Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills).

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

……

	Marks
1. a) Attempt any SIX of the following :	**12**
i) Name the common materials used for forging.	02
Answer: ***(Note: Any four - 1/2 mark each)*** **Common materials used for forging**: 1. Aluminum alloys 5. Low-alloy steels 9. Titanium alloys 2. Magnesium alloys 6. Martensitic stainless steels 10. Tantalum alloys 3. Copper alloys 7. Austenitic stainless steels 11. Molybdenum alloys 4. Plain carbon steels 8. Nickel alloys 12. Tungsten alloys etc.	02
ii) How the fly press works?	02
Answer:***(Note: Working of fly press – 2 marks)*** **Working of fly press:-** A fly press is a type of screw press in which the screw shaft is driven by a flywheel or a pair of fly weights (balls) at the end of arm. The wheel/arm can either be cranked by hand or driven by a motor using a friction coupling. The wheel is weighted so its momentum will maintain the motion of the shaft. Movement of screw causes movement of ram & punch downwards and does the require press operation on material placed over die. Stroke of the collar adjusted with help of Stop Collar / Arrestor. **OR** A Sheet metal is placed over the die. Arm gets quick rotation with the help of handle. Heavy balls stores kinetic energy for long time movement of screw. Movement of screw causes movement of ram & punch downwards. Stroke of the collar adjusted with help of Stop Collar / Arrestor.	02
iii) Define soldering and enlist any two applications.	02
Answer: (*Note: Definition -1mark, Application- ½ mark each*) **Soldering:** Soldering is a method of uniting two or more piece of metal by means of a fusible alloy or metal, called solder, applied in the molten state.	01

Applications: ***(Any Two - 1/2 mark each)*** — 01

1. Circuitry connections of radio & T.V. sets,
2. Wiring joints in electric connections & battery terminals,
3. Radiator brass tube,
4. Copper tubing,
5. Brass halved bearings,
6. Joints in sheet metal objects such as food cans,
7. Roof flashing,
8. Rain gutters,
9. Refrigeration and plumbing machine tools components,
10. Copper foil in stained glass work.

iv) State one application of MIG and TIG welding. — 02

Answer: ***(Note: Application- 1 mark for each)***

Application of MIG Welding-*(Any One)*

1. Repairing of Automobile components like arm, axle beam, axle housing etc.
2. Preparation of pipe joints — 01
3. Reinforce the surface of worn-out railroad track
4. Car industry-for welding of straight, circular welds

Application of TIG Welding-*(Any One)*

1. **Aerospace industry,**
2. **Manufacture of space vehicles,**
3. **Weld small-diameter for thin-wall tubing,**
4. **Welds for piping of various sizes,**
5. **Repair tools and dies,** — 01
6. **Joining thin sheet material,**
7. **Used in the manufacture of chemical plant or boilers**

v) Compare between welding and riveting and bolting. — 02

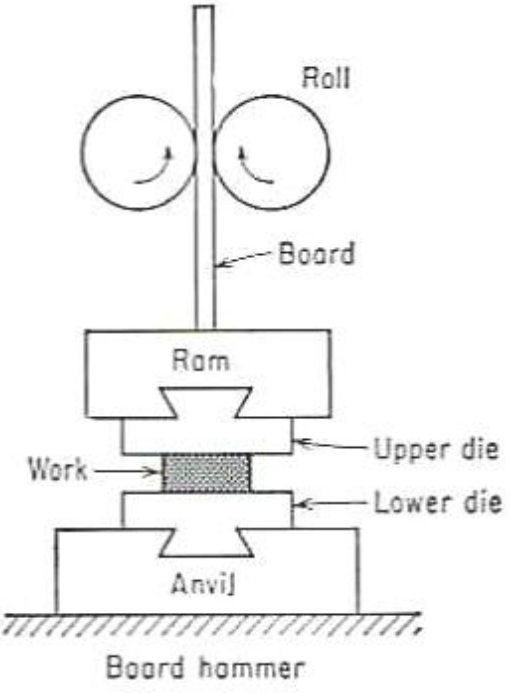
Answer: ***(Note: Any two – 1 mark each, & Marks should be given to equivalent answer)*** — 02

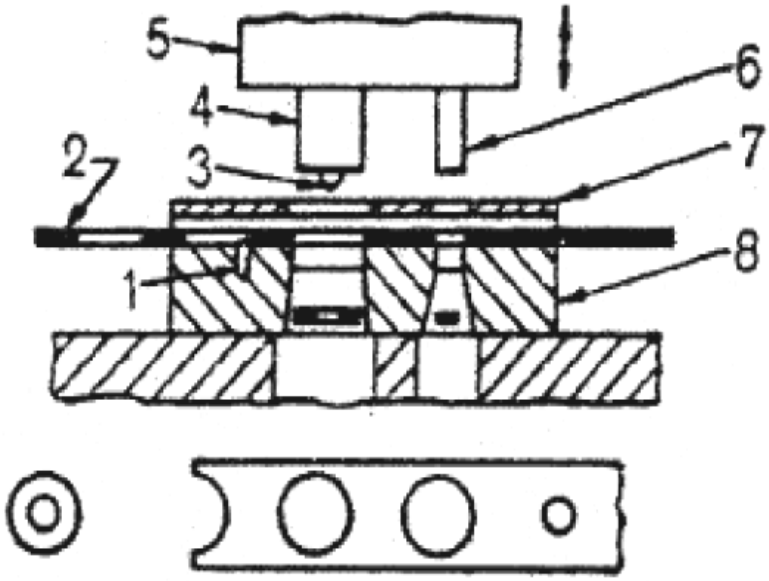
Sr	Welding	Riveting	Bolting
1	Permanent Fastening	Permanent Fastening	Temporary fastening
2	Joined by using fusing	Joined by riveting process	Joined by nut and bolt
3	More time required to join	Moderate time required to join	Less time required to join
4	Inspection is difficult	Inspection is easy as compare to welding	Inspection is easy
5	Skilled manpower required	Semi-Skilled manpower required	Skilled manpower not required
6	Investment of cost equipment is more	Investment of cost equipment is moderate	Investment of cost equipment is less

vi) State the meaning of G70, G71, M02, M30 codes. — 02

Answer: ***(Note: Meaning of Code - ½ mark each)*** — 02

1. **G70-**Input in Inches,
2. **G71-**Metric Input or input in mm,
3. **M02-**End of Program,
4. **M30-**End of program & reset

vii) Classify the CNC machines based on feedback control and control system features.	02
Answer: ***(Note: Classification- 1 mark each type)*** **A. According to control loop feedback system:** 1) Open – loop system 2) Closed – loop system **B. According to type of tool motion control system:** ***(Any two)*** 1) Finite positioning control system: a) Point – to – point system b) Straight cut system 2) Continuous path system: a) Two axes contouring b) Two & half axes contouring c) Three axes contouring d) Multi – axis contouring	01 01
viii) Why is neutral flame extensively used in oxy-acetylene welding?	02
Answer: ***(Note: credit should be given to any equivalent answer)*** **Reasons of using Neutral flame Extensively in Oxy-acetylene welding:** ***(Any Two – 1 mark each)*** 1. The flame is chemically neutral. It effects no chemical change in the molten metal and therefore will not oxidize or carburize the metal. 2. The temperature of the neutral flame is of the order of about 3260 degree Celsius which is lesser than the temperature of oxidizing flame. 3. Neutral flame will not create any roaring sound like oxidizing flame.	02
1. **b) Attempt any <u>TWO</u> of the following:**	**08**
i) With neat sketch describe process of drop forging.	04
Answer: Process of drop forging: ***(Note: Explanation – 2 marks & Sketch – 2 marks)***  	02

• Drop forging is carried out by using drop hammers. They are board or gravity hammer, air lift hammer and power drop hammer. Anvil of drop forging hammer is attached to the frame to permit accurate alignment of upper and lower dies. The ram is fastened to the lower end of vertical hard wood board. • The upper die and ram are raised by friction rolls gripping the board. • After releasing the board, the ram falls under gravity to produce the blow energy. • The hammer can strike between 60-150 blows per minute depending on size and capacity. • The board hammer is an energy restricted machine. The blow energy supplied equals the potential energy due to the weight and the height of the fall. • This energy will be delivered to the metal work-piece to produce plastic deformation.	02
ii) Explain progressive die with neat sketch.	04
Answer: ***(Note: Explanation – 2 marks & Sketch – 2 marks)*** **Progressive Die:**  1. Stop 2.Sheet metal 3.Pilot 4.Blanking punch 5.Ram 6.Piercing punch 7.Stripper 8.die In a progressive die two or more operations are performed simultaneously at two or more stations with each press stroke by mounting separate sets of dies and punch. The metal is progressed from one station to other. Figure shows progressive punching and blanking die. The sheet metal is fed into the first die where a hole is pierced by piercing die set in first cutting stroke of ram. The plate is then advanced in next station. In the second stroke of ram the pilot enters into the pierced hole and correctly locate it while the blanking punch descend and shear the plate to form a washer	02 02
iii) Give advantages and disadvantages of forging process.	04
Answer:***(Note: Advantages – 02 marks & Disadvantages – 02 marks)*** **Advantages of forging processes (Any Four – ½ mark each)** 1) Complex shaped parts can be forged 2) Mass production with greater accuracy is achieved.	02

3) It is very easy to maintain close tolerances.
4) Relatively good utilization of materials.
5) Does not require highly skilled operator.
6) Better reproducibility.
7) Machining is not necessary to obtain final shape.

Disadvantages of forging processes (Any Four – ½ mark each) 02

1) Initial cost of die is high.
2) High tool maintenance.
3) Limitation in size and shape.
4) Heat treatment process increases cost of the product.
5) Brittle materials like cast iron cannot be forged.
6) Complex shape cannot be produced by forging.
7) Rapid oxidation of metal surface at high temperature wears the dies.

2. Attempt any FOUR of the following **16**

a) Distinguish between open die and close die forging. 04

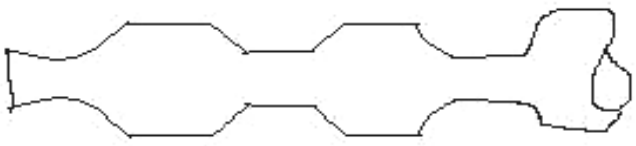
Answer: ***(Note: Any four – 1mark each)***
Difference between open die and close die forging:***(Any Four)*** 04

Sr. No.	Open Die Forging Process	Close Die Forging Process
1.	It is also known as Flat or Smith Die Forging	It is also known as Impression Die Forging
2.	In this process dies have flat faces only.	In this process dies have cavities at inner surface.
3.	There may be chance to change shape & size of product.	There may be no chance to change shape & size of product due to cavity.
4.	Final shape of forging depends on skill of smith.	Final shape of forging depends on accuracy of die cavity.
5.	Complex parts can't be forged easily.	Complex part can be forged easily
6.	It is used to large volume of parts.	It is used to small volume of parts.
7.	Used for job production.	Used for Batch/ mass production.
8.	Less accuracy achieved.	More accuracy is achieved.

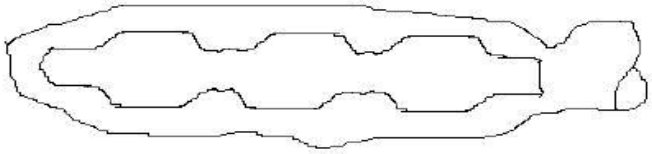
b) Describe forging operation for manufacturing of crankshaft. 04

Answer : ***(Note: Process – 02 marks & Sketches – 02 marks)*** 04

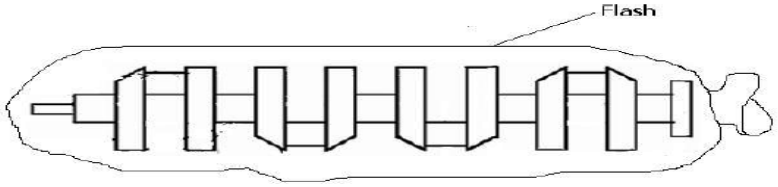
i) Stock is redistributed and size is increased at certain place and reduced at other place by roll forging.



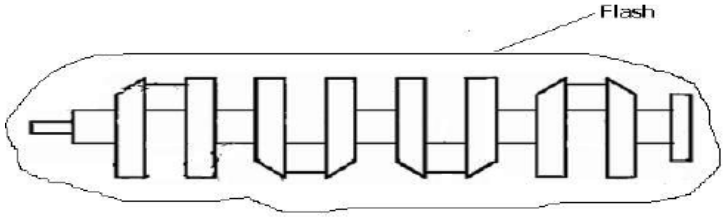
ii) After preliminary roll forging, stock is again roll forged.



iii) This stock is then forged in first impression or blocking die.



iv) The final shape is given to the forging in next blocking die.



v) Then the finished part is then trimmed in blanking die to remove excess metal or flash.

c) Explain defects in forging. 04

Answer: ***(Note: Any four defects -01 mark each)***

Forging defects: ***(Any Four- 1 mark each)*** 04

1.Cold Shuts: Short cracks at corners and at right angles to the surface of forging. It is caused due to metal surface folding against itself during forging. This appears as small cracks at the corners of the forging. This is caused mainly by the improper design of die. Where in the corner and the fillet radii are small as a result of which metal does not flow properly into the corner and the ends up as a cold shut.

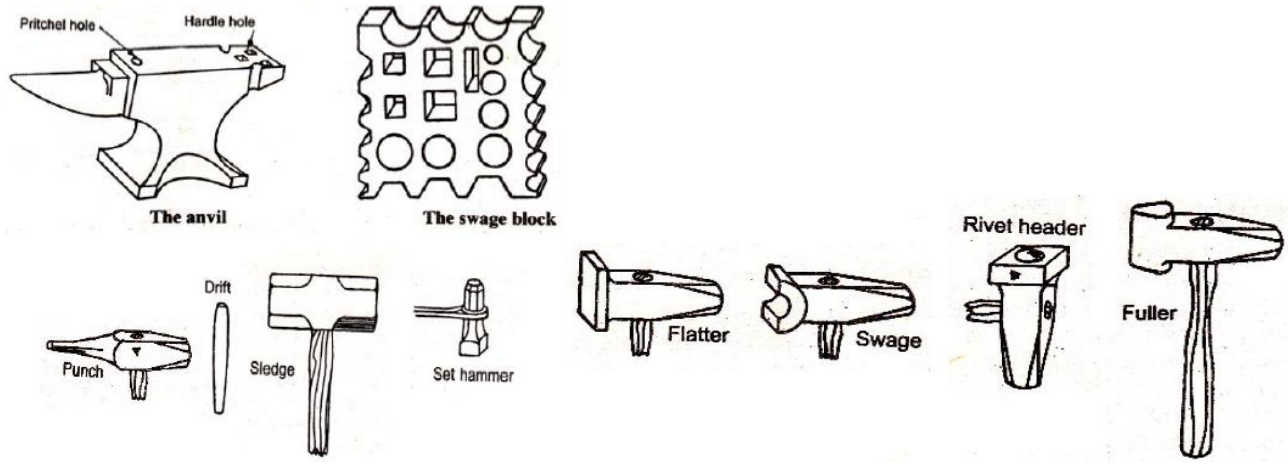
2.Pitting: Small pits (Depressions) on surface. It is caused by scale. When scales are removed from surface, depressions remain which are known as scale pits. This is seen as irregular depurations on the surface of the forging. This is primarily caused because of improper cleaning of the stock used for forging. The oxide and scale gets embedded into the finish forging surface. When the forging is cleaned by pickling, these are seen as depurations on the forging surface.

3.Die shift: It is caused by misalignment between top and bottom forging dies.

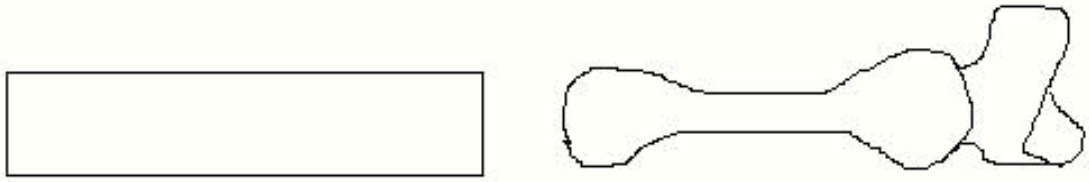
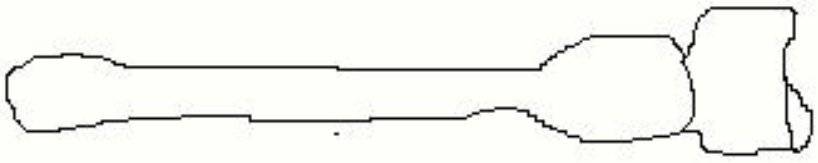
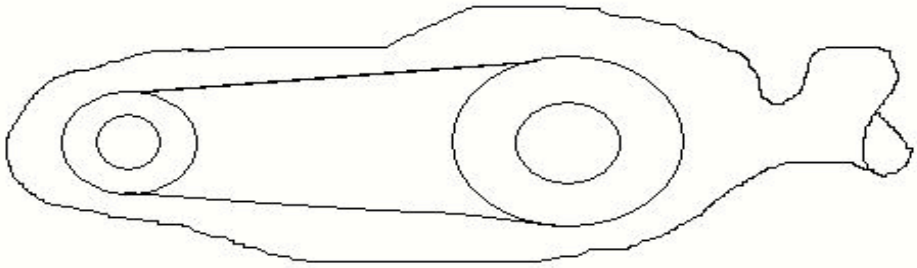
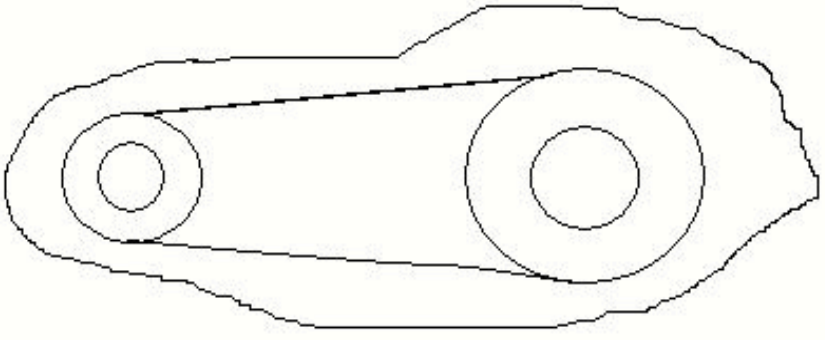
4.Incomplete filling of dies: Undersize of forging due to less amount of metal. It is caused by insufficient amount of metal, insufficient number of blows, incorrect die design or low temperature of stock.

5.Dents: Dents are the result of careless work. **6.Flakes**: These are basically internal ruptures caused by the improper cooling of the large forging. Rapid cooling causes the exterior to cool quickly causing internal fractures. This can be remedied by following proper cooling practices.	
d) Explain any four hand tools used in forging process with neat sketch.	04
Answer: ***(Note: Any four forging Tools – Explanation – 1/2 mark & Sketch – 1/2 mark)***	04

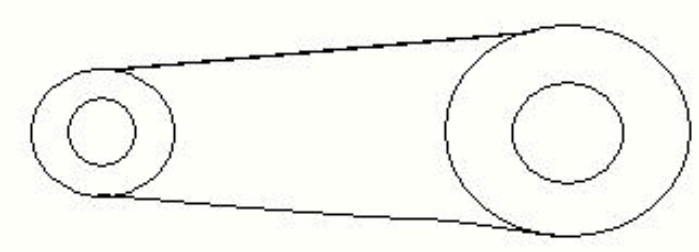
(a) Anvil, (b) Swage, (c) Swage block, (d) Sledge, (e) Punch,
(f) Drift, (g) Flatter, (h) Set hammer, (i) Fuller & (j) Rivet header



1. **Anvil:** -The anvil its forms support for blacksmiths works when hammering. The round hole in the anvil called pritchel hole it used for bending rods of small diameter and as a die for hot punching operations. The square or hardie hole is used for holding square shanks of various fittings.
2. **Swage block:-** This tool is used for mainly squaring, sizing, heading, bending and forming operations.
3. **Swages: -**Swages are used for the work which has to be reduced and finished to round, square or hexagonal form. These are made half grooves of dimensions to suit the work being reduced. Swages consist of two parts. Top part is having a handle and bottom part having a square shank which fit in the hardie hole in anvil face.
4. **Punch and drift:-** punch is used for making hole in metal part. When it is at forging heat, and holes are opened out by driving through a larger tapered punch called a drift.
5. **Flatter: -** flatters are used to give smoothness and accuracy to articles which have already been shaped by fullers and swages.
6. **Set hammers: -** It is really form of flatter. A set hammer is used for finishing corners, in shouldered work where flatter would be in convenient. It is also used for drawing out.
7. **Fullers: -** Fullers are used for necking down a piece of work. They are made in top and bottom tools as in the case of swages. Fullers are made in various shapes and sizes according to needs, the size denoting to width of fuller edge.
8. **Chisels: -**Chisels are used for cutting metals and for necking prior to braking. The edge of chisel made slightly rounded for better cutting action.

e) Name various automobile components made from forging process. Also select the best suited process for them and describe.	04
Answer: ***(Note: Listing of components- 1 mark & Description of process – 3 marks)***	
Automobile components made from forging process are as follows: 1. Connecting Rod, 2. Camshaft, 3. Crankshaft, 4. Gear	01
Description of process: (Any one of the above components – 3 marks) **1. Forging process for manufacturing Connecting rod:** i) Heated stock is elongated by reducing its cross section in first die. The operation is known as fullering.	03
	
ii) The metal is redistributed, increasing the cross section at certain places & reducing at others as required filling the cavities of the die. The operation is known as edging.	
	
iii) The general shape is given in first blocking die.	
	
iv) Finished shape is given to forging in final impression die.	
	

v) Flash is removed.

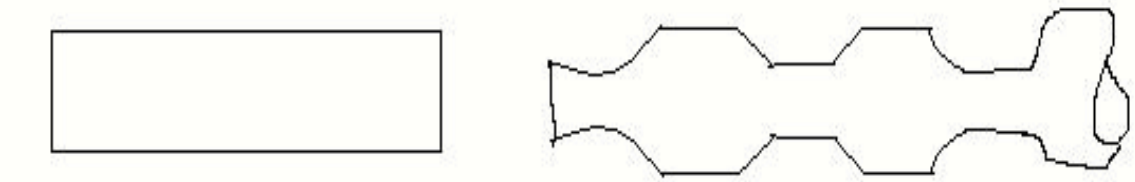


vi) Heat treatment and machining is done as per requirement.

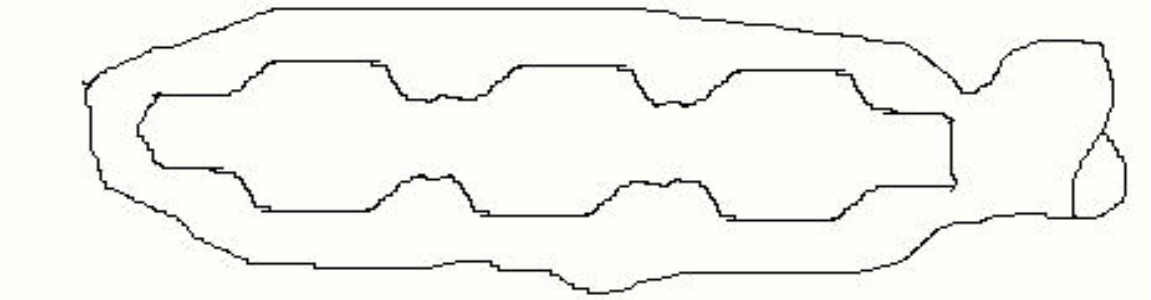
OR

2. Forging process for manufacturing Camshaft:

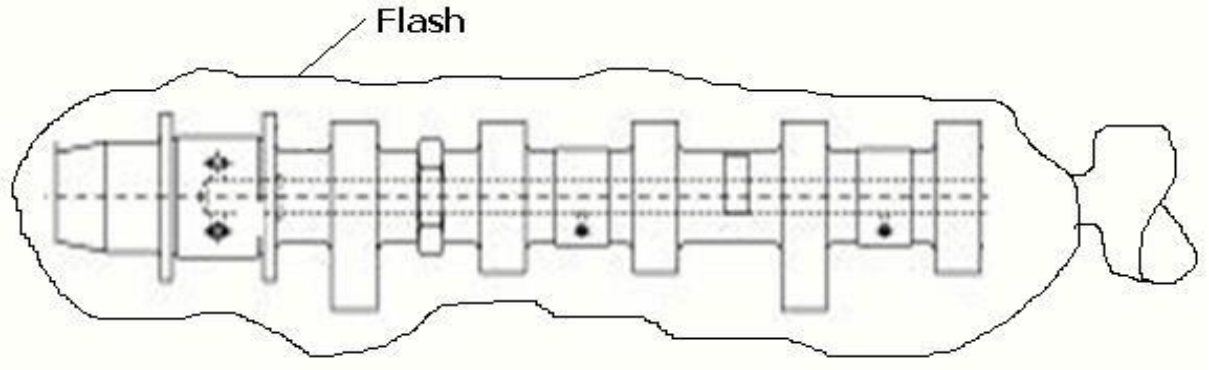
i) Stock is redistributed and size is increased at certain places & reduced at others by rolled forging.



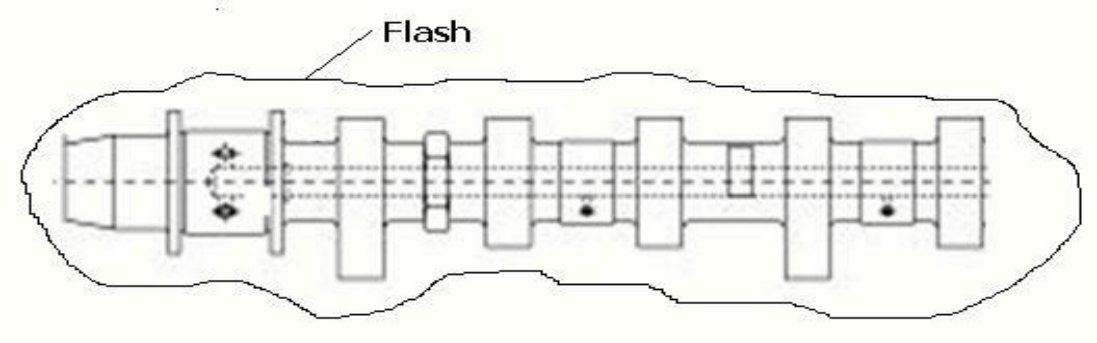
ii) after preliminary roll forging, the stock is again roll forged.



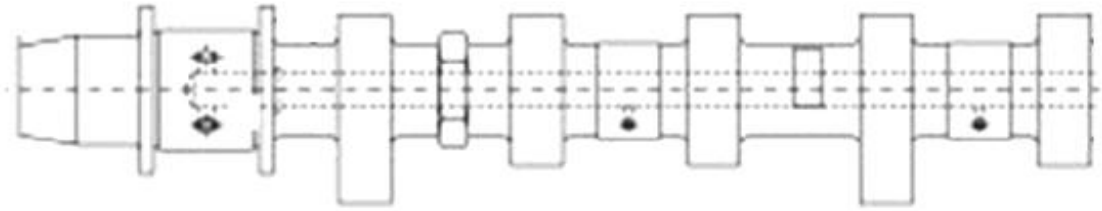
iii) This stock is then forged in first impression or blocking die.



iv) final shape is given to the forging in next blocking die.



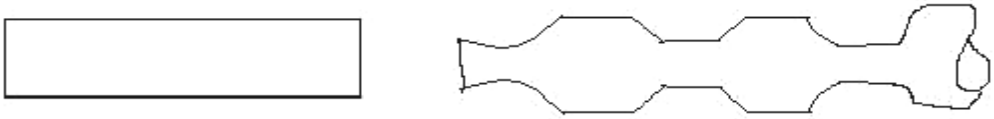
v) finished part is trimmed in blanking die to remove excess metal or flash.



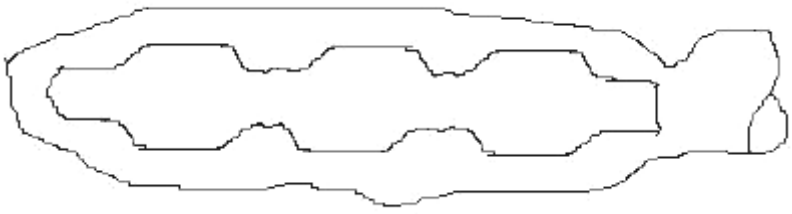
OR

3. Forging process for manufacturing crankshaft:

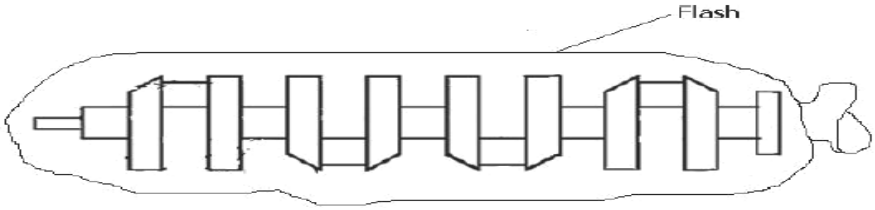
i) Stock is redistributed and size is increased at certain place and reduced at other place by roll forging.



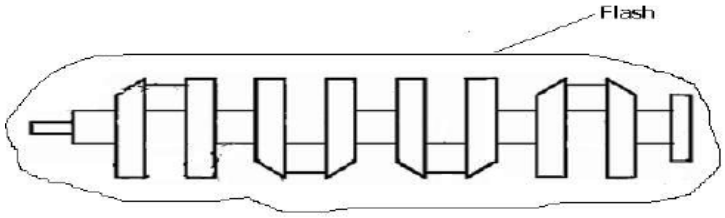
ii) After preliminary roll forging, stock is again roll forged.



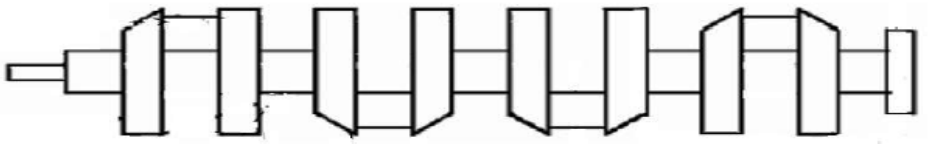
iii) This stock is then forged in first impression or blocking die.



iv) The final shape is given to the forging in next blocking die.



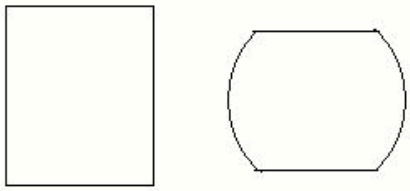
v) Then the finished part is then trimmed in blanking die to remove excess metal or flash.



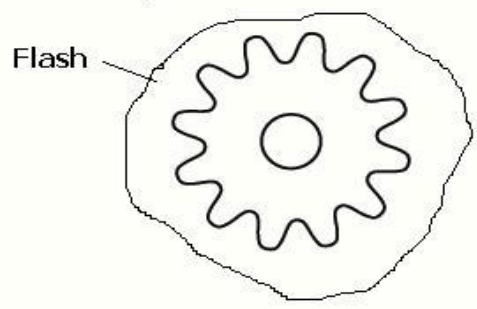
OR

4. Forging process for manufacturing Gear:

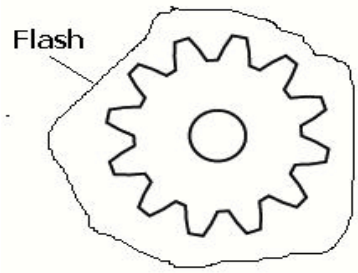
i) The size of the heated stock is reduced with compensation of its length i.e. Upsetting is carried out.

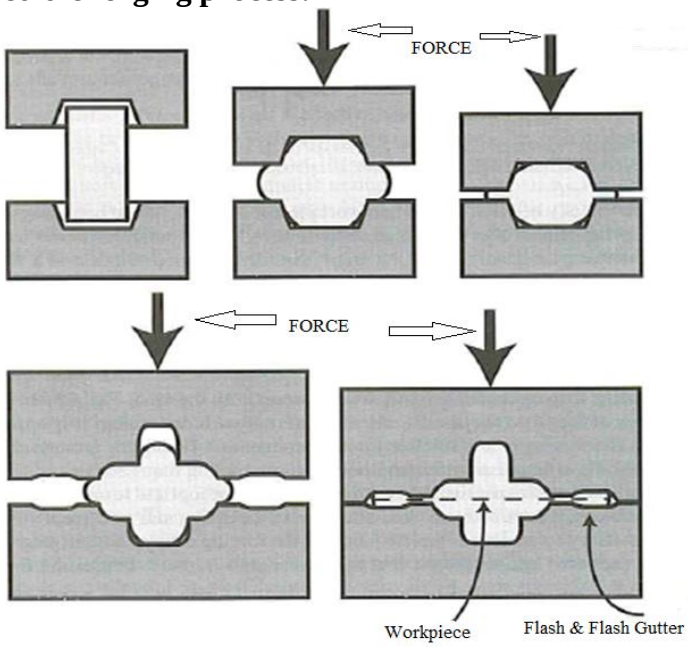


ii) After heading or upsetting, stock is forged in first impression die.



iii) Stock is forged in next impression or blocking die

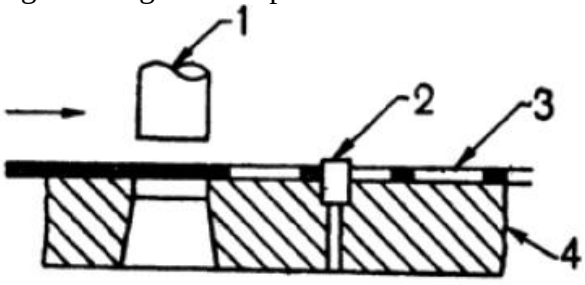


iv) Then the finished part is trimmed in blanking die 	
f) Describe impression die and closed die forging process with neat sketch.	04
Answer ***(Note: Explanation Impression die & Closed die forging – 02 marks& Sketch- 02 marks)*** **Impression die & Closed die forging process:**  ***Fig. Closed and Impression Die Forging.*** Closed Die forging is also known as impression die forging. Close die forging process consist of specially prepared dies to manufacturing forged parts in large quantities. The work piece is placed between cavities of dies as shown in fig. which takes the shape of the die cavities (impression) during forging process. Some materials come outwards and form a flash. Generally this process is used for mass production with high degree of accuracy. Complex shaped parts can be easily forged by this forging process.	02 02
3. Attempt any <u>FOUR</u> of the following:	**16**
a) List various die accessories. Explain any two of them with neat sketch.	04
Answer: ***(Note: Listing – 1 marks & Explanation of any two with neat sketch – 3 marks)*** **Die Accessories are as follows:** ***(Any two -1/2 Mark Each)*** 1) Stops a)Button stop b) Lever stop 2) Pilot a)Direct pilot b)Indirect Pilot	01

3) Knock out
4) Strippers
   a) Fixed stripper
   b) Spring loaded strippers
5) Pressure Pad

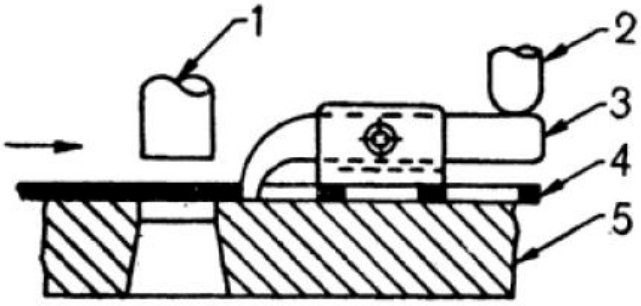
Explanation of Die accessories-*(Any two - Sketch -1 mark each, explanation -1/2 mark each)*

1. **Stops:** The stops are used for correct spacing of the sheet metal as it is fed below the punch to give the greatest output in given length of the plate. 03



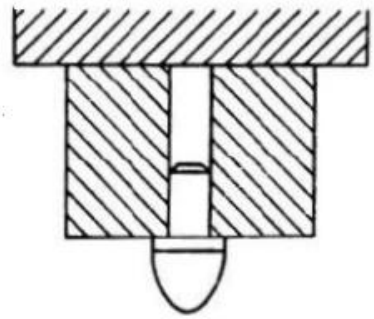
1. Punch, 2. Button, 3. Plate, 4. Die block.
Figure. Button Stop

OR

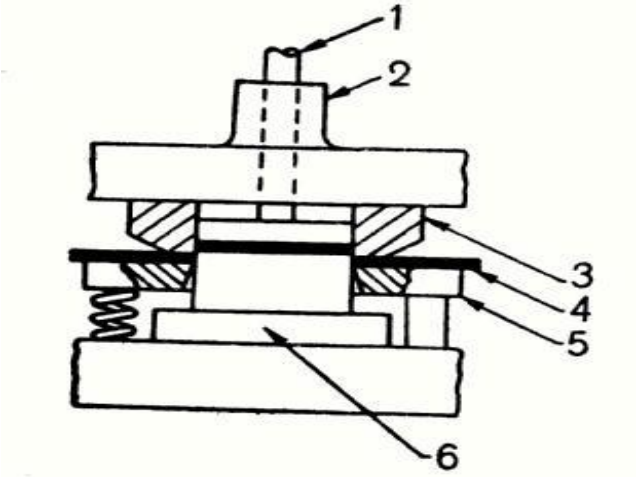


1. Punch, 2.Pin, 3. Lever, 4. Plate,
5. Die block

2. **Pilots:** The pilot illustrated in Figure enables the correct location of the blank when it is fed by mechanical means. The pilot enters into the previously pierced hole and moves the blank to the correct position to be finally spaced by the stops. The pilots are fitted to the punch holders

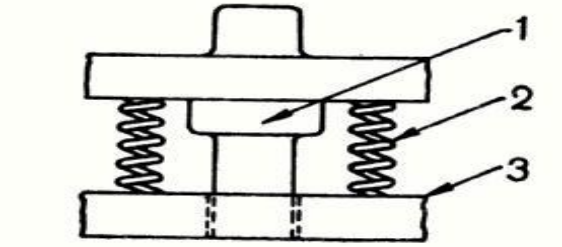


3. Knock out: The function of knock out is to eject the finished components from the die cavity.



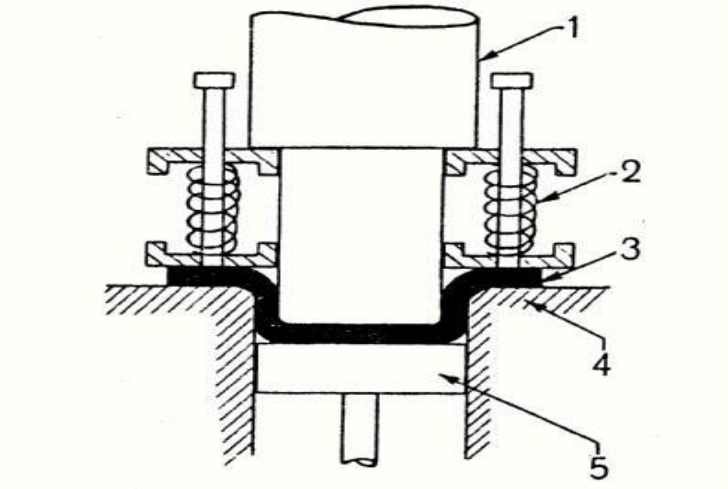
1. Stripper, 2. Die holder, 3. Dic, 4. Plate, 5. Knockout plate, 6. Punch.

4. Stripper: It is used to remove scrap material from the punch. The main function is to strip or discard the workpiece from the punch or the die after the end of cutting or forming operation.

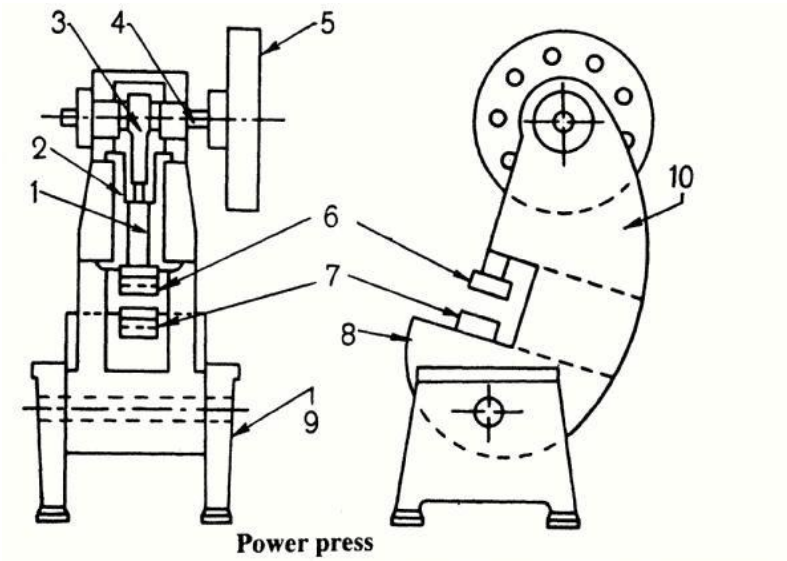
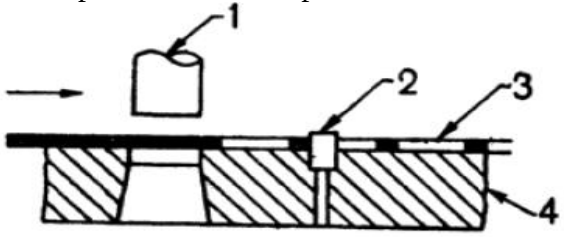


1. Punch, 2. Helical spring,

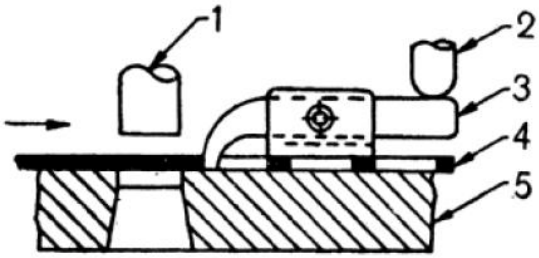
5. Pressure pad: It is used for drawing operation for maintaining flat surface of the cup



1. Punch, 2. Helical spring, 3. Blank, 4. Die, 5. Pressure pad.

b) Describe working of mechanical power press with neat sketch.	04
Answer:*(Note: Working - 02 marks & Sketch – 02 marks)* **Working of Mechanical Power Press:**  **Power press** 1. Ram 2. Ram guide, 3. Pitman, 4. Crankshaft, 5. Flywheel, 6. Punch, 7. Die, 8. Bolster plate, 9. Base, 10. Frame. The ram of mechanical power press is driven by power. In this rotary motion is obtained by electrical motor is converted into reciprocating movement of ram by using different mechanical devices. The fly wheel is mounted at the end of the driving shaft and is connected to it through a clutch. The energy is stored up in the flywheel during idle periods and it is expended to maintain the constant speed of the ram when the punch is pressed into the work. The fly wheel is directly coupled with the electric motor	02 02
c) Explain working of stops and pilots used in mechanical press.	04
Answer :*(Note: Figure - 1 Mark each & explanation - 1 Mark each)* **1. Stops:** The stops are used for correct spacing of the sheet metal as it is fed below the punch to give the greatest output in given length of the plate. Button stop and lever stop. **Button stop:** The button stop illustrated in Fig. is the simplest of the designs. A small pin or a button 2 is fixed to the die block 4 at a measured distance from the punch axis. After the end of each cut, the plate 3 is lifted and pushed aside till the edge of the next slot bears against the button 2. This makes the accurate spacing. The button stop is used in hand presses and in slow acting power presses  1. Punch, 2. Button, 3. Plate, 4. Die block. Figure. Button Stop **OR**	01

Lever stop: - The lever stop illustrated in Fig., is operated by the machine. As the punch 1 descends, the pin 2 attached to the ram pushes the lever 3 which lifts the lever stop, leaving the blank 4 free. The plate is pushed aside immediately when the punch 1 starts moving in the upward strokes, and in the next instant the lever 3 is released from pin pressure that causes the stop to engage with the work making an accurate spacing. — 01



1. Punch, 2.Pin, 3. Lever, 4. Plate, 5. Die block

2. Pilots:

The pilot illustrated in Fig. enables the correct location of the blank when it is fed by mechanical means. The pilot enters into the previously pierced hole and moves the blank to the correct position to be finally spaced by the stops. The pilots are fitted to the punch holders — 01

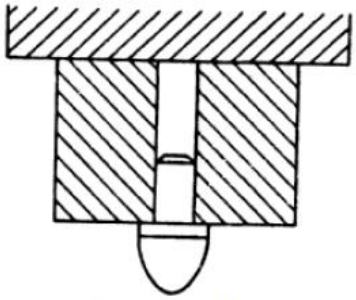


Figure. Pilot — 01

d) Explain MIG welding process with the help of a neat sketch. — 04

Answer: ***(Note: Explanation – 02 marks & Sketch – 02 marks)***

MIG Welding:

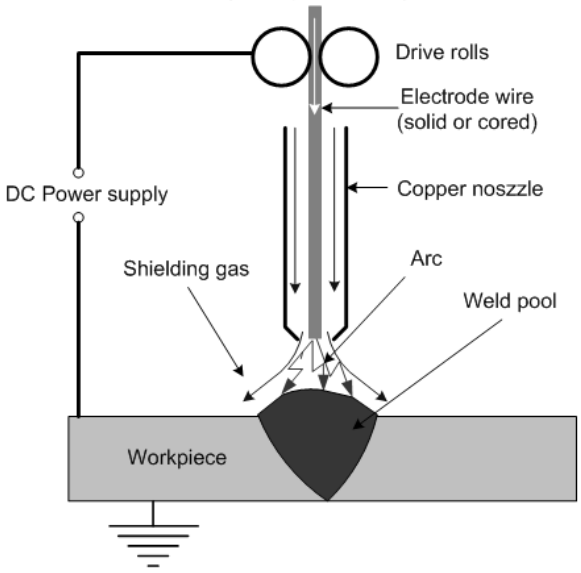
Gas-metal-arc welding is a gas shielded metal arc welding process which uses the high heat of an electric arc between a continuously fed, consumable electrode wire and the material to be welded. Metal is transferred through protected arc column to the work.

In this process, the welding machine is a D.C. constant voltage which at a given wire feed rate will produce necessary current to produce arc. The wire is fed continuously from a reel through a gun to constant surface which imparts a current upon the wire. The welding gun is either air cooled or water cooled depending upon the current being used. — 02

The fused electrode material is supplied to the surfaces of the work pieces, fills the weld pool and forms joint. The welding area is flooded with a gas (an inert gas i.e. Argon, helium, CO2, argon + Oxygen or other gas mixtures) which will not combine with metal. Carbon dioxide is most commonly used as it inexpensive.

Metal inert gas welding

(MIG, GMAW)



02

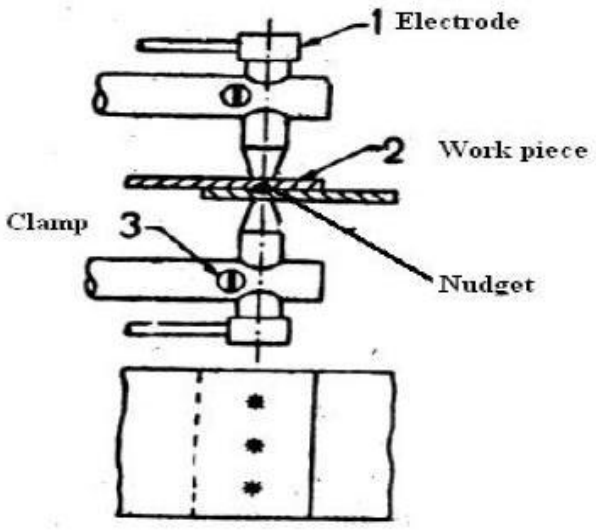
e) Explain resistance welding process with the help of neat sketch. 04

Answer: ***(Note: Explanation - 2 Marks & Sketch - 2 Marks)***

Resistance Welding Process: ***(Any one type of the following)***

1.Resistance Spot welding:

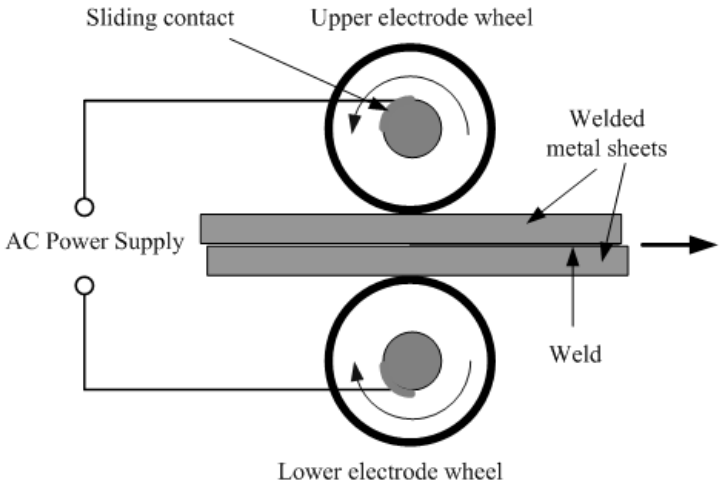
Spot welding is employed to join overlapping strips, sheets or plates of metal at small areas. The pieces are assembled between two electrodes, which must possess high electrical & thermal conductivity and retain the required strength at high temperatures, so they are made of pure copper for a limited amount of service, and of alloys of copper or tungsten, or copper and chromium for continuous working. When current is turned on, the pieces are heated at their contacts to a welding temperature, and with the aid of mechanical pressure the electrodes are forced against the metal to be welded. 02



02

OR

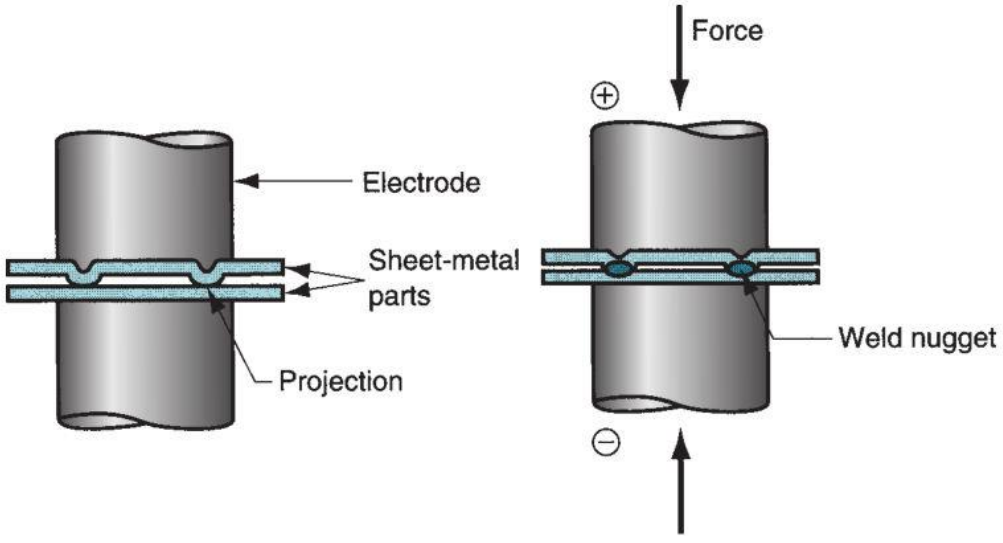
2. Seam Welding is a Resistance Welding (RW) process used for producing continuous joint of overlapping sheets by passing them between two rotating electrode wheels. Heat generated by the electric current flowing through the contact area and pressure provided by the wheels are sufficient to produce a leak-tight weld. Seam Welding is high speed and clean process. Coolant is used to conserve the electrodes and cool the work rapidly to speed up the operation



OR

3.Projection Welding

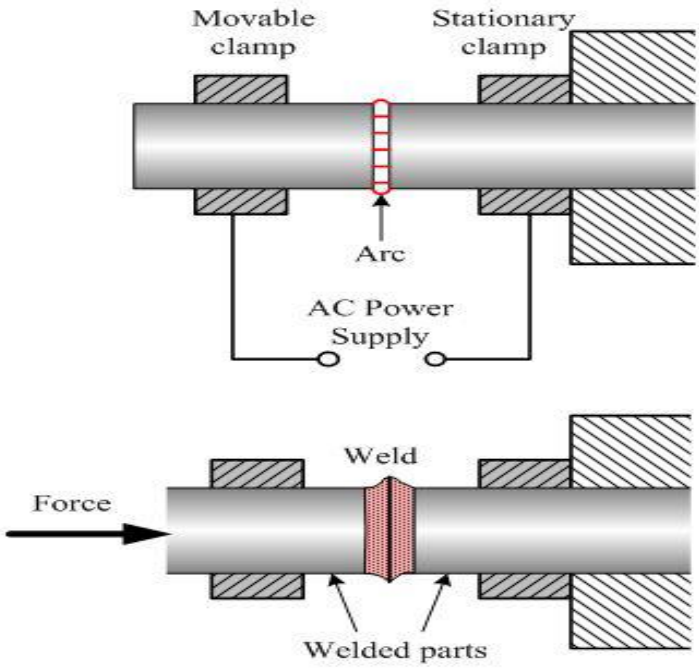
Projection welding is a modification of spot welding. The current and pressure are localised at the weld section by the use of embossed, machined or coined projections on one or both pieces of the Work. The flattening out of these projections under pressure results in good welds at all points of contact.



OR

4.Flash Welding is a Resistance Welding (RW) process, in which ends of rods (tubes, sheets) are heated and fused by an arc struck between them and then forged (brought into a contact under a pressure) producing a weld The welded parts are held in electrode clamps, one of which is stationary and the second is movable.

Flash Welding (FW)

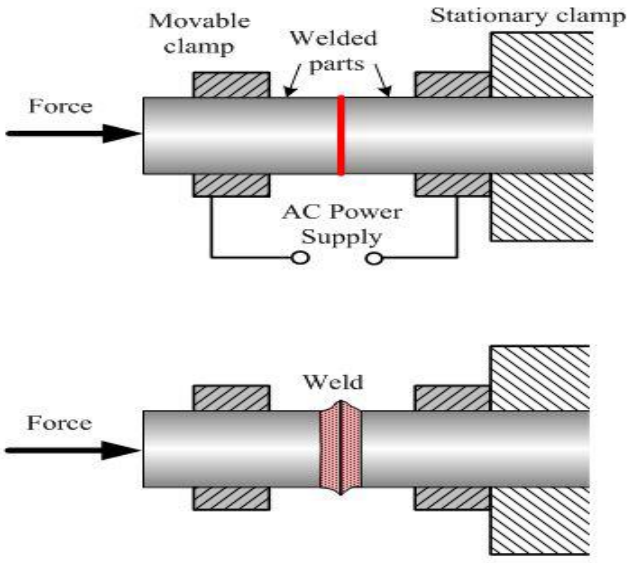


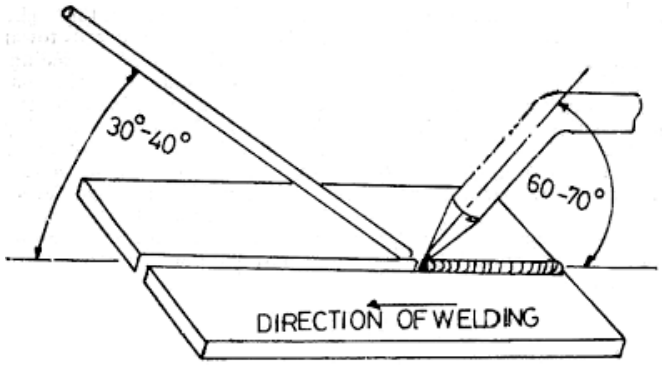
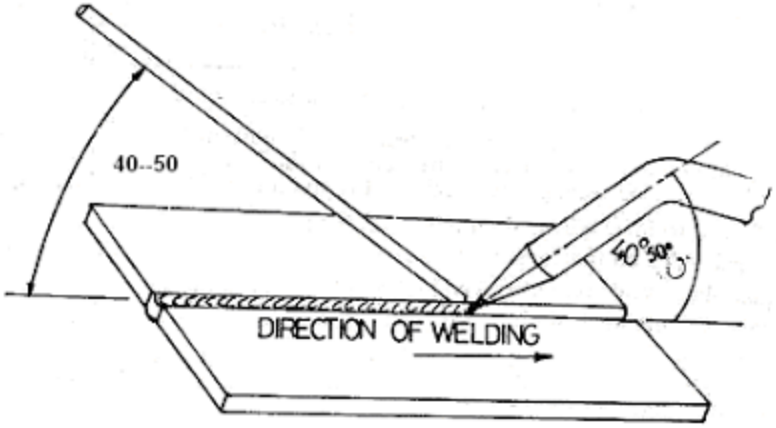
OR

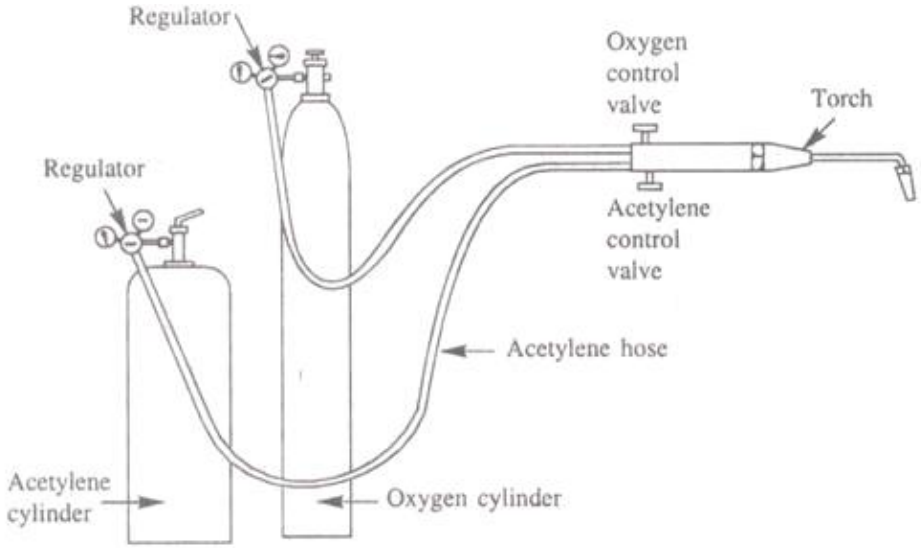
5.Resistance Butt Welding:

It is a Resistance Welding (RW) process, in which ends of wires or rods are held under a pressure and heated by an electric current passing through the contact area and producing a weld. The process is similar to Flash Welding; however in Butt Welding pressure and electric current are applied simultaneously in contrast to Flash Welding where electric current is followed by forging pressure application. Butt welding is used for welding small parts. Butt Welding provides joining with no loss of the welded materials.

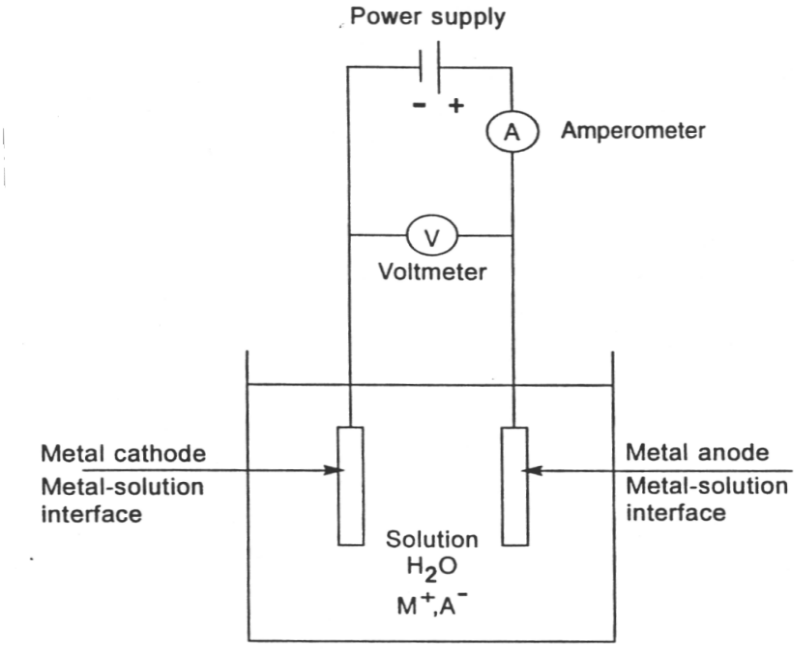
Butt Welding (UW)



f) Describe leftward and rightward welding technique. What are the advantages of R.H. welding over L.H. welding?	04
Answer : ***(Note: Explanation of welding technique - 3mark, Advantages -1 mark)***	
1. Leftward welding technique: (Sketch – 01 mark & Description – ½ mark)	
	01
The weld is made working from right to left. The welder holds welding torch in the right hand and filler rod in the left hand. The blow pipe should be given small sideways movement and the rod should be moved steadily without sideways movement. The head of blow pipe is held at angle between 60 - 70 degree to the plane of the weld and the welding rod at 30 - 40 degree.	½
2. Rightward welding technique: (Sketch – 01 mark & Description – ½ mark)	
	01
Welding is carried from left to right. It has no lateral movement. The welder holds the welding torch in the right hand and the filler rod in the left. The blow pipe should make an angle between 40-50 degree with the plane of the plate and welding rod should be at an angle of 30-40 degree.	½
Advantages of RH welding over LH welding: (Any Two- ½ mark each) 1. Welding speed is higher 2. Fuel consumption is lower 3. It provide better shielding against atmospheric oxidation of the weld metal 4. The weld metal is stronger and tougher 5. It is used for steel work over 12mm thick as well as for lower thickness of sheet.	01

4. Attempt any FOUR of the following:	**16**
a) Explain working principle of gas welding.	04
Answer: ***(Note: Explanation – 02 marks & Equivalent sketch – 02 marks)*** **Working principle of gas welding:** Gas Welding is a fusion welding process. It joins metals, using the heat of combustion of the oxygen/air and combustible gas (i.e. acetylene, hydrogen, propane, or butane) mixture. The purpose of flame is to heat and melt the parent metal and filler rod of the joint. The intense heat produced melts the edges of parts and fuses together to form the welded, generally with the addition of a filler metal. The torch mixes a combustible gas with oxygen in the proper ratio and flow rate providing combustion process at a required temperature. The flame temperature is determined by a type of the combustible gas and proportion of oxygen in the combustion mixture: 4500°F - 6300°F (2500°C - 3500°C). Depending on the proportion of the fuel gas and oxygen in the combustion mixture, the flame may be chemically neutral (stoichiometric content of the gases), oxidizing (excess of oxygen), and carburizing (excess of fuel gas). Welding does not require the components to be forced together under pressure until the weld is forms and solidifies.  Fig. Gas welding	02 02
b) Explain blasting and tumbling processes. State their uses.	04
Answer: ***(Note: explanation of process – 01 mark each & uses – 01 mark each)*** **1. Blasting (Abrasive blast cleaning):** This method is widely used for removing all classes of scale and rust from forgings, castings, weldments, and heat treated parts. Depending on the finish requirements, blasting alone or blasting with pickling is used. In this process the parts are generally cleaned by the use of abrasive particles such as sand, steel grit or shot impelled against the surface to be cleaned. Some cleaning is performed by means of high-velocity air blast, with the blast directed by hand. In many cases, an airless blast machine that cleans by impact is also used. The abrasive is fed from an overhead storage hopper to the center of a radially rotating wheel, whereupon the metallic shot or grit is thrown in a controlled stream upon the work to be cleaned. All traces of sand, scale, oxides and other material are removed, providing an excellent surface for bonding final finishes.	01

Uses: ***(Any Two – ½ mark each)***	
The airless blast machine is used for cleaning engine blocks, crankshafts, castings of different shapes and size, railroad cars, car wheels, oil and gas pipes, steel strip, and many other purposes.	01
2. Tumbling:	
It is least expensive process for removing rust and scale from metal parts. This operation is accomplished by placing work pieces in a drum or barrel, together with stars, jacks, slugs, or abrasive materials. The abrasive materials can be sand, granite chips, and slag or aluminium oxide pallets. In this operation, the barrel is rotated and the movement of the work pieces and the accompanying slugs or abrasive materials against each other produces by friction a fine cutting action which removes fins, flashes, and scales from the products.	01
Uses: ***(Any Two – ½ mark each)***	
1. Cleaning of gold jewelry 2. Cleaning of bolts 3. Cleaning of washers 4. Cleaning of brass cases 5. Engine case cleaning	01
c) List chemical cleaning processes. Explain any one of them.	04
Answer: ***(Note: Listing – 02 marks & Explanation – 02 marks)***	
Chemical Cleaning processes: ***(Any Four – ½ mark each)***	
1. Alkaline cleaning 2. Acid pickling 3. Electrolytic cleaning 4. Emulsified solvent cleaning 5. Vapour degreasing 6. Ultrasonic cleaning	02
Explanation of chemical cleaning processes: ***(Any One of the following – 02 marks)***	
1. **Alkaline Cleaning:** The most common type of cleaning is with alkali for removing oil and grease by saponification or emulsification or both. A bath is prepared from cleaning agents such as caustic soda or sodium metasilicate. These materials are added to some type of soap. The mixture produces an alkali which serves as the cleaning agents. This process is used on all metals except zinc, lead, tin, brass and aluminium.	02
OR	
2. **Acid Pickling:** This cleaning is used for removing unwanted pigmented compounds which are mostly oxides of metal& also used to remove oil and grease. In this either diluted sulphuric, hydrochloric, or phosphoric acid is sprayed on the part, or the parts is dipped into a tank, agitated and then washed and rinsed thoroughly. Acid cleaning causes hydrogen embrittlement i.e. hydrogen absorbed by the steel, which can be reduced by heating the parts after pickling.	
OR	
3. **Electrolytic Cleaning:** This is effective as final cleaning process for removing oil and grease from machined surface when extreme cleanliness is required. It is almost always used for final cleaning of steel parts prior to electro-plating. In electrolyte cleaning, an alkaline cleaning solution is used with electric current passing through the bath in which the parts to be cleaned is one electrode. This causes the emission of oxygen at the positive pole and hydrogen at negative pole. The material from which part is made and the cleaning action desired determine whether the part	

should be made anode or cathode. Parts of soft metals must be cleaned cathodically because they would be badly itched if cleaned anodically. Steel is anodically cleaned because of absence of embrittlement and smut deposition. Chlorides should be carefully avoided and the soap content should be low or excessive foaming with danger of explosion may result.	
d) Describe electroplating process with neat sketch.	04
Answer: ***(Note: Description – 02 marks & Sketch – 02 marks)*** **Electroplating Process:** Electroplating may be described as a process of covering a surface or object usually metallic with a thin adherent coating of same or other metal by electrolysis. The form of original parts is retained. Figure shows a typical electroplating process.  A DC voltage is applied between parts to be plated (which is made cathode) and anode material that is either material to be plated or an inert electrode. Both of these metals are immersed in a electrolyte, which may also contain dissolved salts of the metal to be plated, as well as additions to increase or control conductivity. When voltage is applied, metal ions migrate to the cathode lose their charge, and deposit on the surface. The main factors governing the plating are current density, concentration of electrolyte, and temperature of bath. Almost all commercially available metals can be plated, including aluminium, copper, brass, steel, zinc-based die castings. Plastics can be electroplated provided that they are first coated with an electrically conductive material. The most common platings are zinc, chromium, nickel, copper, tin, and precious metals like gold platinum, silver andrhodium. Chromium plating is widely used because of its pleasing appearance and its resistance to corrosion and wear. Gold, silver and platinum platings are used in jewelry and electronic industry.	02 02
e) Describe hand lapping and machine lapping process with their applications.	04
Answer :***(Note: Description –1 ½ marks each & Applications – ½ mark each)***	

1. Hand Lapping:- ***(Description – 1 ½ & Application – ½ mark & Credit should be given to sketch)***

Lapping can be done by hand held tools for both flat work and external cylindrical work explained as follows: In hand lapping, as shown in Fig., either the lap or the work piece is held by hand and motion of the other enables the rubbing of the two surfaces in contact. This method is used for lapping presswork dies, dies and metal moulds for castings, etc. Sometimes a lapping compound is placed between the two surfaces and then they are moved against each other. 1 ½

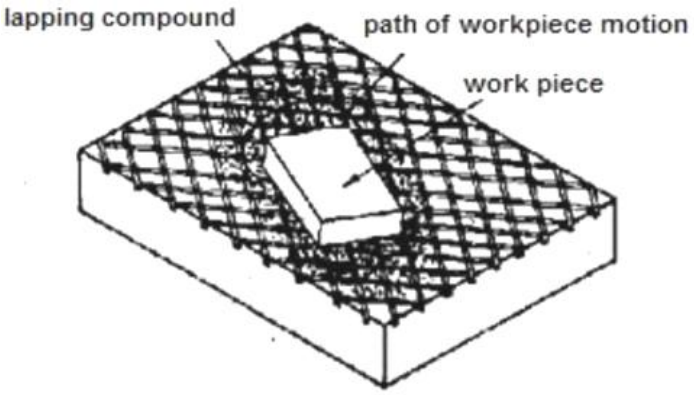


Figure: Hand Lapping

Applications of Hand Lapping: ***(Any One)***

- Press work dies,
- dies & metallic moulds for casting
- surface plates
- engine valves
- valve seats
- piston rings
- plug gauges

½

2. Machine Lapping: ***(Description – 1 ½ & Application – ½ mark & Credit should be given to sketch)***

In Lapping machines for obtaining flat surfaces, work pieces are placed loosely in holders and are held against the rotating lap by means of floating head, the holders rotating slowly move the work piece in an irregular path. When two parallel surfaces are to be produced, two laps may be employed, one rotating below and other above the work piece. Various types of machines are available for lapping round surfaces. 1 ½

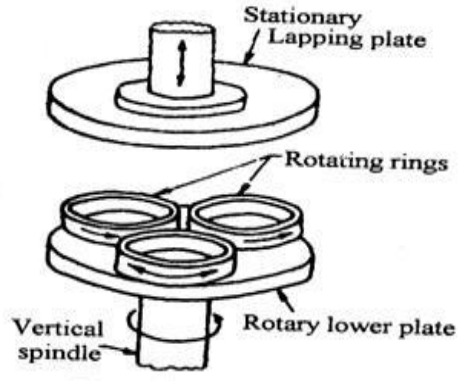


Figure : Machine lapping

Applications of Machine Lapping: ***(Any One)*** ½

- Small cylindrical parts, such as piston pins and ball bearing races.
- Crankshaft
- Camshaft
- Automotive wrist pins
- Diesel engine injector pump parts
- Spray nozzles

f) Distinguish between NC and CNC system. 04

Answer: ***(Note: Any Four distinguishing points – 1 mark each)*** 04

Sr	NC Machines	CNC machines
1	Instructions fed through external medium i.e. Paper tape / magnetic tape	Instructions fed through part program (internal medium) stored in computer memory
2	Small changes in program are not possible on punch tape once produced	Small changes in program are possible.
3	No facility for dry run.	Facility for dry run.
4	Additional information such as number of jobs produced, time per component cannot be obtained.	Additional information such as number of jobs produced, time per component can be obtained.
5	It does not allow compensation for change in cutting tool dimension.	It does allow compensation for change in cutting tool dimension
6	It is hard wired system.	It is soft wired system.
7	Reliability is less	Reliability is more

5. Attempt any <u>FOUR</u> of the following: **16**

a) Explain various formats used in part programming. 04

Answer: ***(Note: Any two of the following – 02 marks each)*** 04

Format is a method of writing the words in the block of instruction.

The following are three programming formats used for part programming: ***(Any two)***

1. Fixed block format.
2. Tab sequential format
3. Word address format

1.Fixed block format:

In this instructions are always given in the same sequence. All the instructions must be given in every block, including those instructions which remain unchanged from the preceding blocks. In this system identifying address letters are not given, but the data must be input in a specified sequence and characters within each word must be of the same length.

Example:

N	X	Y	F	S	
001	15.00	20.00	200	500	EOB
002	75.00	20.00	200	500	EOB

2. Tab Sequential format:

In this program format, instruction in a block are always given in the same sequence as in case of fixed block format and each word is separated by TAB character. If the word remains same in the succeeding block, the word need not be repeated but TAB is required to maintain the sequence of words. Since the words are written in set order, the address letters are not required.

N	X	Y	F	S	
001 TAB 002TAB	15.00TAB 75.00 EOB	20.00TAB	200TAB	500	EOB

3.Word address format:

In this each data is preceded and identified by its address letter e.g. 'x' identifies 'x' co-ordinates, F identifies feed rate and so on. If a word remain unchanged, it need not be repeated in next block. A typical instructions block as follows:

N_ G_ X_ Y_ Z_ R_ F_ S_ T_ M_ EOB

N: Every block has given number according to tool path. Numbers from 1 to 9999 can be used. e.g. N05

G: For preparatory functions i.e. for all type of tool movement, codes obtained by address G are used. G code is followed by coordinates of X, Y and Z axes.
e.g. G00

X, Y, and Z: These addresses are used to represent the distances traveled by tool with respect to axes. e.g. X20, Y50 and Z-20.

R: Radius for curvature is given by address R it is also used to give parameters.
e.g. R20

F: This address is used to give feed. It can be given as mm/min or mm/rev.
e.g. F80 or F0.8

S: To give spindle speed, this address is used. e.g. S500

T: The tools in the magazine or in turret head are numbered. Address T is followed by tool number in the turret head or tool magazine. e.g. T05

M: For miscellaneous functions or all activities except tool movement's M codes are used.
e.g. M05

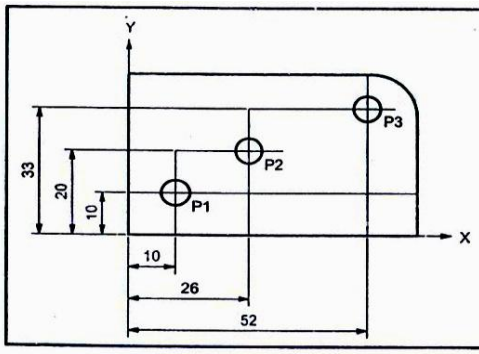
EOB: This sign is used to represent end of block.

b) Explain with suitable example absolute and incremental co-ordinate system. — 04

Answer: ***(Note: Explanation – 02 marks & Example – 02 marks)***

1. Absolute Co- ordinate system: (*Explanation – 01 mark & Example – 01mark)*

In Cartesian co–ordinate geometry system using absolute measurement. Each point is always specified using same zero of given co–ordinate system as shown in fig. It is a system in which all moving commands are referred to one reference point, which is the origin / set point. All the position commands are given from zero point. The main advantage of this system is that it forces the operator to stop the machine in case of interruptions. — 01



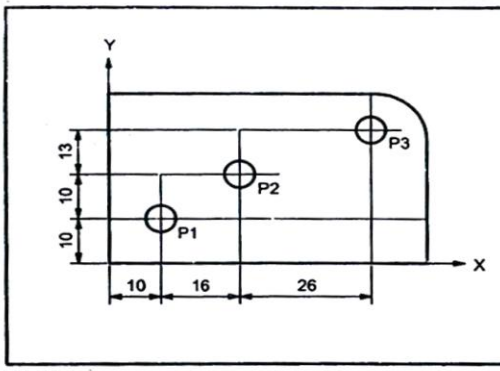
Point	X Coordinate	Y Coordinate
P1	10	10
P2	26	20
P3	52	33

01

2. Absolute Co- ordinate system: (*Explanation – 01 mark & Example – 01mark)*

In Cartesian co–ordinate geometry system using incremental measurement. Each point is always specified using the path differential from the preceding point position. So in such a programming, controller must store & process additional path measurement, as shown in fig. It is a system in which the reference point to the next instruction is the end point of the preceding operation. Each data of applied to the system as a distance increment, measured from preceding point.

01



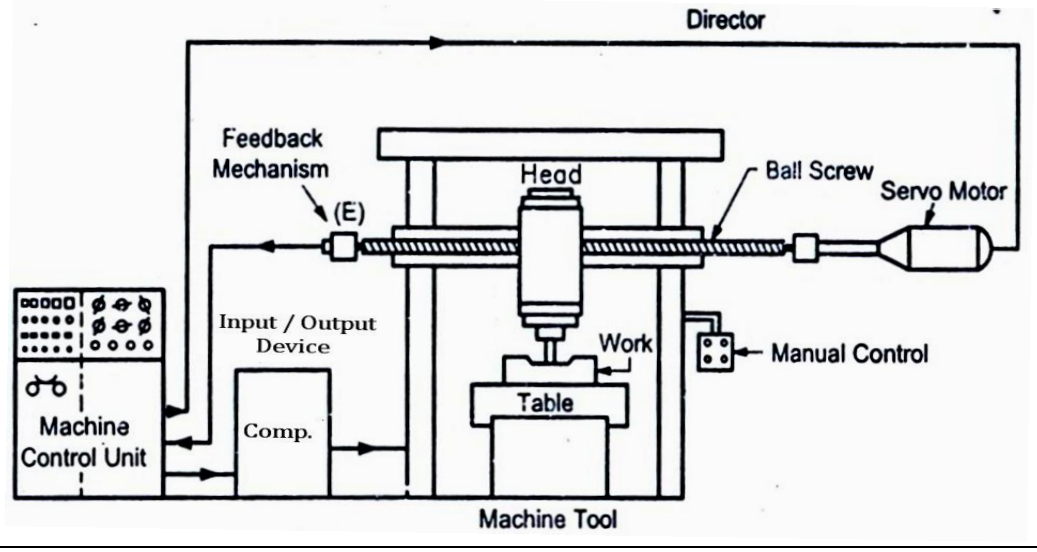
Point	X Coordinate	Y Coordinate
P1	10	10
P2	16	10
P3	26	13

01

c) Explain working principle of CNC machine using block diagram. 04

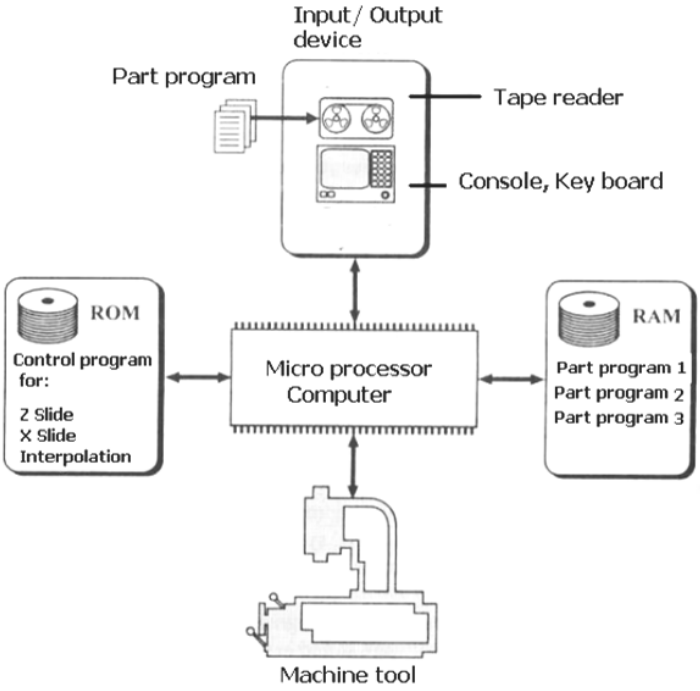
Answer :*(Note: Working principle – 02 marks & block diagram – 02 marks)*

Block Diagram of working principle of CNC machine:



02

OR



Working principle of CNC machine:

In CNC machine, tape reader or any other input media is used for entry of part program. In CNC, entire program is first feed to the inbuilt computer memory. Once the program is stored, the machine cycle is then executed by the program. Software with control algorithms converts part program instruction into actions by the machine tool.

This is done by generating pulses for each axis from the controller. Each pulse produces one small unit of motion (SUM). The slide travel is thus decided by the number of pulses. In a closed loop system, the pulses are feed to reference. The feedback device also send signal to the reference. These two signals are compared and necessary action is controlled. — 02

d) What are the advantages and disadvantages of CNC machines? — 04

Answer: ***(Note: Any Four Advantages – 02 marks & Disadvantages-02 marks)***

Advantages of CNC Machine tools: ***(Any Four - ½ marks each)*** — 02

1) Complex machining operations can be easily done.
2) It gives high degree of accuracy.
3) It requires less inspection.
4) It reduces scrap & waste.
5) It gives high production rate.
6) It has low tooling cost.
7) It reduces human error.
8) It gives more operator safety.
9) It gives more operator efficiency.
10) It reduces space requirements
11) It has Greater flexibility.
12) Tool life gets increased.
13) Lead time is reduced.

Disadvantages of CNC machine tools:*(Any Four- ½ marks each)* — 02

1) It has High Investment cost.
2) Higher maintenance cost.
3) Skill operator is required.
4) Training of operator is required.
5) High tooling cost.
6) Temperature, humidity & dust must be affect machining.
7) Initial cost is high.

e) Describe following part programming. — 04

i) Subroutine
ii) Canned cycle

Answer: ***(Note: Description of each – 02 marks each)***

i) Subroutines:

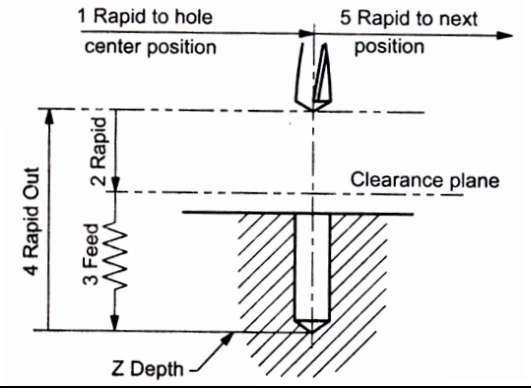
These are powerful time saving technique. It provides the capability of programming certain fixed sequence/frequently repeated operations. These are independent programs with all the operations of a usual part program. These are stored in the memory under separate program numbers. When particular operation is required in the program, the associated subroutine is called for completing the operation. Subroutine also called as sub – programs. After completion of subroutine the control returns to main program. — 02

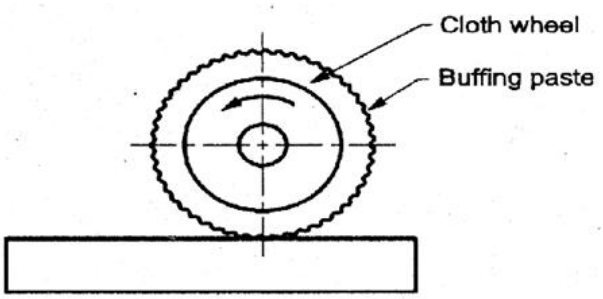
To use & write a subroutine, the following information is required in the forms of codes & symbols: Identification (start) of subroutine, End of subroutine, A means of calling a subroutine.

G –CODE	REQUIRED AXIS / OTHER INPUTS	FUNCTIONS
G22	C=Subroutine No	CALL For Subroutine, Stored Stroke Limit ON
G98	C=Subroutine No	Subroutine Label, Return To Initial Level

ii) **Canned cycles / fixed cycles:**

It is defined as a set of instructions, inbuilt or stored in the system memory, to perform a fixed sequence of operations**.** It reduces programming time and effort. Canned cycle is used for repetitive and commonly used machining operations. To save the repetition of programming of common operations, the cycle is used called affixed cycle/canned cycle. The sequence of standard cycle of operation is stored in the memory of the computer. When that information is required at the time of machining is activated from memory, by using proper G – code. One of the most frequently used canned cycles is the drilling cycles. The cycle shown in fig. activated by using G 81 code. — 02



The cycle of events for fig. is as follows: 1. Rapid traverse to center of first hole. 2. Rapid traverse to clearance plane. 3. Feed to complete depth of hole. 4. Rapid up to clearance plane. 5. Rapid traverse to center of the next hole. 6. Repeat the same procedure for as many holes as required. The programmer has to provide the following data only. 1. The position of the hole centers. 2. The spindle speed. 3. The feed rate. 4. The tool number.	
f) Write a short note on: i) Buffing ii) Burnishing and iii) Polishing	04
Answer: ***(Note: Buffing & Burnishing-1 ½ marks each & Polishing – 01 mark)*** **1) Buffing:** It is the operation in which the workpiece is brought in contact with a revolving, cloth buffing wheel that has been charged with very fine abrasive. The abrasives removes minute amount of metal from the workpiece, eliminate fine scratch marks and produce a very smooth surface. Buffing is used to apply high luster to the workpiece. Buffing wheels are made of discs of linen, cotton, broad cloth or canvas that are made firm by stitching to fasten the layers of cloth together. For buffing on noble metals like gold, silver, etc., canton, flannel or wool cloth buffs are used.  Many types of abrasives are used for buffing, like amorphous silica, aluminium oxide, and rouge or chromium oxide. Amorphous silica is one abrasive that is highly suitable for buffing aluminium, copper, and brass and die castings. Aluminium oxide powders can also be used as abrasive for buffing metals, whereas chromium oxide is used for buffing of stainless steel, chrome and nickel plate. Rouge is used for buffing copper, brass, gold and silver. Buffing compounds can either be greaseless or have a grease base. **2) Burnishing:** It is a process of producing bright and shining and smooth surface of metals. Burnishing is done as a supplementary process after metal cutting operations like turning, milling, shaping etc. In this process surface irregularities (peaks and valleys) formed by cutting tool are considerably reduced and high surface finish is obtained. Burnishing is non-cutting	1 ½

operation and uses no abrasives.

Roller burnishing improves surface finish by removing scratches, tool marks. Roller burnishing is used to improve the mechanical properties of surfaces, as well as shape and surface finish of the work-piece as shown in Fig.

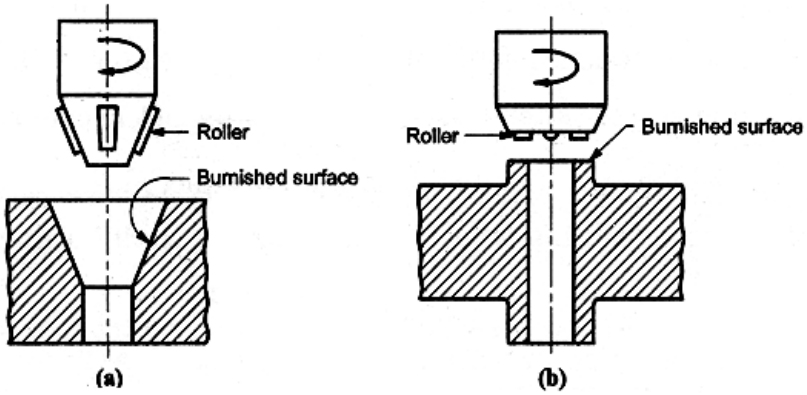


Fig.: Burnishing — 1 ½

3) Polishing:

The removal of oxidization (tarnish) from metal objects is accomplished using a metal polish or tarnish remover; this is also called polishing. To prevent further unwanted oxidization, polished metal surfaces may be coated with wax, oil, or lacquer. — 01

Polishing is a finishing operation to improve the surface finish by means of a polishing wheel made of fabrics or leather and rotating at high speed. The abrasive grains are glued to the outside periphery of the polishing wheel. Polishing operations are often accomplished manually. Polishing is used to remove scratches and burrs and to smooth rough surfaces while butting is used to provide attractive surfaces with high luster.

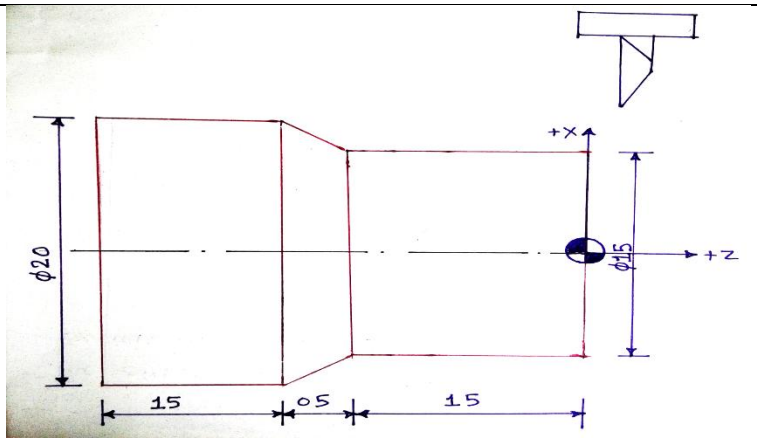
6. Attempt any TWO of the following. — **16**

a) Write part program for the component given in Figure No.1 also give co- ordinate system. — 08

Answer: ***(Note: Co-ordinate table & Sketch – 02 marks & Program – 06 marks)***

Co – ordinate Points Table: — 02

Codes	Points	X	Z
G00	0	22	0.5
G01	1	0	0
G01	2	15	0
G01	3	15	- 15
G01	4	20	- 20
G01	5	20	-35
G00	6	25	20



N0010 P03 G71 G90 G94 EOB
N0020 T01 S1000 M03 EOB
N0030 G00 X22 Z0.5 EOB
N0040 G01 X0.00 F200 EOB
N0050 Z0.00 EOB
N0060 X20.00 EOB
N0070 X15.00 EOB
N0080 Z-15.00 EOB
N0090 X20.00 Z-20.00 EOB
N0100 Z-35.00 EOB
N0110 G00 X25.00 Z20.00 EOB
N0120 M02 EOB

06

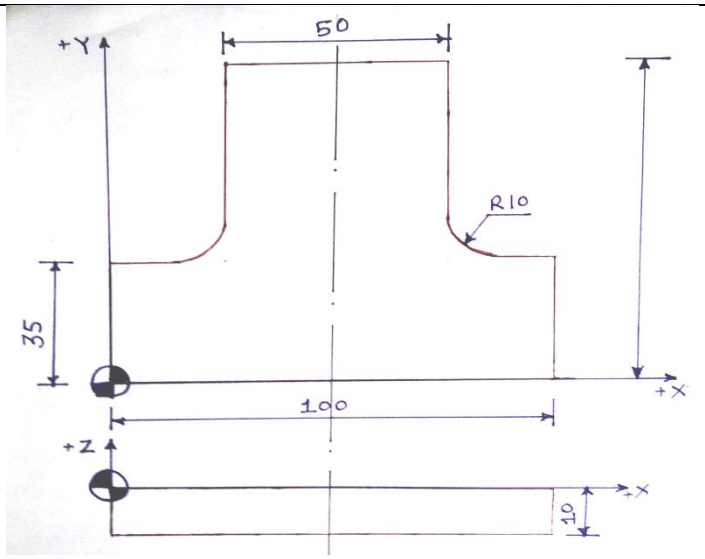
b) Write part program for the component given in figure No.2 — 08

Answer: ***(Note: Co-ordinate table & Sketch – 02 marks & Program – 06 marks)***

Co – ordinate Points Table:

Codes	Points	X	Y	Z	R
G00	0	00	00		
G01	1			-10	
G01	2	100	00		
G01	3	100	35		
G01	4	85	35		
G02	5	75	45		10
G01	6	75	90		
G01	7	25	90		
G01	8	25	45		
G02	9	15	35		10
G01	10	00	35		
G01	11	00	00		
G00	12			02	
G00	13	-10	00		

02



N0010 P03 G71 G90 G94 EOB
N0020 T01 S1000 M03 EOB
N0030 G00 X0 Y0 Z2.0 EOB
N0040 G01 Z-10 EOB
N0050 G01 X100 EOB
N0060 G01 Y35 EOB
N0070 G01 X85 EOB
N0080 G02 X75 Y45 R10 EOB
N0090 G01 Y90 EOB
N0100 G01 X25 EOB
N0110 G01 Y45 EOB
N0120 G02 X15 Y35 R10 EOB
N0130 G01 X0 EOB
N0140 G01 Y0 EOB
N0150 G00 Z2 EOB
N0160 G00 X-10 EOB
N0170 M02 EOB

06

c) Draw labeled sketch of progressive die. Write function of any four parts of progressive die. 08

Answer: ***(Note: Sketch – 4 marks & functions of any four parts – 1 mark each)***

Functions of progressive die parts: ***(Any four-1mark each)***

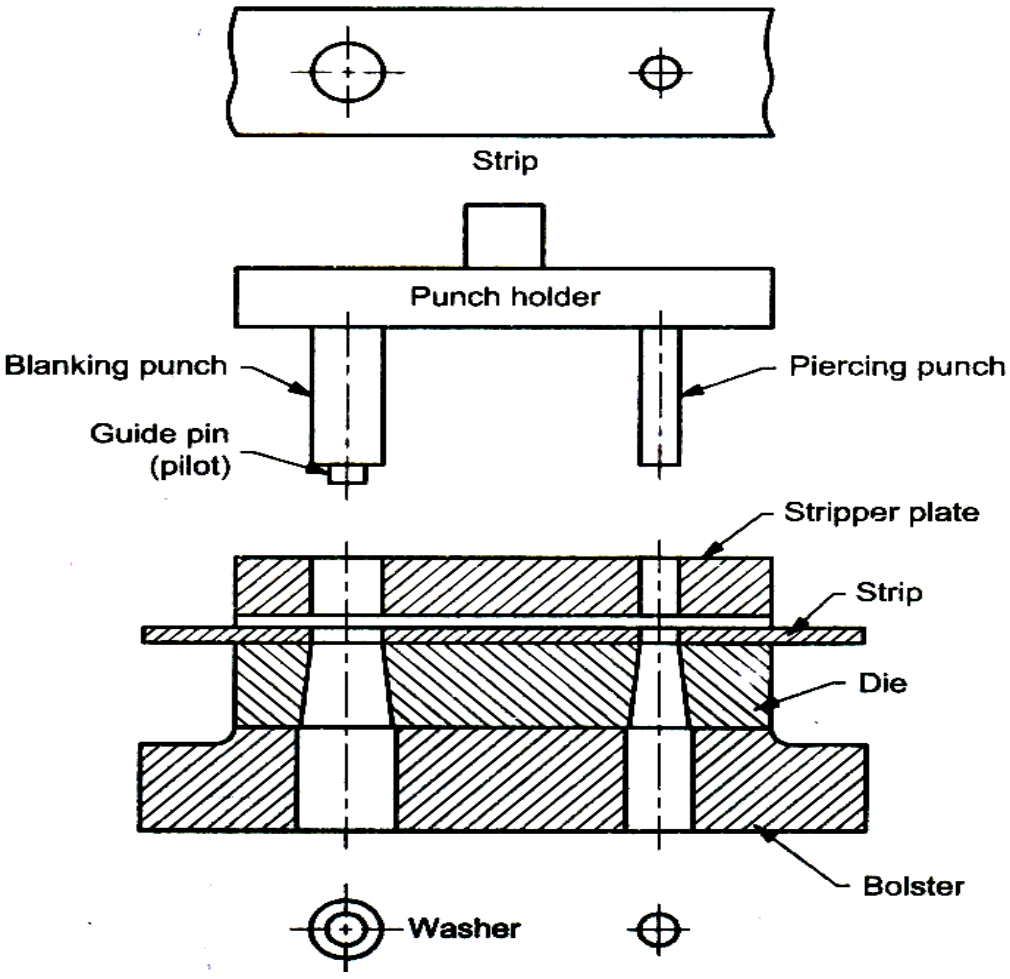
1) **Stripper**: to remove scrap material from the punch as it cleans the die block.
2) **Stock stops**: It controls the advancing of the strip while feeding the stock. (**OR**) Stock stops are used to locate the stock in die set when hand feeding the stock.
3) **Knockout**: The function of knock out is to eject the finished components from the die cavity.
4) **Strip Feeder**: It is used for feeding the strip mostly in automatic operations.
5) **Bolster plate:** for supporting the die block and other accessories of the press.
6) **Backup plate:** for preventing the parts from getting detached (stripper backing plate) and for adjusting the height of the die.
7) **Stops:** for correct spacing of the sheet metal as it is fed below the punch to give the greatest

04

output in given length of the plate.

8) Pilots: They acts as guides during the piercing or blanking operations. (**OR**) The pilots positions the stock strip accurately and bring it into proper position for blanking and piercing operations

Labeled sketch of Progressive Die:



04