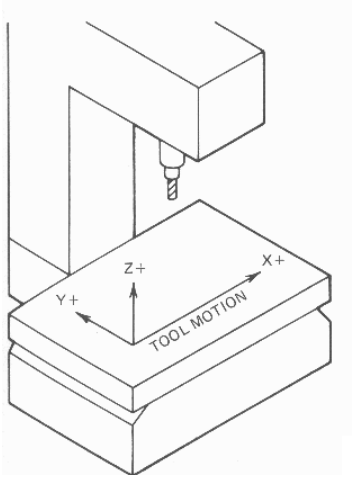
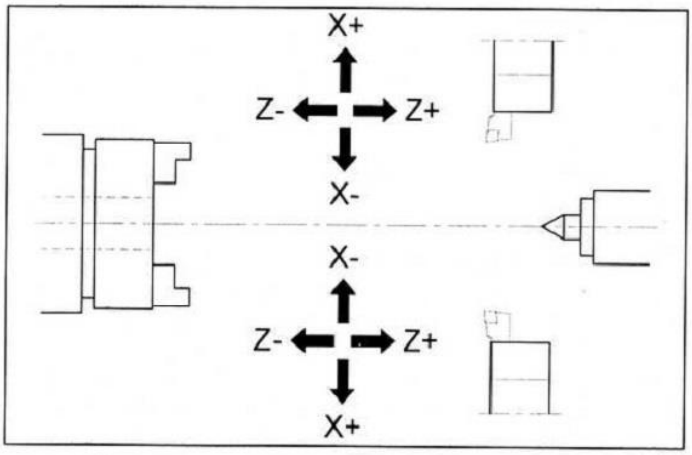
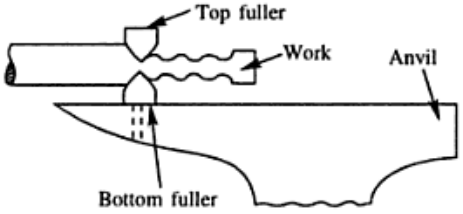
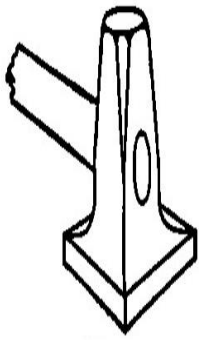
Important Instructions to examiners:

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		**Attempt any FIVE of the following.**	**10**
	a	**Define forging.**	**02**
		Answer: Definition of Forging: Forging can be defined as the controlled plastic deformation of metals at elevated temperatures in to a predetermined size or shape using compressive forces exerted, through some type of die, by a hammer, a press or upsetting machine. OR Forging is a plastic flow of metal by the application of compressive forces in which size and shape is changed permanently without failure. OR Forging is a deformation process in which work is compressed between two dies using either impact or gradual pressure to form the part. OR Forging refers to the production of those parts which must be heated in a close furnace to a desired temperature in order to acquire sufficient plasticity & shaping it in dies under the pressure of heavy hammers, forging machines & presses.	**02**
	b	**List four automotive components manufactured by press work.**	**02**
		Four automotive components produced by press work: *(Any four-1/2 mark each)* Washer, switch panels, automotive body panels, motor cover bracket, steel net, cage, filters, fuel tank, filter cap, brackets, wheel rims, cover plates, clamps, frames, channels, side panel, door panels, bonnets, fenders.	**02**

	c	**State any four names of die accessories.**	**02**
		List of die accessories:- *any four (2 marks)* 1. Stop 2. stripper 3. pilot 4. knock out 5. Pressure pad	**02**
	d	**List four advantage of welding.**	**02**
		Answer: **Advantages of welding process** *(Any four - 1/2 Marks Each)* 1) It produce permanent joint. 2) Large number of metals can be welded. 3) Freedom in design. 4) Strong and tight joining 5) Cost effectiveness 6) Simplicity of welded structures design 7) Welding processes may be mechanized and automated	**½ mark for each** **(any four)**
	e	**Enlist four factors affecting selection of cleaning process.**	**02**
		Answer: **1. Type of Contaminants** **2. Composition of metal** **3. Thickness of rust and scale** **4. Degree of cleanliness required** **5. Condition of metal** **6. Surface finish tolerances** **7. Allowable metal loss.**	**02**
	f	**Sketch axis orientation for VMC**	**02**
		Answer: (Credit should be given to appropriate answer)  **Fig. Axis orientation for VMC**	**02**

	g	**Sketch axis orientation for CNC lathe.**	**02**
		Answer: (Credit should be given to appropriate answer)  Fig. Axis Orientation of CNC Lathe	**02**
2		**Attempt any THREE of the following**	12
	a)	**Draw flatter and Fuller. State its use in forging.**	04
		Answer:(Sketch -01marks each, Use-01marks each)   **Fig. Fuller** **Fig. Flatter** 1. **Fuller:** **Use of Fuller:** Fuller is a forging tool, used to spread the metal. The fuller is placed against the metal stock, and then either the fuller or the stock is struck with a hammer. 2. **Flatter:** **Use of Flatter:** Flatters are used to give smoothness and accuracy to articles which have already been shaped by fullers and swages.	**02** **01** **01**
	b)	**Draw neat labeled sketch of ply press.**	**04**
		Answer: (Sketch – 02 marks, Labelling – 02 marks)	

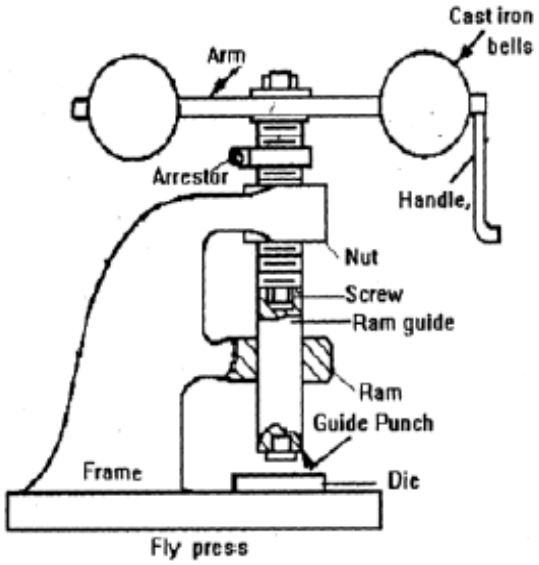
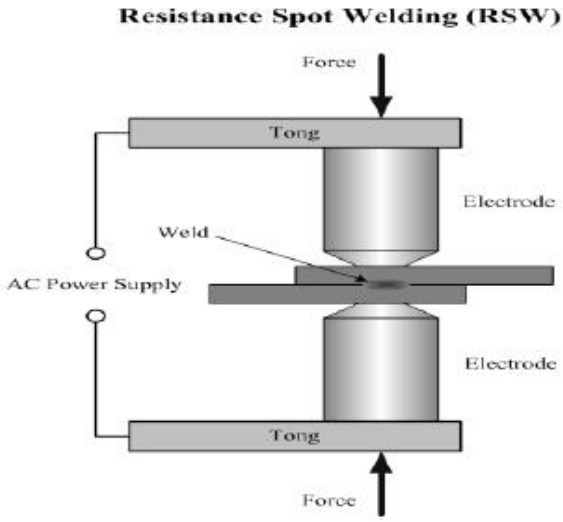


Figure: Construction of Fly Press

04

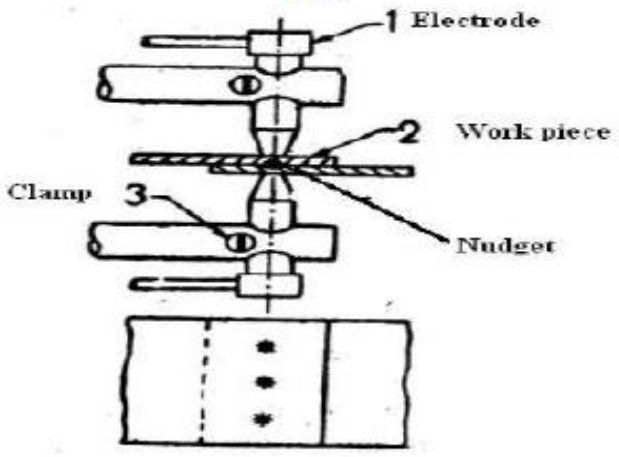
c) **Explain the resistance spot welding process with neat sketch. State its two advantage and disadvantage.** **04**

Answer: 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. **01**



01

OR



Advantages of Resistance Spot Welding (Any Two)

1. Comparatively Low cost
2. Resistance Spot Welding (RSW) method doesn't need highly skilled worker.
3. Distortion or warping of parts is eliminated though it leaves some depressions or indentation.
4. The joint made is highly uniform.
5. Automatic or semi-automatic operation both can be done.
6. There is no need for edge preparation.
7. Welding can be done in quick succession. It just needs a few seconds to make the joint.

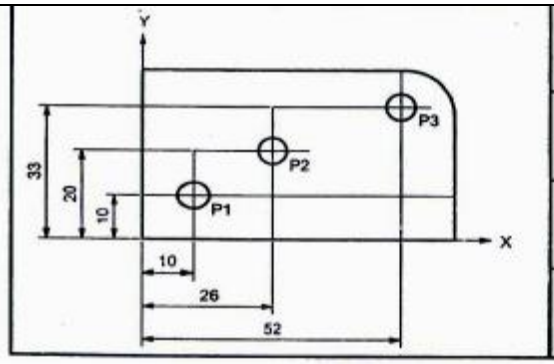
01 (any two)

Disadvantages of RSW – (any two)

1. The equipment cost is high so it can has an effect on the initial cost.
2. Skilled welders or technicians are needed for the maintenance and controlling.
3. Some metals need special surface preparation for making the RSW a success.
4. The thick jobs are not easy to weld.

01 (any two)

	d)	**Describe absolute and Incremental co-ordination system with suitable example.**	04
		1. Absolute Co- ordinate system: (*Explanation – 01 mark & Sketch –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**

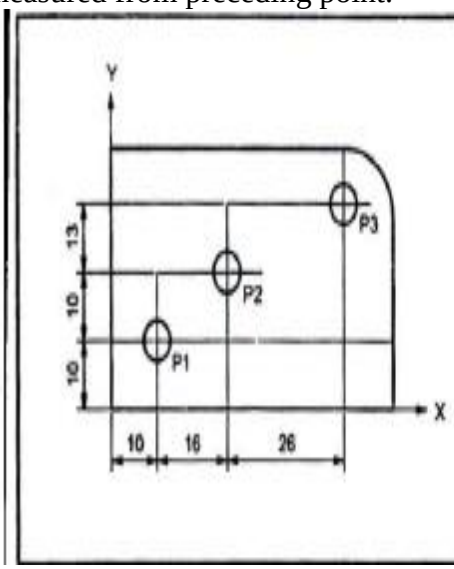


Point	X Coordinate	Y Coordinate
P1	10	10
P2	26	20
P3	52	33

01

2. Absolute Co- ordinate system: (*Explanation – 01 mark & Sketch–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 and 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

3		**Attempt any THREE of the following.**	**12**
	a	**Compare drop forging and press forging processes.**	**04**

Answer: Comparison of drop forging and press forging *(Any four – 1 Mark Each)*

Drop forging	Press forging
1. This process involves **fast** squeezing of metal in dies by applying repeated blows by hammers.	1. This process involves **slow** squeezing of metal in dies by applying pressure.
2. The dies used relatively **more draft** and therefore more complicated shape cannot be forged.	2. The dies used relatively **less draft** and therefore more complicated shape can be forged.
3. Alignment of two dies is **difficult**.	3. Alignment of two dies is **easy**.
4. The life of machines and dies are **shorter**.	4. The life of machines and dies are **longer**.
5. This process **requires** highly skilled operator.	5. This process **does not** require highly skilled operator.
6. This process has **more** noise and vibrations.	6. This process has **less** noise and vibrations.
7. Production rate is **slower**.	7. Production rate is **faster**.
8. **Less** dimensional accuracy.	8. **Better** dimensional accuracy.

(any four -1 mark each)

b) Explain with sketch construction and application of progressive die. **04**

Ans. **Answer:**

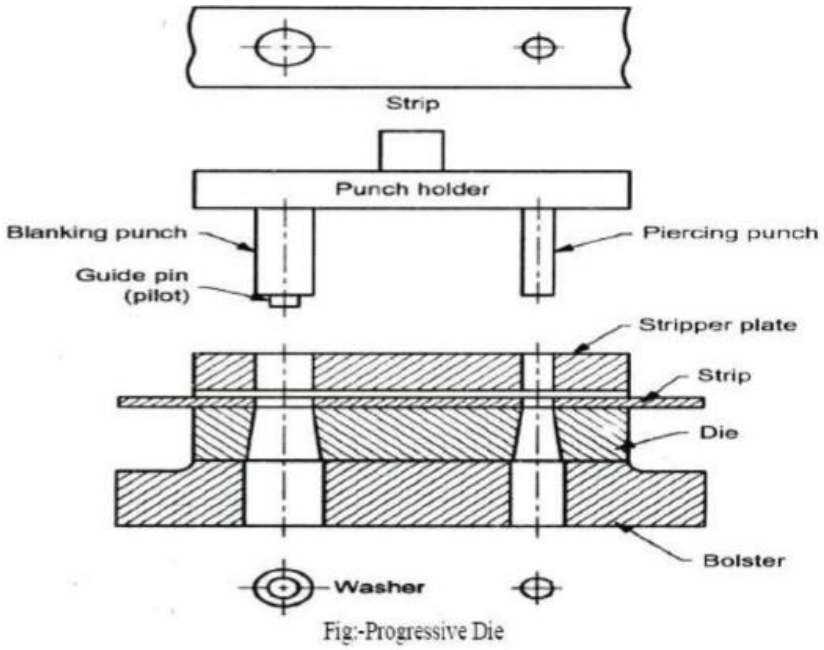
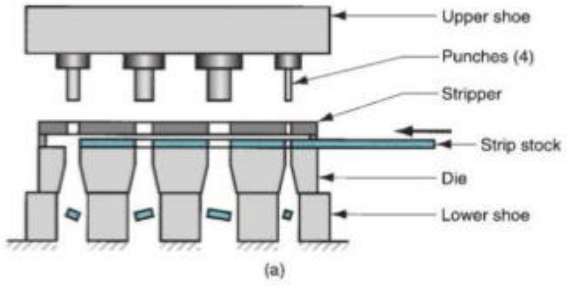
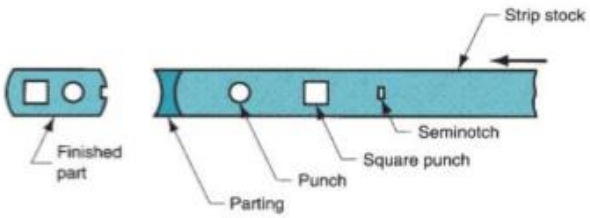


Fig:-Progressive Die

02

OR





Construction-

A progressive die consists of the following parts.: 1. Stop 2. Sheet metal 3. Pilot 4. Blanking punch 5. Ram 6. Piercing punch 7. Stripper Plate 8. Die 9. Bolster Plate **01**

Application-(any two) **01**

Progressive die is used to produce parts for various industries such as automotive, electronics and appliances. Example car brake caliper, washer, lid of a beverage can etc.

c) Classify press and give their application. **04**

Classification of press : (Classification 03 marks for any 03 points, application 01 marks any 02 points)

- Basically classified into two groups :
  a) Manually operated – hand, ball or fly press
  b) Power operated – mechanical, hydraulic etc.
- But Presses are briefly classified as :

a. According To The Type & Design Of Frame :

1. Inclinable 2. Straight Side 3. Adjustable Bed
4. Gap Frame 5. Horning 6. Open End
7. Pillar

b. According To The Positions Of Frame :

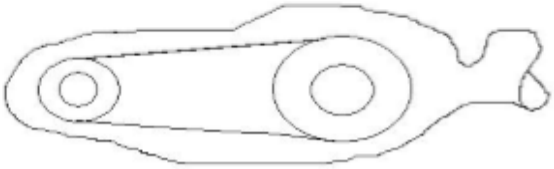
1. Inclinable 2. Inclined
3. Vertical 4. Horizontal

c. According To The Actions :

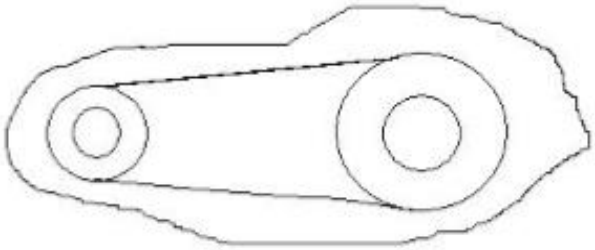
1. Single Action 2. Double Action 3. Triple Action

(Any 03- 1 march each)

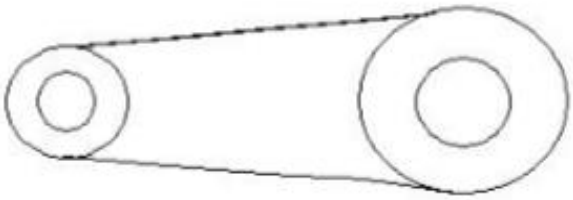
		d. According To The Mechanism Used For Applying Power To Ram : 1. Crank 2. Eccentric 3. Cam 4. Toggle 5. Screw 6. Knuckle 7. Rack & Pinion 8. Hydraulic 9. Pneumatic **e. According To The Number Of Drive Gears :** 1. Single Drive 2. Twin Drive 3. Quadruple Drive **f. According To The Number Of Crankshaft Used :** 1. Single Crank 2. Double Crank **g. According To The Method of Transmission of Power From Motor To Crankshaft :** 1. Direct 2. Non – Geared 3. Single Geared 4. Double Geared 5. Multiple Geared **h. According To The Purpose For Which Used :** 1. Shears 2. Brakes 3. Punching 4. Seaming 5. Extruding 6. Coining 7. Straightening 8. Transfer 9. Forging **Application of press:(Any Two 01 Mark)** Press machines are used for performing sheet metal operations. Following are the sheet metal parts made by using press machine. 1. Car door handles are made using press machine 2. Car doors are mode using press 3. Car bonnet is made using press 4. Car grill 5. Bumper 6. Radiator support **7.** Guard.	***01***
	d)	**Discuss functions of flux used to welding. Identify properties of material suitable for flux and state two materials used as flux.**	**04**
	Ans.	**Functions of flux-** 1. A flux is a material used for removal of oxides and other undesirable substances. 2. Flux is a material used to prevent dissolve or facilitate removal of oxide. 3. During welding, flux chemically reacts with the oxides and a slag is formed that floats to and covers the top of the molten puddle of metal and thus keep put atmospheric oxygen and other gases **Properties of flux: (Any Two)** 1. It has a low density 2. It can deoxidise the melt. 3. It can form a slag layer. 4. It can absorb gases. 5. It should not produce any harmful gases. 6. Melting point should be less. **Materials used for flux-(Any Two)** **1.** For welding aluminium and its alloy: - Flux may contain potassium chloride,	**01** **01**

		lithium chloride etc. **2.** For welding Copper and copper alloy:- Borax (fused), di-sodium phosphate, magnesium silicate, lime etc **3.** For welding ferrous metal :- Mixture of borax, sodium carbonate and potassium bicarbonate; sodium carbonate and sodium bicarbonate; borax ,sodium carbonate and sodium nitrate or borax alone used as flux **4.** For welding carbon steel:- Dehydrated borax and calcium oxide dissolved in liquid **5.** For welding alloy steel:- Mixture of boric acid , Dehydrated borax and calcium fluorides	**02**
4		**Attempt any THREE of the following.**	**12**
	a)	**Select and sketch the forging sequence for manufacturing connecting rod.**	**04**
		a. Fullering:  b. Edging:  c. Blocking 	**04**

d. Finishing



e. Trimming



(a)

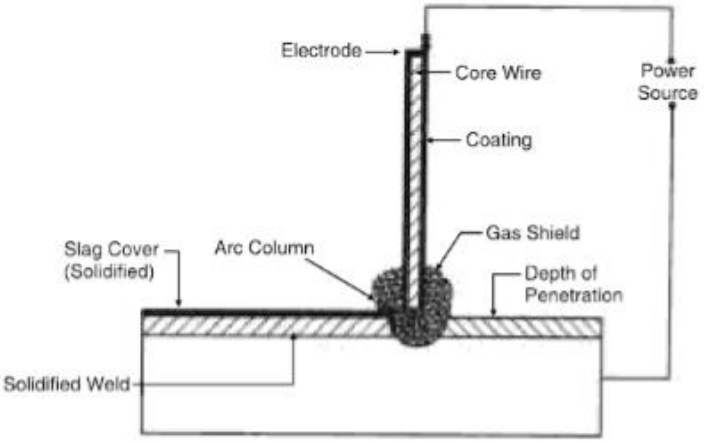
Blank (bar stock)

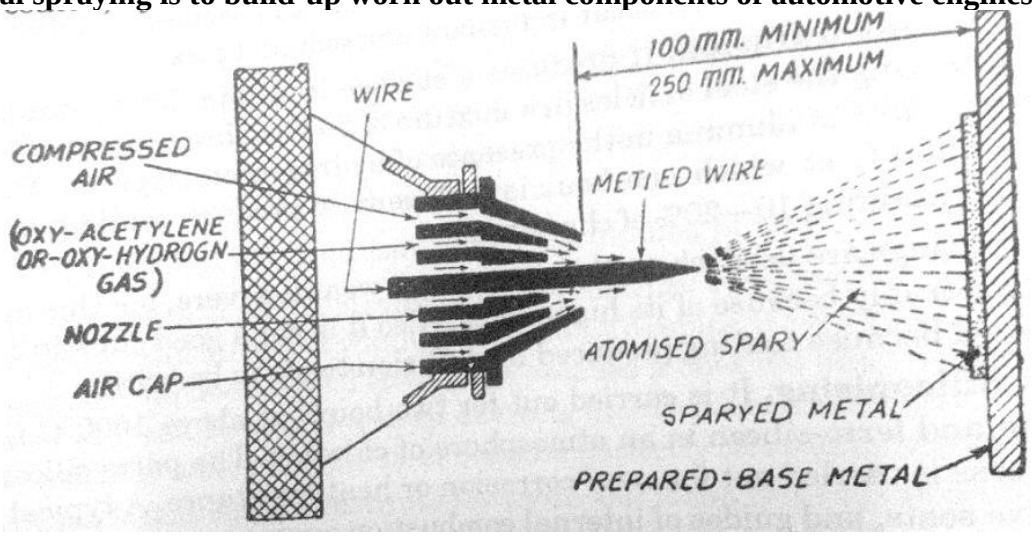
Edging

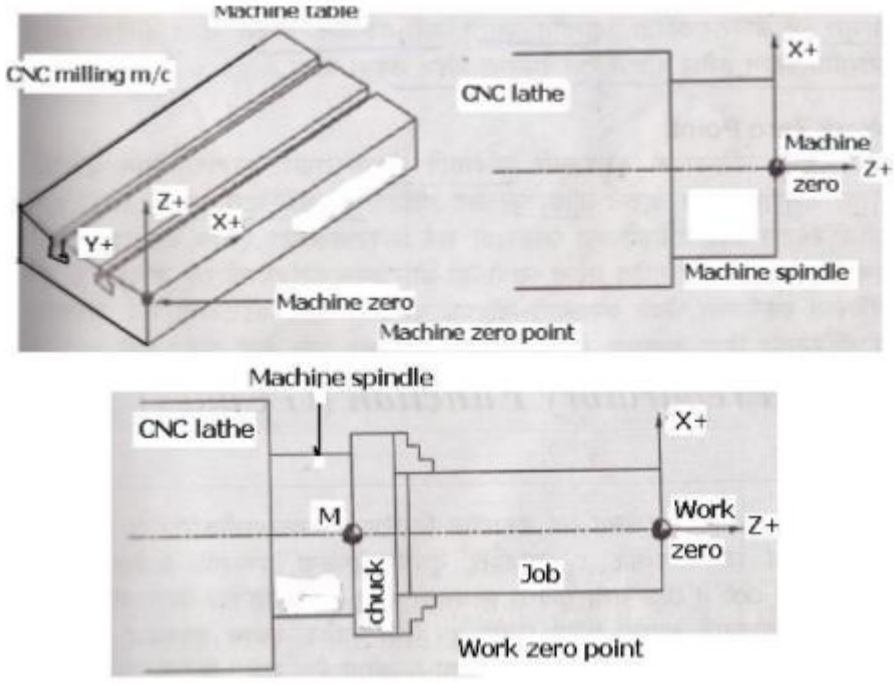
Blocking

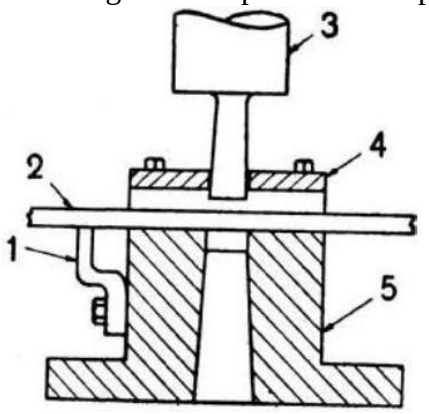
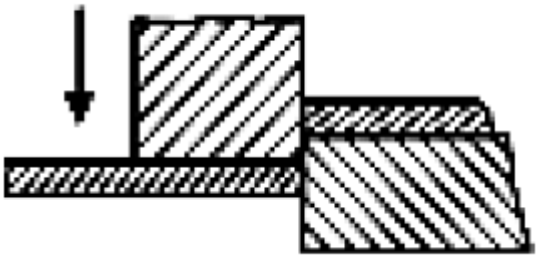
Finishing

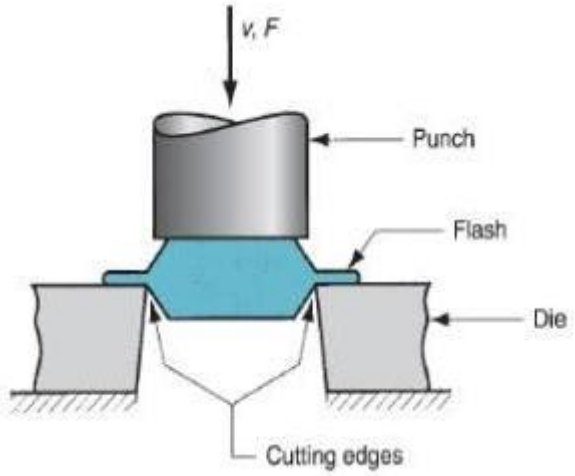
Trimming

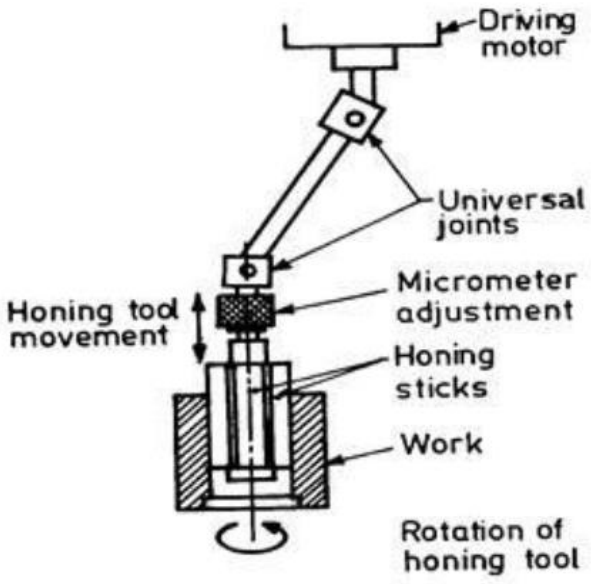
	b)	**Explain the shielded metal arc welding (SMAW) processes with neat sketch. State its two advantages and disadvantages.**	**04**
		Answer: (Sketch -01 marks, description-01 mark, advantages -01 mark, disadvantages – 01 mark)  Fig. Shielded metal arc welding set-up **Working-** Shielded metal arc welding uses a metallic consumable electrode of a proper composition for generating arc between itself and the parent work piece. The molten electrode metal fills the weld gap and joins the work pieces. This is the most popular welding process capable to produce a great variety of welds. The electrodes are coated with a shielding flux of a suitable composition. The flux melts together with the electrode metallic core, forming a gas and a slag, shielding the arc and the weld pool. The flux cleans the metal surface, supplies some alloying elements to the weld, protects the molten metal from oxidation and stabilizes the arc. The slag is removed after Solidification. **Advantages-** 1. Simple , portable and inexpensive equipment **2.** Suitable for outdoor applications **Disadvantages-(any two)** 1. Process is discontinuous due to limited length of the electrode. 2. Weld may contain slag inclusions **3.** Fumes make difficult the process control.	**01** **01** **01** **01**
	c)	**Compare brazing and soldering processes on basis of (i) working temperature (ii) filler material (iii) flux used and (iv) application.**	**04**
		Answer: Point / Soldering / Brazing Working Temperature / Below 470^0 C / Above 470^0 C Filler Material / Solder / Spelter	**1 mark**

		Flux used	Commonly used soldering flux is rosin-based, using the rosin from selected pine trees. For automobile parts acid-based (hydrochloric acid) flux is used	In Brazing borax is used to prevent oxides from forming while the metal is heated.		each
		Applications	Connections of TV and radio sets, wiring joints in electric connections and battery terminals,radiator brass tube, copper tubing.	Parts of bicycle such as frames and rims,exhaust pipe in motor engine, etc		
	d)	**Describe with sketch the surface treatment process used to built-up worn out metal components of automotive engines.**				**04**
		Answer: (credit should be given to appropriate answer) **Metal spraying is to build-up worn out metal components of automotive engines.**  **Fig. Metal Spraying** Metal Spraying 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			**02** **02**

		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.	
	e)	**Explain any four references positions used on CNC machines with suitable example.**	**04**
	Ans	**Reference positions used on CNC machine: (1marks each)** **There are three reference positions on CNC machine:** 1. Machine zero point 2. Work zero point 3. Tool home position 4.Reference point **1. Machine zero point:** At this point coordinates of all axes are zero. Tool moves with respect to this point and position of all axes can be seen on computer screen. Machine zero point is decided by manufacturer of machine. **2. Work zero point:** For preparing a program, first tool path is prepared according to operation sequence and then coordinates of all points are determined. These coordinates are determined by considering an original point on the job where all the axes intersect and coordinates of that point are zero. This original point is known as work zero point. **3. Tool home position:** Tool is placed away from work zero point as well as machine zero point for sake of safety of tool, job and machine. The tool is changed only at home position. **4. Reference point:** A position in the machine working area which is determined exactly by limit switches. The slide positions are reported to the control by the slides approaching. 	**(1marks each)**
5.		**Attempt any TWO of the following.**	**12**

	a)	**Sketch and describe the following press operations:** **1. Punching** **2. Shearing and** **3. Trimming**	**06**
		(i) 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** **(ii) Shearing** Shearing is an operation in which blanks are separated from a sheet-metal strip by cutting the opposite sides of the part in sequence.  Figure: Shearing operation **(iii) Trimming** Trimming is the process of removing the flash around the edges of the finished forging in a separate press by trimmer dies. Trimming basically presses a part through a cutting die that runs the periphery of the work. The cutting dies are precisely designed to remove the flash from a particular part. Most often it is desirable to perform this operation while the work is still hot for maximum efficiency; therefore it is usually incorporated into the larger production process.	**01** **01** **01** **01** **01**

		 Figure: Trimming operation	**01**
	b)	**List microfinishing process. Select and explain the microfinishing process to obtain correct hole geometry.**	**06**
		List of micro finishing processes:: [1] Grinding [2] Honing [3] Lapping [4] Burnishing [5] Buffing [6] Polishing	**02**
		Honing Process (micro finishing process) to obtain correct hole geometry: To correct hole geometry in component, honing is used as a micro finishing process**.** Honing is an abrading process used mainly for finishing round holes by means of bonded abrasive stones called hones. Honing is primarily used to correct out of roundness, taper, tool marks and axial distortion. Abrasives used in honing are Silicon carbide, aluminium oxide, diamond or cubic boron nitride. When honing is done manually; the honing tool is rotated and workpiece is passed back and forth over the tool. Length of motion is such that the stones extend beyond the workpiece surface at the end of each stroke. For precision honing, the work is usually held in a fixture and the tool is given a slow reciprocating motion as it rotates (shown in Fig.). The stones are thus given a complex motion as rotation is combined with oscillatory axial motion. These two motions combine to give a resulting cross-hatch lay pattern. Honing stones may be held in the honing head by cementing them into metal shells, which are clamped into holder or they are cemented directly into holders. Coolants are essential to the operation of this process, to flush away small chips and to keep temperatures uniform.	**02**

		 **Figure: Honing**	**02**
	c)	**Justify use of tool inserts. State the materials used for inserts. Identify the parameters of insert designated as C – N – M – G – 12 – 04 – 08 as per ISO**	**06**
		Justification of tool inserts: The tools with indexible inserts of harder and special grade carbide or ceramic materials. A wear resistant layer of Titanium nitride of Titanium carbide is coated on the insert it reduces the cost of tool. Inserts can be easily removed from the tool holder. So tool changing time and cost of machining are less. **Materials used:** Carbide, Micrograin carbide, CBN, ceramic, cermet, cobalt, diamond PCD, high-speed steel, and silicon nitride **Following are the parameter of insert designated as C – N – M – G – 12 – 04 – 08** C: Symbol for insert shape 12: Turning insert size N: symbol for normal clearance 04: Turning insert thickness M: Symbol for tolerance 08: Turning insert nose radius G: symbol for fixing for chip breaker	**02** **02** **02**
6.		**Attempt any TWO of the following.**	**12**
	a)	**Develop a part program to manufacture a component as shown in Fig. 1 on a CNC lathe machine.**	**06**
		Answer: **Answer:** ***(Note: Co-ordinate table & Sketch – 02 marks & Program – 04 marks)***	

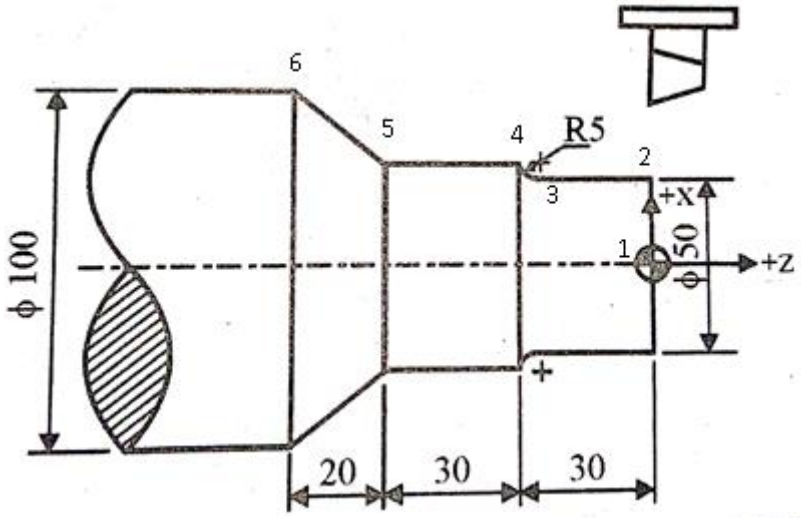


Fig. 1

Co-ordinate Table

Point	X	Z
A	105	0
1	0	0
2	50	0
3	50	-25
4	60	-30
5	60	-60
6	100	-80
B	105	80
A	105	0

02

CNC Part Program:

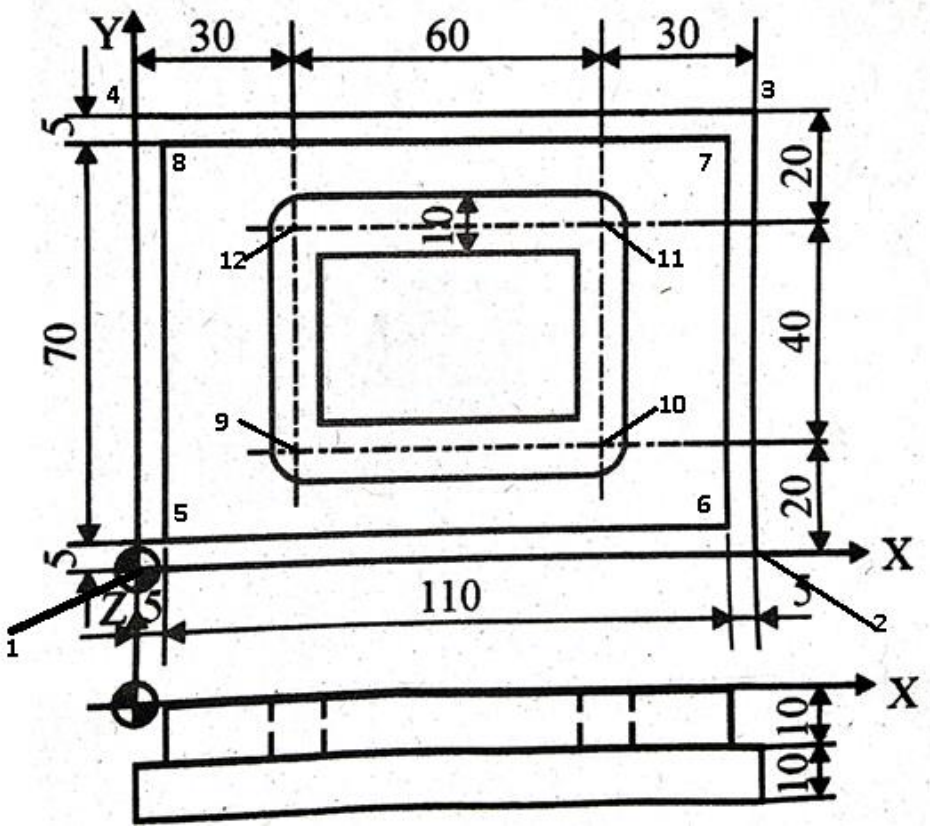
012345

N 10 G28 U0.00 W0.00
N20 G90 G21 G42 G95;
N30 G92 S1500;
N40 G96 S200 T0404 M03 M06;
N50 G00 X105. Z2.00 M08;
N60 G01 X0 Z 0 F0.2;
N70 G01 X50 Z0 ;
N80 G01 X50 Z-25 ;
N90 G02 X60 Z-30 R5;
N100 G01 X60 Z-60 ;
N110 G01 X100 Z-80;
N120 G00 X105 Z-80;
N130 G00 G40 X105 Z0;
N140 G28 U0 W0;
N150 M09;
N160 M05;
N170 M30;

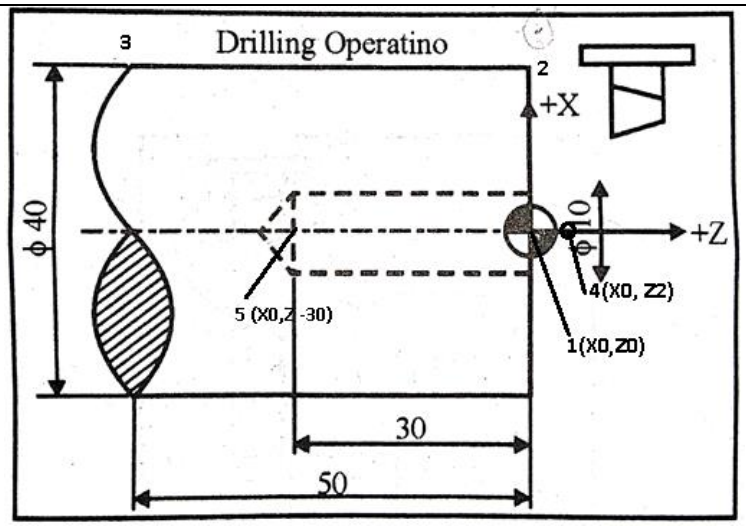
01

02

01

	b)	**Develop a part program to manufacture a component as shown in Fig. 2 on a CNC milling machine.**	**06**
		 Co-ordinate Table **Point** | **X** | **Y** | **Z** **1** | 0 | 0 | 5 **2** | 120 | 0 | -20 **3** | 120 | 80 | -20 **4** | 0 | 80 | -20 **5** | 5 | 5 | -10 **6** | 115 | 5 | -10 **7** | 115 | 75 | -10 **8** | 5 | 75 | -10 **9** | 30 | 20 | -10 **10** | 90 | 20 | -10 **11** | 90 | 60 | -10 **12** | 30 | 60 | -10 **Part Program:**	**02**

		0 001; N10 G90 G21; N20 G17 G94; N30 T01 M06; N40 M03 S1500; N50 M08; N60 G00 X0 Y0 Z5; N70 G42 G00 X0 Y0 Z0; N80 G01 Z-20 F100;…… N90 G01 X120 Y0 Z-20; N100 G01 X120 Y80 Z-20; N110 G01 X0 Y80 Z-20; N120 G01 X0 Y0 Z-20 ; N130 G00 Z5; N140 G00 X5 Y5 Z5;…….. N150 G01 Z-10; N160 G01 X115 Y5 Z-10; N170 G01 X115 Y75 Z-10; N180 G01 X5 Y75 Z -10; N190 G01 X5 Y5 Z-10; N200 G00 X5 Y5 Z5; N210 G40 G00 X0 Y0 Z5;……. N220 G00 X30 Y20 Z5; N230 G01 X30 Y20 Z-10; N240 G01 X90 Y20 Z-10; N250 G01 X90 Y60 Z-10 ; N260 G01 X30 Y60 Z-10; N270 G01 X30 Y20 Z-10; N280 G00 X30 Y20 Z5; N290 G28 U0 Y0; N300 M09; N310 M05; N320 M30;……..	**01** **01** **01** **01**
	c)	**State functions of ATC. Develop a part program to manufacture a component as shown in Fig. 3 on a CNC lathe machine.**	**06**
	Ans.	**Functions of ATC:** An Automatic tool changer or ATC is used in computerized numerical control (CNC) machine tools to improve the production and tool carrying capacity of the machine. ATC changes the tool very quickly, reducing the non-productive time.	**02**



Co-ordinate Table

Point	X	Z
A	50	2
1	0	0
2	40	0
3	40	-50
4	00	02
5	00	-30

01

CNC Part Program:

0005;
N10 G28 U0.00 W0.00
N20 G90 G21 G42 G95;
N30 G92 M03 S1500;

01

N40 G96 S200 T0404 M06 ;
N50 G00 X50. Z02.00 M08;
N60 G01 X00 Z 00 F0.2;
N70 G01 X40 Z 00;
N70 G01 X40 Z-50;
N80 G00 X50 Z 02;

01

N90 T0102 M06 M07;
N100 G00 X00 Z02;
N110 G00 X00 Z00 ;
N120 G74 R2;
N130 G74 Z-30 Q5000 F0.1;
N140 G00 Z5;
N150 G28 U0 W0;
N160 M05 M09;
N170 M30;

01

(This Program is written using Peck Drilling Cycle)
(Credits should be given if program is written considering G00 and G01 codes)