Important Instructions to examiners:

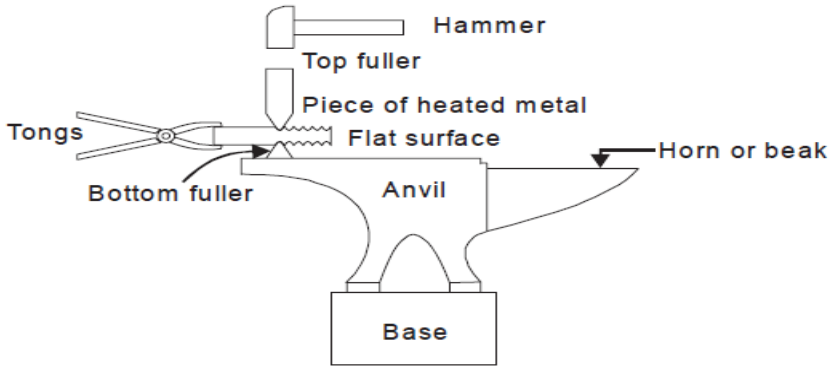
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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 judgement 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.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	(a)	**Attempt any SIX of the following: (2 x 6 =12)**	12
	(i)	**State any two advantages of forging process.**	02
	Ans.	(List any two of the following, 1 Marks for each) **Advantages of forging processes:** 1) Complex shaped parts can be forged 2) Mass production with greater accuracy is achieved. 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	02
1 (a)	(ii)	**Explain blanking operation.**	02
	Ans.	(1&1/2 mark for Explanation, ½ Mark for Figure) **Blanking:** The blanking is the operation of cutting of flat sheet to the desired shape. The piece detached from strip is known a blank. The metal punched out is the required product and the plate with the hole left on the die goes as waste. While blanking the size of the blank is governed by the size of the die and the clearance is left on the punch. Blanking is always performed as the first operation.	02
1 (a)	(iii)	**State the factors on which weldability depends.**	02

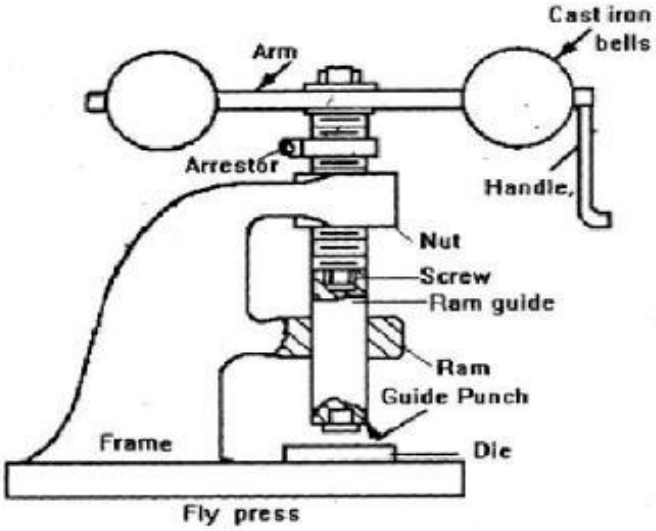
	Ans.	(List any four, ½ Marks for each) **Factors on which weldability depends:** 1. Material grade, material thickness, design, weld property requirement 2. Equipment type, edge preparation design 3. Tip / work piece distance, electrode angle 4. Current, arc voltage, welding speed 5. Availability of equipment 6. Repetitiveness of the operation 7. Quality requirements (base metal penetration, consistency, etc.) 8. Location of work 9. Materials to be joined i.e. base metal composition 10. Appearance of the finished product 11. Size of the parts to be joined 12. Time available for work 13. Skill experience of workers 14. Cost of materials 15. Code or specification requirements 16. Mechanical properties desired in joints	**02**
1 (a)	**(iv)**	**Classify butt welding process.**	**02**
	Ans.	**Classification of Butt Welding Processes:** (Any 2 Types, 1 Marks for each proper classification) 1. Flash Butt Welding 2. Resistance Butt Welding 3. Hand Welding 4. Upset Welding	**02**
1 (a)	**(v)**	**Name various surface coating processes.**	**02**
	Ans.	**Surface coating process:** (Any Four -1/2 marks each) **(1) Metallic coating** **(2) Plastic coating** **(3) Organic coating** **(4) Inorganic coatings** **(5) Conversion coating** **(6) Other metal coating processes**	**02**
1 (a)	**(vi)**	**List the components of NC machines.**	**02**
	Ans.	**Components of NC Machines:** (List any four parts, ½ Mark each) 1. Program input device	

		2. Memory storage 3. Microprocessor 4. Machine control Unit (MCU) 5. Drive system 6. Machine Tool 7. Feedback system 8. Programmable logic controller (PLC) 9. Machine control panel 10. Operator control panel 11. Tape Reader	**02**
1 (a)	**(vii)**	**What is the part programming?**	**02**
	Ans.	**Part Programming:** (2 Marks for Proper Explanation) [1] A **part program** is a set of instructions given to a computerized numerical control (CNC) machine to control its operation. [2] CNC part program contains a combination of machine tool code and machine-specific instructions. [3] It consists of: (a) Information about part geometry (b) Motion statements to move the cutting tool (c) Cutting speed (d) Feed (e) Auxiliary functions such as coolant on and off, spindle direction	**02**
1 (a)	**(viii)**	**List any four applications of forging process.**	**02**
	Ans.	**Applications of Forging Process:** (Any 4 suitable applications, each of ½ Marks) 1. Connecting rod 2. Crankshaft 3. Camshaft 4. Spanner 5. Alloy wheel 6. Differential gears 7. Drive shafts 8. Clutch hubs 9. Universal joints 10. Hand Tools	**02**
1	**(b)**	**Attempt any TWO of the following: (2 x 4 =08)**	**08**
1 (b)	**(i)**	**Give detail classification of forging process.**	**04**
	Ans.	**Classification of forging processes** (Any four , 01 Mark each) **1.Open die forging:** a) Hand forging b) Power forging: i. Hammer forging	

		ii. Press forging **2.Close die forging:** a) Drop forging b) Press forging c) Machine forging	**04**
1 (b)	**(ii)**	**What is Forgability? On which factors it depends?**	**04**
	Ans.	(2 Marks for Definition of Forgability, 2 Marks for Factors affecting) Forgability is defined as the ability of a metal to change size and shape when heated to required temperature and compressed by applying some pressure. **OR** The ease with which forging is done is called forgeability. The Forgability of a material can also be defined as the capacity of a material to undergo deformation under compression without rupture. **Factors affecting on Forging:** [1] Phase Temperature of Material [2] Lattice Structure of Metals [3] Mechanical Properties of Metals [4] Shape and Size of part to be forged	**02** **02**
1 (b)	**(iii)**	**Write forging sequence for spanners.**	**04**
	Ans.	**Forging Sequence for Spanner:** (1) The heated stock is elongated by reducing its cross section in first die. The operation is known as "Fullering". (2) The metal is redistributed, increasing the cross section at certain places and reducing at others as required filling the cavities of the die. The operation is known as "Edging". (3) General shape is given in first blocking die. (4) Finished shape is given to forging in final impression die. (5) Flash is removed. (6) Heat treatment and machining is done as per requirement.	**04**
2		**Attempt any <u>FOUR</u> of the following: (4 x 4 =16)**	**16**
2	**(a)**	**Describe briefly, hand forging and machine forging.**	**04**
	Ans.	(Brief Description of Hand & Machine Forging, 2 Marks Each) **Hand Forging:** [1] Hand forging is the oldest type of metal working process and has influenced the formation of other materials through the age. [2] Smith forging was formerly the process envisioned when we think of the blacksmith wielding a hammer against a piece of hot metal placed upon a rigid anvil.	

		[3] The modern process is the same except that the crafts-person uses a mechanical hammer and manipulators to move heavy pieces. [4] Hand forging is performed in the black smithy shop. The job is heated at the forging temperature in hearth and it is then brought on anvil using tong. [5] It is then forged using hand hammers and other hand forging tools for imparting specific shape.  **Fig. 14.16** Hand forging **Machine (Power) Forging:** [1] Hand hammer blows impact will not be always sufficient enough to affect the proper plastic flow in a medium sized or heavy forging. [2] It also causes fatigue to the hammer man. To have heavy impact or blow for more plastic deformation, power hammer are generally employed. [3] These hammers are operated by compressed air, steam, oil pressure, spring and gravity. [4] They are generally classified as spring hammer and drop hammers. The capacity of these hammers is given by the total weight. [5] The heavier these parts and greater the height from which they fall, the higher will be intensity of blow the hammer will provide.	**02** **02**
2	**(b)**	**Write down the sequence for manufacturing of crankshaft.**	**04**
	Ans.	**Forging Sequence for Manufacturing Crank Shaft:** [1] Stock is redistributed and size is increased at certain place and reduced at other place by roll forging. [2] After preliminary roll forging, stock is again roll forged. [3] This stock is then forged in first impression or blocking die. [4] The final shape is given to the forging in next blocking die. [5] Then the finished part is then trimmed in blanking die to remove excess metal or flash.	**4**
2	**(c)**	**Name the different types of presses used in industry. State the working**	**04**

		principle of press.	
		Types of presses used in industry: (2 Marks for Types, 2 Marks for Working Principle) **According to Source of power to ram:** 1. Crank 2. Cam 3. Eccentric 4. Power screw 5. Rack and pinion 6. Toggle 7. Hydraulic 8. Pneumatic **According to design of frame:** 1. Bench 2. Gap 3. Inclinable 4. Arch 5. Straight side 6. Horn 7. Pillar **Working Principle of Press:** A forming **press**, commonly shortened to press, is a machine tool that changes the shape of a work piece by the application of pressure. Presses can be classified according to their mechanism (source of energy used for operation) hydraulic, mechanical, pneumatic and respectively working on principle of Pascal law, Mechanical Pressure and Pneumatic Pressure.	**02** **02**
2	**(d)**	**Describe fly press with neat sketch.**	**04**
	Ans.	(02 Marks for Description of Fly press, 02 Marks for Neat Sketch) **Fly Press :** [1] It is simplest type of all presses, called as hand press / ball press/single side fly press. [2] It consists of robust cast iron frame. Top portion of frame forms the nut. [3] Vertical screw which can go through the nut. Screw carries an arm. [4] Arm supports two cast iron weights (balls) at two ends. Handle used for rotating the arm. [5] Frame extended below the nut to form guides. Ram attached at the bottom of	**02**

		the screw. [6] Ram carries punch at its bottom. Die is fixed at the press base. [7] Sheet metal placed over the die. Arm gets quick rotation with the help of handle. [9] Heavy balls stores kinetic energy for long time movement of screw. Movement of screw causes movement of ram & punch downwards. [11] Stroke of the collar adjusted with help of Stop Collar / Arrestor. Advance type of fly press is double side Press.  	**02**
2	**(e)**	**Explain forming and punching operation with neat sketch.**	**04**
	Ans.	**(**01 Mark for brief Description of each operation, 01 Mark for suitable sketches of each) **Forming:** **Forming** processes are particular manufacturing processes which make use of suitable stresses (like compression, tension, shear or combined stresses) to cause plastic deformation of the materials to produce required shapes. During **forming** processes no material is removed, i.e. they are deformed and displaced.	**01** **01**

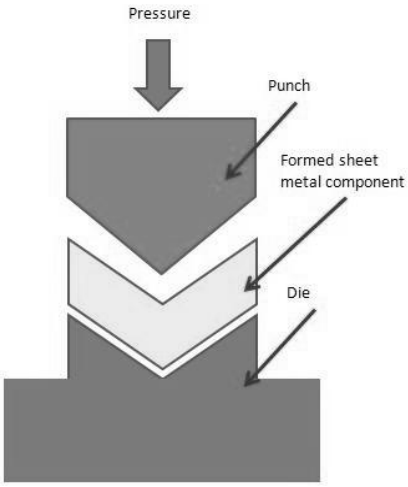
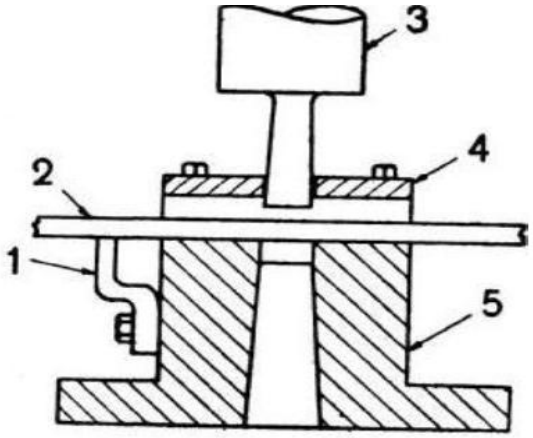


Figure: Drawing Operation — **01**

01

Punching:

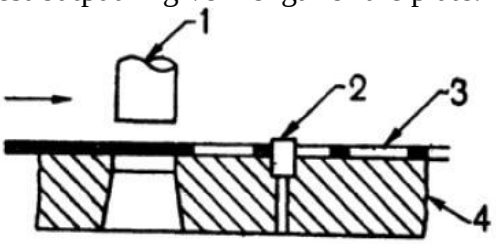
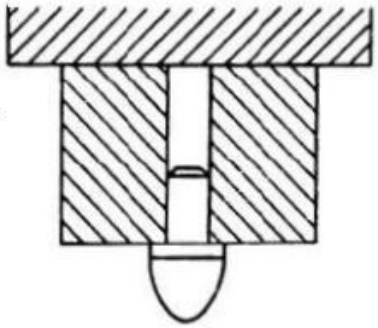
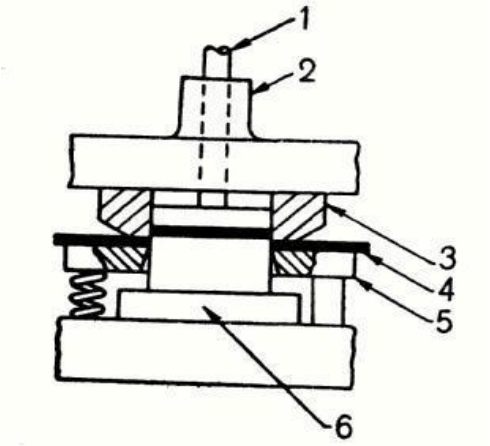
In punching operation, a hole is the desired result. The size of hole is determined by the size of punch and clearance is allowed on the die. The figure shows the spacing of hole on plate2 is actuated by the stop1 the stripper plate 4 is attached to die body 5 prevents sheet metal from being lifted along with the punch 3 after punching operation.

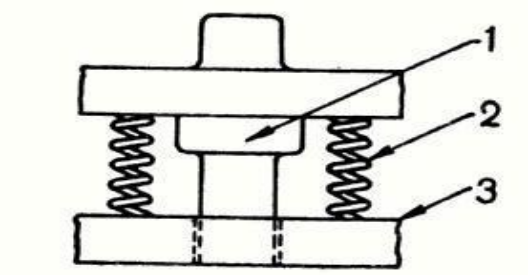


(1.Stop, 2.Plate, 3.Punch, 4.Stripper plate, 5.Die)

Figure : Punching Operation

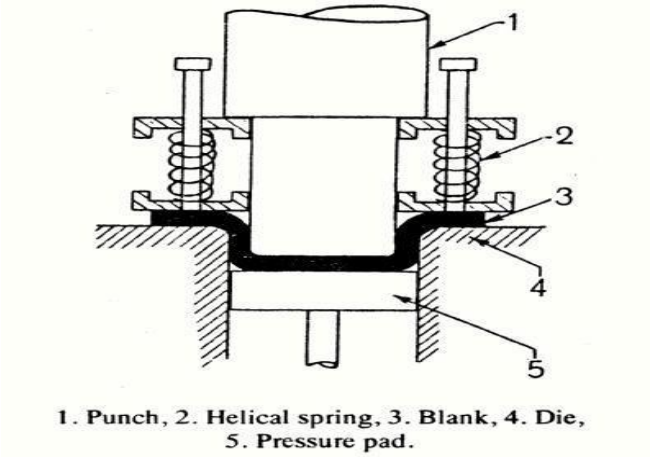
2	**(f)**	**Describe briefly any two die accessories.**	**04**
		(Any two from the following, 1.5 Marks for Brief Description of each, ½ Marks f or each Suitable sketch) **1. Stops:** The stops are used for correct spacing of the sheet metal as it is fed	

		below the punch to give the greatest output in given length of the plate.  1. Punch, 2. Button, 3. Plate, 4. Die block. Figure. Button Stop **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 work piece from the punch or the die after the end of cutting or forming operation.	**04**



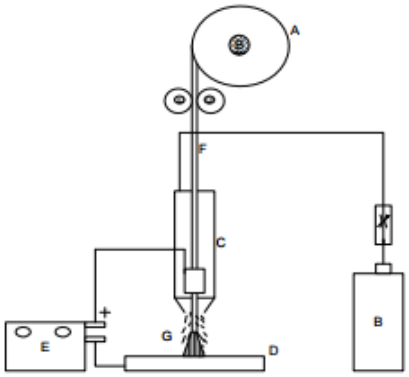
1. Punch, 2. Helical spring,

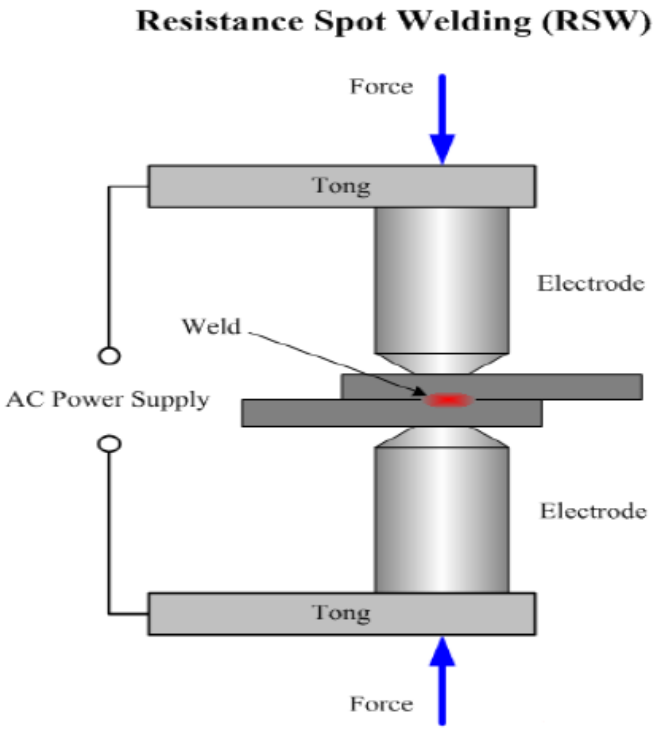
5. Pressure pad: It is used for drawing operation for maintaining flat surface of the cup



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

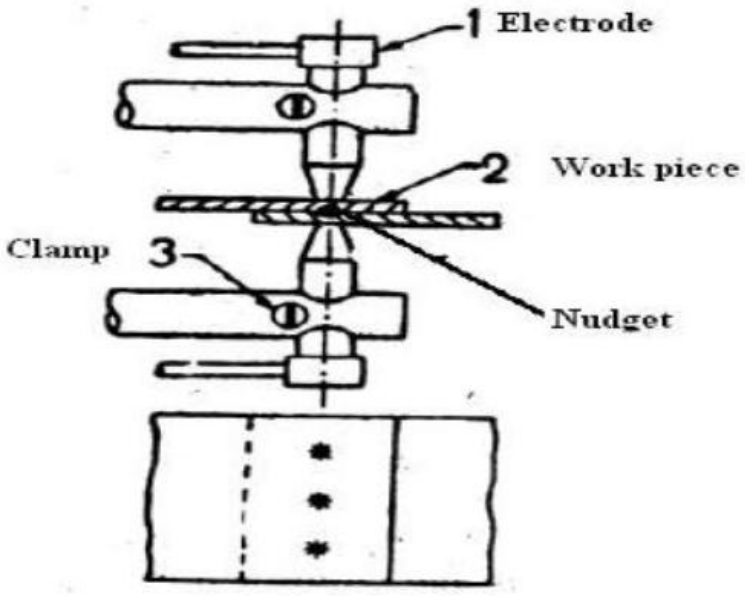
3		**Attempt any FOUR of the following (4 x 4 =16)**	**16**
3	**a**	**List various pressed products which are used in automobiles.**	**4**
	Ans.	(½ Mark each for any eight products) The various pressed products used in automobiles are: 1) Gears 2) Crank Shafts 3) Automobile panels 4) Wires 5) Frames and Chassis 6) Connecting Rods 7) Springs 8) Carburettor bodies 9) Valves 10) Combustion Chamber	½ Mark each for any eight products

		11) Cylinder heads , blocks 12) Gear box cases etc.	
3	**b**	**Draw labeled sketch of MIG Welding.**	**4**
	Ans.	 Schematic of MIG process showing important elements A) Welding spool, B) Shielding gas cylinder, C) welding torch, D) base plate, E) welding power source, and F) consumable electrode.	4
3	**c**	**List common equipments used for arc welding process.**	**4**
	Ans.	(½ Mark each for any eight equipments) 1. A.C. or D.C. machine 2. Electrode (bare or coated) 3. Electrode Holder 4. Cables and its connectors 5. Chipping Hammer 6. Earthing Clamps 7. Wire-brush 8. Helmet 9. Safety Goggles 10. Hand Gloves 11. Apron Sleeves etc.	
3	**d**	**Describe with neat sketch: (i) Spot Welding (ii)Seam Welding**	**4**
	Ans.	**(i) 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.	1



1

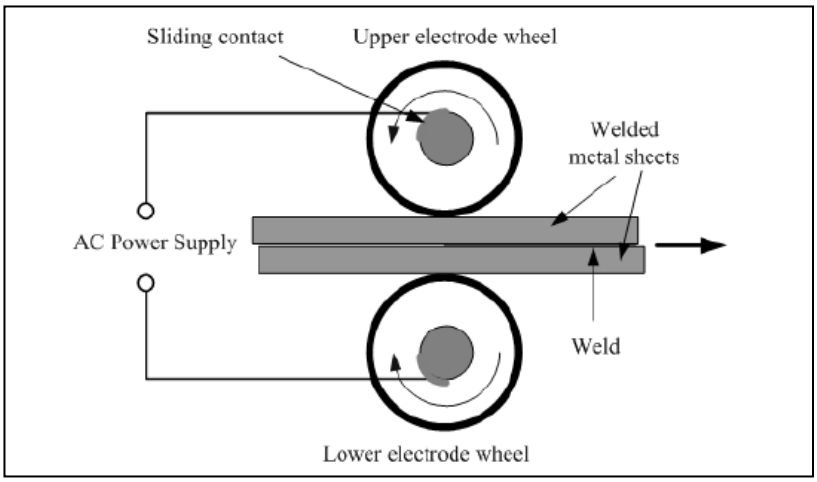
OR

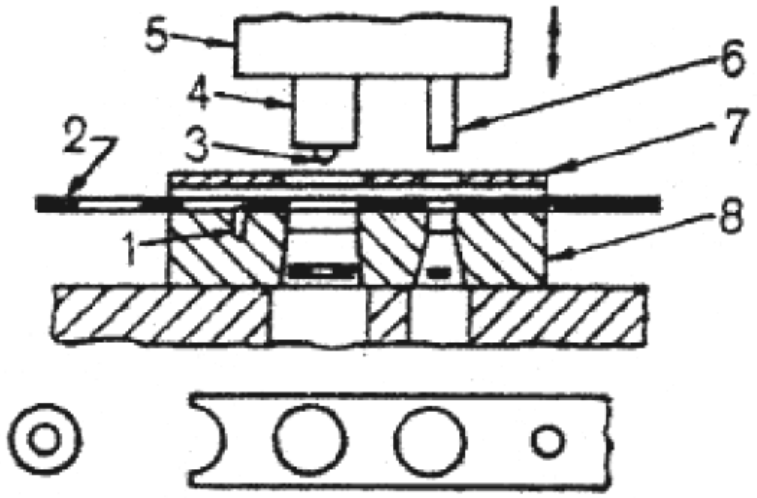


(ii) Seam Welding:

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

1

		conserve the electrodes and cool the work rapidly to speed up the operation.  **Fig. Seam Welding**	1
3	**e**	**Name the types of dies used in press work. Explain any one with neat sketch.**	**4**
	Ans.	**(two marks for types and 2 marks for explanation of any one type)** **The various types dies used in press work are:** **1. Types of dies according to operations performed** (i) Shearing (ii) Bending (iii) Drawing (iv) Squeezing **2. Types of dies according to construction** (i) Simple (ii) Follow or progressive (iii) Compound (iv) Combination (v) Rubber **Progressive Die:**	2 1



1

OR

1. Stop 2.Sheet metal 3.Pilot 4.Blanking punch 5.Ram 6.Piercing punch 7.Stripper 8.die

1

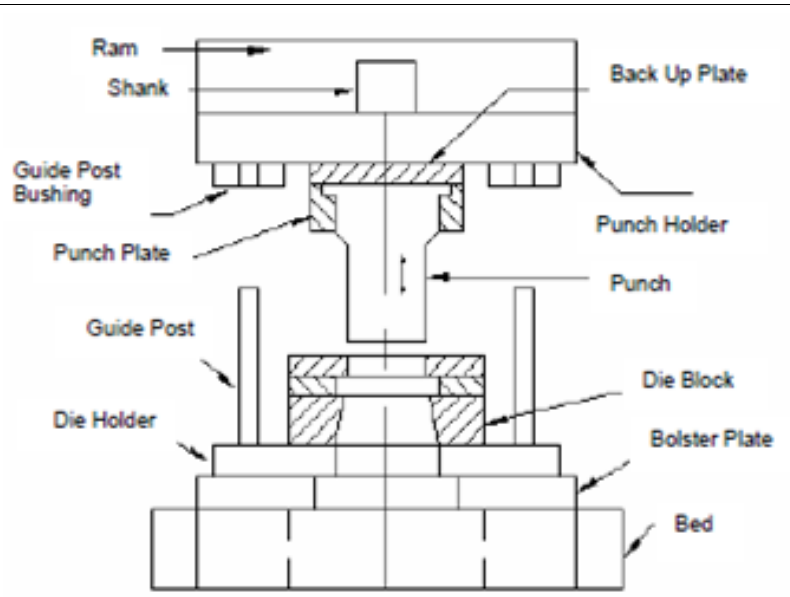
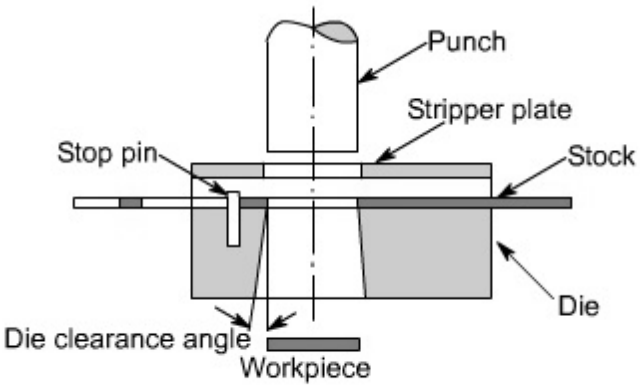
In a progressive die two or more operations are performed simultaneously at two or more stations with each press stroke by mounting separate sets of dies and punch. The metal is progressed from one station to other. Figure shows progressive punching and blanking die. The sheet metal is fed into the first 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

OR

1

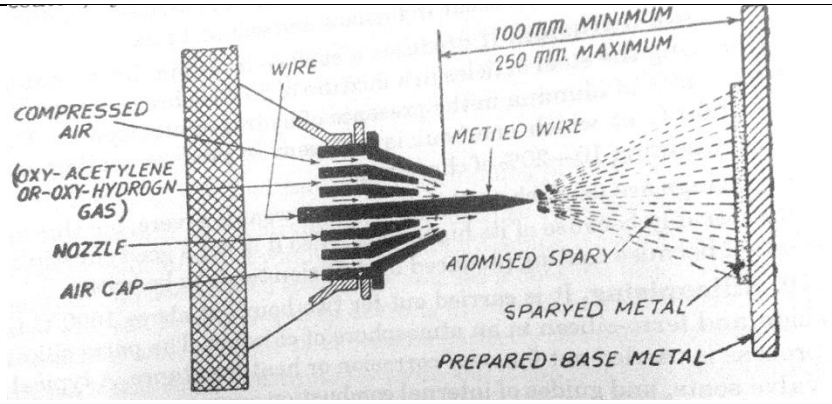
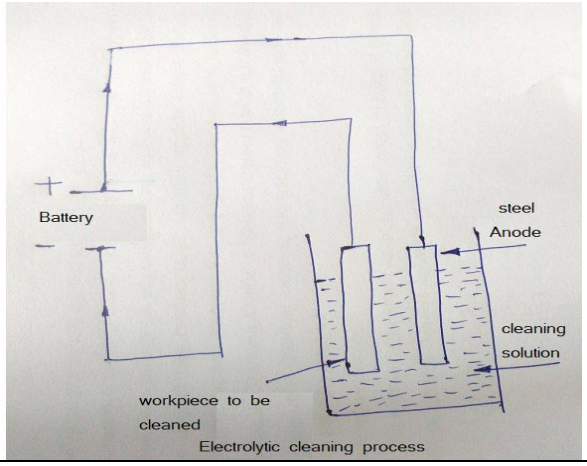
Simple Die:

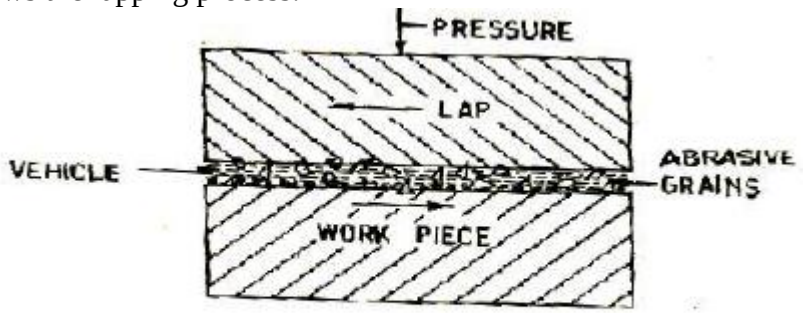
Simple die or single action dies perform single operation for each stroke of the press slide. The operation may be cutting or forming operation such as blanking, punching, piercing etc. performed on these dies. The operations can be performed in a single action of the press slide giving output. These dies are simple in construction and can manufacture by conventional machining processes.

		 **OR** 	
3	**f**	**Describe briefly soldering and brazing operation.**	**4**
	Answer:	**Soldering:** It is a method of joining two or more pieces of metal sheets by means of a fusible alloy or metal , called solder, applied in the molten state. The melting point of the filler metal is below 420^0C. Generally lead and tin alloys are used in various compositions depending upon the use of the joint. Composition of some of the solder is given below: (i) Soft solder- lead 37% and tin 63%. (ii) Medium solder- lead and tin each 50%. (iii) Electrician solder-lead 58% and tin 42% (iv) Plumber's solder- lead 70% and tin 30% Depending on method of heating soldering processes may be classified as dip, iron, resistance, torch, induction, furnace, infrared and ultrasonic type.	2

		Brazing: it is a process of joining two pieces of metals in which a non ferrous alloy is introduced in a liquid state between the pieces of metal to be joined and allowed to solidify. The filler metal is distributed between the closely filled surfaces of the joint by capillary action. The melting point of filler metal is above 420^0C, but lower than the temperature of parent metal. During the process no forging action is present and also the parts do not melt. The bond is produced either by the formation of solid solution or intermetallic compounds of the parent metal and one of the metals in the filler. The strength of the bond is provide by metallic bonding. Copper, Copper alloys, Silver alloys and Aluminium alloys are used for brazing process.	2
4		**Attempt any FOUR of the following (4 x 4 =16)**	**16**
4	**a**	**Describe in brief the equipments required for oxy-acetylene welding.**	**4**
	Ans.	(1 Mark each for any four equipments) The following equipments are required for oxy-acetylene welding. 1. Welding torch or Blowpipe: It is the tool for mixing two gases in the desired volumes and burning the mixture at the end of a tip. It has a handle to carry it and two inlet connections for gases at end. Each inlet has a valve to control the volume of oxygen or other gas. Two gases from two paths mix up in a mixture and flame is produces by igniting the mixture at the tip of the torch. 2. Pressure Regulator: The function of pressure regulator is to reduce the pressure from the cylinder and to maintain it at constant value regardless of the pressure variation at the source. It is also used to adjust the pressure of the gas to torch. Changes in the pressure can be made simply by turning the handle at the regulator. There are two types of pressure regulators *viz*., single stage and double stage. 3. Hose and Fittings: Two hoses to carry oxygen and acetylene separately are required . They connect the regulator mounted on cylinders to the torch. Generally Green colour is adopted for oxygen and red for acetylene. These should be strong, durable, non-porous, light and flexible. To avoid explosion , oxygen fittings should never be greased or oiled. Special hose fittings and connections are provided for attachment to the torch and pressure regulators. 4. Cylinders: The gases are generally stored at high pressure in the steel cylinders. For oxygen which is obtained commercially, cylinders are made up of drawn-steel without seams and carefully heat treated as to develop great strength and toughness. The cylinder is also equipped with high pressure valve and valve-protector cap. It is charged at a pressure of about 150 kg/cm^2 and temperature about 20^0C. A safety fuse plug is also provided so as to release oxygen in case , temperature inside increases. Acetylene cylinders are closely packed with absorbent filler , which is saturated with acetone. 5. Goggles: These are very essential to protect eyes. These are fitted with	1 Mark each for any four equipments

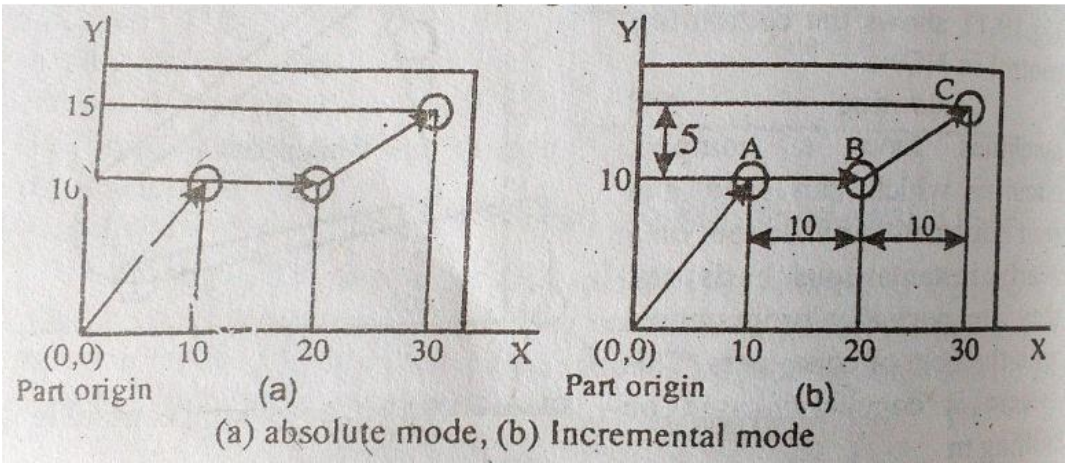
		coloured lenses that prevent harmful heat and the ultraviolet and infra-red rays. 6. Spark Lighter: It provides a convenient and instant means for lighting the welding torch. It consists of a pointed stone and a rough surface which produce a spark when rubbed together. 7. Apron: This protects the clothes of operator from dirt and danger and keeps him alert. 8. Gloves: These are essential to protect hands. 9. Ventilation equipment: It is essential particularly when welding in confined spaces. Fumes given by welding are harmful for lungs. 10. Welding rods: Theoretically the composition and properties of the welding rod should match with the base metal very closely. Therefore proper welding rods should be chosen for various non-ferrous and ferrous metals. 11. Fluxes: in welding of certain metals, fusion of the weld does not takes place very readily particularly when the oxides of the base metal have a higher melting point than the metal itself.	
4	**b**	**Explain metal spraying process and give two applications.**	**4**
	Ans.	Metal praying of metalizing literally means to treat with or coat with a metal or metallic compound. Metalizing as a process normally includes the preparation of base material, the spraying on the metal and finally finishing the surface by grinding. Basically there are two types of equipment are used for metal spraying. One is the metallic gun which consists of a gas torch with a hole in centre of the tip for the wire, a small air turbine and gears to feed in the wire through the tip into the flame as fast as it melts and an air cap around the torch tip and nozzle which supplies a blast of air to atomise the molten metal and deposit it on the prepared surface. In other method powered metal is fed from container through rubber hose to spray-gun and out through the centre of flame , similar to the wire gun. In this case metal is already in atomized form and hence air needed is sufficient to deposit the molten metal on the surface being coated. The metallic-gun using metal in the wire form is commonly used . The wire is fed to spray gun at a definite rate melted by an oxyacetylene flame, and then blown on the surface being coated, by compressed air. A sectional view of metal spraying gun is shown in fig.	1

		 Metal spraying process with Metallic-gun Applications of metal sprayings: 1. Corrosion protection: 2. Sprayed coatings can be applied even to non-metallic surface such as wood, plastic etc. 3. Metal spraying is used for reclaiming the worn out machine parts. 4. Its other applications are in having decorative films, reflecting surfaces and special metal forms.	1 2
4	**c**	**Explain electrolytic cleaning with neat sketch.**	**4**
	Ans.	**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.  Electrolytic cleaning process	2 2

4	**d**	**List various surface finishing processes. Explain lapping.**	**4**
	Ans.	**List of Surface Finishing Processes:** [1] Grinding [2] Honing [3] Lapping [4] Burnishing [5] Buffing [6] Polishing	2
		Lapping Lapping is basically an abrasive process in which loose abrasives function as cutting points finding momentary support of the lap. The process has the following features. (a) Use of loose abrasives between the lap and the work (b) The lap and workpiece are not positively driven, but are guided in contact with each other (c) Relative motion between the lap and work surface should be constantly changing. The effective path is of cycloid in nature. Figure shows the lapping process.	1
		 Fig. Principle of lapping.	1
4	**e**	**State salient features of CNC machines.**	**4**
	Ans.	Salient Features of CNC machines….. 1. A part program can be fed to the controller unit through a keyboard. 2. The part program once entered can be used again and again. That is why the CNC controller is termed as soft wired control. 3. The part program can be edited whenever required. 4. For common and repetitive operations, a sub program can be created and called in the main program whenever required, thereby reducing the main program substantially. 5. The CNC machines have simulation facility whereby the part program can be checked for its accuracy without actual running the machine. 6. The CNC control unit allows compensation for any changes in the dimensions of cutting tools caused due wear or otherwise.	1 Mark each for any four points.
4	**f**	**Differentiate between conventional machines and CNC's.**	**4**
	Ans.		

			Sr. No.	Conventional Machines	CNC Machines	1 Mark each for any four points.
			1	Basically conventional machines have maximum 2 axis, knows ad X and Y axis.	CNC machine have minimum 3 axis known as X, Y, Z axis.	
			2	Leas screw is responsible for axis movement in conventional machine.	Ballscrew is responsible for axis movement is CNC machines.	
			3	All operations are performed manually.(Except some auto mode)	All operations are performed hydraulically or pneumatically.	
			4	There is no use of servo motors and stepping motors for slide movement.	Use of servo motors and stepping motors for slide movement.	
			5	No display units are provided in conventional machine.	Display units are provided in CNC machines.	
			6	Conventional machines have less accuracy.	CNC machines have more accuracy.	
			7	Conventional machines have more operator errors.	CNC machines have less operator errors.	
			8	Less guarding arrangement for conventional machines.	More guarding arrangement for CNC machines.	
			9	Small change is not possible in conventional machine.	Small change is possible in CNC machine.	
			10	No facility for dry run.	Facility for dry run.	
			11	Additional information such as number of jobs produced, time per component can not be obtained.	Additional information such as number of jobs produced, time per component can be obtained.	
			12	It does not allow compensation for change in cutting tool dimension.	It does allow compensation for change in cutting tool dimension.	
5		**Attempt any FOUR of the following**				**16**
5	**a)**	**What are the factors considered while selecting the components for machining on CNC machines?**				**4**
	Answer	• Following are the factors to be considered in selecting components of CNC machines? 1. High precision and repeatability. 2. Reliability. 3. Efficiency -To meet the requirement of high precision. Repeatability and high efficiency the numerically controlled machine tools -should have a structure that is correctly designed to withstand normal weight distribution.				1 1

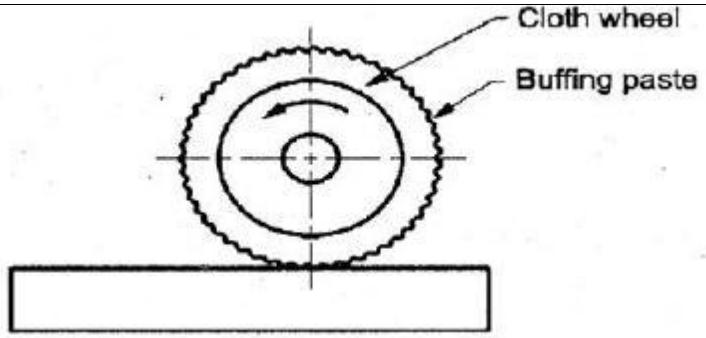
		-The machine structure should not be bend due to heavy cutting force. -All the parts of machine structure should remain in relative relationship regardless magnitude and directions of stress develop due to cutting forces. -The design should be such that the thermal distortion should be minimum. -The machine structure should be provide with efficient and foolproof lubrication and cooling system.The machine structure should be such that removal of swarf is easy and the chips do not fall on the slideways.	1 1
5	**b)**	**Explain two types of programming modes in CNC machines.**	**4**
	Answer	*Two Methods – 2 mark each* **1)Absolute Programming Method** *(1 mark explanation, 1 mark sketch)* It is a system in which coordinates of the points are referred to one reference point, which is the origin / set point. All the position coordinates are given from origin point. The main advantage of this system is that error in calculating the coordinates of one point is not introduced in coordinates of other point. Checking of the program in this system is easy. The G-code used for absolute programming is G-90. **2) Incremental Programming Method:** *(1 mark explanation, 1 mark sketch)* In incremental system the co-ordinates of any point are calculated with reference to previous point i.e. the point at which the cutting tool is positioned is taken as datum point for calculating the co-ordinates of next point to which the movement is to be made. It is difficult to check a part program written on incremental dimension mode. The G-code used for incremental programming is G-91	1 1 2



(a) absolute mode, (b) Incremental mode

Tool position	Absolute		Increment	
	X	Y	X	Y
A	10	10	10	10
B	20	10	10	0
C	30	15	10	5

5	c)	**What are the application of CNC machines?.**	4
	Answer	**Any four application 04 marks** • Drill press • Milling and turning centres • Boring machines • Surface grinders • Manufacturing industries etc.	
5	d	**State the function of G00, G94, M08 and M30 used in CNC part programming.**	4
	Answer	**Answer: 01 mark for each function.** **1) G00 :- Rapid Traverse Function** G00 is the basic G-code for CNC programming to initiate rapid motion mode i.e used for quickly positioning the tool. G00 can be used where the tool is not directly in contact with work piece and where one wants to save the time. **2)G94 - Feed Rate Programming In "mm/min"** **3)M08 – Coolant ON** **4) M30 :-Program End with program reset OR** **End of tape- Tape rewind Automatically** The most common way of ending a program is with an M30. The program will automatically reset to the beginning of the program which will give access to the operator to run the next cycle. Using M30 will help operator to save time during mass production. As soon as the program ends he can place the next component and start the next cycle.	1 1 1 1
5	e)	**Describe briefly how to develop CNC part programme.**	4
	Answer	**Answer: 02 marks for one method** **Procedure for developing part program** There are two methods of part programming: 1.Manual part program and 2. Computer assisted part programming. **1) Manual part programming:** 1. To prepare a part program using the manual method. The programmer writes the machining instructions on a special form called a part programming manuscript. The manuscript is a listing of the relative tool and work piece location. 2. The NC tape is prepared directly from the manuscript. 3. Define the axis coordinates in relation to the work part. 4. Define safe (target point) point and origin point (work zero). 5. The tape is inserted to read the first block in to the system. 6. The functions like machining, tool changing, spindle ON/OFF, coolant ON/OFF, program stop and tape rewinding are carried out as per the program. **2) Computer- assisted part programming**:	2 2

		This method is useful for most critical and complex parts. The part programmer and the computer are main tools in this method. 1.The part programmer first defines the work part geometry 2.He specifies the operation sequence and tool path 3.The computer interprets the list of part programming instructions, performs the necessary calculations to convert this into a detailed set of machine tool motion commands, and then controls a tape punch device to prepare the tape. 4. The tape is verified for accuracy. 5. The NC system machines (makes) the part according to the instructions on tape.	
5	**f)**	**Explain buffing process with neat sketch.**	**4**
		 **Buffing process :-** Buffing is used to give a much higher, lustrous, reflective finish that cannot be obtained by polishing. The buffing process consists in applying very fine abrasives with rotating wheel. Buffing wheels are made of discs of linen, cotton, broad cloth and canvass. They are made more or less firm by the amount of stitching used to fasten the layers of the cloth together. The abrasive is mixed with binder and is applied either on the buffing wheel or on the work. The abrasives may consist of iron oxide chromium oxide, emery etc. The binder is a paste consisting of wax mixed with grease, paraffin and kerosene, or turpentine and other liquid. In this process, work piece 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 work piece, eliminate fine scratch marks and produce a very smooth surface. Buffing is used to apply high luster to the work piece. **Applications :-** Automobiles, motor-cycles, boats, bicycles, sporting items, tools, store fixtures, commercial and residential hardware and household utensils and appliances.	**1 Marks for Figure** **3 Marks description**

Q. No.	Sub Q. N.	Answer	Marking Scheme
6		**Attempt any Two of the following**	16
6	a)	**Write the part programme for the job shown fig.No.1** **Assume suitable data for programming.**	8
	Answer	**Answer:** ***(Note: Co-ordinate table & Sketch – 02 marks & Program – 06 marks)*** **Co – ordinate Points Table**	1

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

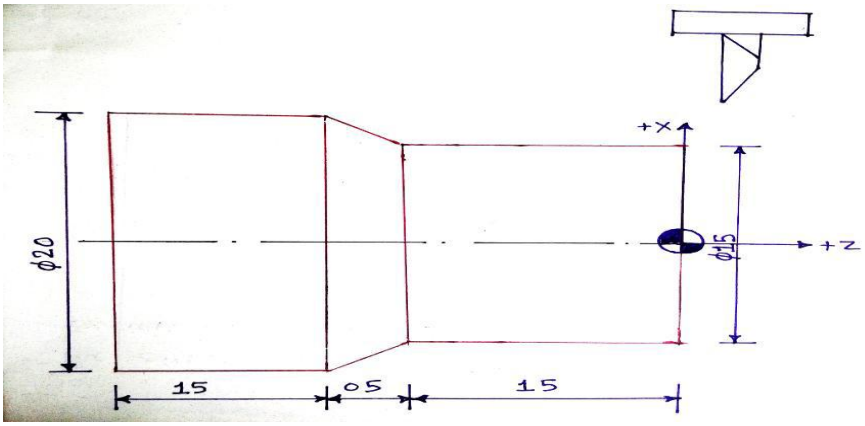


fig no.1

1

Part programme

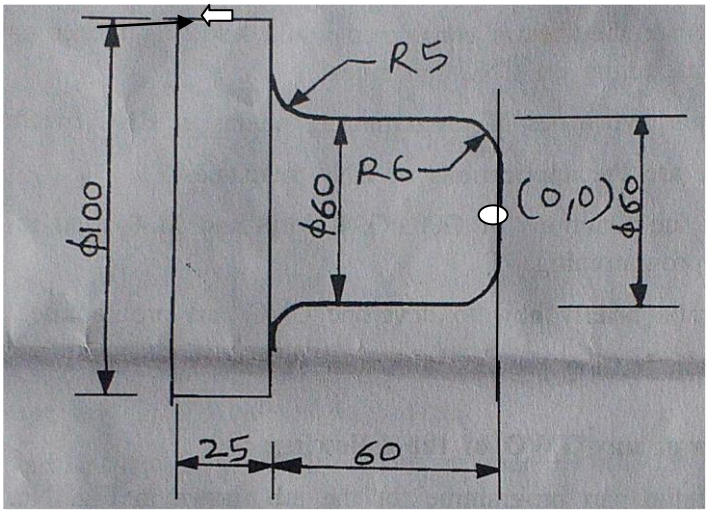
N0010 P03 G71 G90 G94 EOB
N0020 T01 S1000 M03 EOB
N0030 G00 X22 Z0.5 EOB
N0040 G01 X0.00 F200 EOB — 03 marks
N0050 Z0.00 EOB
N0060 X20.00 EOB
N0070 X15.00 EOB
N0080 Z-15.00 EOB
N0090 X20.00 Z-20.00 EOB — 03 marks
N0100 Z-35.00 EOB
N0110 G00 X25.00 Z20.00 EOB
N0120 M02 EOB

6

6	b)	**Write the part programme for the following component.**	
	Answer	**Answer:** ***(Note: Co-ordinate table & Sketch – 02 marks & Program – 06 marks)***	1

Co – ordinate Points Table :

Points	X	Z
P0	0.00	2.00
P1	0.00	0.00
P2	48.00	0.00
P3	60.00	-6.00
P4	60.00	-55.00
P5	70.00	-60.00
P6	100.00	-60.00
P7	110.00	-70.00
P8	110.00	-65.00

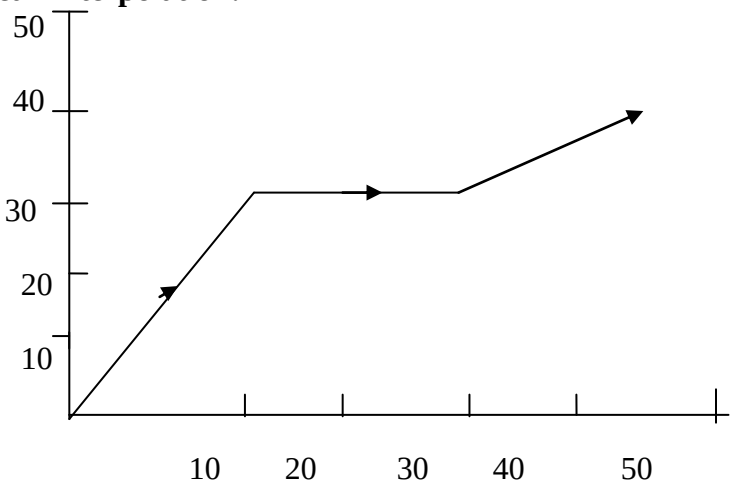
		 Fig,no.2 **Part programme** 01237, N 10 G28 U0.00 W0.00 N20 G90 G21 G42 G95; N30 G92 S1500; N40 G96 S200 T0404 M03; N50 G00 X0.00 Z2.00 M08; N60 G01 X0.00 Z 0.00 F0.2; 04 N70 X48.00 Z0.00 ; N80 G03 X60.00 Z-6.00 R6.00 N90 G01 Z-55.00; N100 G02 X70.00 Z-60.00 R5.00; N110 G01 X100.00; N120 Z-70.00 N130 X110.00 Z-65.00; N140 G00 G28 G40 U0.00 W0.00 02 N150 M05 M09; N160 M30;	6
6	**C)**	**What is interpolation? State its types. Explain linear interpolation with neat sketch**	**8**
	Answer	**Define 01 marks ,sketch 01 marks, types 02 marks, Explain 04 marks** Definition : When the feed rates of individual axis are not constant and they vary continuously through the move it is called interpolation. Following are the types of interpolation: 1. G00- Rapid Traverse	

2. G01-Linear Interpolation

3. G02-Circular Interpolation(Clockwise)

4.G03-Circular Interpolation (Counter clockwise)

1.**Linear Interpolation:-**



Any machining along a straight line, including taper lines, is done using the linear interpolation function G01.The general format for writing an instruction block using G01 is

N-G01 X-Y-Z-F-EOB

The above instruction block will move the cutting tool to a position specified by the coordinates in this block. The feed rate at which the cutting tool is required to move is also specified while using G01.However ,if the feed rate has been defined in one of the previous instruction blocks, the same feed rate will remain active in the current instruction block also.

The use of G00and G01 in writing the instruction blocks is discussed with reference to fig.

(1) Starting point is (0,0) and tool is 20mm above the job surface.
(2) Machining is to be done along 1-2-3
(3) Z=0 is at the surface of workpiece
(4) Depth of groove is 3 mm

Programme	Description
N1 G00 G71 G94 M03 S800 EOB	Absolute mode, metric mode, feed in mm/min and spindle start at 800 rpm CW
N2 G00 X 10.00 Y 30.00 EOB	From starting point (0,0) the cutting tool moves .At rapid feed rate to point 1 with no change In Z coordinate
N3 G00 Z 2.00 EOB	In Rapid feed rate, the cutting tool moves to a point
N4 G01 Z-5.00 F 200 EOB	In Linear interpolation ,the cutting tool moves toDepth 3 mm inside the workpiece at feed rate 200 mm/min.

		N5 G01 X 30.00 EOB	In Linear interpolation, the cutting tool moves toPoint 2	
		N6 G01 X 50.00 Y 45.00 EOB	In Linear interpolation ,the cutting tool moves To point 3	
		N7 G00 Z 20.00 EOB	Tool moves ta a point 20 mm above the job surface, At rapid feed rate.	
		N8 G00 X-10.00 Y 0.00 EOB	Move to point X-10.00 to clear the job for loading /Unloading	
		N9 M02 EOB	Programme End.	