SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)
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Sathy Main Road, SNS Kalvi Nagar, Saravanampatti Post, Coimbatore – 641 035, Tamil Nadu

NAME : ……

COURSE :……

REGISTER NO. :……

Certified that this the bonafide Record of work done by the above student of the

…….. Laboratory

during the academic year …… to ……..

Signature of the Lab-in-Charge **Head of the Department**

Submitted for the practical Examination held on ……

Internal Examiner 1 **Internal Examiner 2**

19AUB201	AUTO COMPONENTS MANUFACTURING LABORATORY	L	T	P	J	C
		3	0	2	0	4

S. No	List of Experiments
LATHE PRACTICE	
1.	Prepare the component using the following operations- Facing, Turning, Step turning, Taper turning and Knurling.
2.	Prepare the component using the following operations- Facing, Turning and Thread cutting (Single start only)
DRILLING PRACTICE	
3.	Prepare the component using the following operations- Drilling, Tapping and Reaming.
MILLING	
4.	Prepare the component using the Surface Milling operations
5.	Prepare the component using the Gear Cutting operations
FOUNDRY	
6.	Prepare the mould using the following patterns: a. Single piece pattern b. Split pattern c. Pattern with self core d. Pattern with core box

L: 0 T:0 P:30 TOTAL: 30 PERIODS

COURSE OTUCOMES

At the end of the course student should be able to

CO1: perform various machining operations using lathe machine

CO2: use different special machine tools to manufacture

CO3: generate various gear profiles

CO4: get exposure by using different types of patterns

CO5: prepare the different types of mould.

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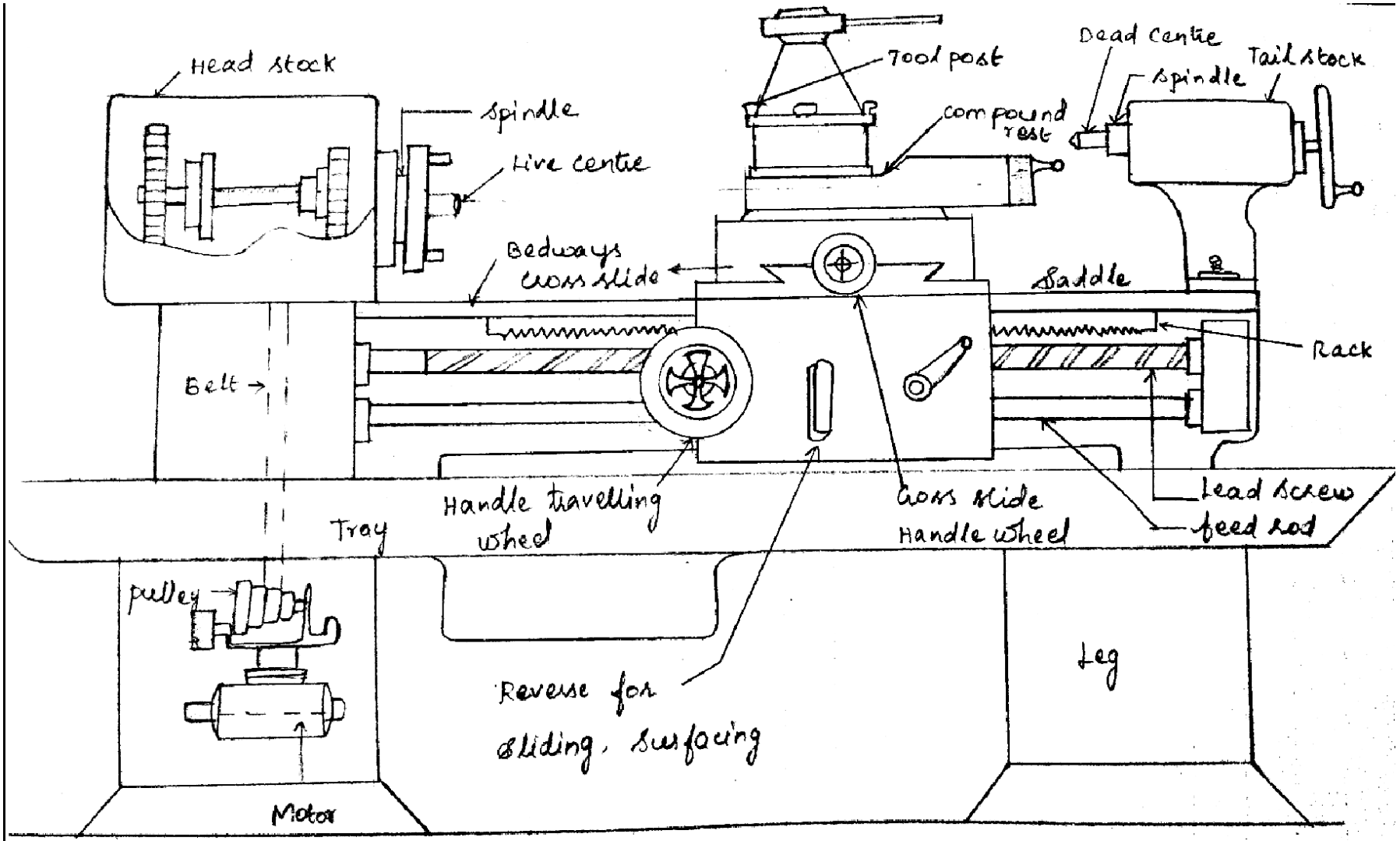

Head stock
Spindle
Live centre
Tool post
compound rest
Dead centre
Spindle
Tail stock
Bedways
cross slide
Saddle
Rack
Belt
Handle travelling wheel
Tray
cross slide Handle wheel
Lead screw
feed rod
pulley
Reverse for sliding, surfacing
Leg
Motor

LATHE

STUDY OF LATHE

Aim:

To study the various parts and operation of lathe.

Introduction:

Lathe is a machine tool, which is used to remove metal from work piece for required shape and size. This is done by holding the work piece firmly on the machine and turning it against the cutting tool, which will remove metal from the work in the form of chips.

Parts of a Lathe and Their Functions:

A schematic diagram of a centre lathe is shown in the figure that shows the various parts of the lathe. The main parts of the lathe are

- Bed
- Head stock
- Tail stock
- Carriage
- Lead screw
- Feed Rod

Center lathe:

This lathe is the most important member of lathe family and most widely used. This lathe is also known as engine lathe. The basic parts of center lathe are bed, headstock, tailstock, and carriages, cross slide, compound rest, tool post and apron.

Bed:

It is the base of the lathe; the headstock and tailstock are located at either end of the bed and the carriage rests over the lathe bed and slides on it.

Headstock:

It carries a hollow spindle .A live center can be fitted in to hollow spindle. The live center rotates with the work piece and hence called live center.

Tailstock:

It is mounted on the bed at right angles end. It is used for supporting the right end of the work piece by means of a dead center. The dead center does not revolve with the work piece and hence called dead center.

Carriage:

It is supported on the lathe bed ways and can move in a direction parallel to the lathe axis .It carries saddle, cross slide, compound rest, tool post and apron. It is an H- shaped casting fitted over the bed. It moves along the guide way.

Cross slide:

It carries the compound rest and tool post. It is mounted on the top of the saddle. It may be moved by hand or may be given feed through apron mechanism.

Compound rest:

It is mounted on the cross –slide .It carries a circular bar called swivel plate, which is graduated on degrees. The upper part is known as the compound slide, and it can be moved by means of the hand wheel.

Tool post:

The tool post is fitted over the compound rest. the tool is clamped in the tool post.

Apron:

Lower part of the carriage is termed as the apron. It is attached to the saddle and hangs in front of the bed .It contains gear, clutch and lever for moving the carriage by a hand wheeler power feed.

Feed mechanism:

The movement of tool relative to the work is termed as feed. A lathe may have three types of feed: longitudinal, cross, and angular feed. The feed mechanisms have different units through which motion id transmitted from the head stock spindle to the carriage. Following are the units: end of bed gearing, feed gear box, feed rod and lead screw, apron mechanism.

Specification of lathe:

Specifying a lathe should possess the following details:

- The length of the bed
- The length between centers
- The height of centers from the bed
- The swing diameter of work over bed.
- The swing diameter of work over bed
- The swing diameter of work over carriage
- The maximum bar diameter which will pass through the hole of head stock spindle

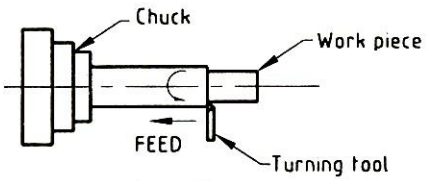
To specify the lathe fully the following details are also given:

- Power unit
- Floor space required
- Lead screw details- pitch diameter, etc.,
- Number of spindle speed
- Feeds
- Spindle nose diameter
- Width of bed

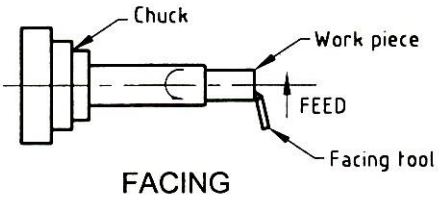
Important operations of a lathe:

Turning:

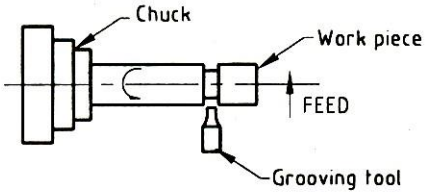
The work piece is held in the chuck or between the centers. The turning tool is held parallel to the axis of the lathe spindle and a cylindrical surface is produced.



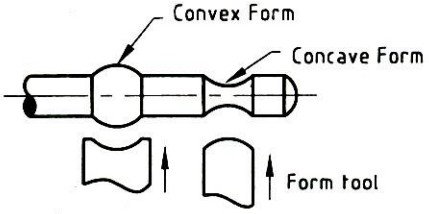
TURNING



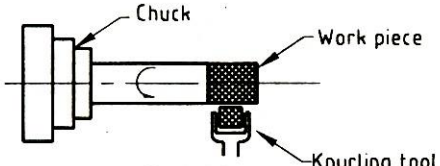
FACING



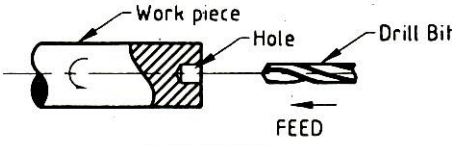
GROOVING



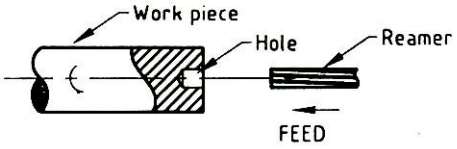
FORMING



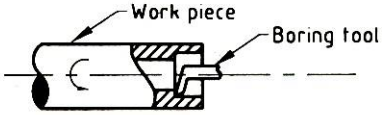
KNURLING



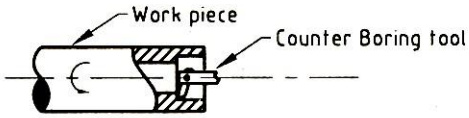
DRILLING



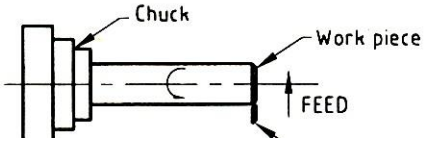
REAMING



BORING



COUNTER BORING



CHAMFERING

For rough turning, the rate of feed of the tool is fast and the depth of cut is heavy. For rough turning the depth of cut may be from 2 to 5mm.For finishing turning the feed and depth of cut will be small. For this a finish turning tool is used and the depth of cut may be from 0.5 to 1mm.

Facing:

Facing is the machining of the end face of the work piece to make it flat. The work piece may be held in the chuck as between the centers. A facing too is fed perpendicular to the axis of operation of the work piece. Only the face of the tool is machined in this processes and hence called facing.

Chamfering:

It is the process of leveling extreme end of the work piece. This is done to protect the end of the work piece from getting damaged. This operation is performed after turning, drilling, boring etc., It is a critical operation to be performed after thread cutting so that the end may pass firstly on the threaded work piece.

Knurling:

The adjustment screw of a micrometer is not smooth either axis cross or diamond shaped pattern is seen. The process by which such patterns are made is call knurling. It is done to give good gripped surface on the work piece. The teeth may be fine, medium or coarse. Very slow speeds are adapted for knurling.

Reaming:

The operations for finishing a drilled or bored hole for smooth finishing are called as reaming. The tool used is called as reamer. It has multiple cutting edges. The reamer is fitted in the tail stock spindle.

Drilling:

It is an operation for making a hole on a work piece. For drilling, work piece is held in the chuck on one side where as the other side remains free. The tool for drilling is called drill. The drill is inserted on the tailstock. When the job rotates, the drill bit is inserted in the tailstock by rotating the hand wheel.

Boring:

It is a process for enlarging a hole produced by drilling. Boring itself cannot produce a hole. The work piece is held in a chuck or face plate. The boring tool is fixed and fed into the job.

Taper turning:

A large number of components used in engineering have a conical shape or a tapered shape. A taper is defined as the uniform change in diameter measured along its length.

Thread cutting:

It is the operations by which threads are cut on the surface of the work piece. The change of gear may be selected as

No of teeth on spindle gear= no. of teeth on lead screw.

Pitch of a thread to be cut = pitch of the lead screw threads.

Safety Precautions:

Before starting:

Before starting the work ensure that

- The work area is clean and tidy.
- The safety guards are in proper condition and are correctly placed.

During working:

- Avoid wearing rings or watches during working.
- Wear safety shoes.
- Wear an apron that is not loose and have the sleeves folded.

After working:

- Clean the machine with a brush and wipe with cotton waste.
- Oil the bed- ways and the lubricating points.
- Clean the precision instrument and wipe them dry before storing.
- Clean the cutting tools and place them in their respective places.
- Clean the surroundings of the machine, wipe the split oil and remove the dwarf.

Result:

Thus we studied the various parts and operations of lathe.

Ex. No: **FACING, PLAIN AND STEP TURNING**
Date:

Aim:

To perform the facing, plain turning and step turning operation on the given job.

Materials Required:

32mm dia X 120mm length – Mild steel round rod.

Tools Required:

Single point cutting tool, Chuck key, Spanner.

Measuring Tools:

Steel Rule, Vernier Caliper, Jenny caliper and Outside caliper.

Sequence of operation:

- Job setting
- Tool setting
- Facing
- Plain turning
- Marking
- Step turning and chamfering.

Procedure:

Job Setting:

The job is hold in the three jaws self-centering chuck and is tightened by using chuck key such that ¾ of the length is projected outside the chuck.

Tool setting:

The single point cutting tool was held on the tool post. The tool is adjusted so that the tool tip must coincide with the lathe axis. This can be done by keeping the tip nearer to the dead center of tailstock and then adjusted.

Facing:

Facing is an operation on Lathe, which is used to bring the length of the cylinder to required dimension. Rough facing is done first and then smooth facing is done.

Plain turning:

Now the carriage is moved parallel to the job by giving a depth of cut by means of cross slide. Reducing the diameter to the required shape does the turning.

Marking:

Chalk is applied on the surface of the job .By using Jenny caliper, mark the required dimensions on the job.

Step turning and chamfering:

The length is marked on the job and turning is done as previously till we get the required dimensions. The compound slide is tilted to 45 deg. And tool is placed parallel to the lathe axis. By moving the compound slide the chamfering was done up to 1mm on the both surface.

After the turning operation was performed, the job was released from the chuck.

Safety Precautions:

- Ensure that the job was well tightened.
- Take care in the alignment of tool in each case.
- Confirm that the chuck key is removed after tightening.
- Don’t bring your hand nearer to the running chuck.

Result:

Thus the facing, Plain turning, Step turning and chamfering were performed on the given work piece by using three jaw chuck center lathe.

Ex. No: **TAPER TURNING AND KNURLING**
Date:

Aim:

To perform the facing, plain turning and taper turning and knurling operation on the given job.

Materials Required:

32mm dia X 120mm length – Mild steel round rod.

Tools Required:

Single point cutting tool, Chuck key, Spanner and Vernier Caliper.

Measuring Tools:

Steel Rule, Vernier Caliper, Jenny caliper and Out side caliper.

Sequence of operation:

- Job setting
- Tool setting
- Facing
- Plain turning
- Marking
- Taper turning.

Procedure:

Job Setting:

The job is hold in the three jaws self-centering chuck and is tightened by using chuck key such that ¾ of the length is projected outside the chuck.

Tool setting:

The single point cutting tool was held on the tool post. The tool is adjusted so that the tool tip must coincide with the lathe axis. This can be done by keeping the tip nearer to the dead center of tailstock and then adjusted.

Facing:

Facing is an operation on Lathe, which is used to bring the length of the cylinder to required dimension. Rough facing is done first and then smooth facing is done.

Plain turning:

Now the carriage is moved parallel to the job by giving a depth of cut by means of cross slide. Reducing the diameter to the required shape does the turning.

Marking:

Chalk is applied on the surface of the job .By using Jenny caliper, mark the required dimensions on the job.

Taper turning:

Calculate the taper angle by using the formula

$$\text{Tan } \theta = D-d / 2L$$

Where,

D- Major diameter of the job

d- Minor diameter of the job

L-Taper length.

The compound rest is fitted to the calculated taper angle and the tool is placed perpendicular to lathe axis. by giving feed to tool post slide the taper turning is performed.

After the turning operation was performed, the job was released from the chuck.

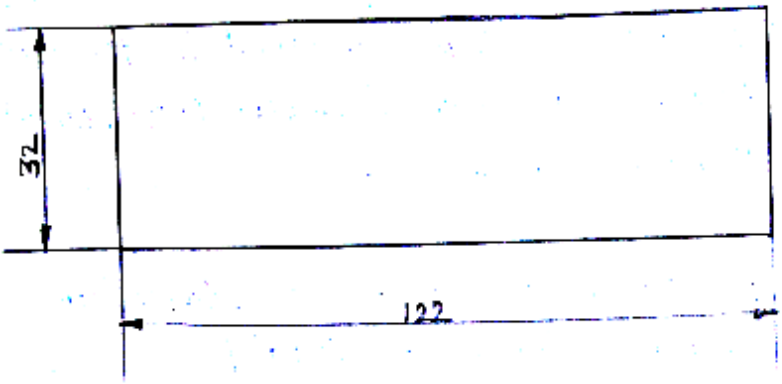
Safety Precautions:

- Ensure that the job was well tightened.
- Take care in the alignment of tool in each case.
- Confirm that the chuck key is removed after tightening.
- Don't bring your hand nearer to the running chuck.

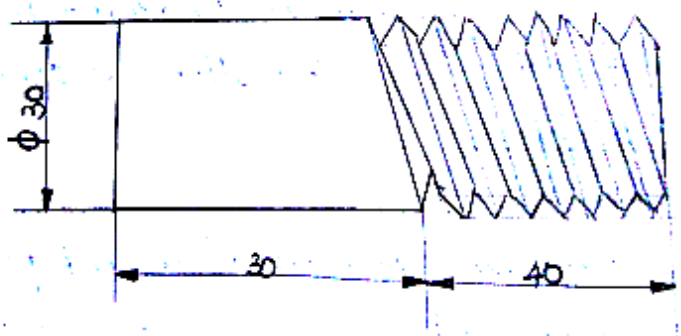
Result:

Thus the facing, Plain turning, taper turning and knurling were performed on the given work piece by using three jaw chuck center lathe.

Before Machining



After Machining :-



Ex. No: **THREAD CUTTING**
Date:

Aim:

To perform the facing, plain turning and thread cutting operation on the given job. (Single start only)

Materials Required:

32mm dia X 120mm length – Mild steel round rod.

Tools Required:

Single point cutting tool, Chuck key, Spanner.

Measuring Tools:

Steel Rule, Vernier Caliper and Try Square.

Sequence of operation:

- Job setting
- Tool setting
- Facing
- Plain turning
- Marking
- Thread cutting.

Procedure:

Job Setting:

The job is hold in the three jaws self-centering chuck and is tightened by using chuck key such that ¾ of the length is projected outside the chuck.

Tool setting:

The single point cutting tool was held on the tool post. The tool is adjusted so that the tool tip must coincide with the lathe axis. This can be done by keeping the tip nearer to the dead center of tailstock and then adjusted.

Facing:

Facing is an operation on Lathe, which is used to bring the length of the cylinder to required dimension. Rough facing is done first and then smooth facing is done.

Plain turning:

Now the carriage is moved parallel to the job by giving a depth of cut by means of cross slide. Reducing the diameter to the required shape does the turning.

Marking:

Chalk is applied on the surface of the job .By using Jenny caliper, mark the required dimensions on the job.

Thread cutting:

The tool is made to touch the job and the readings were noted on the cross slide. Then half nut lever was engaged and a light thread cutting operation is done. Then by using screw pitch gauge, check the obtained thread whether the pitch was correct or not. Then the carriage was moved away from the headstock then by giving proper depth of cut the threading operation was done.

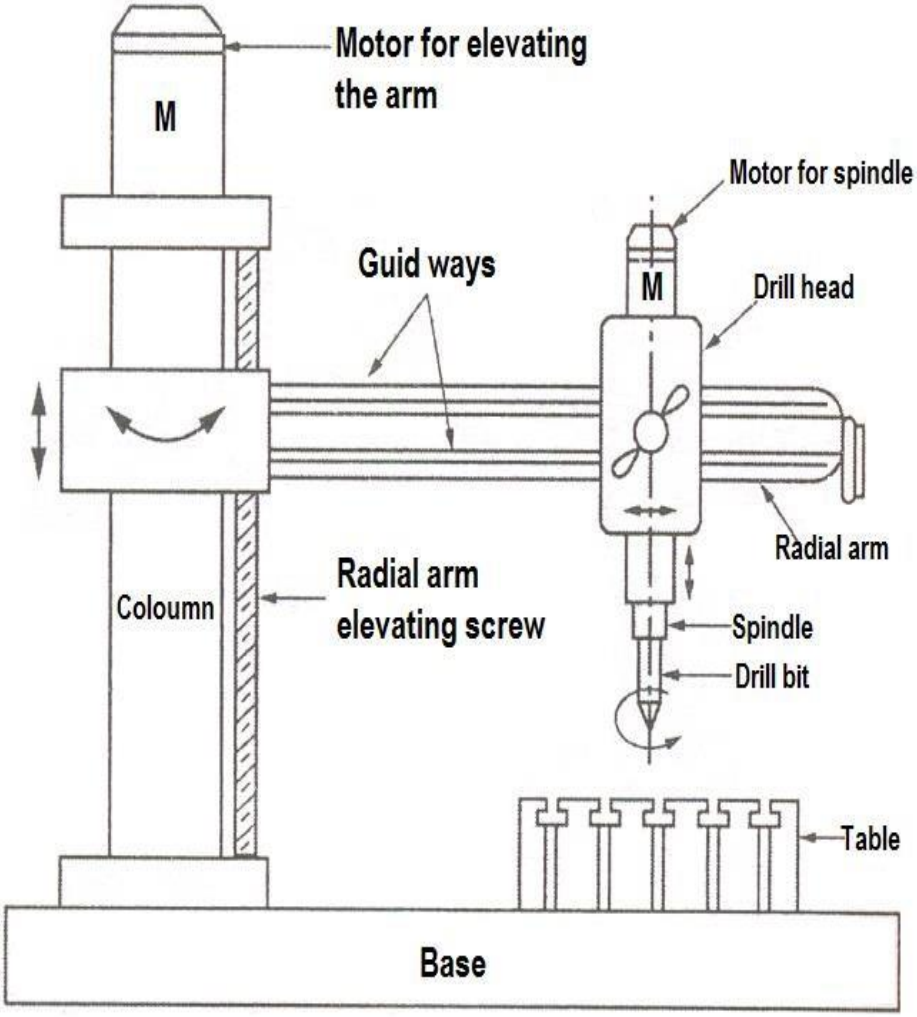
After the turning operation was performed, the job was released from the chuck.

Safety Precautions:

- Ensure that the job was well tightened.
- Take care in the alignment of tool in each case.
- Confirm that the chuck key is removed after tightening.
- Don't bring your hand nearer to the running chuck.

Result:

Thus the facing, Plain turning, thread cutting were performed on the given work piece by using three jaw chuck center lathe.



RADIAL DRILLING MACHINE

Ex. No: **STUDY OF DRILLING MACHINE**
Date:

Introduction:

In a drilling machine holes may be drilled quickly and at a low cost. The hole is generated by the rotating edges of a cutting tool known as the drill, which exerts large force on the work clamped on the table.

Types of drilling machine:

1. Portable
2. Sensitive
3. Upright
4. Radial
5. Gang
6. Multiple spindle
7. Automatic
8. Deep hole

Principle parts of Radial drilling machine:

Base:

The base is a large rectangular casting that it is mounted on its one ends vertically it supports radial arm, electrical motor. This impacts vertical adjustment of the arm by rotating a screw.

Column:

The column is a cylindrical casting, it supports radial arm which may slide up or down on its face. An electric motor is mounted at the top of the column, which impacts vertical adjustments of the arm by rotating a screw passing through a nut to the arm.

Radial arm:

Radial arm is mounted on the column horizontally over the base; the arm may be swung round the column. In some machines this movement is controlled by a separate motor.

Drill Head:

Drill Head is mounted on the radial arm and drills spindle is driven. All the mechanism is housed with in a small drill head. The drill head is properly adjusted and clamped on the radial arm.

Spindle drive and feed mechanism:

A constant speed motor is mounted at the extreme end of radial arm, which balances partially the weight of the overhanging arm. The motor drives a horizontal spindle, which runs along the length of the arm, and motion is transmitted to drill head through bevel gears. In some machines, a vertical motor is fitted directly on the drill head and through gearbox multiple speed and the feed of the spindle can be obtained.

Drilling Machine Operations:

The different operations that can be performed in drilling machines are:

1. Drilling
2. Reaming
3. Boring
4. Counter boring
5. Counter sinking
6. Spot facing
7. Tapping,
8. Lapping
9. Grinding
10. Trepanning

Safety Precautions:

Before starting:

Before starting the work ensure that

- The work area is clean and tidy.
- The safety guards are in proper condition and are correctly placed.

During working:

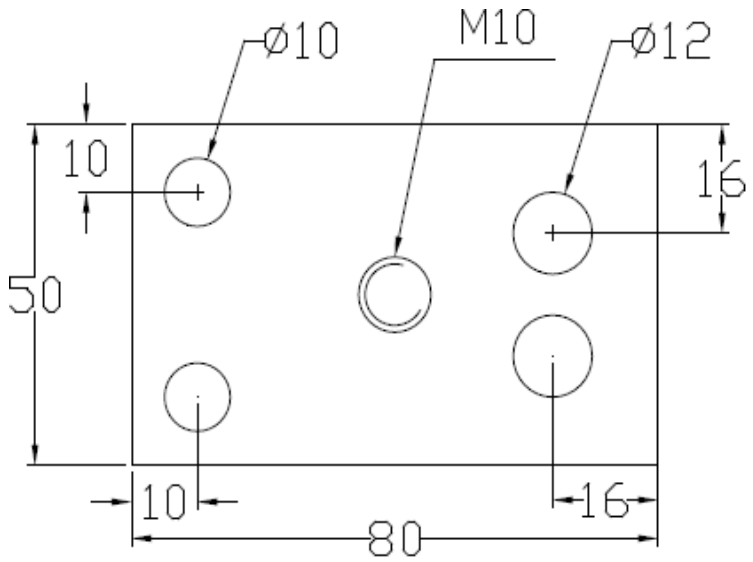
- Avoid wearing rings or watches during working.
- Wear safety shoes.
- Wear an apron that is not loose and have the sleeves folded.

After working:

- Clean the machine with a brush and wipe with cotton waste.
- Oil the bed- ways and the lubricating points.
- Clean the precision instrument and wipe them dry before storing.
- Clean the cutting tools and place them in their respective places.
- Clean the surroundings of the machine, wipe the split oil and remove the dwarf.

Result:

Thus the various parts and operations of radial drilling machine were studied.



ALL DIMENSIONS ARE IN MM

Ex. No: **DRILLING ,TAPPING AND REAMING**
Date:

Aim:

To make holes of given diameter by drilling using Radial drilling machine and internal thread cutting using taps.

Materials required:

50mm X 50mm X 10mm – MS flat

Tools required:

Drill chuck with key, drill bit, scriber punch, hammer and taps.

Measuring tools:

Steel rule, vernier caliper and vernier height gauge.

Sequence of operation:

- Marking and center punching
- Drill bit setting
- Job setting
- Drilling
- Taping

Marking:

The given work piece is marked foe the given dimensions using vernier height gauge and the center points of the hole is punched by using center punch.

Drill bit setting:

The drill bit of 5/16-inch was fixed into the drill chuck and tightened by means of a key.

Job setting:

The job is fixed in the table of radial drilling machine with the help of clamp and bolt assembly fitting in to the T-slots of the table.

Drilling:

The drill tip is made to come in line with the punched center of hole and by radial and longitudinal and lateral adjustment the drill bit is rotated and by downward feed the hole was made.

Tapping:

The job is then removed to set in a vice for tapping internal thread. The taps according to the order of finish are fixed in the tap wrench and by rotation and pressing, lowered in to the holes for cutting internal threads.

Reaming:

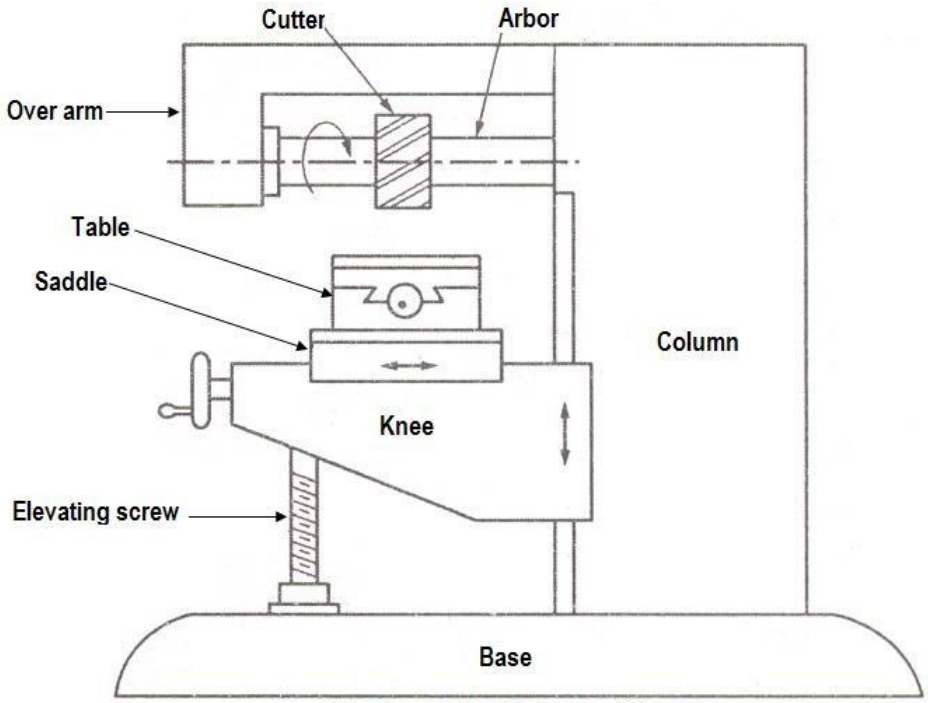
Reaming tool was fixed into the drill chuck and tightened by means of a key. The drill tip is made to come in line with the punched center of hole and by radial and longitudinal and lateral adjustment the drill bit is rotated and by downward feed the reaming was made

Safety precautions:

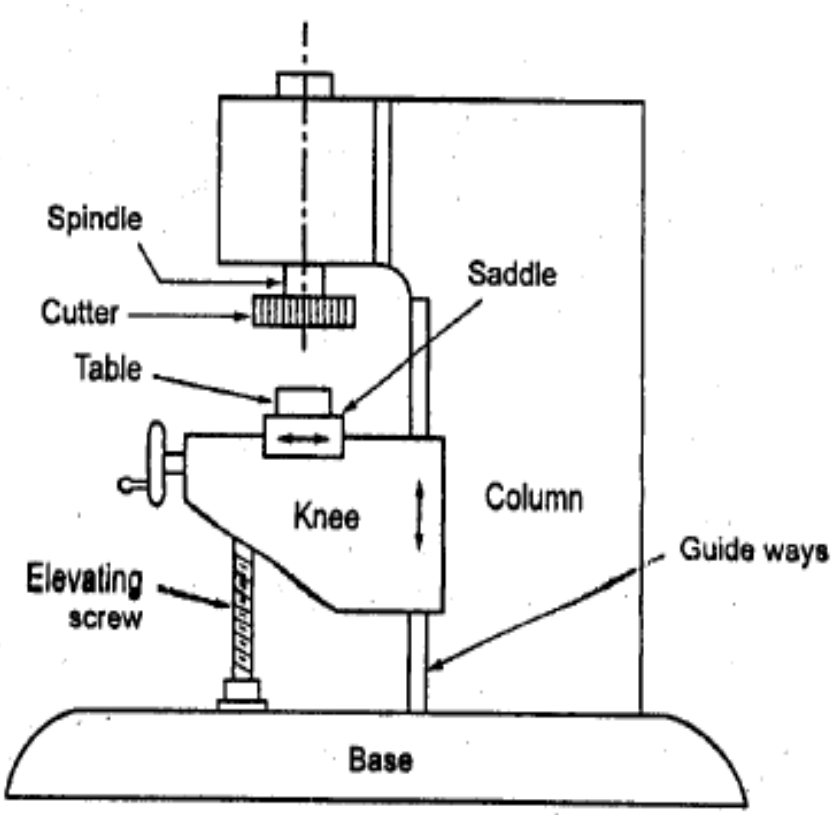
- Keep away when the radial drilling machine is moved radially or sideways.
- Never bring the head close to the tool unit while aligning the drill bit with the punch
- Never plunge the head deep into the hole it may affect the tool and table

Result:

Thus the drilling, tapping and reaming operation was done on the given job.



Horizontal milling machine



Vertical milling machine

Ex. No: **STUDY OF MILLING MACHINE**

Introduction

Milling machine is a machine tool that removes metal by rotating multipoint cutter. This is superior to other machines as regards accuracy and better surface finish. Jacques developed the milling machine in 1782.The first successful plain milling machine was designed in 1818.

Types of milling:

1. Column and Knee type
    - Hand milling
    - Plain milling
    - Universal milling
    - Vertical milling
    - Omniversal milling.
2. Manufacturing of fixed bed type:
    - Simplex
    - Duplex
    - Triplex
3. Planner type
4. Special type
    - Rotary table
    - Drum
    - Planetary
    - Rantograph, profiling and tracer

Principal parts of column and knee type:

Base:

Base is a gray iron casting accurately machined on its top and bottom surface. It carries column at its one end.

Column:

Column is mounted vertically on the base. Front vertical column is provided with dovetail guide ways for supporting knee.

Knee:

Knee is slide up and down on the vertical ways of column adjustment of height is by elevating screw. The knee houses the feed mechanism of the table.

Table:

Table's top contains T-slots for fix the job by vice or fixtures In universal machine it may also swiveled horizontal.

Overhanging arm:

Over hanging arm is to give support for the arbor .The arm is adjustable>It is mounted on the top of the column.

Spindle:

Spindle is located on the upper part of column and receives power through belts, gears, clutches from motor it is provided with a tapered hole into cutting tools, arbors may be inserted.

Arbor:

Arbor is used to fix the milling cutters. It can extend throughout the length of the hollow spindle.

Safety Precautions:

Before starting:

Before starting the work ensure that

- The work area is clean and tidy.
- The safety guards are in proper condition and are correctly placed.

During working:

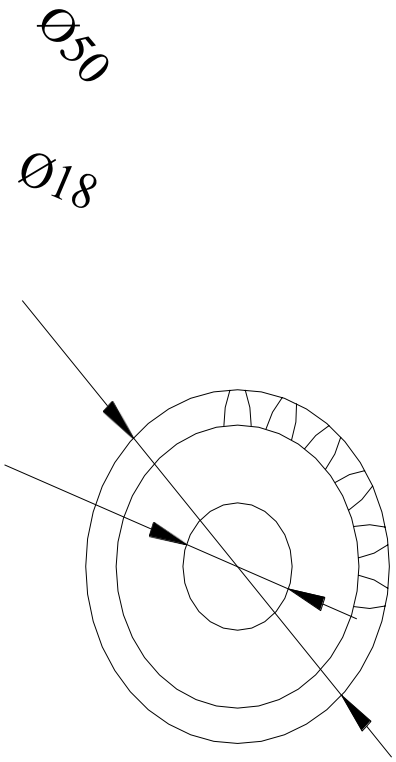
- Avoid wearing rings or watches during working.
- Wear safety shoes.
- Wear an apron that is not loose and have the sleeves folded.

After working:

- Clean the machine with a brush and wipe with cotton waste.
- Oil the bed- ways and the lubricating points.
- Clean the precision instrument and wipe them dry before storing.
- Clean the cutting tools and place them in their respective places.
- Clean the surroundings of the machine, wipe the split oil and remove the dwarf.

Result:

Thus the various parts and operations of milling machine was studied.



All dimensions are in mm

Ex. No: **SPUR GEAR MILLING**
Date:

AIM :

To machine gear to the given module and number of teeth in the given workpiece.

TOOLS AND EQUIPMENTS REQUIRED :

Milling machine, Vernier caliper, Mandrel.

DESCRIPTION :

Cutter setting:

Plain milling cutter is mounted on the arbor of the column in universal milling machine.

Job setting:

The work piece is mounted on the mandriel. This mandrel is fitted in between the dividing head center and tail stock center.

Indexing:

Simple indexing is done using the formula T=40/n, calculate the rotation of the crank handle for required operation.

Hexagonal milling:

The cutter is moved in opposite direction of the cutter rotation and removes the metal then indexing for next position by using crank handle and do the same operation foe the next face. The operation is repeated until the cutting of all faces is done in the full circumference.

Safety precautions:

- Never touch the running cutter with fingers
- Don't remove chips with fingers but by brush or chip hook etc., only
- Measure only when the machine is at rest.

CALCULATION :

Z = No. of teeth = 23

m = module = 2 mm

Blank Diameter = (Z + 2) m

= (23 + 2) 2

= 50 mm

Tooth Depth = 2.25 m

= 2.25 * 2

= 4.5 mm

Indexing Calculation = 40 / Z

= 40 / 23

= 1 17/23

PROCEDURE:

1. Calculate the gear tooth proportions.

   Blank diameter = (Z + 2) m
   Tooth depth = 2.25 m
   Tooth width = 1.5708 m

   where,

   Z = Number of teeth required
   m = module

2. Indexing calculation

   Index crank movement = 40 / Z

3. The dividing head and the tail stock are bolted on the machine table. Their axis must be set parallel to the machine table.

4. The gear blank is held between the dividing head and tailstock using a mandrel. The mandrel is connected with the spindle of dividing head by a carrier and catch plate.
5. The cutter is mounted on the arbor. The cutter is centred accurately with the gear blank.

6. Set the speed and feed for machining.

7. For giving depth of cut, the table is raised till the periphery of the gear blank just touches the cutter.

8. The micrometer dial of vertical feed screw is set to zero in this position.

9. Then the table is raised further to give the required depth of cut.

10. The machine is started and feed is given to the table to cut the first groove of the blank.

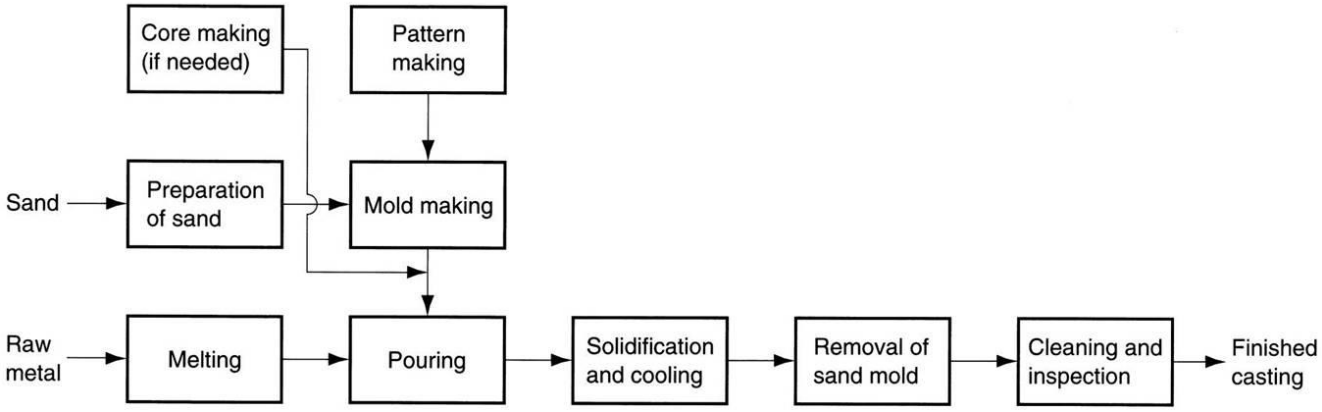
11. After the cut, the table is brought back to the starting position.

12. Then the gear blank is indexed for the next tooth space.

13. This is continued till all the gear teeth are cut.

RESULT :

Thus the required gear is machined using the milling machine to the required number of teeth.



Steps in Sand casting

STUDY OF FOUNDARY

Introduction:

Producing components by casting has been used since the earliest days of civilization. Lot of shapes and sizes can be prepared in a casting process. To make the casting of a component, a cavity of desired shape is to be produced in which the molten metal is poured. Mould is the cavity of the required shape made in moulding consists of all operations done be make a mould.

Pattern:

Pattern is the model used to get required casting. It is used to produce the mould cavity in the sand.

Foundary:

The place where moulding casting are done.

Moulding sand or green sand:

Green sand is an aggregate of sand, bentonite clay, pulverized coal and water. Its principal use is in making molds for metal casting. The largest portion of the aggregate is always sand, which can be either silica or olivine. There are many recipes for the proportion of clay, but they all strike different balances between moldability, surface finish, and ability of the hot molten metal to degas. The coal, typically referred to in foundries as sea-coal, which is present at a ratio of less than 5%, partially combusts in the surface of the molten metal leading to off gassing of organic vapors

Components required for moulding:

The following components are essential for producing mould

- Moulding sand
- Moulding boxes
- Pattern
- Moulding tools

Moulding sand composition:

It is a special type of sand used for making mould. Moulding sand has three constituents. They are,

- **Sand:**

  It has a silica, clay and moisture. Silica is the main constituent of sand. Silica has 80-90% of silicon dioxide. Silicon gives refractoriness to the sand.
- **Clay:**

  It is another constituent of sand. Clay gives more bonding strength to the sand. Generally sand have 5-20% water is added to the sand.
- **Blindness:**

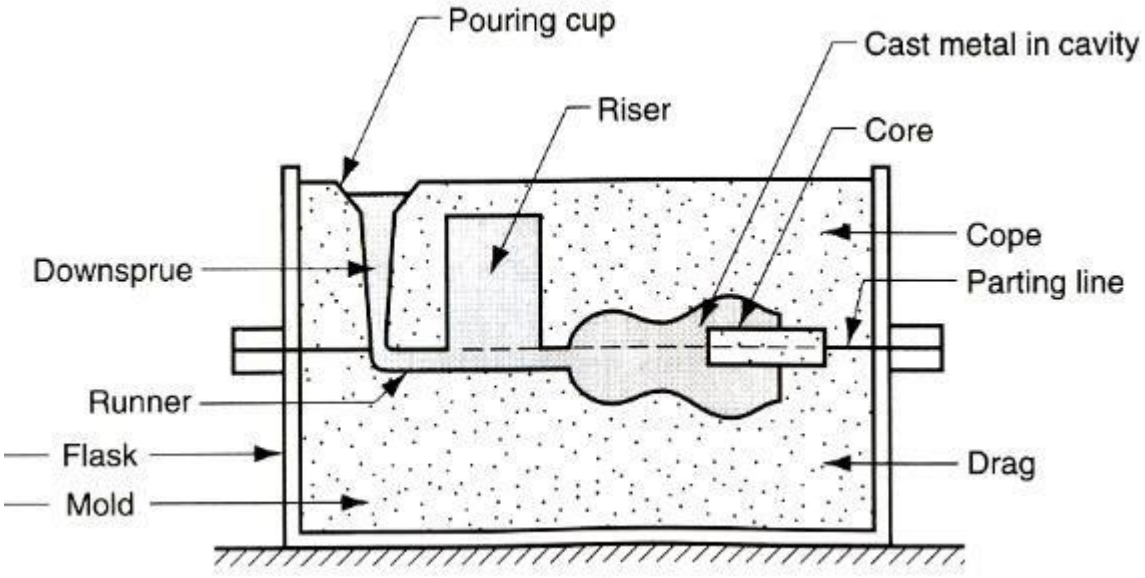
  It is added to the moulding sand to bring the property of cohesiveness. The binder binds the sand together and brings strength.
- **Additive:**

  By adding an additive, properties like strength, refractoriness and permeability can be increased.

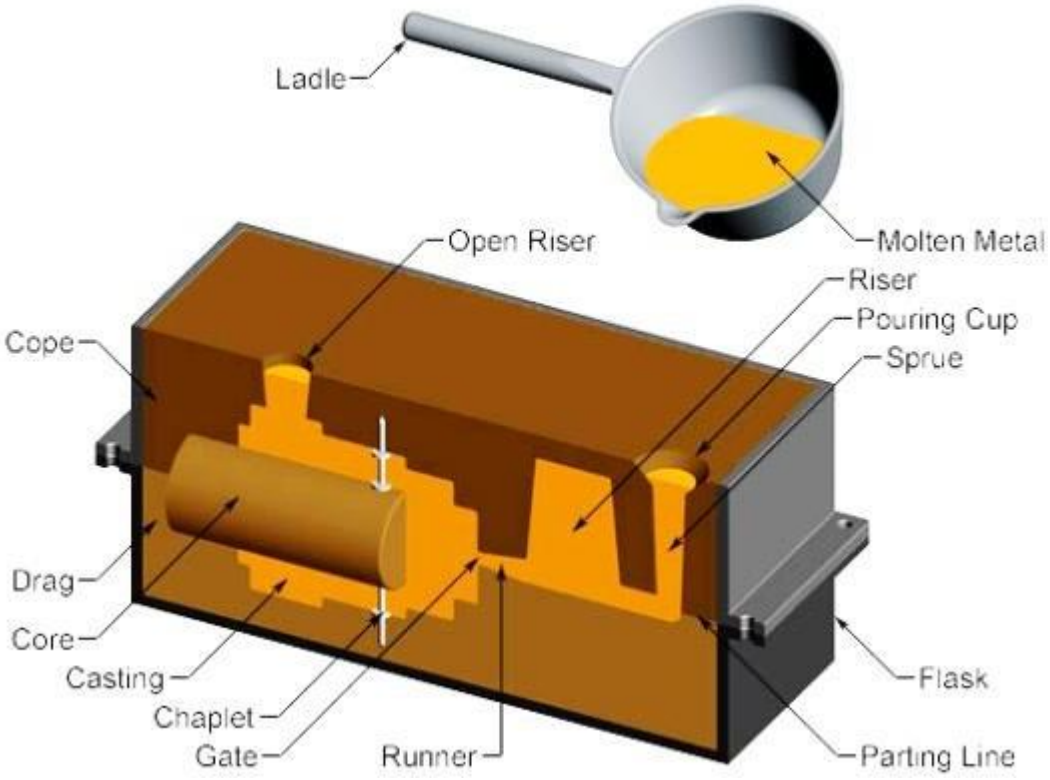
Properties of mouldig sand:

Good moulding sand should have the following properties,

- Porosity
- Plasticity



Sand casting



Adhesiveness
- Cohesiveness
- Refractoriness

Pattern:

A pattern is the replica of the desired casting, used to produce a mould cavity in to which liquid metal is poured when pattern packed in a suitable material produce a cavity called the mould. This cavity when filled with molten metal produces the desired casting.

Pattern material:

The selection of pattern materials depends on the following factors,

- Type of production of castings and the type of moulding process.
- Flexibility in changing the design of pattern
- Number of castings to be produced
- The pattern material should be easily worked, shaped and joined.

The following pattern materials are widely used

- Wood and wood products
- Metals and alloys
- Plastics and rubbers
- Plastics and waxes

Types of Pattern Allowance

- Shrinkage Allowance
- Machining Allowance
- Draft or Taper Allowance
- Distortion Allowance
- Rapping or Shake Allowance

The common types of patterns are:

1) Single piece pattern
2) Split piece pattern
3) Loose piece pattern
4) Gated pattern
5) Match pattern
6) Sweep pattern
7) Cope and drag pattern
8) Skeleton pattern
9) Shell pattern
10) Follow board pattern

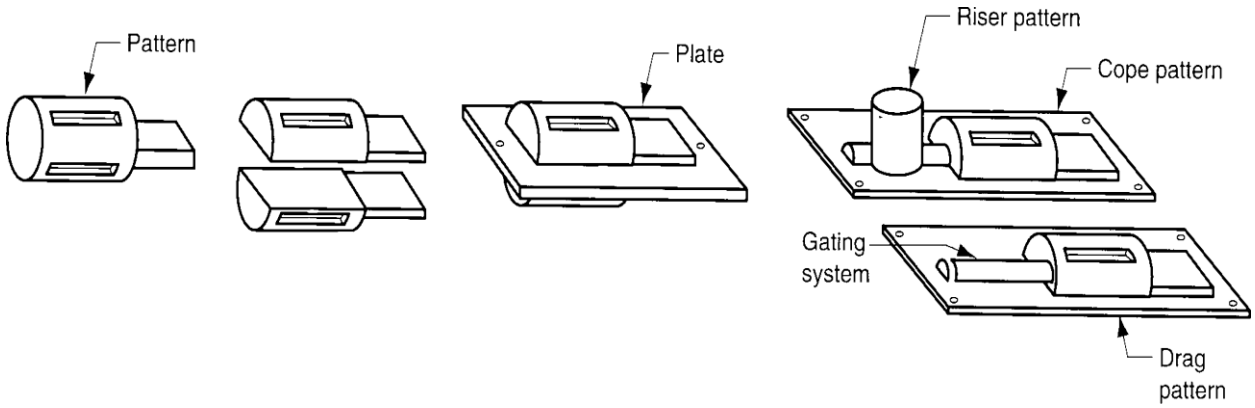
-

Single piece pattern:

This is the simplest type of pattern, exactly like the desired casting. For making a mould, the pattern is accommodated either in cope or drag.
Used for producing a few large castings, for example, stuffing box of steam engine.

Split pattern:

These patterns are split along the parting plane (which may be flat or irregular surface) to facilitate the extraction of the patternout of the mould before the pouring operation. For a more complex casting, the pattern may be split in more than two parts.



Types of patterns used in sand casting:
(a) solid pattern, (b) split pattern, (c) match-plate pattern, and (d) cope-and-drag pattern

Loose piece pattern:

When a one piece solid pattern has projections or back drafts which lie above or below the parting plane, it is impossible to with drawit from the mould. With such patterns, the projections are made with the help of loose pieces. One drawback of loose feces is that their shifting is possible during ramming.

CORE MAKING

- **Core**
- is a body made of refractory material (sand or metal, metal cores being less frequently used), which is set into the prepared mould before closing and pouring it, for forming through holes, recesses, projections, undercuts and internal cavities.
- **Core Prints.** Core prints are the projections on a pattern and are used to make recesses (core seats) in the mould to locate the core

Mould making:

In the casting process a pattern is made in the shape of the desired part. This pattern is made out of wax, wood, plastic, or metal. Simple designs can be made in a single piece or solid pattern. More complex designs are made in two parts, called split patterns. A split pattern has a top or upper section, called a cope, and a bottom or lower section called a drag. Both solid and split patterns can have cores inserted to complete the final part shape. Cores are used to create hollow areas in the mould that would otherwise be impossible to achieve. Where the cope and drag separates is called the parting line.

When making a pattern it is best to taper the edges so that the pattern can be removed without breaking the mould. This is called draft. The opposite of draft is an undercut where there is part of the pattern under the sand making it impossible to remove the pattern without damaging the mould. The moulds are constructed by several different processes dependent upon the type of foundry, metal to be poured, quantity of parts to be produced, size of the casting and complexity of the casting.

Foundry Tools:

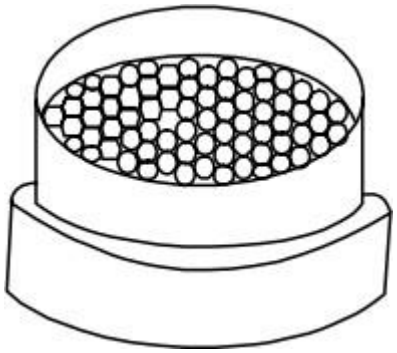
The common hand tools used in foundry shop are fairly numerous. A brief description of the following foundry tools used frequently by molder is given as under.

1. **Hand riddle**

   Hand riddle is shown in Figure (a). 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.

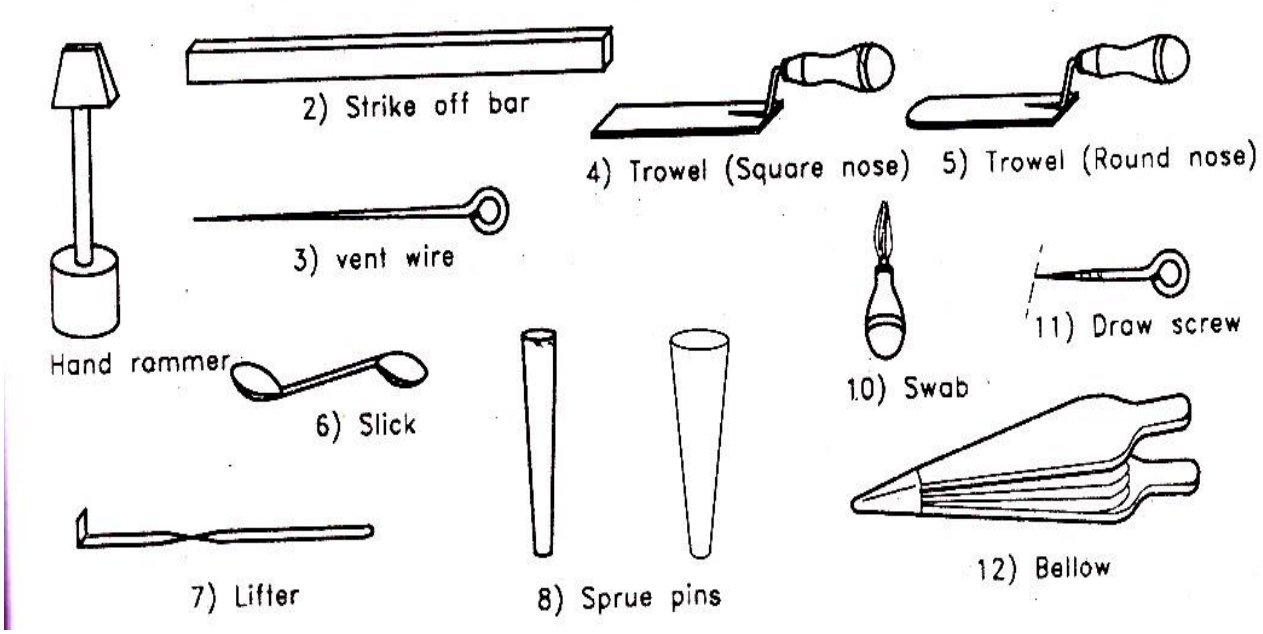
2. **Shovel**

   Shovel is shown in Fig.(b). 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. It should always be kept clean.



a) Hand Riddle

b) Shovel



1. **Hand rammer**

It is generally made of wood or metal. It is small and one end of which carries a wedge type construction, called peen and the other end possesses a solid cylindrical shape known as butt. It is used for ramming the sand in bench molding work.

(ii) Peen rammer

It has a wedge-shaped construction formed at the bottom of a metallic rod. It is generally used in packing the molding sand in pockets and comers.

(iii) Floor rammer

It consists of a long steel bar carrying a peen at one end and a flat portion on the other. It is a heavier and larger in comparison to hand rammer. Its specific use is in floor molding for ramming the sand for larger molds. Due to its large length, the molder can operate it in standing position.

(iv) Pneumatic rammers

They save considerable time and labor and are used for making large molds.

2. **Sprue pin**

Sprue pin is shown in Figure 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. Later its withdrawal from cope produce a vertical hole in molding sand, called sprue through which the molten metal is poured into the mould using gating system. It helps to make a passage for pouring molten metal in mold through gating system

3. **Strike off bar**

Strike off bar (Fig.2) is a flat bar having straight edge and is made of wood or iron. It is used to strike off or remove the excess sand from the top of a molding box after completion of ramming thereby making its surface plane and smooth. Its one edge is made beveled and the other end is kept perfectly smooth and plane.

4. **Draw spike**

Draw spike is shown Fig. 11. It is a tapered steel rod having a loop or ring at its one end and a sharp point at the other. It may have screw threads on the end to engage metal pattern for it withdrawal from the mold. It is used for driven into pattern which is embedded in the molding sand and raps the pattern to get separated from the pattern and finally draws out it from the mold cavity.

5. **Vent rod**

Vent rod is shown in Fig.3. It is a thin spiked steel rod or wire carrying a pointed edge at one end and a wooden handle or a bent loop at the other. After ramming and striking off the excess sand it is utilized to pierce series of small holes in the molding sand in the cope portion. The series of pierced small holes are called vents holes which allow the exit or escape of steam and gases during pouring mold and solidifying of the molten metal for getting a sound casting.

6. **Lifters**

Lifters are shown in Fig. 7. They are also known as cleaners or finishing tool which are made of thin sections of steel of various length and width with one end bent at right angle. They are used for cleaning, repairing and finishing the bottom and sides of deep and narrow openings in mold cavity after withdrawal of pattern. They are also used for removing loose sand from mold cavity.

7. Trowels

Trowels are shown in Fig. 4 and Fig 5. They are utilized for finishing flat surfaces and joints and partings lines of the mold. They consist of metal blade made of iron and are equipped with a wooden handle. The common metal blade shapes of trowels may be pointed or contoured or rectangular oriented. The trowels are basically employed for smoothing or slicking the surfaces of molds. They may also be used to cut in-gates and repair the mold surfaces.

8. Bellows

Bellows gun is shown in Fig. 12. It is hand operated leather made device equipped with compressed air jet to blow or pump air when operated. It is used to blow away the loose or unwanted sand from the surfaces of mold cavities.

Result:

Thus the foundry process was studied.

Ex. No: **MOULD WITH SINGLE PIECE PATTERN**
Date:

Aim:

To prepare a green sand mould for single piece pattern.

Tools Required:

- Moulding boxes
- Moulding board
- Shovel
- Sand rammer
- Strike off bar
- Vent wire
- Riser pin
- Draw spike

Introduction:

- It is a simplest type of pattern. As the name suggest the pattern is ,made from one piece and does not contain loose piece or joint.
- It is expensive. It is used for making a few large size simple casting
- One piece pattern is usually made up of wood or metal depending upon the quantity of casting to be produced.
- Stuffing box of steam engine may be cast with the help of one piece pattern.

Procedure:

1. The flange pattern is placed on the moulding board
2. A suitable core is prepared and placed in the hold of flange pattern
3. Clay wishing is done inside the drag surface
4. Parting sand is applied over the pattern
5. Box is filled with smooth moulding sand and proper ramming is done using flat and peen rammer
6. Excess sand is removed using the strike of bar
7. Drag is tilted upside down
8. The cope is placed on the drag after doing clay wash
9. The runner and riser are placed over the pattern
10. Ramming is done to get a rigid mould
11. Using strike off bar excess sand is removed
12. Vent holes are mark using vent rod
13. Cope is kept circle and pattern is removed using draw pin
14. Gate is prepared using gate cutter
15. Cope and drag are assembled and the mould is ready for casting

Result:

Thus the mould cavity of given single piece pattern is prepared and ready for casting

Ex. No: **MOULD WITH SPLIT PATTERN**
Date:

Aim:

To make green sand mould for the split pattern.

Tools Required:

- Moulding boxes
- Moulding board
- Shovel
- Sand rammer
- Strike off bar
- Vent wire
- Riser pin
- Draw spike

Introduction:

- Pattern of complicated shape cannot be made of one piece because of inherent difficulties associate with moulding operation such pattern are made as split or two piece pattern.
- The upper and the lower part of the split pattern are accommodated in the cope and drag portion of the mould respectively.
- Dowel pins are used for keeping the alignment between the two parts of the pattern.
- Taps and water- stop cocks are produced with the help of split pattern.

Procedure:

- Moulding sand should prepared by mixing thoroughly silica sand with required amount of powder and water
- The drag is filled with green sand after positioning the round on the table.
- The green sand is rammed carefully and the excess sand is stuck off
- Patterns are placed on the moulding board and parting sand should be sprinkled to prevent sticking of moulding sand to the board
- Drag box is placed on the moulding board with its dual pins facing downwards such that the pattern should be approximately at the center of the box
- Now the drag is rolled over on the bottom board and the cope box is assembled with the legs
- engaging dowels is on the drag box parting sand should be sprinkled inside the box45
- Cope is separated from the drag and the pattern is drawn out carefully by using draw spike
- Cope and drag are assembled

Result:

Thus the mould cavity of the given split pattern is obtained.

Ex. No: **MOULD WITH CORE**
Date:

Aim:

To make green sand mould using core.

Tools Required:

- Moulding boxes
- Moulding board
- Shovel
- Sand rammer
- Strike off bar
- Vent wire
- Riser pin
- Draw spike

Procedure:

- The mould box, pattern, tools and the table/floor are cleaned.
- Moulding sand should prepared by mixing thoroughly silica sand with required amount of powder and water
- The drag is filled with green sand after positioning the round on the table.
- The green sand is rammed carefully and the excess sand is stuck off
- Patterns are placed on the moulding board and parting sand should be sprinkled to prevent sticking of moulding sand to the board
- Drag box is placed on the moulding board with its dual pins facing downwards such that the pattern should be approximately at the center of the box
- Now the drag is rolled over on the bottom board and the cope box is assembled with the legs
- engaging dowels is on the drag box parting sand should be sprinkled inside the box45
- Cope is separated from the drag and the pattern is drawn out carefully by using draw spike
- Cope and drag are assembled

Result:

Thus the mould cavity of the given core pattern is obtained.

Viva Questions:

1. **Define Manufacturing?**
   Manufacturing is the process of converting raw materials or parts into finished goods.
2. **Define machining.**
   Machining is the process of producing work piece/component by removing unwanted material from a metal block in the form of chips.
3. **What are the different types of machining processes?**
   The different types of machining process are:
   a. Twining
   b. Grinding
   c. Boring
   d. Drilling
   e. Planing
   f. Shaping
   g. Milling
4. **Classify cutting tools.**
   a. **Single point tools:** These have one cutting edge and are mostly used in lathe, shaper, etc.
   b. **Multi point tools:** These have more than one cutting edge mostly used in milling, grinding, drilling, etc.
5. **What are the functions of cutting fluids?**
   a. It cools the tool and workpiece.
   b. It reduces friction at the tool chip interface hence improves surface finish.
   c. It prevents adhesion of chips to the tool or workpiece.
6. **Name the various cutting tool materials.**
   - High carbon steel
   - High speed steel
   - Cemented carbides
   - Ceramics or Oxides.
   - Sialon
   - Diamond
   - Cubic boron Nitride
   - Coronite
   - Non-ferrous cast alloys
   - Medium Alloy Steels
7. **What are the factors affecting tool life?**
   Cutting speed, Feed and depth of cut, Tool geometry, Tool material, Cutting fluid, Work material, Rigidity of work, tool and machine.
8. **What are the factors should be considered for selection of tool materials?**
   - Volume of production
   - Tool design
   - Type of machining process
   - Physical & Chemical properties
   - Rigidity and condition of machine.

9. State the characteristics of cutting tool materials.

Cutting tool materials should passes following characteristics

- High hardness
- Toughness.
- High wear resistance
- Less cost
- Low coefficient of friction

10. Mention the various parts single point cutting tool?

Shank, Face, Flank, Base, Nose, Cutting edge.

11. How is metal removed in metal cutting?

Metal cutting is the process of producing workpiece component by removing unwanted material from a metal block in the form of chips. During cutting, there should be relative motion between the tool and workpiece.

12. What is the main function of Lathe?

The main function of a lathe IS to remove metal from a work piece to give it desired shape and size. The material from the work piece is removed in the form of chips.

13. What are the various operations can be performed on a lathe?

Facing, Turning, Forming, Knurling, Chamfering, Thread cutting, Drilling, Boring, Recessing, Tapping, Grooving etc.

14. What are the principle parts of a lathe?

Bed, Headstock, Tailstock, Carriage, Cross-slide, Tool post, Leg, etc.

15. What is the main requites of a lathe bed?

The lathe bed should be very strong to withstand: cutting forces and vibrations during machining.

16. What are the uses of headstock?

- Headstock carries a hollow spindle with nose to hold the work piece.
- To mount the driving and speed changing mechanisms.

17. What are the functions of a headstock?

The functions of a headstock are as follows:

- To support the spindle.
- To carry driving mechanism for work piece.
- To give multiple speeds to the spindle

18. State the various parts mounted on the carriage.

Saddle, Compound rest, Cross slide & Tool post.

19. What is a compound rest?

A member or part, which is mounted on the top of the cross slide having a base graduated in degrees.

20. What are accessories of Lathe?

The devices employed for holding and supporting the workpiece and the tool on lathe are called accessories. These include centres, chucks, carriers, face plate, angle plate, mandrels, etc.

21. What is an apron?

The integral part of several gears, levers clutches mounted with the saddle for moving the carriage along with lead screw while thread cutting.

22. List any four work holding devices.

Chucks, Centres, Face plate, Angle plate.

23. Mention the use of chucks.

Chucks are used to hold the work piece of small length and large diameter.

24. What are the various types of chucks?

- 3 jaw chuck or Self cantering chuck.
- 4 jaw chuck or Independent chuck.
- Magnetic chuck
- Collet chuck
- Air or Hydraulic chuck

25. List any four methods by which taper turning are done in a Centre lathe.

- Using tailstock set-over method
- By swivelling the compound rest
- Using taper turning attachment
- Using form tool

26. Write down the formula for calculating taper turning angle by compound rest method.

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

Where,

D - Bigger diameter

d - Smaller diameter

1 - Length of the work piece

27. What is shaper?

The machine, which is having a reciprocating type of machine tool with a single point cutting tool, used to produce flat surfaces called as Shapers.

28. List the different types of parts involved in the shaper

Base, Column, Cross rail, Saddle, Table, Ram, Tool head.

29. What are the different types of mechanism used in shaper?

- Crank and slotted Mechanism
- Whit worth mechanism
- Hydraulic shaper mechanism

30. What are the different operations performed by using shaper?

- Horizontal surface
- Vertical surface
- Angular surface
- Cutting slot and key ways
- Irregular surface

31. What is drilling machine?

It is the one of the machine tools used in workshops. It is used to produce hole on the surface of the work piece and the hole may be drilled quickly and accurately.

32. List the types of drilling machines.

- Portable drilling machine
- Sensitive drilling machine
- Upright drilling machine
- Radial drilling machine
- Gang drilling machine
- Multiple spindle drilling machine
- Automatic drilling machine
- Deep hole drilling machine

33. What are the different operations performed in drilling machine?

Drilling, Reaming, Boring, Counter boring, Counter sinking, Spot facing, Tapping, Lapping, Grinding.

34. What is reaming?

It is the secondary operation after the drilling operation has been performed to produce the accurate hole or finish the hole.

35. What is boring?

It is used to enlarge the hole by means of adjustable cutting tool with only one cutting edge.

36. What is counter boring?

It is used to enlarge the end of the hole cylindrically and the enlarge hole forms the square shoulders with original hole.

37. What is tapping?

It is the operation to produce internal threads by using tap tool.

38. List the types of drill.

Flat or spade drill, Straight fluted drill, Two lip twist drill, Centre drill.

39. Explain the difference between reaming and boring.

In reaming operation, a multi tooth revolving tool is used which is called as Reamer whereas, boring operation is done for enlarging an existing hole size.

40. State various methods used for holding tools in a drill spindle.

The various methods used for holding tools in a drill spindle are,

- By directly fitting in the spindle
- By a sleeve
- By a socket
- By chucks.

41. Define milling.

Milling is the machining process of using rotary cutters (multi cutting tooth) to remove material from the workpiece.

42. What are the specifications of the milling machine?

- The table length &width.
- Number of spindle speeds &feeds.
- Power of driving motor.

43. What are the cutter holding devices?

- Arbors
- Collets
- Adaptors

44. list out the various milling operations?

- Plain or slab milling.
- Face milling.
- Angular milling.
- Gang milling.
- End milling.
- Gear cutting.

45. What are the types of milling machines?

- Horizontal milling machine
- Vertical milling machine
- Planer type
- Special type.

46. What is meant by up-milling and down-milling?

- In up-milling, cutter rotates in a direction opposite to that in which workpiece is fed.
- In down-milling, the directions of rotation of the cutter and workpiece fed are same.

47. What are the special attachments made in the universal milling machine?

Dividing head, Vertical milling attachments, Rotary attachment, Twist drill, Reamer

48. What is vertical milling machine?

In vertical milling machine the spindle is mounted vertical or perpendicular to the table.

49. Define facing operations.

Facing is the proccess of reducing length of the work piece. it is done using cross slide. the tool is fed using the carriage.

50. Define Turning operation.

Turning is the removal of metal from the outer diameter of a rotating cylindrical workpiece. Turning is used to reduce the diameter of the workpiece, usually to a specified dimension, and to produce a smooth finish on the metal. Often the workpiece will be turned so that adjacent sections have different diameters.

51. Define Knurling operation.

A forming process that adds a pattern on the exterior of a workpiece, either for cosmetic reasons or better handling.

Types: Annular rings, Linear knurl, Diamond knurl

52. Define tapper turning.

An operation performed on a lathe that feeds a tool at an angle to the length of the workpiece in order to create a conical shape

53. What is the use of pitch gauge?

A thread pitch gauge also known as a screw pitch gauge or pitch gauge, is used to measure the pitch or lead of a screw thread

This device allows the user to determine the profile of the given thread and quickly categorize the thread by shape and pitch. This device also saves time, in that it removes the need for the user to measure and calculate the thread pitch of the threaded item.

54. What is use of Vernier caliper?

A vernier caliper is used to take measurements that are accurate to within .001 of an inch or .02 of a millimeter, depending whether the vernier is imperial or metric. This set of instructions will focus on imperial, but the same methods can be applied to a metric vernier caliper**.**

55. What is the use of surface gauge?

A surface gauge is very useful when finding the centre of a piece of round section material. It is normally used to ‘scribe’ parallel lines. Its base is heavy and this means it is stable when in used. Surface gauges sometimes have magnetic bases and this means they can be locked onto metal surfaces making it easier to use

56. What is the use of tool post and chuck key?

Tool post used for centring the work piece

Chuck key used for holding the work piece

57. What is the use of V-block?

V block are precision metal working jigs typically used to hold round metal rods or pipes for performing drilling or milling operations.

58. What is the use of scriber?

Scriber is the hand tool used in metal working to mark lines on the work pieces ,prior to machining. The process of using scriber is called scribing and it's just part of the process of marking out.

59. What is the use of bevel protractor?

A bevel protractor is a graduated circular protractor with one pivoted arm; used for measuring or marking off angles. The bevel protractor is used to establish and test angles to very close tolerances.The bevel protractor consists of a beam, a graduated dial and a blade which is connected to a swivel plate (with Vernier scale) by thumb nut and clamp

60. What is the use Try square?

A try square is a woodworking or a metal working tool used for marking and measuring a piece of wood. The square refers to the tool's primary use of measuring the accuracy of a right angle (90 degrees); to try a surface is to check its straightness or correspondence to an adjoining surface .Try square' is sometimes spelled 'tri square'

61. What is draft allowance? How is it provided for patterns?

It the vertical faces of pattern are perpendicular to parting line, the edges of mould may damaged when the pattern is removed from the sand. Hence the vertical faces are mode taper for easy removal of pattern. This slight taper given on the vertical sides of pattern in caused draft allowance.

62. Enumerate the characteristics of following methods of sand ramming.
a) Hand b) Jolt c) Squeeze d) Slinger

Characteristics	*Hand*	*Jolt*	*Squeeze*	*Slinger*
Density Ramming sand	Not uniform	Not uniform	Not uniform	Uniform
Strength	Not Predicated	less	moderate	high
Production rate	less	moderate	fast	fast
Accuracy	less	moderate	more	moderate

63. What are the common allowances provided on pattern?

The various types of pattern allowances normally given are;

Shrinkage allowance
Machining or finish allowance
Draft or taper allowance
Distortion or camber allowance
Rapping or shake allowance

64. What are the functions or riser?

The main function of the riser is to supply excess molten metal to the solidifying casting it allows the escape of air.

65. How pattern differ from casting?

Pattern is slightly larger in size as compared to the casting. Pattern may be in two or three pieces where as a casting is in one piece.

66. What are the tests carried out to determine the quality of casting?

Destructive test: Tensile, Impact, Hardness etc.

Non Destructive: Visual, sound, magnetic particles, dye penetration, ultrasonic etc.

67. Define foundry.

A plant where the castings are made is called a foundry.

68. Define casting.

The Process of producing metal parts by pouring molten metal in to the mould cavity of the required shape and allowing the metal to solidify. The solidified metal piece is called as casting.

69. Define mould.

Mould is the cavity of the required casting made in wood, metal or plastics.

70. Define pattern.

The Model of the required casting made in wood, metal or plastics.

71. Name the various pattern materials.

Wood – Teak wood, white pine etc.
Metal – cast iron, brass, aluminium etc.
Plaster
Plastic
Wax

72. What are the different types of patterns used in foundries?

Solid or single piece pattern, match plate pattern, split pattern, sweep pattern, skeleton Pattern, segmental pattern, loose piece pattern, shell pattern.

73. When do you made core (or) what is function of core in moulding sand?

To provide a hollow surface or recess on the casting, the core is made.

74. What is core print and what is its purpose?

A core print is an extra projection on the pattern. It supports the core.

75. What do you understand by core setting?

Caring or heating the cores to obtain enough hardness is called as core setting.

76. What are requirements of core sand?

Permeability, refractoriness, strength collapsibility, stability.

77. Mention the specific advantages of CO2 process.

Give strength and hardness to core
Process cost is less
It saves time on heating

It can be stored for long use

78. What is the properties good moulding sand?

Porosity or permeability, plasticity or flowability, strength or cohesiveness, adhesiveness, Refractoriness, collapsibility.

79. What are the different types of moulding sand?

Green sand, Dry sand, Synthetic sand, Loam sand, Special sand, parting sand.

80. Write the composition of good moulding sand.

Green sand:

It contains 5 to 8% water and 15 to 20% clay.

Loam Sand:

Loam sand is a mixture of fine sands, fine refractoriness, clay, graphite fiber and water. It contains more clay (50%)

81. List out any five moulding tools:

Shovel, Riddle, Rammer, Trowel, Slick, Strike off bar, lifter

82. What are the uses of runner and riser?

Runner:

It is used to make a sprue a hole in the cope.

It receives the molten metal from the pouring basin and passes to the cavity.

Riser:

It supplies excess molten metal to the solidifying casting.

It allows the escape of air.

83. What are chaplets?

Some times it is not possible to provide sufficient support for a core in the mould being poured, if the cores are bigger in size. In such cases the core is supported with rigid metal pieces called chaplets.

84. What are the different types of furnaces used for casting?

Cupola furnace, open hearth furnace, crucible furnace, pot furnace, Electric furnace.

85. What is need for providing chills in casting?

The chills are used to provide directional solidification or to increase the rate of Solidification where the higher hardness required.

86. Name four different casting defects.

Shifts - Two halves mismatching or casting

Hot tear - Internal or external cracks

Fins - Thin projection of parting line

Inclusions - Foreign material present in casting