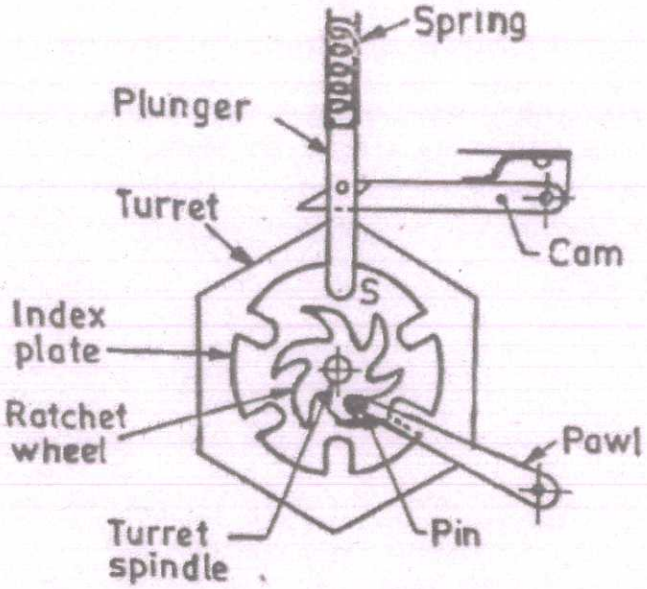
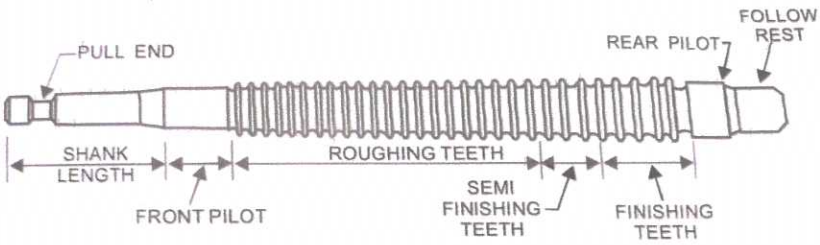
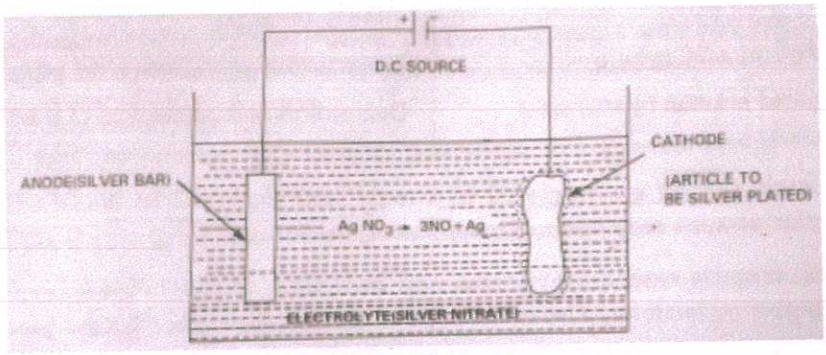
SCHEME OF EVALUATION

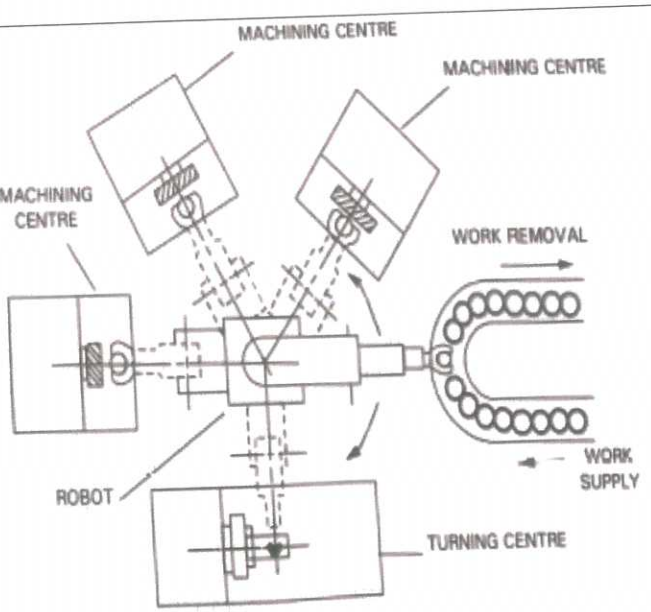
(Scoring Indicators)

Revision: 2015		Course code: 6021		
Course Title: Advanced production processes				
Qn No	Scoring indicator	Split up score	Sub Total	Total
	PART-A			
1.	A tool layout shows the complete set up for machining the work piece, the various operating positions of the turret and tooling to be done.	2	2	
2.	Collets, Chucks, Fixtures.	2 x 1=2	2	
3.	Gears can be made using Die casting, Form milling etc.[any 2 methods]	2 x 1=2	2	
4.	Truing involve removing any high spots on the grinding wheel, thereby the wheel runs concentrically with the spindle. A properly trued wheel will produce perfect round or flat work.	2	2	10
5.	Robot is a programmable work handling device. An industrial robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motions to accomplish a variety of tasks.	2	2	
	PART-B			
II.				
1.	The turret can be indexed along with it's to and fro motion. Mechanism for automatic indexing of turret is shown in figure below. The plunger locks the index plate by spring pressure and prevents rotary movement when the turret is moving forward. During this advancement the tool held in the turret performs its operation. Now indexing of turret is done during backward motion of the turret. At backward position of turret, the actuating cam lifts the plunger out of the groove and unlocks index plate. This is due	(fig 3 +exp 3)	6	

	to riding of the pin on the bevel surface of the cam. By this time, the spring loaded pawl engages with a groove of the ratchet plate, causes the ratchet to rotate as the turret moves backward. When the index plate rotate through one sixth revolution, the pin and plunger drops out of the cam and plunger locks the index plate in the next groove. Thus the turret is indexed and locked in new position. The next tool is now fed forward and the pawl is released from the plate by spring pressure.  			
2.	A hexapod is a new design of six-legged parallel mechanism structure. The hexapod is a closed chain kinematic structure. The most common hexapod configuration comprises six legs, and these legs are linear actuators such as hydraulic cylinders, or in the case of positive mechanism they could be spring loaded. The output piece is defined as the movable platform which has six degree of freedom relative to the other platform, which is the base. With six degree of freedom the movable platform is capable of moving in three linear directions and three angular directions singularly or in any combination. The hexapod consists of six struts, which are hydraulically actuated. These struts are free to expand and contract between the base at the bottom and the top platform. The platform is the output element that gets 6 DOF of the system. The platform receives all	6	6	

	six co-ordinates freedom in motion. Both ends of the hydraulic struts are connected to either the platform or the base using universal joints. Such a system was first introduced in the flight simulators positioning systems. It started to be commercially available for variety of applications that requires sub-micron accuracy.			
3.	Broaching tool is made up of a series of cutting edges which gradually increases in size along its length. The length of broach depends on the amount of metal removal, length of stroke, amount of accuracy, and the degree of finish. Three types of teeth are provided on broach tool. They are Roughening teeth, Semi-finished teeth, and Finishing teeth. The first roughening tooth is the smallest tooth on broach. Rough teeth are designed to cut heaviest metal. The next portion has semi-finished teeth which progressively increase in size upto and including first finishing tooth. Finishing teeth are designed for lighter cuts, and last few finishing teeth are made of same size to attain high degree of accuracy and surface finish. In some broaches last few teeth edges are rounded for burnishing action. The various parts of typical internal pull broach is shown in figure below.  Pull end is designed to permit engagement of the broach with the broaching machine by using puller head. Front pilot keeps the broach in the centre of the hole before cutting. The most of the stock is removed by roughing and semi finished teeth and the hole is finished to required shape by finishing teeth. Rear pilot and follower rest support the broach after the last tooth leaves the hole.	(fig 3 +exp 3)	6	
4.	Types of bonds 1. Vitrified or Ceramic bonds: made from clay, feldspar. Represented by letter 'V'. 2. Resinoid or Organic bonds: made from phenolic type plastics or resins. Represented by letter 'B'.			

	3. Rubber bonds: made of both natural and synthetic rubber. Represented by letter 'R'. 4. Shellac bonds: made of both natural and synthetic shellac. Represented by letter 'E'. 5. Oxychloride bonds: made from oxides and chlorides of magnesium. Represented by letter 'O'. 6. Metal bonds: The major use of metal bonds is with diamond abrasive for grinding under harsh conditions. Metal bonds are also used with aluminium oxide or diamond abrasive to provide conductive wheels for electrolytic grinding.	1 x6=6	6	30
5.	The theory of electroplating is based on the Faraday's laws of electrolysis. The principle of electroplating is that when D.C. is passed through electrolyte(solution containing metallic salts) causes the metallic elements to separate from the solution and are migrated to the cathode(work piece), forming a deposit of pure metal. The particles from the anode (plating metal) pass into the solution to maintain the concentration of electrolyte. Figure below shows principle of electro- plating(Silver-plating).  	(fig 3+exp 3)	6	
6.	The flexible machining cell(FMC) has more than one machine tool with some form of pallet changing equipment, such as a robot or other specialized material handling device. The FMC generally has a fixed process, and parts flow sequentially between operations. The cell locks central computer control with real-time routing, load balancing and production scheduling logic. The use of machining cells reduces the cycle time of the parts produced and subsequently minimizes in-process inventory.			



(fig 3 + exp3) 6

7. Types of joints used in robots.

A joint permits relative motion between two links or arms of robot. Various types of mechanical joints are:

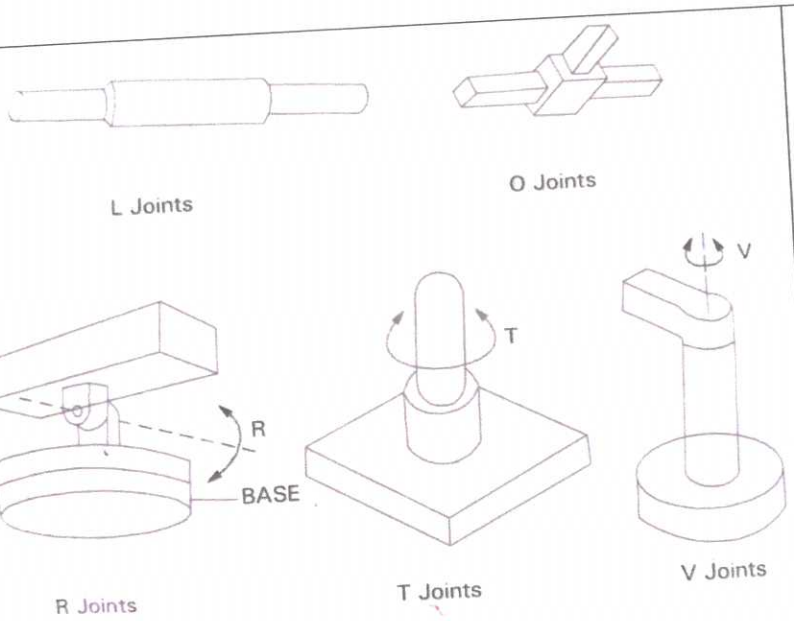
1)Linear joint (L-joint) : Permit linear sliding motion between two links whose arms are parallel.

2)Orthogonal joint(O-joint): Permits linear sliding motion between two links which are perpendicular to each other.

3) Rotational joint (R-joint): Provides rotational relative motion of the joint with the axis of rotation being parallel to the axes of the two links.

4)Twisting joint(T-joint) : Permits rotary motion between two links, the axis of rotation being parallel to the axes of the two links.

5)Revolving joint (V-joint): Provides rotary motion; the axis of the input link is parallel to the axis of rotation, and the axis of output link is perpendicular to the axis of rotation.



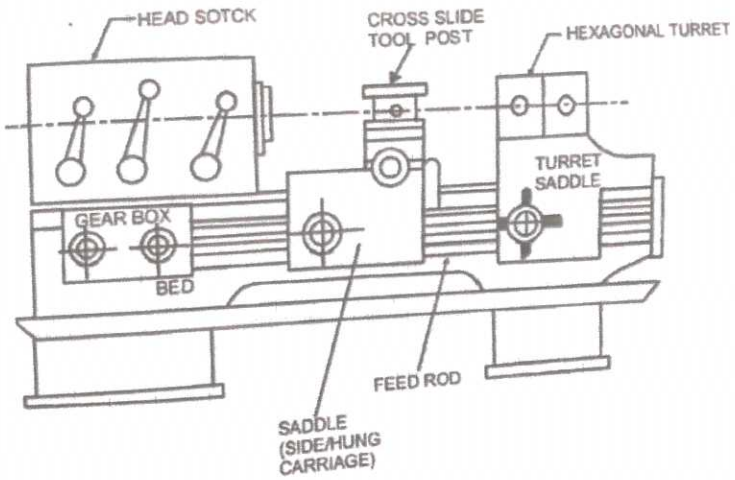
Types of Joints

(fig 3 + exp3) 6

PART-C

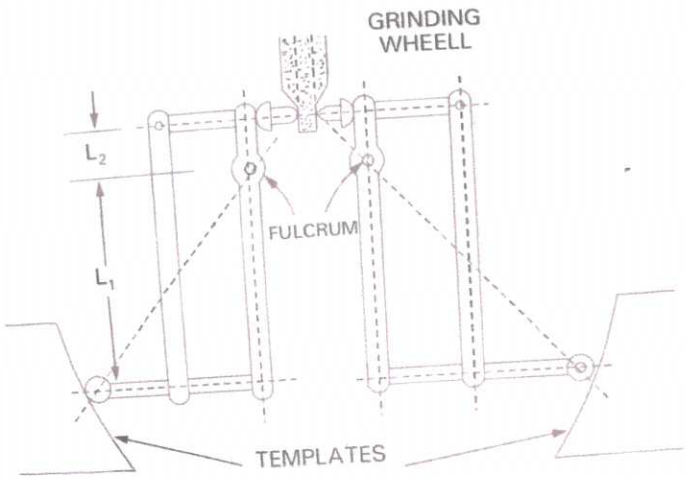
III (a) Turret lathe is a saddle type lathe in which hexagonal turret is mounted on a saddle which slide directly on the guide ways of the bed. It's main parts involves bed, headstock, turret, cross slide and carriage.

(fig4 +exp 4) 8



III (b) The working of mechanical type copying machine is based upon the principle of pantograph and is used to copy the form of an involute gear tooth space on to the grinding wheel of a gear tooth grinding machine. It will be noted that the follower, fulcrum and tracer must all lie on a straight line. Also the type of pantograph

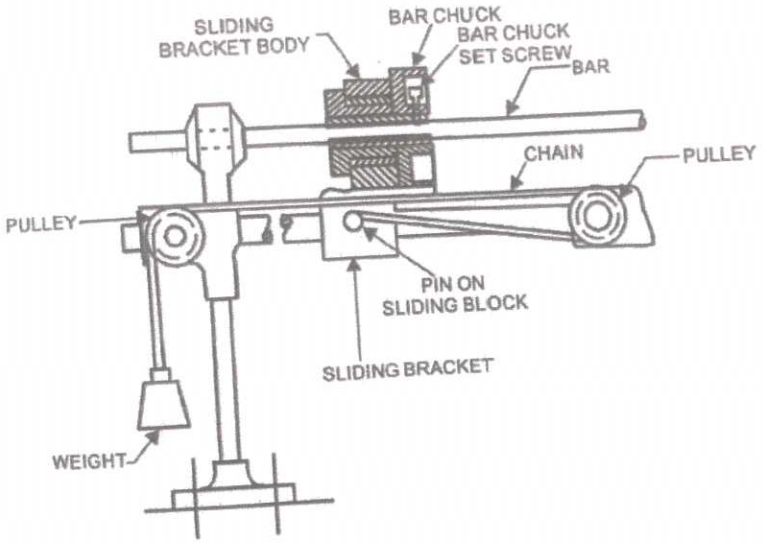
shown produces a reverse image of the template form on the wheel and hence template must be arranged accordingly. The pantograph ratio L_1/L_2 varies usually 5:1 to 10:1.



Panotgraph Copying System

(fig 4+exp 3) | 7

IV (a)



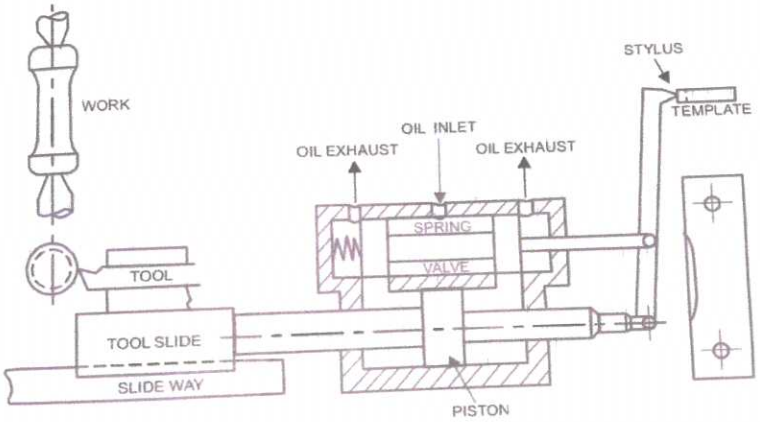
Bar work in turret lathes can be processed conveniently by incorporating bar feed mechanism. The purpose of this mechanism is to fed the bar forward through spindle into the bar stop when the collet chuck open after completing the first piece. Bar may be fed by hand, but one has to stop the machine for feeding the bar and it also wastes a lot of time.

(fig 4 + exp 4) | 8

Various types of bar feeding mechanism have been designed to

feed the bar immediately when the collet opens without stopping the machine. The bar is passed through the bar chuck, lathe spindle, and then through the collet chuck .The bar chuck rotates in a sliding bracket which is mounted on long sliding bar. The weight attached to chain exerts thrust all the time on bar chuck which is holding the bar by means of two set screws and forces the bar through the spindle when the collet chuck is released. Thus bar feeding mechanisms facilitate to feed the bar without stopping the machine.

IV (b)

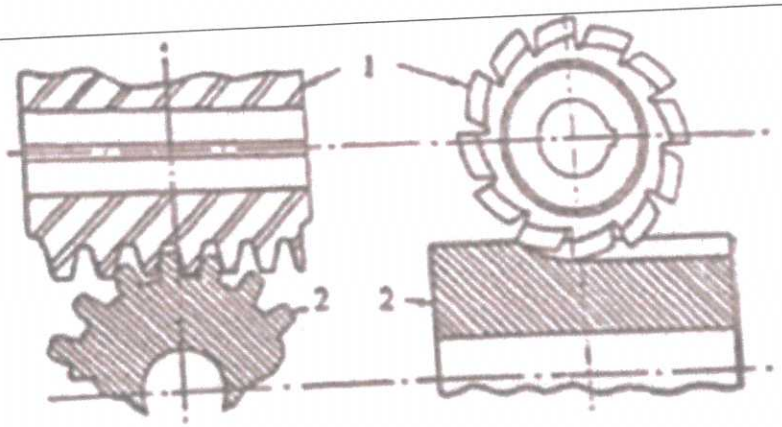


Hydraulic Servo Copying System for a Lathe

(Fig 4 +exp3) 7

Hydraulic Servo copying system has the advantage of having very little contact pressure between the stylus and template. The hydraulic units are basically servo mechanism which magnifies a relatively small input force or signal in order to provide a larger output force or signal for operating the mechanism. This output signal from the servo mechanism must be continually and automatically modified to suit variations in the input signals. In the above figure, as the lathe saddle traverses along the bed, the stylus will follow the template edge always being kept in contact by spring pressure on the left hand end of the valve spool. If the stylus moves to the right then the spool will move to the right. This will allow the oil to the left of the piston to exhaust and will allow oil into the right of the piston hence moving it to the left. Therefore, the tool slide and tool will move to the left reproducing the template shape upon the work piece.

V (a) Hobbing is one of the most fascinating gear generating process by using special cutter called hob on a gear hobbing machine.



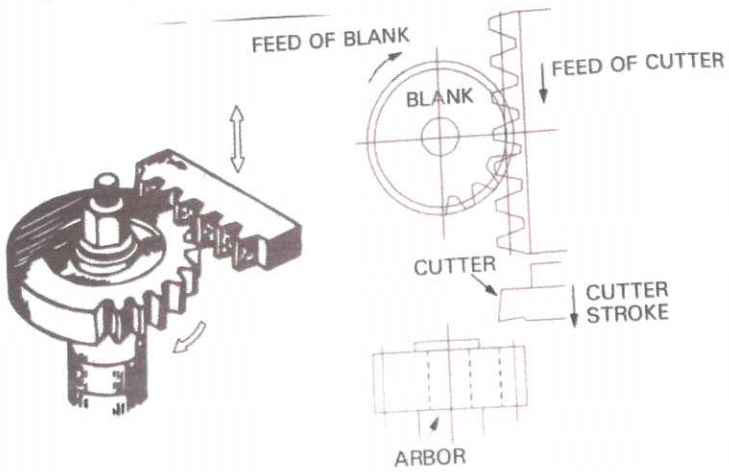
1- Hob
2-Gear blank.

In a gear hobbing machine, the hob is mounted on a spindle which is carried in the hob slide. Hob slide can be traversed vertically in either direction. The spindle head can be tilted about its axis and set at any desired angle for cutting helical gears. The hob rotates and is fed into the gear blank which is in rotation. The hob and blank are geared together so that they are worm and wheel in mesh. The hob in rotation feeds across blank face and generates involute teeth form.

(4 +4) | 8

Gear Planing using Rack cutter.

The gear planning process employs a rake cutter which reciprocates across the face of the blank. The blank rotates in the correct relationship to the longitudinal movement of the cutter as if they roll together as a rack and pinion. The principle of gear making using rack cutter is shown in figure below.



The process is ideally suited for cutting large, double helical gears

and external spur gears.

V (b) In continuous broaching machines the broach is held stationary, while the work pieces are continuously passed under them. In these machines, the work pieces are loaded and unloaded without stopping the machine. This facilitates continuous operations. This type of broaching is used for mass production of small components. Continuous broaching machine is of two types:

(fig 4 + Exp 3) 7

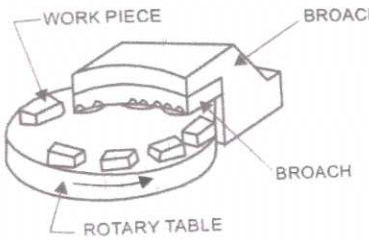


Fig: Rotary table Continuous Broaching Machine

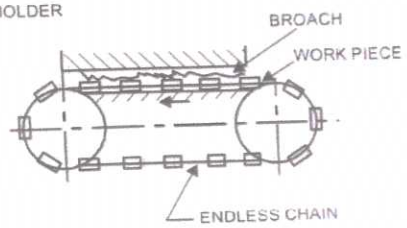


Fig: Horizontal Continuous broaching machine.

1) Rotary table continuous broaching machine.
2) Horizontal continuous broaching machine.

VI (a) A drill jig may be designed for drilling one or more holes. The following types of jigs are widely used in industry.

1) Template jig.

2) Plate jig.

3) Channel jig.

4) Box jig.

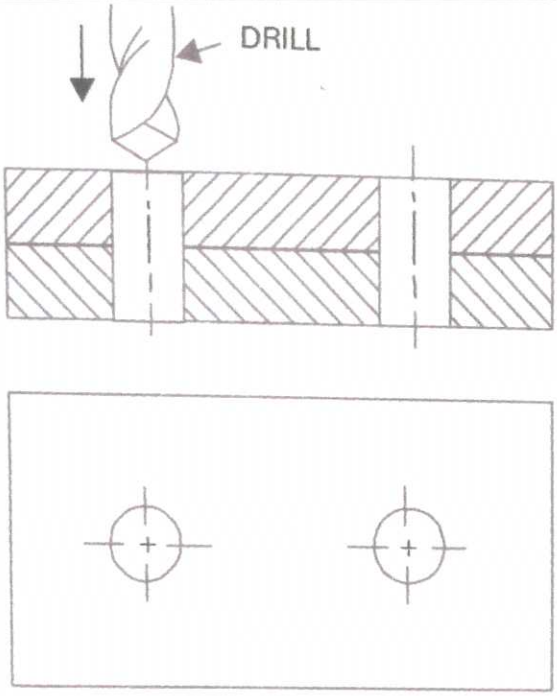
5) Leaf (latch) jig.

6) Indexing jig.

7) Universal jig.

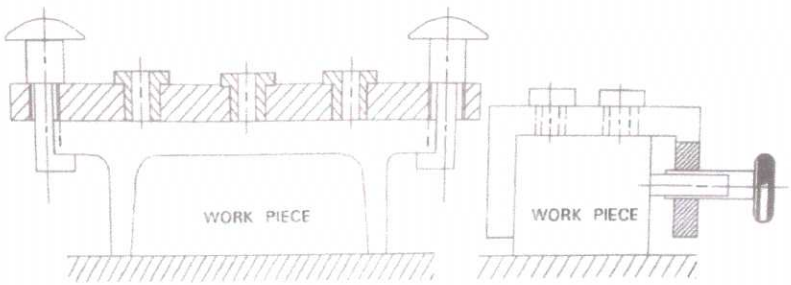
<u>Template jig.</u>

Template jig is a simple jig and it may be used when making plain holes. It consists of holes to guide the tool and is used directly over the component.



Template Jig

Channel jig.



Channel Jig

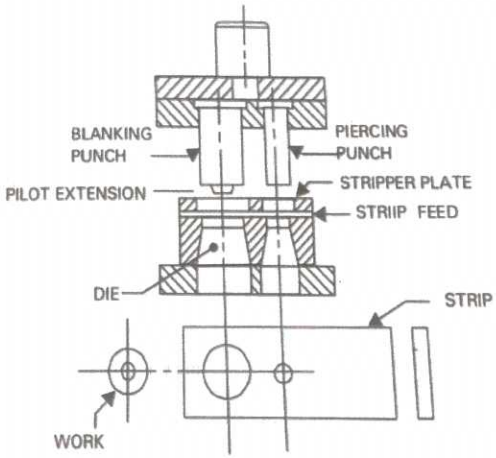
The body of channel jig is in the form of standard channel. The component is located in a channel and is clamped b screw. It is used for drilling simple symmetrical shapes.

VI (b) Progressive die (or follow on die) is used for batch production of small to medium size components. In progressive die two cutting operations (piercing and blanking) are performed at different stations by using separate punch and die for each operation. The cost of progressive die is high and is used for high rate of production. The scrap produced is high in progressive dies.

(4+4) | 8

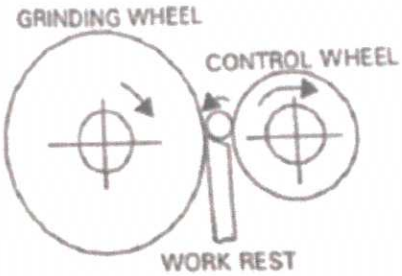
(Fig 4 + Exp 3) | 7 | 60

The strip is fed to the first station where the piercing is done. When the ram ascends the strip is then fed to the second station under blanking punch. During the stroke of press, blanking is performed at second station while piercing at the first station. From then on, each stroke of the press will produce a complete component (washer) as the strip is fed across by the same amount.



VII (a) Centre less grinding is the process of removing material from the outside diameter of a work piece using an abrasive wheel. In it's simplest form a centre less grinder consists of the machine base, grinding wheel, regulating wheel or control wheel and a blade shaped work rest. The work piece is located on it's outside diameter and supported by the work blade which is between the regulating wheel and the grinding wheel. The regulating wheel drives the part and the grinding wheel removes the material.

Centre less Grinding.

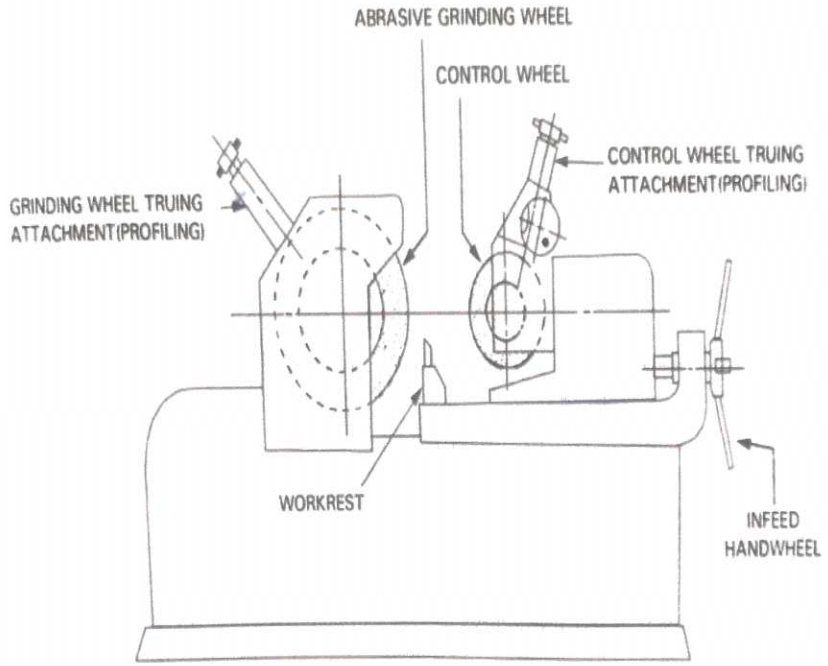


There are three types of centreless grinding:

1. Through-feed grinding.
2. Infeed grinding.

3. End feed grinding.
Centreless grinding machines are relatively simple and

easy to maintain. The figure of a centreless grinder is shown below.



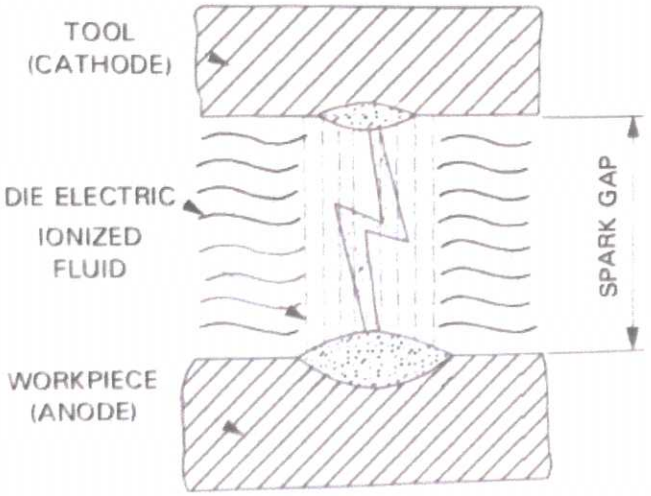
Centreless Grinding Machine

VII (b)

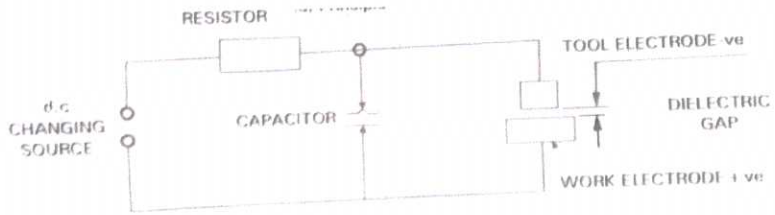
Electrical discharge machining is also known as spark erosion. With this process soft of extremely hard work pieces such as tungsten carbides can be machined. In this process the metal is removed by intense heat of electric spark. The tool and work piece are submerged in dielectric fluid. The spark discharges are created by maintaining sufficient potential difference between tool and work piece separated by a dielectric in a very small gap. A large number of electrons emitted from tool impinges on work material and thus develop a very high temperature. This temperature is sufficient to melt and even vapourise a part of the metal. In this way metal is removed from the work piece.The working principle is as described below.

(Fig 4 + Exp 4)

8

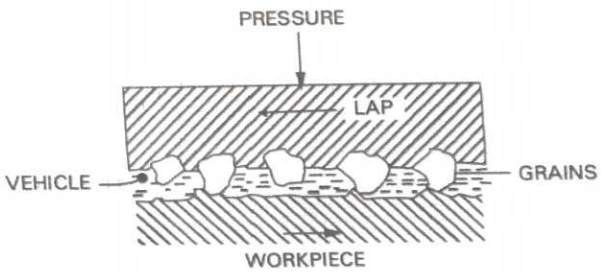


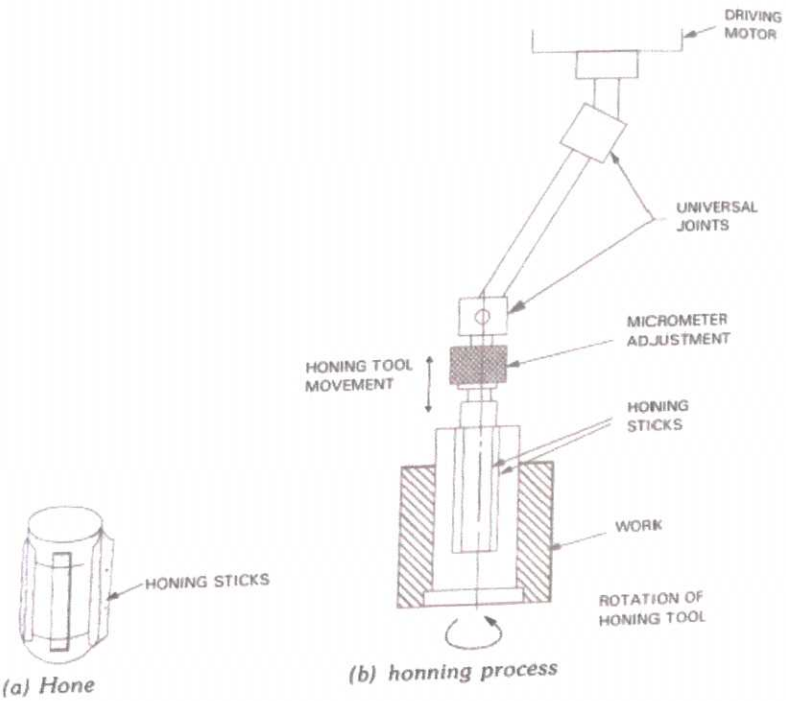
(a) Principle



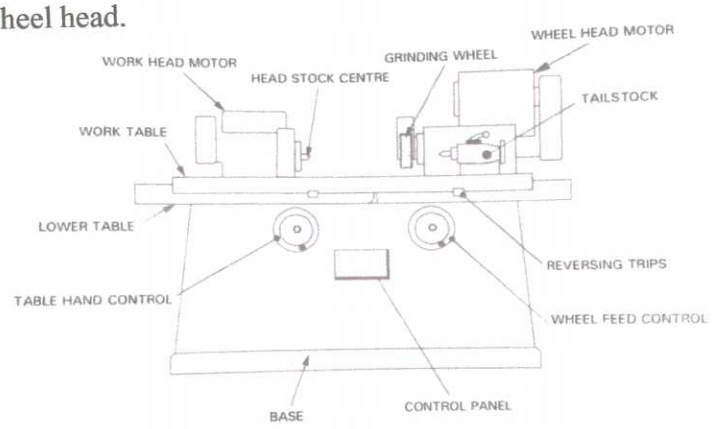
(b) Circuit Diagram

Principle of Electrical-Discharge Machining (EDM)

VIII (a)	 ***Lapping Process*** <u>Lapping :</u> Lapping is an abrasive process used to improve surface finish and to obtain small changes in dimensions or to obtain almost perfect contact between two mating surfaces. Lapping consists of rubbing work surface with lap surface which is charged with fine abrasive particles. The lap material is generally softer than the work material. The lapping pressure is generally kept in the range of 0.01-0.2 N/mm^2. The lapping can be done by	(Fig 4 +Exp 3)	7	

	hand or by machine. In hand lapping either lap or the work is held by hand and a relative motion is produced between them. Machine lapping is performed for obtaining highly finished surfaces in mass production. Honing  (a) Hone (b) honning process Honing is a finishing process in which honing tool rotates and reciprocates in the stationary hole being honed. It is used on hoes and bores which require a fine surface finish and a high degree of accuracy. For honing, the hone is inserted into the hole and adjusted to bear against the walls. Work is kept stationary and the metal is removed as a result of rotary as well as reciprocating motion of the hone in the hole. A cutting fluid is used to remove chips and to keep temperature low.	(4+4)	8	
VIII (b)	In cylindrical grinders the work is mounted between the centres and rotated against the grinding wheel. The work may also be held in a chuck for certain operations. The plain cylindrical grinding machine has the following parts: 1) Bed or Base 2) Table			

3) Head stock
4) Tailstock or Foot stock
5) Wheel head.

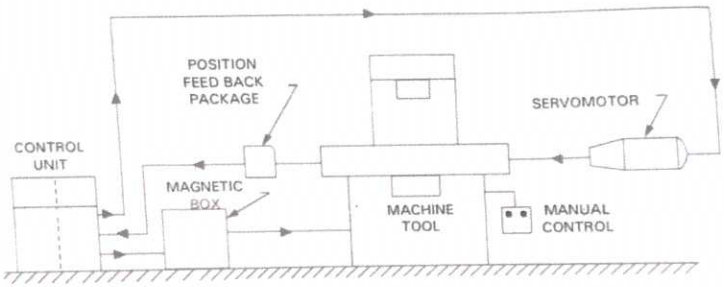


Cylindrical Grinding Machine

(fig 4 + Exp 3) 7

IX (a) The main elements of NC machine tool are:

1) The control unit
2) The drive unit
3) Magnetic box
4) The position feed back package.
5) Manual control
6) Machine tool.



Main Elements of a NC Machine

(fig 4 + Exp 4) 8

The instructions written for manufacturing the components undergo electronic processing and the control unit sends command signals to the drive unit and magnetic box which is electrically controlled. The command signals sent to drive unit through servo motor control the length of travel and feed rate, while the command signals to magnetic box controls the function such as starting or stopping of motor, selecting spindle speed, actuation of tool changes, coolant supply etc.

The position feedback package sends the information about actual position achieved to the control unit. If there is any difference between the position desire and the actual position achieved, the

drive unit is actuated by suitable amplifier from error signal.

Manual control helps the operator to perform function such as motor start-stop, coolant supply control, axes movements, speed change, feed change etc.

IX (b)

Sl. No	Conventional machine tools	CNC machine tools
1.	It requires more manual works.	It requires less manual works.
2.	Skilled labour is needed.	Less skill is enough.
3.	Less accuracy is obtained.	More accuracy is obtained.
4.	Part programming is not required.	Program is required and re-programming is easy.
5.	The system is less flexible.	The system is more flexible.
6.	It is suitable for less production rate.	More suitable for mass production.
7.	No additional features other than machining operation.	CNC's are provided with additional features like part program storage, editing etc.

(1x7) 7

X (a)

The basic components of flexible manufacturing system include:

1. Machine tools and related equipment.
2. Material handling equipment.
3. Computer control system.

8 8

1)Machine tools and related equipment: These include CNC and special purpose machine tools along with required tooling system.

2) Material handling equipment: The functions of material handling system are to move the parts between the machines and to

X (b)	locate these parts for processing at the machines. The work pieces are mounted on the fixtures or pallets and moved through the system by automatically guided vehicle or conveyers. 3)Computer control system: The functions of this system are to control machine tools, material handling system to monitor the performance of the system and to schedule the production. Besides the above components, FMS requires man power(system manager, tool and fixture setter and technicians) to run the system. Applications of robots: 1) Material handling. 2) Spray painting applications. 3) Machine loading applications. 4) Welding applications. 5) In automotive and aerospace industry. 6) Assembly of parts. 7) Inspection purposes.	(1x7)	7	