

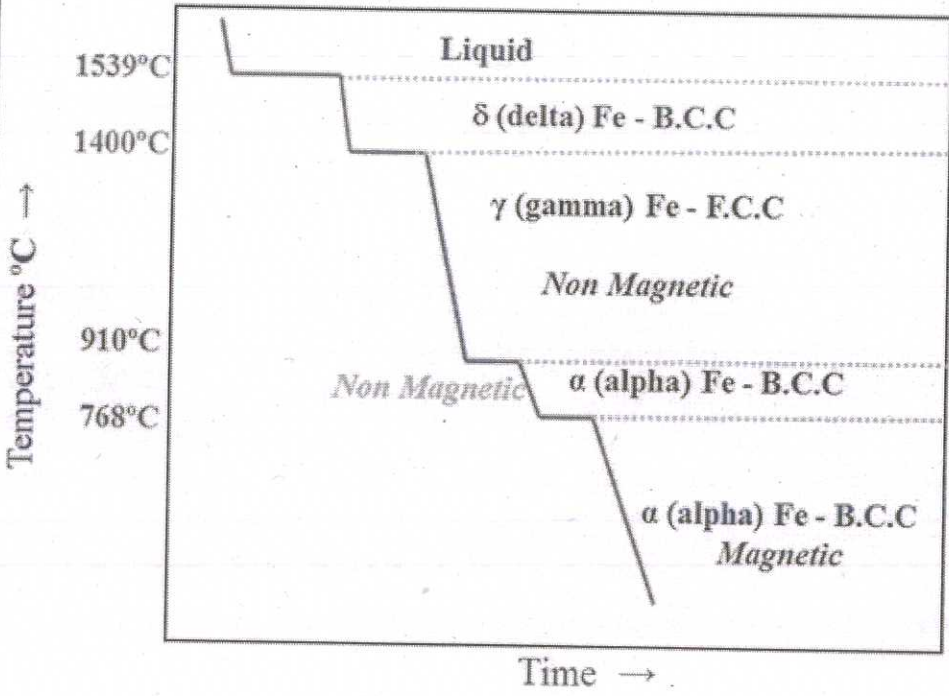
**SCHEME OF VALUATION**

**(Scoring Indicators)**

Revision: 2015

Course Code:4023

Course Title:METALLURGY & MACHINE TOOLS

Qst No	Scoring indicator	Split up score	Sub Total	Total
<b>PART - A</b>				
I				
1	The phenomenon where ductile metals become stronger and harder when they are deformed plastically.	2		2
2	A Mandrel is a device used for holding and rotating a hollow job that has been previously drilled or bored.	2		2
3	Indexing is the operation of dividing the periphery of a workpiece into any number of equal parts.			
4	Mechanism for automatic feed for the table in shaper.	2		2
5	Refine grain structure, To soften metals, Improve grain size,Improve machinability	2		2
		2		2
<b>PART - B</b>				
II 1	 <p>The diagram is a cooling curve for iron. The vertical axis is labeled 'Temperature °C' with an upward arrow, and the horizontal axis is labeled 'Time →'. The curve starts in the 'Liquid' phase. It shows four horizontal plateaus representing phase transformations at the following temperatures: 1539°C (Liquid to δ (delta) Fe - B.C.C), 1400°C (δ (delta) Fe - B.C.C to γ (gamma) Fe - F.C.C), 910°C (γ (gamma) Fe - F.C.C to α (alpha) Fe - B.C.C), and 768°C (α (alpha) Fe - B.C.C to α (alpha) Fe - B.C.C). The region between 910°C and 768°C is labeled 'Non Magnetic', and the region below 768°C is labeled 'α (alpha) Fe - B.C.C Magnetic'.</p>	6 x 1		6

2	<table border="1"> <thead> <tr> <th data-bbox="209 232 296 331">SL NO</th> <th data-bbox="296 232 724 331">SLIP</th> <th data-bbox="724 232 1153 331">TWINNING</th> </tr> </thead> <tbody> <tr> <td data-bbox="209 331 296 398">1</td> <td data-bbox="296 331 724 398">Crystal slip is a line defect.</td> <td data-bbox="724 331 1153 398">Twinning is a surface defect.</td> </tr> <tr> <td data-bbox="209 398 296 544">2</td> <td data-bbox="296 398 724 544">During slip, all atoms in a block move the same distance.</td> <td data-bbox="724 398 1153 544">During twinning, the atoms in each successive plane in a block move through different distances.</td> </tr> <tr> <td data-bbox="209 544 296 645">3</td> <td data-bbox="296 544 724 645">Slip is commonly observed in BCC and FCC metals</td> <td data-bbox="724 544 1153 645">Twinning is commonly observed in HCP metals</td> </tr> <tr> <td data-bbox="209 645 296 745">4</td> <td data-bbox="296 645 724 745">The slipped crystal lattice has the same orientation.</td> <td data-bbox="724 645 1153 745">The twinned crystal lattice is the mirror image of the original lattice</td> </tr> <tr> <td data-bbox="209 745 296 846">5</td> <td data-bbox="296 745 724 846">The stress required for slip is comparatively low.</td> <td data-bbox="724 745 1153 846">The stress required for twinning is comparatively more.</td> </tr> <tr> <td data-bbox="209 846 296 992">6</td> <td data-bbox="296 846 724 992">The stress necessary to propagate slip is usually higher than the stress required to start slip.</td> <td data-bbox="724 846 1153 992">The stress necessary to propagate twinning is usually higher than the stress required to start it.</td> </tr> </tbody> </table>	SL NO	SLIP	TWINNING	1	Crystal slip is a line defect.	Twinning is a surface defect.	2	During slip, all atoms in a block move the same distance.	During twinning, the atoms in each successive plane in a block move through different distances.	3	Slip is commonly observed in BCC and FCC metals	Twinning is commonly observed in HCP metals	4	The slipped crystal lattice has the same orientation.	The twinned crystal lattice is the mirror image of the original lattice	5	The stress required for slip is comparatively low.	The stress required for twinning is comparatively more.	6	The stress necessary to propagate slip is usually higher than the stress required to start slip.	The stress necessary to propagate twinning is usually higher than the stress required to start it.	6 x 1	6	6
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3	<ul style="list-style-type: none"> <li>a) Cutting fluid washes away the chips and hence keeps the cutting region free</li> <li>b) It protects the finished surface from corrosion.</li> <li>c) It decreases wear and tear of cutting tool.</li> <li>d) It improves machinability.</li> <li>e) It cools the tool and workpiece</li> <li>f) It prevents expansion of work pieces.</li> <li>g) It increases tool life.</li> </ul>	6x1 (Any six)		6																					
4	<p>In this method tailstock centre is moved horizontally out of line with the lathe axis. This movement is called offset. The offset is done by adjusting the setover screw. The work is fitted between the centres. Due to the offset of the tailstock, the axis of rotation of work is inclined at an angle to the lathe axis. This angle is equal to the half of the taper angle. To obtain taper, the cutting tool is fed parallel to the lathe axis.</p>	Exp-3																							

Drill Stock Offset for Taper Turning

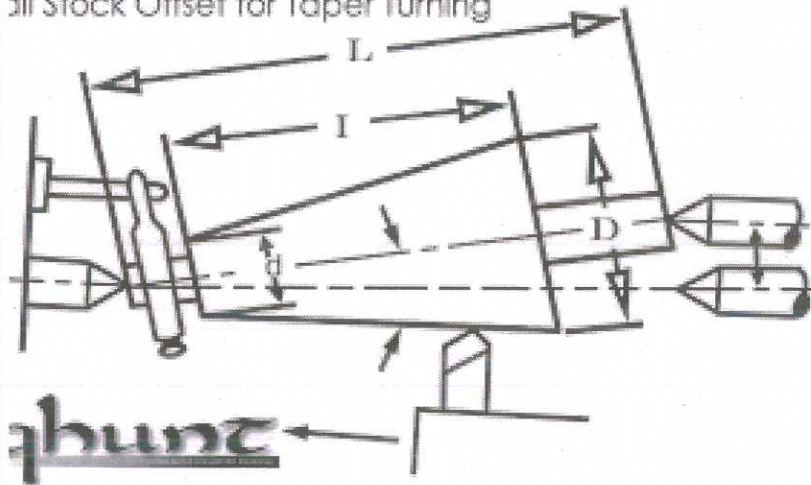


Fig-3

6

5

The tools are fitted into the drill spindle by different methods They are

- i) By directly fitting in the spindle
- ii) By a sleeve
- iii) By a socket
- iv) By a chuck
- v) Tapping attachment

4x0.5

2

6

(Any four)

**SPINDLE** - All drilling machines have their spindle bored out to a standard taper to receive the taper shank of the tool. While fitting the tool, the shank of the drill is forced into the tapered hole and the tool is gripped by friction. To ensure a positive drive, the tang of the tool fits into a slot at the end of the taper hole. The tool may be removed by pressing a tapered wedge known as drift into the slotted hole of the spindle.

**SLEEVE** - If the shank of the tool is smaller than the taper in the spindle hole, a taper sleeve is used. The outside taper of the sleeve conforms to the spindle taper and the inside taper holds the shank of the smaller size tools. The sleeve has a flattened end which fits into a slot of the spindle. The tang of the tool fits into a slot provided at the end of the taper hole of the sleeve.

2x2  
(Any two)

4

**SOCKET** - A Socket consists of a solid shank attached to the end of a cylindrical body. The taper shank of the socket conforms to the taper of the drill spindle and fits into it. The body of the socket has a tapered hole larger than the drill spindle taper into which the taper shank of any tool may be fitted.

**CHUCK** - The drill chuck has a taper shank which fits into the taper hole of the spindle. The jaws fitted in the body of the chuck holds the straight shank drills.

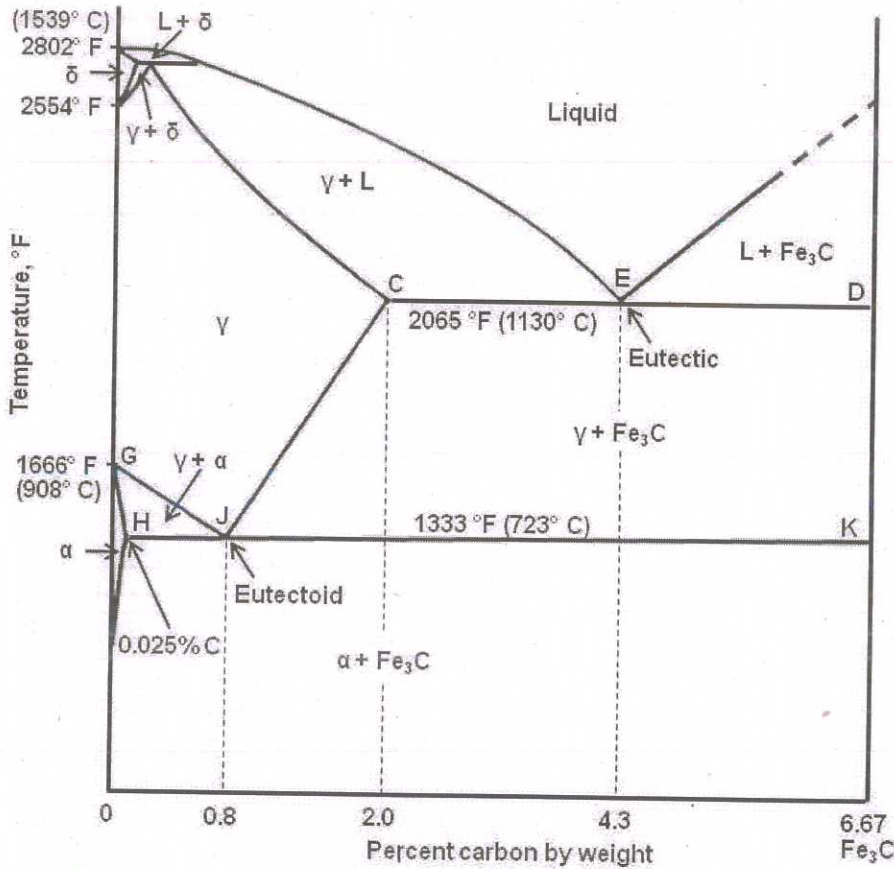
6	SL NO	SHAPER	PLANNER	6x1	6	6
	1	The work is held stationary and the cutting tool on the ram is moved back and forth across the work.	The tool is stationary and the work piece travels back and forth under the tool.			
	2	It is used for shaping much smaller work	It is meant for larger jobs			
	3	A shaper is a light machine	It is a heavy duty machine			
	4	A shaper uses one cutting tool at a time	Several tools can cut simultaneously on a planner			
	5	The shaper is driven using quick return link mechanism.	The drive on the planner table is either by gears or by hydraulic means.			
	6	Shaper can employ light cuts and finer feed.	Planer can employ heavier cuts and coarse feed.			
7	<p>Specification of a Slotter</p> <p>i) Max. Length of Ram stroke</p> <p>ii) Diameter of work table in mm</p> <p>iii) Type of drive</p> <p>iv) Maximum table travel</p> <p>v) Power input</p> <p>vi) Floor space required</p> <p>vii) No of speeds available</p> <p>viii) No of feeds available</p>			6x1 (Any six)	6	6

Qst No	Scoring indicator	Split up score	Sub Total	Total
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**PART - C**

**UNIT-I**

III a



**The iron-iron carbide equilibrium diagram labeled in general terms**

III b)

The powder metallurgy is a process for fabricating components by compacting finely powdered metallic or non metallic or both materials. It is a solid state fabrication technique. It involves following process steps,

- i) Powder production
- ii) Mixing of powders
- iii) Compacting
- iv) Secondary operations

Powder production- Very fine powders are obtained using various techniques.

Mixing of powders- The fine powders are mixed along with a lubricant. The lubricant helps in imparting good fluidity to the powders.

7

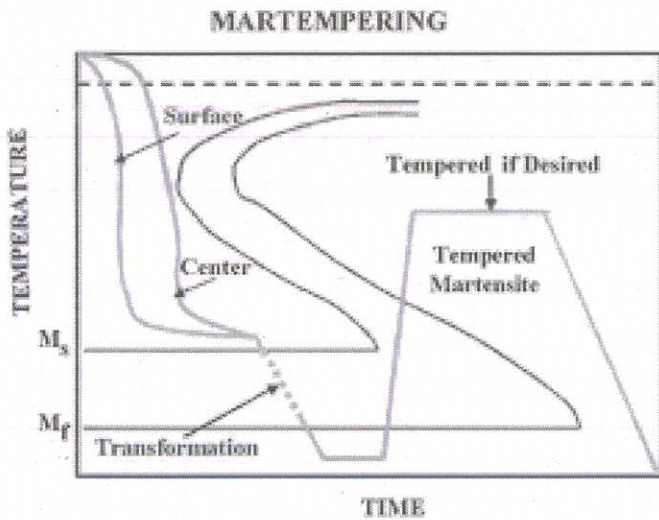
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Compacting- The blended powder is compacted in a mold or die.

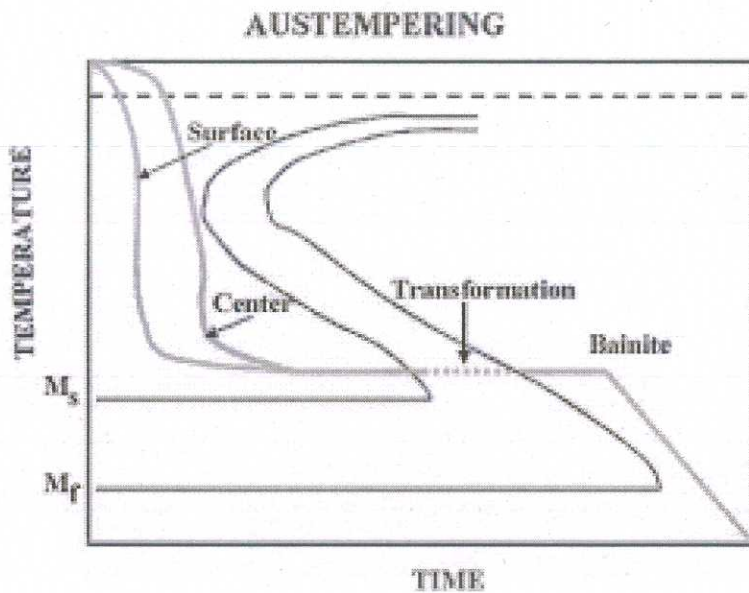
Sintering- The compacted mass is sintered at a high temperature in a furnace in a controlled atmosphere.

Secondary operations- It includes sizing to achieve high dimensional accuracy, machining, treatment and final inspection to check the quality of final product.

IV a



Steel is heated above the transformation range, then suddenly quenched in a molten salt bath at a temperature 80 to 300°C. The piece is held at that temperature until the outside temperature are equalized. The part is then reheated and cooled at moderate rate.



Steel is heated above the transformation range, then suddenly quenched in a molten salt bath at a temperature 200 to 450°C. The piece is held at that temperature until the outside temperature are equalized. The part is then reheated and cooled at moderate rate.

Fig-2  
Exp-2

4

8

Fig-2  
Exp-2

4

IV b

Crystal defects are four types. Point defect, line defect, surface defect and volume defect.

**Point defect** -Point defects are the irregularities or deviations from ideal arrangement around a point or an atom in a crystalline substance. Point defects are vacancy, interstitial, frenkel defect, schottky defect.

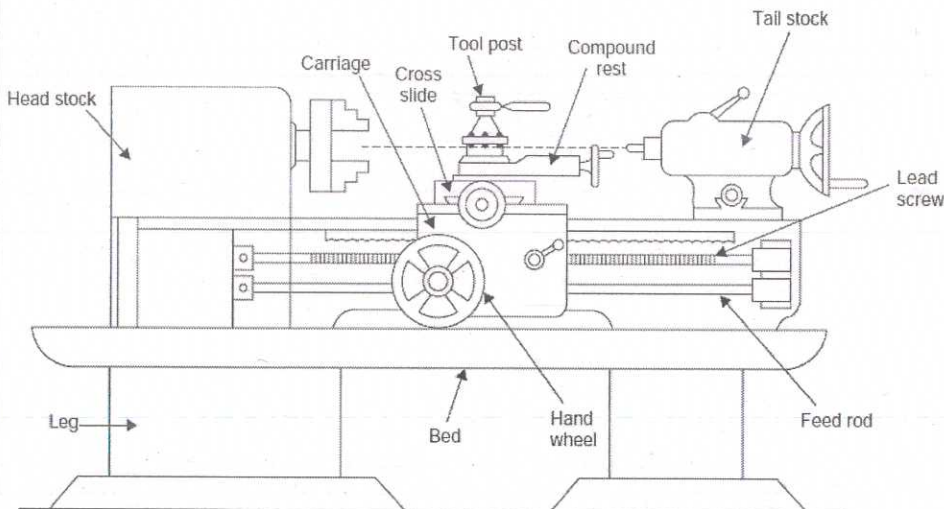
**Line defect**- Line defects are the irregularities or deviations from ideal arrangement in entire row of lattice points. Line defects are edge dislocation and screw dislocation.

**Surface defect**-Surface imperfections arise from a change in the stacking of atomic planes or across a boundary. They are of 2 types. External or internal surface imperfections. Internal surface defects are grain boundaries, tilt boundaries, twin boundaries and stacking faults.

**Volume defects**-Volume defects are cracks, presence of large vacancy, foreign particle inclusion and non crystalline regions which have the dimensions of the order of 0.2nm.

7

V a



8

V b

The various types of chips in metal cutting are

i Continuous chips

If the metal chips formed during machining is without breakage then it is called continuous types of chips. Conditions which are responsible for the formation of continuous chips are ductile materials, large rake angle of the tool, high cutting speed, minimum friction between chip and tool interface

ii Discontinuous chips

If the chip formed during machining crosses with breakage is called discontinuous chips. Discontinuous types of chips are formed when hard and brittle materials is machined. Conditions-low feed rate, small rake angle of the tool, high cutting

3x1.5

4.5

speed, too much of depth of cut

iii Continuous chips with built up edge

This type of chip is formed by machining ductile material with high friction and the chip tool interface. Conditions-excessive feed rate, small rake angle of the tool, low cutting speed and lack of coolant.

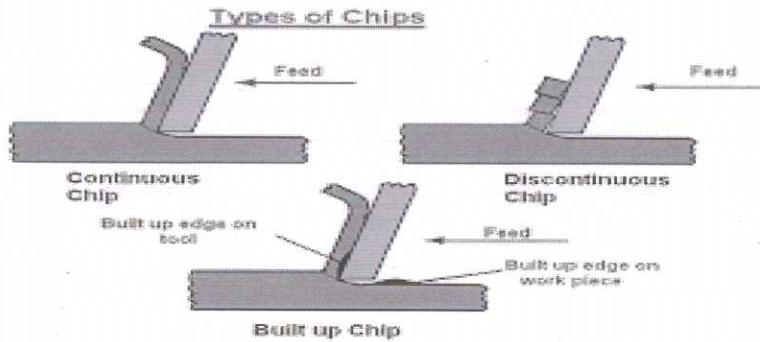


Fig-2.5

2.5

7

VI a

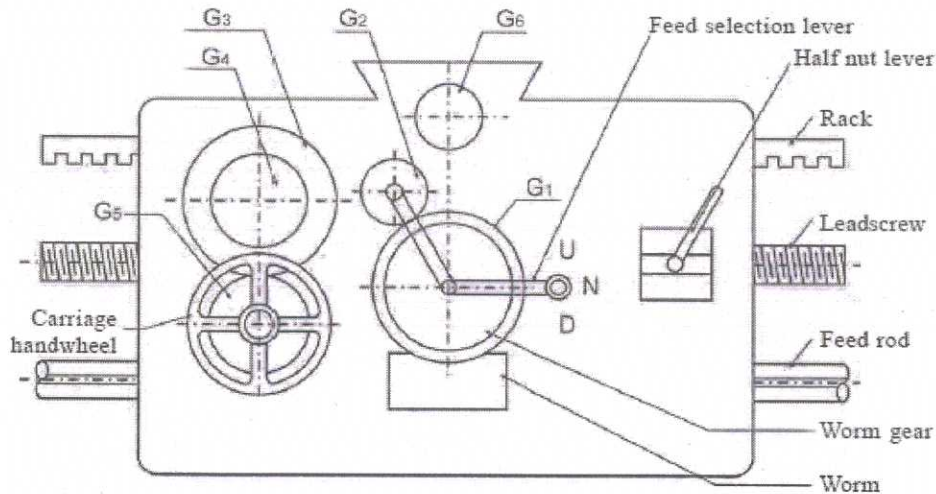


Fig-4

8

Apron is attached to the carriage and hangs over the front side of the lathe bed. It is useful in providing power and hand feed to both carriage and cross-slide. It is also used to provide power feed to the carriage during thread cutting through two half nuts.

Exp-4

The feed selection lever can be kept in neutral, up and down positions to obtain the following movements. i) Hand feed and power feed to the carriage. ii) Hand feed and power feed to the cross slide

VI b

Work holding devices in lathe

- i) Three jaw chuck and four jaw chuck
- ii) Collet chuck and magnetic chuck
- iii) Lathe centres

iv) Lathe dogs

v) Mandrels

vi) Rests

vii) Face plate

**Lathe dogs** - Lathe dogs are cast metal devices used to provide a firm connection between the head stock spindle and the workpiece mounted between centres.

**Face plate** - A lathe face plate is a flat round plate that threads to the headstock spindle to the lathe. The face plate is used for irregularly shaped workpiece that cannot successfully held by chucks.

6x0.5

3

(Any six)

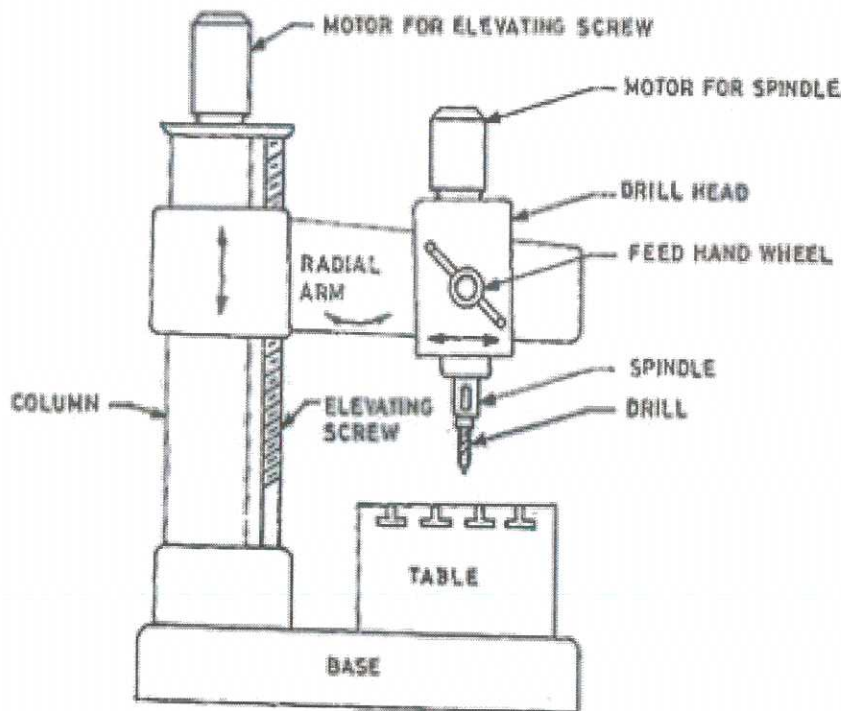
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2 x 2

4

(Any two)

VII a



8

VII b Cutting parameters of drilling machine are Cutting speed, Feed and Depth of cut.

**Cutting Speed** - The cutting speed in a drilling operation refers to the peripheral speed of a point on the cutting edge of the drill. It is usually expressed in meters per minute. The cutting speed ( $v$ ) may be calculated as

$$\text{Cutting Speed} = \pi d N / 1000 \text{ m/min}$$

Where,  $d$  - is the diameter of the drill in mm

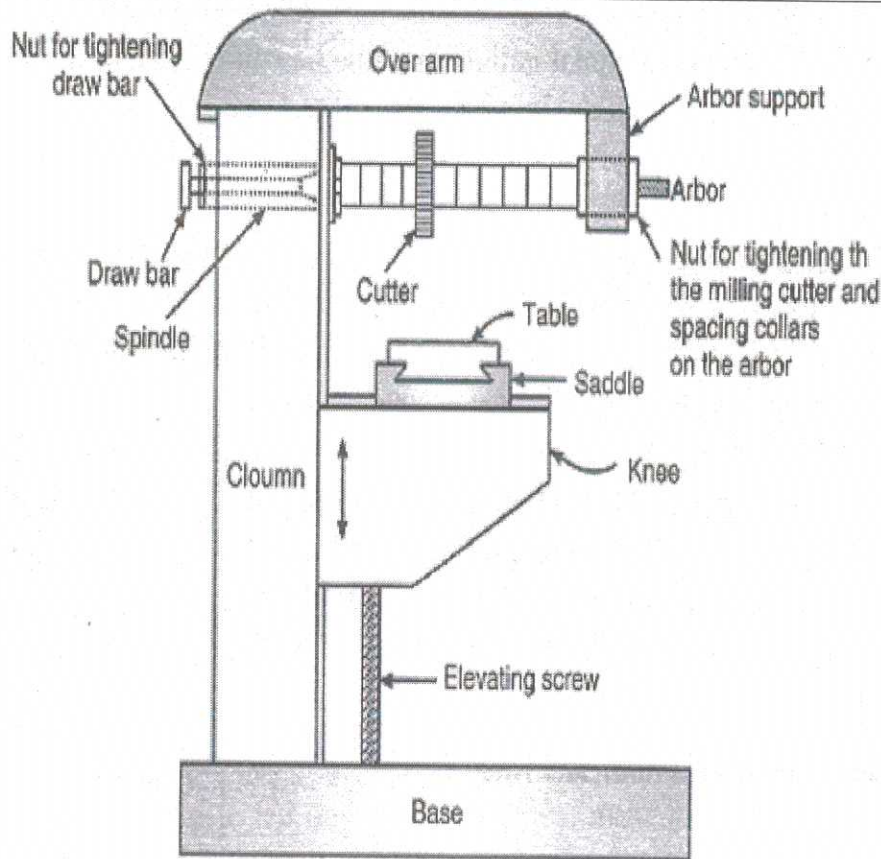
$N$  - Speed of the drill spindle in rpm

7

**Feed** - The feed of a drill is the distance the drill moves into the work at each revolution of the spindle. It is expressed in millimeters. The feed may also be expressed as feed per minute. Feed depends upon factors like the material to be drilled, the rigidity of the machine, power, depth of the hole and type of finish required.

**Depth of cut** - The depth of cut in drilling is equal to one half of the drill diameter. If  $d$  is the diameter of the drill, the depth of cut  $(t) = d/2$  mm

VIII a



8

VIII b

The tool holding devices in Milling machine are Arbor, Collet, Adapter, Screwed on arbor.

4x0.5 2

**Arbor**- Milling cutters with central holes are mounted and keyed on a shaft called arbor. The arbors are made with taper shanks for correct alignment with the machine spindle. The left side of the arbor is threaded internally to receive a draw bolt. This draw bolt connects the arbor with the spindle. A long key way is cut on the entire length of the arbor. Cutters are mounted at desired positions on the arbor by placing spacing collars between them. The spindle rotation is transmitted to the arbor and the cutter is rotated.

**Collet** - It is a form of sleeve bushing used to hold arbors or cutters having a smaller shank than the spindle taper. Collets are connected to the spindle by a draw bolt and the rotary motion is transmitted to the cutters.

2x2.5 5

**Adapters** - Milling cutters having shanks are generally mounted on adapters. The outside taper of the adapter conforms to the taper hole of the spindle. The shank of the cutter fits into the taper hole of the adaptor.

(Exp Any 2)

**Screwed arbor** - The small cutters having threaded holes at the center are held by screwed arbors. It has a threaded nose at one end and a taper shank at the other end. The shank of the arbor is mounted on the spindle.

7

IX a

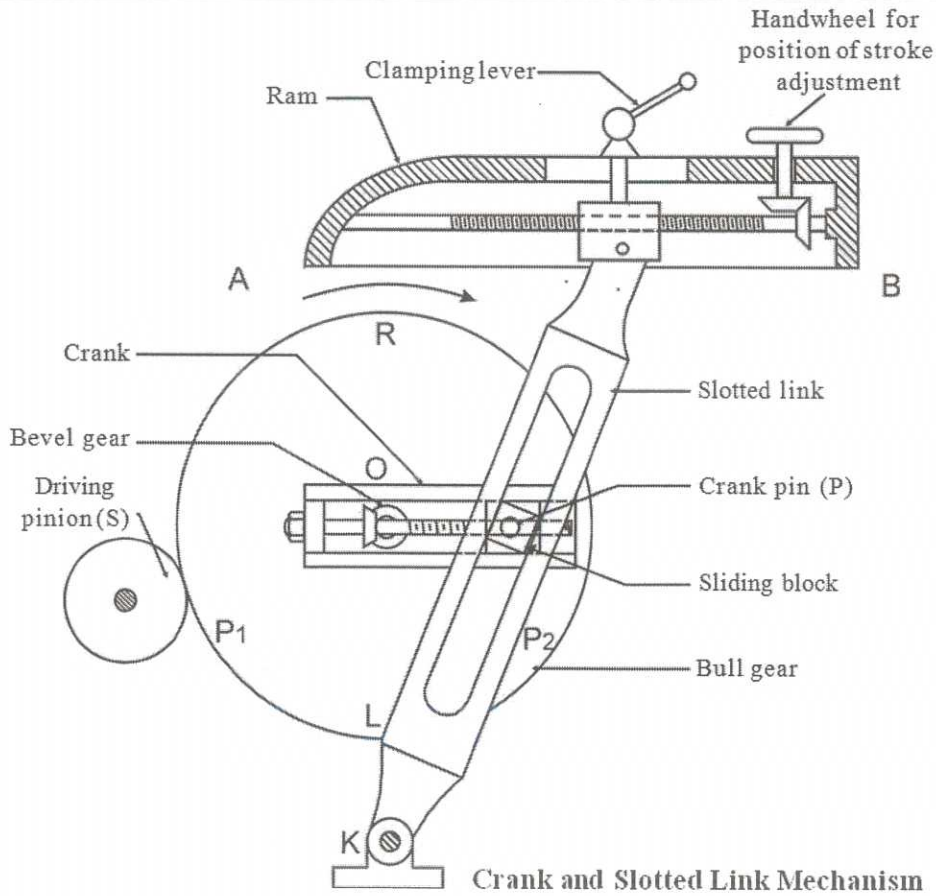


Fig- 4

8

An electrical motor runs the driving pinion(S) at a uniform speed. This pinion makes the bull gear(M) to rotate at a uniform speed. Bull gear is a large gear fitted inside the column. The point 'O' is the centre of the bull gear. A slotted link having a long slot along its length is pivoted about the point 'K'. A sliding block 'N' is fitted inside the slot and slides along the length of the slotted link. 'P' is the crank pin and 'OP' can be considered as a crank. When the bull gear rotates, the sliding block also rotates in the crank pin circle. This arrangement provides a rocking movement to the rocker arm. As the top of the slotted link is connected to the ram, the ram reciprocates horizontally. So bull gear rotation is converted into the reciprocating movement of the ram.

Exp-4

IX b Operations performed on a slotting machine

The slotting machine can be used to cut slots, splines keyways for both internal and external jobs such as machining internal and external gears.

It can be used for shaping internal and external profiles

It can be used for works as machining concave, circular, semi-circular and convex surfaces.

It can be used for machining vertical surfaces, machining angular or inclined

7x1

7

7

surfaces, machining of shapes which are difficult to produce on a shaper machine and machining dies and punches.

It can be used for internal machining of blind holes.

X a

The planer machine used to produce flat and plane surfaces by a single point cutting tool. The planer machine is very large compared to a shaper machine. The planer machine is capable of machining heavy work piece, which cannot be fit on a shaper table.

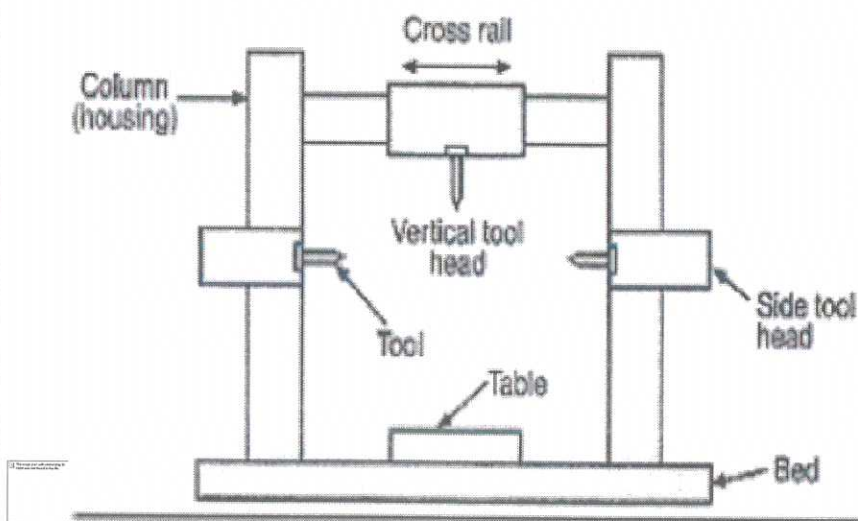


Fig-4

Working principle

In planer machine cutting tool is held stationary on tool post which is mounted on cross rail and the job along with planer table, reciprocates past the tool during the cutting stroke. Cutting is done only in the forward stroke of the machine table and the return stroke of the table is idle and completed quickly. Several tools can be made to work simultaneously on the job.

Exp-4

Xb

Work holding devices in shaper

- 1) Shaper vise
- 2) Clamps and stop pins
- 3) T-bolts and step blocks
- 4) Angle plate
- 5) V-Block
- 6) Special fixtures

6x0.5

3

Vice- It is the most common and simple workholding device used in a shaper. Types of vices are plain vice, Swivel vice, Universal vice.

Clamps and stop pins - T-bolts are fitted into the T-slots of the table. The work is placed on the table. The work is supported by a rectangular strip at one end and by a stop pin at the other side. The screw is tightened to secure the work properly on the machine table.

4x1

4

(Any Four)

Angle plate- It have accurately machined two sides at right angles.Solts are provided on both the sides. One of the sides is bolted to the machine table and the workpieces are held on the other side.

V- block - It is a metal block having a 'V' shaped groove on it.It is used for holding cylindrical workpieces. Operations like keyway cutting, slot cutting and machining flat surfaces can be performed on the cylindrical workpieces held on a 'V' block.