia for simple Geometrical Sections, Rectangular, circular and triangular section
   d) Radius of Gyration.
3.5 Calculation of Moment of Inertia and Radius of Gyration of
a) I – Section.
b) Channel Section.
c) T – Section.
d) L – Section (Equal & unequal lengths)
e) Built up Sections (Simple cases only)

4.0 Dynamics
4.1 Definition of Kinematics and Kinetics
4.2 Classification of motion
4.3 Definition of displacement, velocity and acceleration
4.4 Laws of motion (without derivation)
4.5 Solving the problems related to the rectilinear motion of a particle
4.6 Motion of projectile and solving the numerical problems
4.7 Newton’s laws of motion.
4.8 D’Alembert’s principle
4.9 Definition Law of conservation of energy
4.10 Work-Energy principle
4.11 Law of conservation of momentum
4.12 Impulse –momentum equation
4.13 Solving the kinetic problems using the above principles
4.14 Rotary motion of particle and laws of motion
4.15 Definition and Differentiate Centripetal and Centrifugal forces.
4.16 Simple harmonic motion.
4.17 Definition of the terms frequency, time period, amplitude and circular frequency
4.18 SHM equation, natural frequency
4.19 Simple problems on SHM

5.0 Simple Machines
5.1 Definition of Simple machine, and uses of simple machine, levers and inclined plane.
5.2 Fundamental terms like mechanical advantage, velocity ratio and efficiency.
5.3 Expressions for VR in case of Simple/Differential pulley/pulleys of 3 systems, Worms and Worm wheel, Rack and pinion, Winch crabs, &Screw jack.
5.4 Conditions for reversibility and self locking.
5.5 Law of Simple Machine.
5.6 Effort lost in friction, Load Equivalent of Friction Max. M.A. and Max. efficiency.

6.0 Basic Link Mechanism
6.1 Definition of terms: link, kinematic pair, kinematic chain, mechanism, structure and machine.
6.2 Quadric cycle chain and its inversions.
6.3 Slider Crank chain and its inversion.
**REFERENCE BOOKS:**

6. Theory of Machines by S.S.Rathan TMH P
WORKSHOP TECHNOLOGY

Subject Title : Workshop Technology
Subject Code : M - 106
Periods per Week : 04
Periods per Year : 120

TIME SCHEDULE

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OBJECTIVES

Up on completion of the course the student shall be able to comprehend the following

1. Comprehend the use of Basic workshop tools and its operation
   a. State the importance of workshop processes.
   b. List the various workshop processes and explain briefly about each.

1.1 Carpentry
   a. Identify various carpentry tools.
   b. Distinguish between marking tools, measuring tools and cutting tools.
   c. List work holding devices.
   d. Explain wood working processes viz., sawing, chiselling and planning.
   e. Explain the use of carpentry joints such as lap joint, dovetail joint, mortise and tenon joint with legible sketch
   f. Explain the working of wood working machines.

1.2 Fitting
   a. List various fitting tools.
   b. Distinguish between marking and measuring tools.
   c. List cutting tools.
   d. List various work holding devices.
   e. List various checking and measuring instruments.
f. Explain fitting operations such as marking, sawing, chipping, filing, grinding, drilling and tapping with legible sketch.

1.3 Forging
a. List various tools used in black-smithy.
b. List equipment used in a forging shop.
c. Explain the important smithy operations.
d. Explain the working principle of machine forging.
e. Explain machine forging operations such as upsetting, drawing down and punching with legible sketch.
f. Explain the working principle of forging press with legible sketch.
g. List the forging defects.

1.4 Sheet Metal
a. List various marking tools in sheet metal work.
b. List various stakes.
c. List various measuring tools used in sheet metal work.
d. List various sheet metal joints.
e. Describe sheet metal operations such as shearing, bending, drawing and squeezing.
f. Differentiate between riveting, soldering & brazing.

2. Drilling
2.1 State the working principle of drilling.
2.2 List out different types of drilling machines.
2.3 Draw the line diagrams of the sensitive and radial drilling machines.
2.4 Identify the parts of these machines.
2.5 Describe the functions of each part.
2.6 Specifications of drilling machines.
2.7 Write the nomenclature of the drill bit.
2.8 Write the geometry of twist drill.
2.9 List the functions of twist drill elements.
2.10 List the different operations on drilling machine.

3. Foundry
3.1 Acquaint with foundry as a manufacturing process.
3.2 State the advantages of casting over other process.
3.3 State the limitations of the process.
3.4 List the various hand moulding tools.
3.5 State the properties of good moulding sand.
3.6 State the types of moulding sands. List the ingredients in foundry sand.
3.7 List the various types of patterns.
3.8 State the sequence of pattern making operations.
3.9 Identify the colour codes.
3.10 List out the various moulding processes.
3.11 State the need and types of cores.
3.12 Describe the casting processes.
3.13 Identify the defects in casting.
3.14 Describe special casting processes.

4. Mechanical working of metals
1.1 Define mechanical working of metals.
1.2 Differentiate cold working with hot working.
1.3 Illustrate the working principle of hot rolling, piercing, spinning, extrusion and drawing.
1.4 State advantages and limitations of hot working.
1.5 Identify various cold working processes such as rolling, bending and squeezing.
1.6 State advantages and limitations of cold working.

COURSE CONTENT

1 Introduction

Methods of manufacturing processes - casting, forming, metal removal processes, joining processes, surface finishing processes, basic workshop processes - carpentry, fitting, hand forging, machine forging, sheet metal work, cold and hot working of metals.

1.1 Carpentry

1.1.1 Marking & measuring tools: scales, rules, fourfold wooden rule, flexible measuring rule (tape), straight edge, try square, bevel square, combination square, marking knife, marking gauge, mortise gauge, cutting gauge, wing compass, trammel, divider, outside calliper, inside calliper, odd leg calliper, spirit level, plum bob, specifications & uses.

1.1.2 Cutting Tools

Saws: ripsaw, cross cut saw (hand saw), panel saw, tenon or back saw, dovetail saw, bow saw, coping saw, compass saw, pad or keyhole saw, specifications & uses.

Chisels: Firmer chisel, bevelled edge firmer chisel, parting chisel, mortise chisel, inside and outside gauges, specifications and uses.

Planes: Jack plane (wooden jack plane, metal jack plane), rough plane, smoothing plane, rebate plane, plough plane, router, spoke shave, special planes and their specifications and uses.

Boring Tools:

Gimlet, braces- wheel brace, ratchet brace, bit-shell bit, twist bit (auger bit), expansive bit, centre bit, router bit, countersink bit, drill, reamer their specifications & uses.

1.1.3 Striking tools:

Hammers - Warrington hammer, claw hammer, mallet, specifications & uses.

1.1.4 Holding devices

Bench vice, bench stop, bench hold fast, sash cramp (bar cramp) G- cramp, Hand screw, specifications & uses.
1.1.5 Miscellaneous tools
Rasps and files, scraper, oilstone, glass paper, pincer, screw driver, cabinet screw driver, ratchet-screw driver, saw set, oil stone slip. specifications and uses.

1.1.6 Carpentry Processes
Marking, measuring, sawing, chiselling, planning, boring, grooving, rebating & moulding.

1.1.7 Carpentry joints
Halving Joint, mortise and tenon joint, bridle joint, butt joint. dowel joint, tongue & groove joint, screw & slot joint, dovetail joint, corner joint.

1.1.8 Wood working machines
Wood working lathe (wood turning lathe), circular saw, band saw, wood planer, sanding machine, belt sander, spindle sander, disc sander and grinder, specifications and uses.

1.3 Fitting

1.3.1 Cutting tools
Chisels: Flat chisel, cross cut chisel, half round chisel, diamond point chisel, side chisel, specifications and uses.
Files: Different parts of a file – sizes and shapes - flat file, hand file, square file, piller file, round file, triangular file, half round files, knife edge file, needle file – specifications and uses.
Scrapers: Flat, triangular, half round scrapers, specifications & uses.
Drill bits: Flat drill, straight fluted drill, twist drill, parallel shank, tapered shank, specifications & uses.
Reamer: Hand reamer, machine reamer, straight and spiral flutes reamers, specifications and uses.
Taps: Hand taps - taper tap, plug tap and bottoming tap, specifications and uses.
Dies & Sockets: Dies - solid, adjustable - specifications and uses.

1.3.2 Striking Tools
Hammers: Parts, ball peen, cross peen, straight peen hammers, soft hammer, sizes, specifications and uses.

1.3.3 Holding Devices
Vices: Bench vice, leg-vice, hand vice, pin vice, tool maker’s vice, pipe vice, care of vices, specifications and uses.

1.3.4 Marking Tools
Surface plate, V-block, angle plate, try square, scriber, punch, prick punch, centre punch, number punch, letter punch, specifications and uses.
1.3.5 **Miscellaneous Tools**
Screw drivers, spanners, single ended & double ended, box type, adjustable spanners, cutting pliers, nose pliers, allen keys, specifications and uses.

1.3.6 **Checking and measuring instruments**
**Checking instruments.**
*Callipers:* Outside&Inside callipers, hermaphrodite (odd leg) calliper with firm joint, spring callipers, transfer calliper sizes & uses, dividers - sizes & uses.

**Measuring instruments:**
Combination square, bevel protractor, universal bevel protractor, sine bar, universal surface gauge, engineer's parallels, slip gauges, plane gauge, feeler gauge, angle gauge, radius & template gauge, screw pitch gauge, telescopic gauges, plate & wire gauge, ring and plug gauges, snap gauges specifications & uses, vernier callipers, vernier height gauge, vernier depth gauge, micrometer - outside & inside, stick micrometer, depth micrometer, vernier micrometer, screw thread micrometer specifications and uses.

1.3.7 **Fitting Operations**
Marking, sawing, chipping, filing, scraping, grinding, drilling, reaming, tapping and dieing.

1.4 **Forging**

1.4.1 **Hand forging tools:** Anvil, swage block, hand hammers - types; sledge hammer, specifications and uses, tongs - types, specifications & uses, chisel - hot & cold chisels specifications & uses. swages - types and sizes, fullers, flatters, set hammer, punch and drift - sizes and uses.

1.4.2 **Equipment:** Open and closed hearth heating furnaces, hand and power driven blowers, open and stock fire, fuels-charcoal, coal, oil gaseous fuels.

1.4.3 **Smith Operations:** Upsetting, drawing down, setting down, punching, drifting, bending, welding, cutting, swaging, fullering and flattering.

1.4.4 **Machine Forging:** Need of machine forging, forging hammers - spring hammer, pneumatic hammer, drop hammer, forging press, hydraulic press - line diagram, machine forging operations - drawing, upsetting, punching, tools used in machine forging.

1.4.5 **Forging defects:** Types and remedies.

1.5 **Sheet Metal Work**

1.5.1 Metals used for sheet metal work.

1.5.2 **Sheet metal hand tools:**
**Measuring tools** - steel rule, circumference rule, thickness gauge, sheet metal gauge, straight edge, scribe, divider, trammel points, punches, chisels, hammers, snips or shears, straight snip,
double cutting shear, squaring shear, circular shear, bench & block shears.

**Stakes:** Double seaming stake, beak horn stake, bevel edged square stake, Hatches stake, needle stake, blow Horn stake, hollow mandrel stake, pliers (flat nose and round nose), grocers and rivet sets, soldering iron, specifications & uses.

1.5.3 **Sheet Metal Operations**

**Shearing:** Cutting off, parting, blanking, punching, piercing, notching, slitting, lancing, nibbling and trimming.

**Bending:** Single bend, double bend, straight flange, edge hem, embossing, beading, double hem or lock seam.

**Drawing:** Deep drawing, shallow or box drawing.

**Squeezing:** Sizing, coining, hobbing, ironing, riveting.

1.5.4 **Sheet Metal Joints**

**Hem Joint:** single hem, double hem & wired edge, seam joint - lap seam, grooved seam, single seam, double seam, dovetail seam, burred bottom seam or flanged seam.

1.5.5 **Fastening Methods**

Rivetting, soldering, brazing & spot welding.

2 **Drilling**

2.1 **Type of drilling machines:** sensitive & radial and their constructional detail and specifications.

2.2 **Drill bits:** Terminology - geometry of twist drill - functions of drill elements.

2.3 **Operations:** Drilling, reaming, boring, counter boring, counter sinking, tapping, spot facing and trepanning.

3 **Foundry.**

3.1 **Introduction:** Development of foundry as a manufacturing process, advantages and limitations of casting over other manufacturing processes.

3.2 **Foundry equipment:**

**Hand moulding tools:** shovel, riddle, rammers, trowels, slicks, lifter, strike - off bar, spruepin bellow, swab, gate cutter, mallet, vent rod, draw spike, rapping plate or lifting plate, pouring weight, gagger, clamps, spirit level, moulding boxes, snap box & flash box.

3.3 **Sands:** Properties of moulding sand - porosity, flowability, collapsibility, adhesiveness, cohesiveness and refractoriness.

3.4 **Types of moulding sand:** green sand, dry sand, loam sand, facing sand, backing sand, parting sand, core sand, system sand their ingredients and uses.

3.5 **Pattern making:** Materials such as wood, cast Iron, aluminium, brass, plastics their uses and relative advantages, classification of patterns such as solid (one piece), two piece and three pieces, split patterns, gate patterns and shell patterns, sequence in pattern making, pattern allowances and colour codes.
3.6 **Cores**: Need of cores, types of cores.
3.7 Casting: green sand and dry sand moulding, cement bonded moulding, shell moulding, ceramic moulding, defects in castings and their remedies.
3.8 Special casting processes: (Principles and applications only) die casting – hot chamber and cold chamber, centrifugal casting, CO$_2$ process, investment casting.

4 **Mechanical working of metals**

4.1 **Introduction**: Hot working and cold working
4.2 **Hot working processes**: rolling - types of rolling, two high mill, three high mills, four high mills, piercing or seamless tubing, drawing or cupping, spinning, extrusion - direct or forward extrusion, indirect or backward extrusion, tube extrusion, Impact extrusion.
4.3 Effects of hot working of metals, advantages & limitations of hot working of metals.
4.4 **Cold working process**: Rolling, drawing - wire drawing, tube drawing, bending, roll forming, angle bending, spinning, extrusion, squeezing, cold heading, thread rolling, peening.
4.5 Effects of cold working of metals, advantages & limitations of cold working.

**REFERENCE BOOKS**

1. Production Technology by Jain & Gupta (Khanna Publishers)
2. Elementary Workshop Technology by Hazra Chowdary & Bhattacharya (Media Promotors)
4. Workshop Technology Vol I & II by Raghuvamshi
The Course is aimed at developing basic graphic skills so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation.

Pre-Requisite: Clear visualization and sound pictorial intelligence

OBJECTIVES

On completion of this subject the student shall be able to

1.0 Understand the basic concepts of Engineering Drawing
   1.1 State the importance of drawing as an engineering communication medium.
   1.2 State the necessity of I.S. Code of practice for Engineering Drawing.
   1.3 Explain the linkages between Engineering drawing and other subjects of study in diploma course.
2.0 **Use of Engineering Drawing Instruments (No. of drawing plates: 01)**

2.1 Select the correct instruments and draw lines of different orientation.
2.2 Select the correct instruments and draw small and large Circles.
2.3 Select the correct instruments for measuring distances on the drawing.
2.4 Use correct grade of pencil for different types of lines, thickness and given function.
2.5 Select and use appropriate scales for a given application.
2.6 Identify different drawing sheet sizes as per I.S. and Standard Lay-outs.
2.7 Prepare Title block as per I.S. Specifications.
2.8 Identify the steps to be taken to keep the drawing clean and tidy.

**Drawing Plate 1:** (Having two exercises)

3.0 **Write Free Hand Lettering and Numbers (No. of drawing plates: 01)**

3.1 Write titles using sloping lettering and numerals as per B.I.S (Bureau of Indian standards)
3.2 Write titles using vertical lettering and numerals as per B.I.S.
3.3 Select suitable sizes of lettering for different layouts and applications.
3.4 Practice the use of lettering stencils.

**Drawing plate 2:** (Having 5 to 6 exercises)

4.0 **Understand Dimensioning Practice (No. of drawing plates: 01)**

4.1 State the need of dimensioning the drawing according to accepted standard.
4.2 Define “Dimensioning”.
4.3 Identify notations of Dimensioning used in dimensioned drawing.
4.4 Identify the system of placement of dimensions in the given dimensioned drawing.
4.5 Dimension a given drawing using standard notations and desired system of dimensioning.
4.6 Dimension standard features applying necessary rules.
4.7 Arrange dimensions in a desired method given in a drawing.
4.8 Identify the departures if any made in the given dimensioned drawing with reference to SP-46-1988, and dimension the same correctly.

**Drawing Plate 3:** (Having 08 to 10 exercises)

5.0 **Apply Principles of Geometric Constructions**

5.1 Divide a given line into desired number of equal parts internally.
5.2 Draw tangent lines and arcs.
5.3 General method to construct any polygon.
5.4 Introduction to conics
5.5 Construction of ellipse, parabola and hyperbola by general method
5.5 Construct ellipse by concentric circles method
5.6 Construct parabola by rectangle method, rectangular hyperbola, involute, cycloid and helix from the given data.
5.7 State the applications of the above constructions in engineering practice.
Drawing Plate -4: Draw one plate having problems up to construction of polygon
Drawing Plate -5: Draw one plate having problems of construction of conics
Drawing Plate -6: Draw one plate having problems of construction of involute, cycloid and helix

6.0  **Apply Principles of Projection of points, lines, planes & solids**  
(No. of Drawing Plate: 03)

6.1 Visualize the objects
6.2 Introduction to I-angle and III-angle projections
6.3 Draw the projection of a point with respect to reference planes (HP & VP)
6.4 Draw the projections of straight lines with respect to two references Planes (up to lines parallel to one plane and inclined to other plane)
6.5 Draw the projections of planes (up to planes perpendicular to one plane and inclined to other plane)
6.6 Draw the projections of solids (up to axis of solids parallel to one plane and inclined to other plane)

Drawing Plate -7: Draw one plate having problems up to projection of points and Lines (15 exercises)
Drawing Plate -8: Draw one plate having problems of projection of planes  
(6 exercises)
Drawing Plate -9&10: Draw Two plates having problems of projection of solids  
(total 10 exercises)

7.0  **Understand the need for auxiliary views**
7.1 State the need of Auxiliary views for a given engineering drawing.
7.2 Draw the auxiliary views of a given engineering component
7.3 Differentiate between auxiliary view and apparent view

Drawing plate No.11: (Having 4 exercises)

8.0  **Appreciate the need of Sectional Views**
8.1 Explain the need to draw sectional views.
8.2 Select the section plane for a given component to reveal maximum information.
8.3 Explain the positions of section plane with reference planes
8.4 Differentiate between true shape and apparent shape of section
8.5 Draw sectional views and true sections of regular solids discussed in 6.0
8.6 Apply principles of hatching.

Drawing Plate – 12: Draw one plate having problems of section of solids  
(6 exercises)
9.0 **Apply principles of orthographic projection (No. of plates: 04)**

9.1 Explain the principles of orthographic projection with simple sketches.

9.2 Prepare an Engineering drawing of a given simple engineering part in first angle projection.

9.3 Draw the orthographic view of an object from its pictorial drawing.

9.4 Draw the minimum number of views needed to represent a given object fully.

Drawing Plate 13: (Having 10 to 12 exercises)

10.0 **Prepare pictorial drawings**

10.1 State the need of pictorial drawings.

10.2 Differentiate between isometric scale and true scale.

10.3 Prepare Isometric views for the given orthographic drawings.

Drawing plate 14: (Having 10 to 12 exercises)

11.0 **Interpret Development of surfaces of different solids**

11.1 State the need for preparing development drawing.

11.2 Prepare development of simple engineering objects using parallel line and radial line method.

11.3 Prepare development of surface of engineering components like trays, funnel, 90° elbow & rectangular duct.

Drawing plate No. 15: (Having 10 exercises)
### KEY competencies to be achieved by the student

<table>
<thead>
<tr>
<th>S.No</th>
<th>List of Practical</th>
<th>Key Competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Importance of Engineering Drawing</td>
<td>• Explain the linkages between Engineering drawing and other subjects of study in Diploma course.</td>
</tr>
<tr>
<td>2.</td>
<td>Engineering Drawing Instruments</td>
<td>• Select the correct instruments to draw various entities in different orientation</td>
</tr>
<tr>
<td>3.</td>
<td>Free hand lettering &amp; Numbering</td>
<td>• Write titles using sloping and vertical lettering and numerals as per B.I.S (Bureau of Indian standards)</td>
</tr>
<tr>
<td>4.</td>
<td>Dimensioning Practice</td>
<td>• Dimension a given drawing using standard notations and desired system of dimensioning</td>
</tr>
<tr>
<td>5.</td>
<td>Geometrical construction</td>
<td>• Construct ellipse, parabola, rectangular hyperbola, involute, cycloid and helix from the given data.</td>
</tr>
<tr>
<td>6.</td>
<td>Projection of points, Lines, Planes &amp; Solids</td>
<td>• Draw the projection of a point, straight lines, planes &amp; solids with respect to reference planes (HP&amp; VP)</td>
</tr>
<tr>
<td>7.</td>
<td>Auxiliary views</td>
<td>• Draw the auxiliary views of a given Engineering component</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Differentiate between Auxiliary view and apparent view</td>
</tr>
<tr>
<td>8.</td>
<td>Sectional views</td>
<td>• Differentiate between true shape and apparent shape of section</td>
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<tr>
<td></td>
<td></td>
<td>• Use conventional representation of Engineering materials as per latest B.I.S. Code.</td>
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<tr>
<td></td>
<td></td>
<td>• Apply principles of hatching.</td>
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<tr>
<td></td>
<td></td>
<td>• Draw simple sections of regular solids</td>
</tr>
<tr>
<td>9.</td>
<td>Orthographic Projection</td>
<td>• Draw the minimum number of views needed to represent a given object fully.</td>
</tr>
<tr>
<td>10.</td>
<td>Pictorial drawing</td>
<td>• Differentiate between isometric scale and true scale.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Draw the isometric views of given objects.</td>
</tr>
<tr>
<td>11.</td>
<td>Development of surfaces</td>
<td>• Prepare development of Surface of Engineering components like trays, funnel, 90° elbow &amp; rectangular duct.</td>
</tr>
</tbody>
</table>
COURSE CONTENT

NOTE

1. I.S. / B.S Latest Specification should invariably be followed in all the topics.
2. A-3 Size Drawing Sheets are to be used for all Drawing Practice Exercises.

1.0 The importance of Engineering Drawing

2.0 Engineering drawing Instruments
Classifications: Basic Tools, tools for drawing straight lines, tools for curved lines, tools for measuring distances and special tools like mini drafter & drafting machine – Mentioning of names under each classification and their brief description
-Scales: Recommended scales reduced & enlarged
-Lines: Types of lines, selection of line thickness - Selection of Pencils
-Sheet Sizes: A0, A1, A2, A3, A4, A5, Layout of drawing sheets in respect of A0, A1, A3 sizes, Sizes of the Title block and its contents - Care and maintenance of Drawing Sheet, Drawing plate:
Lay out of sheet – as per SP-46-1988 to a suitable scale.
Simple Exercises on the use of Drawing Instruments. Importance of Title Block.

3.0 Free hand lettering & numbering
Importance of lettering – Types of lettering
-Guide Lines for Lettering
Recommended sizes of letters & numbers - Advantages of single stroke or simple style of lettering - Use of lettering stencils

4.0 Dimensioning practice
Purpose of engineering Drawing, need of I.S.I code in dimensioning
-Shape description of an Engineering object -Definition of Dimensioning size description
-Location of features, surface finish, fully dimensioned Drawing -Notations or tools of dimensioning, dimension line extension line, leader line, arrows, symbols, number and notes, rules to be observed in the use of above tools

5.0 Geometric Construction
Division of a line: to divide a straight line into given number of equal parts internally examples in engineering application.
Construction of tangent lines: to draw tangent lines touching circles internally and externally.
Construction of tangent arcs
i) To draw tangent arc of given radius to touch two lines inclined at given
angle (acute, right and obtuse angles).

ii) Tangent arc of given radius touching a circle or an arc and a given line.

iii) Tangent arcs of radius \( R \), touching two given circles internally and externally.

Construction of polygon: construction of any regular polygon of given side length using general method

Conical Curves: Explanation of Ellipse, Parabola, Hyperbola, as sections of a double cone and a loci of a moving point, Eccentricity of above curves – Their Engg. application viz. Projectiles, reflectors, P-V Diagram of a Hyperbolic process,

Construction of any conic section of given eccentricity by general method

Construction of ellipse by concentric circles method

Construction of parabola by rectangle method

Construction of rectangular hyperbola

General Curves: Involute, Cycloid and Helix, explanations as locus of a moving point, their engineering application, viz, Gear tooth profile, screw threads, springs etc. - their construction

6.0 **Projection of points, lines and planes & solids**

Projecting a point on two planes of projection - Projecting a point on three planes of projection - Projection of straight line.

(a) Parallel to both the planes.

(b) Perpendicular to one of the planes.

(c) inclined to one plane and parallel to other planes

Projection of regular planes

(a) Plane perpendicular to HP and parallel to VP and vice versa.

(c) Plane perpendicular to HP and inclined to VP and vice versa.

Projection of regular solids

(a) Axis perpendicular to one of the planes

(b) Axis parallel to VP and inclined to HP and vice versa.

7.0 **Auxiliary views**

Need for drawing auxiliary views - Explanation of the basic principles of drawing an auxiliary views explanation of reference plane and auxiliary plane - Partial auxiliary view.

8.0 **Sectional views**

Need for drawing sectional views – what is a sectional view - Location of cutting plane – Purpose of cutting plane line – Selection of cutting plane to give maximum information (vertical and offset planes) - Hatching – Section of regular solids inclined to one plane and parallel to other plane

9.0 **Orthographic Projections**

Meaning of orthographic projection - Using a viewing box and a model – Number of views obtained on the six faces of the box, - Legible sketches of only 3 views for describing object - Concept of front view, top view, and side view sketching these views for a number of engg objects - Explanation of first angle projection. – Positioning of three views in First angle projection - Projection of points as a
means of locating the corners of the surfaces of an object – Use of miter line in drawing a third view when other two views are given - Method of representing hidden lines - Selection of minimum number of views to describe an object fully.

10.0 Pictorial Drawings

Brief description of different types of pictorial drawing viz., Isometric, oblique, and perspective and their use - Isometric drawings: Iso axis, angle between them, meaning of visual distortion in dimensions - Need for an isometric scale, difference between Isometric scale, and ordinary scale difference between Isometric view and Isometric projection - Isometric and non-Isometric lines - Isometric drawing of common features like rectangles, circular shapes, non-isometric lines - Use of box and offset methods

11.0 Development of Surfaces

Need for preparing development of surface with reference to sheet metal work - Concept of true length of a line with reference to its orthographic projection when the line is (i) parallel to the plane of projection (ii) inclined to one principal and parallel to the other - Development of simple solids like cubes, prisms, cylinders, cones, pyramid (sketches only) - Types of development: Parallel line and radial line development - Procedure of drawing development, drawings of trays, funnels, 90° elbow pipes and rectangular ducts.

REFERENCE BOOKS

Engineering Graphics by P I Varghese – (McGraw-hill)

Engineering Drawing by Basant Agarwal & C.M Agarwal - (McGraw-hill)

Engineering Drawing by N.D.Bhatt.


SP-46-1998 – Bureau of Indian Standards.
BASIC WORKSHOP PRACTICE

Subject Title : Workshop Practice
Subject Code : M-108
Periods/Week : 06
Periods Per Year : 180

OBJECTIVES
Up on completion of the course the student shall be able to

FITTING SHOP
1. Acquaint with marking and measuring tools.
2. Perform marking, cutting and sawing on M.S. flats of 6 mm thick.
3. Perform drilling, chamfering and tapping operations.
4. Perform assembling of two pieces.

FORGING SHOP
1. Identify the various holding and striking tools.
2. Explain the method of hot forming.
3. Identify the correct forging temperatures for metals.
4. Prepare different sections from round bars.
5. Prepare components like rings, hooks, hexagonal bolt etc.

CARPENTRY SHOP
1. Draw the grain structure of wood grains.
2. Identify the appropriate marking and measuring tools.
3. Use of appropriate cutting tools.
4. Prepare various joints like lap, half lap and dovetail joints.
5. Prepare round objects on wood turning lathe.
6. Prepare simple household article.

SHEET METAL WORK
1. Identify various marking and measuring tools used in sheet metal work.
2. Identify various types of stakes and snips.
3. Perform various sheet metal joints.
4. Perform various sheet metal operations.
5. Practice the development of surfaces to prepare funnel, elbow etc...
6. Prepare simple utility articles.

FOUNDRY
1. Prepare moulding sand.
2. Make use of foundry tools.
3. Prepare moulds for couplings, connecting rods, pulleys.
4. Prepare cores for hallow jobs by using different core boxes.
5. Practice the casting and fettling aspects of the above.
6. Practice the melting and casting process of aluminium to prepare some castings.
KEY competencies to be achieved by the student.

**FITTING SHOP**

<table>
<thead>
<tr>
<th>Title of the Job</th>
<th>Key Competency</th>
</tr>
</thead>
</table>
| Marking and Chipping on Mild steel flat of 12 mm thick                           | - Identify appropriate measuring tool  
- Handle appropriate marking tool  
- Handle appropriate chipping tool  
- Mark the dimensions  
- Remove the material by chipping from MS flats |
| Cutting with hack saw of MS flats of 6mm thick                                   | - Use the hack saw while cutting MS flats  
- Load and unload hack saw blade from its frame |
| Marking, Cutting, drilling, chamfering and tapping on a MS flat of 2 mm thick    | - Locate the hole on M.S. plate  
- Identify appropriate drill bit  
- Load and unload drill bit from the machine  
- Identify appropriate taps  
- State the specifications of taps and drill  
- Tap the hole |
| Assembling of two pieces, matching by filing                                     | - Identify appropriate file  
- State the specifications of a file  
- File the specimen |
## FORGING SHOP

<table>
<thead>
<tr>
<th>Title of the Job</th>
<th>Key Competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion of Round to Square</td>
<td>– Heat the specimen to the appropriate temperature</td>
</tr>
<tr>
<td></td>
<td>– Identify the holding and striking tools</td>
</tr>
<tr>
<td></td>
<td>– Hammer the specimen to the required shape</td>
</tr>
<tr>
<td>Conversion of Round to Hexagon</td>
<td>– Heat the specimen to the appropriate temperature</td>
</tr>
<tr>
<td></td>
<td>– Identify the holding and striking tools</td>
</tr>
<tr>
<td></td>
<td>– Hammer the specimen to the required shape</td>
</tr>
<tr>
<td>Preparation of a Chisel from round</td>
<td>– Heat the specimen to the appropriate temperature</td>
</tr>
<tr>
<td>rod</td>
<td>– Identify the holding and striking tools</td>
</tr>
<tr>
<td></td>
<td>– Hammer the specimen to the required shape</td>
</tr>
<tr>
<td>Preparation of a ring and hook from</td>
<td>– Heat the specimen to the appropriate temperature</td>
</tr>
<tr>
<td>M.S round</td>
<td>– Identify the holding and striking tools</td>
</tr>
<tr>
<td></td>
<td>– Hammer the specimen to the required shape</td>
</tr>
<tr>
<td>Preparation of a hexagonal bolt and</td>
<td>– Heat the specimen to the appropriate temperature</td>
</tr>
<tr>
<td>nut</td>
<td>– Identify the holding and striking tools</td>
</tr>
<tr>
<td></td>
<td>– Upset the cylindrical rod</td>
</tr>
<tr>
<td></td>
<td>– Hammer the specimen to the required shape</td>
</tr>
</tbody>
</table>
## CARPENTRY SHOP

<table>
<thead>
<tr>
<th>Title of the Job</th>
<th>Key Competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting of wood with hand saw</td>
<td>- Identify the orientation of grains</td>
</tr>
<tr>
<td></td>
<td>- Identify appropriate saw for cutting in each of the directions viz. across and along the grains</td>
</tr>
<tr>
<td></td>
<td>- Handle appropriate measuring and marking tools</td>
</tr>
<tr>
<td></td>
<td>- Perform cutting operation</td>
</tr>
<tr>
<td>Planning of wood</td>
<td>- Identify the direction for planning wood stock</td>
</tr>
<tr>
<td></td>
<td>- Load and unload the blade of a jack plane</td>
</tr>
<tr>
<td></td>
<td>- Remove the material with the jack plane</td>
</tr>
<tr>
<td>Chiselling of wood</td>
<td>- Identify the direction for chiseling wood stock</td>
</tr>
<tr>
<td></td>
<td>- Use the chisel to remove the material</td>
</tr>
<tr>
<td>Preparation of a Dove tail joint</td>
<td>- Use the chisel to remove the material</td>
</tr>
<tr>
<td></td>
<td>- Finish the specimen with rasp file</td>
</tr>
<tr>
<td>Preparation of Mortise and Tenon joint</td>
<td>- Use the chisel to remove the material</td>
</tr>
<tr>
<td></td>
<td>- Finish the specimen with rasp file</td>
</tr>
<tr>
<td>Wood turning on lathe</td>
<td>- Identify the various parts of a wood turning lathe</td>
</tr>
<tr>
<td></td>
<td>- State the specifications of a turning lathe</td>
</tr>
<tr>
<td></td>
<td>- Turn the specimen on the lathe</td>
</tr>
<tr>
<td>Preparation of any household article (ex: stool)</td>
<td>- Prepare the drawings of a stool required for a particular drawing table</td>
</tr>
<tr>
<td></td>
<td>- State the specifications of the wood stock required</td>
</tr>
<tr>
<td></td>
<td>- Identify the type of joints to be made</td>
</tr>
<tr>
<td></td>
<td>- Identify the operations to be made and their sequence</td>
</tr>
<tr>
<td></td>
<td>- Perform operations to produce pieces of joint</td>
</tr>
<tr>
<td></td>
<td>- Assemble all joints as per the drawing</td>
</tr>
</tbody>
</table>
### SHEET METAL WORK

<table>
<thead>
<tr>
<th>Title of the Job</th>
<th>Key Competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice on cutting of sheet</td>
<td>– Identify the marking and cutting tools&lt;br&gt;– Cut the sheet</td>
</tr>
<tr>
<td>Formation of joints like grooved joint, locked groove joint</td>
<td>– Identify the marking and cutting tools&lt;br&gt;– Cut the sheet&lt;br&gt;– Perform bending along the marked lines.</td>
</tr>
<tr>
<td>Preparation of a rectangular open type tray</td>
<td>– Identify the marking and cutting tools&lt;br&gt;– Drawing development of objects&lt;br&gt;– Cut the sheet&lt;br&gt;– Perform bending along the marked lines.</td>
</tr>
<tr>
<td>Preparation of hollow cylinder</td>
<td>– Identify the marking and cutting tools&lt;br&gt;– Drawing development of objects&lt;br&gt;– Cut the sheet&lt;br&gt;– Perform bending along the marked lines and form the joint</td>
</tr>
<tr>
<td>Preparation of pipe elbow</td>
<td>– Identify the marking and cutting tools&lt;br&gt;– Drawing development of objects&lt;br&gt;– Cut the sheet&lt;br&gt;– Perform bending along the marked lines and to form the elbow</td>
</tr>
<tr>
<td>Preparation of funnel</td>
<td>– Identify the marking and cutting tools&lt;br&gt;– Drawing development of objects&lt;br&gt;– Cut the sheet&lt;br&gt;– Perform bending along the marked lines and to form the funnel</td>
</tr>
<tr>
<td>Preparation of utility articles such as dust pan, kerosene hand pump</td>
<td>– Identify the marking and cutting tools&lt;br&gt;– Drawing development of objects&lt;br&gt;– Cut the sheet&lt;br&gt;– Perform bending along the marked lines and to form the article</td>
</tr>
<tr>
<td>Title of the experiment</td>
<td>Key competency</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Moulding and Casting of solid bearing</td>
<td>- Select the suitable sand and its mix for the mould</td>
</tr>
<tr>
<td></td>
<td>- Cut the gates and runners</td>
</tr>
<tr>
<td></td>
<td>- Pour the sufficient quantity of molten metal</td>
</tr>
<tr>
<td>Moulding and Casting of flange coupling</td>
<td>- Select the suitable sand and its mix for the mould</td>
</tr>
<tr>
<td></td>
<td>- Prepare and place the core</td>
</tr>
<tr>
<td></td>
<td>- Cut the gates and runners</td>
</tr>
<tr>
<td></td>
<td>- Pour the sufficient quantity of molten metal</td>
</tr>
<tr>
<td>Moulding and Casting of split bearing</td>
<td>- Select the suitable sand and its mix for the mould</td>
</tr>
<tr>
<td></td>
<td>- Cut gates and runners</td>
</tr>
<tr>
<td></td>
<td>- Allow proper alignment of cope over drag</td>
</tr>
<tr>
<td></td>
<td>- Pour the sufficient quantity of molten metal</td>
</tr>
<tr>
<td>Moulding and Casting of connecting rod</td>
<td>- Select the suitable sand and its mix for the mould</td>
</tr>
<tr>
<td></td>
<td>- Prepare and place the core</td>
</tr>
<tr>
<td></td>
<td>- Cutting of gates and runners</td>
</tr>
<tr>
<td></td>
<td>- Pouring the sufficient quantity of molten metal</td>
</tr>
<tr>
<td>Moulding and Casting of V-pulley</td>
<td>- Select the suitable sand and its mix for the mould</td>
</tr>
<tr>
<td></td>
<td>- Cut gates and runners</td>
</tr>
<tr>
<td></td>
<td>- Pour sufficient quantity of molten metal</td>
</tr>
<tr>
<td>Moulding and Casting of Gear pulley</td>
<td>- Select the suitable sand and its mix for the mould</td>
</tr>
<tr>
<td></td>
<td>- Cut gates and runners</td>
</tr>
<tr>
<td></td>
<td>- Pour sufficient quantity of molten metal</td>
</tr>
</tbody>
</table>
COURSE CONTENT

FITTING SHOP
1. Marking and chipping on Mild – steel flat 12 mm thick.
2. Cutting with hack saw, M.S. Flats of 6 mm thick.
3. Marking, cutting, drilling, Chamfering and tapping on a M.S. Flat 12 mm thick.
4. Assembling of two pieces, Matching by filing (6 mm thick M.S. Plate)

FORGING SHOP
1. Conversion of round to square.
2. Conversion of round to Hexagon.
3. Preparation of chisel from round rod.
4. Preparation of ring and hook from M.S. round.
5. Preparation of a hexagonal bolt and nut.

CARPENTRY SHOP
1. Cutting of wood with hand saw.
2. Planning of wood.
3. Planning and chiseling of wood.
4. Orientation of wood grain.
5. Preparation of dovetail joint.
7. Wood turning on a lathe.
8. Preparation of one household article.

SHEET METAL WORK
1. Practice on cutting of sheet
2. Formation of joints like grooved joints, locked groove joint
3. Preparation of a rectangular open type tray
4. Preparation of hollow cylinder
5. Preparation of pipe elbow
6. Preparation of mug.
7. Preparation of funnel
8. Preparation of utility articles such as dustpan, kerosene hand pump.

FOUNDRY
Moulding and casting of
1. Solid bearing
2. Flange coupling
3. Split bearing
4. Connecting rod
5. V – pulley
6. Gear pulley
## DIPLOMA IN MECHANICAL ENGINEERING
### SCHEME OF INSTRUCTIONS AND EXAMINATIONS
#### III Semester

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Name of the Subject</th>
<th>Instruction period / week</th>
<th>Total Period / year</th>
<th>Scheme of Examination</th>
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<tr>
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<td></td>
<td>Theory</td>
<td>Practical / Tutorial</td>
<td>Duration (hours)</td>
</tr>
<tr>
<td>ME-301</td>
<td>Mathematics - II</td>
<td>4</td>
<td>-</td>
<td>60</td>
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<tr>
<td>ME-302</td>
<td>Engineering Materials</td>
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<td>-</td>
<td>75</td>
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<td>ME-303</td>
<td>Basic Electrical &amp; Electronics</td>
<td>4</td>
<td>-</td>
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<td>ME-304</td>
<td>Engineering</td>
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<td>-</td>
<td>60</td>
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<tr>
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<td>Strength of Materials</td>
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### THEORETICAL SUBJECTS
- ME-301: Mathematics - II
- ME-302: Engineering Materials
- ME-303: Basic Electrical & Electronics Engineering
- ME-304: Basic Thermodynamics
- ME-305: Strength of Materials
- ME-306: Production Technology-I

### PRACTICAL SUBJECTS
- ME-308: Fuels Lab
- ME-309: Electrical Engineering Lab
- ME-310: Manufacturing & Fabrication Engg. Lab-I

The duration of the sessional examination is 3 hours, and there are no marks allocated for end examinations.
ENGINEERING MATERIALS

Subject Title: Engineering Materials
Subject Code: M-302
Periods per week: 05
Periods per Semester: 75

TIME SCHEDULE

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OBJECTIVES
Up on completion of the course the student shall be able to

1.0 **Introduction, Mechanical properties of engineering materials**

1.1 State the importance of various Engineering Materials used in Mechanical processes / industries.

1.2 List the various engineering materials and their applications.

1.3 Define the following Properties.
   i) Tensile, compressive and shear strength
   ii) Ductility
   iii) Hardness
   iv) Toughness
   v) Brittleness
   vi) Impact strength
Fatigue and Creep strength

2.0 Testing of Materials

2.1 Differentiate between destructive and non-destructive tests.

2.2 Describe the testing procedure for tensile strength, compression strength, shear strength, Impact strength, and hardness of metals.

2.3 Describe the procedure for Testing Materials by X-Ray, gamma – Ray, Magnaflux, Ultrasonic and penetrate test.

3.0 Structure of materials

3.1 State the meaning of space lattice.

3.2 Define unit cell.

3.3 Describe the three main types of space lattice.

3.4 State the formation of grains by dendrite growth.

3.5 State the effect of rate of cooling on grain formation.

3.6 State the effect of grain size on mechanical properties.

3.7 Identify the factors promoting grain size.

3.8 Identify important stages in the phenomenon of recrystallisation.

4.0 Production of Iron and Steel

4.1 Name the various raw materials required for production of iron.

4.2 Describe the method of producing Pig Iron in Blast furnace.

4.3 Describe the puddling furnace to produce wrought iron.

4.4 Explain the process of manufacturing cast iron in Cupola.

4.5 Describe the steps in manufacturing steel by Bessemer process, L.D. process, Open Hearth and Electric Process.

5.0 Iron - Carbon Equilibrium Diagram

5.1 Explain the cooling curves of pure metal.

5.2 Identify the allotropic forms of pure iron with temperatures, their crystal structures.

5.3 Draw the iron carbon diagram, identify various structures of the iron carbon system.

5.4 Locate Eutectic, Peritectic and Eutoctioid points from the Iron Carbon diagram.

5.5 Obtain the composition of phases in a steel/cast Iron from the iron carbon diagram.
6.0 **Heat Treatment Processes of Steel.**
6.1 State the importance of heat treatment for steels.
6.2 Describe the main features of the various heat treatment operations.
6.3 Differentiate annealing and normalising.
6.4 Describe the effect of cooling rate in hardening.
6.5 State the importance of tempering.
6.6 Explain use of case hardening processes like; carburizing, nitriding and cyaniding
6.7 Describe TTT curves.
6.8 Understanding Sub Zero treatment and Vacuum Hardening

7.0 **Ferrous, Non-Ferrous Metals and their alloys**
7.1 Classification of Cast Iron – Grey, White, Malleable, Spheroidal – composition, properties and applications.
7.2 State the basis of classification of plain carbon steels.
7.3 List out the application of these steels.
7.4 Describe the need for alloying the steel with other elements.
7.5 State the composition, properties, and industrial applications of alloy steels.
7.6 Identify the need for non-ferrous metals and their alloys in engineering application.
7.7 Describe the properties of – Copper, Aluminum, Tin, Zinc, lead, Nickel, Magnesium and Chromium.
7.8 Indicate the composition, properties, and industrial application of the important – non-ferrous alloys.
7.9 Identify the properties of bearing metals.

8.0 **Powder Metallurgy.**
8.1 Explain the applications of powder metallurgy as a primary manufacturing process.
8.2 State the important characteristics of metal Powders.
8.3 Explain the methods of producing powders.
8.4 Explain the processes of forming to shape, pressing, centrifugal compacting, extruding, gravity sintering, rolling, isostatic moulding, explosive compacting, hot pressing, spark sintering.
8.5 Explain the finishing operations.
8.6 State the advantages and limitations of powder metallurgy.
COURSE CONTENT

1.0 Introduction, Mechanical properties of engineering materials
1.1 A few Mechanical Engineering Materials, Importance of their study with applications.
1.2 Various mechanical properties of engineering materials - Tensile strength, Compressive strength, Ductility, Malleability, Hardness, Toughness, Britteness, Impact strength, Fatigue, Creep resistance

2.0 Testing of materials
2.1 Destructive testing tests on UTM to determine tensile, compressive and shear strengths – Tests on Brinell & Rock Well hardness test – Impact test on Izod & Charpy tester.
2.2 Non destructive testing – Procedure for testing materials by X-ray, gamma ray, magnetic flux and ultrasonic testing.

3.0 Structure of Materials
3.1 Crystals of metals, Space lattices, Unit cell, three main types of metallic space lattices, namely Face Centered Cubic, Body Centered Cubic, Hexagonal Close Packed.
3.2 Crystallisation of metal, formation of grains by dendrite growth, grain boundary, grain size control, effect of grain size on properties – factors

4.0 Production of Iron and Steel.
4.1 Raw materials, iron ores, Lime stone, Coal-their availability in India. General Survey of Iron and steel making in India.
4.2 Manufacturing of pig iron from blast furnace.
4.3 Wrought iron by pudding furnace.
4.4 Cast Iron from cupola.
4.5 Production of steel by Bessemer, L.D. process; Open hearth and Electric processes.

5.0 Iron - Carbon Equilibrium Diagram.
5.1 Cooling curve for pure metal.
5.2 Allotropic forms of pure Iron.
5.3 Iron carbon equilibrium diagram.
6.0 Heat Treatment of Steels.
6.1 Importance of heat treatment.
6.2 Heat treatment processes – annealing, normalizing, hardening, tempering, carburizing, nitriding and cyaniding with specific examples of engineering applications of the above.
6.3 Sub Zero treatment – its importance.
6.4 Vacuum hardening – its importance.

7.0 Ferrous, Non- Ferrous metals and their alloys.
7.1 Classification of Cast Iron – Grey, White, Malleable, Spheroidal – Composition, properties and applications.
7.2 Plain Carbon Steels: Effect of carbon in steels, Soft, Mild, Medium and High carbon and also their properties and applications.
7.3 Alloy Steels: Nickel Steels, Chromium steels, 18/8 stainless steel, High Speed Steels, Manganese Steel.
7.4 Properties and uses of Copper, Aluminium, Tin, Zinc, Lead, Nickel, Magnesium and Chromium.
7.5 Muntz metal, Admiral metal, Phosphour Bronze, Gun Metal.
7.6 Aluminum Bronze, Constantan, Monel Metal.
7.7 Properties of Bearing metals, Babbit metals.

8.0 Powder Metallurgy.
8.1 Primary manufacturing process – definition, important characteristic of metal powders,
8.2 Methods of producing powders.
8.3 Forming to shape – pressing, centrifugal compacting, Extruding, Gravity sintering, Rolling, isostatic moulding explosive compacting, sintering, Hot pressing, spark sintering,
8.4 Finishing operation.
8.5 Advantages and limitations of powder metallurgy.

REFERENCE BOOKS

Powder Metallurgy by T.T.T.I, ECH
Material Science by Raghavan.
Physical Metallurgy by Avner
ELECTRICAL ENGINEERING & BASIC ELECTRONICS

Subject Title : Basic Electrical & Electronics Engineering  
Subject Code  : M-303  
Periods/Week  : 04  
Periods per semester : 60

TIME SCHEDULE

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OBJECTIVES

*Up on completion of course the student shall be able to*

1.0 Comprehend Basic Electrical Fundamentals.
   1.1 Define Ohm’s Law.
   1.2 State the Laws of Resistance.
   1.3 State work, power and energy, with units.
   1.4 State and explain Kirchoff’s laws.
   1.5 Simple Problems on the above.
   1.6 Define
      a. Magnetic field strength
      b. Flux
      c. Permeability
      d. Reluctance
   1.7 Define
      a. Electric field
      b. Electric field intensity
      c. Permittivity
   1.8 State capacitance.
   1.9 State Faraday’s laws of Electro Magnetic Induction. (no problems)
   1.10 Explain dynamically and statistically induced E.M.F. (no problems)
   1.11 State Lenz’s Law. (no problems)
   1.12 Explain Fleming’s right hand rule. (no problems)
1.13 Explain inductance
   a. Self inductance
   b. Mutual inductance
   c. Coefficient of coupling
1.14 Solve problems on self and mutual inductances.
1.15 Explain energy stored in a magnetic field.
1.16 Derive an expression for lifting power of a magnet.

2.0 Understand D.C. Machines.
2.1 Explain working principle of D.C. Generator.
2.2 Constructional features of D.C. Generator and materials used.
2.3 (a) List the type of D.C. Generators.
   (b) Draw schematic diagram of each type.
2.4 (a) Write formula for E.M.F equation of a D.C. Generator [no derivation]
   (b) state the relation between currents and voltages for different types of D.C generators.
2.5 Label the terminals of a D.C. Generator for armature, field and inter pole windings.
2.6 Draw power flow diagram of D.C. Generator. (no problems on above)
2.7 Sketch the connection of welding generator
2.8 Explain the principle of operation of D.C. Motor.
2.9 (a) List out types of motors.
   (b) Draw Schematic diagram of each type.
2.10 a) Explain back e.m.f.
   (b) State the relation between currents and voltages.
2.11 Write formula for speed of D.C. Motor in terms of supply voltage, current and flux.
2.12 Explain necessity of starters.
2.13 Describe with sketch the connection diagram of D.C. 3 point starter.
2.14 Explain speed control of D.C. Motors.
   a. Field control  b. Armature control
2.15 List the applications of D.C. motors

3.0 Understand A.C. Fundamentals and A.C.Machines
3.1 Explain
   i) Alternating current
   ii) Amplitude (Peak Value)
   iii) Time Period
   iv) Frequency
   v) Instantaneous value
   vi) Average value
   vii) R.M.S Value
   viii) Form Factor
3.2 Explain graphical and vector representation of alternating quantities.
3.3 Explain phase, phase difference.
3.4 State power in an A.C. circuit and power factor [No derivation]
   i) Pure resistance
   ii) Pure inductance
   iii) Capacitance
3.5 Explain single phase circuit
   a) Simple series circuit consisting R-L, R-C, and R-L-C.
   b) Simple parallel circuit R-L-C.
3.6 Calculate the impedance, current, PF, Power and Voltage drops in a given (R-L-C) circuit.
3.7 Solve simple problems on series circuits.
3.8 Explain poly phase and 3 phase system.
3.9 Explain phase difference in 3 phase system.
3.10 State Star-Delta connection.
3.11 Explain working principle of alternator.
3.12 Explain constructional features of Alternators.
3.13 State frequency and speed relations.
3.14 Explain working principle of transformer And rating of transformer.
3.15 Write relation between turns ratio, Voltage ratio and current ratios.
3.16 Describe with sketch a welding Transformer.
3.17 Explain three phase induction motor working Principle.
3.18 Explain constructional features of – 3 phase Induction motors.
   a. Squirrel cage induction motor.
   b. Wound rotor induction motor.
3.19 Describe with sketch
   a. D.O.L Starter
   b. Star – Delta Starter
   c. Rotor resistance starter
3.20 Explain forward and reverse running of Induction motor.
3.21 State the application of 3 phase induction Motor.
3.22 Explain the working principle of single Phase induction motor.
3.23 List out types of single phase induction Motors.
3.24 Sketch circuit diagram for single phase Induction motors.
3.25 Explain forward and reverse running of Single phase induction motor.
3.26 Applications of single phase induction Motors.

4.0 Understand the Principles of Semi-Conductor Devices.
4.1 Classify materials as conductor, semi-conductors and insulators.
4.2 Distinguish between intrinsic and extrinsic semiconductors.
4.3 Describe the formation of P- type and N- type materials.
4.4 Identify majority and minority carries in P&N type materials.
4.5 Explain the formation of PN Junction diode.
4.6 Describe the working of PN junction diodes with forward bias & reverse bias.
4.7 Understand the working of PNP & NPN transistors
4.8 Draw the different transistor configuration.
4.9 Sketch the input & output characteristics of C.B., C.E & C.C. configuration.
4.10 Describe the operation of Zener diode.
4.11 Distinguish between Zener & Avalanche break – down.
4.12 Explain the operation of LED, LCD & the materials used.
5.0 Understand Electrical Measuring Instruments and Safety Procedures.
5.1 Explain construction and working principle of moving Coil ammeter and volt meter.
5.2 Explain construction and working principle of moving iron ammeter and voltmeter.
5.3 Explain construction-working principle of dynamometer type wattmeter.
5.4 Explain construction and working principle of A.C. single phase induction type energy meters.
5.5 Sketch connection diagram of single phase energy meter with load.
5.6 Explain effect of electrical shock and burn.
5.7 State procedure to be adopted in case of electric shocks.
5.8 State purpose of earthing of electrical equipment and machinery.
5.9 Describe the procedure for pipe earthing.

COURSE CONTENT

1.0 Basic Concepts and Electro Magnetic Induction
1.1 Definitions: Ohm’s Law, Laws of resistance work, power, energy with units.
1.2 Kirchoff’s Laws – Simple problems.
1.3 Definitions and units magnetic field strength, flux, flux density, permeability, reluctance.
1.4 Definitions and units electric field, field strength, permittivity, capacitance.
1.5 Faraday’s laws of Electro – magnetic induction.
1.6 Dynamically and statically induced e.m.f.
1.7 Lenz’s Law, Fleming’s right hand rule.
1.8 Problems on above.
1.9 Inductance – self and mutual – coefficient of coupling.
1.10 Energy stored in a magnetic field.
1.11 Lifting power of magnet.

2.0 D.C. Machines
2.1 D.C. Generators
   a) Principle of operation.
   b) Parts of generator and materials use.
   c) Types of generators and schematic diagrams.
   d) E.M.F equation (No derivation) and voltage current relations.
   e) Nomenclature used for determining armature, field and interpole windings etc.
   f) Power flow diagram
   g) Welding Generator.

2.2 D.C. Motors
   a) Principle of operation.
   b) Types of motors and schematic diagrams
   c) Back e.m.f and speed equation and relation between voltages and currents.
d) Starters necessity and connection diagram of 3 point starter.
e) Speed control – field and armature control.
f) Applications of motors.

3.0 **A.C. Fundamentals and Machines**

3.1 Definition – alternating current, voltage amplitude, time period frequency, instantaneous value, Average value, r.m.s. value, form factor.

3.2 Graphical and vector representation of Alternating quantities.

3.3 Phase difference.

3.4 Power in A.C. Circuits and power factor (No Derivation).

3.5 Nature of current when alternating voltage is applied to pure resistance, inductance and capacitance – magnitude of current, power factor, power factor angle and power.

3.6 A.C. Circuits.

3.7 Single phase series circuits – calculation of impedance, current, power factor, power and voltage drops.

3.8 3 – phase circuits
   a) Definition of poly phase and 3 phase circuits.
   b) Phase difference in 3 phase system.
   c) Star and delta connections, definitions of phase values and line values.

3.9 Alternators – principle of working.

3.10 Constructional features of alternators.

3.11 Speed and frequency relations.

3.12 Transformers working principle.

3.13 Single phase transformers.
   a) Voltage ratio
   b) Current ratio
   c) Turns ration.

3.14 Welding transformer.

3.15 Phase Induction Motor
   b) Construction of induction motor
      i) Squirrel cage induction.
   c) Starters.
      i) D.O.L.
      ii) Star/Delta starter.
      iii) Rotor resistance starter.
   d) Forward and reverse running of Induction motors.

3.16 Single phase induction motors.
   a) Types of single phase induction motors.
   b) Circuit diagram of each type of single Phase induction motor.
   c) Forward and reverse running of single Phase induction motors.
   d) Applications of single phase induction Motors.

4.0 **Semi – Conductors.**

4.1 Semi – conductors – N-Type, P-type.

4.2 Behaviour of PN Junction diode

4.3 Introduction of PNP, NPN Transistors.
4.4 Transistor configuration – Zener diodes.
4.5 LED, LCD, Seven segment display.

5.0 Electrical Measuring Instruments & Safety Procedures
5.1 Construction and principle of operation of moving coil permanent magnet type ammeter and voltmeter and moving iron ammeter and voltmeter.
5.2 Construction and working principle of
   a) Dynamometer and wattmeter.
   b) A. C. Single phase induction type Energy meter.
   c) Connection diagram of single phase energy meters with load
5.3 Safety Procedures.
   a) Effects of shock and burns.
   b) Procedures to be adopted in case of electrical shocks.
   c) Earthing of electrical equipment and machine.

REFERENCE BOOKS
2. Mehta.V.K - Principles of Electronics
BASIC THERMODYNAMICS

Subject Title : Basic Thermodynamics
Subject Code : M-304
Periods/Week : 04
Periods per Semester : 60

TIME SCHEDULE

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OBJECTIVES

*Up on completion of the course the student shall be able to*

**1.0 Understand the Fundamentals and laws of Thermodynamics.**

1.1 Define the various terms associated with the thermodynamic system.
1.2 Name the types of thermodynamic systems.
1.4 Explain the closed system with examples.
1.5 Explain the open system with examples.
1.6 Explain the isolated system with examples.
1.7 List the thermodynamic properties of system.
1.8 Define the various thermodynamic properties.
1.9 Write examples for each property and its units of measurement.
1.10 State the number of properties required to define the state of a system.
1.11 Define the modes of energy transfer to and from a system.
1.12 Represent the state of a system on a graph.
1.13 State the zeroth law of thermodynamics.
1.14 State the first law of thermodynamics.
1.15 State the second law of thermodynamics.
1.16 Solve problems dealing with conversion of heat into work and vice versa.
1.17 Write non-flow energy equation.
1.18 Write steady flow energy equation.
1.19 Solve simple problems on energy equation.
2.0 Understand the laws of perfect gases.
2.1 Define the term ‘Perfect Gas’.
2.2 State “Boyle’s law”.
2.3 State “Charle’s law”.
2.4 State “Avagadro’s law”.
2.5 State “Regnault’s law”.
2.6 State “Joule’s law”.
2.7 Derive characteristic gas equation.
2.8 Write the universal gas equation.
2.9 State relationship between characteristic gas constant (R), universal gas constant (G) and molecular weight (M).
2.10 Define specific heat at constant pressure ($C_p$).
2.11 Define specific heat at constant volume ($C_v$).
2.12 Infer why $C_p$ is more than $C_v$?
2.13 Derive the relationship connecting the two specific heats and characteristic gas constant (R).
2.14 Solve simple problems using gas laws.

3.0 Understand Thermodynamic Processes on gases.
3.1 List out the different thermodynamic processes on gases.
3.2 Derive an expression for work done in Iso-choric process.
3.3 Derive an expression for work done in Iso-baric process.
3.4 Derive an expression for work done in hyperbolic process.
3.5 Infer that Isothermal process is the same as hyperbolic process for gases.
3.6 Derive an expression for work done in polytropic process.
3.7 Derive an expression for work done in isentropic process.
3.8 Justify that work done in throttling process is zero.
3.9 Explain the concept of entropy.
3.10 Derive the expression for change of Entropy for the above processes.
3.11 Compute the change in internal energy of gas during a process.
3.12 Write the relationship between heat supplied, internal energy and work done.
3.13 Sketch pressure- volume and temperature - Entropy diagram for the above processes.
3.14 Solve simple problems on the above processes.

4.0 Know the fuels and combustion.
4.1 Define the term fuel.
4.2 Name different types of fuels with examples.
4.3 Outline the applications of different fuels.
4.4 Define higher calorific value of a fuel.
4.5 Define lower calorific value of a fuel.
4.6 Re-write Dulong’s formula for calorific value from chemical composition of a fuel.
4.7 Estimate the calorific value using the above formula.
4.8 Compare solid, liquid and gaseous fuels.
4.9 Explain with line diagram the components of a Bomb-calorimeter.
4.10 Narrate the sequence of procedure for the determination of calorific value using Bomb calorimeter.

4.11 Compute the calorific value using the test data on a bomb calorimeter unit.

4.12 Explain the working principle of Junker’s gas calorimeter with a line diagram.

4.13 Narrate the sequence of procedure in the determination of C.V. of a gaseous fuel with Junker’s calorimeter.

4.14 Calculate the C.V. of a fuel with the help of test data.

4.15 Write the balance of chemical equation for the composition of Unit mass/unit volume of a given fuel.

4.16 Estimate the minimum air required for complete combustion of unit mass/unit volume of a fuel.

4.17 Estimate the percentage composition of flue gases during combustion with or without excess air.

4.18 Estimate the weight of exhaust gases obtained by complete combustion of unit weight of a fuel of given composition.

4.19 Explain with a line diagram the working of Orsat’s apparatus.

4.20 Narrate the sequential procedure in conducting flue gas analysis by using Orsat’s apparatus.

4.21 Explain with the help of line diagram the working of mechanical type of CO₂ recorder.

**COURSE CONTENT**

1.0 Fundamentals and laws of Thermodynamics.

1.1 Definitions for system - boundary, surroundings, working fluid and state of a system.

1.2 Types of thermodynamic systems – closed, open and isolated systems with examples.

1.3 Properties of system- Intrinsic and Extrinsic properties with examples.

1.4 Definitions for properties like pressure (p), Volume (v), Temperature (T), Enthalpy (H), Internal energy (U) and their units.

1.5 Definitions for quasi-static work, flow- work, specific heat.

1.6 Zeroth, first, second laws of thermodynamics, simple problems on conversion of Heat into Work and vice versa.

1.7 Steady flow energy equation (without proof), simple problems.

2.0 Laws of perfect gases.

2.1 Brief explanation of perfect Gas Laws – Boyle’s law, Charle’s Law – Avagadro’s Joule’s law and Regnault’s law.

2.2 Derive characteristic gas equation - universal gas equation, universal gas constant and their relationship with molecular weight of gas.

2.3 Specific heat at constant pressure, specific heat at constant volume for a gas. Derivation for an expression showing the relationship between the two specific heats and characteristic gas constant.

2.4 Simple problems on gas equation.
3.0 Thermodynamic processes on gases.
3.1 Types of thermodynamic processes, Isochoric, Isobaric, Isothermal, Hyperbolic, ISENTROPIC, Polytrophic and Throttling processes. Equations representing the above processes.
3.2 Concept of Entropy.
3.3 Derivation for work done, change in internal energy and Entropy for the above processes.
3.4 Calculation of heat supplied or rejected during the above processes.
3.5 Simple problems on the above processes.

4.0 Fuels and Combustion.
4.1 Definition of fuel. Types – solid, liquid and gaseous fuels, examples and uses of different types of fuels.
4.2 Calorific values (Higher and lower) of fuels, Dulong’s formula for calorific value. Calculation of calorific value of a fuel with given chemical composition.
4.3 Bomb calorimeter unit-description-procedure for determination of C.V. of solid or liquid fuel using Bomb calorimeters, calculation of C.V. with test data.
4.5 Problems on C.V. determination with Junker’s calorimeter test data.
4.6 Balance chemical equations for the combustion of carbon, Hydrogen, sulphur, Methane, Ethane etc.
4.7 Calculation of minimum air required for the complete combustion of unit mass/unit volume of fuel having a given composition. Conversion of volumetric analysis to gravimetric analysis, and vice-versa. Calculation of percentage composition (by weight and volume) of flue gases. Calculation of weight of flue gases obtained by combustion of fuel with and without excess air, simple problems.
4.8 Brief description of Orsat’s Apparatus & use, procedure for determination of flue gas analysis, chemicals used for absorption of different gases in flue gases.
4.9 Brief description and working of a mechanical type of CO₂ recorder.

REFERENCE BOOKS

1.0 Engineering Thermodynamics P. K. Nag TMH Publishers
2.0 Engineering Thermodynamics C. P. Arora
3.0 Thermal Engineering - R. S. Khurmi S.Chand & Company
STRENGTH OF MATERIALS

Subject Title: Strength of Materials
Subject Code: M-305
Periods/Week: 05
Periods per Semester: 75

TIME SCHEDULE

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<th>Essay type Questions</th>
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<td>02</td>
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<td>Shear Force and bending moment</td>
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<td>21</td>
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OBJECTIVES

Up on completion of the course the student shall be able to

1.0 Simple Stresses and Strains
   1.1 Define the strength, Mechanical properties of commonly used engineering materials.
   1.2 Identify the nature and effect of tensile, compressive and shear forces.
   1.3 Define the terms stress, strain, Poisson’s ratio and elastic modullii.
   1.4 Draw the typical stress - strain curve for ductile and brittle materials under tension indicating salient points on it.
   1.5 Mention the significance of Factor of Safety.
   1.6 Write down the relation between elastic constants E,N,K,& 1/m.
   1.7 Compute stress and strain values in bodies of uniform section and of composite section under the influence of normal forces.
   1.8 Calculate thermal stresses, in bodies of uniform section and composite sections.
   1.9 Compute changes in axial, lateral and volumetric dimensions of bodies of uniform sections under the action of normal forces.
2.0 **Strain Energy**

2.1 Define resilience, proof – resilience and modulus of resilience.
2.2 Derive an expression for the strain energy.
2.3 Obtain expressions for instantaneous stress developed in bodies subjected to –
   i) Gradually applied load.
   ii) Suddenly applied load
   iii) Impact/shock load.
2.4 Comparison of proof resilience in bodies subjected to the above loads.

3.0 **Shear Force and Bending Moment Diagrams**

3.1 List the types of beams.
3.2 List the types of loading
3.3 Explain the terms shear force and bending moment.
3.4 Compute shear force and bending moment at any section of beam.
3.5 Draw the diagrams of S.F. & B.M.

4.0 **Theory of Simple Bending and Deflection of Beams**

4.1 State the theory and terms of simple bending.
4.2 List the assumptions in theory of simple bending
4.3 Derive the bending equation \( M / I = \sigma / y = E / R \)
4.4 Calculate Bending stress, Modulus of section and Moment of resistance.
4.5 Calculate the safe load, safe span and dimensions of cross section.
4.6 Define and explain the deflection.
4.7 State the formulae for deflection in cantilever and simply supported beams.
4.8 Calculate the values of deflection in the given beams.

5.0 **Torsion in Shafts and Springs**

5.1 Function of Shaft
5.2 Explain Polar M.I. of solid and hollow shaft
5.3 List the assumptions in theory of Simple Torsion
5.4 Derive the torque equation \( T / J = f_s / R = G\theta / L \)
5.5 Design of solid and hollow shafts and power transmitted
5.6 Comparison for strength and weight of solid and hollow shafts of the same length and material
5.7 Function of spring
5.8 Types and applications of springs
5.9 Define the terms related to closed coil helical spring
5.10 State the formulae for the stress and deflection of closed coil helical spring
5.11 Compute the stress and deflection of the closed coil helical spring

6.0 **Thin Cylindrical Shells**

6.1 Definition of cylindrical shell
6.1 Definition of longitudinal and hoop stress
6.2 Derive the expression for longitudinal and hoop stress for seamless and seam shells.
6.3 Design of thin cylindrical shells.

COURSE CONTENT

1 Simple Stresses and Strains
1.1 Types of forces.
1.2 Stress, Strain and their nature.
1.3 Mechanical properties of common engineering materials.
1.4 Significance of various points on stress – strain diagram for M.S. and C.I. specimens
1.5 Significance of factor of safety
1.6 Relation between elastic constants.
1.7 Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces.
1.8 Thermal stresses in bodies of uniform section and composite sections.
1.9 Related numerical problems on the above topics

2 Strain Energy
2.1 Strain energy or resilience, proof resilience and modulus of resilience.
2.2 Derivation of strain energy for the following cases
   i) Gradually applied load.
   ii) Suddenly applied load
   iii) Impact/shock load.
2.3 Related numerical problems.

3 Shear Force & Bending Moment Diagrams
3.1 Types of beams with examples.
   a) Cantilever beam,
   b) Simply supported beam,
   c) Over hanging beam,
   d) Continuous beam,
   e) Fixed beam.
3.2 Types of Loads – Point load, UDL and UVL.
3.3 Definition and explanation of shear force and bending moment.
3.4 Calculation of shear force and bending moment and drawing the diagrams by the analytical method only for the following cases.
   a) Cantilever with point loads.
   b) Cantilever with uniformly distributed load.
   c) Simply supported beam with point loads.
   d) Simply supported beam with uniformly distributed load.
   e) Over – hanging beam with point loads, at the centre and at free ends.
   f) Over – hanging beam with uniformly distributed load throughout.
   g) Combination of point and U.D.L. for the above and problems there upon.
4 Theory of Simple Bending and Deflection of Beams
4.1 Explanation of terms
   a) Neutral layer
   b) Neutral Axis
   c) Modulus of Section
   d) Moment of Resistance
   e) Bending stress.
   f) Radius of curvature.
4.2 Assumptions in theory of simple bending.
4.3 Bending Equation \( \frac{M}{I} = \frac{\sigma}{E} = \frac{E}{R} \) with derivation.
4.4 Problems involving calculations of bending stress, modulus of section and moment of resistance.
4.5 Calculation of safe loads and safe span and dimensions of cross-section.
4.6 Definition and explanation of deflection as applied to beams.
4.7 Deflection formulae without proof for cantilever and simply supported beams with point load and uniformly distributed load only (Standard cases only).
4.8 Related numerical problems.

5 Torsion in Shafts and Springs
5.1 Definition and function of shaft
5.2 Calculation of polar M.I. for solid and hollow shaft.
5.3 Assumptions in simple torsion
5.4 Derivation of formula \( \frac{T}{J} = \frac{fs}{G} = \frac{G\theta}{L} \)
5.5 Problems on design of shaft based on strength and rigidity
5.6 Numerical Problems related to comparison of strength and weight of solid and hollow shafts.
5.7 Explanation about spring
5.8 Classification of springs
5.9 Nomenclature of closed coil helical spring
5.10 Deflection formula for closed coil helical spring (without derivation)
5.11 Explanation about stiffness of spring
5.12 Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils

6 Thin Cylindrical Shells
6.1 Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell.
6.2 Derivation of expressions for the longitudinal and hoop stress for seamless and seam shells.
6.2 Related numerical Problems for safe thickness and safe working pressure.

REFERENCE BOOKS:
1. Strength of Materials by B.C.Punmia
3. Strength of Materials by Ramamrutham

PRODUCTION TECHNOLOGY - I

Subject Title : Production Technology - I
Subject Code : M – 306
Periods Per Week : 04
Periods Per Semester : 60

TIME SHEDULE

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OBJECTIVES

Up on completion of the course the student shall be able to understand the following

1. Lathe & Lathe Work
   1.1 State the working principle of lathe.
   1.2 Write classification of lathes.
   1.3 Draw the line diagram of engine lathe.
   1.4 Identify the parts of lathe.
   1.5 Describe the functions of each part in lathe.
   1.6 Indicate the specifications of a lathe.
   1.7 List out the various operations performed on lathe including special operations.
   1.8 Explain methods of taper turning with line diagrams.
   1.9 Calculate the included angle for taper turning.
   1.10 List out different work holding devices.
   1.11 Nomenclature of Lathe (single point) tool.
   1.12 Significance of various angles.
   1.13 Tool signature.
   1.14 Identify various types of production lathes.
   1.15 Illustrate the working principle of turret lathe, Capstan, Automatic and Semi-automatic lathes & copying lathes.
   1.16 Know the differences between automatic and semi-automatic lathes.
   1.17 Know the need of copying lathes.
   1.18 State the advantages and applications of production lathes.
2.0 **Shaper, Slotter, Planer.**
- 2.1 Illustrate the working principles of shaper, slotter, and planer.
- 2.2 Illustrate the constructional details of the above machines.
- 2.3 Explain the functions of important parts of the machines.
- 2.4 List out the operations performed on these machines.
- 2.5 State the specifications of each machine.
- 2.6 Explain the principle of quick-return mechanism as applied to shaper/planer.
- 2.7 Describe the different methods of obtaining quick return motion.
- 2.8 Explain the principle of hydraulic drive with the help of a line diagram applied to shaper.

3.0 **Broaching machine**
- 3.1 Define Broaching.
- 3.2 Classify broaching machines.
- 3.3 Illustrate the working principles of broaching machines.
- 3.4 Illustrate the constructional details of the broaching machines.
- 3.5 State the advantages & limitations of broaching.

4.0 **Cutting Fluids, Coolants & Lubricants.**
- 4.1 State the properties of cutting fluids and coolants.
- 4.2 Mention the types of fluids.
- 4.3 State the composition of cutting fluids and coolants.
- 4.4 Point out the relative merits of the cutting fluids and coolants.
- 4.5 Select the proper cutting fluids and coolants for various machining operations.
- 4.6 Classify the lubricants.
- 4.7 List out various properties of lubricants.

5.0 **Welding.**
- 5.1 State the necessity of welding.
- 5.2 Classify the welding process.
- 5.3 State the advantages and limitations of welding.
- 5.4 Explain the principle of arc welding.
- 5.5 Identify the tools and equipment of arc welding.
- 5.6 Choose the proper electrodes for given metals.
- 5.7 Explain the principles of gas welding.
- 5.8 Identify the tools and equipment of oxy-acetylene welding.
- 5.9 Explain different welding procedures in arc and gas welding.
- 5.10 Define the terms soldering & brazing.
- 5.11 Differentiate soldering from brazing.
- 5.12 Explain the principles of soldering & brazing.
- 5.13 Select correct soldering materials for a given job.
- 5.14 Explain soldering / brazing techniques.
- 5.15 Identify the gas cutting equipment.
- 5.16 State the principle of flame cutting.
5.17 State the relative advantages of flame cutting over other types of cutting.
5.18 Identify the various defects in welds.
5.19 List the reasons for the above.
5.20 Explain non-destructive testing of welds.
5.21 List out various (special) modern welding techniques.
5.22 State in brief the principle of at least four modern welding techniques.
5.23 Explain the principle of TIG and MIG welding.

COURSE CONTENT

1.0 Lathe and Lathe Work
1.1 Working Principle of Lathe
1.2 Types of Lathes - Engine lathe – construction details – specifications.
1.3 Nomenclature of single point cutting tool, geometry, tool signature, functions of tool angles.
1.4 General and special operations – (Turning, facing, taper turning thread cutting, knurling, forming, drilling, boring, reaming, key way cutting.)
1.5 Methods of taper turning – explanation
1.6 Lathe accessories viz., work holding devices and tool holding devices
1.7 Turret lathe: sketch – operation – advantages.
1.8 Capstan lathe: sketch – operation – advantages.
1.9 Comparison of engine (centre lathe) – turret – capstan lathe.
1.10 Semi automatic lathe – features.
1.11 Automatic lathe – features.
1.12 Copying lathe – applications.

2.0 Shaping, Slotting, Planning.
2.1 Introduction to shaper, slotter, planer.
2.2 Constructional details and specifications of shaper, slotter and planer.
2.3 Operations on these machines.
2.4 Tools and materials.
2.5 Driving mechanisms - quick return arrangement - crank & slotted lever mechanism, whit worth mechanism, hydraulic drive.

3.0 Broaching Machines
3.1 Introduction to broaching.
3.2 Types of broaching machines – horizontal type (single ram & duplex ram) vertical type, pull up, pull down, and push down.
3.3 Elements of broach tool, broach teeth details – nomenclature – types – tool material.
4.0 Cutting Fluids, Coolants & Lubricants.
   4.1 Introduction.
   4.2 Types of cutting fluids.
   4.3 Properties and functions of fluids and coolants.
   4.4 Fluids and coolants required in turning, drilling, shaping, sawing & Broaching.
   4.5 Selection of cutting fluids, methods of application of cutting fluid.
   4.6 Classification of lubricants (solid, liquid, gaseous)
   4.7 Properties and applications of lubricants.

5.0 Welding.
   5.1 Introduction.
   5.2 Classification of welding processes.
   5.3 Advantages and limitations of welding.
   5.4 Principles of arc welding.
   5.5 Arc welding equipment.
   5.6 Choice of electrodes for different metals.
   5.7 Principle of gas (oxy – acetylene) welding.
   5.8 Equipment of gas welding.
   5.9 Welding procedures (arc & gas)
   5.10 Soldering and Brazing techniques.
   5.11 Types and applications of solders & fluxes.
   5.12 Various flame cutting processes.
   5.13 Advantages and limitations of flame cutting.
   5.14 Defects in welding.
   5.15 Testing and inspection.
   5.16 Modern welding methods, (Submerged, CO₂, Atomic – Hydrogen, ultrasonic welding),
   5.17 Brief description of MIG & TIG Welding.

REFERENCES

1. Welding Technology by Little.
2. Elements of Work Shop Technology vol. I & II by Hazra Choudry
3. Engineering Metrology by Jain
4. Welding Technology by Parmar
5. Manufacturing Technology (volume-1) by P.N.Rao (MGH Pub)
MACHINE DRAWING

Subject Title : Machine Drawing
Subject Code : M-307
Periods/ Week : 07
Periods/Semester : 105

TIME SCHEDULE

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Note:-
Candidate has to answer all questions in part- A and one question out of two in part- B

OBJECTIVES

Up on completion of the course the student shall be able to

1.0 Introduction
   1.1. Know the importance of Machine drawing.
   1.2. Review of 1st angle and 3rd angle Projections
   1.3. Review of Orthographic Projections and Sectional Views.

2.0 Know about fastening devices.
   2.1. Drawing the standard thread profiles.
   2.2. Draw/sketch bolted connections to standard proportions.
   2.3. Draw/sketch different types of screws.
   2.4. Draw/sketch different types of rivets and riveted connections.
   2.5. Draw/sketch different types of keys and cotters.

3.0 Prepare assembly drawing.
   3.1. List the sequence of steps for preparing assembly drawing.
   3.2. Prepare the assembly drawing for the given components drawing.
   3.3. Prepare the list of parts.

4.0 Formulate piping layouts.
   4.1. State the distinction between pipes and tubes.
   4.2. Identify the common components of a piping layout.
4.3. Identify the conventional symbols used for the various components of piping layout.
4.4. Prepare single line and double line diagrams of piping layouts.
4.5. Draw the assembly drawing and sectioned views of pipe joint.
4.6. Explain the use of packing material in joint.

**5.0 Appreciate welded fabrication drawing.**
5.1. Identify the different types of welds and their symbolic representation as per B.I.S., SP-46-1988.
5.2. Identify the elements of welding symbol and their standard location on the symbol.
5.3. State welding process to be used, surface contour and finish of weld when given in symbolic form.
5.4. Prepare a working drawing of welded fabrications.

**Key competencies to be achieved by the student**

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<td>Appraise the importance of sectional views in Mechanical Engineering</td>
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<td>Fastening devices</td>
<td>Differentiate the temporary and permanent joints and their applications</td>
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<td>Acquaint with the nomenclature of thread profile</td>
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<td>Draw the bolts, screws, nuts, rivets, keys and cotters with standard proportions</td>
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<td>Assembly drawing</td>
<td>Understand function, working principle and field of application for the machine and its parts</td>
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<td>Study the external and internal features of each part</td>
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<td>Put the overall dimensions</td>
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<td>Prepare the table of parts giving part number, its name, material and quantity</td>
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<td>Piping layouts</td>
<td>Acquaint with the symbols used for the various components of piping layout</td>
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<td>Understand the importance and use of all the valves and packing material used in pipe fittings</td>
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<td>Welded fabrication drawing</td>
<td>Acquaint with the weld symbols</td>
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<td>Specify the weld joint</td>
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<td>Understand the various weld joints and their uses</td>
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**COURSE CONTENT**

**1.0 Introduction**
1.1. Importance of Machine Drawing.
1.2. Brief revision of 1st and 3rd angle projections
1.3. Understand the concepts of Orthographic projections and Sectional views.

**2.0 Fastening Devices.**
2.1. Temporary and Permanent fastenings and their areas of application-thread nomenclature, forms of screw thread profiles, metric, B.A., Acme, Knuckle, etc.

2.2. Bolts and Nuts: Specification of bolts and nuts, Different types of bolted joints (like using through bolts, studs, screws etc.,) in different applications. Purpose of lock nuts and their Types.

2.3. Keys and cotters: Types of keys and cotters: Difference between key and cotter uses.


**Drawing Plate: 1**

1. Exercise on Orthographic projections and Sectional views.
2. Thread Nomenclature and forms of screw thread profiles.
4. Drawing of various types of lock nuts & types of keys indicating their proportionate dimensions.

3.0 Assembly Drawings.

3.1. Need and functions of assembly and detailed drawings.
3.2. Steps in preparing assembly drawings.
3.3. Bill of materials and parts list.
3.4. Exercises in preparing assembly drawings of commonly available engineering components.

**Drawing Plate: 2**

**Draw the views / sectional views of**

1. Jib and cotter joint assembly
2. Knuckle joint assembly
3. Assembly of muff coupling (sleeved & split) coupling
4. Screw jack assembly,
5. Stuffing box.

**NOTE:** With the knowledge gained by the above exercises students must be able to draw exercises on Socket and spigot joint, protective type flanged coupling, piston of petrol engine, cross head, connecting rod, eccentric, flexible coupling, universal coupling, sleeve and cotter joint, Oldham’s-coupling, lathe tool post, big end of a connecting rod, foot step bearing, Plummer block, lathe tail stock.

4.0 Piping layouts.

4.1. Classification of pipes and tubes.
4.2. Components of pipes lay-out.
4.3. Screw fitting bend, elbow, tee, lateral Cross-nipple, reducing socket and plug.
4.4. Unions: screwed, ground and flanged.
4.5. Valves: Gate valve: angle valve, check valve.
4.6. Various conventional symbol used for the above components.
Drawing Plate: 3
1. Single line diagram of pipe layout two exercises.
2. Double line diagram of pipe layout one exercise.
3. Cast iron flanged pipe joint, spigot and socket joint, hydraulic pipe joint, expansion joint, screwed joint, union joint - draw half sectional elevation and end view.

5.0 Welded fabrication drawings.
5.1. Different types of weld and their basic symbols including sectional representation as per table of I.S. standards, fillet, square butt, single V-Butt, double V-Butt, single bevel butt, double bevel butt, stud, bead (edge or seal) spot, seam.
5.2. Elements of welding symbol and their standard location the symbol as per IS standards reference Kode arrow head, weld symbol supplementary symbol dimensions of welds, method of welding process, special reference.
5.3. Significance of arrow & position of arrow head significance of reference line as per I.S. standards with reference to fillet, V-Butt an stud welds.
5.4. Supplementary symbols and special instructions: surface of reference line; as per I.S. standards with reference to fillet, V-Butt an stud welds.
5.5. Dimensions of welds : length, location and spacing of welds as per I.S., B.I.S., standards with showing dimensions required on a welding.
5.6. Need of special reference

Drawing Plate: 4
1. Drawing tables and figs. Referred in the contents above taking form I.S. standards.
3. Preparing working drawing of welding fabrication from given data.

REFERENCE BOOKS
1. T.S.M & S.S.M in respect of Technical Drawing by TTTI, Madras
FUELS LABORATORY

Subject Title: Fuels Laboratory
Subject Code: M – 308
Total No. of Periods: 03
Total Periods Per Semester: 45

TIME SCHEDULE

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Major Components</th>
<th>Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Flash &amp; Fire point tests</td>
<td>12</td>
</tr>
<tr>
<td>2.</td>
<td>Viscosity measurement</td>
<td>09</td>
</tr>
<tr>
<td>3.</td>
<td>Calorific value tests</td>
<td>09</td>
</tr>
<tr>
<td>4.</td>
<td>Carbon residue test</td>
<td>09</td>
</tr>
<tr>
<td>5.</td>
<td>Calibration of pressure gauge</td>
<td>06</td>
</tr>
<tr>
<td></td>
<td><strong>Total No. Periods</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>

OBJECTIVES

Up on Completion of the course the student shall be able to:

1.0 Understand the determination of flash and fire point of a given sample of fuel using given apparatus
   1.1 Define the flash and fire points of fuels and lubricants.
   1.2 Distinguish between “open” and “close” tests.
   1.3 Identify the Parts of apparatus
   1.4 Explain the function of each component part
   1.5 Handle the apparatus
   1.6 Manipulate the apparatus
   1.7 Perform the precise operations to determine flash and fire point of given sample of fuel
   1.8 Record the observations
   1.9 List the Precautions and safety procedures
   1.10 Explain the need and scope of the Experiment in industry

2.0 Understand the determination of Viscosity of a given sample of oil using given apparatus
2.1 Explain the properties of lubricating oil
2.2 Explain the viscosity of oil and its units
2.3 Explain the importance of viscosity as applied to Oils.
2.4 Relate the Absolute viscosity and kinematic viscosity
2.5 Classify the viscometers
2.6 Identify the parts of viscometer
2.7 Handle the apparatus
2.8 Manipulate the apparatus
2.9 Perform the precise operations to record Redwood seconds
2.10 Use empirical formulae to determine the Kinematic & Absolute viscosities of given Oil.
2.11 State the effect of temperature on these oil properties.
2.12 Draw the graph between the temperature and viscosities.
2.13 Explain the need and scope of the Experiment

3.0 Understand the determination of Calorific value of a given sample of fuel using given apparatus
3.1 Explain the phenomenon of combustion of fuel
3.2 Explain the caloric value of fuel
3.3 State the differences between higher and lower Calorific values of fuels.
3.4 List the types of fuels
3.5 Identify the various Calorimeters for determining the Calorific values of Solid, Liquid and gaseous fuels.
3.6 Identify the parts of Junker’s Gas Calorimeter
3.7 Handle the apparatus
3.8 Manipulate the apparatus
3.9 Perform precise operations on bomb, Junker’s Calorimeter to record various parameters
3.10 Determine the Calorific values of solid, liquid and gaseous fuels
3.11 Explain the need and scope of the Experiment

4.0 Understand the determination of amount of carbon residue of a given sample of petroleum product
4.1 Explain the phenomenon of oil evaporation
4.2 Identify the parts conradson tester.
4.3 Handle the apparatus
4.4 Manipulate the apparatus
4.5 Perform precise operations on conradson tester to record Weights of crucible
4.6 Determine the percentage carbon residue
4.7 Explain the need and scope of the Experiment

5.0 Understand the need and importance of calibration of pressure gauges.
5.1 Define the term pressure
5.2 Explain the function of component parts of Dead weight Pressure gauge tester
5.3 State the principle on which the dead weight pressure gauge tester works
5.4 Handle the apparatus
5.5 Manipulate the apparatus
5.6 Perform precise operations on Dead weight Pressure gauge tester

<table>
<thead>
<tr>
<th>Title of the experiment</th>
<th>Key competency</th>
</tr>
</thead>
</table>
| 1. Flash and Fire point tests | 1. Observe the flame for change in colour and type of flame  
2. Record the temperature of fuel using thermometer |
| 2. Viscosity measurement | 1. Handle the Hydrometer to measure the density of given oil  
2. Record the temperature of oil using thermometer  
3. Record the time to collect 50 ml of oil |
| 3. Calorific value tests | 1. Weigh the water collected and condensed steam  
2. Record the inlet & outlet temperature of water  
3. Record volume of gas burnt |
| 4. Carbon residue test | 1. Weigh the porcelain crucible with and without oil  
2. Measure the weight of carbon residue |
| 5. Calibration of pressure gauge | 1. Operate of screw pump to generate system pressure  
2. Observe and record the pressure due to mass load  
3. Record the gauge pressure |

5.7 Observe and record the pressure due to mass load
5.8 Record the gauge pressure
5.9 Explain the need and scope of the Experiment

**KEY competencies to be achieved by the student**

**COURSE CONTENT**

1. Determination of flash and fire points of various fuels and lubricants using Abel’s, Pensky Martin’s, and Cleveland’s apparatus.
2. Determination of Kinematics and Absolute viscosities of the fuel and lubricating Oils using Redwood & Saybolt viscometers.
3. Determination of Calorific values of Solid and liquid fuels using Bomb Calorimeter.
   Determination of Calorific value of gaseous fuel by using Junker’s Calorimeter.
5. Calibration of a pressure gauge using dead weight pressure gauge tester
ELECTRICAL ENGINEERING LABORATORY

Subject Title : Electrical Engineering Laboratory
Subject Code  : M-309
Periods/Week  : 03
Periods/Year  : 45

TIME SCHEDULE

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Major Topics</th>
<th>No. of Periods (3 periods per Session)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Network Laws &amp; Theorems</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Calibration of meters</td>
<td>06</td>
</tr>
<tr>
<td>3</td>
<td>Measurement of Power</td>
<td>06</td>
</tr>
<tr>
<td>4</td>
<td>Speed control of DC Motor</td>
<td>06</td>
</tr>
<tr>
<td>5</td>
<td>Brake test on 3-phase squirrel cage induction motor</td>
<td>03</td>
</tr>
<tr>
<td>6</td>
<td>Identification of components</td>
<td>06</td>
</tr>
<tr>
<td>7</td>
<td>Earthing and Safety</td>
<td>06</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>45</td>
</tr>
</tbody>
</table>

OBJECTIVES

Upon the completion of the practice the student shall be able to

I Verify Network Laws & Theorems
   1. Verify Ohm’s Law
   2. Verify the limitations of Ohm’s law
   3. Verify Kirchhoff’s current Law
   4. Verify Kirchhoff’s Voltage law

II Calibrate the different meters
   1. Calibrate Dynamometer type of wattmeter
   2. Calibrate single phase Energy meter

III Measure Power in DC and AC circuit
   1. Measure power across a Resistor using voltmeter and ammeter when connected across a DC supply.
2. Measure power and Power factor in 1 - Ø inductive circuit by using Wattmeter, Volt meter and Ammeter when connected across an AC supply.

IV Perform Speed control of DC Shunt Motor by
    (a) Rheostatic control method
    (b) Field control method

V Conduct Brake test on 3-phase squirrel cage induction motor.
    1. Conduct brake test on 3-phase squirrel cage induction motor.

VI Identify the various components
    1. Identify resistors based on their colour code.
    2. Identify capacitors based on their colour code.
    3. Identify diodes with their rating
    4. Identify Zener diode.
    5. Identify the type of transistor (NPN or PNP) and their terminals (C,E,G).

VII Demonstrate Earthing and Safety
    1. Demonstrate Pipe Earthing
    2. Demonstrate Plate Earthing

Safety Precautions
General Safety Precautions to be observed by the student for all Electrical laboratory Practices
    1. Every student has to bring insulated tool kit and follow the general safety precautions throughout the lab sessions
    2. Whenever handling/using a meter check for ‘zero’ position of the pointer and adjust for ‘zero’ position if there is any deviation

COURSE CONTENT

(I) Network Laws & Theorems
    Ohm's Law - limitations of Ohm's law - Verification of Ohms Law - Kirchoff's current law - Kirchoff's Voltage law - Super position theorem - Thevenin's theorem

(II) Calibration of meters
    Dynamometer type of wattmeter - Single phase Energy meter

(III) Measurement of Power
    Across a Resistor in DC circuit - Across an Inductive circuit in an AC circuit.

(IV) Perform Speed control of DC Shunt Motor by
    Rheostatic control method - Field control method

(V) Brake test on 3-phase squirrel cage induction motor.
    Conduct Brake test on 3-phase squirrel cage induction motor.

(VI) Identify the various components
    Identify the various components - Resistors, Capacitors, Diode, Zener Diode, Transistor.

(VII) Earthing and Safety.
    Demonstrate Pipe Earthing - Plate Earthing - First aid.
MANUFACTURING AND FABRICATION ENGINEERING LAB

Subject Title : Manufacturing and Fabrication Lab
Subject Code : M – 310
Periods per Week : 03
Periods per Semester : 45

OBJECTIVES
Up on the completion of the course the student shall be able to:

1.0 Understand the concepts of foundry
   1.1 Know the sand moulding procedures in foundry.
   1.2 Prepare a mould sand mix.
   1.3 Identify various tools used in foundry shop.
   1.4 Prepare mould in two boxes, three boxes.
   1.5 Prepare a mould ready for casting with proper provision for runners, risers and gates
   1.6 Place the cope over the drag without any mismatch
   1.7 Prepare the molten metal and calculate the amount of metal to be poured in the mould

2.0 Know the working of Lathe and be in a position to operate the same.
   2.1 Perform a plain turning operation on a lathe machine.
   2.2 Select proper tool to perform the job.
   2.3 Centring the job by dial gauge
   2.4 Select the suitable speed for different operations
   2.5 Make use of various measuring instruments for taking dimensions.
   2.6 Perform step turning operation on lathe.
   2.7 Calculate the taper angle.
   2.8 Know the different taper turning methods on lathe
   2.9 Turn the required tapers by swivelling the compound rest.
   2.10 Produce articles of industrial application such as ring gauges, plug gauges, handle etc.

3.0 Arc Welding
   3.1 Prepare the edges for welding
   3.2 Select the suitable electrode, voltage and current
   3.3 Handle the Electrode Holder for laying welding beads.
   3.4 Understand the operation of welding transformer and generator.
   3.5 Perform various weld joint operations.
### Key competencies to be achieved by the student.

<table>
<thead>
<tr>
<th>Title of the experiment</th>
<th>Key competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moulding and Casting of solid bearing</td>
<td>- Select the suitable sand and mix it for the mould</td>
</tr>
<tr>
<td></td>
<td>- Cut gates and runners</td>
</tr>
<tr>
<td></td>
<td>- Pour sufficient quantity of molten metal</td>
</tr>
<tr>
<td>Moulding and Casting of flange coupling</td>
<td>- Select the suitable sand and mix it for the mould</td>
</tr>
<tr>
<td></td>
<td>- Prepare and place the core</td>
</tr>
<tr>
<td></td>
<td>- Cutting of gates and runners</td>
</tr>
<tr>
<td></td>
<td>- Pouring the sufficient quantity of molten metal</td>
</tr>
<tr>
<td>Moulding and Casting of split bearing</td>
<td>- Select the suitable sand and mix it for the mould</td>
</tr>
<tr>
<td></td>
<td>- Prepare and place the core</td>
</tr>
<tr>
<td></td>
<td>- Cutting of gates and runners</td>
</tr>
<tr>
<td></td>
<td>- Pouring the sufficient quantity of molten metal</td>
</tr>
<tr>
<td>Moulding and Casting of connecting rod</td>
<td>- Select the suitable sand and mix it for the mould</td>
</tr>
<tr>
<td></td>
<td>- Prepare and place the core</td>
</tr>
<tr>
<td></td>
<td>- Cutting of gates and runners</td>
</tr>
<tr>
<td></td>
<td>- Pouring the sufficient quantity of molten metal</td>
</tr>
<tr>
<td>Moulding and Casting of V-pulley</td>
<td>- Select the suitable sand and mix it for the mould</td>
</tr>
<tr>
<td></td>
<td>- Cut gates and runners</td>
</tr>
<tr>
<td></td>
<td>- Pour sufficient quantity of molten metal</td>
</tr>
<tr>
<td>Moulding and Casting of Gear pulley</td>
<td>- Select the suitable sand and mix it for the mould</td>
</tr>
<tr>
<td></td>
<td>- Cut gates and runners</td>
</tr>
<tr>
<td></td>
<td>- Pour sufficient quantity of molten metal</td>
</tr>
<tr>
<td>Plain turning</td>
<td>- Check the centring of the work piece using dial gauge</td>
</tr>
<tr>
<td></td>
<td>- Fix the cutting tool at proper inclination</td>
</tr>
<tr>
<td></td>
<td>- Select the suitable speed, feed and depth of cut for rough and finishing operations</td>
</tr>
<tr>
<td></td>
<td>- Check the dimensions</td>
</tr>
<tr>
<td>Title of the experiment</td>
<td>Key competency</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------</td>
</tr>
</tbody>
</table>
| Step turning            | • Check the centring of the work piece using dial gauge  
                        | • Fix the cutting tool at proper inclination  
                        | • Select the suitable speed, feed and depth of cut for rough and finishing operations  
                        | • Check the dimensions |
| Taper turning           | • Check the centring of the work piece using dial gauge  
                        | • Fix the cutting tool at proper inclination  
                        | • Select the suitable speed, feed and depth of cut for rough and finishing operations  
                        | • Check the dimensions  
                        | • Rotate the compound rest to the suitable angle |
| Collar turning          | • Check the centring of the work piece using dial gauge  
                        | • Fix the cutting tool at proper inclination to turn the work piece  
                        | • Select the suitable speed, feed and depth of cut for rough and finishing operations  
                        | • Check the dimensions |
| Knurling                | • Check the centring of the work piece using dial gauge  
                        | • Fix the cutting tool at proper inclination to turn the work piece  
                        | • Selecting the suitable speed, feed and depth of cut for rough and finishing operations  
                        | • Checking the dimensions  
                        | • Fix the knurling tool and selecting the suitable speed and feed |
| Welding                 | • Edge preparation  
                        | • Hold the electrode at suitable angle and distance with respect to the work piece to maintain the arc  
<pre><code>                    | • Check the bead |
</code></pre>
<table>
<thead>
<tr>
<th>Title of the experiment</th>
<th>Key competency</th>
</tr>
</thead>
</table>
| Layout of beads         | • Edge preparation  
                          | • Hold the electrode at suitable angle and distance with respect to the work piece to maintain the arc  
                          | • Check the bead |
| Lap joint               | • Edge preparation  
                          | • Hold the electrode at suitable angle and distance with respect to the work piece to maintain the arc  
                          | • Check the bead |
| Butt joint              | • Edge preparation  
                          | • Hold the electrode at suitable angle and distance with respect to the work piece to maintain the arc  
                          | • Check the bead |

COURSE CONTENT

1 Foundry
   Moulding and casting of
   1.1 Solid bearing
   1.2 Flange coupling
   1.3 Split bearing
   1.4 Connecting rod
   1.5 V – Pulley
   1.6 Gear pulley

2 Machine Shop (Turning)
   2.1 Plain Turning
   2.2 Step Turning
   2.3 Taper Turning
   2.4 Turning Collars
   2.5 Knurling
   2.6 Facing

3. Welding
   3.1 Layout of Beads
   3.2 Butt joints.
   3.3 Lap joints.
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Name of the Subject</th>
<th>Instruction period / week</th>
<th>Total Period / year</th>
<th>Scheme of Examination</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Theor y</td>
<td>Practic al/Tuto rial</td>
<td>Duration (hours)</td>
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<tr>
<td>ME - 401</td>
<td>Mathematics - III</td>
<td>4</td>
<td>60</td>
<td>3</td>
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<tr>
<td>ME - 402</td>
<td>Design of Machine Elements-I</td>
<td>4</td>
<td>60</td>
<td>3</td>
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<tr>
<td>ME - 403</td>
<td>Industrial Engineering</td>
<td>4</td>
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<td>ME - 404</td>
<td>Heat Power Engineering-I</td>
<td>5</td>
<td>75</td>
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<td>ME - 405</td>
<td>Fluid Mechanics &amp; Machinery</td>
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<td>ME - 406</td>
<td>Production Technology -I</td>
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<td>ME - 407</td>
<td>Production Drawing</td>
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<tr>
<td>ME - 408</td>
<td>Communication Skills Practice</td>
<td>-</td>
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<td>45</td>
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<tr>
<td>ME - 409</td>
<td>Material Testing Lab</td>
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<td>ME - 410</td>
<td>Manufacturing &amp; Fabrication Engg. Lab-II</td>
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</table>
DESIGN OF MACHINE ELEMENTS- I

Subject Title : Design of Machine Elements - I
Subject Code : M – 402
Periods/Week : 04
Periods/Semester : 60

TIME SCHEDULE

<table>
<thead>
<tr>
<th>S. No</th>
<th>Major Topics</th>
<th>Periods</th>
<th>Weightage of Marks</th>
<th>Short Answer Questions</th>
<th>Essay Type Questions</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>Introduction</td>
<td>03</td>
<td>08</td>
<td>01</td>
<td>1/2</td>
</tr>
<tr>
<td>2.</td>
<td>Bolted Joints</td>
<td>12</td>
<td>21</td>
<td>02</td>
<td>1 1/2</td>
</tr>
<tr>
<td>3.</td>
<td>Riveted Joints and Welded Joints</td>
<td>15</td>
<td>26</td>
<td>02</td>
<td>02</td>
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<tr>
<td>4.</td>
<td>Shafts, Keys and Couplings</td>
<td>18</td>
<td>34</td>
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<td>21/2</td>
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<td>5.</td>
<td>Bearings</td>
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<td>110</td>
<td>10</td>
<td>08</td>
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</tbody>
</table>

OBJECTIVES

Up on completion of the course the student shall able to comprehend

1. Introduction
   1.0 To understand the basic requirements of design.
   1.1 To define the term design.
   1.2 To identify the factors governing design.
   1.3 To state general design procedure.
   1.4 To use relevant Indian Standard Codes.

2. Bolted Joints
   2.1 Explain screw thread nomenclature and specifications of screw threads
   2.2 To know the strength of screwed fasteners
   2.3 To know the stresses in bolts
   2.4 Design the size of bolt for a given load requirement.
   2.5 Design the size of eye bolt for a given load requirement
   2.6 To draw an eye bolt (not to scale) showing the proportions

3. Riveted Joints and Welded Joints
   3.1 To list out the types of riveted joints
   3.2 To know the types of failures in riveted joints
   3.3 To evaluate the strength of a riveted joint
   3.4 Design a riveted joint under the given conditions
   3.5 Concept of Diamond or Lozenge joint
   3.6 To identify the merits and demerits of welded joints
   3.7 To list out the types of welded joints
3.8 Know the terms related to welded joints
3.9 To calculate the strength of simple butt and lap joints

4. **Shafts, Keys and Couplings**
   4.1 State the functions and types of shafts.
   4.2 Design solid and hollow shafts to transmit a given power a given RPM based on strength and rigidity.
   4.3 Design an axle.
   4.4 Know standard sizes of shafts as per I.S.
   4.5 Explain the function of keys and splines.
   4.6 Name the recommended materials used for keys and splines.
   4.7 Explain the possible ways of failure of a key under load.
   4.8 Design and sketch a rectangular sunk key considering failure against shear and crushing for a given torque and also using empirical relations.
   4.9 Write all the proportions of a spline for a given application referring tables.
   4.10 Know the specifications of parallel, gib-head and taper sunk keys as per B.I.S.
   4.11 Explain the function of a coupling.
   4.12 Calculate various dimensions of muff coupling for a shaft of given size using empirical relations and sketch.
   4.13 Design a cast iron flange-coupling (rigid type) for a given torque.

5. **Bearings**
   5.1 State the function of bearings
   5.2 classify the bearings
   5.3 Advantages and disadvantages of sliding contact bearings
   5.4 select a bearing for given loads using tables
   5.5 Design a simple journal bearing using McKee’s equation
   5.6 Calculate heat generated and dissipated in journal bearing
   5.7 Calculate heat generated and dissipated in collar bearing based on uniform pressure and uniform wear
   5.8 State advantages and disadvantages of anti-friction bearings
   5.9 Illustrate a ball / roller bearing
   5.10 Specify a bearing

**COURSE CONTENT**

1. **Introduction**
   Factors governing the design of machine element - nature of load, working stress, mechanical properties of the material of the product, process of manufacture, reliability, durability, Cost, life of product and safety. 
   General sequence of steps in designing a machine element. Need of standard data for design purpose, use of machine design data, handbooks and other data manuals.

2. **Bolted Joints**
   Revision of nomenclature, form of threads – specifications. Strength of screwed fasteners and failure of bolts due to different reasons stresses due to initial tightening and stresses due to external forces stress due to combination of forces – Stresses due to shear loads application.
Design of Nut – Hexagonal and square shapes only.
Design of eye bot for a given load and sketching - using empirical proportions, applications of eye-bolt.

3. **Riveted joints and Welded Joints**
   - Types of Riveted joints; Caulking and Fullering;
   - Types of failures;
   - Strength equations; Efficiency of joints; Simple problems on lap joints and butt joints;
   - Concept of Diamond or Lozenge joint: Simple problems.
   - Types of Welded joints; Advantages and disadvantages over other joints;
   - Terms related to weld; strength equation;
   - Calculation of strength of welded joints (problems on eccentric loading are omitted)

4. **Shafts, Keys and Couplings**
   - **shafts**
     - Function of shafts and materials used for shafts
     - Standard sizes of shafts as per I.S.
     - Design of diameters for solid and hollow shafts to transmit a given power at given rpm.,
       - a) based on strength
       - b) based on rigidity.
     - Design of axle.
     - Numerical problems
   - **keys**
     - Function of keys and splines specification of splines.
     - Materials of keys and splines.
     - Discussion over nature of failure of key-effect of key way and the shaft strength.
     - Design of a rectangular sunk key considering its failure against shear and crushing – given the power transmitted by the shaft and rpm.
     - Design of rectangular sunk key using empirical proportions for given diameter of the shaft. Check for strength.
     - Proportions of a spline for a given application using tables.
   - **Couplings**
     - Function of coupling & types of couplings.
     - Calculation of proportions of a muff coupling (solid) for a given shaft size using empirical formulae, sketching the same from the computed dimensions.
     - Rigid flange coupling : Calculation of dimensions for a C.I. flange coupling and coupling bolts for a given torque using empirical proportions – Sketching the flange coupling with the computed dimensions.
     - Numerical problems and sketching.

5. **Bearings**
   - Functions, Types of bearings
   - Journal bearing – terminology, McKee’s Equation, Bearing Modulus
   - Friction in journal bearing, Friction circle, power lost in friction at a bearing
   - Thrust bearing- Power lost in friction, flat pivot and flat collar under conditions of uniform intensity of pressure and wear
   - Rolling contact bearings – advantages and disadvantages
   - Components of rolling contact bearing
   - Market or commercial specifications of ball and roller bearings as per BIS standards
REFERENCES

INDUSTRIAL ENGINEERING
Subject Title : Industrial Engineering.
Subject Code : M-403
Periods/Week : 04
Periods per Semester : 60

TIME SCHEDULE
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<th>Short Answer Questions</th>
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OBJECTIVES
Up on completion of the course the student shall be able to

1.0 A. Understand the principle of work study.
   1.1 Apply method study to a given situation.
   1.2 State the steps involved in method study.
   1.3 Identify the elements of chart used in method study.
1.4 Assemble the elements with symbols to form the required chart.
1.5 State the question in their order to analyse the operational sequence.
1.6 Analyse the question to form the best sequence.
1.7 Conclude the best sequence
1.8 Draw modified chart.

B. **Understand the work measurement techniques.**
1.9 State the purpose of work Measurement.
1.10 Describe the time – study Equipment.
1.11 Describe the sequence of making Time – study.
1.12 State the rules for elemental Break down
1.13 State the procedure of recording the Time.
1.14 Explain the need for rating factor.
1.15 Compute normal time.
1.16 Explain the importance of Allowances.
1.17 Compute the standard time for an operation using observed time.
1.18 State the advantages of PMTS (Predetermined Motion Time Standards).
1.19 Compute standard time using PMTS data.
1.20 State the purpose of work – sampling.
1.21 State the advantages of work – sampling.
1.22 Describe the method of conducting work – sampling.
1.23 Draw conclusion from work sampling.

2.0 **Understand the job evaluation & merit rating**
2.1 Define job evaluation
2.2 State the purpose and procedure of job evaluation
2.3 Know the job analysis, job description and jobs specification
2.4 Explain the methods of job evolution
   a) Ranking Method
   b) Classification Method
   c) Factor comparison Method
   d) Point Rating method
2.5 State the advantages and disadvantages of above methods
2.6 Define the merit rating
2.7 State the purpose of merit rating
2.8 Explain the methods of merit rating
   a) Rating Scale method
   b) Check list method
   c) Employee comparison method
2.9 State the advantages and disadvantages of merit rating.

3.0 **Understand the wage systems existing in industry.**
3.1 State the types of wages.
3.2 Define the terms base wage, production bonus.
3.3 State the different incentives.
3.4 Outline the standard wage plans such as Halsey, Rowan, Emerson, Taylor’s differential piece rate system
3.5 State the incentives for supervisor and executives.
3.6 Solve problems in calculating wages under different wage plans.

4.0 **Understand inspection procedures & the quality control functions.**
4.1 Distinguish between the terms quality of design and quality of manufacturing.
4.2 Discuss quality – cost relationship.
4.3 Discuss quality variation parameters.
4.4 Know inspection procedures.
4.5 State the different inspection methods.
4.6 Identify the difference between different methods of inspection.
4.7 State the advantages and limitations of the methods.
4.8 Define statistical terms.
4.9 State the meaning of above terms.
4.10 State the characteristics of normal distribution.
4.11 Apply normal distribution and use of its characteristics to construct control charts.
4.12 Construct control charts for variables and attributes.
4.13 Interpret control chart for “process in control” or “process out of control”.
4.14 Decide the use of proper chart in given situation.
4.15 Apply the principles of “Random Sampling”.
4.16 Identify the situation where Random Sampling is useful.
4.17 Compute the probability of acceptance for a given product.
4.18 Draw O.C. curve for single sampling plans.
4.19 Interpret required values for O.C. Curves.

COURSE CONTENT

Contribution of work study to productivity

1.0 Method Study.
Meaning and purpose.
Process chart symbols- types.
Operation process chart; method of Constructing.
Flow process chart, its elements and Relational ship.
Flow diagrams.
Other tools for method analysis.
Analysing the charts and methods by questioning processes.
Decisions for improving the Methods.
Purpose, basic procedures.
Time study equipment – stop watch, study board, time study forms.
Making time study, checking the methods, break down of the job – recording – selection of elements – measurement of time.
Time study – rating – average rating – normal performances, factors affecting performances, rating scales, rating factor.
Allowance to be considered in determining standard time – determination of standard time.
Predetermined motion time standard, Standard data, uses of the standard data.
Work sampling; work sampling procedure – Purpose – collection of data – determination of the results.
2.0 **Job Evaluation & Merit Rating**
Job evaluation – definition, objectives and procedure, job analysis Job description and Job specification.
Methods of Job Evaluation – Ranking, classification, factors comparison and point rating methods
Merit rating – definition and objectives
Methods of merit rating – rating scale, check list and employee comparison methods, advantages and disadvantages of merit rating

3.0 **Wage Systems.**
Wages – definition, types – wage differentials – reasons, Methods of wage payments, Types of incentives, standard wage plans – Halsey, Weir, Emersons, Rowan’s Gantt’s task and Bonus systems, - Taylor’s piece rate system, Merric’s piece rate system – Numerical problems on the above plans, Incentives to the supervisor and executives.

4.0 **Inspection and Statistical quality control - Inspection**

**Control chart for variables**
Average and grand average – their significance determination of upper and lower control limits of X and R using statistical tables, construction of X and R charts for a group of samples.
Analysis of control charts – process out of control, and in control’. Thumb rules for analysis – shifts, runs, trends, erratic fluctuations.

**Control chart for attributes** – fraction defective - percent defective - P,NP, 100P charts – significance – characteristics of X and R charts – calculation of P from data – control limits -process 'in control ' and 'out of control' – differences between P,NP and 100P charts.
Sampling procedure lot,Meaning of the term- lot - lot quality, lot size, sample size and acceptance number – lot sampling.
Probability of acceptance - producer's risk - consumers' risk LTPD, AOQ and AOQL.

**Single sampling plan** - Parameters that affect the lot size and sample size and acceptance number – effect of sample size and acceptance number on Probability of acceptance (Pa) - ‘OC’ curves of a single sampling plan – calculation of Pa - Double sampling plan - Variables involved in double sampling plan – Calculation of Pa.
REFERENCE BOOKS

1. Work study – by Ralph Banes.
2. Work study – by I.L.O.
3. Industrial Engineering & Management Science - by T.R.Banga
4. S.Q.C – by Grant & Levenworth
5. S.Q.C -by Juran
6. S.Q.C -by Gupta

HEAT POWER ENGINEERING-I

Subject Title : Heat Power Engineering-I
Subject Code : M-404
Periods/Week : 05
Periods per Semester : 75

TIME SCHEDULE

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<th>Essay type Questions</th>
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<td>Air Compressors</td>
<td>17</td>
<td>21</td>
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<td>01 ½</td>
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</table>
OBJECTIVES

Up on the completion of the course the student shall be able to

1.0 Appreciate the study of air standard cycles.
   1.1 Define the term ‘Air Standard cycle’
   1.2 Define the term ‘Reversible Cycle’.
   1.3 Explain with a line diagram the Working of cutot cycle.
   1.4 State the assumptions made in Carnot cycle.
   1.5 Derive the formula for the air standard efficiency of a Carnot cycle.
   1.6 Solve simple problems on Carnot Cycle.
   1.7 Explain the working of Otto Cycle with help of a line diagram.
   1.8 State the assumptions made in Otto Cycle.
   1.9 Derive the formula for air standard Efficiency of Otto Cycle.
   1.10 Solve simple problems on Otto Cycle.
   1.11 Explain the working of a Diesel cycle with line diagrams.
   1.12 State assumptions made in Diesel Cycle.
   1.13 Derive the formula for Air Standard Efficiency of Diesel Cycle.
   1.14 Solve the simple problems on Diesel Cycles.
   1.15 State the reasons for Carnot cycle being highly efficient than any other cycle working between the same temperature limits.

2.0 Comprehend the construction, working and performance of internal combustion engines.
   2.1 Define “Heat Engine”.
   2.2 Classify heat engines.
   2.3 Give examples for each type.
   2.4 Summarise the advantages of internal combustion engines over external combustion engines.
   2.5 Classification of Internal Combustion Engines
   2.6 Draw the neat sketch of an I.C. engines and name the various parts.
   2.7 Explain with line diagram the working of a four-stroke diesel engine.
   2.8 Explain with a line diagram the working of a two-stroke diesel engine.
   2.9 Explain with a neat sketch the working of a four-stroke petrol engine.
   2.10 Explain with a neat sketch the working of a two-stroke petrol engine.
   2.11 Compare two stroke engines with four stroke engines.
   2.12 Compare diesel engines with petrol engines.
   2.13 Draw the valve time diagrams for two-stroke petrol and diesel engines also draw the valve time diagram for four-stroke petrol and diesel engines.
   2.14 Name the various elements of the fuel systems of diesel engine.
   2.15 Explain with sketches the working of the elements of fuel system of diesel engine.
   2.16 Name the various elements of the fuel system of a petrol engine.
   2.17 Explain the functions of the elements of the fuel system in a petrol engine.
   2.18 Explain with a line diagram the working of a simple carburettor.
   2.19 Explain with a line diagram the working of a zenith carburettor.
   2.20 State the methods of cooling in I.C. engine cylinders.
2.21 Explain with a sketch air – cooling in I.C. engine.
2.22 Explain with line sketch the working of water cooling system with thermo syphon method of circulation.
2.23 Explain with neat sketch the working of water – cooling system with a radiator and forced circulation.
2.24 Compare air cooling system with water – cooling system.
2.25 Name the ignition systems used in petrol engines.
2.26 Explain with line sketch the working of a battery – coil ignition system.
2.27 Explain with sketch the working of a magneto ignition system.
2.28 Compare the battery ignition system with magneto ignition system.
2.29 Name the different methods of lubricating systems in I.C. engines.
2.30 Explain with sketches the methods of lubricating systems in I.C. engines.
2.31 Name the different methods of governing I.C. engines.
2.32 Explain the hit and miss method governing of I.C. engines.
2.33 Explain the quality method of governing of I.C engines.
2.34 Explain with line sketch the quantity method of governing of petrol engines.
2.35 Explain the meaning of super charging of I.C. engines.
2.36 List out the objectives of super charging in I.C. engines.
2.37 Write the formula for brake power.
2.38 Write the formula for indicated powder.
2.39 Write the formula for Mechanical Efficiency.
2.40 Write the formula for Thermal Efficiency.
2.41 Write the formula for Relative Efficiency.
2.42 understand Heat balance sheet.
2.43 Solve simple problems on the performance of I.C. engines using brake test data.

3.0 Comprehend the construction and working of air compressor.
3.1 State the functions of air compressors.
3.2 Enumerate the uses of compressed air.
3.3 Name the different types of compressors.
3.4 Explain with line diagram the working of a single reciprocating air compressor.
3.5 Write the formula for work done and power required by a single stage compressor.
3.6 Solve simple problems on single acting reciprocating air compressors.
3.7 State the advantages of multi- stage compressors over single stage compressor.
3.8 Explain the use of inter cooler.
3.9 State the conditions for minimum work done in two stage compression.
3.10 Write the formula for work done and power required in two stage compressor.
3.11 Solve simple problems in two stage air compressor.
3.12 Name the types of rotary compressors.
3.13 Explain with line diagram the working of a centrifugal compressor.
3.14 Explain with line diagram the working of an axial flow type compressor.
3.15 Explain with line sketch the working of a vane type compressor.

4.0 Understand the working and applications of gas turbines & Jet Propulsion.
4.1 Give broad classification of gas turbines.
4.2 Compare Gas turbines with Steam turbines.
4.3 Compare gas turbines with reciprocating I.C. engines.
4.4 Mention the applications with limitations of gas turbine.
4.5 Explain with line diagrams the working of an open cycle constant pressure type gas turbine.
4.6 Explain with line diagram the working of a closed cycle type gas turbine.
4.7 Represent cycle of operation for the above type on P-V and T-s diagrams.
4.8 Explain with line diagram the principles of operation of Ramjet engine and turbo-jet engines.
4.9 State the application of jet engine.
4.10 Explain with line sketches the working of rocket engine.
4.11 Identify the fuels used in jet propulsion.

COURSE CONTENT

1.0 Air standard cycles.
1.1 Meaning of air standard cycle-its use-Reversible and irreversible process – reversible and irreversible cycles conditions for reversibility of a cycle.
1.2 Brief description of Carnot cycle with P.V. and T-S diagrams, Assumption made – Efficiency - Problems on Carnot cycle.
1.3 Brief explanation of Otto cycle with P.V. and T-S diagrams, assumptions made – Efficiency - Simple problems on Otto cycle.
1.4 Brief description of Diesel cycle with P.V. and T-S diagrams, Assumption made – Efficiency - Simple problems on Diesel cycle.
1.5 Reasons for the highest efficiency of Carnot cycle over other cycles working between same temperature limits.

2.0 Internal Combustion Engines.
2.1 Heat engines – Internal combustion engines and external combustion engines advantages of I.C. engines over external combustion engines classification of I.C. engines, neat sketch of I.C. engine indicating component parts, state the function of each part and materials used for the component parts – Cylinder, crank case, crank pin, crank, crank shaft, connecting rod, wrist pin, piston, cooling pins cylinder heads, exhaust valve, inlet valve.
2.2 Brief explanation on the principle of working of four-stroke diesel engine and two-stroke diesel engine.
2.3 Brief explanation on the principle of working of four stroke and two stroke petrol engines.
2.4 Comparison of two stroke engines and four stroke engines. Comparison of diesel engine and petrol engine.
2.5 Draw the valve time diagrams for two stroke and four stroke engines.
2.6 Descriptive treatment, with sketches of a diesel fuel system, fuel tanks, fuel filter, fuel pump and fuel injector.
2.7 Descriptive treatment of petrol engine fuel system functions of tank, fuel filter, fuel pump and carburettor, principles of working of a Zenith Carburettor (Line sketch) and its advantages over simple carburettor.
2.8 Cooling system I.C. engines, air cooling, water cooling system with thermo siphon method of circulation and water cooling system with
radiator and forced circulation (description with line diagram). Comparison of air cooling and water cooling system.

2.9 Ignition systems – Battery coil ignition and magneto ignition (description and working). Comparison of two systems.

2.10 Types of lubricating systems used in I.C. engines descriptive treatment only with line diagram.

2.11 Types of governing of I.C. engines – hit and miss method, quantitative method, qualitative method and combination methods of governing their applications. Objective of super charging.


3.0 Air Compressors.

3.1 Functions of air compressor – uses of compressed air – types of air compressors.

3.2 Single stage reciprocating air compressor its construction and working (with line diagram) using P.V. diagram Formulae for work done and power required- simple problems on calculation of work done and power required.

3.3 Multi stage compressors – advantages over single stage compressors. Use of air cooler – conditions for minimum work in two stage compressor (without proof) Formulae for work done and power required in two stage compressors – simple problems.

3.4 Rotary compressors – types – descriptive treatment of Centrifugal compressor, axial – flow type compressor and vane-type compressors.

4.0 Gas Turbines & Jet Propulsion


4.4 Principle of operation of Ram – jet engine and turbojet engines – application of jet engines.

4.5 Rocket engine – its principle of working & application.

4.6 Fuels used in jet – propulsion.

REFERENCE BOOKS

2. Thermal Engineering by Mathur & Mehta
3. Fundamentals of I.C. Engines by Heywood
4. Thermal Engineering by P.L.ballaney
FLUID MECHANICS & HYDRAULIC MACHINERY

Subject Title : Fluid Mechanics & Hydraulic Machinery
Subject Code : M-405
Periods/Week : 05
Periods per Semester : 75

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OBJECTIVES

Up on completion of the course the student shall be able to

Know the importance of Fluid mechanics, its application in the present day industry and will be in a position to understand the working of Hydraulic Machines.

PART – A – Fluid Mechanics

1.0 Understand the various properties of fluids
   1.1 Define fluid, give examples
   1.2 Differentiate between compressible (gases) and incompressible (liquids) fluids; ideal and real fluids,
   1.3 State the various units used in fluid mechanics.
   1.4 Define various properties of fluids and state their units
   1.5 Define intensity of pressure; differentiate between gauge pressure and absolute pressure.
   1.6 State units for pressure.
   1.7 Explain the working principle of various instruments used for determining the pressure of fluids.

2.0 Understand the behaviour of liquids in motion
   2.1 State types of flow, Distinguish laminar flow and turbulent flow and concept on Reynolds number.
   2.2 State the various types of energies and the total energy.
   2.3 Know about the velocity of a flowing liquid
   2.4 Understand the discharge equation and equation of continuity of flow.
2.5 State Bernoulli’s equation and its application in hydraulics
2.6 Explain the working principle of venturimeter, pitot tube, water and current meters
2.7 Solve problems (simple) on law of continuity, Bernoulli’s equation, Venturimeter and Pitot tube.
2.8 Define Co-efficient of Velocity (Cv), Co-efficient of Contraction (Cc), Co-efficient of discharge (Cd).

3.0 Comprehend flow of liquids through pipes
3.1 List various losses when liquid flows through pipes
3.2 Mention the equation for loss of head due to friction in pipes
3.3 State Darcy’s and chezy’s formulae
3.4 Explain the hydraulic gradient and total energy line
3.5 Calculate the velocity of flow, discharge and diameter of pipes connecting two reservoirs
3.6 Explain the function of siphon and give reason for limiting the height of the pipes
3.7 Explain how the power can be transmitted through pipes carrying liquid under pressure
3.8 Express the condition for maximum power through pipes
3.9 Solve simple problems on power transmission through pipes

4.0 Analyse forces due to the impact of jets
4.1 Derive expression for force of jet on fixed vertical, flat plate, fixed inclined flat plate, and moving flat plate
4.2 Derive expression for the force of jet on a series of plates fixed on the rim of a wheel
4.3 Draw velocity triangles for fixed and moving curved blades
4.4 Find the expressions for work done, power and efficiency in the above

B. Hydraulic machines

5.0 Understand the working of hydraulic (water) Turbines
5.1 state the importance of water turbines
5.2 Draw the layout of a hydroelectric power station
5.3 Classify the water turbines and also sub-classify them based on the direction of flow of water
5.4 Explain the working of Pelton wheel, Francis turbine and Kaplan turbine
5.5 Describe the governing of water turbines
5.6 Solve simple problems on water turbines

6.0 Know the working of pumps
6.1 Explain the function of pump
6.2 Classify the pumps
6.3 Explain the principle of operation of reciprocating pumps
6.4 Mention the constructional details of single acting and double acting pumps
6.5 State the effect of velocity and acceleration of fluids in suction and delivery pipes
6.6 Solve simple problems on power required to drive reciprocating pump
6.7 Explain the principle of operation of centrifugal pumps
6.8 Mention the constructional details of centrifugal pump
6.9 Compare the centrifugal pump with a reciprocating pump
6.10 Appreciate the importance of priming in centrifugal pump
6.11 Identify the effects of leakages of air, its prevention
6.12 Know the working of multi-stage pumps
6.13 Define the efficiency of a centrifugal pump
6.14 Explain the phenomenon of cavitation and state its effect
6.15 Solve simple problems on centrifugal pumps
6.16 Draw the layout of a centrifugal pump installation
6.17 Know the working of Jet pump & submersible pump

COURSE CONTENT

PART – A – Fluid Mechanics

1.0 Properties of fluids
1.1 Definition of fluid, compressible and incompressible fluids
1.2 Units used in Fluid Mechanics.
1.3 Fluid properties-Density, specific weight, specific gravity, viscosity and surface tension, compressibility and capillarity.
1.4 Intensity of pressure, gauge and absolute pressures.
1.5 Measurement of pressures by piezo-meter, , U-Tube - manometer, differential manometer bourdon pressure gauge

2.0 Flow of Liquids
2.1 Types of Flow and concept on Reynold’s Number.
2.2 Pressure, potential and kinetic energy of liquids, total energy, equation of continuity of flow
2.3 Velocity of liquids and discharge
2.4 Bernoulli’s equation, its practical applications
2.5 Venturiometers, pitot-tube, current meters
2.6 Problems on Bernoulli’s Equation, Venturimeter and pitot tube.
2.7 Definition of Cv,Cc, Cd

3.0 Flow through pipes
3.1 Loss of head in pipes due to friction- Darcy’s & Chezy’s formula (without proof)
3.2 Hydraulic gradient and total energy line
3.3 Calculation of discharge, velocity, diameter of pipe etc., for pipes connecting two reservoirs (considering frictional losses only)
3.4 Siphon, study of pressure head variations at its different sections, minimum pressure at apex and its influence in causing separation (Numerical problems omitted)
3.5 Expressions for power transmitted through pipes.
3.6 Expressions of transmission efficiency, condition for maximum efficiency (without proof.)
4.0 **Impact of jets**

4.1 Derivation of formulae for the force of jet on
   a) Fixed vertical flat plate
   b) Fixed inclined flat plate
   c) Moving flat plates – vertical and inclined
   d) Series of flat plates fixed on the rim of a wheel

4.2 Force of jet striking at the centre and at the top of a fixed curved blade and moving curved blade, velocity triangles

4.3 Work done, power and efficiency in the above cases. Simple problems only

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**PART – B – Hydraulic Machines**

5.0 **Water turbines**

5.1 Introduction to hydraulic machines- water turbines, pumps

5.2 Use of water turbines in Hydra-electric power stations; line sketch showing layout of hydro-electric power plant with head race, dam, sluice gate, pen stock, turbine, generator and tail race.

5.3 Classification of turbines-impulse and reaction turbines brief sub-classification as axial, radial and tangential flow type

5.4 Working principle of Pelton wheel, Francis turbine and Kaplan turbine with simple line sketches only.

5.5 Governing of Water turbines

5.6 Simple Problems on power & efficiency of water turbines

---

6.0 **Pumps**

6.1 Function of a pump

6.2 Classification of pumps

6.3 Principle of operation of a reciprocating pump

6.4 Constructional details of single acting, double acting pumps.

6.5 Effect of velocity and acceleration of fluids, in suction and delivery pipes (without proof)

6.6 Expression for theoretical power required to drive the pump(without proof). Simple problems

6.7 Working principle of centrifugal pump

6.8 Installation of centrifugal pump, showing its mountings and other accessories

6.9 Priming of centrifugal pump and its necessary leakages of air its prevention

6.10 Constructional details of centrifugal pump

6.11 Efficiency of centrifugal pump

6.12 Cavitation and its effect. Simple problems on work, power and efficiency

REFERENCE BOOKS

2. Hydraulic Machines By S.Anantha Swamy
3. Hydraulic Machines By R.C. Patel
4. Hydraulics By Malhotra & Malhotra
5. Hydraulics & Hydraulic Machinery By Yeaple

PRODUCTION TECHNOLOGY - II

Subject Title: Production Technology-II
Subject Code: M – 406
Periods Per Week: 04
Periods Per Semester: 60

TIME SCHEDULE

<table>
<thead>
<tr>
<th>S.No</th>
<th>Major Topics</th>
<th>Number of Periods</th>
<th>Weightage of Marks</th>
<th>Short Answer Questions</th>
<th>Essay Type Questions</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Milling</td>
<td>20</td>
<td>39</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>2</td>
<td>Gear Making</td>
<td>10</td>
<td>16</td>
<td>02</td>
<td>01</td>
</tr>
<tr>
<td>3</td>
<td>Grinding and finishing processes</td>
<td>16</td>
<td>34</td>
<td>03</td>
<td>02½</td>
</tr>
<tr>
<td>4</td>
<td>Metrology</td>
<td>14</td>
<td>21</td>
<td>02</td>
<td>01½</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>60</td>
<td>110</td>
<td>10</td>
<td>08</td>
</tr>
</tbody>
</table>

OBJECTIVES
Up on completion of the course the student shall be able to understand

1.0 Milling
1.1 Explain the principle of working of a Milling machine.
1.2 Classify the milling machines.
1.3 Illustrate the constructional details.
1.4 Explain the functions of each part of the machine.
1.5 Describe the various milling operations.
1.6 Identify the different milling cutters.
1.7 Select the tool and work holding devices.
1.8 Explain the different indexing methods.
1.9 Explain the specifications of milling machines.

2.0 Gear Making
2.1 Identify the different methods of producing gears.
2.2 Illustrate gear shaping.
2.3 Sketch the gear hob.
2.4 Identify the various components of hobbing m/c.
2.5 Describe the working of the above m/c.
2.6 List out the sequence of operations in generating gear by gear hobbing m/c.
2.7 Explain the different methods of finishing & checking gear teeth dimensions.
2.8 Specify the gears.
2.9 Identify the gear materials.
2.10 State the different heat treatment processes applied to gears.

3.0 Grinding and finishing Processes
3.1 Explain the principle of metal removal by grinding.
3.2 Identify different abrasives.
3.3 Explain the bonds and grinding wheel manufacturing processes.
3.4 Identify the grinding wheel from the standard code (Marking system or designation of wheel).
3.5 State the factors for selecting the grinding wheels.
3.6 State the methods of grinding.
3.7 Classify the grinding machines.
3.8 Illustrate the cylindrical, surface, tool and cutter grinders.
3.9 Identify the different work holding devices.
3.10 State the methods of wheel maintenance.
3.11 State different finishing processes by grinding.(Honing, Lapping, Superfinishing)
3.12 Explain the principle of electro-plating with a sketch.
3.13 Explain the principle of hot dipping processes namely galvanising, tin coating, Parkerizing and anodising.
3.14 Describe organic coatings.
3.15 State the principles of metal spraying.
3.16 State the features of wire process and powder process.
3.17 Select the appropriate process for surface roughness of a given application.
4.0 Metrology

4.1 Identify various linear and angular measuring instruments.
4.2 Explain the principle of working of (at least 4 types) comparators with sketches.
4.3 Predict the amount of measuring accuracy using the comparator.
4.4 Identify the inaccuracies in surface finish.
4.5 Suggest the surface finish measuring instrument.
4.6 State the use of collimator and microscope.
4.7 State the principle of working of interferometer.

COURSE CONTENT

1.0 Milling
1.1 Introduction.
1.2 Types of milling machines: plain, Universal, vertical, constructional details – specifications.
1.3 Milling operations
1.4 Indexing: simple, compound and Differential indexing.
1.5 Milling cutters – types – nomenclature of teeth – teeth materials
1.6 Tool Signature of Milling cutter.
1.7 Tool & work holding devices.

2.0 Gear Making
2.1 Manufacture of gears – by casting, moulding – stamping - coining extruding- rolling – Machining.
2.2 Gear generating methods: Gear Shaping with pinion cutter & rack cutter
2.3 Gear hobbing – Description of gear hob – Operation of gear hobbing machine.
2.4 Gear finishing processes.
2.5 Gear materials and specification.
2.6 Heat treatment processes applied to gears.

3.0 Grinding and finishing processes
3.1 Introduction – principles of Metal Removal by Grinding.
3.2 Abrasives – Natural & Artificial.
3.3 Bonds and binding processes: Vitrified, silicate, shellac, rubber, bakelite.
3.4 Factors effecting the selection of grind wheels – size and shape of wheel – kind of abrasive – grain size – grade and strength of bond – structure of grain – spacing – kinds of bind material.
3.5 Standard marking systems: Meaning of letters & numbers sequence of marking – Grades of letters.
3.7 Principle of centreless grinding
3.8 Advantages & limitations of centreless grinding
3.9 Work- holding devices.
3.10 Wheel maintenance – Balancing of wheels – Dressing and trimming of grind wheels: Coolants used.
3.11 Finishing by grinding: Honing, Lapping, Super finishing
3.12 Electroplating – Basic principles – Plating metals – applications.
3.13 Hot dipping: Galvanizing, Tin coating, parkerising, Anodizing.
3.14 Metal spraying: wire process, powder process and applications.
3.15 Organic coatings: Oil base Paint, Lacquer base, Enamels, Bituminous paints, rubber base coating.
3.16 Finishing specifications.

4.0 Metrology.
4.1 Linear measurement: Slip gauges and dial indicators.
4.2 Angle measurements: Bevel protractor, Sine Bar, Angle Slip Gauges.
4.3 Comparators :a) Mechanical  b) Electrical  c) Optical  d) pneumatic
4.4 Measurement of surface roughness: methods of measurements by comparison, tracer instruments and by interferometry.
4.5 Collimators.
4.6 Measuring Microscope. Interferometer.

REFERENCE BOOKS

Production Technology - R.C.Patel
Production Technology - Jain & Gupta.
Gear Technology - Charthathi
A Text Book of Production Engg. - Dora
Tool Design - Donaldson

PRODUCTION DRAWING

Subject Title : Production Drawing
Subject Code : M-407
Period/Week : 07
Period per Semester : 105

TIME SCHEDULE

<table>
<thead>
<tr>
<th>S.No</th>
<th>Major Topics</th>
<th>Number</th>
<th>Weightage</th>
<th>Short</th>
<th>Essay Type</th>
</tr>
</thead>
</table>

I-86
**OBJECTIVES**

*Up on the completion of the course the student shall be able to*

1.0 **Understand the need of production drawing.**
   1.1 Distinguish the machine drawing from a production drawing.
   1.2 State the factors that govern the preparation of a production drawing.
   1.3 Identify the components of a production drawing.
   1.4 List the function of the component.
   1.5 Prepare the relevant views of the part and dimension the part.
   1.6 Indicate the details of specific processes like, heat treatment, welding, counter boring etc.

2.0 **Interpret dimension to obtain a fit as per BIS standards.**
   2.1 State definition of fit, allowance and tolerance.
   2.2 Select dimension from standards to give different type of fit for a given mating parts.
   2.3 Compute the fit from tables.
   2.4 Indicate fits on the drawings.

3.0 **Identify the standard symbol and indication added to it, to represent surface finish.**
   3.1 Indicate the roughness grade number and corresponding symbol as per BIS.
   3.2 Indicate surface roughness on drawings.

4.0 **Interpret and estimate the material requirement.**
   4.1 Identify the material of various components.
   4.2 Specify the raw material as per commercial/BIS Standards.
4.3 Identify the standard part that can be procured directly from the market and specify the part as per commercial/BIS Standards for procurement.

5.0 Write the process sheet of production and prepare the number of production drawings.
   5.1 Indicate the sequence of process of production.
   5.2 Specify the relevant tools to obtain the accuracy and finish.
   5.3 Indicate the suitable equipment.
   5.4 Specify the type of measuring instruments to be used to check the prescribed accuracy.
   5.5 Prepare exercises on production drawing as mentioned in the contents.

6.0 Know the method of preparing blue print and ammonia prints.
   6.1 Understand the preparation of blue and ammonia prints from tracing.
   6.2 List the advantages and disadvantages of the above prints.
   6.3 Identify the other methods of reproducing drawing.

### KEY COMPETENCIES TO BE ACHIEVED BT THE STUDENT

<table>
<thead>
<tr>
<th>Topic</th>
<th>Key competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drawing of a Component</td>
<td>Understand the difference between machine drawing and production drawing.</td>
</tr>
<tr>
<td></td>
<td>Identify the components in Assembly Drawing</td>
</tr>
<tr>
<td></td>
<td>Appraise the importance of symbols.</td>
</tr>
<tr>
<td>Limits, Fits &amp; Tolerances</td>
<td>Use of fits, allowances and tolerances.</td>
</tr>
<tr>
<td></td>
<td>Identify tolerance grades and zones.</td>
</tr>
<tr>
<td></td>
<td>Distinguish types of fits, limits</td>
</tr>
<tr>
<td></td>
<td>Select suitable fit for mating parts</td>
</tr>
<tr>
<td>Surface finish</td>
<td>Identify the surface texture, symbols and grading as per BIS</td>
</tr>
<tr>
<td></td>
<td>Indicate surface roughness symbols on drawings</td>
</tr>
<tr>
<td>Specification of materials</td>
<td>Identify of different material of each component drawing.</td>
</tr>
<tr>
<td>Process sheet &amp; Exercises in Production Drawing</td>
<td>Interpret the production processes and the sequences.</td>
</tr>
<tr>
<td></td>
<td>Indicate equipment and measuring instruments to produce and check the accuracy of the component.</td>
</tr>
<tr>
<td>Reprographic process</td>
<td>Operate the Xerox machine, Ammonia printing machine and microfilming machine</td>
</tr>
</tbody>
</table>
COURSE CONTENT

1.0 Introduction and Drawing of component.
Need of preparing a production drawing, requirements for manufacturing a product like equipment, tools, measuring instruments depending upon processes, accuracy and finish data available in machine drawing – components of a production drawing, fits and tolerances, surface finish, specific processes, material of the component.
Read a given assembly drawing – study of the functions of the various parts of the assembly drawing.
Preparation of detailed drawing of a specified part of the assembly.

2.0 Limits, fits and tolerances.
Definitions of limits, fits and tolerances.
Select dimensions from BIS standards to obtain clearance, transition and interference fits for a given set to mating parts – computation of fit and tolerance from BIS table.
Preparation of drawing of mating parts and representation of fits and tolerances.
Exercises in computing tolerance and representation on the drawings for different types of fits.

3.0 Surface finish.
Standard symbol of surface finish and indications added to it.
Representation of quality of surface finish on the drawing as BIS roughness grade numbers.

4.0 Specifications of materials.
Materials of the parts of the assembly – size of part, estimation of raw material required for a component and specification.
Standard components (parts) like bolts, nuts, bearings etc. – specification of standard parts.

5.0 Process sheets and Production drawing exercises.
Sequence of processes of production for a particular product.
Specifications of relevant equipment and tools to obtain the desired accuracy and surface finish.
Selection of measuring instruments to check the accuracy.
Prepare the relevant views of the part(s) of a given assembly drawing needed for the purpose of production.
Dimension the views obtained in 7.1, and indicate on it with relevant notes the specific processes.
Compute the fit from ISI tables as per the function of the component and indicate the limits at appropriate place on the drawing prepared.
Mark the surface finish symbols with indications added.
Prepare the process sheet indicating sequence of processes and equipment, tools, measuring instruments required.

6.0 Reprographic processes.
Brief description, sequence of operations to prepare Ammonia prints, Advantages and limitations.
Other reproduction processes of drawings like Xerox, Microfilming etc.

**NOTE:** In order to develop the abilities required in the preparation of production drawing in the student, the use of actual production drawing from the local industries as exercises to the students is of vital importance.

**Exercises**

Flange Coupling  Universal Coupling  Eccentric  
Clapper Block  Connecting rod  Drill jig  
Lathe tail stock  Revolving Centre  Knuckle Joint  
Plummer Block  Lathe Tool post  Non Return valve  
Foot Step bearing  Stuffing box

**REFERENCE BOOKS**

2. Blur print reading for Mechanical Trades by B.R.Sachdeva.  
5. Production Drawing by K.Venkat Reddy  
MATERIAL TESTING LABORATORY

Subject Title : Material Testing Lab
Subject Code  : M-409
Periods/Week  : 03
Periods/Semester : 45

TIME SCHEDULE

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Experiment Title</th>
<th>No. of Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Tensile test</td>
<td>06</td>
</tr>
<tr>
<td>2.</td>
<td>Compression test</td>
<td>06</td>
</tr>
<tr>
<td>3.</td>
<td>Impact test</td>
<td>06</td>
</tr>
<tr>
<td>4.</td>
<td>Hardness test</td>
<td>09</td>
</tr>
<tr>
<td>5.</td>
<td>Torsion test on springs</td>
<td>09</td>
</tr>
<tr>
<td>6.</td>
<td>Study of micro structure of Metals and alloys</td>
<td>09</td>
</tr>
<tr>
<td></td>
<td>Total Periods</td>
<td>45</td>
</tr>
</tbody>
</table>

OBJECTIVES

Up on the completion of the course the student shall be able to:

1.0 Material testing Laboratory – Understand the various material testing methods.
   1.1 Define the various properties of materials such as: yield stress, Ultimate stress, percentage elongation, Young’s Modulus.
   1.2 Conduct experiments on concrete cube, cast iron, timber to test for its compressive strength.
   1.3 Know the method of determining the Young’s modulus of materials by the principle of deflection.
   1.4 Determine the modulus of rigidity by the method of deflection of helical springs.
   1.5 Appreciate the importance of various mechanical properties such as hardness, impact strength.
   1.6 Perform tests to determine the above.
   1.7 Learn the method of preparing a specimen for the metallography.
   1.8 Study and interpret the microstructure of specified ferrous and non ferrous materials.
   1.9 Handle the metallurgical microscope to study the microstructures.
Key competencies to be achieved by the student
<table>
<thead>
<tr>
<th>Exercise</th>
<th>Key competencies expected</th>
<th>Max. Marks</th>
<th>Marks awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tensile test</td>
<td>A. Fix specimen in the jaws of the machine</td>
<td>A. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Fit strain gauge to the specimen</td>
<td>B. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Apply load gradually on the specimen</td>
<td>C. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. Record load, elongation, diameter without error</td>
<td>D. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. Plot graph stress vs strain</td>
<td>E. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F. Locate points of elastic limit, yield stress, ultimate stress on the graph</td>
<td>F. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total: 10</td>
<td></td>
</tr>
<tr>
<td>2. Compression test</td>
<td>A. Place the specimen in the machine properly</td>
<td>A. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Apply load on the specimen</td>
<td>B. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Record load</td>
<td>C. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total: 5</td>
<td></td>
</tr>
<tr>
<td>3. Impact test</td>
<td>A. Prepare specimen by making V notch at the required height</td>
<td>A. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Fix specimen on the machine</td>
<td>B. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Release load to hit the specimen precautious</td>
<td>C. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. Record load</td>
<td>D. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total 5</td>
<td></td>
</tr>
<tr>
<td>4. Hardness test</td>
<td>A. Place the specimen on the machine at correct location</td>
<td>A. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Identify suitable indenter for the specimen</td>
<td>B. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Make indent on the specimen</td>
<td>C. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. Measure diameter of indentation</td>
<td>D. 3</td>
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<tr>
<td></td>
<td>E. Calculate hardness number</td>
<td>E. 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total 10</td>
<td></td>
</tr>
</tbody>
</table>
COURSE CONTENT

1. Determination of yield stress, ultimate stress, percentage reduction in area, percentage elongation, Young’s modulus by conducting tension test on Universal testing machine.
2. Determination of crushing strength of concrete cube, cast iron, glass, tiles, timber etc., using UTM/CTM
3. Determination of Young’s Modulus by the method of deflection.
4. Determination of Modulus of rigidity of spring steel by the deflection of springs.
5. Determination of impact strength of the material using Izod and Charpy’s tests.
7. Specimen preparation for the metallography.

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Key competencies</th>
<th>Max. Marks</th>
<th>Marks awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Torsion test of springs</td>
<td>A. Measure spring diameter and spring wire diameter with vernier caliperse B. Measure deflection applying load C. Calculate modulus of rigidity of spring material</td>
<td>A. 4 B. 2 C. 4</td>
<td>Total 10</td>
</tr>
<tr>
<td>6. Study of microstructure of Metals and alloys</td>
<td>A. Preparation of specimen B. Handling microscope to observe microstructure C. Plot microstructure</td>
<td>A. 5 B. 2 C. 3</td>
<td>Total 10</td>
</tr>
</tbody>
</table>
MANUFACTURING & FABRICATION ENGINEERING LAB-II

Subject Title : Manufacturing/Fabrication Engg. Lab II
Subject Code : M-410
Periods/Week : 03
Periods per Semester : 45

OBJECTIVES

Up on the completion of the course the student shall be able to

1.0 Know the working of Lathe, and will be in a position to operate the same.
1.1 Calculate the gear ratio for thread cutting.
1.2 Cut threads on a lathe machine.
1.3 Produce articles of industrial application such as snap gauges, plug gauges, handle etc.
1.4 Perform the combination of operations to produce jobs.
1.5 Perform special turning operations to produce machine handle, eccentric turning, male and female fit assembly

2.0 Welding.
   . 2.1 Weld the material to produce. T, H, and angular joints.

3.0 Foundry
   . 3.1 Prepare a mould for connecting rod, pulleys.
   . 3.2 Core preparation for hollow jobs.

COURSE CONTENT

A. Machine Shop (Turning)
   . 1. Thread cutting 2. Handle 3. Combination of all the operations.
4. Eccentric turning. 5. Male and female fit assembly

**B. Welding**
4. 2-joints (H Joints and T Joints)

**3. Foundry**
1. Connecting rod, 2. core making 3. pulleys.

### Key competencies Expected from the student

<table>
<thead>
<tr>
<th>S.No</th>
<th>Exercise</th>
<th>Key competency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Machine shop (Turning Shop)</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Thread cutting</td>
<td>a. Center the job with dial gauge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Fix the cutting tool in suitable angle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Turn the component with suitable speed and feed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>d. Cut the threads with back gear arrangements</td>
</tr>
<tr>
<td>2</td>
<td>Production of handle</td>
<td>a. Align job with the axis of lathe</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Cut the threads with back gear arrangements</td>
</tr>
<tr>
<td>3</td>
<td>Combination of all operations</td>
<td>a. Centering the job</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Uniform feeding of the tool</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Fixing the cutting tool in correct position</td>
</tr>
<tr>
<td></td>
<td></td>
<td>d. Cutting the metal with suitable speed and feed</td>
</tr>
</tbody>
</table>
| 4  | Eccentric turning | a. Fix the job in a chuck with correct eccentricity  
b. Fixing the cutting tool in correct position  
c. Cutting the metal with suitable speed and feed |

| 5  | Male and female fit assembly | a. Center the job with dial gauge  
b. Fix the cutting tool in correct position  
c. Turn the component with suitable speed and feed  
d. Locate the center of hole  
e. Select suitable drill bit  
f. Drill the hole with suitable speed and feed  
g. Enlarge the hole to suitable diameter by using boring tool |

**Welding**

| 6  | T-Joints, H-Joints, Angular Joints | a. Edge preparation  
b. Hold the electrode at suitable angle  
c. Identify the suitable Method of welding technique.  
d. Maintain proper distance between work piece and electrode tip produce arc  
e. Check the weld bead |

**Foundry**

| 7  | Connecting rod | a. Select the suitable sand and its mix for the mould  
b. Place the pattern in correct position  
c. Ram the sand properly  
d. Provide vent holes  
e. Remove the pattern slowly  
f. Cut gates and runners  
g. Pour sufficient quantity of molten metal into the mould cavity |

| 8  | Core making | a. Prepare suitable core sand mix  
b. Selection of wooden mould box  
c. Pour the core sand into the mould box and proper ramming of the sand  
d. Proper baking of the core |
<table>
<thead>
<tr>
<th></th>
<th>Pulleys</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Select the suitable sand and its mix for the mould</td>
</tr>
<tr>
<td></td>
<td>b. Place the pattern in correct position</td>
</tr>
<tr>
<td></td>
<td>c. Prepare the core</td>
</tr>
<tr>
<td></td>
<td>d. Place the core in correct position</td>
</tr>
<tr>
<td></td>
<td>e. Ram the sand properly</td>
</tr>
<tr>
<td></td>
<td>f. Provide vent holes</td>
</tr>
<tr>
<td></td>
<td>g. Remove the pattern slowly</td>
</tr>
<tr>
<td></td>
<td>h. Cut gates and runners</td>
</tr>
<tr>
<td></td>
<td>i. Pour sufficient quantity of molten metal into the mould cavity</td>
</tr>
</tbody>
</table>
## DIPLOMA IN MECHANICAL ENGINEERING
### SCHEME OF INSTRUCTIONS AND EXAMINATIONS
#### V Semester

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Name of the Subject</th>
<th>Instruction period / week</th>
<th>Total Period / year</th>
<th>Scheme of Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td>Practical/ Tutorial</td>
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</tr>
<tr>
<td>ME-501</td>
<td>Industrial Management</td>
<td>4</td>
<td>-</td>
<td>60</td>
</tr>
<tr>
<td>ME-502</td>
<td>Design of Machine Elements -II</td>
<td>4</td>
<td>-</td>
<td>60</td>
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<td>Heat Power Engineering-II</td>
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INDUSTRIAL MANAGEMENT

Subject Title: Industrial Management
Subject Code: M –501
Periods/Week: 04
Periods per Semester: 60

TIME SCHEDULE

<table>
<thead>
<tr>
<th>S. No.</th>
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<th>Periods</th>
<th>Weightage Of Marks</th>
<th>Short Answer Questions</th>
<th>Essay Type Questions</th>
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<td>1.</td>
<td>Principles and functions of Management</td>
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<td>2.</td>
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OBJECTIVES

Up on completion of the course the student shall be able to

1.0 Understand the principles of management as applied to industry.

1.1 Define industry, commerce (Trade) and business.
1.2 Explain the scope and need for management.
1.3 Understand the evolution of management
1.4 Explain the principles of scientific management.
1.5 Understand functions of Management.
1.6 Differentiate between management and administration.

2.0 Understand types of ownerships, the organisation structure of an industry and the behaviour of an individual in an organisation.

2.1 Explain types of ownerships
2.2 Differentiate types of ownerships.
2.3 Explain salient features of joint stock companies.
2.4 Need of organisation structure of an industry.
2.5 Explain the line, staff and Functional organisations along with legible sketches.
2.6 List the advantages and limitations of line, staff and functional organisations.
2.7 List different departments in a large scale industry.
2.8 Explain the factors of effective organisation.
2.9 Explain organisational behaviour.
2.10 Explain job analysis.
2.11 Assess the incurring applicants.
2.12 Outline the selection process.
2.13 List the sources of manpower.
2.14 State motivation theories.
2.15 State Maslow’s Hierarchy of needs.
2.16 Explain the phenomena of satisfaction.
2.17 Explain the performance levels.
2.18 Explain reward system
2.19 List different leadership models.
2.20 Explain the trait theory of leadership.
2.21 Explain behavioural theory of Leadership.
2.22 Explain the process of decision Making.
2.23 Explain the communication process.
2.24 Analyse the behaviour of groups in an organisation.
2.25 Explain group dynamics.
2.26 Detail the process of managing conflict.
2.27 Explain conflict resolution strategies.

3.0 Understand the different aspects of production management.
3.1 Differentiate and integrate production, planning and control.
3.2 Relate the production department with other departments.
3.3 State the need for planning and it’s advantages.
3.4 Explain the stages of Production, planning and control.
3.5 Explain routing methods.
3.6 Explain scheduling methods.
3.7 Explain dispatching.
3.8 Draw PERT/CPM networks.
3.9 Identify the critical path.

4.0 Understand the role of materials management industries.
4.1 Explain the role of the materials in Industry.
4.2 Derive expression for inventory control.
4.3 Explain ABC analysis.
4.4 Define safety stock.
4.5 Define reorder level.
4.6 Write the expression for economic ordering quantity and mention the terms involved in the expression.
4.7 Explain stock layout.
4.8 List stores records.
4.9 Explain the Bin card.
4.10 Describe Cardex method.
4.11 Explain purchasing procedures.
4.12 List purchase records.
4.13 List the stores equipment
4.14 Explain the need of material handling methods.
4.15 Explain material handling methods. List out hoists, cranes, conveyers, trucks, and forklift trucks.
4.16 Explain break-even analysis.
COURSE CONTENT

1. **Principles and functions of management.**

2. **Organisation Structure & organisational behaviour.**

3. **Production Management.**
   Production, planning and control, relation with other departments, need for planning and its advantages, Routing, scheduling, despatching, PERT and CPM, simple problems.

4. **Materials Management.**
   Materials in industry, inventory control model, ABC Analysis, Safety stock, reorder, level, Economic ordering quantity, Break even analysis, Stores layout, stores equipment, Stores records, purchasing procedures, purchase records, Bin card, Cardex, Material handling, Manual lifting, Hoist, Cranes, conveyors, trucks, fork trucks.

REFERENCE BOOKS

1. Industrial Engineering and Management -by O.P Khanna
2. Production Management- by Buffa.
4. Personnel Management by Flippo.
DESIGN OF MACHINE ELEMENTS-II

Subject Title : Design of Machine Elements-II
Subject Code : M – 502
Periods/Week : 04
Periods/Semester : 60

TIME SCHEDULE

<table>
<thead>
<tr>
<th>S. No</th>
<th>Major Topics</th>
<th>Periods</th>
<th>Weightage of Marks</th>
<th>Short Answer Questions</th>
<th>Essay Type Questions</th>
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<tr>
<td>1.</td>
<td>Belts and chain drives</td>
<td>12</td>
<td>21</td>
<td>02</td>
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<td>2.</td>
<td>Gear drives</td>
<td>12</td>
<td>21</td>
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<td>3.</td>
<td>Fly wheels and Governors</td>
<td>14</td>
<td>26</td>
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<td>Brakes and Clutches</td>
<td>14</td>
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OBJECTIVES

Up on completion of the course the student shall be able to

1. **Understand the Design of Belts and chain drives**
   1.1 Explain the selection criteria of various means of power transmission.
   1.2 Identify various types of belts.
   1.3 Identify different types of drives in belts.
   1.4 Design a stepped pulley for a belt drive.
   1.5 Compute power transmitted.
   1.6 Design belt dimensions for a given power transmission.
   1.7 Apply the effect of centrifugal tension in the above cases.
   1.8 List the Components of chain drives
   1.9 State advantages of chain drives.
   1.10 List the types of chains (problems on chain drives omitted)

2. **Understand the Design of Gear drives**
   2.1 Explain the nomenclature of spur gear tooth.
   2.2 Identify various tooth profiles of gear.
   2.3 List different types of gear trains
   2.4 Design different types of gear trains for given velocity ratios
   2.5 Explain the applications of gear trains

3. **Understand the Design of Fly wheels and Governors**
   3.1 State the function of flywheel
   3.2 Explain the terms related to flywheel
   3.3 State the formula for energy stored by flywheel
   3.4 Solve simple problems on fly wheel
   3.5 Explain the function of governor using legible sketch.
3.6 Description of working principle of Watt governor and Porter governor using legible sketch
3.7 Explain the terms – sensitiveness, stability, isochronism, hunting, effort and power of governor
3.8 Solve simple problems on governors

4. **Understand the Design of Brakes and Clutches**
   4.1 State the function of brakes
   4.2 Explain the classification of brakes
   4.3 Explain block brake & shoe brake
   4.4 Explain band brake
   4.5 Explain the Function of clutch
   4.6 Classify clutches
   4.7 Design single plate and multi-plate clutches based on uniform pressure and uniform wear
   4.8 Solve simple problems on brakes and clutches

5. **Understand the Design of Cams.**
   5.1 Explain the features of cam profile.
   5.2 Classify the cams.
   5.3 Define terms related to cam profile.
   5.4 Draw angular - displacement diagram for lift motion for:
      a) Uniform velocity.
      b) S.H.M.
      c) Uniform acceleration & retardation.
   5.5 Draw simple cam profiles in above three cases for knife edged, flat and roller followers. (offset followers are omitted)

**COURSE CONTENT**

1. **Belts and chain drives**
   Factors to be considered while selecting the type of drive
   Belt drive, types of belt drives; belt materials, belt joints
   length of open and crossed belts (without proof).
   Design of stepped pulley belt drive only.
   Expression for the ratio of belt tensions (without proof).
   Concept of centrifugal tension – Relation between centrifugal tension and the tension on tight side for transmitting maximum power (derivation omitted).
   Permissible stress in the belt per unit width : per unit cross section.
   Calculation of belt thickness and width for given permissible stress for open and crossed belts, considering centrifugal tension and without considering centrifugal tension. – simple problems
   Chain drives –advantages-Types of chains – Roller and silent chains.
   (problems on chain drives omitted)

2. **Gear drives**
   Gear tooth terminology – involute and cycloidal profiles
   Simple, compound, reverted & Epi cyclic gear trains.
   Design of number of teeth for simple, compound and reverted gear trains for a given speed ratio and sketching the arrangement.
Applications of gear trains – thread cutting on a lathe – back gear assembly of a lathe
Selection of gear wheels to cut threads for a given pitch on a lathe.
Problems on screw cutting on lathe – Back gear assembly - 3- Speed gear box of an automobile.
Description and application of epi-cyclic gear trains (Problems on epi-cyclic gear trains not included)

3. Fly wheels and Governors
Purpose and applications of fly wheels – Definitions of Coefficient of fluctuation of speed and Coefficient of fluctuation of energy.
Turning moment diagram of flywheels
Formula for energy stored by fly wheel (without proof) – simple problems
Governor – function – types
Explanation of Simple Watt governor and Porter governor
Sensitiveness, Stability, Isochronism, Hunting, Effort and Power of governor
Simple problems on watt governor and porter governor.

4. Brakes and clutches
Function of brakes – Classification of brakes
Working of simple shoe brake and band brakes only.
Simple problems on shoe brake and band brakes only.
Function of clutch – classification of clutches
Working of single plate and multi-plate clutches
Simple problems on single plate and multi-plate clutches based on uniform pressure and uniform wear

5. Cams
Classification of cams and followers – uses.
Working principle of plate and cylindrical cams.
Nomenclature of radial cam.
Explanations of terms cam profile, base-circle, cam angles, trace point.
Motion of follower – Uniform velocity, uniform acceleration and retardation and simple harmonic motion – Time Vs. displacement diagram only.
Construction of cam profile of a plate cam with knife edged, flat & roller follower
for all three types of motions stated above.
Problems on drawing of cam profiles as stated above for the follower axis passes through the axis of the cam shaft (offset followers not included)

REFERENCES
ESTIMATING AND COSTING

Subject Title : Estimating and Costing
Subject Code : M-503
Periods/Week : 04
Periods per Semester : 60

TIME SCHEDULE

<table>
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<th>S. No.</th>
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<th>Weightage of Marks</th>
<th>Short Answer Questions</th>
<th>Essay Type Questions</th>
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</table>

OBJECTIVES

On completion of the course the student shall be able to

2.0 Understand the elements of costing.
   2.1 Define Costing
   2.2 List the objectives of costing
   2.3 Explain the elements of costing
   2.4 Define Depreciation
   2.5 Explain the causes of depreciation
   2.6 Compute depreciation by different methods.
   2.7 Explain the components of cost - prime cost, factory cost, office cost, total cost
   2.8 Calculate the cost of a product taking into consideration all the items.
   2.9 Calculate the selling price of a Product.

3.0 Understand the fundamentals of estimation.
   3.1 Define Estimation.

I -107
3.2 List the qualities of Estimator.
3.3 List the objectives and functions of estimation.
3.4 Explain the various constituents of estimation.
3.5 Explain the estimating procedure.

4.0 **Estimate the weight of material required for a product and machining times**
4.1 Divide the component drawing into simple and smaller geometrical configurations.
4.2 Calculate the volumes and the weight of the material required.
4.3 Estimate the cost of material.
4.4 Solve simple problems on the above.
4.5 Estimate time required for machining like turning, drilling, shaping, boring, screw cutting and grinding.
4.6 Use standard tables for feeds, cutting speeds.
4.7 Solve problems on the above.

5.0 **Estimate the fabrication cost.**
5.1 Meaning of Fabrication – types of fabrication.
5.2 Estimate the cost of Fabrication by Gas welding – using table
5.3 Estimate the cost of Fabrication by Arc welding.
5.4 Estimate the cost of Gas cutting – using table

Note: Use Gas welding & Gas cutting table for obtaining consumption of gas, filler rods, rate of welding, speed of cutting.

6.0 **Estimate forging cost.**
6.1 Define Forging.
6.2 List types of forging
6.3 Explain various forging losses.
6.4 Estimate the length, net and gross weight and cost of forging for a given component.

7.0 **Estimate foundry cost.**
7.1 List steps for making castings in foundry.
7.2 Explain the allowances provided in foundry.
7.3 State the various costs involved in estimating foundry cost
7.4 Estimate foundry cost.

**COURSE CONTENT**

5.0 **Elements of costing.**
Explanation of term costing – objectives of cost accounting – elements of cost viz., material, labour and expenses – Depreciation-causes: Calculation of depreciation charges by a few important methods.
Determine the items that go into prime cost. On cost, calculate the cost of a product taking into consideration all items. Calculate the selling price of a product.

6.0 **Fundamentals of estimating**
Explanation of the term, objectives and function of estimating – principal constituents of the estimating of the cost of component – design time, drafting, planning and production time, design and procurement or manufacture of special tools and equipment, estimate work, labour, materials, overheads, miscellaneous expenses – estimating procedure.

7.0 **Estimation of weights of materials and machining time.**
Principles of dividing the component drawing into simple and smaller geometrical configurations. Calculation of volumes and the weight of the material. Estimating the cost Exercises in the calculation of weight of material and cost. Basic formula for the calculation of machining times for operations like, turning, drilling, shaping, boring, screw cutting and grinding,. Use of standard table of feeds, cutting speed etc. Exercises for the calculation of machining time for the above mentioned operations.

8.0 **Estimation of fabrication cost.**
Explain the term fabrication – types, estimate the cost of fabrication by gas welding and arc welding – estimate the cost of gas cutting – exercises for the calculation of fabrication cost.

9.0 **Estimation of forging cost.**

10.0 **Estimation of foundry cost.**
Process for finding the foundry cost, cost of metal, cost of metal melting, moulding cost, core cost, cleaning cost, grinding and tooling cost. Methods of estimating the above. Exercises in estimating the foundry cost.

**REFERENCE BOOKS**

1. Mechanical Estimating & Costing -by B.P.Sinha
2. Industrial Engineering & Management Science. - by T.R.Banga
HEAT POWER ENGINEERING - II

Subject Title : Heat Power Engineering - II
Subject Code : M-504
Periods/Week : 04
Periods per Semester : 60

TIME SCHEDULE

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<th>Essay type Questions</th>
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<td>Properties of Steam</td>
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<td>Steam Boilers</td>
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<td>32</td>
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<td>3</td>
<td>Steam Nozzles</td>
<td>10</td>
<td>18</td>
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<td>Steam Turbines</td>
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</table>

OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Understand the Properties of Steam
   1.1 Define the various properties of steam
   1.2 Compute the enthalpy, internal energy and entropy at given pressure.
   1.3 Use of the steam tables
   1.4 Interpret the data in steam tables to calculate enthalpy and entropy.
   1.5 Compute the above values using Mollier chart.
   1.6 Solve simple problems on the above.
   1.7 Identify the various thermodynamic processes (Expansion & Compression of vapours)
   1.8 Compute the work done, internal energy, enthalpy and entropy in each of the above processes.
   1.9 Represent the above process on T-S and H-S diagrams
   1.10 Calculate dryness fraction by using Steam calorimeters

2.0 Understand the Working of Steam Boilers.
   2.1 State the function and use of boilers.
   2.2 Draw the line diagrams of Cochran Boiler and Babcock Wilcox Boiler.
   2.3 Explain the working of above boilers.
   2.4 Distinguish between water tube and fire-tube boilers
   2.5 Recognise the need of high-pressure modern boilers
2.6 Explain the working principle of Lamont and Benson Boilers with diagrams.
2.7 Identify the boiler mountings (all types).
2.8 Explain the function of a few mountings only (with sketches) such as pressure gauge, water level indicator, safety valve and fusible plug.
2.9 Identify the boiler accessories.
2.10 Illustrate the function of only a few accessories such as economiser, Super Heater, Steam traps & Separators.
2.11 Explain the terms actual/equivalent evaporation and factor of evaporation.
2.12 Define boiler Power & efficiency
2.13 Write the formula for the above.
2.14 Compute the equivalent and actual evaporation from given data.
2.15 Solve problems on Boiler Power & efficiency
2.16 Draw heat balance for boiler performance
2.17 Explain draught systems (Natural, forced & induced) in detail.

3.0 Steam Nozzles
3.1 Flow of steam through nozzle.
3.2 Velocity of steam at the exit of nozzle in terms of heat drop analytically and by using Mollier chart.
3.3 Discharge of steam through nozzles
3.4 Critical pressure ratio with proof
3.5 Calculation of cross-sectional areas at throat and exit for maximum discharge
3.6 Effect of friction in nozzles and Super saturated flow in nozzles.
3.7 Working of steam jet injector.
3.8 Simple problems of nozzles.

4.0 Steam Turbines
4.1 Explain the principle of working of a turbine
4.2 Classify the Turbines with examples.
4.3 Differentiate the impulse turbines from reaction turbine
4.4 Principle of working of simple De-Laval turbine with a line diagram.
4.5 Draw velocity triangles
4.6 Identify various blade angles
4.7 Derive formula for work done, axial thrust, energy lost, power and efficiencies.
4.8 State the necessity of compounding a turbine.
4.9 Describe the methods of reducing rotor speeds with the help of diagrams (3 compounding methods)
4.10 Explain the working principle of Parson’s Reaction Turbine with a line diagram.
4.11 Velocity triangle for Parson’s reaction turbine.
4.12 Simple problems on Single stage Impulse turbines (without blade friction) and reaction turbines (including data on blade height)
4.13 Define the terms bleeding & reheating.
4.14 State the necessity of governing a turbine
4.15 Explain the methods of turbine governing.

5.0 Steam Condensers
5.1 Define the Steam condenser
5.2 State the functions of steam condenser
5.3 Classify the condensers
5.4 Explain the working principle of Low level counter – Flow and Parallel – Flow jet condensers with legible sketch
5.5 Explain the working principle of High level Jet condenser with legible Sketch
5.6 List the Advantages and Disadvantages of High- Level Jet condenser
5.7 Explain the working principle of Ejector condenser with legible Sketch
5.8 Explain the working principle of Shell and Tube Surface condenser with Legible sketch
5.9 Distinguish between Down flow and Central flow Surface Condenser
5.10 Explain the working principle of Evaporative condenser with legible Sketch
5.11 List the Advantages and Disadvantages of Surface condenser
5.12 Distinguish between Jet Condenser and Surface Condenser
5.13 Derive the Formulae for cooling water required, Condenser efficiency, Corrected vacuum, Absolute pressure and Vacuum efficiency
5.14 Solve Simple problems on Steam condensers to Estimate the Cooling water required, Condenser efficiency and Vacuum efficiency
5.15 Define Air Extraction
5.16 List the types of Air Extraction systems
5.17 Distinguish between Dry-air Extraction and Wet-air Extraction systems
5.18 Explain the working principle of Air pump and Steam –Jet Air Ejector with legible sketch

COURSE CONTENT

1.0 Properties of steam.
   1.1 Formation of steam under constant pressure, dryness, fraction and degree of superheat, specific volume.
   1.2 Determination of enthalpy, internal energy, internal latent heat, entropy of wet, dry and superheated steam at a given pressure using steam tables and Mollier chart.
   1.3 Simple direct problems on the above using tables and charts.
   1.4 Vapour processes – simple problems using tables and charts.
   1.5 Steam calorimeters – Separating, throttling, Combined Separating and throttling calorimeters – problems.

2.0 Steam Boilers.
   2.1 Function and use of steam boilers.
   2.2 Classification of steam boiler with examples.
   2.3 Brief explanation with line sketches of Cochran and Babcock Wilcox Boilers.
   2.4 Comparison of water tube and fire tube boilers.
   2.5 Description with line sketches and working of modern high pressure boilers Lamont and Benson boilers.
   2.6 Brief explanation with line sketches of boiler mountings namely, pressure gauge, water level indicator, fusible plug, blow down cock, stop valve, safety valve (dead weight type, spring loaded type, high pressure and low water safety alarm).
2.7 Brief explanation with line sketches of boiler accessories such as feed pump, economiser, super heater and air pre-heater only.
2.8 Study of steam traps & separators.
2.9 Explanation of the terms: Actual evaporation, equivalent evaporation, factor of evaporation, boiler horse power and boiler efficiency.
2.10 Formula for the above terms without proof.
2.11 Simple direct problems on the above.
2.12 Draught systems (Natural, forced & induced).

3.0 Steam Nozzles
3.1 Flow of steam through nozzle.
3.2 Velocity of steam at the exit of nozzle in terms of heat drop by analytical and mollier diagram.
3.3 Discharge of steam through nozzles.
3.4 Critical pressure ratio.
3.5 Methods of calculation of cross-sectional areas at throat and exit for maximum discharge.
3.6 Effect of friction in nozzles and Super saturated flow in nozzles.
3.7 Working steam jet injector.
3.8 Simple problems of nozzles.

4.0 Steam Turbines
4.1 Classification of steam turbines with examples.
4.2 Difference between impulse & reaction turbines.
4.3 Principle of working of a simple De-lavel turbine with line diagrams.
4.4 Velocity diagrams.
4.5 Expression for work done, axial thrust, tangential thrust, blade and diagram efficiency, stage efficiency, nozzle efficiency.
4.6 Methods of reducing rotor speed compounding for velocity, for pressure or both pressure and velocity.
4.7 Working principle with line diagram of a Parson’s Reaction turbine – velocity diagram.
4.8 Simple problems on single stage impulse turbines (without blade friction) and reaction turbine including data on blade height.
4.9 Bleeding, re-heating and re-heating factors (Problems omitted).
4.10 Governing of steam turbines: Throttle, By-pass & Nozzle control governing.

5.0 Steam Condensers
5.1 Steam condenser, its functions, Classifications
5.2 Low level counter – Flow and Parallel – Flow jet condensers, High level Jet condenser and Ejector condenser, Advantages and Disadvantages of High-Level Jet condenser
5.3 Shell and Tube Surface condenser, Down flow, Central flow Surface Condenser and Evaporative condenser, Advantages and Disadvantages of Surface condenser
5.4 The Formulae for cooling water required, Condenser efficiency, Corrected vacuum, Absolute pressure and Vacuum efficiency
5.5 Simple problems on Steam condensers to Estimate the Cooling water Required, Condenser efficiency and Vacuum efficiency
5.6  Air Extraction, Types of Air Extraction systems, Dry-air Extraction and Wet-air Extraction systems, Air pump and Steam –Jet Air Ejector

**REFERENCE BOOKS:**

1. Thermodynamics by Ballaney
2. Elements of Heat Engines – Volume II by R.C. Patel & Karamchandani
3. Thermal Engineering Domkundwar by Arora & S.
4. Thermal Engineering by Roy & Sarao
5. Thermal Engineering by Vasandani & Kumar
FLUID POWER SYSTEMS

Subject Title : Fluid Power Systems.
Subject Code : M-505
Periods/Week : 04
Periods per Semester : 60

TIME SCHEDULE

<table>
<thead>
<tr>
<th>S No.</th>
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<th>No. of Periods</th>
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<th>Short Answer Questions</th>
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<td>Hydro - Pneumatic systems</td>
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</table>

OBJECTIVES

Up on completion of the course the student shall be able to understand the following.

1.0 Oil power Hydraulics
   A) Hydraulics Circuits.
      1.1 Appreciate the use of Hydraulic control system.
      1.2 State merits and demerits of hydraulic control system.
      1.3 State the essential components of hydraulic circuits and their functions.
      1.4 List and Explanation various types of Hydraulic pumps and Motors.
      1.5 State the function of Control Valves.
      1.6 Classify control valves.
      1.7 Explain pressure, directional and flow control valves.
   B) Circuit devices
      1.8 State the purpose of intensifier.
      1.9 Explain the principal of working of intensifier.
      1.10 Types of accumulators.
      1.11 Selection of intensifiers and accumulators for specific application.
      1.12 Explain the principle of Hydraulic Jack.
      1.13 Explain the principle of Hydraulic crane.
   C) Oil Reservoirs
      1.14 State the functions of oil reservoir
      1.15 Identify the elements of a Fluid Reservoir
      1.16 Explain the purpose and types of filters
1.17 Explain the purpose of seals and packings.
1.18 Identify the different types of seals and packings.

2.0 Pneumatics
A) Pneumatic Power Unit
2.1 State the elements of pneumatic circuits
2.2 State the areas of application of pneumatic power unit
2.3 Compare with hydraulic power unit
2.4 Identify different symbols used for pneumatic circuit
2.5 Able to draw and understand the circuit diagram.
2.6 Classify the compressors.
2.7 Explain the working of Regulator, Filter and Lubricator (R-F-L)

B) Pneumatic circuit valves
2.8 Explain the function of circuit valves.
2.9 Explain the different methods of actuation of valves.
2.10 Describe the direction control valves – Spool type.
2.11 Explain the working of Flow control valves.

C) Air Cylinders
2.12 State various types of Air Cylinders.
2.13 Explain the function of various parts of Air Cylinder.
2.14 Know the factors pertaining to installation and maintenance of Air Cylinders.
2.15 Know the applications of Air Cylinder

D) Pneumatic Circuits
2.16 Explain the principle of working of power operator holding devices.
2.17 Explain the pneumatic safety circuits.
2.18 Explain the meaning of Remote control.
2.19 Describe the components of Remote control system.
2.20 Explain different Remote control valves and switches.

3.0 Hydro Pneumatic Systems
3.1 Explain the advantages and applications of combined air and oil systems.
3.2 Explain the principle of combination system.
3.3 Explain the methods of combining the hydraulic cylinder to Air cylinder.
3.4 Explain the principle of Air controlled hydraulic valve.
3.5 Describe the use of air as cushion for hydraulics system.

4.0 Hydro Pneumatic measurements
4.1 Illustrate the working of flow meter (Mechanical Type)
4.2 Illustrate the working of flow meter (Electro Magnetic Type)
4.3 Illustrate the working of flow meter (Ultrasonic)
4.4 Illustrate the working of Air gauge.
COURSE CONTENT

1. Oil power hydraulics
   A) Hydraulic circuit
      1.1 Introduction to hydraulic control system.
      1.2 Merits and demerits of hydraulic control system.
      1.3 Essential components of Hydraulics circuits and their functions.
      1.4 Hydraulic pumps and Motors – Gear type, Screw type, vane type, Radial and Axial piston type.
      1.5 Control valves – functions, classification and Rating.
      1.6 Principle of working of pressure control valves – relief valve and pressure compensating valve.
      1.7 Directional control valves – Spool type
      1.8 Flow control valves – Gate, Plug, Needle, Butterfly, Non-Return valve.

   B) Circuit devices
      1.9 Intensifiers – purpose - principle of working (with line diagram)
      1.10 Intensifiers as shock suppressor, fluid makeup device, Leakage compensator, emergency source of power and holding device.
      1.11 Types of Accumulators – dead weight, Spring loaded.
      1.12 Hydraulic jack and Crane.
      1.13 Elements of Fluid Reservoir – Filter, Air vent, Strainer, Baffles etc.
      1.14 Capacity of a Fluid Reservoir.
      1.15 Seals and packings – purpose and types.

2. Pneumatics
   A) Pneumatic power unit
      2.1 Applications of pneumatic power unit
      2.2 Compare with hydraulic circuit
      2.3 Identification of pneumatic symbols
      2.4 Draw a pneumatic circuit
      2.5 Classify Air compressors
      2.6 Working details of regulator, filter and lubricator (R-F-L Circuit)

   B) Pneumatic valves
      2.7 Function of valves
      2.8 Methods of actuation of valves.
      2.9 Direction control valves – Spool type – Two-way, three-way, four-way, Pilot and solenoid valves

   C) Air Cylinders
      2.11 Classification of Air Cylinders
      2.12 Function of parts of Air Cylinder – Tube, cover, packing gland, cushion assembly, piston and piston seal.
      2.13 Installation, maintenance and application

   D) Pneumatic Circuits
      2.14 Principle of working of power operator holding devices – Lever clamp, Toggle clamp, Wedge clamp, power vice, Mandrels, collets and chucks.
2.15 Pneumatic safety circuits for a) Protection against pressure drop b) protection against overload
2.16 Remote control of pneumatic system – Pilot operated valves, solenoid valves and cam operated valves.

3. Hydro – Pneumatic System
3.1 Advantages and Applications of combined Air and oil system.
3.2 Principle of combination system
3.3 Methods of combining the hydraulic cylinder to air cylinder
3.4 Air controlled hydraulic valve
3.5 Use of air as cushion for hydraulic systems

4. Hydro – Pneumatic Measurements
4.1 Mechanical flow meter
4.2 Electromagnetic flow meter
4.3 Ultrasonic type flow meter
4.4 Air gauge

REFERENCE BOOKS:
1. Pneumatics by SRIHARI RAO
2. Pneumatic controls by FESTO
3. Fluid Power Pneumatics by ALAN H. JOHN
4. Pneumatics by FLIPPO
5. Pneumatics By TTI
6. Hydraulics & Pneumatics by RAY & RAO
7. Fluid Power & Pneumatics by AUDEL Series
MACHINE TOOL ENGINEERING

Subject Title : Machine Tool Engineering
Subject Code : M – 506
Periods Per Week : 04
Periods Per Semester : 60

TIME SCHEDULE

<table>
<thead>
<tr>
<th>S.No</th>
<th>Major Topics</th>
<th>Number of Periods</th>
<th>Weightage of Marks</th>
<th>Short Answer Questions</th>
<th>Essay Type Questions</th>
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<tr>
<td>1</td>
<td>Modern Machining Process</td>
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<td>2</td>
<td>Plastic processing</td>
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<td>3</td>
<td>Press Tools, Jigs and Fixtures</td>
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<td>4</td>
<td>Jig Boring</td>
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<td>08</td>
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</tbody>
</table>

OBJECTIVES
Up on completion of the course the student shall be able to

1.0 Understand the Modern Machining Processes.
   1.1 Distinguish between non-conventional machining processes and traditional methods.
   1.2 State their relative advantages.
   1.3 Explain the principle of working of ultrasonic machining.
   1.4 List the equipment used in U.S.M. processes.
   1.5 Explain the principle of electric discharge machining with a legible sketch.
   1.6 Explain the working of Abrasive jet machining with a legible sketch
   1.7 Explain the working of Laser beam machining with a legible sketch
   1.8 State the principle of chemical machining.

2.0 Understand the concept of Plastic Processing.
   2.1 State the principle of manufacturing plastic products.
   2.2 Explain the methods of injection moulding, compression moulding, transfer moulding with legible sketches.
   2.3 Explain the principle of extruding, casting and calendering with legible sketches.
   2.4 State the principle of machining and welding plastics.
   2.5 Explain the different fabrication methods – sheet forming, blow moulding, laminating and reinforcing.
   2.6 List Engineering applications of plastics.
3.0 Understand the use of Press Tools, Jigs and Fixtures.

3.1 Explain the Importance of Press Tools
3.2 Classify presses based on power and design of frame.
3.3 Explain the constructional details of a power press with the help of a legible sketch
3.4 State the meaning of Press size.
3.5 Explain Press Tools – Punch and die.
3.6 Explain Die-clearance and Die Accessories
3.7 Explain shear action in die cutting operation – Punch and die clearances, Angular clearance, centre of pressure, cutting forces.
3.8 Explain various press working operations.
3.9 Explain different types of dies.
3.10 List various die operations
3.11 List types of jigs and explain their constructional details with the help of legible sketches
3.12 State general considerations in design of drill jigs
3.13 State the function of drill bush.
3.14 List different types of fixtures and explain their constructional details with the help of legible sketches.
3.15 Differentiate between jigs and fixtures.
3.16 Advantages of Jigs and Fixtures
3.17 Explain basic principle of location.
3.18 Identify different locating methods and devices.
3.19 Understand basic principle of clamping.
3.20 Identify different types of clamps and their constructional details with the help of legible sketches.

4.0 Understand the process of Jig Boring.
4.1 List the situations where jig-boring machines are needed.
4.2 State the principle of working of a jig boring machine.
4.3 Explain the process of button boring on lathes.
4.4 Classify the jig boring machines.
4.5 Explain the constructional details of open front machine and cross rail type machine with the help of legible sketches.
4.6 Explain the function of above machines.
4.7 Describe the systems of location of holes.

COURSE CONTENT

1.0 Modern Machining Processes.

Introduction – comparision with traditional machining.
Ultrasonic machining - principle – Description of equipment - applications.
Electric Discharge Machining - Principle – Description of equipment – Type of EDM Processes - applications.
Abrasive jet machining - principle - description of equipment – application.
Laser beam machining - principle - description of equipment- application.
Chemical machining – Principle – description of equipment - Applications.

2.0 Plastics Processing.

Processing of plastics - Injection moulding - Compression moulding - Transfer moulding – Extruding - Casting - Calendaring
Fabrication methods - Sheet forming methods, Blow moulding - Laminating plastics (sheets, rods & tubes) - Tool angles for machining Plastics - Coolants used in machining of plastics - Applications of Plastics

3.0 Press Tools, Jigs and Fixtures:
Introduction - Types of Presses – hand, power, gap, inclinable, adjustable, horn, straight side, pillar presses.
Constructional details of a power press - Press size.
Press Tools – Punch and die
Die Accessories – Stops, Pilots, strippers, Knock outs, pressure pads.
Shear action in die cutting operation – punch and die clearance and angular clearance, centre of pressure, cutting forces.
Press working operations: blanking, piercing and forming, lancing, cutting off and parting, notching, shaving, trimming, embossing, beading and curling, bulging, twisting, coining, swaging, hole flanging or extruding – line sketches and meaning of terms.
Sheet metal bending: bending methods, spring back, bend allowance, bending pressure – sketches and empirical formulae.
Types of dies meaning of inverted, progressive, compound and combination dies.
Material selection for punch and die.
Definition of jig - Types of jigs - leaf jig, box and handle jig, template jig, plate jig, Indexing jig, Universal jig, vice jigs.
Explain the constructional details of the above jigs.
General consideration in the design of drill jigs
Explain drill bush
Types of fixtures : vice fixtures, milling fixtures, boring fixtures, grinding fixtures - Explain the constructional details of the above fixtures.
Basic principles of location - Explain the locating methods and devices
Explain the basic principles of the clamping - Types of clamps - strap clamps, cam clamps, screw clamps, toggle clamps, hydraulic and pneumatic clamps.

4.0 Jig Boring.
Introduction - Button boring on lathes- Jig boring on vertical milling machine.
Types jig boring machines - Open front machine - Cross rail type machine constructional details & their working - System of location of holes.

REFERENCE BOOKS
1. Manufacturing Technology - Hajra Chowdhary
   Volume I & II
2. Manufacturing Technology - P.N.Rao
   Volume I & II
3. Production Technology - R.C.Patel
4. Production Technology - Jain & Gupta.
5. Tool Design - Donaldson
CAD PRACTICE

Subject Title : CAD PRACTICE
Subject Code : M – 507
Periods per week : 06
Period per semester : 90

TIME SCHEDULE

<table>
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<tr>
<td>1.</td>
<td>Introduction to CAD</td>
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<tr>
<td>2.</td>
<td>Selecting commands &amp; Working with drawing</td>
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<td>3.</td>
<td>Viewing drawing</td>
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<td>4.</td>
<td>Working with coordinates</td>
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<td>5.</td>
<td>Creating simple and complex entities</td>
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<td>Getting Drawing information</td>
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<td>7.</td>
<td>Modifying entities</td>
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<td>8.</td>
<td>Working with text</td>
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<td>9.</td>
<td>Dimensioning drawing</td>
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<td>2D Drawing</td>
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<td>11.</td>
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<td>13.</td>
<td>Working with blocks</td>
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<td>15.</td>
<td>3D Drawings</td>
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TOTAL : 90
OBJECTIVES

Up on completion of the course the student shall be able to

1.0 Understand about the Computer Aided Drafting and its software
   1.1 Define Computer Aided Drafting
   1.2 List the Advantages of CAD
   1.3 Explain the importance of CAD software
   1.4 Explain the features of Graphic Work station
   1.5 Use CAD Environment: Screen, Various tool bars and menus.

2.0 Use appropriate selection commands
   2.1 Practice commands using toolbars, menus, command bar
   2.2 Practice repeating a command, Nesting a command and modifying a command
   2.3 Use prompt history window and scripts
   2.4 Practice mouse shortcuts
   2.5 Practice the Creating the drawing, Opening existing and damaged Files, saving the drawing
   2.6 Practice the setting up a drawing
   2.7 Practice the setting and changing the grid and snapping alignment
   2.8 Practice the Entity snaps

3.0 Use Viewing tools of CAD
   3.1 Practice the use of Scroll bar, pan command, and rotating view to move around within drawing
   3.2 Practice the changing of magnification of drawing
   3.3 Practice the displaying of multiple views
   3.4 Practice the use of controlling visual elements like Fill, Text, Blips and Line weight

4.0 Use coordinate systems of the drawing
   4.1 Practice how the coordinate system work
   4.2 Practice how the coordinate system displayed
   4.3 Practice the Find tool to determine the coordinates of a point
   4.4 Practice the Two dimensional coordinates such as Absolute Cartesian, Relative Cartesian and Polar coordinates
   4.5 Practice the use of right-hand rule
   4.6 Practice the how to enter into x, y, z - coordinates
   4.7 Practice the Three dimensional coordinates such as Spherical and Cylindrical coordinates
   4.8 Practice the use of filters in two and three dimensions
   4.9 Practice the defining user coordinate system
   4.10 Practice the use of present user coordinate system

5.0 Create the simple and complex entities
   5.1 Draw the lines,circles,arcs,ellipses,elliptical arcs,rays and infinite lines
   5.2 Practice the Creation of point entities
   5.3 Practice the Editing of point entities
   5.3 Draw the complex shapes like rectangles, polygons, polylines,
Splines, donuts, planes

5.4 Practice the adding of hatch pattern

6.0 Use the drawing information retrieving tools Measure, Divide, Calculate, Display, and Track
6.1 Measure the intervals on entities
6.2 Divide the entities into segments
6.3 Calculate the areas defined by points, of closed entities, and combined entities
6.4 Calculate the distance between the entities
6.5 Calculate the angle between the entities
6.6 Display the information about the entities and drawing status
6.7 Track time spent working on a drawing

7.0 Use the Modifying tools to modify the properties of entities
7.1 Practice the entity selection and deselection methods
7.2 Practice the Deletion of entities
7.3 Practice the Copying of entities within a drawing, between drawings
7.4 Practice the making of parallel copies, Mirroring entities and Arraying entities
7.5 Practice the Rearranging of entities by Moving, Rotating and Reordering
7.6 Practice the Resizing of entities by Stretching, Scaling, Extending, Trimming, and Editing the length
7.7 Practice the Braking and joining of entities
7.8 Practice the creating, modifying the groups and ungrouping of Entities
7.9 Practice the Editing of polylines: Opening, Closing, Curving, Decurving, Joining, Changing width and editing vertices
7.10 Practice the Exploding of entities
7.11 Practice the Chamfering and Filleting of entities

8.0 Use the Text tool to create and formatting the various types of text Fonts and its styles
8.1 Practice the creating, naming and modifying the text fonts
8.2 Practice the Creation of line text, paragraph text
8.3 Practice the Setting of line text style and its alignment
8.4 Practice the Setting of Paragraph text style and its alignment
8.5 Practice the Changing of line text and Paragraph text
8.6 Practice the use of alternate text editor

9.0 Use Dimensioning concepts to create dimensions, Edit dimensions, Control dimension styles & variables and Adding geometric tolerances
9.1 Practice the creating of linear, Angular, Diametral, Radial, Ordinate dimensions
9.2 Practice the creating leaders and annotations
9.3 Practice the making dimensions oblique
9.4 Edit the dimension text
9.5 Practice the Controlling of dimension arrows and format
9.6 Practice the Controlling of line settings and dimension text
9.7 Practice the Controlling of dimension units, and dimension tolerance
10.0 Create 2D Drawings
10.1 Create 2D drawings of standard mechanical components

11.0 Organize the information on layers
11.1 Practice the setting a current layer, layers color, line type, line
       Weight, print style
11.2 Practice the locking and unlocking of layers
11.3 Practice the layer visibility and layer printing
11.4 Practice the setting of current line type
11.5 Practice the loading of additional line types
11.6 Practice the creating and naming of line type
11.7 Practice the editing of line type

12.0 Create Isometric Views
12.1 Create Isometric views of simple objects

13.0 Use the Blocks, Attributes and External references to manage the
Drawing
13.1 Define a block
13.2 Explain the purpose of a block
13.3 Practice the creating a block
13.4 Practice the inserting a block
13.5 Practice the redefining a block
13.6 Practice the exploding a block
13.7 Define an Attribute
13.8 Practice the editing attribute definitions
13.9 Practice the attaching attribute to blocks
13.10 Edit attributes attached to blocks
13.11 Extract attributes information
13.12 Define external reference
13.13 Practice the Attaching, Removing, and Reloading of external
       references
13.14 Practice the Binding, Clipping and changing the path of external
       References

14.0 Use the Layouts, Layout view ports, and customizing printing
in CAD
14.1 Define layout for printing
14.2 Understand the layouts
14.3 Practice the viewing of drawings in paper and model space
14.4 Display the model and layout tabs
14.5 Create the new layout
14.6 Reuse the layouts from other files
14.7 Manage the layouts in a drawing
14.8 Define layout view ports
14.9 Create layout view ports
14.10 Practice the viewing and scaling of layout view ports
14.11 Modify the layout viewports
14.12 Select the appearance of print dialog
14.13 Set the paper size and orientation
14.14 Select a printer or a plotter
14.15 Set the scale and view
14.16 Choose how line weight print

**15.0 3D Drawings**
15.1 Explain the concept of 3D
15.2 Create 3D solids using solid tool bar options
15.3 Create 3D Drawings of Standard Mechanical Components
15.4 Practice Rendering

**KEY competencies to be achieved by the student**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Experiment Title</th>
<th>Key Competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to CAD</td>
<td>• Open/close Autocad program</td>
</tr>
<tr>
<td></td>
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<td>• Understands Autocad Graphic User Interface(GUI) and various toolbars</td>
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<tr>
<td>2.</td>
<td>Selecting commands &amp; Working with drawing</td>
<td>• Use prompt history window and scripts</td>
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<td>• Practice the setting up a drawing</td>
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<td>• Practice the Entity snaps</td>
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<tr>
<td>3.</td>
<td>Viewing drawing</td>
<td>• Use Scroll bar, pan command, and rotating view to move around within drawing</td>
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<td>• Control visual elements like Fill, Text, Blips and Line weight</td>
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<td>4.</td>
<td>Working with coordinates</td>
<td>• Use Two dimensional coordinates and Three dimensional coordinates</td>
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<td>• Use right-hand rule</td>
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<tr>
<td></td>
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<td>• Use filters in two and three dimensions</td>
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<tr>
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<td>• Define user coordinate system</td>
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<tr>
<td>5.</td>
<td>Creating simple and complex entities</td>
<td>• Draw the simple shapes like lines, circles, arcs and complex shapes like polygons, planes etc.,</td>
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<tr>
<td></td>
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<td>• Practice the adding of hatch pattern</td>
</tr>
<tr>
<td>6.</td>
<td>Getting Drawing information</td>
<td>• Measure the intervals and distance between entities</td>
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<tr>
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<td>• Divide the entities into segments</td>
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<td>• Calculate the areas defined by points, of closed entities, and Combined entities</td>
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<td>9.</td>
<td>Dimensioning drawing</td>
<td>• Create linear, Angular, Diametral, Radial, Ordinate dimensions</td>
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<td>• Practice the making dimensions oblique</td>
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<td>• Edit the dimension text</td>
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<td>• Practice the Controlling of dimension units, and dimension tolerance</td>
</tr>
<tr>
<td>10.</td>
<td>2D Drawings</td>
<td>• Use proper 2D commands to create 2D drawings</td>
</tr>
<tr>
<td>12.</td>
<td>Isometric Views</td>
<td>• Use Iso snap command to create Isometric views</td>
</tr>
</tbody>
</table>
### COURSE CONTENT

1.0 **The Computer Aided Drafting and its software**
   Definition of Computer Aided Drafting, the Advantages and importance of CAD software, The features of Graphic Work station, CAD Environment: Screen, Various tool bars and menus.

2.0 **Selection of commands**
   Commands using toolbars, menus, command bar
   Repeating a command, Nesting a command and modifying a command
   Use of prompt history window and scripts, mouse shortcuts
   Creating the drawing, Opening existing and damaged files, saving of drawing, setting up a drawing
   Setting and changing the grid and snapping alignment, the Entity snaps

3.0 **Use of viewing tools of CAD**
   Use of Scroll bar, pan command, and rotating view to move around within drawing, changing of magnification of drawing
   Displaying of multiple views, the use of controlling visual elements like Fill, Text, Blips and Line weight

4.0 **Use of coordinate systems of the drawing**
   Two dimensional coordinates such as Absolute, Cartesian, Relative Cartesian and Polar coordinates, the use of right-hand rule,
   Three dimensional coordinates such as Spherical and Cylindrical Coordinates, the use of filters in two and three dimensions, Defining user Coordinate system

<table>
<thead>
<tr>
<th>S.No</th>
<th>Experiment Title</th>
<th>Key Competency</th>
</tr>
</thead>
</table>
| 13.  | Working with blocks | - Create, insert and explode a block  
- Attach attribute to blocks  
- Edit and extract attributes attached to blocks |
| 14.  | Printing drawing | - Display the model and layout tabs  
- Create the new layout and Manage the layouts from other files  
- Practice the viewing, scaling and Modifying of layout view ports  
- Set the paper size, orientation, scale, view and line weight to print |
| 15.  | 3D Drawings | - Region 2D Drawings  
- Use proper 3D commands to create 3D drawings |
5.0 **Creating simple and complex entities**
Drawing of lines, circles, arcs, ellipses, elliptical arcs, rays and infinite lines, Creating and editing of point entities
Drawing of complex shapes like rectangles, polygons, polylines, Splines, donuts, planes, and adding of hatch pattern

6.0 **Use the drawing information retrieving tools Measure, Divide, Calculate, Display, and Track**
Measuring the intervals on entities, dividing the entities into segments
Calculation of areas of defined by points, closed entities, and combined Entities, calculate the distance and angle between the entities
Displaying the information about the entities and drawing status
Tracking time spent working on a drawing.

7.0 **Use the Modifying tools to modify the properties of entities**
Entity selection and de-selection methods, the Deletion of entities
Copying of entities within a drawing, between drawings, parallel copies, Mirroring entities and Arraying entities
The Rearranging of entities by Moving, Rotating and Reordering
The Resizing of entities by Stretching, Scaling, Extending, Trimming, and Editing the length
The Breaking and joining of entities, The creating, modifying the groups and ungrouping of Entities
Editing of polylines: Opening, Closing, Curving, Decurving, Joining, Changing width and editing vertices,
The Exploding of entities, the Chamfering and Filleting of entities

8.0 **Use the Text tool to create and formatting the various types of text**
**Fonts and its styles**
The creating, naming and modifying the text fonts, the Creation of line text, paragraph text, setting of line text style and its alignment
The Setting of Paragraph text style and its alignment, the Changing of line text and Paragraph text, the use of alternate text editor

9.0 **Use Dimensioning concepts to create dimensions, Edit dimensions, Control dimension styles & variables and Adding geometric tolerances**
The creating of linear, Angular, Diametral, Radial, Ordinate dimensions
The creating leaders and annotations, making dimensions oblique,
Editing the dimension text, controlling of dimension arrows and format
The Controlling of line settings and dimension text, the Controlling of dimension units, and dimension tolerance

10.0 **2D Drawings**
Using appropriate commands creation of 2D drawings of standard mechanical components

11.0 **Organize the information on layers**
Setting a current layer, layers color, line type, line Weight, print style
Locking and unlocking of layers, the layer visibility and layer printing
Setting of current line type, the loading of additional line types, creating and naming of line type, editing of line type
12.0 Isometric Views
Create Isometric views of simple objects

13.0 Use the Blocks, Attributes and External references to manage the Drawing Blocks
The purpose of a block, creating a block, inserting a block, redefining a block, exploding a block
Attribute
Editing attribute definitions, attaching attribute to blocks
Editing attributes attached to blocks, Extracting attributes information
External reference
Attaching, Removing, and Reloading of external references
The Binding, Clipping and changing the path of external references

14.0 Use the Layouts, Layout view ports, and customizing printing in CAD layout for printing
Layouts, Viewing of drawings in paper and model space, Displaying of model and layout tabs, creating the new layout, Reuse the layouts from other files, Manage the layouts in a drawing
Define layout view ports
Create layout view ports
Practice the viewing and scaling of layout view ports, Modify the layout viewports,
Select the appearance of print dialog
Setting the paper size and orientation, selecting a printer or a plotter
Setting the scale and view, choosing line weight

15.0 3D Drawings
3D drawings of standard components
Rendering of 3D images

REFERENCE BOOKS
4MCAD User Guide- IntelliCAD Technology Consortium (WWW.intellicad.org)

4MCAD Software:
1. 4MCAD Viewer,
2. 4MCAD Classic,
3. 4MCAD Standard,
4. 4MCAD Professional.
HYDRAULICS & PNEUMATIC LABORATORY

Subject Title : Hydraulics&Pneumatics Laboratory

Subject Code : M-509
Periods/Week : 03
Periods/Semester : 45

TIME SCHEDULE - Hydraulics Lab (M – 509 A)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Major Components</th>
<th>No. of Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Venturimeter</td>
<td>03</td>
</tr>
<tr>
<td>2.</td>
<td>Pipe Friction</td>
<td>03</td>
</tr>
<tr>
<td>3.</td>
<td>Pelton Wheel</td>
<td>03</td>
</tr>
<tr>
<td>4.</td>
<td>Kaplan turbine</td>
<td>03</td>
</tr>
<tr>
<td>5.</td>
<td>Francis turbine</td>
<td>03</td>
</tr>
<tr>
<td>6.</td>
<td>Reciprocating pump</td>
<td>03</td>
</tr>
<tr>
<td>7.</td>
<td>Centrifugal Pump</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>21</strong></td>
</tr>
</tbody>
</table>

OBJECTIVES
Up on Completion of the Lab the student shall be able to:

1.0 Venturimeter
   1.1 State the practical applications of venturimeter.
   1.2 Record the manometric head readings from U-tube manometer
   1.3 Record the time taken for collecting discharge by varying the discharge
   1.4 Calculate the areas of the pipe and throat of the given venturimeter
   1.5 Calculate coefficient of discharge of venturimeter.

2.0 Pipe friction
   2.1 Measure the length of the given pipe
   2.2 Record the manometric head readings from U-tube manometer
   2.3 Record the time taken for collecting discharge by varying the discharge
   2.4 Calculate the loss of head through the pipe
   2.5 Calculate the friction factor

3.0 Pelton Wheel
   3.1 Identify the components of Pelton wheel
   3.2 Start turbine by switching on jet of water slowly
   3.3 Apply load steadily
   3.4 Record load, speed
   3.5 Calculate power and efficiency of turbine
4.0 Kaplan Turbine
   4.1 Identify the components of Kaplan Turbine
   4.2 Start turbine by giving input water supply
   4.3 Apply load steadily
   4.4 Record load, speed
   4.5 Calculate power and efficiency of turbine

5.0 Francis Turbine
   5.1 Identify the components of Francis Turbine
   5.2 Start turbine by switching on jet of water slowly
   5.3 Apply load steadily
   5.4 Record load, speed
   5.5 Calculate power and efficiency of turbine

6.0 Reciprocating Pump
   5.6 Identify the components of reciprocating pump
   5.7 Record the suction and delivery pressures from pressure gauges
   5.8 Record the time taken for collecting the discharge
   5.9 Record the energy meter readings and calculate input power
   5.10 Calculate the output power
   5.11 Calculate the efficiency

6.0 Centrifugal Pump
   6.1 Identify the components of centrifugal pump
   6.2 Record the suction and delivery pressures from pressure gauges
   6.3 Record the time taken for collecting the discharge
   6.4 Record the energy meter readings and calculate input power
   6.5 Calculate the output power
   6.6 Calculate the efficiency
### Key competencies to be achieved by the student

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Key competency expected</th>
<th>Max. Marks</th>
<th>Marks awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calculation of coefficient of discharge of Venturimeter</strong></td>
<td>A. Maintain constant head</td>
<td>A. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Record readings of U-tube manometer without parallax error</td>
<td>B. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Record time taken for collection of specific quantity of water</td>
<td>C. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. Calculate discharge and coefficient of discharge of venturimeter</td>
<td>D. 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. Repeat experiment for different heads (discharge)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Determination of pipe friction</strong></td>
<td>A. Ensure flow through pipe is full to remove air bubbles</td>
<td>A. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Record time taken for collection of specific quantity of water in tank</td>
<td>B. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Calculate pipe friction using formula</td>
<td>C. 2</td>
<td></td>
</tr>
<tr>
<td><strong>Pelton wheel</strong></td>
<td>A. Start turbine by switching on jet of water slowly</td>
<td>A. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Apply load steadily</td>
<td>B. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Record load, speed</td>
<td>C. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. Calculate power and efficiency of turbine</td>
<td>D. 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. Plot performance curves</td>
<td>E. 3</td>
<td></td>
</tr>
<tr>
<td><strong>Kaplan Turbine</strong></td>
<td>A. Start turbine by switching on water supply</td>
<td>A. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Apply load steadily</td>
<td>B. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Record load, speed</td>
<td>C. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. Calculate power and efficiency of turbine</td>
<td>D. 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. Repeat experiment by Varying load/speed; Plot performance curves</td>
<td>E. 3</td>
<td></td>
</tr>
<tr>
<td>Exercise</td>
<td>Key competency expected</td>
<td>Max. Marks</td>
<td>Marks awarded</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Francis Turbine</td>
<td>A. Start turbine by switching on water supply</td>
<td>A. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Apply load steadily</td>
<td>B. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Record load, speed</td>
<td>C. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. Calculate power and efficiency of turbine</td>
<td>D. 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. Repeat experiment by Varying load/speed; Plot performance curves</td>
<td>E. 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total 10</td>
<td></td>
</tr>
<tr>
<td>Reciprocating Pump</td>
<td>A. Maintain steady flow in suction and delivery pipes</td>
<td>A. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Record suction and delivery pressure gauge readings</td>
<td>B. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Record time for collection of specific quantity of water, electrical meter reading</td>
<td>C. 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. Calculate indicated power and efficiency</td>
<td>D. 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. Vary the head (flow) and repeat experiment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centrifugal Pump</td>
<td>A. Maintain steady flow in suction and delivery pipes</td>
<td>A. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Record suction and delivery pressure gauge readings</td>
<td>B. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Record time for collection of specific quantity of water, electrical meter reading</td>
<td>C. 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. Calculate indicated power and efficiency</td>
<td>D. 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. Vary the head (flow) and repeat experiment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COURSE CONTENT**

1. Determination of Coefficient of discharge of Venturimeter.
2. Determination of major losses in pipes due to friction.
3. Determination of B.P. and efficiency of Pelton wheel.
5. Determination of B.P. and efficiency of Francis turbine.
6. Determination of I.P. and overall efficiency of a reciprocating pump
7. Determination of I.P. and efficiency of the Centrifugal pump
TIME SCHEDULE - PNEUMATICS LAB (M – 509 B)

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Major Topics</th>
<th>No. of periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to Pneumatic components</td>
<td>03</td>
</tr>
<tr>
<td>2.</td>
<td>Direct control of a single-acting cylinder</td>
<td>03</td>
</tr>
<tr>
<td>3.</td>
<td>Direct control of a double-acting cylinder</td>
<td>03</td>
</tr>
<tr>
<td>4.</td>
<td>Speed control of a double-acting cylinder</td>
<td>03</td>
</tr>
<tr>
<td>5.</td>
<td>Control of a double-acting cylinder with OR logic</td>
<td>06</td>
</tr>
<tr>
<td>6.</td>
<td>Control of a double-acting cylinder with AND logic</td>
<td>06</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>24</td>
</tr>
</tbody>
</table>

OBJECTIVES

Up on completion of the Lab the student shall be able to

1.0 Understand about the working of Pneumatic components.
   1.1 Explain Pneumatics
   1.2 Identify & List Symbols used in Pneumatic circuits.
   1.3 Explain the phenomena of compressed air for transmitting power.
   1.4 State Pascal’s law.
   1.5 List all the pneumatic applications.
   1.6 Define Pneumatic actuator.
   1.7 Classify the actuators.
   1.8 Explain Linear actuators and Rotary actuators.
   1.9 Define valve.
   1.10 List different types of valves.
   1.11 Explain the function of a valve.
   1.12 Identify the components of a valve.
   1.13 Identify about ports and positions.
   1.14 List the Applications of valves.

2.0 Direct control of a Single-acting cylinder
   2.1 Draw the circuit diagram for actuating a single-acting cylinder.
   2.2 Select the suitable valve. eg: 3/2 valve.
   2.3 Connect 3/2 valve to the actuator.
   2.4 Actuate the single-acting cylinder by operating 3/2 valve.

3.0 Direct control of a Double-acting cylinder
   3.1 Draw the circuit diagram for actuating a Double-acting cylinder.
   3.2 Select the suitable valve. eg: 4/2 valve.
   3.3 Connect 4/2 valve to the actuator.
3.4 Actuate the double-acting cylinder by operating 4/2 valve.

4.0 Speed control of a Double-acting cylinder
4.1 Draw the pneumatic circuit for controlling the speed of double-acting cylinder.
4.2 Select 4/2 or 5/2 valve and a throttle valve.
4.3 Connect 4/2 valve and throttle valve as per the circuit.
4.4 Operate the 4/2 valve and adjust the throttle valve to control the speed of double-acting cylinder

5.0 Control of a Double-acting cylinder with OR LOGIC
5.1 Draw the pneumatic circuit for controlling the speed of double-acting cylinder using OR logic.
5.2 Select two 3/2 valves and a shuttle valve (OR Valve).
5.3 Connect 3/2 valves and OR valves to the double-acting cylinder as per the circuit.
5.4 Operate either one of the 3/2 valves to control the speed of double-acting cylinder.

6.0 Control of a Double-acting cylinder with AND LOGIC
6.1 Draw the pneumatic circuit for controlling the speed of double-acting cylinder using AND logic.
6.2 Select two 3/2 valves and AND valve.
6.3 Connect 3/2 valves and AND valves to the double-acting cylinder as per the circuit.
6.4 Operate two valves simultaneously to control the speed of double-acting cylinder.
### KEY competencies to be achieved by the student

<table>
<thead>
<tr>
<th>S.No</th>
<th>Experiment Title</th>
<th>Key Competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to Pneumatics</td>
<td>• Identify the components of a pneumatic circuits.</td>
</tr>
<tr>
<td>2.</td>
<td>Direct control of a single-acting cylinder</td>
<td>• Select the suitable valve.eg:3/2 valve.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Connect 3/2 valve to the actuator.</td>
</tr>
<tr>
<td>3.</td>
<td>Direct control of a double-acting cylinder</td>
<td>• Select the suitable valve.eg:4/2 valve.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Connect 4/2 valve to the actuator.</td>
</tr>
<tr>
<td>4.</td>
<td>Speed control of a double-acting cylinder</td>
<td>• Select two 3/2 valves and a shuttle valve(OR Valve).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Connect 3/2 valves and OR valves to the double- acting cylinder as per the circuit.</td>
</tr>
<tr>
<td>5.</td>
<td>Control of a double-acting cylinder with OR logic</td>
<td>• Select two 3/2 valves and a shuttle valve(OR Valve).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Connect 3/2 valves and OR valves to the double- acting cylinder as per the circuit.</td>
</tr>
<tr>
<td>6.</td>
<td>Control of a double-acting cylinder with AND logic</td>
<td>• Select two 3/2 valves and AND valve.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Connect 3/2 valves and AND valves to the double- acting cylinder as per the circuit.</td>
</tr>
</tbody>
</table>

### COURSE CONTENT

1.0 Identify the Pneumatic components and its applications.

2.0 An experiment on Direct control of a single-acting cylinder and to know the functioning of the equipment.

3.0 An experiment on Direct control of a double-acting cylinder and to know the functioning of the equipment.

4.0 An experiment on Speed control of a double-acting cylinder and to know the functioning of the equipment.

5.0 An experiment on controlling the speed of a double-acting cylinder with OR logic and to know the functioning of the equipment.

6.0 An experiment Control speed of a double-acting cylinder with AND logic and to know the functioning of the equipment.
**FIELD PRACTICES**

**Subject Title**: FIELD PRACTICES  
**Subject Code**: M – 510  
**Periods Per Week**: 06  
**Periods Per Semester**: 90

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**TIME SCHEDULE**

1. **Production**

<table>
<thead>
<tr>
<th>Project</th>
<th>Skill Exercise</th>
<th>Number of Periods</th>
</tr>
</thead>
</table>
| Measuring sizes with a vernier caliper | • Measure the outside diameter, Inside diameter of a bore  
• Measure the width of a tongue  
• Measure the length of a step  
• Measure the depth of a stepped bore | 04 |
| Filing practice | • File the of Drill base of 151x101x6 on all sides to remove material 1 mm | 04 |
| Drilling practice | • Drill through holes of 4XØ6 (@ 6.6) from all the corners of the Drill base of 150x100x5 (Repeat the same procedure for Drill Guide) | 04 |

The above practices can be exercised by considering similar components fulfilling the above requirements

<table>
<thead>
<tr>
<th>Project</th>
<th>Skill Exercise</th>
<th>Number of Periods</th>
</tr>
</thead>
</table>
| Gear hobbing | • Perform gear hobbing on a given MS job with OD Ø74, ID Ø17 and thickness 10mm, Take 1 module as teeth thickness (or)  
Performing spur gear cutting on a given MS job with OD Ø74, ID Ø17 and thickness 10mm, Take 1 module | 06 |
| Manufacture of solid shaft | • Turn and face the given cylindrical rod according to the dimensions  
• Cut the key way on the above shaft for the flat key  
• Make the seat to mount the bearing on the above shaft | |
| Cutting splines on the shaft | • Turn and face the given cylindrical rod according to the dimensions  
• Index the job using dividing head  
• Cut the splines on the above shaft on milling machine | |
| Cutting straight teeth on the gear blank | • Index the job using dividing head  
• Cut the teeth on the gear blank on milling machine | |
### 1. Production (contd........

<table>
<thead>
<tr>
<th>Project</th>
<th>Skill Exercise</th>
<th>Number of Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing of square threaded screw</td>
<td>• Turn and face the given cylindrical rod according to the dimensions&lt;br&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Cut the square threads on the rod for given pitch using back gear of the lathe</td>
<td></td>
</tr>
<tr>
<td>Preparing template for involute gear</td>
<td>• Understand the law of gearing&lt;br&gt;</td>
<td>04</td>
</tr>
<tr>
<td>tooth</td>
<td>• Understand the properties and importance of involute profile</td>
<td></td>
</tr>
<tr>
<td>Casting of flange coupling</td>
<td>• Prepare the pattern&lt;br&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Prepare the mould and core for the flange coupling&lt;br&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Drill the holes on the casted flange&lt;br&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Cut the key way in the hub of flange</td>
<td></td>
</tr>
</tbody>
</table>

### 2. Fabrication

<table>
<thead>
<tr>
<th>Project</th>
<th>Skill Exercise</th>
<th>Number of Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabrication of Almirahs and trunk</td>
<td>• Measure the gauge of the sheet with gauge plate&lt;br&gt;</td>
<td></td>
</tr>
<tr>
<td>boxes</td>
<td>• Produce marking on sheet&lt;br&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Cut the sheet as per marking&lt;br&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Bend, weld the sheets&lt;br&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Apply primer and paint</td>
<td></td>
</tr>
<tr>
<td>Critical cases</td>
<td>• List out the sequencing of job planning when you have received a oversized component</td>
<td></td>
</tr>
</tbody>
</table>

Practically with the support of the process sheet proforma adopted.
Eg:1. Supporting of heavy weight job by using Jigs & Fixtures
2. If the dia.of the rod is more while testing on a UTM the suitable jaws will be replaced for holding

### 3. Servicing

<table>
<thead>
<tr>
<th>Project</th>
<th>Skill Exercise</th>
<th>Number of Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repair and Maintenance of</td>
<td>• Engines Eg:Differential,Gear box &amp; M/c parts &amp; its components,etc</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Refrigeration and Air conditioning test rigs Eg:Evacuating &amp; charging of the Refrigerant,etc</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Pumps Eg:Inlet &amp; outlet valves,foot valve,gland of a pump,etc.</td>
<td></td>
</tr>
</tbody>
</table>

The visit may arranged to the following:
• Tyre servicing centers
• Servicing and maintenance of Automobiles
• Refrigeration system in dairies
• Thermal power plants
• Workshops (RTC)
4. Human Resource management

<table>
<thead>
<tr>
<th>Project</th>
<th>Skill Exercise</th>
<th>Number of Periods</th>
</tr>
</thead>
</table>
| Manpower requirement    | • Planning and Assessing man power  
                          | Student will be guided to prepare the man power requirement in the laboratories by assessing the demand.  
                          | Eg: Boring of a component with an authorised process sheet, etc  
                          | Skilled technician-1, Store keeper-1, Transport Asst.-1, Helper-1 |                   |

5. Inventory management

<table>
<thead>
<tr>
<th>Project</th>
<th>Skill Exercise</th>
<th>Number of Periods</th>
</tr>
</thead>
</table>
| Material requirement    | • Handle the Store House and its transactions  
                          | • Select the Appropriate Storehouse Equipment  
                          | • Use Appropriate methods to Preserve the Store house material  
                          | • Practice Replenishment of material  
                          | • Practice Identification of store materials  
                          | • Maintain Appropriate Records in Store Accounting  
                          | • Use Material Budgeting Techniques  
                          | • Use Techniques of Inventory control  
                          | • Practice Purchasing and Disposal procedures  
                          | • Use Quality control and Value Analysis  
                          | • Practice Negotiation procedures  
                          | • Use Transportation and Disposal procedures |                   |

Note: The student has to identify the material requirement in his field of working and should have knowledge on purchasing, store maintenance and disposal of unserviceable & outdated components & equipment.

6. Case studies

<table>
<thead>
<tr>
<th>Project</th>
<th>Skill Exercise</th>
<th>Number of Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct energy audit for workshop/Home/SSI unit</td>
<td>• Collect information about energy utilization in a local industry. Identify energy saving measures (to be) taken up in the industry</td>
<td></td>
</tr>
</tbody>
</table>

Note: The visit may arranged to appropriate industry to collect the information.
6. Safety

<table>
<thead>
<tr>
<th>Project</th>
<th>Skill Exercise</th>
<th>Number of Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mock drill</td>
<td>• Rescue the persons from crash</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Rescue the persons from Fire accident</td>
<td></td>
</tr>
<tr>
<td>Eg: Fire Accident</td>
<td>• Knowledge &amp; practice on fire extinguishers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Using of sand buckets</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Informing to the fire fighting agency.</td>
<td></td>
</tr>
<tr>
<td>First Aid</td>
<td>• Practice the First aid procedures</td>
<td></td>
</tr>
<tr>
<td>Eg: Hitting of a shaper ram</td>
<td>• Cleaning the injured area with spirit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Applying betadin over injury</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Temporary bandage over the injury</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Moving person to nearest hospital</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Artificial Respiration incase of electrical shock, etc</td>
<td></td>
</tr>
</tbody>
</table>

SKILLS
Up on completion of the skill session the student shall be able to

1.0 Measure the outside and inside diameters of a bore
   • Check the condition of the caliper
     ➢ Confirm the looseness of the locking screw
     ➢ Clean every part of the caliper with rags
     ➢ Close the jaws, and examine the opening through light
     ➢ Check whether the zero points coincide

Measuring Outside diameter:
   • Open out the movable jaw slightly more than the measurable size
   • Place the jaws at right angles to the axis of the work piece
   • Close the jaw over the work piece such that the nib of the jaws just slip from the point of contact
   • Lock the nib and record the reading

Measuring Inside diameter:
   • Open out the ribs of the vernier caliper slightly less than the measurable size.
   • Place the nibs inside the bore surface such that the nibs are parallel to the axis of the work piece and centre of the bore
   • Open out the nibs so as to make contact on the bore surfaces, and swing the nibs to measure the maximum value of the bore size
   • Lock the nib and record the reading
2.0  **File the of Drill base of 151x101x6 on all sides to remove material 0.5 mm**
- Wear the apron
- Check the raw material (Drill base) size as per the work sheet (151x101x6)
- Select the suitable height of the vice
- Clamp the work piece centrally across the base firmly in position
- File surfaces flat and parallel to an accuracy of ±0.05 mm
- File angle to 90° to a try-square accuracy
- Check for flatness and squareness using tri-square
- Measure the specifications of job is to be 150x100x5

3.0  **Drill through holes of 4XØ6 (@ 6,6) from all the corners of the Drill base of 150x100x5**
- Wear the apron
- Follow safety and procedural precautions
- Check the Drill base for its size
- Mark and locate the centres for the holes to be drilled
- Mount the job in a machine vice, using parallels and clamp it securely
- Set the work table in such a manner that the drill can be fixed and removed without disturbing the vice or table
- Fix a centre drill on the chuck in a drilling machine spindle and align with the centre mark on the job
- Spot the hole location with the centre drill
- Remove the centre drill and fix the required drill of Ø6 without disturbing the vice or table
- Perform an operation of drilling a hole of a diameter of Ø6 up to a depth of 1mm for first go
- Operate a coolant pump
- Drill through hole as per requirement

4.0  **Perform gear hobbing on a given MS job with OD-Ø74, ID-Ø17 and Thickness 10mm, Take 1 module as teeth thickness**
- Wear the apron
- Check the raw material specifications OD-Ø74, ID-Ø17 and thickness 10mm size as per the work sheet
- Fix the job on appropriate mandrel using watchers and ensure that the one side of mandrel to be fitted in the cullet of the Miller and another side should be tightened using nut
- Fix the 1 module cutter(Gear hobber) specified as  $0^\circ.8^1 M20^0 L A , 0^0 57^1 80^0 PA$
- Set the index table to suit the cutter specifications
- Set the feed as 0.15 mm / rev as per the Gear train chart
- Set the speed as 624 m/min for the material MS EN8 as per the speed chart
- Switch on the machine to perform the operation i.e Gear hobbing
- Ensure that the operation is completed in 08 min
- Take care of safety and procedural precautions
• Remove the chips from the job
• Clean the machine
• Remove the job with mandrel from machine cullet

5. Material Requirement (Note: The faculty in charge needs to plan appropriate situation to accomplish the given exercises)

- **Handle the Store House and its transactions**
  1. Draw a typical layout of storeroom considering
     a) Optimum utilization of space
     b) Easier accessibility to all materials
     c) Maximum security of all materials
     d) Minimization of spoilage and damage
  2. Select appropriate Store depot based on their function and utility
     a) For minimum possible stocks of spares, Equipments, Tools
     b) If regular supplies are received, Un-necessary hold- ups and delays in work are avoided
        • CSD – Central Store Depot
        • BSD – Branch Store Depot
        • TSD – Tool Store Depot

- **Select the Appropriate Storehouse Equipment**
  1. Identify storeroom equipment for a given materials
  2. Group the articles according to their nature of storage
  3. Arrange appropriate racks to store various materials like Bar, Tubes, Angles, Plate, Sheet, Tyre and Drum
  4. Use Various measuring equipment to receive the different types of material
  5. Which type of material handling equipment do you select, If you are given the following materials
     a) Bricks
     b) Reels of wire
     c) Drums
     d) Bales of paper
  6. Which type of material handling equipment do you select to lift the machines of 2 to 6 tonnes up to the height of 40 feet

- **Use Appropriate methods to Preserve the Store house material**
  1. Preserve the following material according to the manufacturing criteria, degree of temperature and duration
     1. Metals
     2. Timber
     3. Textiles
     4. Rubber goods
     5. Chemicals
     6. Leather goods
  2. Maintain Replenishment of stock by fixing
     a) Maximum level
     b) Minimum level
     c) Order level
     d) Danger level
• **Practice Replenishment of material**
  Represent graphically the Working stock and Safety stock in Replenishment of material

• **Practice Identification of stores**
  1. Classify and Use Identification system for a given Raw material, Consumables, Machines and Equipment, Inflammable stores, Chemicals, Furniture, General stores, Scrap materials, Packaging materials, Fuel stock

• **Maintain Appropriate Documents in Store Accounting**
  1. Prepare the Documents for recording of Receipt of material
     - a) Material Receipt book
     - b) Material Receipt Note
     - c) Daily Receipt Voucher
     - d) Damage/Shortage/Excess Report
     - e) Package slip
     - f) Bin Card
     - g) Stock Ledger
     - h) Stock Identification Card
  2. Prepare the Documents for recording of Inspection of material
     - a) Purchase order
     - b) Daily Receipt Voucher
     - c) Inspection Note
     - d) Rejection Note
     - e) Bin Card
     - f) Stock Ledger
     - g) Stock Identification Card
  3. Prepare the Documents for recording of Issue of material
     - a) Material Requisition Slip
     - b) Bin Card
     - c) Gate pass
     - d) Stock Ledger
     - e) Stores Advice Note
  4. Prepare the Documents for recording of Verification of Stores
     - a) Stock- Taking Sheet
     - b) Stock Valuation Sheet
     - c) Bin Card
     - d) Material Transfer Note
     - e) Material Return Note
     - f) Stock Ledger
  5. Prepare the Documents for recording of Material Control
     - a) Stock Day sheet
     - b) Stock Ledger Card
     - c) Kardex Card

• **Use Material Budgeting Techniques**
  1. Practice the Estimation of Consumption and Purchase of materials of a given Organization
2. Use the Techniques for Drawing up a Material Budget of a given Organization.

- **Use Tools and Techniques of Inventory control**
  1. Practicing of Estimation of Consumption and Purchase of materials of a given Organization
  2. Use the Techniques for Drawing up a Material Budget of a given Organization

- **Use Tools and Techniques of Inventory control**
  1. Practice the Estimation of Inventory carrying cost, Stock-out Cost and Control levels of a given Organization.
  2. Use the Tools and Techniques of Inventory control
  3. Prepare the Stock Control Card

- **Practice Purchasing and Disposal procedures**
  1. Practicing the purchasing principles of six ‘R’s.
     a) Right Quality
     b) Right Quantity
     c) Right Time
     d) Right Price
     e) Right place, and
     f) Right Source
  2. Use the Various Order Quantities in purchasing and Disposal
  3. Practicing the use of purchasing systems considering legal aspects of purchasing
  4. Practicing the use of the following documents in purchase procedure
     a) Purchase Requisition
     b) Purchase Enquiry
     c) Suppliers Quotation
     d) Comparative statement
     e) Purchase Order
        Bill / Invoice

- **Use Quality control and Value Analysis**
  1. Practicing the use of the following Methods of describing quality of the product
     a) Samples
     b) Brand name
     c) Specifications
     d) Grades
  2. Use the Five stages of Quality control for an effective accomplishment of Onerous task
  3. Practicing the use of Techniques of Value Analysis in reducing the product cost
     a) EXCHANGE, and
     b) MISS
• **Practice Negotiation procedures**
  1. Practice the Phases of Negotiation
     [Note: Arrange a practicing session between two parties]
• Use Transportation and Disposal procedures
  1. Practicing the following tasks to be carried out for effective transportation of goods of an enterprise
     Estimation of
     a) Cost of transportation
     b) Commodity value
     c) Size of Shipment
     d) Distance control
     e) Type of Transport
     f) Speed
  2. Practicing the appropriate Disposal procedures
     a) Surplus Items
     b) Obsolete Items
     c) Scrap Items
## DIPLOMA IN MECHANICAL ENGINEERING
### SCHEME OF INSTRUCTIONS AND EXAMINATIONS
#### VI Semester/(THIRD YEAR)

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Name of the Subject</th>
<th>Instruction period / week</th>
<th>Total Period / year</th>
<th>Scheme of Examination</th>
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<td></td>
<td>Theory</td>
<td>Practical/ Tutorial</td>
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<tr>
<td>ME-601</td>
<td>Entrepreneurship and Project Management</td>
<td>4</td>
<td>-</td>
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<tr>
<td>ME-602</td>
<td>Refrigeration &amp; Air Conditioning</td>
<td>5</td>
<td>-</td>
<td>75</td>
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<tr>
<td>ME-603</td>
<td>Energy Sources &amp; Power Plant Engineering</td>
<td>4</td>
<td>-</td>
<td>60</td>
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<tr>
<td>ME-604</td>
<td>CAM</td>
<td>3</td>
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<td>ME-605</td>
<td>Measurement &amp; Control Systems</td>
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<td>ME-606</td>
<td>Automobile Engineering</td>
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<td>ME-607</td>
<td>CAM Lab</td>
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<td>ME-608</td>
<td>T.E and R &amp; AC Lab</td>
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<td>ME-610</td>
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TIME SCHEDULE

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Major Topics</th>
<th>Periods</th>
<th>Weightage Of Marks</th>
<th>Short Answer Questions</th>
<th>Essay Type Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Role of Entrepreneur and Entrepreneurial Development</td>
<td>12</td>
<td>26</td>
<td>02</td>
<td>02</td>
</tr>
<tr>
<td>2.</td>
<td>Marketing ,Sales &amp; Feasibility study</td>
<td>12</td>
<td>26</td>
<td>02</td>
<td>02</td>
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<tr>
<td>3.</td>
<td>Industrial legislation &amp; safety</td>
<td>18</td>
<td>29</td>
<td>03</td>
<td>02</td>
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<tr>
<td>4.</td>
<td>Introduction to ISO 9000 &amp; T.Q.M.</td>
<td>18</td>
<td>29</td>
<td>03</td>
<td>02</td>
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<tr>
<td></td>
<td>Total</td>
<td>60</td>
<td>110</td>
<td>10</td>
<td>08</td>
</tr>
</tbody>
</table>

OBJECTIVES

Up on completion of the course the student shall be able to

5.0 Understand the role of entrepreneur in economic development and in improving the quality of life.
   5.1 Explain the concepts of Entrepreneurship.
   5.2 Define the word entrepreneur.
   5.3 Explain the role of Entrepreneurship.
   5.4 List the qualities of an entrepreneur.
   5.5 Explain the requirements of an entrepreneur.
   5.6 Outline the expectations of Entrepreneurship.
   5.7 Explain the role of entrepreneurs in promoting Small Scale Industries.
   5.8 Explain the details of self-employment schemes.
   5.9 Explain the method of product selection.
   5.10 Explain the method of site selection.
   5.11 Outline the method of plant layout.
   5.12 State the needs for a planned and co-ordinated effort.
   5.13 State the importance of follow up.
   5.14 Describe the small business scheme.
   5.15 List the financial assistance programmes.
   5.16 List the organisations that help an entrepreneur.
   5.17 Conduct a demand survey.
   5.18 Conduct a market survey

6.0 Understand marketing, sales and feasibility study.
   6.1 Explain marketing functions.
   6.2 Explain Sales function.
   6.3 List out market conditions.
   6.4 Differentiate Sellers and Buyers’ market.
   6.5 Differentiate monopoly, oligarchy, and perfect competition.
6.6 Conduct market and demand surveys.
6.7 Differentiate product and production analysis.
6.8 List the input materials, i.e. Bill of materials
6.9 Define the main policy requirements.
6.10 Explain the selection of site.
6.11 Evaluate Economic and Technical factors.
6.12 Prepare feasibility study.
6.13 List different products currently in demand with market or industry.
6.14 Explain Role of advertising, media of advertising and selection of media

7.0 Comprehend the provisions of industrial legislation in India. & Safety procedures
7.1 Describe employer and employee relations.
7.2 Describe the mechanics of Trade Unions.
7.3 Describe mechanics of settlement of in outs.
7.4 Explain the significance of collective bargain.
7.5 List Welfare activities.
7.6 List subsidy schemes.
7.7 Explain the total welfare concept.
7.8 List the rights and responsibilities of employees and employers.
7.9 List the salient features of Indian Factories Act.
7.10 List the salient features of Minimum Wages Act.
7.11 List the salient features of Industrial Disputes Act.
7.12 List the salient features of Workmen’s Compensation Act
7.13 List the salient features of E. S. I. Act.
7.14 List the salient features of consumer protection rights Act
7.15 Explain the importance of safety at Work place.
7.16 Explain the significance and mechanics of safety education.
7.17 Explain hazard and accident.
7.18 List different hazards in the Industry.
7.19 Explain the causes of accidents.
7.20 Explain the direct and indirect cost of accidents.
7.21 List types of fire extinguishers.
7.22 Describe the method of artificial Respiration.
7.23 List provisions of Indian Electricity Rules laid in the electricity act1923.

8.0 Understand ISO 9000 & TQM.
8.1 Explain the concept of quality.
8.2 List the quality systems and elements of quality systems.
8.3 State the principles of quality Assurance.
8.4 State the Indian Standards on quality systems.
8.5 List the evolution of ISO standards.
8.6 Explain ISO standards and ISO 9000 series of quality systems.
8.7 State the constituents of ISO 9000 series of standards for quality systems.
8.8 State the outstanding features and drawbacks of ISO 9000 series of standards.
8.9 List the beneficiaries of ISO 9000.
8.10 Explain 5-S principles and ZERO DEFECT.
COURSE CONTENT

1. Role of Entrepreneur & Entrepreneurial Development.
   Materials in industry, inventory control model, ABC Analysis, Safety stock, reorder, level, Economic ordering quantity, Cost Elements of Cost, Contribution, Break even analysis, Stores layout, stores equipment, Stores records, purchasing procedures, purchase records, Bin card, Cardex, Material handling, Manual lifting, Hoist, Cranes, conveyors, trucks, fork trucks.

2. Marketing, Sales & Feasibility Study
   Sellers and Buyers markets, Marketing, Sales, Market conditions, monopoly, oligarchy, perfect competition, Budgets, Pricing Policies. Market Survey, Product and production Analysis, Materials input, Manpower, Location, Economic and Technical Evaluation, preparation of Feasibility study reports, - different products – Mechanical, Electrical, Electronics, consumer items, Consumer desires etc.

3. Industrial Legislation and safety

4. Introduction to ISO 9000 and TQM
   Concept of quality discussed by B. Crosby W. Edward, Deming, Joseph M. Juran, Koori Ishikawa, Genichi Taguchi, Shigco Shingo. Quality systems – Definitions of the terms used in quality systems like, quality policy, quality management, quality systems, quality control and quality assurance.
   Drawbacks of ISO 9000 series of standards, list the beneficiaries of ISO 9000 (Whom does ISO 9000 help).

REFERENCE BOOKS
1. Industrial Engineering and Management - by O.P Khanna
2. Production Management - by Buffa.
5. Personnel Management by Flippo.
REFRIGERATION AND AIR CONDITIONING

Subject Title : Refrigeration & Air conditioning
Subject Code : M-602
Periods/Week : 05
Periods per Semester : 75

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Major Topics</th>
<th>No. of Periods</th>
<th>WEIGHTAGE</th>
<th>SHORT</th>
<th>ESSAY</th>
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<tbody>
<tr>
<td>1.</td>
<td>Fundamentals of Refrigeration &amp; Air Refrigeration</td>
<td>10</td>
<td>13</td>
<td>01</td>
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<tr>
<td>2.</td>
<td>Vapour compression &amp; Vapour absorption Refrigeration Systems</td>
<td>18</td>
<td>26</td>
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<td>3.</td>
<td>Refrigerants, Refrigeration equipment &amp; Applications</td>
<td>16</td>
<td>26</td>
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<td>4.</td>
<td>Fundamentals of A/c &amp; A/c Equipment</td>
<td>08</td>
<td>13</td>
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<td>5.</td>
<td>Psychrometry, Cooling &amp; Heating loads</td>
<td>14</td>
<td>19</td>
<td>03</td>
<td>01</td>
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<tr>
<td>6.</td>
<td>Applications of A/c, Servicing and maintenance of Refrigeration and A/c equipment</td>
<td>09</td>
<td>13</td>
<td>01</td>
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<td><strong>110</strong></td>
<td><strong>10</strong></td>
<td><strong>08</strong></td>
</tr>
</tbody>
</table>

OBJECTIVES
Up on completion of the course the student shall be able to

1.0 Understand the various methods of Refrigeration.
1.1 Define refrigeration.
1.2 Explain the history of refrigeration.
1.3 Explain different methods of refrigeration such as ice, dry, ice, steam jet water refrigeration, liquid nitrogen refrigeration.
1.4 Express unit of refrigeration in Terms of ton of refrigeration.
1.5 Define coefficient of Performance.
1.6 Evaluate power required per ton of refrigeration.
1.7 Explain the principle of open air refrigeration.
1.8 Analyse carnot refrigeration Cycle.
1.9 Analyse Bell-Coleman air-cycle.
1.10 Calculate COP in above cases.
1.11 Explain principle of closed air Refrigeration.
1.12 Distinguish between open air system with closed air system.

2.0 Understand Vapour Compression, and Vapour absorption Refrigeration Systems.
2.1 Explain the importance of vapour compression system.
2.2 Explain vapour compression refrigeration with the help of T-S and P-H diagrams.
2.3 Distinguish between wet and dry compression.
2.4 Explain the effects of under cooling and super heating and effect of pressure changes on COP.
2.5 State the use of flash chamber and accumulator.
2.6 Calculate COP of plant working on vapour compression system.
2.7 Explain principle of simple vapour absorption systems.
2.8 List refrigerant – Absorber pairs in the above system.
2.9 State the desirable properties of refrigerants absorbers.
2.10 Describe the working principle of vapour absorption refrigeration system with the help of a legible sketch.
2.11 Calculate “COP” of the ideal vapour absorption system.
2.12 Differentiate two fluid system and three fluid absorption system.
2.13 Explain working of solar powered refrigeration system with the help of a legible sketch.
2.14 Explain the working of electrolux refrigeration with the help of a legible sketch.
2.15 Explain the working of Lithium Bromide absorption refrigeration system with the help of a legible sketch.

3.0 Understand the Refrigerants, Refrigeration Equipment and applications of Refrigeration
3.1 Distinguish between primary and secondary refrigerants.
3.2 State the requirements of Refrigerants.
3.3 List the properties of refrigerants.
3.4 List the commonly used refrigerants.
3.5 Explain different types of compressors such as reciprocating and rotary.
3.6 State the function of condenser and classify the condensers.
3.7 Explain different types of condensers such as shell & tube, shell and coil, fin and tube, flooded tube type with the help of a legible sketch.
3.8 State the function of evaporator and classify the evaporators.
3.9 Explain various types of evaporators such as shell & tube, shell and coil, fin and tube, flooded tube type with the help of a legible sketch.
3.10 Explain the functions of various types of expansion devices such as capillary tube, thermostatic expansion valves and solenoid valves with the help of a legible sketch.
3.11 Explain the refill type and throw away type dryers.
3.12 Explain the working of domestic refrigerator with the help of a legible sketch.
3.12 Explain the working of ice Plant with the help of a legible sketch.
3.13 Explain the working of water cooler with the help of a legible sketch.
3.14 Explain the working of cold storage with the help of a legible sketch.
3.15 Explain the production of dry ice with the help of a legible sketch.

4.0 Understand fundamentals of A/c and A/c equipment
4.1 Define air conditioning.
4.2 List modern applications of A/c.
4.3 Explain Air conditioning as applied to human comfort.
4.4 Explain the functions of fans, ducts, filters (wet, dry, electric & viscous types) C.F dust collector with the help of a legible sketches.
4.5 Explain the use of heating and cooling coils.
4.6 Explain the air distribution system.

5.0 Understand Psychrometry, Cooling and Heating loads.
5.1 Define the terms humidity, Relative humidity, dew point, DBT & WBT, Absolute humidity, humidity ratio.
5.2 Explain the features of psychrometric chart.
5.3 Plot psychometric processes on the above chart.
5.4 Explain the psychrometric patterns for heating and cooling processes.
5.5 Define Fundamentals of Heat transfer – Conduction, convection and Radiation.
5.6 Compute cooling load – components involved in cooling load.
5.7 Compute heating load – components involved in heating load.
( Problems on load calculations are Omitted )

6.0 Appreciate the applications of A/C.
6.1 Explain the working of air coolers.
6.2 Explain the working of window air – conditioner.
6.3 Explain the working of cooling tower installations.
6.4 Explain the working of A/c systems viz., centralised and unitary systems.
6.5 Explain the working of summer/winter/year round air conditioners.
6.6 Explain the symptoms of gas shortage.
6.7 Explain the methods of leakage detection.
6.8 List the causes of common Breakdown.
6.9 List the remedial measures for breakdown.

COURSE CONTENT

REFRIGERATION

1.0 Fundamentals of Refrigeration and Air Refrigeration
Introduction – Definition and meaning of refrigeration, methods of refrigeration – unit of refrigeration – COP. Thermodynamic analysis of Refrigeration cycles, Carnot refrigeration cycle – Air refrigeration cycle (Bell – Coloman) open air and closed air systems of refrigeration.

2.0 Vapour Compression and absorption Refrigeration Systems.
3.0 Refrigerants, Refrigeration Equipment and applications
Primary and secondary refrigerants with examples – requirements of a refrigerant – properties of refrigerants – Commonly used refrigerants
Compressors – types of compressors.
Condensers – types of condensers.
Evaporators – types of evaporators.
Expansion devices – types of expansion devices –
Refill type and throw away type driers.

AIR CONDITIONING

4.0 Fundamentals of A/c and A/c equipment
Comfort air conditioning: Human comfort – effective temperature – Factors governing effective temperature conditions that effect body heat – comfort chart.
A/C Cycle equipment such as fans, supply ducts, outlets, return outlets and ducts, filters & dust collectors heating/cooling coil-Air distribution.

5.0 Psychrometry, Cooling and Heating
Conduction, convection and Radiation definitions - Heating and cooling load .

6.0 Applications of A/C, Servicing and maintenance of Refrigeration and A/c equipment
Food preservation – freeze drying.
Servicing & Maintenance of Refrigeration and A/c Equipment – trouble shooting.

REFERENCE BOOKS
1. Refrigeration and Air Conditioning – by Domakundavar
2. Refrigeration and Air Conditioning – by C P Arora
3. Basic Refrigeration and Air conditioning - by P N Ananthanarayana
4. Refrigeration and Air Conditioning – by Sarao & Gabi
5. Refrigeration and Air Conditioning – by Dosatt
6. Refrigeration and Air Conditioning – by Stoecker
7. Trouble shooting of Refrigeration & -by Ananthanarayana
Air conditioning
ENERGY SOURCES AND POWER PLANT ENGINEERING

Subject Title: Energy Sources and Power Plant Engineering
Subject Code: M-603
Periods/Week: 04
Periods/Semester: 60

TIME SCHEDULE

<table>
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<th>S. No.</th>
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OBJECTIVES

*Up on the completion of the course the student shall be able to*

1.0 Understand Energy Sources
   1.1 State various energy sources, give examples
   1.2 Classify energy sources as renewable and non-renewable energy
   1.3 State Advantages and disadvantages of renewable and non-renewable energy sources.
   1.4 Appreciate the need of renewable energy sources
   1.5 State the different types of renewable energy sources

2.0 Understand Solar and Wind Energy
   2.1 State the amount of solar radiation reaching the earth’s surface
   2.2 Determine the solar constant
   2.3 State the principle of measuring solar radiation by pyranometer and pyrheliometer
   2.4 State the principle of conversion of solar radiation into heat.
   2.5 Explain the function of liquid flat collector
   2.6 Explain the working principle of solar air heater with a sketch
   2.7 State the application of solar air heater
   2.8 Identify different types of concentrating collectors
2.9 Explain the working principle of concentrating collector (focusing type, parabolic trough collector and flat plate collectors with plain reflectors).
2.10 State the different methods of storing solar energy
2.11 Understand the methods of sensible heat, latent heat and thermo chemical storage.
2.12 Explain the working principle of solar pond with a sketch
2.13 State the applications of solar pond
2.14 Explain with the help of sketches the construction details and working principle of different types of solar water heater, solar space heater, absorption refrigerator type solar space cooler, solar still, cabinet and connective type of solar drier, box type solar cooker.
2.15 Understand the principle of photo–voltaic conversion.
2.16 State the working principle of solar cell
2.17 Explain the conversion energy and current voltage characteristics of solar cell.
2.18 State the use of photo voltaic cell for power generation
2.19 Understand the solar photovoltaic arrays.
2.20 Explain the solar water pumping system with a sketch
2.21 State the advantages and limitations of solar energy conversion.
2.22 Understand the power available in the wind and force caused by it on the blades.
2.23 State the collection of wind data and estimate the energy
2.24 State the different considerations for sight selection for installing wind mill.
2.25 Identify the basic components of a wind mill
2.26 Explain the construction details on the working principle of the wind mill
2.27 State the differences between horizontal axis and vertical axis type wind mills.
2.28 Define the terms co-efficient of performance and tip speed ratio
2.29 Plot curves to indicate the variation of co-efficient of performance with tip speed ratio.
2.30 Explain the method of generation of electricity by wind mill

3.0 Comprehend Fuel Cells and MHD Generator
3.1 Understand the working principle of fuel cell
3.2 Explain the construction details and working principle of Bacan’s High pressure fuel cell with a sketch
3.3 State the different types of fuels used in fuel cells
3.4 Explain the working principle of aluminium air fuel cell
3.5 Explain the working principle of MHD Generator

4.0 Understand Bio and Tidal Energy
4.1 Understand the meaning of bio-mass and bio-gas
4.2 State the principle of bio-gas generation
4.3 State the chemical composition and properties of bio-gas
4.4 State the applications of bio-gas
4.5 List out the different types of bio-gas plants
4.6 Explain the construction details and working principle of fixed dome type and floating dome type bio-gas plants with sketches
4.7 State the different materials used for bio-gas generation
4.8 Express bio-gas plant capacity
State the method of starting of bio-gas plant.
4.9 State the methods of generator control and load control
4.10 Identify the energy available in tides and its usefulness in conversion
4.11 State the working principle of tidal power plant
4.12 State the different operation methods of utilisation of tidal energy
4.13 Understand single basin and double basin arrangements
4.14 State the site requirements for installation of tidal power plant
4.15 State the advantages and limitations of tidal power generation

5.0 Analyse the elements of Thermal and Nuclear Power Plants.

5.1 Draw the layout of a thermal power plant.
5.2 Explain the layout.
5.3 Locate the Boiler, superheater, turbine, Electric Generator, Condenser and hot well pump in the layout.
5.4 Explain function of circulating water pump, Economiser, Air heater, Soot Blower.
5.5 Explain the dust extraction, Electrostatic precipitator.
5.6 Explain about the ash removal, water cooling.
5.7 Explain about the feed water treatment.
5.8 Explain about the coal handling
5.9 Explain about the coal storage.
5.10 Identify the fuel handling equipment.
5.11 Trace the ash disposal system.
5.12 State the necessity of condensing the steam
5.13 State the principle of condensation in condenser
5.14 List different types of condensers
5.15 Understand the chain reaction
5.16 Understand the process of nuclear fission and nuclear fusion.
5.17 List nuclear fuels
5.18 State the characteristics of atomic power plants
5.19 Explain the principle of working of a nuclear reactor
5.20 Classify the nuclear reactor
5.21 Explain the working principle of: (i) PWR (ii) BWR power plant.
5.22 Explain the working principle of: (i) GCR (ii) Liquid metal - C.R. Power plant.
5.23 Explain about the nuclear power in India.

6.0 Understand the environmental pollution.

6.1 Explain the various pollutants and their effect on the environment viz.,
   i) Particulate pollutants.
   ii) Solid waste pollutants.
   iii) Gaseous pollutants.
6.2 Explain the effect of thermal pollution
6.3 Explain green house gases and green house effect
6.4 Explain the phenomena of global warming
6.5 Explain the effects of nuclear radiation
6.6 Explain the disposal of nuclear waste
   (i) Ground (ii) Air (iii) Ocean
COURSE CONTENT

1.0 Introduction: Various energy sources, Examples for energy sources, advantages and disadvantages, Need for alternate sources of energy – types of non conventional (renewable) energy sources – solar energy, wind energy, energy from bio- mass and bio-gas, tidal and wave energy, hydrogen energy, fuel cells

2.0 Solar and Wind Energy


Solar Energy Applications
i) Solar water heater – natural circulation type and forced circulation type.
ii) Solar space heater – passive type and active type
iii) Solar space cooling – absorptive refrigeration system
iv) Solar still, Solar drier – cabinet type and convective type and Solar cooker

Photo voltaic conversion – solar cell – working principle – conversion efficiency and current voltage characteristics of a solar cell – photo voltaic cell for power generation solar photo voltaic arrays – solar water pumping system – Advantages and disadvantages of solar energy.


4.0 Bio and Tidal Energy
Tidal Energy: Introduction to tidal power – components of tidal power plants – operation methods and utilisation of tidal energy – single basin and double basin arrangements- site requirements – advantages and limitations of tidal power generation.

5.0 Steam and Nuclear Power Plant

Steam Power Plant

Layout of a Thermal Power Plant, Choice of site, explanation of important elements in layouts:- Such as Boiler, Condenser, Feed water system, Circulating water pumps, Economiser, Air heater, Soot-Blower, Forced draught Fan, Dust collectors, Electro static precipitator

Supporting activities:- Such as Water cooling, Feed water treatment, Coal handling, Coal storage, Chimney.

Description of fuel handling equipment, unloading equipment, preparing equipment, modern ash handling equipment, dust collection and disposal, roots blower, condensers, principles classification – comparison – condensers and vacuum efficiencies and simple problems.

Nuclear – Power Plants

Nuclear energy chain reaction, nuclear materials, reactor, nuclear fission, nuclear fusion, characteristics of automatic power plants, nuclear fuels, working principle of nuclear reactor, classification of reactors, working principle of PWR and BWR, Gas – Cooled reactor, liquid metal – cooled reactor, nuclear power in India

6.0 Environment Pollution.

Introduction - Pollutants particulate/solid/gaseous - Thermal pollution
Collection, greenhouse gases, greenhouse effect, global warming. Nuclear waste disposal.

REFERENCE BOOKS

1. Non conventional Energy source by G.D Rai.
2. Energy Technology by S. Rao & Dr. D.B. Palekr (Non conventional, Renewable and conventional)
3. Solar energy utilisation by G.D.Rai
4. Introduction to alternate sources of energy by TTTI, Madras
5. Solar energy by S.P. Sukhatme
8. Thermal Engineering by Arora & S. Domkundwar
CAM

Subject Title : Computer Aided Machines
Subject Code   : M – 604
Periods per week : 03
Period per semester : 45

TIME SCHEDULE

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<td>CIMS &amp; Flexible Manufacturing Systems</td>
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OBJECTIVES

Up on completion of the course the student shall be able to

1. Computer Aided Machines
   1.1. Define CAM
   1.2. Identify the functions of CAM
   1.3. Appreciate the advantages of CAM
   1.4. Familiarize with the term computer integrated production system
   1.10 Familiarize with the terms material requirement planning (MRP I) and manufacturing resources planning (MRP II)

2. CNC Machines and their Components
   2.1. Define numerical control
   2.2. Identify the components of NC & CNC systems
   2.3. Differentiate between NC, CNC & DNC systems
   2.4. Manufacturing Methodology on NC system
   2.5. Illustrate the working principle of CNC system
   2.6. Familiarize with the term Machining Centre
   2.7. Identify the maintenance aspects of CNC machines
   2.8. Appreciate the role of CNC in computer integrated manufacturing environment
   2.9. Identify the various spindle drives
   2.10 Illustrate slide ways
   2.11 Familiarize with linear motion bearings, recirculatory ball screws
2.12 Appreciate the importance of automatic tool change
2.13 Illustrate tool magazine
2.14 Identify the various feed back devices

3. **CNC Part Programming**
   3.1. Familiarize with structure of NC part program
   3.2. Differentiate between manual and computer aided programming methods
   3.3. Familiarize with G & M codes
   3.4. Know the method of programming tool information, feed, speed data
   3.5. Identify the various programming cycles like thread cutting cycle etc.
   3.6. Write a part program in G & M codes for a simple turning job
   3.7. Appreciate the importance of macros, sub routines, canned cycles, mirror image
   3.8. Appreciate the necessity of tool nose radius compensation in programming
   3.9. Familiarize with APT programming

4. **CIMS & FMS**
   4.1. Define CIMS
   4.2. Appreciate the necessity of CIMS
   4.3. Appreciate the advantages of CIMS
   4.4. Identify FMS as a sub set of CIMS
   4.5. Identify the components of FMS
   4.6. Illustrate the working of FMS
   4.7. Identify the benefits of FMS
   4.8. Appreciate the importance of coordinate measuring machine.
   4.9. Illustrate the main features of CNC, CMM
   4.10 Advantages of CNC, CMM

5. **Robotics**
   5.1. Define a robot
   5.2. Classify robots
   5.3. Identify the various elements of a robot
   5.4. Illustrate the working of a manipulator
   5.5. Illustrate the types of end effectors
   5.6. Identify the applications of robots
   5.7. Appreciate the role of robots in CIMS

**COURSE CONTENT**

1. **Computer Aided Design and Manufacturing**
   1.1. CAM definition
   1.2. Functions of CAM
   1.10 Benefits of CAM
   1.11 Integrated CAD / CAM Organization - concept
   1.12 Computer integrated production system – features and advantages
   1.13 Introductory treatment to MRP I & II

2. **CNC Machines and their components**
   2.1. Introduction to numerical control
   2.2. Features of NC system – advantages and limitations in comparison to conventional systems
2.3. Components of NC system – layout showing control unit, data input, feed back devices and machining unit
2.4. Manufacturing methodology on NC system – preparation of manuscript – programming – input to control unit – manufacturing
2.5. Development of CNC and DNC systems – comparative treatment of features for NC, CNC, DNC
2.6. Block diagram of CNC system and functions of each component
2.7. Working principle of CNC system – advantages over NC system
2.8. Types of turning centers – machining centers – horizontal, vertical
2.9. Specifications of CNC machines.
2.10 Care and maintenance of CNC machines
2.11 Spindle drives – DC drive – AC drive and linear induction motors
2.12 Slide ways – types with illustrations
2.13 Bearings – linear motion bearings – recirculatory ball screws
2.14 Automatic tool change – working of tool magazine
2.15 Feed back devices – encoders – linear transducers’

3. CNC Part programming
   3.1. CNC program procedure – coordinate system – reference points – zero points
   3.2. Preparatory and miscellaneous functions (G & M codes)
   3.3. Methods of part programming – manual and APT programming
   3.4. Tool information – speed – feed data
   3.5. Interpolation – linear and circular
   3.7. Programming Practice problems on turning jobs

4. CIMS & FMS
   4.2. Flexible manufacturing system – definition – features – necessity
   4.3. Components of FMS – functions of each component – illustration
   4.4. Advantages and limitations of FMS

5. Robotics
   5.2. Components of robot – illustration – functions of each component
   5.3. Manipulator – illustration – degrees of freedom
   5.4. End effectors - types with illustration – necessity and application
   5.5. Industrial application of robots – advantages and limitations
   5.6. Artificial intelligence – introductory treatment only

REFERENCE BOOKS :
2. Computer Integrated Manufacturing, PHI – Paul G. Ranky
3. Industrial Robotics, PHI – Gordon. N. Mair
6. CNC Machines, New Age – B.S. Pabla and M. Adithan
MEASUREMENT & CONTROL SYSTEMS

Subject Title : Measurement & Control Systems
Subject Code : M – 605
Periods per week : 05
Period per semester : 75

TIME SCHEDULE

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OBJECTIVES

Up on completion of the course the student shall be able to :

1. Understand the Measurement systems & their characteristics
   1.1 Define Measurement
   1.2 Explain the Significance of measurement
   1.3 **Methods of Measurements** -
      Explain
      Direct and Indirect
      Primary, Secondary and Tertiary
      Contact and Non-contact
   1.4 Classify Instruments
   1.5 List the Instruments and Measuring Systems-Its Functions
   1.6 List the Applications of measurement systems
   1.7 List the Instrument characteristics (Static & Dynamic)

   **Explain Static Characteristics:**
   1.7.1 Scale range and scale span
   1.7.2 Scale readability
   1.7.3 Repeatability and reproducibility
   1.7.4 Drift
   1.7.5 Noise- signal to noise ratio- sources of noise
   1.7.6 Accuracy and precision
   1.7.7 Static sensitivity
1.7.8 Linearity
1.7.9 Hysteresis
1.7.10 Threshold
1.7.11 Dead time and dead zone
1.7.12 Resolution or discrimination

**Explain Dynamic Characteristics:**
1.7.13 Speed of response and measuring lag
1.7.14 Fidelity and dynamic error
1.7.15 Overshoot

2. **Understand the Measurement Errors**
   2.1 Explain the scope of Errors
   2.2 Classify errors and explain
      2.2.1 Instrument errors
      2.2.2 Environmental errors
      2.2.3 Translation and signal transmission errors
      2.2.4 Observation errors
      2.2.5 Operational errors
      2.2.6 System interaction errors
   2.3 Factors to be considered for selecting an instrument

3. **Understand the Transducers**
   3.1 Define Transducer
   3.2 Explain Mechanical detector-transducer elements
      3.2.1 Elastic elements
      3.2.2 Mass sensing elements
      3.2.3 Thermal detectors
      3.2.4 Hydro-pneumatic elements
   3.3 Classify Transducers and explain
      3.3.1 on the basis of transduction form used,
      3.3.2 primary and secondary transducers
      3.3.3 passive and active transducers
      3.3.4 analog and digital transducers
   3.4 Explain Resistive transducer, piezo electric transducer, capacitive transducer
   3.5 Define Strain gauges
      3.5.1 List the requirements of strain gauge
      3.5.2 Explain the types of strain gauges
      3.5.3 Explain Unbonded metal strain gauges
      3.5.4 Explain Bonded metal wire strain gauges
      3.5.5 Explain Bonded metal foil strain gauges
      3.5.6 Explain Bonded semiconductor strain gauges
   3.6 Explain Rosettes

4. **Understand the Measurement of Angular Speed, Temperature, Pressure and Flow**
   4.1 Measurement of angular speed
   4.2 List the types of Tachometers
      Explain the working principle of following Tachometers with a legible sketch
4.2.1 Mechanical Tachometers-Revolution counter and timer, slipping
Clutch Tachometer
4.2.2 Electrical Tachometers-Drag cup tachometer, and Tachogenerator
4.2.3 Contactless Electrical Tachometer-Inductive pickup, and Capacitive, pickup tachometer

4.3 Measurement of Temperature
4.4 List the types of Thermometers
  4.4.1 Explain Liquid in glass thermometer
  4.4.2 Explain Bimetallic thermometer
  4.4.3 Explain Thermocouples
  4.4.4 Explain Thermistor
  4.4.5 Explain Pyrometers-Radiation and Optical

4.5 Measurement of Pressure
4.6 List the Types of pressure measurement devices
  4.6.1 Explain Bourdon tube pressure gauge

4.7 Measurement of Flow
  4.7.1 Explain Rotameters
  4.7.2 Explain Hot wire anemometer(constant temp and constant current)
  4.7.3 Explain Ultrasonic flow meter

5. Understand the Control Systems
5.1 Explain the Concept of a control system
5.2 List the Elements of Control Systems
5.3 Classify control systems-
5.4 Explain the following with legible sketch
  5.4.1 Open loop and Closed loop systems
  5.4.2 Servo mechanisms
  5.4.3 Rotational system
  5.4.4 Electrical systems
  5.4.5 Analog systems
  5.4.6 Pneumatic controller
  5.4.7 Pneumatic relay, Pneumatic Actuator
  5.4.8 Hydraulic control systems
5.5 List the Applications of Pneumatic control systems

COURSE CONTENT

1. Measurement systems & their characteristics
   Definition of Measurement, Significance, Methods of Measurements, Classification of Instruments, Instruments and Measuring Systems-Its functions, Applications of measurement systems, Instrument characteristics (Static & Dynamic)

2. Measurement of Errors
   Classification of errors- Instrument errors, Environmental errors, Translation and signal transmission errors, Observation errors, Operational errors, System interaction errors, Factors to be considered for selecting an instrument
3. **Transducers**
   Mechanical detector-transducer elements, Transducer-Classification of Transducers, Resistive transducer, piezo electric transducer, capacitive transducer, Strain gauges -requirements of strain gauge-types, Rosettes

4. **Measurement of Angular Speed, Temperature, pressure and Flow**
   Measurement of angular speed-Tachometers, Mechanical Tachometers-Electrical Tachometers-Contactless Electrical Tachometer
   Measurement of Temperature-Thermometer, Liquid in glass thermometer, Bimetallic thermometer, Thermocouples, Thermistor, Pyrometers-Radiation and Optical
   Measurement of Pressure-Types, Bourdon tube pressure gauge
   Measurement of Flow- Rotameters, Hot wire anemometer(constant temp and constant current) and Ultrasonic flow meter

5. **Control Systems**
   What is a control system- Classification, Open loop and Closed loop systems-Servo mechanisms-Rotational systems- Electrical systems-Analog systems-Pneumatic controller-Pneumatic relay- Pneumatic Actuator-Hydraulic control systems
   Elements of Control Systems
   Applications of Pneumatic control systems

**REFERENCE BOOKS:**

Mechanical Measurements and Instrumentation & Control – A.K.Sawhney
   Puneet Sawhney

Mechanical Measurements & Control --Dr.D.S.Kumar
   Mechanical Measurements & Control -- R.V.Jalgaonkar
   Instrumentation Devices & Systems -- C.S.Narang
   Mechanical & Industrial Measurements -- R.K.Jain
   Instrumentation,Measurement and Analysis -- B.C.Nakra and -- K.K.Chaudhry
AUTOMOBILE ENGINEERING

Subject Title : Automobile Engineering
subject code : M-606
No. of periods/week : 04
Periods/Semester : 60

TIME SCHEDULE

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<th>S.No</th>
<th>Major Topics</th>
<th>Number of Periods</th>
<th>Weightage of Marks</th>
<th>Short Answer Questions</th>
<th>Essay Type Questions</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction &amp; Chassis Construction</td>
<td>10</td>
<td>16</td>
<td>2</td>
<td>1</td>
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<tr>
<td>2</td>
<td>Transmission &amp; Clutches</td>
<td>16</td>
<td>32</td>
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<td>3</td>
<td>Propeller shaft and rear axle</td>
<td>10</td>
<td>18</td>
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<tr>
<td>4</td>
<td>Suspension system</td>
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<td>13</td>
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<tr>
<td>5</td>
<td>Front axle and steering</td>
<td>12</td>
<td>18</td>
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<td>6</td>
<td>Brakes</td>
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<td>Total</td>
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</table>

OBJECTIVES

Up on completion of the course the student shall be able to

1.0 Introduction & Chassis construction
1.1 Identify various components of an automobile.
1.2 Explain the function of basic structure, power plant, transmission system, auxiliaries, controls of the automobiles.
1.3 Identify the various types of Chassis construction.
1.4 Explain conventional Chassis construction.
1.5 Explain Frame construction.
1.6 Identify the materials for frame
1.7 Defects in Frames.
1.8 Explain the frameless construction.

2.0 Transmission & Clutches
2.1 Understand the term Transmission.
2.2 Functions of transmission system.
2.3 Concept of total resistance to the vehicle motion - tractive effort- Necessity of transmission.
2.4 Types of gear boxes.
2.5 Selector Mechanism.
2.6 Lubrication of gear box.
2.7 The Requirements for the effective functioning of Clutch.
2.8 Components of clutch.
2.9 Mechanical operation of clutch.
2.10 Identify the main types of clutches.
2.11 Principle of friction clutches.
2.12 Different types of dry friction clutches.
2.13 Hydraulically operated (Fluid type) clutch.

3.0 Propeller Shaft and rear axle.
3.1 Identify the functions of propeller shaft.
3.2 Explain construction of propeller shaft.
3.3 Know about various universal joints in automobile
3.4 Functions and operation of a differential in an automobile.
3.5 Sketch general arrangement of a live rear axle
3.6 Identify loads on rear axle.
3.7 Identify different methods of supporting rear axle.
3.8 Know the difference between semi-Floating and fully floating rear axle.

4.0 Suspension System
4.1 Objectives of vehicle suspension.
4.2 Identify various factors considered for suspension
4.3 Know about different types of suspension springs
4.4 Construction of leaf spring and its mounting on front and rear axles.
4.5 Different types of rubber springs.
4.6 Explain air suspension system with a diagram.
4.7 Explain the principle of shock absorber.
4.8 Explain the construction and working of a telescopic type of shock absorber.

5.0 Front Axle and Steering.
5.1 Understand the terms Front Axle and Steering.
5.2 Stub Axle types.
5.3 Front wheel assembly
5.4 Factors of wheel alignment.
5.5 Balance of wheels-Inflation of tyres- Brake Adjustment.
5.6 Steering geometry
5.7 Steering linkages.
5.8 Correct Steering angle.
5.9 Steering mechanism
7.10 Cornering force – Self righting torque.
7.10 Under steering – over steering.
7.11 Principle of power steering.

6.0 Brakes
6.1 Know the requirements of automobile brake.
6.2 Explain briefly the transfer of weight during braking operation.
6.3 Know about the wheel skidding and techniques to prevent wheel skidding.
6.4 Various factors influencing braking effect.
6.5 Classify the brakes.
6.6 Describe mechanical shoe brake.
6.7 Draw a simple diagram to show the layout of a hydraulically operated four wheel brake system and explain its working in detail.
6.8 Draw a schematic diagram showing the layout of complete air pressure system of brakes and explain the working of its main units in detail.

COURSE CONTENT
1.0 Introduction & Chassis construction
1.1 Identify the various components of an automobile.
1.2 To know briefly about the basic structure, the power plant, transmission system, the auxiliaries the controls and the superstructure of an Automobile.
1.3 Different types of Chassis construction.
1.4 Explain the functions of the Frame.
1.5 Explain the loads on the frame,
1.6 Describe frame construction with a neat sketch.
1.7 Identify the various materials for frame.
1.8 Briefly explain about subframes and defects in frames.
1.9 Explain the frameless construction with a sketch.

2.0 Transmission and Clutches
2.1 Introduction
2.2 Functions of transmission system
2.3 Concept of total resistance to the vehicle motion – Tractive effort – necessity of transmission.
2.4 Working of Sliding mesh – Constant mesh – Synchromesh gear boxes.
2.4 Working of selector mechanism with gear lever on top of transmission case.
2.6 Lubrication of gear box.
2.7 Functions of clutches.
2.8 Requirements of Clutch.
2.9 Brief description of Components of clutch, clutch plate- clutch facing – pressure plate – Springs – Bearings.
2.10 Mechanical operation of clutch.
2.11 Main types of clutches (friction clutch and fluid clutch only)
2.12 Principle of friction clutches – coefficient of friction (μ), Axial Pressure (w) and mean radius of contact surfaces(R)
2.13 Description and working of dry friction clutches – Single plate multi plate.
2.14 Working of Hydraulically operated single plate clutch.

3.0 Propeller Shaft and rear axle.
3.1 State the functions of propeller shaft.
3.2 Explain the construction of propeller shaft with a neat sketch.
3.3 Describe various universal joints in automobiles.
3.4 Explain the function and operation of differential in an automobile.
3.5 Draw the general arrangement of a live rear axle.
3.6 Explain different loads on rear axle.
3.7 Explain different methods of supporting rear axle shafts with sketch.
3.8 Explain the difference between semi-floating and fully floating rear axle.

4.0 Suspension System
4.1 State the objectives of vehicle suspension
4.2 Explain the factors to be considered for suspension system.
4.3 Different types of suspension springs.
4.4 Explain the construction of leaf spring and how it is mounted on rear and front axles with neat sketch.
4.5 Explain different types of rubber springs.
4.6 Explain briefly the action of air springs
4.7 Draw the schematic diagram showing the layout of an air suspension system and describe its working
4.8 Explain principle, construction and working of a telescope type of shock absorber.

5.0 Front Axle and Steering
5.1 Introduction to front axle.
5.3 Description of front wheel stub axle assembly.
5.4 Factors influencing of wheel alignment.
5.5 Factors pertaining to wheels – Balance of Wheels - Inflation of tyres – Brake adjustment-Concept of Steering Geometry – Camber – Kingpin inclination – combined angle - castor – Toe-in & Toe-out.

5.6 Steering linkage – principle of correct steering angle (without mathematical analysis) simple equation

5.7 Details of Ackerman steering mechanism.

5.8 Concept of cornering force-self righting torque.

5.9 Concept of under steering & over steering.

6.0 Brakes

6.1 State the requirements of a automobile brake.

6.2 Explain briefly the transfer of weight during braking operation.

6.3 Explain wheel skidding and describe techniques to prevent wheel skidding.

6.4 Describe various factors influencing braking effect.

6.5 Classification of brakes.

6.6 Explain mechanical shoe brake with a neat sketch.

6.7 Show the layout of a hydraulically operated four wheel brake system with a simple diagram and explain its working in detail.

6.8 Draw a schematic diagram showing the layout of complete air brake system and explain the working of its main units in detail.

REFERENCE BOOKS:

1. The motor vehicle - Newton steeds. & Garret
2. Automotive Chassis - P.M. Heldt.
3. Mechanism of the car - A.W. Judge
5. Automotive Engineering - G.B.S. Narang
6. An introduction to Automobile Engineering - N.R. Khatawate
CAM-LAB

Subject Title : CAM-LAB
Subject Code : M-607
Periods/ week : 06
Periods per Semester : 90

OBJECTIVES
Up on completion of the course the student shall be able to
1. Use incremental system and absolute system on dimensioning.
2. Identify the parts and functions of CNC lathe.
3. Write simple part program using G-Codes and M-Codes.
4. Edit and execute a part program using CNC lathe machine simulation package.
5. Prepare part program as per the drawing.
6. Produce part as per the drawing using CNC lathe machine.

COURSE CONTENTS
1. CNC Introduction
2. Study of turning.
3. G – codes and M- codes
4. Simulation software practice.
5. Structure of program.
7. Turning exercise – circuits interpolation CW, CCW.
8. Turning Exercise - Taper turning and Peck drilling.

Note: The simulation softwares available in the market:
FANUC, SIEMENS, HI NUMERIC, GSK etc.,
<table>
<thead>
<tr>
<th>Exercise</th>
<th>Key competencies expected</th>
<th>Max. Marks</th>
<th>Marks awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. CNC introduction</td>
<td>G. Operate the knobs of the machine - Switch on / off</td>
<td>G. 5</td>
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<tr>
<td></td>
<td>H. Know the functions of various parts / switches</td>
<td>H. 5</td>
<td></td>
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<tr>
<td>6. Study of turning</td>
<td>B. what is turning</td>
<td>D. 2</td>
<td></td>
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<td></td>
<td>C. Know the usage of incremental system and absolute system of co-ordinate system</td>
<td>E. 2</td>
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<td></td>
<td>D. To know the tool used for turning</td>
<td>F. 2</td>
<td></td>
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<tr>
<td></td>
<td>E. To know the speeds and feeds used for turning</td>
<td>G. 2</td>
<td></td>
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<tr>
<td></td>
<td>F. To know the depth of cut to be employed</td>
<td>H. 2</td>
<td></td>
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<tr>
<td>7. G-Codes and M-Codes</td>
<td>A. To know the preparatory and miscellaneous functions</td>
<td>A. 3</td>
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<td></td>
<td>B. To know the meanings of various G-Codes and M-Codes</td>
<td>B. 4</td>
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<td></td>
<td>C. To identify frequently used G-Codes and M-Codes</td>
<td>C. 3</td>
<td></td>
</tr>
<tr>
<td>8. Simulation software practice</td>
<td>A. To know what is simulation</td>
<td>A. 2</td>
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<td></td>
<td>B. To know how to set the software in simulation mode</td>
<td>B. 3</td>
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<td></td>
<td>C. To open an existing part program</td>
<td>C. 3</td>
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<tr>
<td></td>
<td>D. To practice simulation for the program</td>
<td>D. 2</td>
<td></td>
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<tr>
<td>9. Structure of program</td>
<td>A. To know the block numbers</td>
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<td></td>
<td>B. To start the program</td>
<td>B. 3</td>
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<tr>
<td></td>
<td>C. To understand various steps in the program</td>
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<td></td>
<td>D. To know the end of the program</td>
<td>D. 2</td>
<td></td>
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<tr>
<td>10. Turning exercise – step turning canned</td>
<td>A. To know what is a canned cycle</td>
<td>A. 1</td>
<td></td>
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<tr>
<td>cycle</td>
<td>B. To select proper cutting speed and feed for the given job</td>
<td>B. 2</td>
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<td></td>
<td>C. To write a part program to produce the part as per the given drawing</td>
<td>C. 3</td>
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<td></td>
<td>D. To enter the program in the software and to simulate the program and edit if necessary</td>
<td>D. 2</td>
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<td></td>
<td>E. To fix the job and set the tool</td>
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<td></td>
<td>F. To execute the part program</td>
<td>F. 1</td>
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<tr>
<td>11. Turning exercise – circuits interpolation</td>
<td>A. To know what is interpolation</td>
<td>A. 2</td>
<td></td>
</tr>
<tr>
<td>CW, CCW</td>
<td>B. To use the codes for interpolation in part program</td>
<td>B. 3</td>
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<td></td>
<td>C. To write and enter the program in the system</td>
<td>C. 3</td>
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<td></td>
<td>D. To simulate and to execute the program</td>
<td>D. 2</td>
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<td>Exercise</td>
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<td>Max. Marks</td>
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<tr>
<td>12. Turning exercise – Taper turning and Peck drilling</td>
<td>A. To select proper values of cutting speeds and feeds for taper turning and peck drilling</td>
<td>A. 1</td>
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<td>B. To write part program for taper turning and peck drilling as per the given drawing</td>
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<td></td>
<td>C. To select suitable cutting tools for the two operations separately</td>
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<td>D. To fix the tools in the turret</td>
<td>D. 1</td>
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<td></td>
<td>E. To fix the job</td>
<td>E. 1</td>
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<td></td>
<td>F. To simulate and to edit the part program if necessary</td>
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<td></td>
<td>G. To execute the part program</td>
<td>G. 1</td>
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<td>13. Turning exercise – Thread cutting and grooving</td>
<td>A. To select proper values of cutting speeds and feeds for Thread cutting and grooving</td>
<td>A. 1</td>
<td>14. Turning exercise – Thread cutting and grooving</td>
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<td>B. To write part program for Thread cutting and grooving as per the given drawing</td>
<td>B. 3</td>
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<td></td>
<td>C. To select suitable cutting tools for the two operations separately</td>
<td>C. 2</td>
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<tr>
<td></td>
<td>D. To fix the tools in the turret</td>
<td>D. 1</td>
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<td>E. To fix the job</td>
<td>E. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F. To simulate and edit the program if necessary</td>
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<td>G. To execute the part program</td>
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THERMAL ENGINEERING & REFRIGERATION AND AIR CONDITIONING LABORATORY

Subject Title : Thermal Engineering & Refrigeration and Air Conditioning Lab
Subject Code : M – 608
Periods Per Week : 03
Periods Per Semester : 45

A.THERMAL ENGINEERING LABORATORY

TIME SCHEDULE

<table>
<thead>
<tr>
<th>S.No</th>
<th>TE Lab</th>
<th>Number of Periods</th>
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<tbody>
<tr>
<td>1</td>
<td>Economic Speed Test</td>
<td>03</td>
</tr>
<tr>
<td>2</td>
<td>Water Cooling Curves</td>
<td>03</td>
</tr>
<tr>
<td>3</td>
<td>Morse Test</td>
<td>03</td>
</tr>
<tr>
<td>4</td>
<td>Performance Curves</td>
<td>06</td>
</tr>
<tr>
<td>5</td>
<td>Heat Balance Sheet</td>
<td>06</td>
</tr>
<tr>
<td>6</td>
<td>Mercet Boiler</td>
<td>03</td>
</tr>
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<td><strong>Total</strong></td>
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</table>

OBJECTIVES
Up on completion of the course the student shall be able to
1. Understand the importance of economic speed of given S.I. / C.I. engine.
   1.1 Identify the type of engine and its parts
   1.2 Circulating cooling water through the engine jacket before starting the engine and after shutting the engine
   1.3 Cranking the engine and operating decompression lever
   1.4 Maintain constant load
   1.5 Varying the fuel supply by operating the lever
   1.6 Record the corresponding readings of fuel consumption and speed
2. Appreciate the importance of drawing water cooling curves on IC engines.
2.1 Identify the type of engine and its parts
2.2 Circulating cooling water through the engine jacket before starting the engine and after shutting the engine
2.3 Cranking the engine and operating decompression lever
2.4 Maintaining constant load and speed
2.5 Controlling flow rate of cooling water into the engine
2.6 Record the readings of cooling water temperatures at inlet and outlet.
2.7 Record the fuel consumption rate by using stop watch.

3. Identify the application of Morse test on multi-cylinder petrol / diesel engine
   3.1 Identify the type of engine
   3.2 Circulating cooling water through the engine jacket before starting the engine and after shutting the engine
   3.3 Cranking the engine and operating decompression lever
   3.4 Varying the load
   3.5 Maintaining constant speed
   3.6 Disconnecting engine cylinders one by one by operating the lever
   3.7 Record the readings in spring balance without parallax error

4. Understand the importance of performance characteristics of given IC engine.
   4.1 Identify the type of engine and its parts
   4.2 Circulating cooling water through the engine jacket before starting the engine and after shutting the engine
   4.3 Cranking the engine and operating decompression lever
   4.4 Varying the load
   4.5 Record the load
   4.6 Record the speed by using tachometer
   4.7 Handling the stop watch for measuring time for 10c.c consumption of fuel
   4.8 Draw the graphs (B.P. Vs R.P.M., B.S.F.C. Vs R.P.M., B.M.E.P. Vs R.P.M., Mechanical Efficiency Vs R.P.M.)

5. Understand the importance of heat balance of given IC engine.
   5.1 Identify the type of engine and its parts
   5.2 Circulating cooling water through the engine jacket before starting the engine and after shutting the engine
   5.3 Cranking the engine and operating decompression lever
   5.4 Adjust the load
   5.5 Identify the cooling water inlet and outlet
   5.6 Record the reading of cooling water temperature at inlet and outlet
   5.7 Record time taken for 10c.c. fuel consumption
   5.8 Record exhaust gas temperature
   5.9 Calculation of quantity of heat liberated by the fuel and the heat equivalent of brake power, heat carried away the jacket cooling water and heat carried away by the exhaust gases.

6. Identify the pressure Vs temperature relationship of saturated steam by using Mercet Boiler.
   6.1 Identify type of boiler and various parts of it.
6.2 Heat the water filled in boiler drum by using Bunsen burner
6.3 Identify the formation of saturated steam
6.4 Record the readings of pressure and temperature
6.5 Draw the graph between Pressure Vs Temperature.

**COURSE CONTENT**

1. Economic speed Test.
2. Water cooling curves.
3. Morse test on petrol / diesel engine.
4. Performance curves.
6. Investigation of Pressure Vs Temperature relationship of saturated steam by using Mercet boiler.

**Key competencies Expected from the student for Thermal Engineering Lab (M-608A)**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Exercise</th>
<th>Key competency</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Economic speed Test</td>
<td>e. Circulating cooling water through the engine jacket before starting the engine and after shutting the engine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>f. Cranking the engine and operating decompression lever</td>
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<td>g. Maintain a constant load</td>
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<td>h. Varying the fuel supply by operating the lever</td>
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<td></td>
<td></td>
<td>i. Record the corresponding readings of fuel consumption and speed</td>
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<tr>
<td>2</td>
<td>Water cooling curves</td>
<td>c. Circulating cooling water through the engine jacket before starting the engine and after shutting the engine</td>
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<td></td>
<td></td>
<td>d. Identifying the valve to allow cooling water into the engine</td>
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<tr>
<td></td>
<td></td>
<td>e. Maintaining constant load and speed</td>
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<tr>
<td></td>
<td></td>
<td>f. Record load and speed</td>
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<tr>
<td></td>
<td></td>
<td>g. Controlling flow rate of cooling water into the engine</td>
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<tr>
<td></td>
<td></td>
<td>h. Record the readings of cooling water temperatures at inlet and outlet.</td>
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<tr>
<td></td>
<td></td>
<td>i. Record the fuel consumption rate by using stop watch</td>
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<td>j. Draw graphs (s.f.c. Vs exit temperature of cooling water)</td>
</tr>
</tbody>
</table>
| 3 | Morse test on multi-cylinder diesel / petrol engine | e. Cranking the engine and operating the decompression lever  
  f. Varying the load  
  g. Maintaining constant speed  
  h. Disconnecting engine cylinders one by one by operating the lever  
  i. Record the readings in spring balance without parallax error |
|---|---|---|
| 4 | Performance curves | a. Cranking the engine and operating the decompression lever  
  b. Varying the load  
  c. Record the load  
  d. Record the speed by using tachometer  
  e. Handling the stop watch for measuring time for 10c.c consumption of fuel  
  f. Draw the graphs (B.P. Vs R.P.M., B.S.F.C. Vs R.P.M., B.M.E.P. Vs R.P.M., Mechanical Efficiency Vs R.P.M.,) |
| 5 | Heat balance sheet | a. Identify the locations of cooling water inlet and outlet  
  b. Allow cooling water to enter the cylinder jacket.  
  c. Cranking the engine and operating the decompression lever  
  d. Adjust the load  
  e. Record the load and speed  
  f. Record the reading of cooling water temperature at inlet and outlet  
  g. Record time taken for 10c.c fuel consumption  
  h. Record exhaust gas temperature |
| 6 | Mercet boiler | a. Heating of water by using Bunsen burner  
  b. Identify the formation of saturated steam  
  c. Record the readings of pressure and temperature  
  d. Draw the graph between pressure Vs temperature. |
B. REFRIGERATION & AIR CONDITIONING LAB

TIME SCHEDULE

<table>
<thead>
<tr>
<th>S.No</th>
<th>R &amp; AC Lab</th>
<th>Number of Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Familiarisation with R&amp;AC Tools Basic Operations on soft Copper tube</td>
<td>03</td>
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<tr>
<td>2</td>
<td>COP of Vapour Compression cycle test rig</td>
<td>03</td>
</tr>
<tr>
<td>3</td>
<td>COP of domestic refrigerator test rig</td>
<td>03</td>
</tr>
<tr>
<td>4</td>
<td>COP of water cooler test rig</td>
<td>03</td>
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<tr>
<td>5</td>
<td>Leak detection of refrigeration equipment</td>
<td>03</td>
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<tr>
<td>6</td>
<td>Evaluate the C.O.P. of A.C. system</td>
<td>03</td>
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<tr>
<td>7</td>
<td>Vacuumisation and Charging of compressor</td>
<td>03</td>
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<td></td>
<td><strong>Total</strong></td>
<td><strong>21</strong></td>
</tr>
</tbody>
</table>

OBJECTIVES

Up on completion of the course the student shall be able to

1. Identify various tools used in R&AC
2. To perform basic fabrication operations viz., flaring, swaging, bending and brazing on soft copper tubes.
3. Identify the various components of a Vapour Compression cycle test rig and to draw the refrigerant circuit and the electrical circuit.
4. Evaluate the c.o.p of a given Vapour Compression cycle test rig.
5. Study the given Domestic Refrigerator test rig
   a. conduct a performance test on domestic refrigerator test rig
   b. evaluate the c.o.p. of domestic refrigerator test rig
6. Study the given water cooler
   a. Identify different types of water coolers
   b. conduct a performance test on water cooler test rig
   c. evaluate the c.o.p. of water cooler test rig
7. Identify various types leak detection methods of a refrigeration system
   a. Detect the leakages of given vapour compression refrigeration system by using soap solution method.
   b. Know the methods of arresting leakages
   c. Arrest the leakages if any by soldering
8. Identify the various components of an AC system
   a. Conduct a performance test on given air-conditioning system
   b. Evaluate the C.O.P. of given air-conditioning system
9. Know the method of vacuumization and refrigerant charging for a given vapour compression system.
   a. Evacuate the given V.C.R. system using a vacuum pump
b. Charge the given V.C.R. system by using suitable refrigerant gas

c. Run the system for at least 15 min. and check for the build up of pressure in the pressure gauge.
## Key competencies Expected from the student for M-608B Refrigeration & Air Conditioning Lab

<table>
<thead>
<tr>
<th>S.No</th>
<th>Exercise</th>
<th>Key competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basic fabrication operations on soft copper tube</td>
<td>a. Using the tools to perform flaring, swaging, bending and brazing operations</td>
</tr>
</tbody>
</table>
| 2    | C O P of Vapour Compression cycle test rig. | a. Identify the components of vapour compression system  
b. Insert thermometers in suction line and discharge line  
c. Run the given V.C. cycle test rig for some time  
d. Record the values of pressure and temperature when the pressure gauges are stabilized  
e. Record the energy meter reading  
f. Reading the values from Pressure Vs Enthalpy diagram of the given refrigerant |
| 3    | C.O.P. of domestic refrigerator test rig | a. Identify the components of domestic refrigerator test rig.  
b. Insert thermometers in suction line and discharge line  
c. Run the given domestic refrigerator test rig for some time  
d. Record the values of pressure and temperature when the pressure gauges are stabilized  
e. Record the energy meter reading  
f. Reading the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant |
| 4    | C.O.P. of water cooler test rig | a. Identify the components of water cooler test rig.  
b. Insert thermometers in suction line and discharge line  
c. Run the given water cooler test rig for some time  
d. Record the values of pressure and temperature when the pressure gauges are stabilized  
e. Record the energy meter reading  
f. Reading the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant |
| 5  | Leak detection of refrigeration equipment | a. Clean the equipment by using cotton waste  
b. Apply soap solution over suction lines, discharge lines and various joints  
c. Detect the leaks by observing the air bubbles  
d. Arrest the leaks if any by using soldering |
| 6  | Evaluate C.O.P. of A.C. system | a. Identify the components of given vapour compression air-conditioning test rig.  
b. Insert thermometers in suction line and discharge line  
c. Run the given V.C. A.C. system for some time  
d. Record the pressure and temperature readings when the pressure gauges are stabilized.  
e. Record the energy meter reading  
f. Reading the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant |
| 7  | Vacuumization and charging of refrigeration system | a. Detect the leaks in the given refrigeration system  
b. Arrest the leaks if any  
c. Evacuate the system by using a vacuum pump  
d. Charge the system by suitable refrigerant gas  
e. Run the system for some time and check for the build up of pressure by observing the pressure gauge reading. |

**COURSE CONTENT**

1. Basic fabrication operations on soft copper tube.
2. Determination of COP of Vapour Compression cycle test rig.
3. Determination of COP of domestic refrigerator test rig.
4. Determination of COP of water cooler test rig.
5. Leak detection of refrigeration equipment.
6. Conduct a performance test on given air-conditioning system and evaluate C.O.P. of the system.
7. Vacuumization & Charging, pressure testing of given refrigeration system.
MANUFACTURING /SERVICING AND MAINTANANCE LAB

Subject Title : Manufacturing /Servicing and Maintenance Lab
Subject Code : M-609
Periods/Week : 03
Periods per Semester : 45

Objectives
Up on completion of the course the student shall be able to

A. MACHINE SHOP
1. Know the operation of slotter and a planer.
2. Understand the principle of indexing on milling machine.
3. Cutting a V-block on shaping machine.
4. To know the operation of milling machine and shaping machine.
5. Perform various operations on milling machine and shaping machine.

B. WELDING
1. Produce utility articles such as shoe rack, garden chair, wash basins, stools etc

C. FOUNDRY
1. Prepare a mould for flange coupling.
2. Understand the operation of cupola and pit furnace.
3. Prepare a metal casting of simple objects in Aluminium.

D. SERVICING AND MAINTANANCE
1. Know the servicing methods of IC-Engine parts.
2. Overhauling of petrol and diesel Engines.
3. Locate fault finding and rectify the same.
4. Prepare maintenance Schedules and estimations.
5. Selection of Appropriate recovery methods for a given machine elements and performing recovery processes by using appropriate methods such as arc/gas welding, metal spraying, applying adhesives etc.
6. Know the servicing methods of sewing machine, pumps
7. Know the testing and inspection methods of machine tools.
8. Dismantle and assemble machine tools.
9. Recondition the parts.
10. Service and overhaul machine of general nature.
11. Locate the faults and rectify the same.
12. Prepare maintenance schedules and estimates.
COURSE CONTENT

A. Machine Shop
   1. V-Block, 2. Gear Cutting on Milling Machine, 3. Splines on Slotting Machines,
      4. Practice on Planning machines, 5. Key way cutting, 6. Various Milling operations,
      7. T-slot cutting on milling machine

B. Welding

C. Foundry

D. Service and Maintenance
   Carburettor, Injectors, Piston Assembly,
   Gear Box, Clutch, Valve Assembly, Propellar Shaft and Universal Joint,
   Differential, Axles etc.,

   Sub – assembly of small components such as, Tail stock, checks of lathes, 3-jaw chuck, 4-jaw chuck.
   Measurement of wear on M/c elements such as, lathe beds, guide ways & shapers.
   Selection of appropriate recovery methods for a given M/c element and performing recovery processes by using appropriate methods such as:
   Arc/Gas Welding, Metal spraying, Applying adhesives etc.
   Fault finding and repairs of equipment such as machine tools, washing machines.
   Maintenance of various machine tools & engines including preparation of preventive maintenance schedule of a typical workshops.
### Key competencies to be achieved by the student

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Key competencies expected</th>
</tr>
</thead>
</table>
| 1. Key way cutting by slotting machine       | A. Fix the job on slotting machine table  
                                           | B. Set the tool and give the table feed  
                                           | C. Set the stroke of the ram              |
| 2. Indexing on slotting / milling machine    | A. Know parts of dividing head  
                                           | B. Identification of suitable indexing method  
                                           | C. Calculation of revolutions of indexing crank  
                                           | D. Select index plate  
                                           | E. Select of hole circle                     |
| 3. T-slot cutting on milling machine         | A. Identify T-slot cutter  
                                           | B. Exact setting of work-tool location     |
| 4. Bevel / Helical gear cutting on milling machine | A. Calculate no. of teeth on meshing gears for compound indexing  
                                                       | B. Identify suitable HOB  
                                                       | C. Select suitable holder for bevel gear blank |
| 5. Servicing of Carburetor, Injectors, Piston Assembly, Gear Box, Clutch, Valve Assembly, Propeller Shaft and Universal Joint, Differential, Axles etc., | A. Select suitable dismantling/assembly tools.  
                                           | B. Identify the problem  
                                           | C. Rectify the defect  
                                           | D. Select suitable lubricant.  
                                           | E. Locate lubricating points.                |
| 6. Assembly of small components such as, Tail stock, checks of Lathes, 3-jaw chuck, 4-jaw chuck. | A. Select suitable dismantling/assembly tools.  
                                           | B. Identify the problem  
                                           | C. Rectify the defect  
                                           | D. Select suitable lubricant.  
                                           | E. Locate lubricating points. }
PROJECT WORK

Subject Title : Project work
Subject Code : M-610
Periods/Week : 06
Periods/Semester : 90

OBJECTIVES

*Up on completion of the course the student shall be able to*

1.0 *Prepare technical project report.*
   1.1 Identify component with mechanical bias.
   1.2 Design and draw the production drawings.
   1.3 Prepare a project report with details of materials, processes etc.
   1.4 Develop a prototype/model of the product with the facilities available in polytechnic.

2.0 *Conduct survey to establish a small scale unit.*
   2.1 Identify and select a product with an aim to set up a small scale industry.
   2.2 Conduct a detailed market survey.
   2.3 List out the raw materials, equipment and tools needed for the manufacture of a specified quantity.
   2.4 Explore the various financial arrangements to start the manufacture of a product under technocrat scheme in small scale industrial sector.
   2.5 Make a survey of requirements of the department of industries, municipal, health, inspectorate of factories for starting an industry.
   2.6 Plan for a type of organisation.
   2.7 Select a site.
   2.8 Prepare a techno feasibility report consisting of drawings, plant layouts, building requirements, machinery and equipment requirements, raw material, labour, production and administrative staff requirements, waning capital, material flow sheet, cash flow sheet, financial analysis etc.

3.0 *Develop working models to show scientific and engineering principles studied in the curriculum and repair, up gradation and maintenance of equipment which are exist.*

COURSE CONTENT

*The following activities are envisaged in this course at study*

1. Identification and selection of a product with an aim to set small scale industry.
2. Conduct a detailed market survey.
3. Preparation of production drawings.
4. List out the raw materials, equipment and tools needed for manufacturing a specified quantity.
5. Develop a prototype model of the product in workshop (if possible) with the available facilities in the Polytechnics.
6. Explore the various financial arrangements to start the manufacturing of the product under technocrat scheme in small scale industrial sector.
7. Make a detailed survey of requirements of the department of industry, municipal, health inspectorate of factories, electrical inspectorate, banks, other financial agencies etc., for starting an industry.
8. Plan for type of organisation.
9. Selection of site.
10. Preparation of techno feasibility report consisting of production drawings, plant layout, building requirements, equipment requirement, list of raw materials and their availability, tools and other items, labour force production, ministerial staff requirement, material flow sheet, cash flow sheet, financial analysis etc.
11. Working models, repairs upgradation maintenance of equipment.

**Note: 1.** *Product selection may be done by the Polytechnic in consultation with the local industries and other agencies.*

*The student should submit techno feasibility report on a product selected with an aim to set up an industry in small scale sector.*

**Key competencies to be achieved by the student**

<table>
<thead>
<tr>
<th><strong>Project work</strong></th>
<th><strong>Key competencies expected</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical project report</td>
<td>A. Product selection&lt;br&gt; B. Design product&lt;br&gt; C. Prepare production drawings as per design&lt;br&gt; D. Develop prototype model of product&lt;br&gt; E. Prepare technical project report</td>
</tr>
<tr>
<td>Conduct survey to establish a small scale unit</td>
<td>A. Ability to conduct market survey to identify product to be produced&lt;br&gt; B. Prepare feasibility report of product&lt;br&gt; C. Convince financial organisations&lt;br&gt; D. Approach government agencies for technical and financial help&lt;br&gt; E. Ability to take risk and other leadership qualities</td>
</tr>
<tr>
<td>Develop working models and upgrade/repair existing equipment</td>
<td>A. Knowledge of production processes and scientific and engineering principles&lt;br&gt; B. Understand working principles of equipment and machines</td>
</tr>
</tbody>
</table>