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.

Q1 a) Attempt any six of the following.	12
i) Classify forging processes.	2
Ans:- ***Any 4 of the following (each carry ½ mark)*** I. Open die forging: a) Hand forging b) Power forging: i. Hammer forging ii. Press forging II. Close die forging: a) Drop forging b) Press forging c) Machine forging	
ii) State any four forgeable materials and write one application of each.	2
Ans:- ***Any 4 of the following (each carry ½ mark)*** 1) Aluminium alloys: aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment, automotive 2) Magnesium alloys : aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment,	

automotive 3) Copper alloy : aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment, automotive 4) Carbon and low alloy steel : aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment, automotive 5) Matertensitic stainless steels: aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment, automotive 6) Maraging steels: aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment, automotive 7) Austenitic stainless steels: aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment, automotive 8) Nickel alloys : aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment, automotive 9) Titanium alloys : aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment, automotive 10) Columbium alloys: aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment, automotive 11) Tantalum alloys: aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment, automotive 12) Molybdenum alloys : aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment, automotive 13) Tungsten alloys : aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment, automotive 14) Beryllium: aerospace, ordnance/shipbuilding, general industrial equipment, off-highway equipment/railroad, hand tools & hardware, valves, fittings, oil field applications, agricultural machinery & equipment, automotive	
iii) State two press working operations and give one example of each.	2
Ans: ***Any 2 of the following (each carry 1 mark)*** Blanking: washer, gear, switch panels, automotive body panels, motor cover bracket Punching: washer Piercing: automotive body panels	

Notching : automotive body panels Perforating : steel net, cage, grill making, filters, utensils Trimming : automotive body panels Shaving: automotive body panels Slitting: automotive body panels Lancing: automotive body panels Angle bending: frames, bridge construction, fabrication work, building construction, channels making Curling: utensils Tube forming: piping industries, oil refineries, water supply system Embossing :art work, name plates, Deep drawing : utensils	
iv) List two die accessories and write their functions.	2
Ans:- ***Any 2 of the following (each carry 1 mark)*** <u>Stripper:</u> to remove scrap material from the punch as it cleans the die block. <u>Pilots:</u> The pilots positions the stock strip accurately and bring it into proper position for blanking and piercing operations OR They acts as guides during the piercing or blanking operations. <u>Stock stops</u>: Stock stops are used to locate the stock in die set when hand feeding the stock OR It controls the advancing of the strip while feeding the stock. <u>Knock out</u>: The function of knock out is to eject the finished components from the die cavity. <u>Strip Feeder</u>: It is used for feeding the strip mostly in automatic operations.	
v) What is welding? Explain.	2
Ans:- ***definition 1,explanation 1 mark*** Welding is a process of joining similar metals by application of heat with or without application of pressure and addition of filler materials. OR Welding is defined as " a localized coalescence of metals, where in coalescence is obtained by heating to suitable temperature with or without the application of pressure and with or without the use of filler metal. OR Welding is a materials joining process which produces coalescence of materials by heating them to suitable temperatures with or without the application of pressure or by the application of pressure alone, and with or without the use of filler material. Welding joins different metals and their alloys with the help of number of processes in which heat is supplied either	

electrically or by means of gas torch. In order to join two or more pieces of metal together by one of the welding processes, the most essential required is heat. Pressure may also be employed. Some filler materials are also used to increase the different properties of the weld. Welding is mostly used in automobile industries Aircraft constructions Bridges, Buildings, Pressure vessels tanks, storage tanks, rail road's constructions, ship building, piping's and pipelines.	
vi) What is forgeability?	2
Ans:- ***definition 2 marks*** Forgeability is defined as the tolerance of a metal or alloy for deformation without failure, regardless of forging pressure requirements. OR Forgeability is defined as the ability if metal to change the size and shape when heated to required temperature and compressed by applying some pressure.	
vii) Write classification of CNC machines.	2
Ans:- ***Any 4 of the following (each carry ½ mark)*** **A. According to control loop feedback system:** 1) Open – loop system 2) Closed – loop system **B. According to type of tool motion control system:** 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 **C. According to programming methods:** 1) Absolute programming method 2) Incremental programming method **D. According to type of controller:** 1) NC based controller system 2) CNC based controller system	

viii) What is part of programming on CNC machining?	2
Ans:- ***2 marks*** Part programming is a set of instructions which instructs the machine tool about the processing step to be performed for the manufacture of a component. Part programming is the procedure by which the sequence of processing steps and other related data, to be performed on the CNC machine is planned and documented. It is an important component of the component will depend on how correctly the program has been prepared. The information documented in the program has consists of 1) The co-ordinate values of the entire tool path. 2) The co-ordinate values are prefixed with certain codes indicating the type of movement of the tool. 3) The co-ordinate values are also suffixed with certain codes indicating the various machine functions such as start/ stop, spindle or coolant on /off feed rates etc 4) The programming can be done either manually or with the help of computer.	
ix) What is meant by 'G' and 'M' codes?	2
Ans:- ***Each carry 1 mark*** **'G' Codes (Preparatory Functions)** ❖ The preparatory function instructs the machine tool to get prepared for the operation to follow, ❖ The preparatory function is represented by two digits preceded by letter 'G' ❖ e.g. GOO, GO1, G99 etc ❖ **M- codes (Miscellaneous function)** ❖ the Miscellaneous function word is used to specify certain Miscellaneous function or auxiliary functions which do not relate to the dimensional movements of the machine. ❖ The Miscellaneous function is represented by two digits preceded by letter 'M' ❖ e.g. MOO, M05, M08, M3O etc.	

Q1 b) Attempt any two of the following. 8

i) Differentiate between NC and CNC machines. 4

Ans:- ***each difference carry 1 mark***

Sr.No	Point	NC Machine	CNC Machine
1	Input Medium	Instruction fed through external medium i.e. paper tape or magnetic tape	Instruction fed through part programme stored in computer memory.
2	Flexibility	Alteration or change in programme is not possible on tape once produced.	Alteration or change in programme can be made any time of working.
3	Dry Run	No facility for dry run.	Dry run can be taken.
4	Information about machine utilization	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	Tool Compensation	Does not allow compensation for change in cutting tool dimension.	Allow compensation for change in cutting tool dimension.
		OR	
6		Instruction fed through **external medium** i.e. paper tape / magnetic tape.	instruction fed through part program **(internal medium)** stored in computer memory.
7		Small changes in program is **not** possible on punch tape once produced.	Small changes in program is possible on punch tape once produced.
8		No facility for dry run.	No facility for dry run.
9		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.
10		It does **not allow** compensation for change in cutting tool dimension.	It does **allow** compensation for change in cutting tool dimension.

ii) For sheet metal work, write specification of press. 4

Ans:- ***Any 4 specification, each carry 1 marks***

1. Dimensional size:
    a) Enough space to accept the tool.
    b) Length of stroke of the punch.
    c) Opening to push the sheet in.

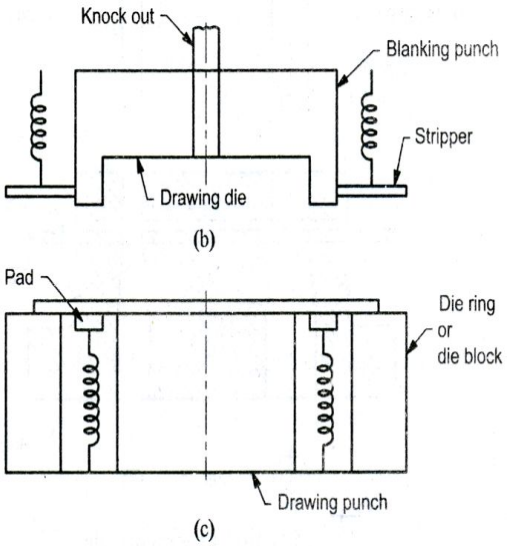
2. Force required to enable the stroke.
3. Speed of the machine.
4. Tolerances that should be maintained for a specific number of component - production

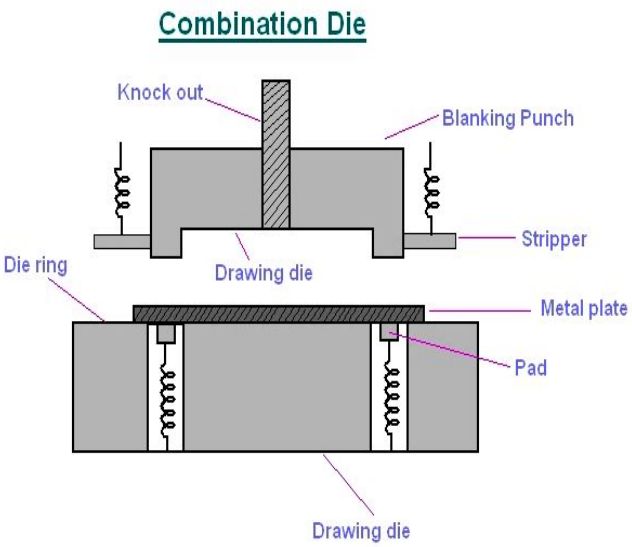
iii) Describe with sketch the construction of the combination die. 4

Ans:- ***fig. 2mark, construction 2 mark***

Combination dies:

- In this also, more than one operation may be performed at one station
- But it differs from compound dies
- In this cutting operation is combined with bending / drawing operation
- Die ring which is mounted on the die shoe is hallow in shape at bottom side
- In this hallow portion flange of pads moves up / downwards
- These pads are placed proper position with the help of springs
- Drawing punch of required shape is attached to the die shoe
- Blanking punch is hold in punch holder
- Drawing die have some shape on it
- The knock out pin is used to remove finished product from the die & punch





OR

- In a combination die more than one operation can be performed on one station.
- Combination die is a press tool in which a cutting operation(usually blanking) is combined with a shaping or

deforming operation (such as bending, drawing, coining etc) - A combination die is a single station die, but a double action press is used. - In a blanking and drawing combination die first of all the blanking punch is actuated and it separates the blank from the strip and then it exerts sufficient pressure on the edges of the blank to serve as blank holder when the drawing punch descends and draws the blank into the desired shape. - The die consists of die ring and a blanking punch. - The die ring is mounted on the die-shoe and counter bored at the bottom to allow the flange of a pad to travel up and down. - A drawing punch of required shape is fastened to the die shoe. - The blanking punch is secured to the punch holder. - A spring stripper strips the skeleton from the blanking punch. - A knockout extending through the centre opening and through the punch stem ejects the part on the upstroke as it comes in contact with the knockout bar on the press.	
Q2 Attempt any four of the following.	16
a) Write advantages and limitations of forging.	4
Ans:- ***2 advantages 2 marks, 2 disadvantages 2 marks*** **Advantages of forging:** **1. Strength:** ❖ Forging reduces the failures. ❖ In this process workpiece yields with high strength to weight ratio. ❖ Due to this, it can be able to withstand fluctuating stress caused by sudden shock loading. **2. Metal conservation:** ❖ Practically there is no waste of metals. **3. Weight saving:** ❖ Strong thin-walled parts may be produced without damaging important physical requirements. **4. Machining time:** ❖ Forging can be made to close tolerances, which reduces machining time for finishing operations of the products.	

5. Speed of production:

- High rate of production is possible.

6. Incorporation in welded structures:

- Parts can be welded easily due to fibrous structure.

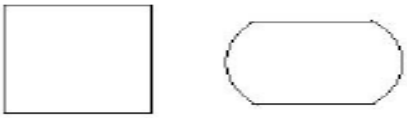
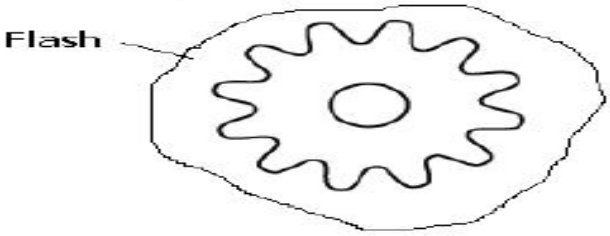
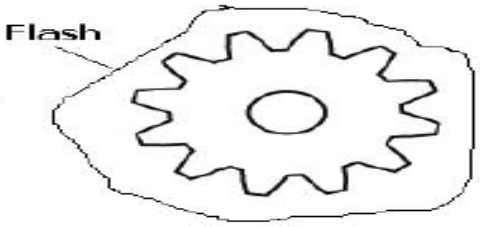
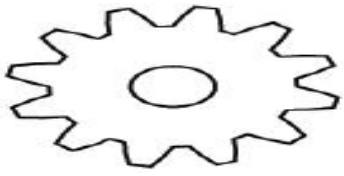
7. It maintains uniform and same quality all over parts

8. It gives close tolerances.

9. It gives smooth surface finish.

Disadvantages of forging :

1. High tool cost.
2. High tool maintenance
3. No cord holes.
4. Limitation in size and shape.
5. Heat treatment process increases cost of the product.
6. Brittle materials like cast iron cannot be forged.
7. Complex shape cannot be produced by forging.

b) State forging sequences for gears.	4
Ans:- ***each step carry 1 mark*** **Gears:** 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. 	
c) What are the press working materials? State their two essential properties.	4
Ans:-***2 marks for material, 2 marks for properties*** ❖ The main material used for press works are aluminium, copper, brass, mild steel. ❖ The galvanized iron(G.I) sheets also used for press work. ❖ Duralumin, Y-alloys are used for deep drawing operation. ❖ Copper alloys such as naval brass, cartridge brass, Babbitt metal are used for blanking & punching operation. ❖ Other materials used in press work are stainless steel & its alloys, different types of steels & its alloys.	

- Mild steel, brass and copper are the chief materials used in press working operations.
- The steel strip or sheet metal is most commonly used in press working.
- Steel sheets used in press work may be annealed, dead soft, soft, bright annealed, quarter hard, half hard, three quarter hard, and extra spring half.
- From the above grades of steel, the harder grades are used for easy blanking and punching, and dead soft for deep drawing.
- Brass used in press work may be annealed, quarter hard, half hard, hard, extra hard, etc.
- Cartridge brass (70% cu and 33% zn) is used extensively for deep drawing operations.
- Other press work materials are alloy steels, electrical steels, stainless and heat resistance steels, wrought aluminium alloys, wrought magnesium alloys, zinc and zinc alloys, titanium and its alloys etc.

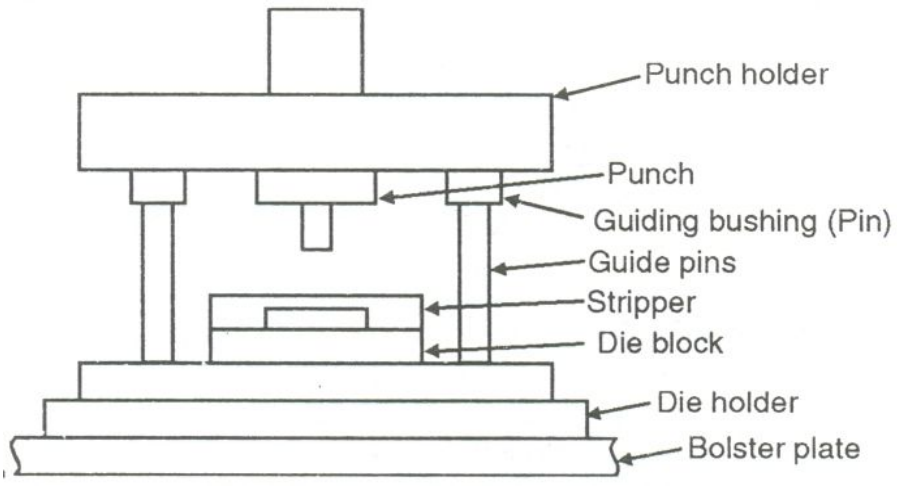
d) Give any two press components used in an automobile and state which press operations are used for them. 4

Ans:- ***2 marks for components, 2 marks for operation***

1. Body panel – blanking, punching, cupping, bending
2. Washers – blanking,
3. Oil sump – deep drawing
4. Tappet cover- deep drawing
5. Cylinder head cover - deep drawing
6. Brackets – bending, flanging
7. Channels – angle bending
8. Frame - bending, flanging, angle bending
9. Bumper – panel drawing
10. Fuel tank – deep drawing
11. Bonate - panel drawing

e) Sketch standard die-set and label all the parts.

Ans:- ***2 marks for neat sketch, 2 marks for labeling***



f) Give classification of welding processes.	4

Ans:- ***each type ½ marks***

- Arc welding
  - Carbon Arc Welding;
  - Shielded Metal Arc Welding (SMAW);
  - Submerged Arc Welding (SAW);
  - Metal Inert Gas Welding (MIG, GMAW);
  - Tungsten Inert Gas Arc Welding (TIG, GTAW);
  - Electroslag Welding (ESW);
  - Plasma Arc Welding (PAW);
- Resistance Welding (RW);
  - Spot Welding (RSW);
  - Flash Welding (FW);
  - Resistance Butt Welding (UW) ;
  - Seam Welding (RSEW);
- Gas Welding (GW);
  - Oxyacetylene Welding (OAW);
  - Oxyhydrogen Welding (OHW);
  - Pressure Gas Welding (PGW);
- Solid State Welding (SSW);
  - Forge Welding (FOW);
  - Cold Welding (CW);
  - Friction Welding (FRW);
  - Explosive Welding (EXW);
  - Diffusion Welding (DFW);
  - Ultrasonic Welding (USW);
- Thermit Welding (TW);
- Electron Beam Welding (EBW);
- Laser Welding (LW).

Q3. Attempt any four of the following.	16
a) Describe forging process for connecting rod.	4

Ans:- ***2 marks for fig, 2 marks for sequence***

- It can be made by forging the bar stock.
- The blank shape gradually changes, as shown in fig. (a) of connecting rod.

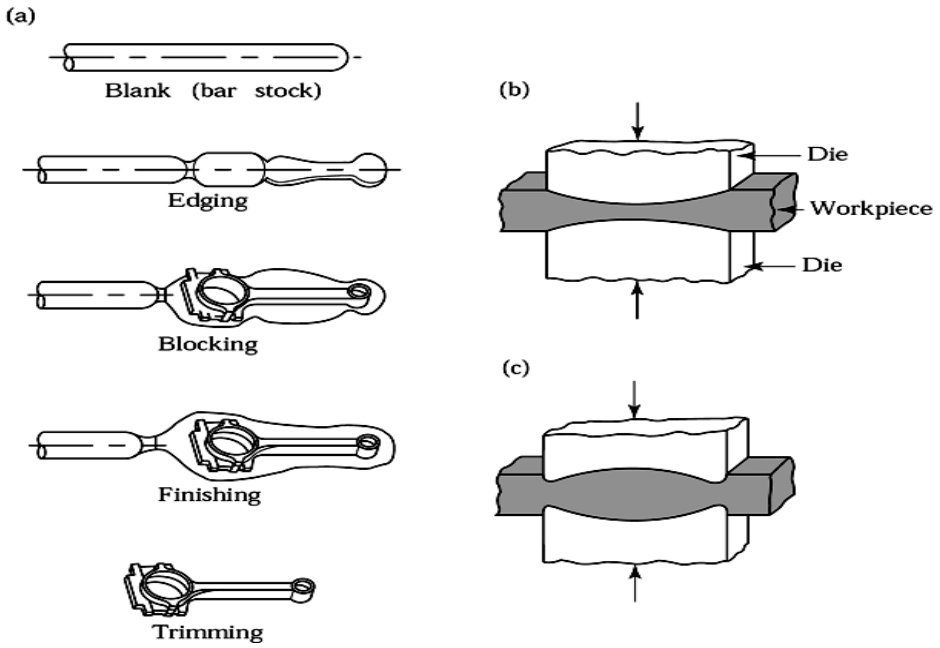


Fig. Forging Sequence for Connecting Rod

- Performing processes, such as Fullering and Edging [fig. (b) and fig. (c)] are used to distribute the material into various regions of the blank.
- In **Fullering**, material is distributed away from an area.
- In **Edging**, it is gathered into a localized area.
- The part is then formed into the rough shape of a connecting rod by a process called **blocking** using blocker dies.
- The final operation is the finishing of the forging in close die forging that gives the forging its final shape.

The flash is removed usually by a trimming operation (fig.)

b) Sketch any four hand tools used in forging operation.	4

Ans:- ***1 marks each***

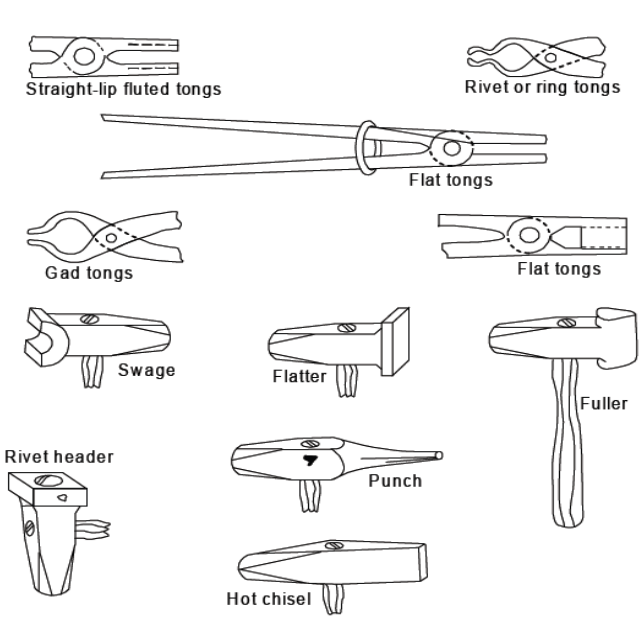


Fig. Hand forging tools

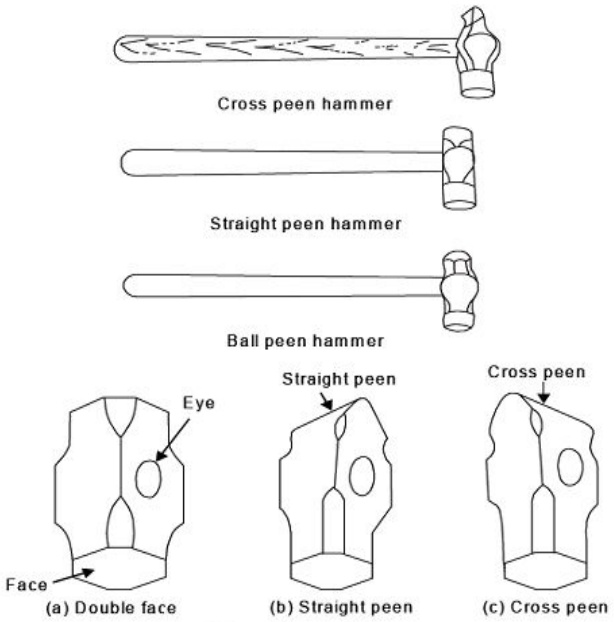
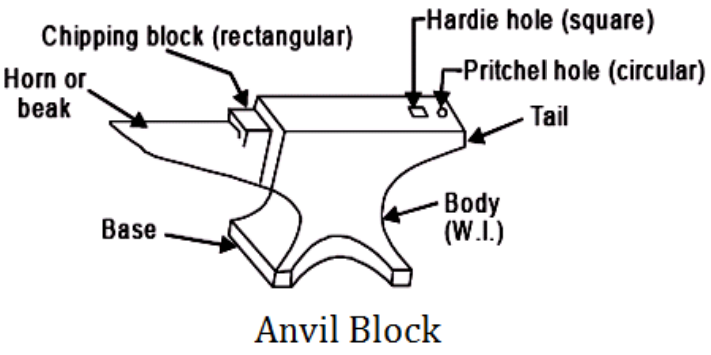
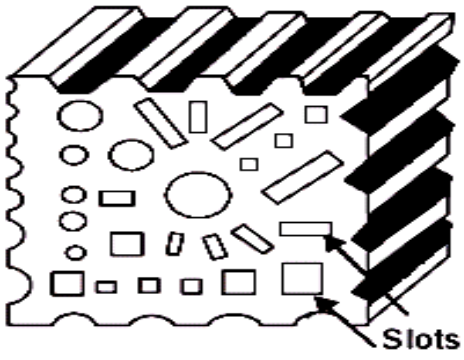
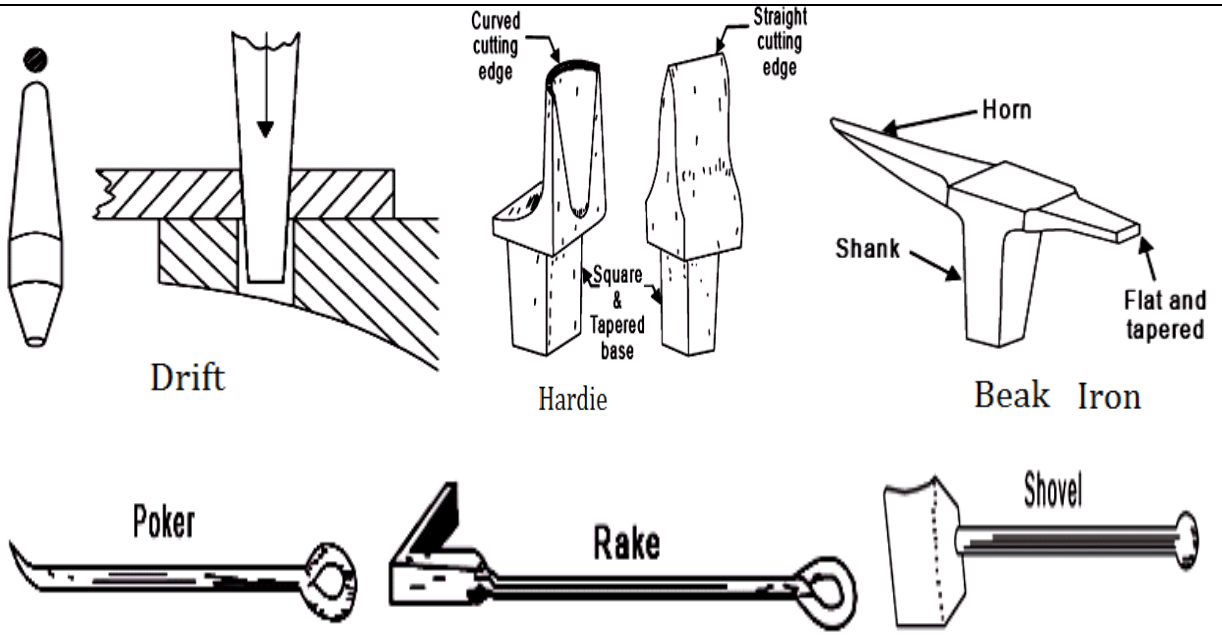


Fig. Types of hammers



Anvil Block





c) Differentiate between Blanking and Punching. 4

Ans:- ***Each difference carry 1 mark***

Sr. No.	Blanking	Punching
1	Blanking is the operation of cutting a shape from a metal strip.	Punching is the cutting of a slug from the metal to produce a hole.
2	The piece detached from strip is known a blank.	The piece detached from strip is known as slug.
3	The removed blank is used for further operation.	The slug detached from strip is scrap(or waste).
4	In this operation the blank is useful product and left out strip is waste.	In this operation the punched sheet in which the hole has been made is the useful product and slug is the waste.
5	Blanking is always the first operation.	Punching is mostly the successive operation.

d) Describe the purpose of pilots and strippers. 4

Ans:- ***2 purposes of pilots 2 marks, 2 purposes of strippers 2 marks***

Pilots:-

- pilots are used in progressive.
- A pilot positions the stock strip accurately and brings it into proper position for blanking and piercing operations.
- The pilot prevents the bucking of the strip against the stop.

- To be effective the pilot must be strong enough to align the stock without bending.
- There are two types of pilots
- 1) direct pilot
- 2) Indirect pilot
- Direct pilot:- pilot which use mounted on the face of a punch are called direct pilots.
- the pilot holder is generally a block of steel which can be fastened to the punch holder.
- Indirect pilots:- These pilots are designed to enter previously pierced holes in the strip at some distance away from the blanking punches,.

Strippers :-

The function of the stripper is to remove the stock from the punch after a blanking or piercing operation.

The stripper is usually of the same width and length as the die block. In the simples dies the stripper may be fastened with the same screws and dowels that fasten the die block, and the screw heads will be counter bored into the stripper. In more complex dies the stripper fastener will be independent. The stripper thickness must be more than required to withstand the force experienced to strip the stock from the punch. Stripper may be of two types

a) Fixed stripper: - These are generally solidly attached to the die block.

b) Spring operated stripper: - These strippers travel up and down in the shank of a punch.

e) Describe coining and embossing press operations with sketch. 4

Ans:- ***1 marks for fig., 1 mark for description each***

Embossing operation:

- ❖ It is the process through which specific shapes are produced on sheet metal blanks with the help of punch & dies
- ❖ It is used for decorative purpose / names , trade marks
- ❖ Punch operates relatively at low speed to allow metal to stretch

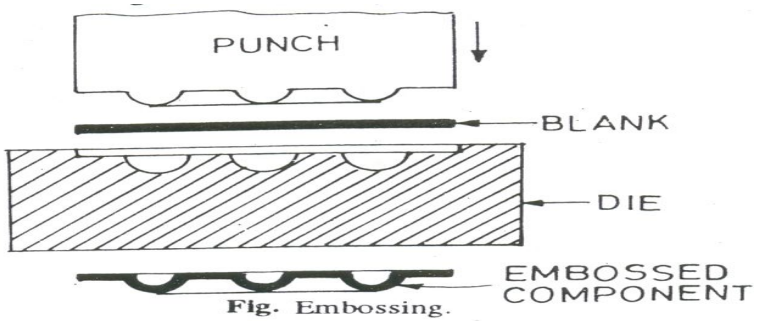
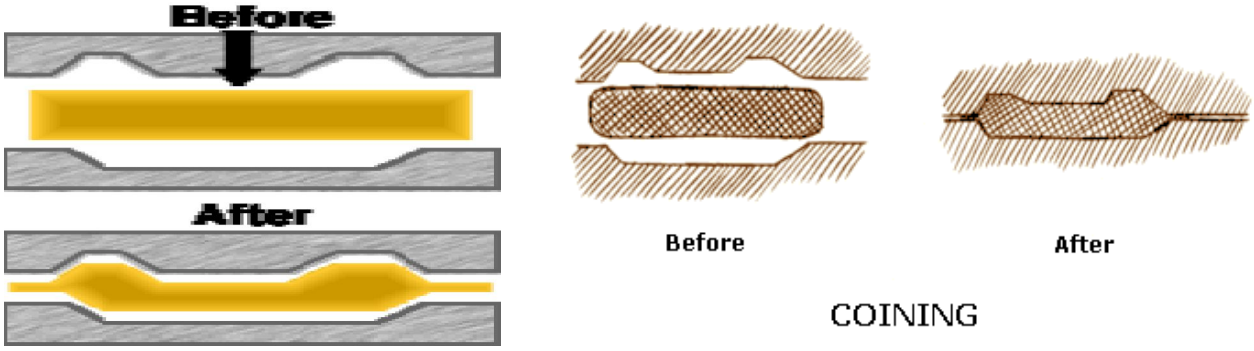


Fig. Embossing.

Coining :

Coining is a closed die squeezing operation in which all surfaces are work are confined or restrained. Shallow configuration on the surface of flat objects such as coins, badges, or medals are produced by this process. In coining, the metal thickness is changed, as is the internal structure of the workpiece. A closed die is generally used to confine the metal and the workpiece will be an accurate reproduction of the die cavity. In this process the design is engraved on the punch as well as the die.

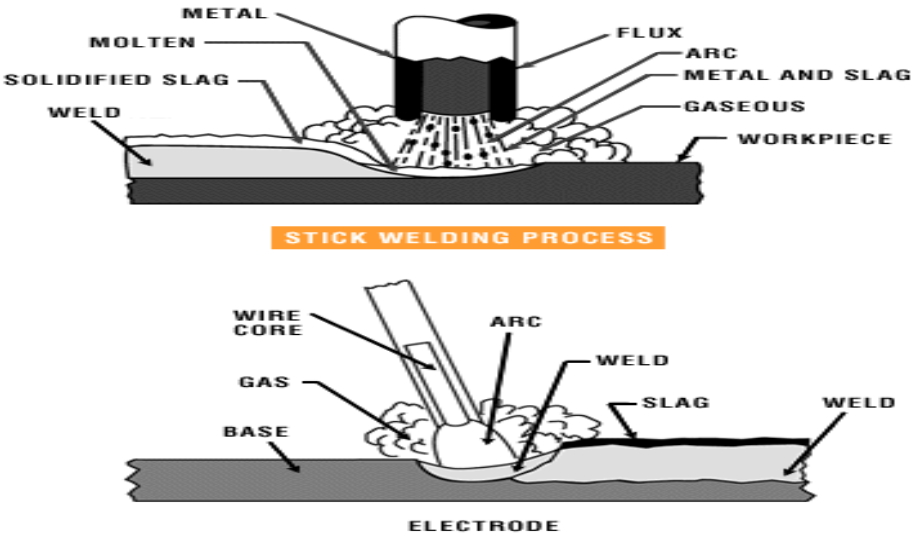


f) Describe with sketch working principle of Arc welding. 4

Ans*:- fig. 2 marks, 2 marks for description*

Arc welding is a welding process, in which heat is generated by an electric arc struck between an electrode and the work piece.

Electric arc is luminous electrical discharge between two electrodes through ionized gas.



Electric arc between the electrode and work piece closes the electric circuit. The arc temperature may reach 10000°F (5500°C), which is sufficient for fusion the work piece edges and joining them.

When a long join is required the arc is moved along the joint line. The front edge of the weld pool melts the welded surfaces when the rear edge of the weld pool solidifies forming the joint.

When a filler metal is required for better bonding, filling rod (wire) is used either as outside material fed to the arc region or as consumable welding electrode, which melts and fills the weld pool. Chemical compositions of filler metal are similar to that of work piece.

Molten metal in the weld pool is chemically active and it reacts with the surrounding atmosphere. As a result weld may be contaminated by oxide and nitride inclusions deteriorating its mechanical properties. Neutral **shielding gases** (argon, helium) and/or **shielding fluxes** are used for protection of the weld pool from atmospheric contamination. Shields are supplied to the weld zone in form of a flux coating of the electrode or in other forms.

Q4) Attempt any four of the following. 16

a) Differentiate between spot welding and seam welding. 4

Ans:-***each difference carry 1 mark***

Spot Welding	Seam Welding
1) It is a welding process in which two or more sheets of metal are joined by spot welding.	1) It is a welding process in which two metal sheets are joined by seam welding.
2) This method uses pointed copper electrodes.	2) This method uses circular rolling electrodes.
3) It cannot produce gas-tight or liquid tight joints.	3)It produces gas-tight or liquid tight joints.
4) Welding can be done along any pattern.	4)welding can be done only along the straight or uniform curved lines.
5) Two sheets of 12.5mm thickness can be welded by spot welding.	5)The thickness of the sheet is limited upto 3mm.
6) It is widely used in automotive industry for joining vehicle body parts.	6)It is widely used for welding process vessels and tanks.

b) What are types of flames used in gas welding? 4

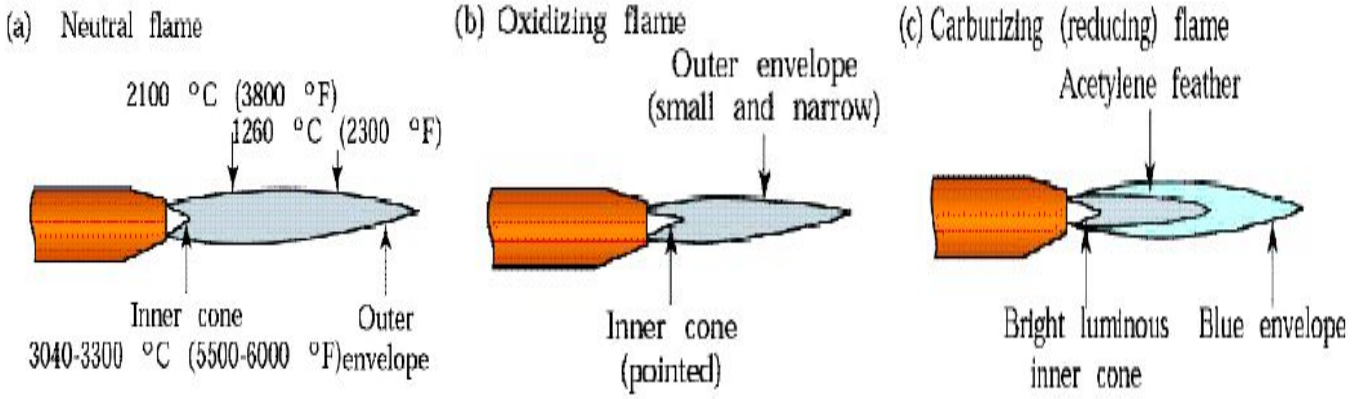
Ans:- ***2 marks for fig., 2 marks for types and explanation***

TYPES OF FLAMES

- When acetylene is burned in air, it produces a yellow sooty flame, which is not enough for welding applications
- Oxygen is turned on, flame immediately changes into a long white inner area (Feather) surrounded by a

transparent blue envelope is called **Carburizing flame** (30000c)

- This flames are used for hardening the surfaces
- Addition of little more oxygen give a bright whitish cone surrounded by the transparent blue envelope is called **Neutral flame** (It has a balance of fuel gas and oxygen)
- Most commonly used flame because it has temperature about 32000c
- Used for welding steels, aluminium, copper and cast iron
- If more oxygen is added, the cone becomes darker and more pointed, while the envelope becomes shorter and more fierce is called **Oxidizing flame**
- Has the highest temperature about 34000c
- Used for welding brass and brazing operation



c) Describe with neat sketch resistance welding. 4

Ans– ***2 marks for fig., 2 marks for description (Any 1 type)***

Resistance Welding is a welding process, in which work pieces are welded due to a combination of a pressure applied to them and a localized heat generated by a high electric current flowing through the contact area of the weld.

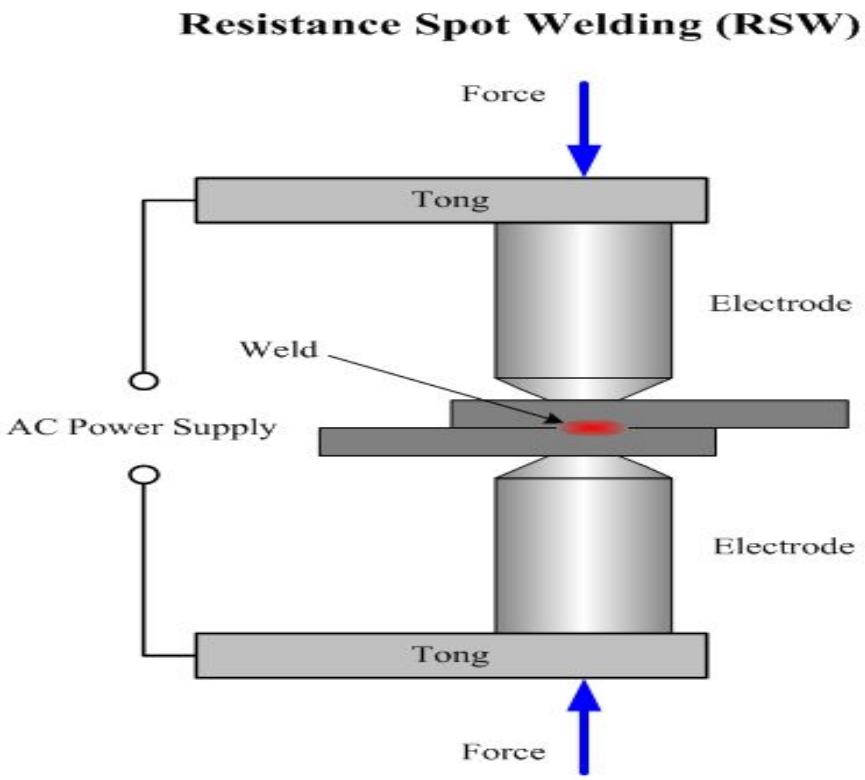
Heat produced by the current is sufficient for local melting of the work piece at the contact point and formation of small weld pool (”nugget”). The molten metal is then solidifies under a pressure and joins the pieces. Time of the process and values of the pressure and flowing current, required for formation of reliable joint, are determined by dimensions of the electrodes and the work piece metal type.

AC electric current (up to 100 000 A) is supplied through copper electrodes connected to the secondary coil of a welding transformer.

The most popular methods (Types) of Resistance Welding are:

- Spot Welding (RSW)
- Flash Welding (FW) (Projection Welding)
- Resistance Butt Welding (UW)

- Seam Welding (RSEW)



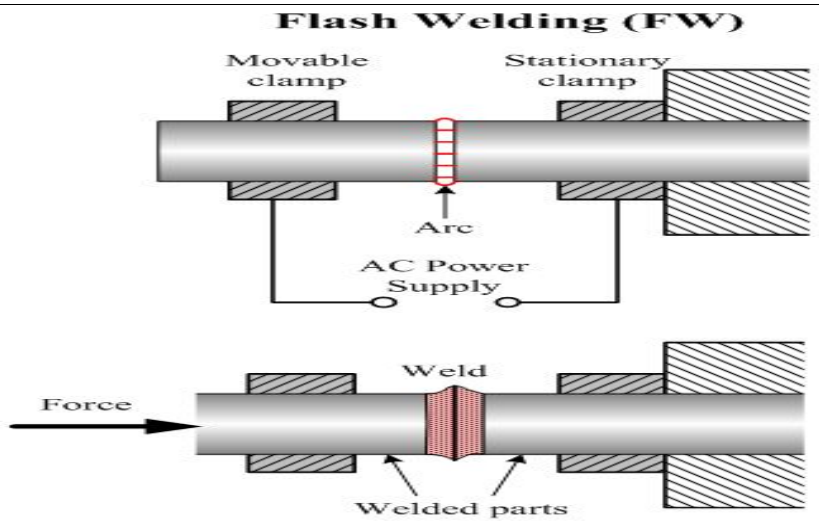
Spot Welding (RSW)

Spot Welding is a Resistance Welding (RW) process, in which two or more overlapped metal sheets are joined by spot welds.

The method uses pointed copper electrodes providing passage of electric current. The electrodes also transmitt pressure required for formation of strong weld.
Diameter of the weld spot is in the range 1/8" - 1/2" (3 - 12 mm).
Applications:
Spot welding is widely used in automotive industry for joining vehicle body parts.

Flash Welding (FW) (Projection Welding)

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 method permitts fast (about 1 min.) joining of large and complex parts.
Welded part are often annealed for improvement of Toughness of the weld.

Steels, Aluminum alloys, Copper alloys, Magnesium alloys, Copper alloys and Nickel alloys may be welded by Flash Welding.

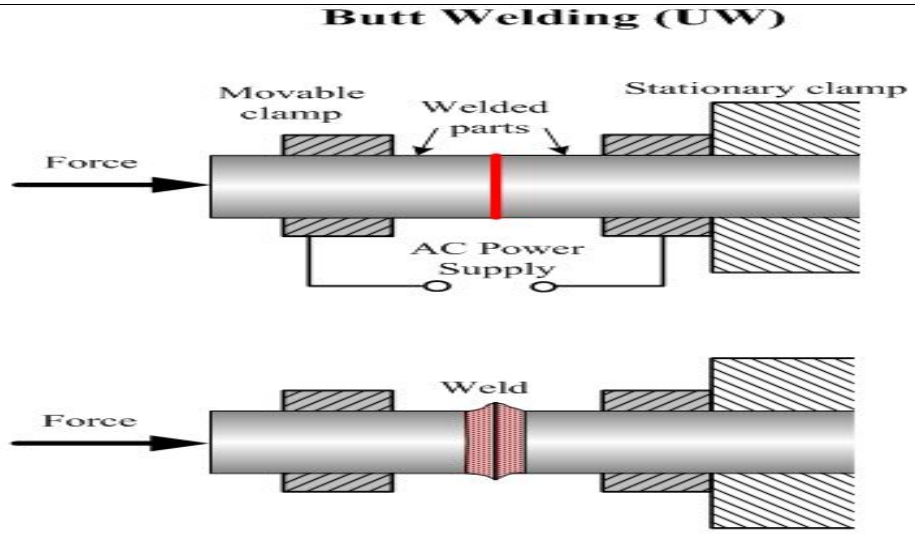
Thick pipes, ends of band saws, frames, aircraft landing gears are produced by Flash Welding.

Resistance Butt Welding (UW)

Resistance Butt Welding 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.

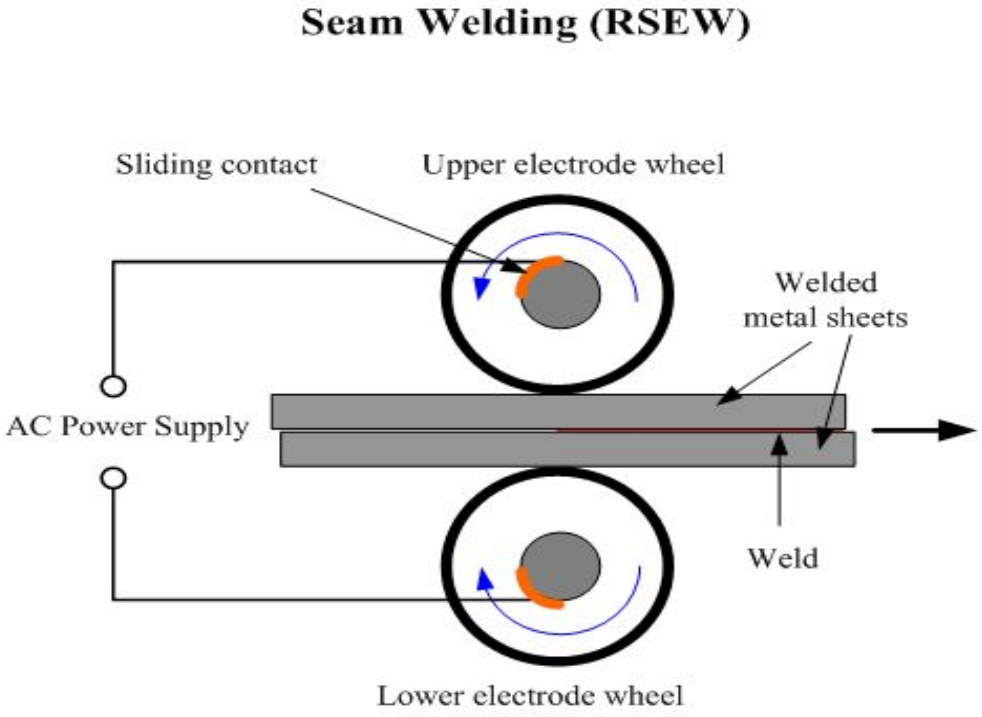
The process is similar to Flash Welding, however in Butt Welding pressure and electric current are applied simultaneously in contrast to Flash Welding where electric current is followed by forging pressure application.

Butt welding is used for welding small parts. The process is highly productive and clean. In contrast to Flash Welding, Butt Welding provides joining with no loss of the welded materials.
Seam Welding (RSEW)



Seam Welding is a Resistance Welding (RW) process of continuous joining 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, which is used when continuous tight weld is required (fuel tanks, drums, domestic radiators).



d) Differentiate between Soldering and Brazing. 4

Ans:-***each difference carry 1 mark***

Soldering.	Brazing.
1. Process of joining the metals by melting filler metal only and without melting of base metal is called as soldering. The melting point of filler metal is below 450^{oc}.	1. Process of joining the metals by melting filler metal only and without melting of base metal is called as brazing. The melting point of filler metal is above 450^{oc} up to 850^{oc}.
2. The filler metal is called as solder.	2. The filler metal is called as spelter.
3. The joint is weak.	3. The joint is strong.
4. Filler material is generally alloy of tin and lead.	4. Filler material is generally alloy of brass.
5. Used for mounting electronic components on PCB and joining sheet metal parts not subjected to high temperature and load. etc.	5. used for joining pipes, pipe bends, two metals having different melting temperatures etc.
6. Depending on heating method soldering processes are classified as Torch soldering, Furnace soldering, Dip soldering, Wave soldering etc.	6. Depending on heating method brazing processes are classified as Torch brazing, Furnace brazing, Resistance brazing, Diffusion brazing etc.
7. Zinc chloride is most common soldering flux.	7. Borax is most common brazing flux.

e) Write advantages and disadvantages of CNC over NC machines. 4

Ans:- ***any 4 advantages & 4 disadvantages -each carry ½ mark***

Advantages of CNC Machine tools:

- It gives greater use of machine.
- Complex machining operations can be easily done.
- It gives high degree of accuracy.
- It requires less inspection.
- It reduces scrap & waste.
- It gives high production rate.
- It has low tooling cost.
- It reduces human error.
- It gives more operator safety.
- It gives more operator efficiency.

- It reduces space requirements
- It has Greater flexibility.
- Tool life gets increased.
- Lead time is reduced.
- In case of CNC lathe the carbide tip tools are used hence cutting speed faster than conventional lathe & also high feed rate.
- CNC lathe movement is controlled by computer (which runs the program while in conventional lathe manual or auto feed is given. More flexibility available in CNC lathe.
- CNC lathe can achieve higher accuracy with closed tolerance and very good surface finish as compared to conventional lathe.
- Once the programme is prepared and fed, less manual interference required in case of CNC lathe hence less skill operator can work on the machine.
- Though the initial cost of CNC lathe is more but for mass production and accuracy and quality job CNC lathe has very good option than conventional lathe.
- Program can be stored in the memory and can be used when ever required in batch production. Such facility is not available in conventional lathe.
- Machines are comparatively small, need not required rigid foundations as conventional machines. Less vibration.
- For superior repeatability, reduce machine down time as fast machining cycle.
- Tool path simulation are available in CNC lathe which gives idea about job. This feature is not available in conventional machine.

Disadvantages of CNC machine tools:

- It has High Investment cost
- It has Complicated maintenance & it's cost.
- Skill operator is required
- training of operator is required.
- Parts are imported from aboard.
- High tooling cost.
- Temperature, humidity & dust must be affect machining.
- Initial cost is high.

f) State four ISO codes in part programming and write their meaning. 4

Ans:- ***any 4 of the following (½ mark for code, ½ mark for its meaning)***

1) PREPARATORY FUNCTIONS (G CODES):

G Codes	Functions
G00	Rapid Point To Point Positioning Rapid Travel
G01	Linear Interpolation- Straight Linear Axis
G02	Clockwise Circular Interpolation
G03	Counter-Clockwise Circular Interpolation
G04	A Dwell, Stoppage of Axis Motion, Delay in Seconds
G22	CALL For Subroutine, Stored Stroke Limit ON
G25	Do Loop
G27	Zero Reference Point Return Check
G28	Home Position Of Tool
G70	Inch Mode Programming
G71	Metric Mode Programming
G74	Stock Removal In Facing On Turing Centers D = Depth Of Cut
G79	Canned Cycle ON
G80	Canned Cycle OFF
G90	Absolute Programming
G91	Incremental Programming
G94	Feed Rate Programming In “mm/min”
G95	Feed Rate Programming In “mm/rev”
G98	Subroutine Label, Return To Initial Level

G99	Return To Reference Level

2) MISCELLANEOUS FUNCTIONS (M CODES)

M Codes	Functions
M00	Program STOP-Terminate the auto operation
M01	Optional or planned stop
M02	Program end
M03	Spindle ON- forward / Clockwise rotation
M04	Spindle ON- reverse / Counter-Clockwise rotation
M05	Spindle OFF
M06	Tool change
M07	Coolant ON (Flood)
M08	Coolant ON (MIST)
M09	Coolant OFF
M30	End of tape- Tape rewind Automatically

Q5) Attempt any four of the following. 16

a) State four surface cleaning processes and write their applications. 4

Ans:- ***any 4 from the following (1 mark for each type description)***

I. Chemical Cleaning

II. Mechanical Cleaning.

I. **Chemical Cleaning:** it usually involves cleaning of oil and grease from the surface. It involves one or more of following actions:

a. **Solution:** The soil dissolves in the cleaning solution.

b. **Saponification:** A chemical reaction that converts animal or vegetable oil in to soap that is soluble in water.

c. **Emulsification:** the cleaning solution reacts with the soil or lubricant deposits forms an emulsion; the soil and emulsifier then becomes suspended in the emulsion.

d. **Dispersion:** the concentration of soil on the surface is decreased by surface-active-elements in the cleaning solution.

e. **Aggregation:** Lubricants are removed from the surface by various agents in the cleaner and are collected as large dust particles.

Depending on cleaning fluids used, the chemical cleaning is named as

a. Alkaline cleaning
b. Acid pickling
c. Electrolytic cleaning
d. Emulsified solvent cleaning
e. Vapour degreasing
f. Ultrasonic cleaning

The following processes are important from syllabus point of view

a. Alkaline cleaning: the most common type of cleaning is with alkali. It is efficient in removing oil and grease by saponification or emulsification or both. Mineral, lard and unpigmented drawing components are easily removed by alkaline cleaners. Silicones, paraffin, and sulphurised, oxidized or carbonized oil are difficult but can be removed by alkaline cleaners.

In this process, a bath is prepared from cleaning agents, such as caustic soda or sodium metasilicate. These materials are added to some type of soap to aid in emulsification. 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.

On assemblies comprised of dissimilar metals, the presence of alkaline solution in crevices may result in galvanic corrosion, and even a trace of alkali will contaminate paint and phosphate coating. Parts are therefore thoroughly rinsed after cleaning.

b. Acid Pickling: The most common method of removing unwanted pigment compounds which are mostly oxides of metal is by acid pickling. Either diluted sulphuric, hydrochloric or phosphoric acid is sprayed on the part; or the part is dipped in to a tank, agitated, and then washed and rinsed thoroughly. Alkaline cleaning of the part should be

used first to remove dirt and oil in order to obtain even removal of oxides during pickling process.

Acid pickling is also used to remove oil and grease. In some applications, acid pickling is used to remove light rust. Acid cleaners are unable to remove polishing and buffing compounds.

Acid cleaning of steel parts creates hydrogen, which is absorbed by steel and causes "hydrogen embrittlement". The hydrogen in the steel of course, be reduced by heating the parts after pickling. Since splash and vapour from the acid solution corrode equipment and tanks, the maintenance cost is high and working condition is disagreeable.

c. Electrolyte 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.

II Mechanical Cleaning: it usually involves physically disturbing the contaminants, often with wire or fiber brushing, abrasive blasting, tumbling or steam jets. Many of these processes are effective in removing rust, scale and other solid contaminants. Mechanical cleaning may also be used for decorative purpose as in polishing.

Mechanical cleaning methods are:

a. Abrasive blast cleaning (Blasting)

b. Tumbling

c. Barrel rolling

d. Power brushing

e. Machine polishing and buffing.

The following processes are important from syllabus point of view

a. Abrasive blast cleaning (Blasting): 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 centre of a radially rotating wheel, whereupon the metallic shot or grit is hurled in a controlled stream upon the work to be cleaned. All traces of sand, scale, oxides and other material are removed right down to virgin metal, providing an excellent surface for bonding final finishes.

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.

b. Tumbling: Tumbling, often is the least expensive process for removing rust and scale from metal parts. Parts configuration and size are the primary limitations of the process. Tumbling in dry abrasive (deburring compounds) is effective for removing rust and scale from small parts of simple shape. However parts with complex shapes, with deep recess and other irregularities, cannot be descaled uniformly by tumbling. It may require several hours if the method is used.

The operation is accomplished by placing workpieces in a drum or barrel, and totally filled together with stars, jacks slugs or abrasive materials. The material can be sand, granite chips, slag or aluminium oxide pellets. In operation, the barrel is rotated, and the movements of the workpiece and accompanying slugs or abrasive material against each other produces by friction a fine cutting action which removes the fins, flashes and scale from the product.

Note: *Barrel rolling is same as tumbling, except that the barrel is loaded only 40 to 60 percent capacity, while in tumbling a drum is packed nearly full.*

b) Describe with sketch electroplating process.	4

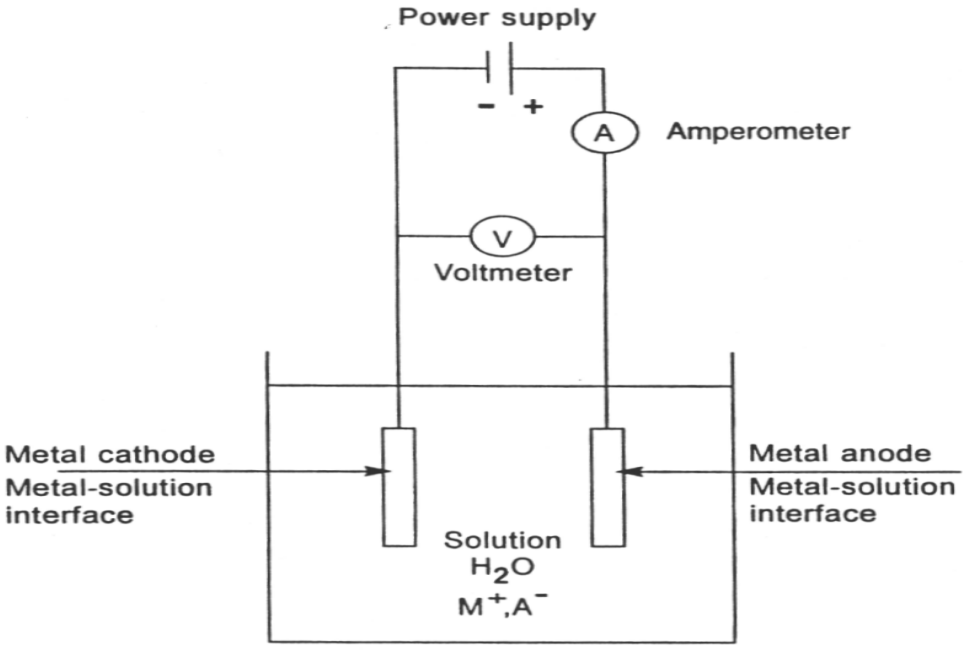
Ans:- ***2 marks for fig. 2 marks for description***

Electroplating: 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.

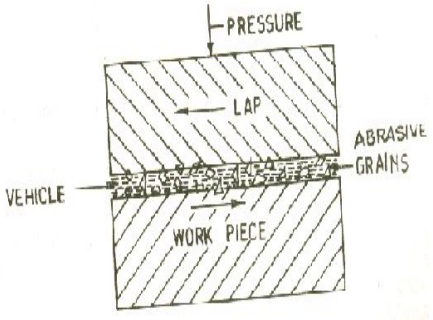
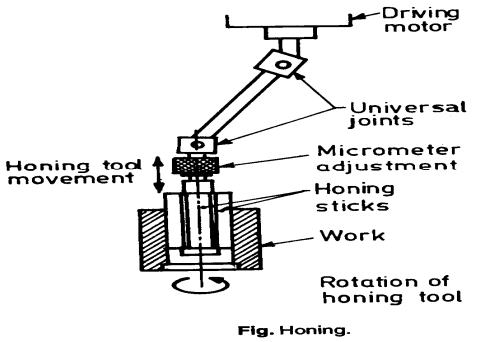
Almost all commercially available metals can be plated, including aluminium, copper, brass, steel, zinc-based die castings. Plastics can be electroplated provided that they are first coated with an electrically conductive material.

The most common platings are zinc, chromium, nickel, copper, tin, and precious metals like gold platinum, silver and rhodium. 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.



c) Differentiate between lapping and honning. 4

Ans:- **each difference carry 1 marks**

S.N	Lapping	Honing
01	Mostly performed for finishing flat and other external surfaces	Mostly performed for finishing internal holes
02	Uses loose abrasives and a lap	Uses bonded abrasives called hones or honing stones
03	Used for finishing engine valve and valve seats, limit gauges, crankshaft, surface plate, races of bearings etc.	Used for finishing IC engine cylinders, gun barrels, ring gauges, big and small ends of connecting rod etc.
04	Process is costly	Process is economical
05		 Fig. Honing.

d) What factors are considered for selection of finishing process for a particular application? 4

Ans:- ***any 4 of the following (each carry 1 mark)***

I. Availability of the finishing equipment.

II. Permissible loss of the metal from the surface.

III. Shape and size if the component to be finished.

IV. Specified tolerances for the surface finish.

V. Quantum of production and considerations.

VI. Type and composition of the metal

VII. The degree of surface finish needed.

VIII. To reduce friction between two mating parts having a relative motion.

IX. For controlling wear.

X. To achieve dimensional and geometrical accuracies.

XI. To increase the fatigue strength.

XII. To achieve quite operation of machine parts.

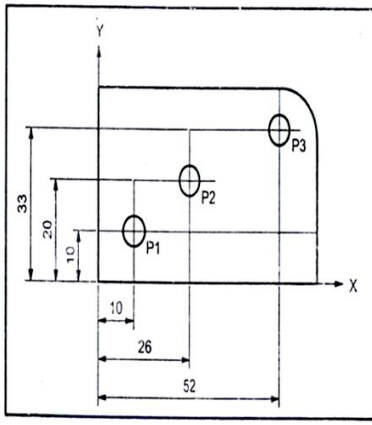
XIII. For good appearance.

e) Describe with sketch absolute and incremental co-ordinate system. 4

Ans:-***1 mark for fig., 1 mark for description (for each system)***

1) ABSOLUTE PROGRAMMING METHOD:

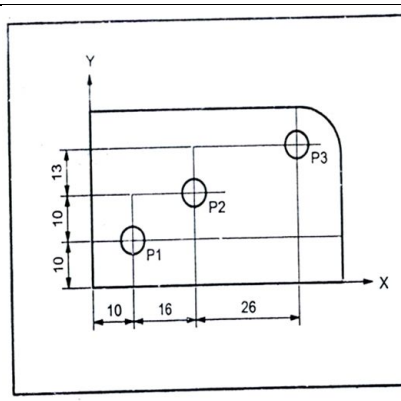
- In Cartesian co–ordinate geometry system using absolute measurement.
- Each point is always specified using same zero of given co–ordinate system as shown in fig.
- It is a system in which all moving commands are referred to one reference point, which is the origin / set point.
- All the position commands 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.



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

2) INCREMENTAL PROGRAMMING METHOD:

- 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.



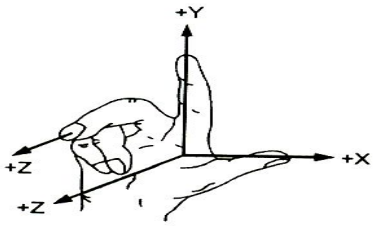
Point	X Coordinate	Y Coordinate
P1	10	10
P2	16	10
P3	26	13

f) Sketch axes system in CNC machines and explain how axes are identified in CNC machining? 4

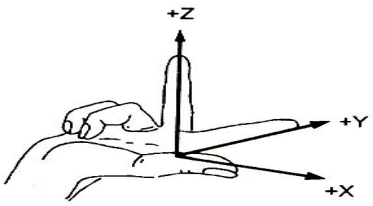
Ans:- ***2 marks for fig., 2 marks for explanation***

Axis Identification – X, Y, & Z Axis:

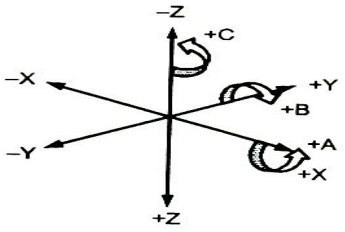
- Axis identification for each type of machine tool is suggested in the **EIA** (Electronic Industries Association).
- This also confirms to **ISO** recommendation.
- The nomenclature of three main axes **(X, Y, & Z)** is based on the right hand rule
- Involving the middle and index figure with thumb of the right hand, as shown in fig.
- The thumb indicates the orientation of **X – axis.**
- The index figure indicates the orientation of **Y – axis.**
- The middle figure indicates the orientation of **Z – axis.**
- An important way of the information supplied to the control system is slide displacement.
- Most machines have two / more slides (usually perpendicular to each other).
- They can be moved in one of two directions.
- The axis for vertical milling machine & drilling machine as shown in fig.
- The axis for horizontal lathe machine & boring machine as shown in fig.
- The Z – axis is always the main spindle axis & for safety purpose, it is positive in towards the tool holder (away from the work).
- The programmer should ignore the directional sign (in this case negative) from in front of the positional data, the tool always move from the work.
- The X – axis is always horizontal & parallel to the surface of the work.
- The Y – axis is always perpendicular to both the & Z axis.



(a) For Horizontal-Z



(b) For Vertical-Z



(c) Cartesian Coordinates

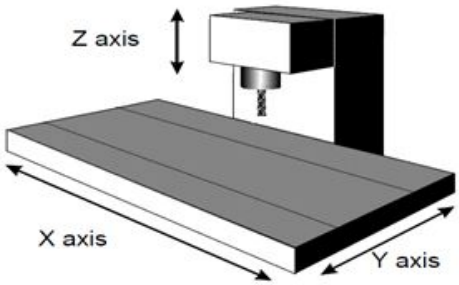


Fig. The main axes of a vertical machining center. (Denford Inc.)

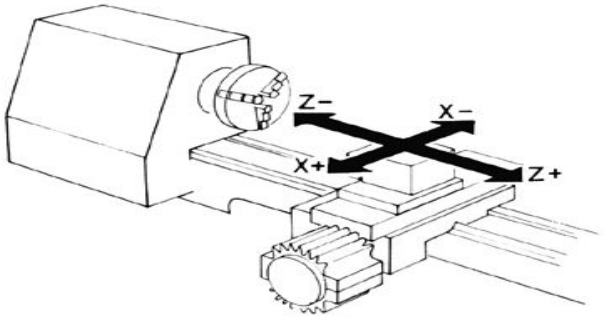
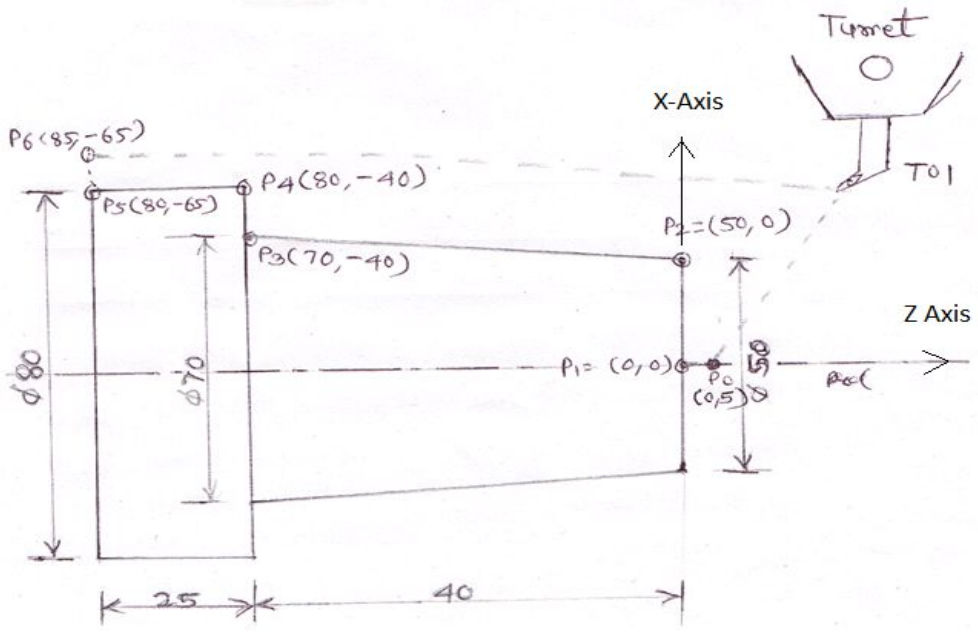


Fig. The main axes of a lathe or turning center. (Emco Maier Corp)

Q6) Attempt any two of the following. 16

a) Write the part program by using ISO codes for component shown in figure No.1 on CNC Lathe. 8

Ans:- ***2 marks for co –ordinate dia., 6 marks for program***



PART PROGRAM N01 G90 G71 G95 G00 E0B N02 T01 M06 E0B N03 S1000 M03 E0B N04 M08 E0B N05 G00 X0 Z5.0 E0B (safely point) N06 G01 X0 Z 0 F0.1 E0B N07 G01 X50 Z 0 F0.1 E0B N08 G01 X70 Z -40 F0.1 E0B N09 G01 X 80 Z -40 F0.1 E0B N10 G01X80 Z -65 F0.1 E0B N11 G00 X85 Z - 65 E0B N12 M09 E0B N13 M05 E0B N14 G00 X100 Z 150 EOB (return to safely point it may be anything) N15 M30 E0B **Note – students can assume the data for following parameters :** **Spindle speed, feed rate, co – ordinate system, tool no., tool starting & ending position**	
b) Describe the procedure to develop the part program and write four ISO codes used in part programming.	8
Ans:-***6 marks for part programming procedure, 2 marks for ISO codes (Any 4)*** 1) Sequence Number (N-word) The first word in every block is the sequence Number. 2) Preparatory functions (G-codes) It is represented by the letter 'G' plus two digits. e.g. G00 G01 F0 G99 3) Co-ordinates (X,Y and Z words) These words gives final co-ordinates. 4) Feed function (F word)	

It is used for to specify the feed- rate in the machining operation.

5) Spindle feed function (S word)

It is specified in revolution per minute e.g. S500,S 1000 etc

6) Tool selection function(T word)

It specifies which tool is to be used in the operation.

7) Miscellaneous function (M word)

It is specify certain Miscellaneous which do not related to the dimensional movements of the machine.

8) End of block (E0B word)

The E0B symbol identities the end of instruction block.

2) PREPARATORY FUNCTIONS (G CODES):

G Codes	Functions
G00	Rapid Point To Point Positioning Rapid Travel
G01	Linear Interpolation- Straight Linear Axis
G02	Clockwise Circular Interpolation
G03	Counter-Clockwise Circular Interpolation
G04	A Dwell, Stoppage of Axis Motion, Delay in Seconds
G22	CALL For Subroutine, Stored Stroke Limit ON
G25	Do Loop
G27	Zero Reference Point Return Check
G28	Home Position Of Tool
G70	Inch Mode Programming
G71	Metric Mode Programming
G74	Stock Removal In Facing On Turing Centers D = Depth Of Cut
G79	Canned Cycle ON

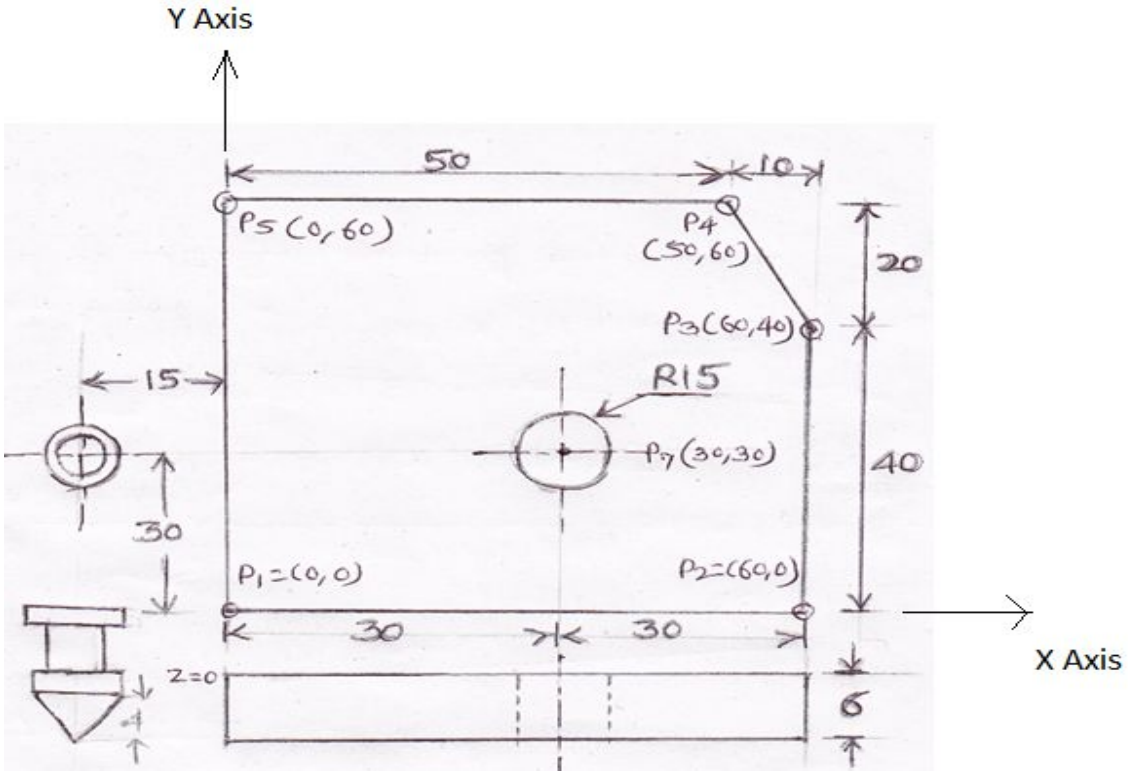
G80	Canned Cycle OFF
G90	Absolute Programming
G91	Incremental Programming
G94	Feed Rate Programming In “mm/min”
G95	Feed Rate Programming In “mm/rev”
G98	Subroutine Label, Return To Initial Level
G99	Return To Reference Level

3) MISCELLANEOUS FUNCTIONS (M CODES)

M Codes	Functions
M00	Program STOP-Terminate the auto operation
M01	Optional or planned stop
M02	Program end
M03	Spindle ON- forward / Clockwise rotation
M04	Spindle ON- reverse / Counter-Clockwise rotation
M05	Spindle OFF
M06	Tool change
M07	Coolant ON (Flood)
M08	Coolant ON (MIST)
M09	Coolant OFF
M30	End of tape- Tape rewind Automatically

c) Write the part program using ISO codes for component shown on figure No.2 on VMC machine.	8

Ans:- ***2 marks for co –ordinate dia., 6 marks for program***



PART PROGRAM

N01 G00 G90 G94 G71 E0B

N02 G54 E0B (work of set x01 y0 defined)

N03 T01 M06 E0B

N04 S1000 M03 E0B

N05 M08 E0B

N06 G00 Z5 E0B

N07 G00 X-Z5 Y-25 E0B

N08 G01 Z-6 F500 E0B

N09 G01 Z-6 F500 E0B

N10 G01 X60 Y0 F100 E0B

N11 G01 X60 Y40 F100 E0B

N12 G01 X 50 Y60 F80 E0B

N13 G01 X0 Y60 F100 E0B

N14 G01 X0 Y0 F100 E0B

N15 G00 G40 X-25 Y-25 E0B

N16 M09 E0B

N17 M05 E0B

N18 G00 Z100 E0B

N19 G28 X0 Y0 Z0 E0B OR G00 X150 Y150 E0B

N20 T02 M06 EOB

N21 S800 M03 EOB

N22 G00 X30 Y30 EOB

N23 M08 EOB

N24 G00 Z5 EOB

N25 G01 Z – 6 F80 EOB (G81 drilling cycle may be used)

N26 Z5 EOB

N27 M09 EOB

N28 M05 EOB

N29 G28 X0 Y0 Z0 EOB

N30 M30 E0B

Note – students can assume the data for following parameters :

Spindle speed, feed rate, co – ordinate system, tool no., tool starting & ending position