

ENGINEERING MECHANICS

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

TIME SCHEDULE

S No.	Major Topics	No. of Periods	Weightage of Marks	Short Answer Questions	Essay Type Questions
1	Statics	22	21	02	1 ½
2	Friction	18	16	02	01
3	Geometrical properties of sections	22	18	01	1 ½
4	Dynamics	28	26	02	02
5	Simple machines	20	21	02	1 ½
6	Basic Link Mechanisms	10	08	01	½
	Total	120	110	10	08

OBJECTIVES

Upon 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 State the importance of mechanics in engineering.
- 1.3 Review the system of units used.
- 1.4 Explain the concept of force
- 1.5 List the types of forces
- 1.6 Explain the force system
 - a) Co-planar and Non-coplanar,
 - b) Parallel and Non-Parallel,
 - c) Like and Unlike, d) Concurrent and Non-concurrent
- 1.7 Explain the concept of equilibrium
- 1.8 State the parallelogram law of forces
- 1.9 State the triangle law of forces
- 1.10 State the polygon law of forces
- 1.11 State the Lami's theorem.
- 1.12 Explain the concept of free body diagram
- 1.13 Solve the problems involving concurrent coplanar forces
- 1.14 Solve simple problems involving non-concurrent coplanar forces
- 1.15 Solve simple problems using Lami's theorem
- 1.16 Define the term couple and moment of couple with legible sketch.
- 1.17 Explain the properties of a couple
- 1.18 State the condition of equilibrium of a body acted upon by co-planar forces.

2.0 Understand the concept of Friction

- 2.1 Explain 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 State the need for finding the centroid and centre of gravity for various engineering applications
- 3.3 Locate the C.G. of a given section.
- 3.4 Explain the method of determining the centroid by 'Method of moments'
- 3.5 Determine the position of centroid of standard sections-T, L, I, Channel section, Z - section, unsymmetrical I section
- 3.6 Determine the position of centroid of built up sections.
- 3.7 Explain the meaning of the term moment of Inertia.
- 3.8 Define the term polar moment of inertia
- 3.9 Explain the term radius of gyration
- 3.10 State the necessity of finding Moment of Inertia for various engineering applications
- 3.11 Determine Moment of Inertia and Radius of gyration for regular geometrical sections like T, L, I, Channel section, Z- section, unsymmetrical I section
- 3.12 State Parallel axis theorem and perpendicular axis theorem
- 3.13 Determine MI of standard sections by applying parallel axes theorem
- 3.14 Determine MI of standard sections by applying perpendicular axes theorem
- 3.15 Calculate the moment of Inertia of composite sections.
- 3.16 Calculate radius of gyration of standard sections.
- 3.17 Determine the polar M.I for solid and hollow circular section applying perpendicular axes theorem.
- 3.18 Solve the related numerical problems

4.0 Understand the concept of Dynamics

- 4.1 Define the terms Kinematics and Kinetics
- 4.2 Classify the motion types
- 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 State the D'Alembert's principle
- 4.9 Define the 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 applications of simple harmonic motion in engineering.
- 5.0 Comprehend the Principles involved in Simple Machines**
 - 5.1 Define the important terms of simple machines
 - a) Machine, b) Mechanical Advantage, c) Velocity Ratio, d) 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, winch 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 important terms of basic link mechanism
 - a) Link, b) kinematic pair, c) Kinematic chain, d) Mechanism, structure & 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 and 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) Z - section
 - f) 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 Newton's 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 D'Alembert's principle
- 4.8 Definition Law of conservation of energy
- 4.9 Work-Energy principle
- 4.10 Law of conservation of momentum
- 4.11 Impulse –momentum equation
- 4.12 Solving the kinetic problems using the above principles
- 4.13 Rotary motion of particle and laws of motion
- 4.14 Definition and differentiate centripetal and centrifugal forces.
- 4.15 Simple harmonic motion.
- 4.16 Definition of the terms frequency, time period, amplitude and circular frequency
- 4.17 SHM equation, natural frequency
- 4.18 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 and explanation 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:

1	Engineering Mechanics	by	Singer	B.S.Publications
2	Engineering Mechanics	by	Basudeb Bhattacharya –	Oxford Publishers
3	Engineering Mechanics	by	A Nelson	Mc Graw Hill Publishers
4	Engineering Mechanics	by	I.B.Prasad	
5	Engineering Mechanics	by	R.S.Khurmi	S.Chand & Company
6	Theory of Machines	by	S.S.Rathan	TMH P

WORKSHOP TECHNOLOGY

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

TIME SCHEDULE

S. No	Major Topics	No. of Periods	Weightage of Marks	Short Answer Questions	Essay type Questions
1	Basic Workshop tools & operations				
	(1) Carpentry	20	16	2	1
	(2) Fitting	25	26	2	2
	(3) Forging	15	13	1	1
	(4) Sheet metal	12	13	1	1
2	Drilling	10	13	1	1
3	Foundry	22	16	2	1
4	Mechanical working of metals	16	13	1	1
	Total	120	110	10	08

OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Comprehend the use of Basic workshop tools and its operation

- State the importance of workshop processes.
- List the various workshop processes and explain briefly about each.

1.1 Carpentry

- Identify various carpentry tools.
- Distinguish between marking tools, measuring tools and cutting tools.
- List work holding devices.
- Explain wood working processes viz., sawing, chiselling and planing.
- Explain the use of carpentry joints such as lap joint, dovetail joint, mortise and tenon joint with legible sketch
- Explain the working of wood working machines.

1.2 Fitting

- List various fitting tools.
- Distinguish between marking and measuring tools.
- List cutting tools.
- List various work holding devices.
- List various checking and measuring instruments.
- 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

2.0 Understand the concept of 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 Write the 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.

3.0 Understand the concept of 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.
- 3.7 List the ingredients in foundry sand.
- 3.8 List the various types of patterns.
- 3.9 State the sequence of pattern making operations.
- 3.10 Identify the colour codes.
- 3.11 List the various moulding processes.
- 3.12 State the need and types of cores.
- 3.13 Describe the casting processes.
- 3.14 Identify the defects in casting.
- 3.15 Describe special casting processes.

4.0 Mechanical working of metals

- 4.1 Define mechanical working of metals.
- 4.2 Differentiate cold working with hot working.

- 4.3 Illustrate the working principle of hot rolling, piercing, spinning, extrusion and drawing.
- 4.4 State advantages and limitations of hot working.
- 4.5 Identify various cold working processes such as rolling, bending and squeezing.
- 4.6 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.

1.1.2 Striking tools:

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

1.1.3 Holding devices

Bench vice, bench stop, bench hold fast, sash cramp (bar cramp) G- cramp, Hand screw, specifications & uses.

1.1.4 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.

1.1.5 Carpentry Processes

Marking, measuring, sawing, chiselling, planning, boring, grooving, Rebating & moulding.

1.1.6 Carpentry joints

Halving Joint, mortise and tenon joint, bridle joint, butt joint.

dowel joint, tongue & groove joint, screw & slot joint, dovetail joint, corner joint.

1.1.7 **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.

1.2 **Fitting**

1.2.1 **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, pillar file, round file, triangular file, half round files, knife edge file, needle file – specifications and uses.

Scrapers: Flat, triangular, half round scrapers, specifications & uses.

Saws: Hand hacksaw - solid frame, adjustable frame, specifications & uses, hand hacksaw blades. Power hack saw –description(horizontal reciprocating type), power hacksaw blade, specifications and uses, teeth set - saw material.

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.

1.2.2 **Striking Tools**

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

1.2.3 **Holding Devices**

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

1.2.4 **Marking Tools**

Surface plate, V-block, angle plate, try square, scribe, punch, prick punch, centre punch, number punch, letter punch, specifications and uses.

1.2.5 **Miscellaneous Tools**

Screw drivers, spanners, single ended & double ended, box type, adjustable spanners, cutting pliers, nose pliers, allen keys, specifications and uses.

1.2.6 **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.

1.2.7 **Fitting Operations**

Marking, sawing, chipping, filing, scrapping, grinding, drilling, reaming, tapping and dieing.

1.3 **Forging**

1.3.1 **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.

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

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

1.3.4 **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.

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

1.4 **Sheet Metal Work**

1.4.1 Metals used for sheet metal work.

1.4.2 **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, Hatchet stake, needle stake, blow horn stake, hollow mandrel stake, pliers (flat nose and round nose), grocers and rivet sets, soldering iron, specifications & uses.

1.4.3 **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.

1.4.4 **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.

1.4.5 **Fastening Methods**

Rivetting, soldering, brazing & spot welding.

2 **Drilling**

2.1 **Type of drilling machines:** sensitive & radial drilling machines, their constructional details 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, CO₂ 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 Promoters)
3. Manufacturing Technology (Vol I) by P N Rao (Mc Graw Hill)
3. Workshop Technology Vol I & II by Raghuvamshi

BASIC WORKSHOP PRACTICE

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

TIME SCHEDULE

S.No	Major Title	No of Periods
1.	Fitting shop	36
2.	Forging shop	39
3.	Carpentry shop	51
4.	Sheet metal work	51
	Test	03
	Total	180

OBJECTIVES

Upon completion of the course the student shall be able to

- Practice the required operations in Fitting Shop
- Practice the required operations in Forging Shop
- Practice the required operations in Carpentry Shop
- Practice the required operations in Sheet metal Shop

Competencies and Key competencies to be achieved by the student.

Title of the Job	Competencies	Key Competencies
<p>Fitting shop</p> <p>1. Marking and Chipping on Mild steel flat of 12 mm thick (12)</p>	<ul style="list-style-type: none"> - Identify appropriate measuring tool - Handle appropriate marking tool - Handle appropriate chipping tool - Mark the dimensions - Remove the material by chipping from MS flats 	<ul style="list-style-type: none"> • Mark the dimensions • Remove the material by chipping from MS flats
<p>2. Cutting with hack saw of MS flats of 6mm thick (06)</p>	<ul style="list-style-type: none"> - Check the raw material for size - Fix the work piece in vice - Mark the work as per given dimensions - Perform dot punching - Load and unload hack saw blade from its frame - Use the hack saw to perform cutting operation 	<ul style="list-style-type: none"> • Load and unload hack saw blade from its frame • cut the work as per marked dimensions using Hack saw
<p>3. Drilling, chamfering on a MS flat of 2 mm thick (06)</p>	<ul style="list-style-type: none"> - Check the raw material for size - Apply the chalk on the surface and on all sides of the flat - Layout the dimensions and mark the lines using dot punch - Chamfer the edges through filing - Locate the hole centres using odd leg callipers and centre punching - Identify appropriate drill bit - Load and unload drill bit from the machine 	<ul style="list-style-type: none"> • Load and unload drill bit from the machine • Identify appropriate taps • Tap the hole

<p>4. Tapping and Dieing on a MS flat of 2 mm thick (06)</p>	<ul style="list-style-type: none"> - Check the raw material for size - Identify appropriate tap and die - Secure the tap in the wrench - Tap the hole - Hold the bar in bench vice - Fix the die in die stock - Cut external threads using a Die - Check the fit for accuracy 	<ul style="list-style-type: none"> • Secure the tap in the wrench • Tap the hole • Fix the die in die stock • Cut external threads using a Die
<p>5. Assembling of two pieces, matching by filing (06)</p>	<ul style="list-style-type: none"> - Cut the pieces to size using hack saw - File surface of flat for trueness - Mark the surfaces as per dimensions - Dot punch the marked lines - Cut with hack saw as per marked lines - Smooth the surfaces with file - Assemble the two pieces 	<ul style="list-style-type: none"> • Identify appropriate file • File the specimen • Assemble two pieces

Title of the Job	Competencies	Key Competencies
<p>Forging shop</p> <p>6. Conversion of Round to Square (09)</p>	<ul style="list-style-type: none"> - Identify the holding and striking tools - Heat the specimen to the appropriate temperature - Remove the specimen and hold it on the anvil - Hammer the specimen to the required shape 	<ul style="list-style-type: none"> • Heat the specimen to the appropriate temperature • Hammer the specimen to the required shape
<p>7. Conversion of Round to Hexagon (09)</p>	<ul style="list-style-type: none"> - Identify the holding and striking tools - Heat the specimen to the appropriate temperature - Remove the specimen and hold it on the anvil - Hammer the specimen to the required shape 	<ul style="list-style-type: none"> • Heat the specimen to the appropriate temperature • Hammer the specimen to the required shape
<p>8. Preparation of a Chisel from round rod (09)</p>	<ul style="list-style-type: none"> - Identify the holding and striking tools - Heat the specimen to the appropriate temperature - Remove the specimen and hold it on the anvil - Hammer the specimen to the required shape 	<ul style="list-style-type: none"> • Heat the specimen to the appropriate temperature • Hammer the specimen to the required shape
<p>9. Preparation of a ring and hook from M.S round (06)</p>	<ul style="list-style-type: none"> - Identify the holding and striking tools - Heat the specimen to the appropriate temperature - Remove the specimen and hold it on the anvil - Hammer the specimen to the required shape 	<ul style="list-style-type: none"> • Heat the specimen to the appropriate temperature • Hammer the specimen to the required shape
<p>10. Preparation of a hexagonal bolt and nut (06)</p>	<ul style="list-style-type: none"> - Identify the holding and striking tools - Heat the specimen to the appropriate temperature - Remove the specimen and hold it on the anvil - Hammer the specimen to the required shape 	<ul style="list-style-type: none"> • Heat the specimen to the appropriate temperature • Hammer the specimen to the required shape

Title of the Job	Competencies	Key Competencies
<p>Carpentry Shop</p> <p>11.Cutting of wood with hand saw (06)</p>	<ul style="list-style-type: none"> - Identify the orientation of grains - Select appropriate saw for cutting in each of the directions viz. across and along the grains - Select appropriate work holding device - Handle appropriate measuring and marking tools(Steel rule, Try square, Marking gauge) - Mark dimensions on work using Marking gauge - Fix the work in the vice - Perform cutting along the grains using Rip saw - Change the position of work in the vice - Perform cutting perpendicular to the grains using cross cut saw 	<ul style="list-style-type: none"> • Identify the orientation of grains • Mark dimensions on work using marking gauge • Perform cutting along and perpendicular to the grains using appropriate saw
<p>12.Planning of wood(06)</p>	<ul style="list-style-type: none"> - Identify the direction for planning wood stock - Select appropriate jack plane - Prepare the jack plane for planning (Load and unload the blade of a jack plane) - Select appropriate work holding device - Perform marking on work using appropriate tool - Fix the work in the vice - Plane the surfaces on all four sides using jack plane 	<ul style="list-style-type: none"> • Identify the direction for planning wood stock • Prepare the jack plane for planning • Plane the surfaces on all four sides using jack plane

Title of the Job	Competencies	Key Competencies
<p>Contd.,,,</p> <p>13.Chiselling of wood (06)</p>	<ul style="list-style-type: none"> - Select appropriate chisels and saw - Select appropriate work holding device - Select appropriate measuring and marking tools - Fix the work in the vice - Mark the position of grooves on work using marking gauge - Cut sides of grooves by hand saw - Chip the material using firmer chisel by applying pressure with mallet - Finish the grooves with rasp file 	<ul style="list-style-type: none"> • Select appropriate chisels and saw • Mark the position of grooves on work using marking gauge • Cut sides of grooves by hand saw • Chip the material using firmer chisel by applying pressure with mallet
<p>14.Preparation of a Dove-tail joint (09)</p>	<ul style="list-style-type: none"> - Select the appropriate cutting tools and work holding devices - Plane the wooden pieces on all sides - Mark at an angle of 75° with bevel square - Trim the dovetail by chisel to exact size - Cutt the dovetail groove on second piece - Finish the groove - Assemble the two pieces to prepare dovetail halving joint by using mallet 	<ul style="list-style-type: none"> • Trim the dovetail by chisel to exact size • Mark at an angle of 75° with bevel square • Cutt the dovetail groove on second piece • Assemble the two pieces to prepare dovetail halving joint by using mallet
<p>15.Preparation of Mortise and Tenon joint (09)</p>	<ul style="list-style-type: none"> - Select the appropriate cutting tools and work holding devices - Plane the two pieces to the required size using jack plane - Mark the dimensions to make Tenon using mortise gauge - Cut tenon with tenon saw along the marked lines 	<ul style="list-style-type: none"> • Mark the dimensions to make Tenon and mortise on two pieces using mortise gauge • Cut tenon with tenon saw along the marked lines

Title of the Job	Competencies	Key Competencies
<p>Contd.,,, Preparation of Mortise and Tenon joint</p>	<ul style="list-style-type: none"> - Use firmer chisel to remove the excess material to set finished tenon - Mark the dimension to make mortise on the second piece with mortise gauge - Use mortise chisel to provide recess in the second piece to accommodate tenon - Assemble the two pieces by fitting the tenon into mortise 	<ul style="list-style-type: none"> • Use mortise chisel to provide recess in the second piece to accommodate tenon • Assemble the two pieces by fitting the tenon into mortise
<p>16.Wood turning on lathe (06)</p>	<ul style="list-style-type: none"> - Select appropriate tools - Plane the four corners of the work piece using jack plane - Mark the centres of the work on either side - Mount the work between head stock & tailstock centres - Fix the tool in the tool post & Position it in appropriate height - Start the lathe to make the work piece to revolve at desired speed - Feed the bevel gauge against the rotating work to get the required size and shape - Use outside callipers to check the diameter of the pin - Use parting off tool to reduce the diameter on either ends of the pin - Remove the rolling pin between centres and cut off excess material on either sides 	<ul style="list-style-type: none"> • Mark the centres of the work on either side • Fix the tool in the tool post & position it in appropriate height • Start the lathe to make the work piece to revolve at desired speed • Feed the bevel gauge against the rotating work to get the required size and shape

Title of the Job	Competencies	Key Competencies
<p>Contd.,,,</p> <p>17.Preparation of any household article (ex: stool) (09)</p>	<ul style="list-style-type: none"> - Prepare the drawings of a stool required for a particular drawing table - State the specifications of the wood stock required - Identify the type of joints to be made - Identify the operations to be made and their sequence - Perform operations to produce pieces of joint - Assemble all joints as per the drawing 	<ul style="list-style-type: none"> • Prepare the drawings of a stool required for a particular drawing table • Identify the operations to be made and their sequence • Perform operations to produce pieces of joint • Assemble all joints as per the drawing

Title of the Job	Competencies	Key Competency
<p>Sheet metal Work</p> <p>18.Practice on cutting of sheet (06)</p>	<ul style="list-style-type: none"> - Cut the required sheet from the stock using snip - Mark the dimensions on the sheet using scriber & steel rule - Draw the circular shapes using divider - Perform rough cutting of the curved shapes using chisel and finish cutting using snips - Cut the straight edges using straight snips 	<ul style="list-style-type: none"> • Identify the marking and cutting tools • Cut the sheet of different shapes using appropriate tools
<p>19.Formation of joints like grooved joint, locked groove joint (06)</p>	<ul style="list-style-type: none"> - Cut the sheet into two halves - Form the flange on the sheet by folding the sheet along scribed lines using mallet & stakes - Perform bending edges of sheets applying moderate pressure using mallet - Interlock the bent edges and apply 	<ul style="list-style-type: none"> • Identify the marking and cutting tools • Cut the sheet • Perform bending along the marked lines.

	pressure with mallet to make required joint	
Title of the Job	Competencies	Key Competency
20.Preparation of a rectangular open type tray (09)	<ul style="list-style-type: none"> - Draw the development of the object to be made - Place the pattern on the sheet - Mark the dimensions using scribe - Shear the required piece from the stock using straight snips - Mark the lines on the sheet to form bends - Strengthen the sides of sheet by single hem using hatchet stake - Form the sheet into desired shape using stakes - Seam the corners by inserting laps of the adjacent sides with single hem 	<ul style="list-style-type: none"> • Drawing development of objects • Cut the sheet • Seam the corners by inserting laps of the adjacent sides with single hem
21.Preparation of hollow cylinder (06)	<ul style="list-style-type: none"> - Draw the development of the object to be made - Place the pattern on the sheet - Mark the dimensions using scribe - Shear the required piece from the stock using straight snips - Mark the lines on the sheet to form bends - Strengthen the sides of sheet by single hem on top & bottom side using hatchet stake - Form the flat sheet into cylindrical shape by cylindrical stake and apply pressure using mallet - Prepare single hem on to longitudinal sides in 	<ul style="list-style-type: none"> • Identify the marking and cutting tools • Drawing development of objects • Cut the sheet • Interlock the sides and apply pressure using mallet to make a strong joint

	<p>opposite directions</p> <ul style="list-style-type: none"> - Interlock the sides and apply pressure to make a strong joint 	
Title of the Job	Competencies	Key Competency
22.Preparation of pipe elbow (09)	<ul style="list-style-type: none"> - Draw the development of a cylindrical pipe truncated at an angle of 45° on one side - Scribe the lines on the sheet by placing the pattern on it - Cut the sheet over the marked dimensions using curved snips - Hem the straight side of the sheet and flange the curved side - Fold the edges of joining sides - Form the sheet into cylindrical shape using stakes - Seam the sides using mallet - Repeat the similar operation for making the second pipe - Butt the treated portions of the cylindrical pipes at rectangles - Seam the two pipes - Solder the joint to make leak proof 	<ul style="list-style-type: none"> • Draw the development of a cylindrical pipe truncated at an angle of 45° on one side • Cut the sheet over the marked dimensions using curved snips • Form the sheet into cylindrical shape using stakes

Title of the Job	Competencies	Key Competency
23.Preparation of funnel (09)	<ul style="list-style-type: none"> - Draw the development of upper conical part - Place the pattern on the sheet and cut to required size - Hem the upper side of the sheet - Flange out the bottom side of the sheet - Fold the edges of the joining sides - Form the sheet into conical shape using appropriate stake and mallet - Repeat the similar operation for making the bottom part - Seam the top conical part and bottom conical part to obtain required funnel 	<ul style="list-style-type: none"> • Draw the development of upper and bottom conical parts • Place the pattern on the sheet and cut to required size • Form the sheet into conical shape using appropriate stake and mallet • Seam the top conical part and bottom conical part to obtain required funnel
24.Preparation of utility articles such as dust pan, kerosene hand pump (06)	<ul style="list-style-type: none"> - Draw the development of given dust pan - Scribe the lines on the sheet and cut to required size - Hem all the four sides to strengthen the edges - Form the sheet into designed shape using suitable stakes and mallet - Solder the corner lap joints to make the required dust pan 	<ul style="list-style-type: none"> • Identify the marking and cutting tools • Drawing development of objects • Cut the sheet • Perform bending along the marked lines and to form the article

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.
6. Mortise and tenon 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.

REFERENCE BOOKS

1. Manufacturing Technology (Vol I) by P N Rao (Mc Graw Hill)
2. Principles of Foundry Technology by P L Jain (Mc Graw Hill)