TEERTHANKER MAHAVEER UNIVERSITY
Moradabad

FACULTY OF ENGINEERING

TEERTHANKER MAHAVEER UNIVERSITY

N.H.-24, Delhi Road, Moradabad - 244001, Uttar Pradesh

DEPARTMENT OF MECHANICAL ENGINEERING

Workshop Practice (Lab)
Subject Code: EME-162/262

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Syllabus

Course Code: EME162/262	**B.Tech- Semester-I** **Workshop Practice (Lab)**	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be:**	
CO1.	**Understanding** the concepts to prepare simple wooden joints using wood working tools.	
CO2.	**Applying** the techniques to produce fitting jobs of specified dimensions.	
CO3.	**Applying** the concepts to prepare simple lap, butt, T and corner joints using arc welding equipment.	
CO4.	**Applying** the concepts of black smithy and lathe machine to produce different jobs.	
CO5.	**Creating** core and moulds for casting.	
LIST OF EXPERIMENTS:	***Perform any ten (10) experiments selecting at least one from each shop***	
1	**Carpentry Shop**: 1. To prepare half-lap corner joint. 2. To prepare mortise &tenon joint. 3. To prepare a cylindrical pattern on woodworking lathe.	
2	**Fitting Bench Working Shop:** 1. To prepare a V-joint fitting 2. To prepare a U-joint fitting 3. To prepare a internal thread in a plate with the help of tapping process	
3	**Black Smithy Shop:** 1. To prepare a square rod from given circular rod 2. To prepare a square U- shape from given circular rod	
4	**Welding Shop:** 1. To prepare a butt and Lap welded joints using arc welding machine. 2. To prepare a Lap welded joint Gas welding equipment. 3. To prepare a Lap welded joint using spot welding machine	
5	**Sheet-metal Shop:** 1. To make round duct of GI sheet using 'soldering' process. 2. To prepare a tray of GI by fabrication	
6	**Machine Shop:** 1. To study the working of basic machine tools like Lathe m/c, Shaper m/c, Drilling m/c and Grinding m/c. 2. To perform the following operations on Centre Lathe: Turning, Step turning, Taper turning, Facing, Grooving and Knurling 3. To perform the operations of drilling of making the holes on the given metallic work-piece (M.S.) by use of drilling machine.	

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7	**Foundry Shop:** 1. To prepare core as per given size. 2. To prepare a mould for given casting.	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

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EXPERIMENT NO. 01

Experiment: To study the working of basic machine tools like Lathe m/c, Shaper m/c, Drilling m/c and Grinding m/c

OBJECTIVE:

1. Study of a lathe m/c, its functions, operations and specifications
2. Study of a shaper m/c, its functions, operations and specifications
3. Study of a Drilling m/c, its functions, operations and specifications
4. Study of a Grinding m/c, its functions, operations and specifications

01 Lath Machine

A lathe is a versatile machine tool which can perform a number of functions on a work-piece while holding it between two rigid and strong supports and machining it with the help of a cutting tool mounted on a tool post.
Lathes are of following types-

1. Bench / Centre lathes

2 Speed lathes

3 Engine lathes

4 Tool-room lathes

5. Capstan and turret lathes

6 Automatic and semiautomatic lathes

7. Special purpose lathes

A centre lathe has following parts-

1. Bed- It is the main supporting frame. The bed is cast out of cast iron to damp out the vibrations. The guides provided on it support cross-slide.

2. Head stock- It houses gearing systems, which get the power through belt system, and holds the chuck where work-piece is fastened.

3. Carriage-It consists of following parts-

1. Saddle 2. Compound rest 3. Tool post

4. Tail stock- It is a rigid support capable of sliding on the guides of the beds. It can support the work-piece as well some cutting tool.

5. Legs- Legs form the base for mounting bed and electric motor. Legs are firmly secured to the ground. Legs are cast from cast iron to absorb vibrations.

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Lathe specifications – A lathe is specified by following specifications-

A- Maximum length of the work-piece that can be turned or maximum distance between centres.

B- Maximum swing in the gap (in case of gap lathes only)

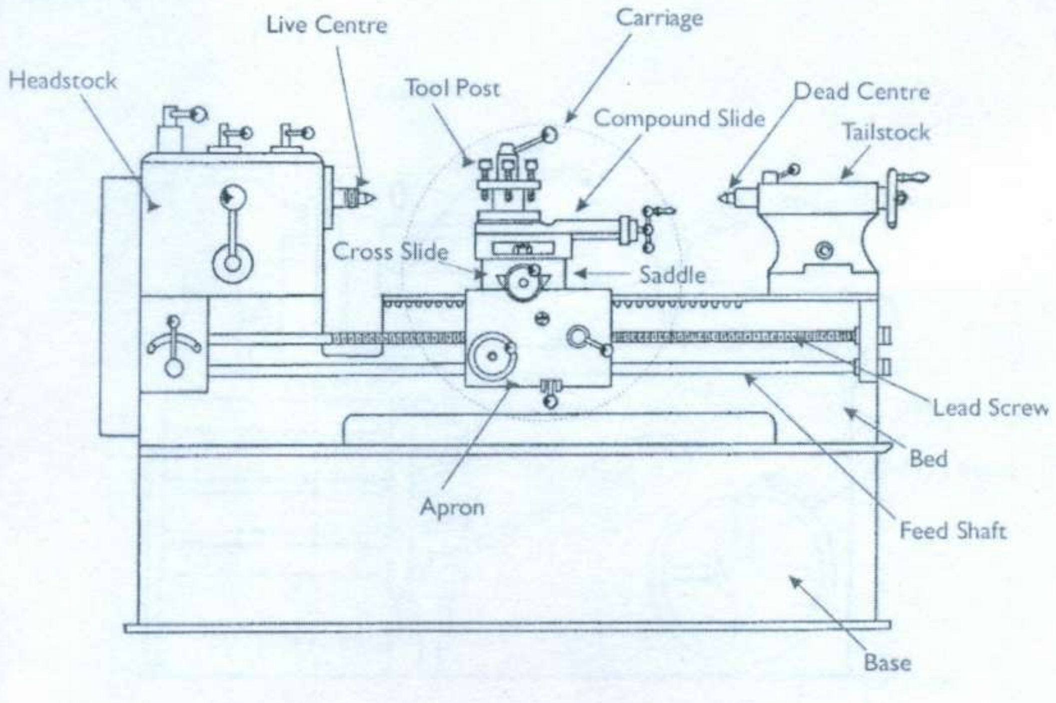
C- Height of the centre above beds.

D- Maximum swing over carriage

E- Maximum swing over bed.

Following operations can be performed on a lathe-

1. Facing
2. Turning
3. Drilling
4. Reaming
5. Knurling
6. Threading
7. Grinding, Milling, Tapping (These operations are performed with the special attachments)



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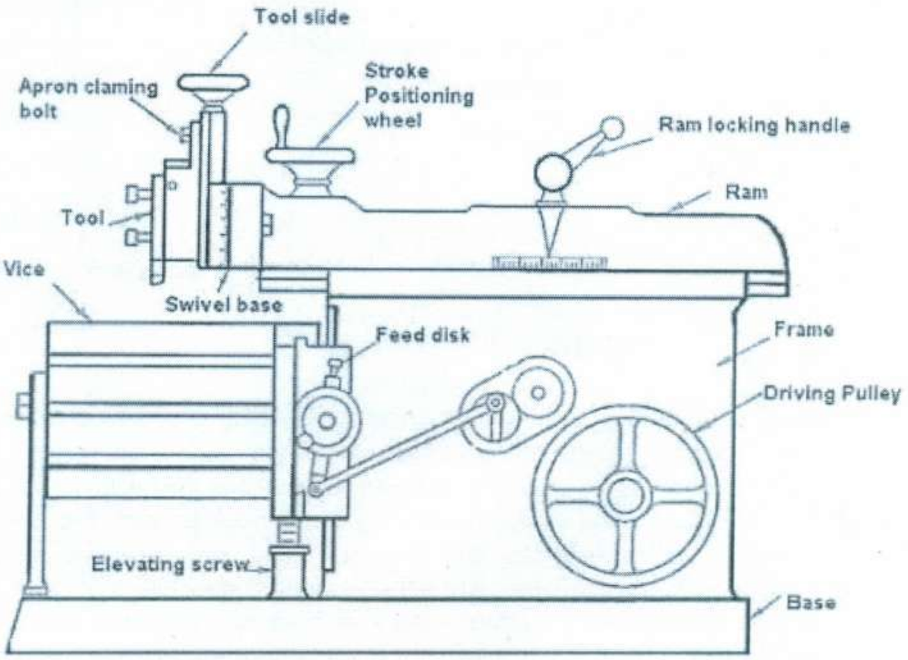
02 Shaper Machine

The shaper machine is a reciprocating type of machine basically used for producing the horizontal, vertical or flat surfaces. The shaper holds the single point cutting tool in ram and work piece is fixed in the table. During the return stroke, no metal is cutting. Shaper Machine is a production machine in which the single point cutting tools are attached and the work piece is fixed and while moving forward the tool cuts the work piece and in return, there is no cut on the work piece and used for producing flat and angular surfaces.

Shaper Machine Parts:

Shaper Machine consists of following parts:

A. Base
B. Column
C. Table
D. Cross rail
E. Ram
F. Clapper Box



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A. Base:

The base is the most important part of the shaper because it holds all the loads of the machine. It is made up of cast iron. It absorbs vibration and other forces that occur while performing shaping operations.

B. Column:

The column is mounted on the base. It is also made up of cast iron. Column supports the ram that is moving forward and backward for operation. It also acts for covering the drive mechanism.

C. Table:

It is mounted on the saddle. It is also one of the important parts of the machine. The table can be moved crosswise by rotating the cross-feed rod and also for vertical by rotating the elevating screw. It is a box-like casting with an accurately machined side and top surfaces. These surfaces having T-Slots for clamping the work. In heavier type shaper machines, the table clamped with table support to make it more rigid.

D. Cross rail:

It is also mounted on the column on which the saddle is mounted. The vertical movement and Horizontal movement is given to the table by raising or lowering the cross rail using the elevating screw and by moving the saddle using the cross feed screw.

Shaper Machine Operation:

Generally, there are Four types of Operation performed on Shaper that are:

- Vertical Cutting Operation
- Horizontal Cutting Operation
- Inclined Cutting and
- Angular or Irregular Cutting Operation

03 Drilling Machine

Working Principle of Drilling Machine: When the power is given to the motor, the spindle rotates and thereby the stepped pulley attached to it also rotates. On the other end, one more stepped pulley is attached and that is inverted to increase or decrease the speed of the rotational motion. It is a machine which is used to drill the holes on the components or work piece with the help of drill bits. The drill bits are also called as Multi-point cutting tools which can have their rapid impact on the Material Removal Rate (MRR) i.e. a single-point cutting tool (like the one used in a lathe machine) can remove the material slowly whereas, a multi-point cutting tool removes the material at a faster rate and thereby increases MRR.

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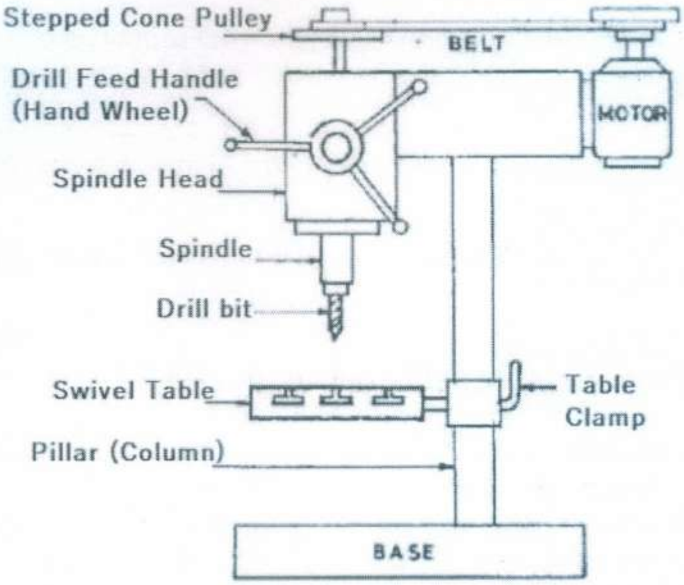

Parts of Drilling Machine:

The parts of Drilling Machine are as follows.

- Base
- Vertical Column
- Swivel Table
- Power Transmission system (Stepped Cone Pulley)
- Drill Feed Handle (Hand Wheel)
- Chuck
- Table Clamp
- Drill bit
- Spindle

➢ **Base:** The base is made up of Cast Iron which has the capability of high compressive strength, good wear resistance, and good absorbing capability (i.e. absorb the vibrations induced during working condition) and for these reasons, it acts as a base to the drilling machine.

➢ **Vertical Column:** It is exactly placed at the center of the base which can act as a support for rotating the Swivel table and holding the power transmission system.

➢ **Swivel Table:** It is attached to the column which can hold the machine vice in the grips and thereby, the work piece is fixed in the machine vice to carry out the drilling operation.

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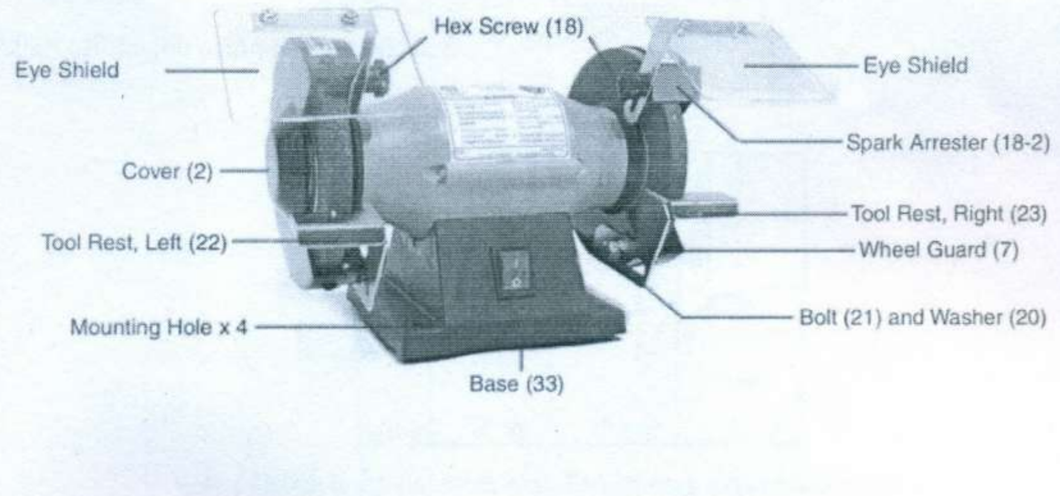
- **Chuck:** It is used to hold the work piece. Generally, 3 jaw chuck is used for holding circular components and 4 jaw chuck is used for holding rectangular components.

- **Table Clamp:** It is used to lock the swivel table at the desired location.

- **Spindle:** It is used to hold the drill bit along with jaws.

04 Grinding Machine

A grinding machine is an industrial power tool that is used to perform the grinding operation. Grinding is the process of removing excess material from a work piece by the application of the abrasion technique. Generally grinding is a finishing operation that is carried out after other machining operations. In the grinding process, abrasion takes place between abrasive material and work piece by relative motion. The grinding machine works on the principle of the grinding process. This is a machining process in which finishing work is carried out on the work piece. In this process, a solid object composed of abrasive particles is given a relative motion with the work piece. Due to this relative motion when these abrasive particles come in contact with the work piece abrasion takes place and excess material is removed from the work piece.



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EXPERIMENT NO. 02

Experiment: To perform the following operations on Centre Lathe: Turning, Step turning, Taper turning, Facing, Grooving and Knurling.

OBJECTIVE: preparation of a job for Turning, Step turning, Taper turning, Facing, Grooving and Knurling

TOOLS USED: Metal scale, surface gauge, outside callipers, turning tool, knurling tool and grooving tool.

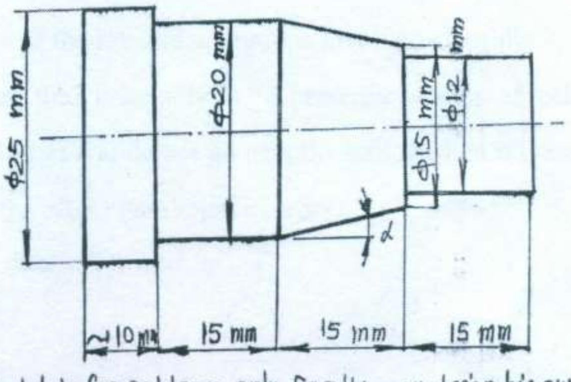
MATERIAL: M.S. Rod Diameter 25 mm, length 150 mm

MACHINE TOOL USED: Centre lathe

PROCEDURE:

1. See that the cutting tool is properly sharpened.
2. Open the jaws of the chuck and firmly tightened the work-piece such that it projects out by about by 70 mm.
3. Face the piece
4. Turn the piece till a diameter of 20 mm is turned to a length of 45 mm
5. Turn diameter 12 mm from the end to a length 15 mm.
6. Set the tool post at angle and start turning till a diameter 15 mm at the smaller end is achieved.

7 Part off the job using parting off tool.



Note : Sketch is for guidance only. Faculty may design his own job.

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8. For knurling, adjust the knurling tool properly on the job and give the depth of cut to the tool by cross slide and give the longitudinal motional motion to the tool. Knurling should be completed in a single pass.

9. For proper turning, first calculate the taper angle by the formula –

$$\tan = \frac{D - d}{2l}$$

Where D = Max. dia.
d = Minimum dia.
l = Length between max. and min dia

θ = taper angle

$$\tan = \frac{20 - 17}{2 \text{ X } 30} = 0.05$$

$\theta = \tan^{-1}2.86$

Set the taper angle on the compound rest and then turn the taper by compound slide. Check the dimensions as per drawing.

6. PRECAUTIONS:

i. Before starting a machine understand its functions and controls properly.

ii. Understand the figure of the job and operations involved carefully.

iii. Set the speed and start the3 lathe only in the presence of shop of technician.

iv. Do not wear loose clothes and do not go near the motor when it is running.

v. Switch off the machine after completion of work.

iii. Differentiate between dead and live centre.

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EXPERIMENT NO. 03

Experiment: To prepare a Mould for a given casting.

Raw material required: Moulding sand, parting sand, facing sand, single piece solid pattern, bottom board, moulding boxes etc.

Tools Required: Molding board, Drag and cope boxes, Molding sand, Rammer, Strike-off bar, Bellows, Riser and sprue pins, Gate cutter, Vent rod, Wire Brush etc.

THEORY

FOUNDRY INTRODUCTION

Metal casting is the process of forming metallic objects by melting metals then pouring it into the shaped cavity of a mould and allowing it to solidity. The process of casting involves the basic operation of pattern making, sand preparation, moulding, melting of metal, pouring in moulds, cooling, shake-out, felting, heat treatment, finishing and inspection. The casting process involving the use of sand as moulding medium can be classified as sand moulding process.

PATTERN

A pattern is a model or the replica of the object (to be casted). It is embedded in molding sand and suitable ramming of molding sand around the pattern is made. The pattern is then withdrawn for generating cavity (known as mold) in molding sand.

COMMON PATTERN MATERIALS:

The common materials used for making patterns are wood, metal, plastic, plaster, wax or Mercury.

TYPES OF PATTERNS

The types of the pattern and the description of each are given as under.

1. One piece or solid pattern 2. Two piece or split pattern 3. Cope and drag pattern 4. Three-piece or multi- piece pattern 5. Loose piece pattern 6. Match plate pattern 7. Follow board pattern 8. Gated pattern 9. Sweep pattern 10. Skeleton pattern 11. Segmental or part pattern.

1. Single-piece or solid pattern: Solid pattern is made of single piece without joints, partings lines or loose pieces. It is the simplest form of the pattern. Typical single piece pattern is shown in Fig. 1.

2. Two-piece or split pattern: When solid pattern is difficult for withdrawal from the mold cavity, then solid pattern is split in two parts. Split pattern is made in two

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pieces which are joined at the parting line by means of dowel pins. The splitting at the parting line is done to facilitate the withdrawal of the pattern. A typical example is shown in Fig.2

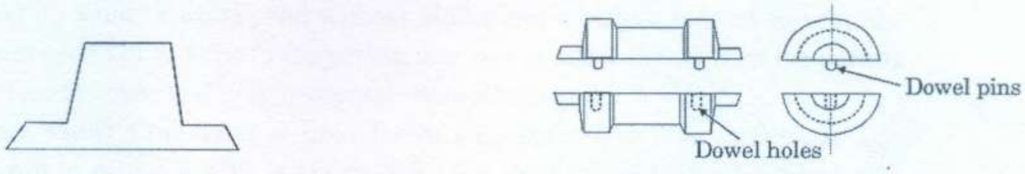

Figure 1 & 2

BINDER

In foundry shop, the clay acts as binder which may be Kaolonite, Ball Clay, Fire Clay, Limonite, Fuller's earth and Bentonite. Among all the above binders, the bentonite variety of clay is the most common. However, this clay alone cannot develop bonds among sand grins without the presence of moisture in molding sand and core sand.

ADDITIVE

Additives are the materials generally added to the molding and core sand mixture to develop some special property in the sand. Some commonly used additives for enhancing the properties of molding and core sands are discussed as Coal dust, Corn flour, Dextrin, Sea coal, Wood flour, Silica flour.

KINDS OF MOULDING SAND

Molding sands can also be classified according to their use into number of varieties which are described below.

- **Green sand:** Green sand is also known as tempered or natural sand which is a just prepared mixture of silica sand with 18 to 30 percent clay, having moisture content from 6 to 8%. The clay and water furnish the bond for green sand. It is fine, soft, light, and porous.
- **Dry sand:** Green sand that has been dried or baked in suitable oven after the making mold and cores, is called dry sand. It possesses more strength, rigidity and thermal stability.
- **Loam sand:** Loam is mixture of sand and clay with water to a thin plastic paste. Loam sand possesses high clay as much as 30-50% and 18% water.
- **Facing sand:** Facing sand is just prepared and forms the face of the mould. It is directly next to the surface of the pattern and it comes into contact molten

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metal when the mould is poured. Initial coating around the pattern and hence for mold surface is given by this sand. This sand is subjected severest conditions and must possess, therefore, high strength refractoriness.

- **Backing sand:** Backing sand or floor sand is used to back up the facing sand and is used to fill the whole volume of the molding flask.
- **Parting sand:** Parting sand without binder and moisture is used to keep the green sand not to stick to the pattern and also to allow the sand on the parting surface the cope and drag to separate without clinging
- **Core sand:** Core sand is used for making cores and it is sometimes also known as oil sand. This is highly rich silica sand mixed with oil binders such as core oil which composed of linseed oil, resin, light mineral oil and other bind materials.

PROPERTIES OF MOULDING SAND

The basic properties required in molding sand and core sand are described as under.

- **Refractoriness:** Refractoriness is defined as the ability of molding sand to withstand high temperatures without breaking down or fusing thus facilitating to get sound casting. It is a highly important characteristic of molding sands. Refractoriness can only be increased to a limited extent
- **Permeability:** It is also termed as porosity of the molding sand in order to allow the escape of any air, gases or moisture present or generated in the mould when the molten metal is poured into it. All these gaseous generated during pouring and solidification process must escape otherwise the casting becomes defective
- **Cohesiveness:** It is property of molding sand by virtue which the sand grain particles interact and attract each other within the molding sand.
- **Green strength:** The green sand after water has been mixed into it must have sufficient strength and toughness to permit the making and handling of the mould. For this, the sand grains must be adhesive, i.e. thev must be capable of attaching themselves to another body
- **Dry strength:** As soon as the molten metal is poured into the mould, the moisture in the sand layer adjacent to the hot metal gets evaporated and this dry sand layer must have sufficient strength to its shape in order to avoid erosion of mould wall during the flow of molten metal
- **Flowability or plasticity:** It is the ability of the sand to get compacted and behave like a fluid. It will flow uniformly to all portions of pattern when rammed and distribute the ramming pressure evenly all around in all directions
- **Adhesiveness:** It is property of molding sand to get stick or adhere with foreign material such sticking of molding sand with inner wall of molding

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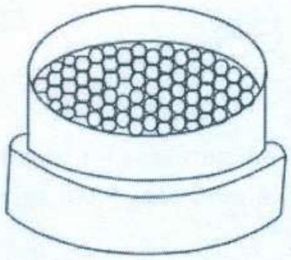
box

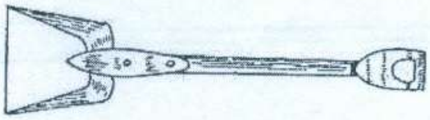
- **Collapsibility:** After the molten metal in the mould gets solidified, the sand mould must be collapsible so that free contraction of the metal occurs and this would naturally avoid the tearing or cracking of the contracting metal.

HAND TOOLS USED IN FOUNDRY SHOP

- **Hand riddle:** It consists of a screen of standard circular wire mesh equipped with circular wooden frame. It is generally used for cleaning the sand for removing foreign material such as nails, shot metal, splinters of wood etc. from it. Even power operated riddles are available for riddling large volume of sand.

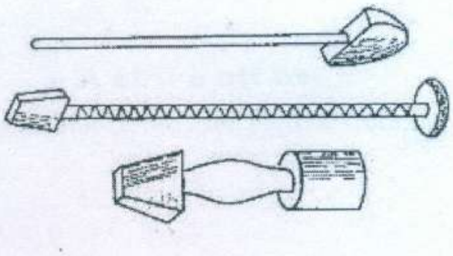


- **Shovel:** It consists of a steel pan fitted with a long wooden handle. It is used in mixing, tempering and conditioning the foundry sand by hand. It is also used for moving and transforming the molding sand to the container and molding box or flask.



Showel

- **Rammers:** Rammers are shown in Fig. These are required for striking the molding sand mass in the molding box to pack or compact it uniformly all around the pattern.



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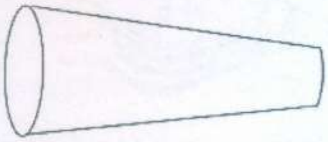
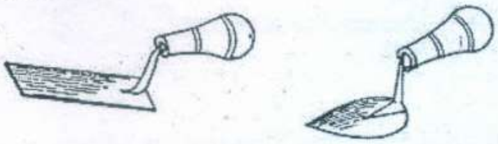
- **Sprue pin:** It is a tapered rod of wood or iron which is placed or pushed in cope to join mold cavity while the molding sand in the cope is being rammed



- **Trowels:** These are used for finishing flat surfaces and comers inside a mould. Common shapes of trowels are shown as under. They are made of iron with a wooden handle.



Trowels

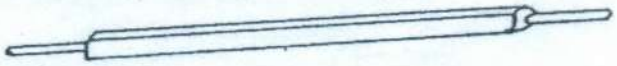
- **Lifter:** A lifter is a finishing tool used for repairing the mould and finishing the mould sand. Lifter is also used for removing loose sand from mould.

LIFTER

- **Vent wire:** It is a thin steel rod or wire used to make small holes, called vents, in the sand mould to allow the exit of gases and steam during casting.

Vent wire

- **Strike of bar:** It is a flat bar, made of wood or iron to strike off the excess sand from the top of a box after ramming. Its one edge made beveled and the surface perfectly smooth and plane.



A strike off bar

- **Bellow:** A bellow is used to blow loose sand particle from the pattern and mould cavity

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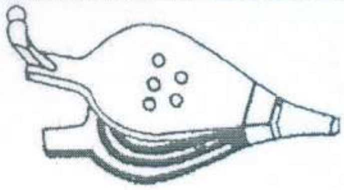
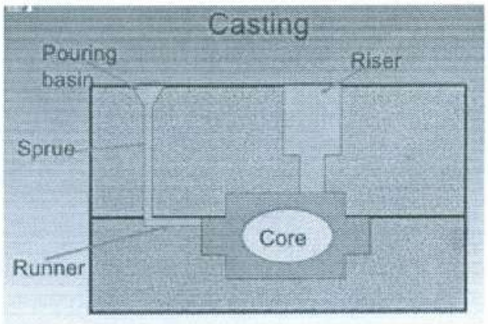


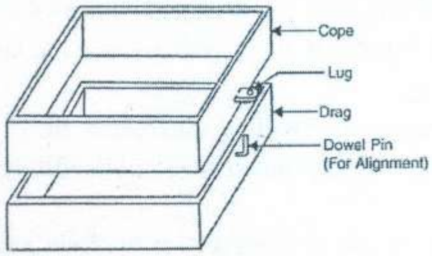
- **Gate cutter:** Gate cutter is a small shaped piece of sheet metal commonly used to cut runners and feeding gates for connecting sprue hole with the mold cavity.

- **Runner and riser:** **I**n a casting both runner and riser is used to pass the molten metal into the mould cavity. The main difference is that runner is a horizontal pathway into the mould cavity whereas riser is a vertical pathway. Runners are connected channels that convey the molten metal to different parts of the mould. The primary function of riser as attached with the mould is to feed molten metal to accommodate shrinkage occurring during solidification of the casting.



MOULDING BOX:

Moulding box is also called moulding flask. It is frame or box of wood or metal. It is made of two parts cope and drag as shown in figure.



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SEQUENCE OF OPERATIONS:

1. Sand preparation
2. Placing the mould flask(drag) on the moulding board/ moulding platform
3. Placing the pattern at the centre of the moulding flask
4. Ramming the drag
5. Placing runner and riser
6. Ramming the cope
7. Removal of the pattern, runner, riser
8. Gate cutting

Procedure: Mould Making

1. First a bottom board is placed either on the molding platform or on the floor, making the surface even.
2. The drag molding flask is kept upside down on the bottom board along with the drag part of the pattern at the centre of the flask on the board.
3. Dry facing sand is sprinkled over the board and pattern to provide a non-sticky layer.
4. Freshly prepared molding sand of requisite quality is now poured into the drag and on the pattern to a thickness of 30 to 50 mm.
5. Rest of the drag flask is completely filled with the backup sand and uniformly rammed to compact the sand.
6. After the ramming is over, the excess sand in the flask is completely scraped using a flat bar to the level of the flask edges.
7. Now with a vent wire which is a wire of 1 to 2 mm diameter with a pointed end, vent holes are in the drag to the full depth of the

   flask as well as to the pattern to facilitate the removal of gases during casting solidification. This completes the preparation of the drag.
8. Now finished drag flask is rolled over to the bottom board exposing the pattern.
9. Using a slick, the edges of sand around the pattern is repaired

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10. The cope flask on the top of the drag is located aligning again with the help of the pins of the drag box.
11. Sprue of the gating system for making the sprue passage is located at a small distance of about 50 mm from the pattern. The sprue base, runners and in-gates are also located as shown risers are also placed. Freshly prepared facing sand is poured around the pattern.
12. The moulding sand is then poured in the cope box. The sand is adequately rammed, excess sand is scraped and vent holes are made all over in the cope as in the drag.
13. The sprue and the riser are carefully withdrawn from the flask
14. Later the pouring basin is cut near the top of the sprue.
15. The cope is separated from the drag any loose sand on the cope and drag interface is blown off with the help of the bellows.
16. Now the cope and the drag pattern halves are withdrawn by using the draw spikes and rapping the pattern all around to slightly enlarge the mould cavity so that the walls are not spoiled by the withdrawing pattern.
17. The runners and gates are to be removed or to be cut in the mould carefully without spoiling the mould.
18. Any excess or loose sand is applied in the runners and mould cavity is blown away using the bellows.
19. Now the facing paste is applied all over the mould cavity and the runners which would give the finished casting a good surface finish.
20. A dry sand core is prepared using a core box. After suitable baking, it is placed in the mould cavity.
21. The cope is placed back on the drag taking care of the alignment of the two by means of the pins.
22. The mould is ready for pouring molten metal. The liquid metal is allowed to cool and become solid which is the casting desired.

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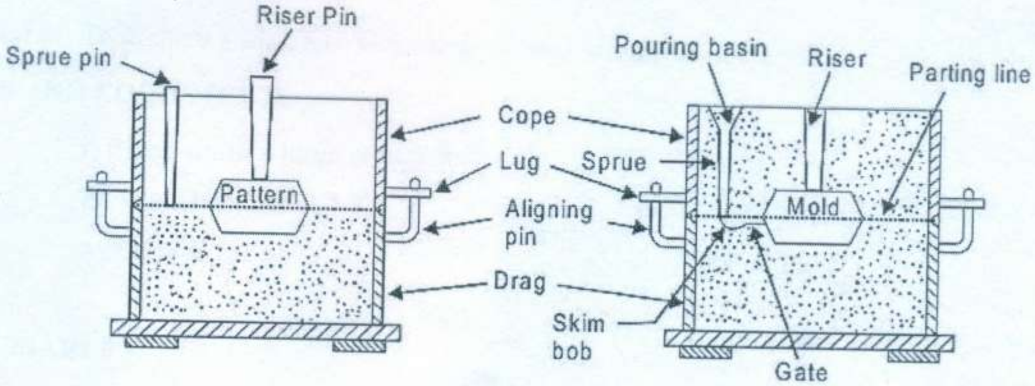

Result: The required mould is prepared for a given casting.

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EXPERIMENT NO. 04

Experiment: To prepare a square U-shape from given circular rod.

TOOLS AND EQUIPMENT:

i. Black-smith's forge or hearth
ii. Anvil
iii. Hand hammer -1.5 Kg
iv. Tongs
v. Outside caliper
vii. Metal scale

CONSUMABLES:

i. Mild steel rod of diameter 10 mm, length 50 cm

ii. Hard coke, soft coke, wood scrap and kerosene for operating furnace

THEORY:

1. BLACKSMITY/FORGING

Forging or Black smithy in general refers to the process for the heating of metal in order to manipulate it into desired forms and shapes based on particular concepts or designs. As such, hand forging is still the process of forging metal, only this time the process is manually guided by a forger with the aid of specially designed equipment that are specifically made for such a purpose. Even though hand forging is labour intensive, the process is still favored over machine produced metals in certain instances due to the perception that it offers some advantages over the other type. The process for hand forging is different from that of machines, and the tools utilized are also different from those used in the mechanized process.

1.1. Hand Forging

The process of hand forging is an ancient one that has been utilized for many centuries by professionals who are generally referred to as blacksmiths. Basically, they shape the metal by heating and applying blows of varying pressure to the metal in order to manipulate it into a desired contour that is keeping with the design the blacksmith is trying to achieve. Apart from the fact that this method of forging metal requires a lot of labor and strength, it also has some benefits over the metals that are forged in other ways. One of the benefits of hand forging is the fact the metal produced through this method is usually stronger than metal produced by other techniques, such as casting or welding The main reason is that the repeated blows from the blacksmith and the careful monitoring of the process results in a less porous material tha is better refined than most tactics.

1.2. Machine Forging

A forging machine is also called a press or punch press; the machine presses down on a metal blank and creates a specific shape. Operated in one of three common temperatures - cold, warm and hot-, the designation is keyed to the temperature of the metal being shaped. Using

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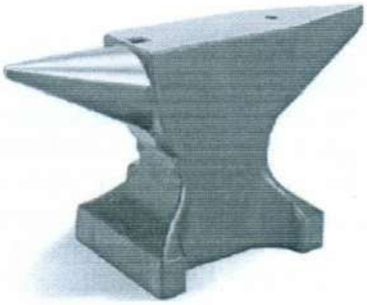
enough pressure to stamp a basic shape from a solid piece of metal in a single strike, the forging machine often operates from a flywheel mechanism that powers a stamping die downward and into the second component piece of the total die, continually pressing due to the inertia of the spinning flywheel. It is a common design trait for a forging machine.

Forging Tools:

- **Anvil:** An anvil is a basic tool, a block with a hard surface on which another object is struck. The block is as massive as is practical, because the higher the inertia of the anvil, the more efficiently it causes the energy of the striking tool to be transferred to the work piece.



- **Sledge Hammer:** A sledgehammer is a tool with a large, flat, often metal head, attached to a lever (or handle). The size of its head allows a sledgehammer to apply more force than other hammers of similar size. Along with the mallet, it shares the ability to distribute force over a wide area. This is in contrast to other types of hammers, which concentrate force in a relatively small area.

- **Tongs:**

Tongs are a tool used to grip and lift objects, of which there are many forms adapted to their specific use. Some are merely large pincers or nippers, but most fall into three classes:

1. Tongs which have long arms terminating in small flat circular ends of tongs and are pivoted close to the handle, as in the common fire-tongs, used for picking up pieces of coal and placing them on a fire.

2. Tongs consisting of a single band of metal bent round one or two bands joined at the head by a spring, as in sugar tongs (a pair of usually silver tongs with claw-shaped or spoon-shaped ends for serving lump sugar), asparagus-tongs and the like.

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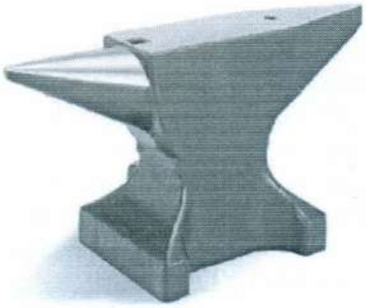

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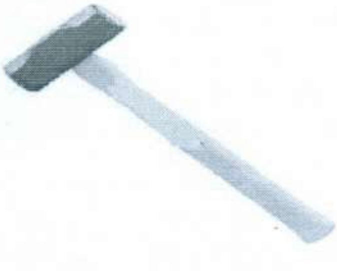

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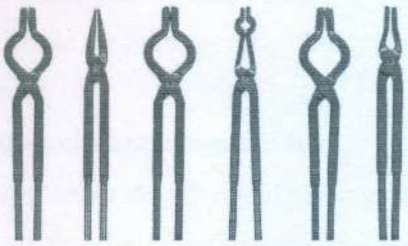
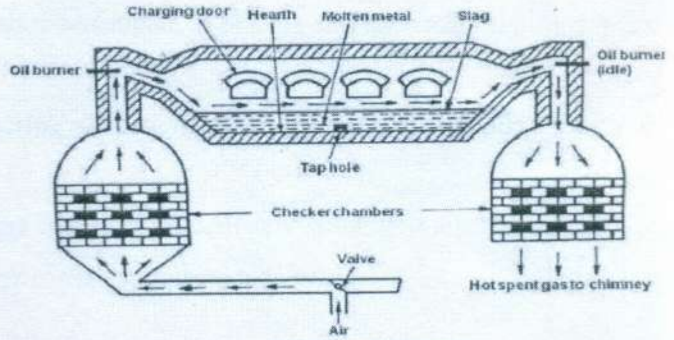
3. Tongs in which the pivot or joint is placed close to the gripping ends, such as a driller's round tongs, blacksmith's tongs or crucible-tongs.



➢ **Open Hearth Furnace:**

Open hearth furnaces are one of a number of kinds of furnace where excess carbon and other impurities are burnt out of pig iron to produce steel. Since steel is difficult to manufacture due to its high meting point, normal fuels and furnaces were insufficient the open hearth and furnace was developed to overcome this difficulty Compared to Bessemer steel which a displaced, its main advantages were that did not expose the steel to excessive nitrogen (which would cause the steel to become brittle) was easier to control, and it permitted the melting and refining of large amounts of scrap iron and steel.

The open-hearth process is a batch process and a batch is called a "heat. The furnace is first inspected for possible damage. Once it is ready or reopened, it is charged with light scrap, such as sheet metal shredded vehicles or waste metal the furnace is heated using burning gas once it has melted, heavy scrap such as building, construction of steel milling scrap is added, together with pig iron from blast furnaces. Once all the steel has melted slag forming agents such as limestone, are added the oxygen in iron oxide and other impurities decarburize the pig iron by burning excess carbon away forming steel to increase the oxygen contents of the heat, iron ore can be added to the heat. The process is far slower than that of Bessemer converter and thus easier to control and sample for quality assessment. Preparing a heat usually takes 8 h to 8 h 30 min to complete into steel. As the process is slow it is not necessary to burn all the carbon away as in Bessemer process, but the process can be terminated at given point when desired carbon contents be achieved.



Open Hearth Furnace

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PROCEDURE:

i. Get the hearth to be started, take the help of shop technician.

ii. Place the work piece inside the burning coke till it attains the plastic state ie. It is heated to white heat.

iii. Hold the job with tongs and place it over the anvil.

iv. With the help of hammer make the job round placing on the nose of the anvil.

v. Place the calipers and get the idea of dimensions over the red-hot work piece Hammer the red-hot work piece till the given dimensions as shown in fig. 2.

vi. Hammering it to be done by another student while it is held on the anvil.

vii. Heating to red hot condition may be done again, if the job cools down.

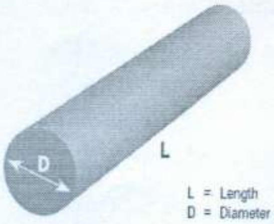

Fig. 1 Circular rod

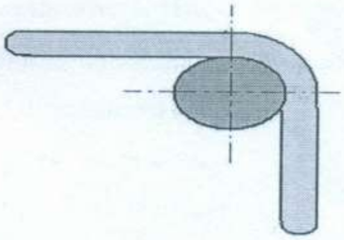

Fig. 2 U-shaped rod

PRECAUTIONS:

i. All the inflammable material should be stored away from the hearth.

ii. Take help of shop technician in placing and taking out the work piece from the hearth.

iii. While hammering with sledge hammer see that nobody is there in the area of working.

iv. Lift the sledge hammer immediately after it jump; it will prevent the sledge hammer from swaying away from side-ways.

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EXPERIMENT NO. 05

Experiment: To prepare half-lap corner joint.

OBJECTIVE

Preparation of a half lap corner joint.

TOOLS AND EQUIPMENT

i. Metal scale ii. Iron jack plane iii. Panel saw or cross cut saw
iv. Firmers Chisel v. Pencil vi. Hammer 400 gm
vii. Tri-square viii Carpentry vice fitted over working table

CONSUMABLES

Shisham wood 150 X 60 X 30mm - 2 pieces

PROCEDURE (Ref. Fig 1&2)

i. Fix a wooden piece in the carpenter vice thickness-wise.
ii. Plane all the four surfaces with the help of iron jack plane. Check the plane surface with the help of tri-square for its dimensional accuracy.
iii. Mark both the pieces according to the given dimensions
iv. Cut the unwanted portion of the wood from both the pieces.
v. Join the two end to make the joint.

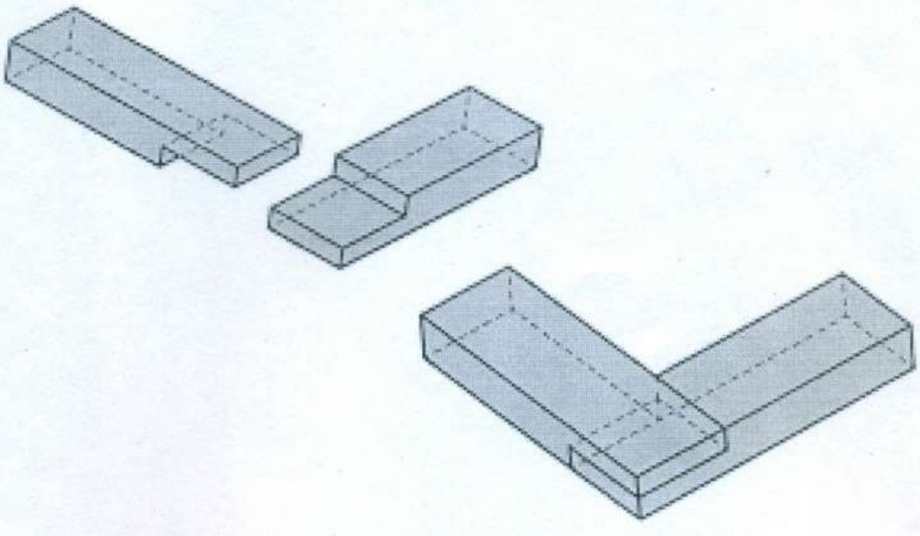

Fig. (1& 2)

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PRECAUTIONS

i. Always use sharpened tools, therefore, get it sharpened before starting the work.

ii. Hold the job firmly in the vice.

iii. Hammer the chisel away from yourself.

iv. Sawing should be done with light and even strokes.

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EXPERIMENT NO. 06

Experiment: To prepare mortise & tenon joint.

OBJECTIVE

preparation of a mortise and tenon joint

TOOLS AND EQUIPMENT

A. Holding and supporting equipment-

i. Working table
ii. Carpentry vice

B. TOOLS AND EQUIPMENT

i. Metal scale
ii. Iron jack plane
iii. Panel saw or cross cut saw
iv. Firmers Chisel
v. Mortise chisel
vi. Hammer 400 gm
vii. Mortise gauge
viii. Tri-square
ix. Carpentry vice fitted over working table

C. CONSUMABLES

Shisham wood 300 X 60 X 30mm

3. PROCEDURE

i. Cut-off the given piece of wood the saw.
ii. Fix a wooden piece in the carpenter vice thickness-wise.
iii. Plane the surface with the help of iron jack plane. Check the plane surface with the help of tri-square.
iv. Reverse the wooden piece and plane it maintaining width 50 mm (as given, refer fig -1) and check its planliness.
v. prepare the other side also with the side procedure maintaining dimension 20 mm and planliness of the surface simultaneously checking the perpendicularity of all the adjacent surface with the tri-square.
vi. Prepare the other piece also following the same procedures.

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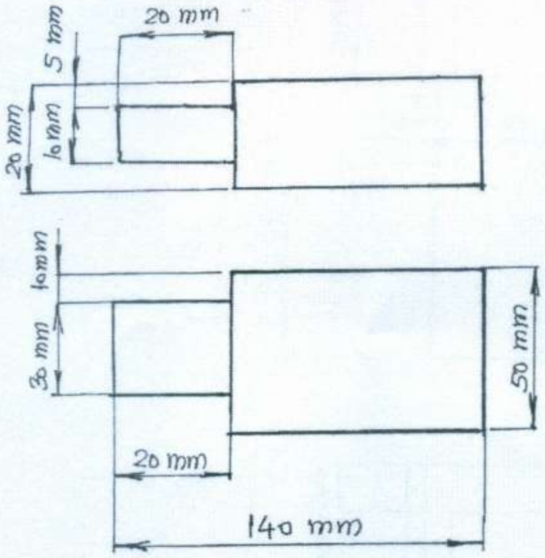
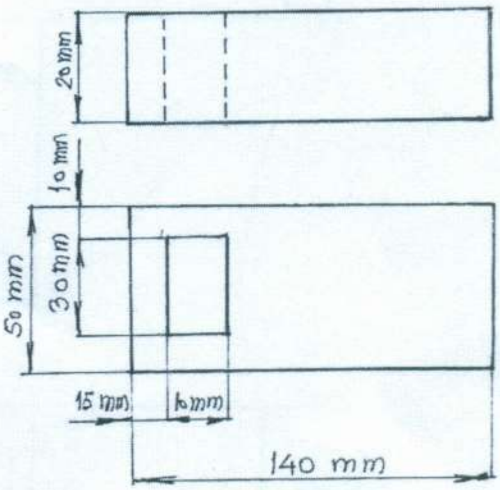
vii. Tenon in one piece is to be prepared according to the following procedures-

a. Mark on one-piece dimensions for making tenon using mortise gauge as given in the fig -1

b. Scoop out the portion using firmers chisel and hammer and make tenon.





Note : Sketch is for guidance only. Faculty may design his own joint.

Fig. 1 **Fig. 2**

viii. Mortise in other wooden piece is prepared according to the following procedures-

a. Mark on the piece the dimensions of mortise using mortise gauge as given in the fig -2 by suitably adjusting the marking pins of the gauge.

b. Prepare the mortise (ie. Cavity) by using mortise chisel and hammer.

ix. While preparing the mortise and tenon care is to taken that all the surface are perpendicular to each other. This is frequently checked with the tri-square.

x. Finally fit the mortise and tenon as shown in the fig. 3

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EXPERIMENT NO. 07

Objective: To prepare a butt and Lap welded joints using arc welding machine.

Tools and Equipments:- (i) Welding Transformer 350 amp (ii) Leads (iii) Earthing (iv) Electrode Holder (v) Wire Brush (vi) Tongs

Safety Equipment

(i) Shield (ii) Gloves (iii) Apron

Consumables

(i) M.S.Plate 100x30x3 – 2 Nos. (ii) Electrode

THEORY

Arc welding is a fusion welding and non-pressure process where heat required for melting base metal and electrode (core wire and coating material) at4400oC is obtained by the flow of high ampere current through arc which provides necessary resistance.

The heat is produced as per the formula-H = I^2Rt (Refer Fig. given below)

Where H – Heat I – Current R – Electrical resistance offered by the arc.

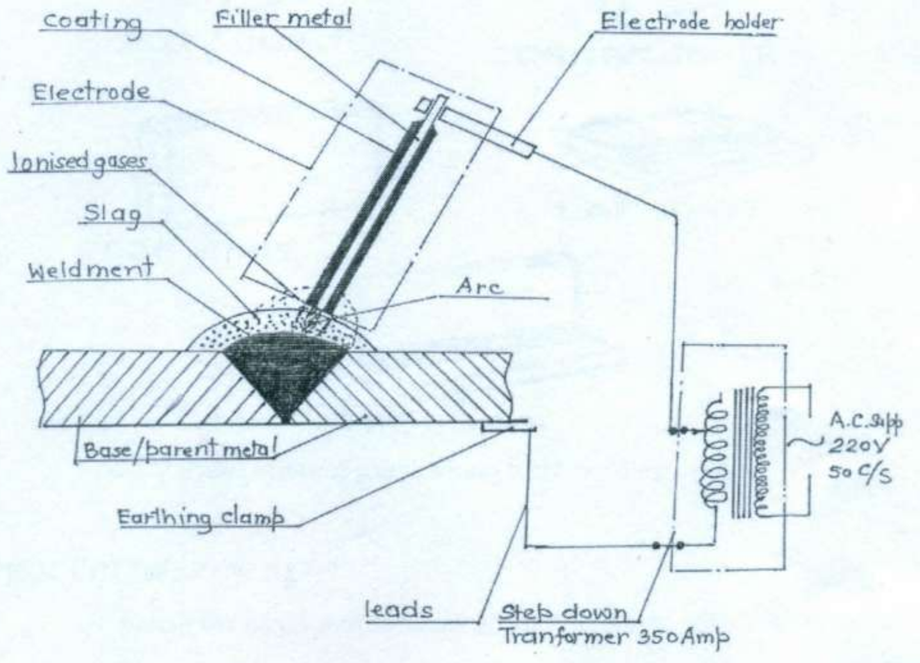

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Fig.1. Arc Welding Machine

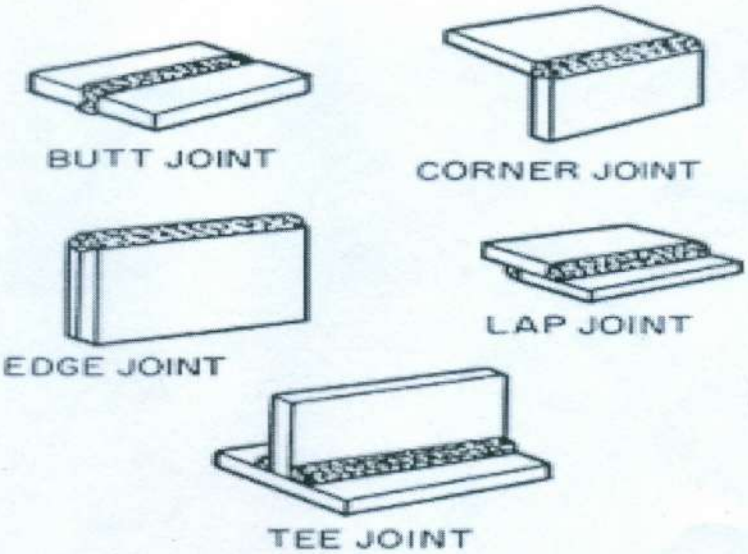

Fig. 2 Various types of joints through arc welding

PROCEDURE: Refer fig – 1

i. Finish the edges and surfaces of the two pieces where the welding is to be done.

ii. Place the two pieces in proper position for lap welding on the welding stand

iii. Tack the two pieces by electric arc welding at the two ends of the joint

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iv. Now strike the arc at the one end and move the electrode up to the second end making the complete weld.
v. Similarly, weld the other side of the plates.
vi. After completing the weld, remove the slag from the joint by chipping hammer.
vii. Clean the joint by wire brush

PRECAUTIONS:

i. Glare of the arc is not be seen with naked eyes.
ii. In case, if electrode sticks take it out immediately by frequent sideways bending of the electrodes.
iii. Never wear loose clothes in the shop.
iv. While welding, see that nobody is beholding the arc glare with naked eyes.

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EXPERIMENT NO. 08

OBJECTIVE: To prepare a Lap welded joint by gas welding equipment.

TOOLS & EQUIPMENT:

(i) Oxygen cylinder (ii) Acetylene cylinder

(iii) Oxygen pressure regulator (iv) Acetylene pressure regulator

(v) Hoses for oxygen & acetylene gas (vi) Cylinder Key

(vii) Blow Torch (viii) Igniter

(ix) Wire brush (x) Tongs

SAFETY EQUIPMENT:

(i) Gloves (ii) Goggles

CONSUMABLES:

(i) M.S plate, 100x30x2 mm-2 Nos. (ii) Spelter (iii) Borax

THEORY: Oxy–acetylene gas welding is a fusion welding and non-pressure welding process where heat required for melting base/parent metal and filler metal i.e. spelter is obtained from exothermic reaction of oxygen and acetylene. A temperature as high as 3100C -3400C is obtained according to following reactions. The exact nature of flame is obtained by adjusting their proportions.

Stage of combustion-

I- stage- $C_2H_2 + O_2 \longrightarrow CO + H_2 + 18.7\ MJ/m_3$ of C_2H_2

$CO + O_2$ (from cylinder) $\longrightarrow CO_2$ (This makes inner cone)

II-stage- $CO+H_2+O_2$ (Atmospheric air) $\longrightarrow CO_2+H_2O+35.7\ MJ/m^3$ of C_2H_2

(This makes envelope)

Depending on the quantities of oxygen and acetylene in the combustible products, three types of flames are produced. These are

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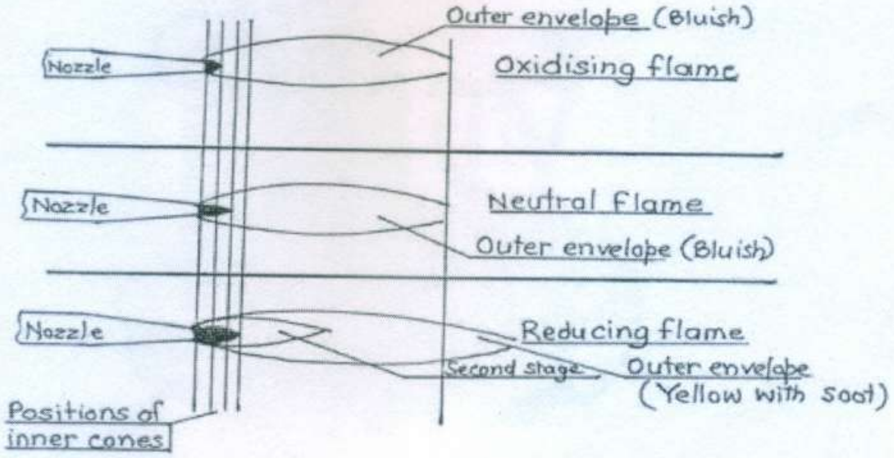

Fig. Type of Flame

Depending on the quantities of oxygen and acetylene in the combustible products, three types of flames are produced-

(A) Neutral Flame: When complete combustion is there, ie. No trace of unused / un-burnt oxygen or acetylene is there. This is the best flame and is recommended for ferrous metals. Ratio C2 H2: O2 = 1:1

(B) Oxidising Flame: When unused oxygen there in the flame is more oxygen than required for complete combustion of acetylene. This flame is recommended for nonferrous metals and for gas cutting of ferrous metals.

(C) Reducing /Carburising Flame: When combustion product contains more acetylene than required. This flame is recommended for welding lead only and case-hardening of MS. Borax is required for dissolving oxides from the surface of base metal.

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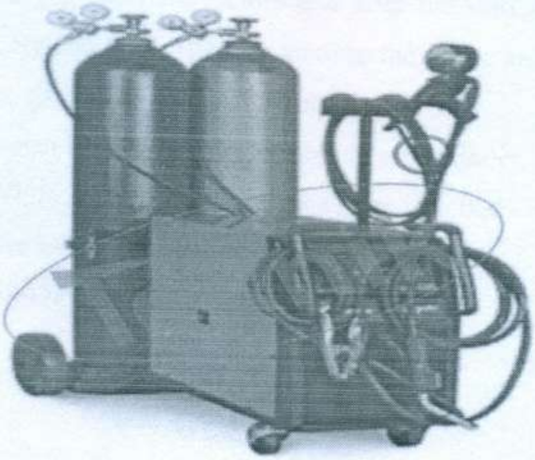

Fig. Gas welding Machine

PROCEDURE

(i) Open the cylinder valves with the help of cylinder key.

(ii) Tighten the handles of pressure regulators for opening the inlet gases.

(iii)Pressure is read from the meter of the regulators.

(iv)Open slightly the acetylene knobs (Maroon colour) on the nozzle let some mixture come out.

(v) Move the spelter and flame till welding is complete.

(vi)Following the same procedure weld on other side also.

(vii) For stopping the welding close the oxygen knobs first till flame extinguishes, next close the acetylene knobs.

(viii) Close the pressure regulators and gas cylinders.

(ix)Let the job cool down, clean with wire brush and hand over the job. To the concerned technician after marking the roll number on it.

PRECAUTIONS:

(i) Place oxygen and acetylene cylinder in upright position.

(ii) After opening the gas cylinder and pressure valves, check there is no leakage.

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(iii) Purging be done before and after the start of welding process by opening the acetylene knob first for starting the flame and for extinguishing the flame close the oxygen and oxygen knobs first.

(iv) Never impinge the flame on any gas cylinder.

(v) While igniting the flame, see there is nobody in front of torch.

(vi) Use safety equipment, especially goggles.

(vii) Never wear loose clothes.

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EXPERIMENT NO. 09

Aim: - To prepare a V- joint fitting from the given two M.S pieces.

- **Tools required: -**

1. Bench vice
2. Steel rule
3. Try square
4. Ball peen hammer
5. Scriber
6. Hack saw with blade
7. Dot punch and Centre punch
8. Surface plate
9. Vernier height gauge
10. Rough and smooth flat files
11. Flat chisel and triangular file

- **Material required:** - Mild steel (M.S) plate of size 48 x 34 – 2 Nos.

- **Sequence of Operations: -**

1. Filing
2. Checking flatness and square ness
3. Marking and measuring
4. Punching
5. Sawing
6. Chipping
7. Finishing

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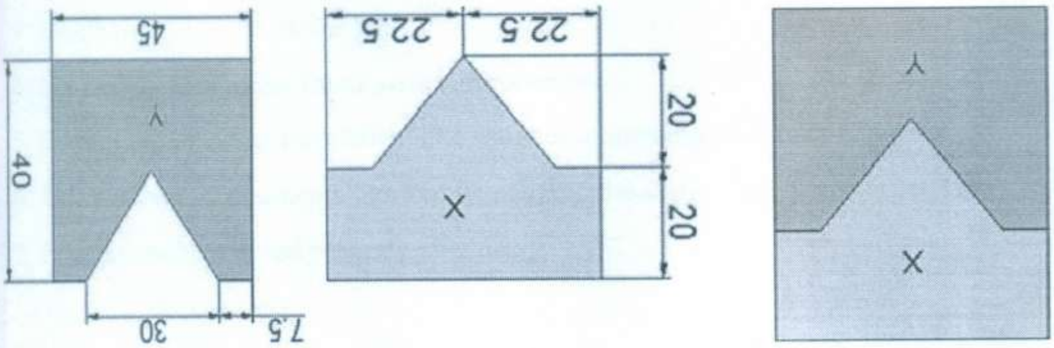

Procedure: -

1. The burrs in the pieces are removed and the dimensions are checked with a steel rule.

2. The pieces are clamped one after the other and the outer mating edges are filed by using rough and smooth files.

3. The flatness, straightness and square ness i.e. right angle between adjacent sides are checked with help of Try-square.

4. Chalk is then applied on the surfaces of the two pieces.

5. The given dimensions of the V-fitting are marked with help of vernier height gauge carefully.

6. Using the dot punch, dots are punched along the above scribed lines.

7. Using the hack saw, the unwanted portions are removed.

8. Using the flat chisel, the unwanted material in the piece Y is removed.

9. The cut edges are filed by the half round file.

10. The corners of the stepped surfaces are filed by using a square or triangular file to get the sharp corners.

11. The pieces (X and Y) are fitted together and the mating is checked for the correctness of the fit.

Safety precautions: -

1. Care is taken to see that the marking dots are not crossed, which is indicated by the half of the punch dots left on the pieces.

2. Apply pressure in forward direction during hack sawing.

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3. Don't rub steel rule on the job.
4. Fix blade in hack saw frame with correct tension.
5. During hack sawing the coolant like water or lubricating oil is to be used.
6. Use precision instruments like vernier calipers and vernier height gauge carefully.
7. Files are to be cleaned properly after using.

Result: - V- fit is made as per the required dimensions.

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EXPERIMENT NO. 10

Experiment: - To make a tray using the given G.I. Sheet.

Tools required: -

1. Steel rule
2. Scriber
3. Straight snip
4. Bench vice
5. Stake
6. Cross peen hammer
7. Wooden mallet
8. Cutting pier

Material required: - Galvanized Iron (G.I) sheet 110 x 125 mm size.

Sequence of operations: -

1. Cleaning
2. Surface leveling
3. Marking
4. Cutting
5. Folding

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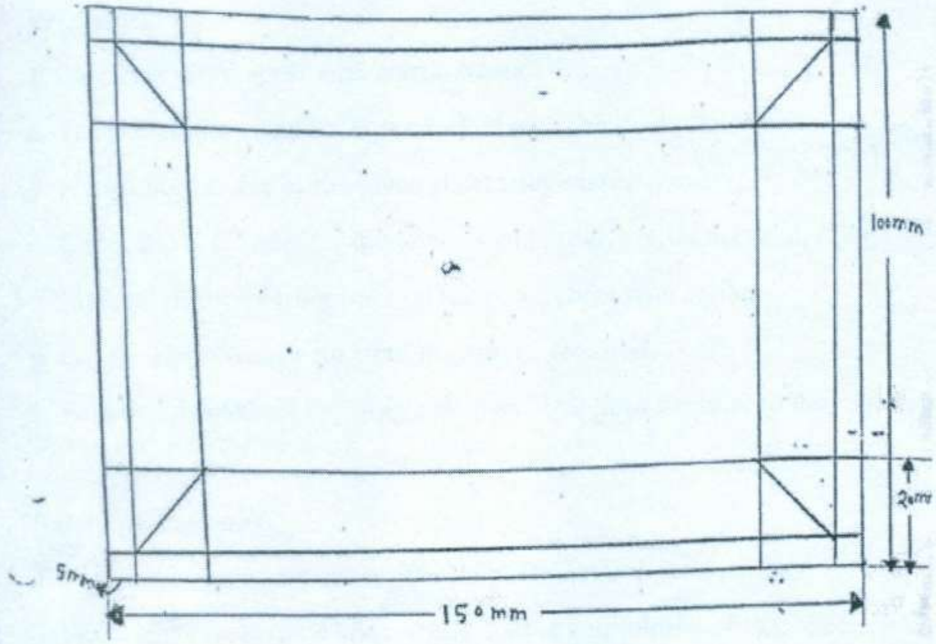
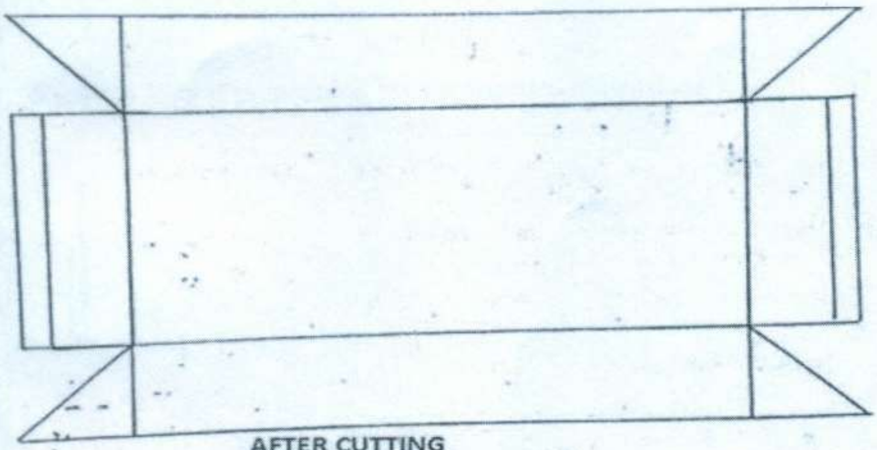
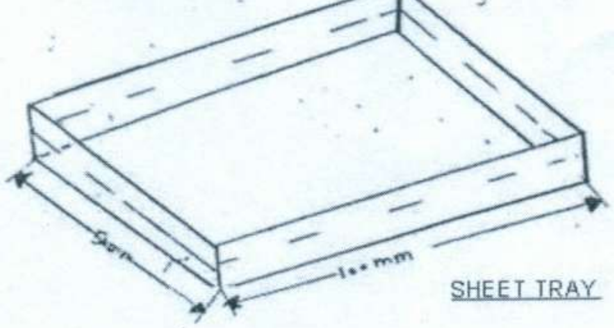




AFTER CUTTING



SHEET TRAY

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Procedure: -

1. Clean the given sheet with cotton waste.
2. The size of the given sheet is checked with the steel rule.
3. Flatten the surface of the given sheet with wooden mallet.
4. Check the G.I. Sheet for dimensions and remove extra material, if any.
5. Mark all the measuring lines on the given sheet with scriber.
6. Cut the given sheet with straight snips as required.
7. Fold the given sheet by using stakes and ball peen hammer to the required shape.

Safety precautions: -

1. For marking purpose use scriber only. Do not use pencil or pen.
2. Sufficient care is to be taken while cutting and folding of G.I. sheet.
3. Remove the waste pieces immediately from the work place.

Result: - Tray is prepared as per the required dimensions.

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