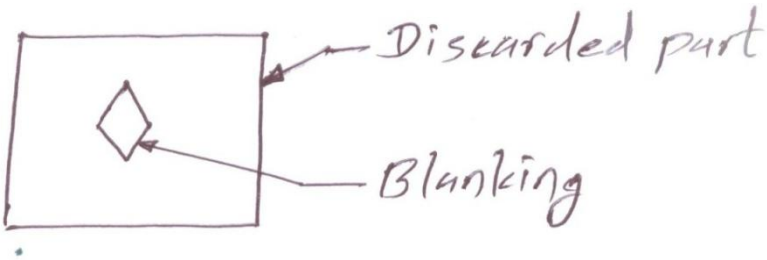
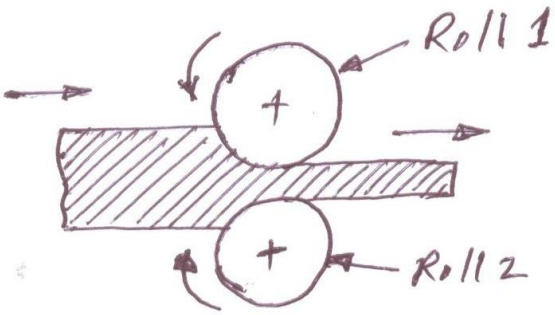
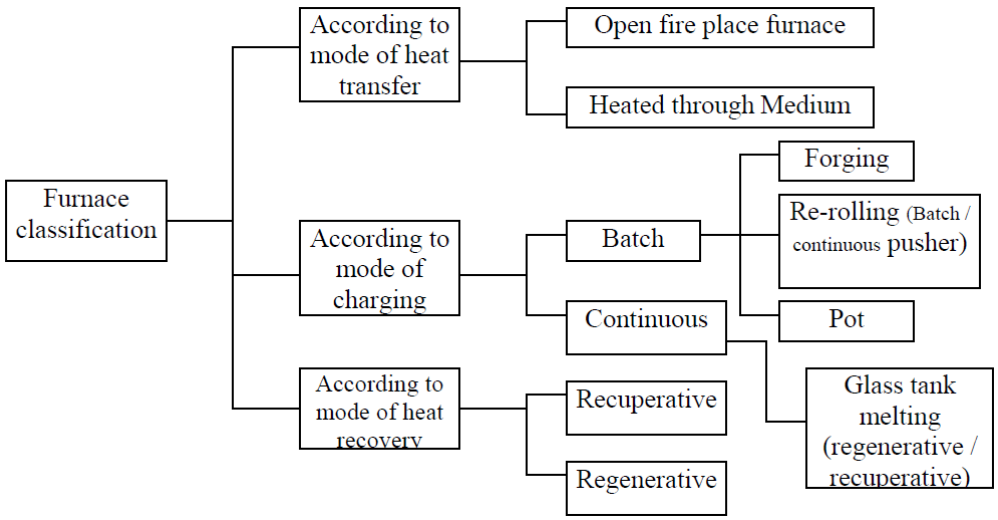
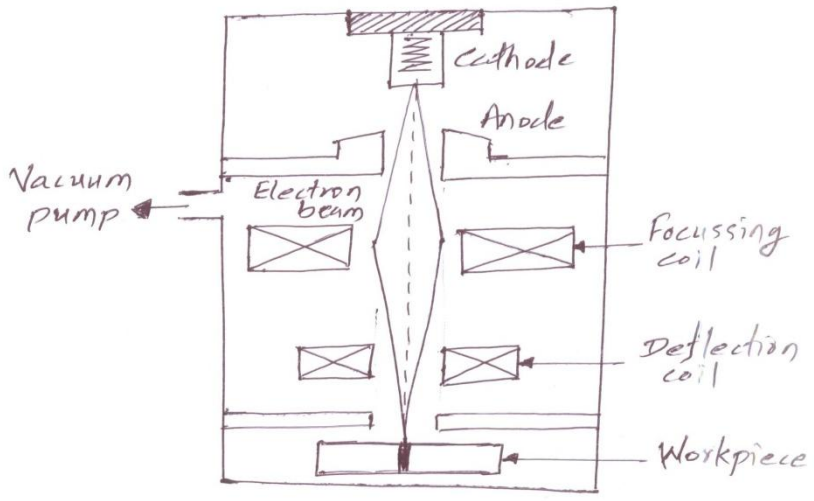
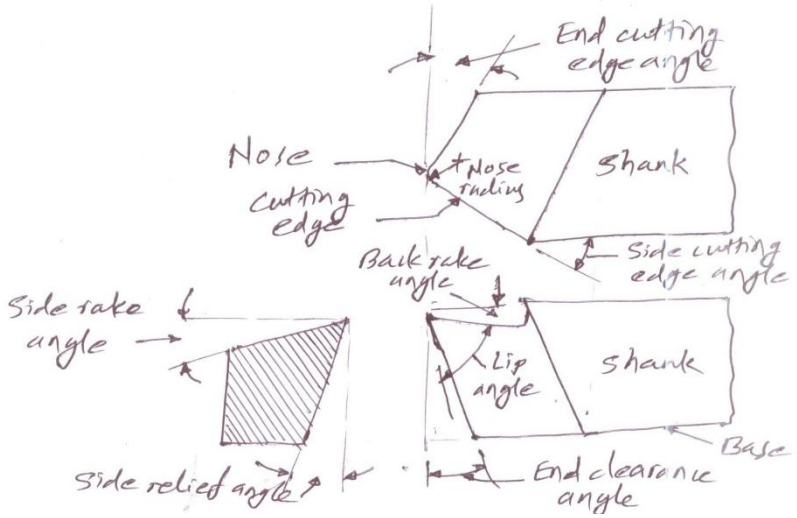
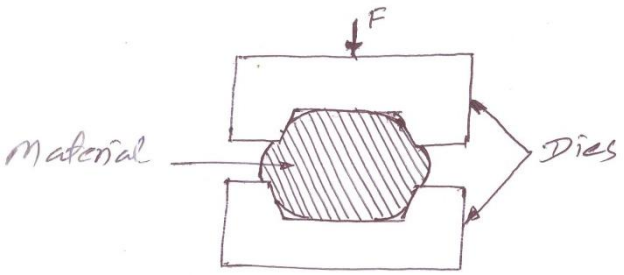
Important Instructions to examiners:

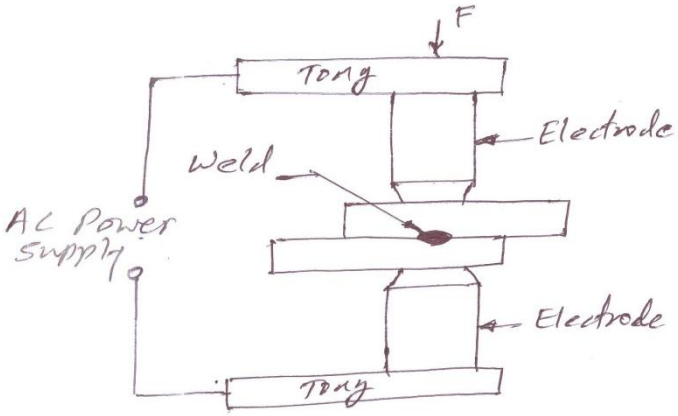
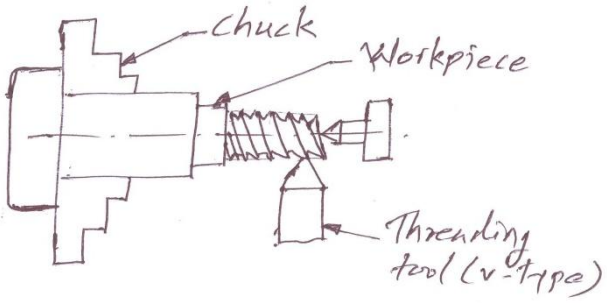
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling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

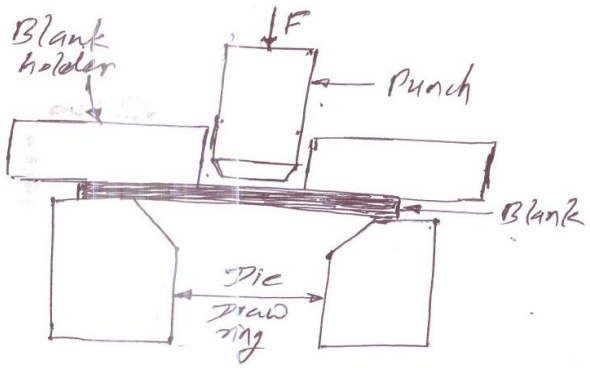
Q. No.	Sub Q.	Answer	Marking Scheme
1.	a)	**Attempt any SIX of the following**	12
	i	Forging (Definition 1m and types 1m) Forging is a manufacturing process involving the shaping of using localized compressive forces. Types- Cold forging, Hot forging, Open die forging and Closed die forging	2
	ii	Blanking (Definition 1m and Sketch 1m)  Blanking- It is a shearing process using a die and punch where the exterior portion of the shearing operation is to be discarded. OR Blanking is the operation of cutting flat shapes from sheet metal.	2
	iii)	Properties of moulding sand (any four 2m) 1. Porosity 2. Flowability 3. Collapsibility 4. Adhesiveness 5. Cohesiveness 6. Refractoriness	2
	iv)	Two roll mill (Definition 1m and sketch 1m)	2

		 Two-roll mills are the simplest variety, in which the material is crushed between two rollers before it continues on to its final destination. The spacing between these two rollers can be adjusted by the operator.	
	v)	Classification of furnaces 	2
	vi)	Applications of centrifugal casting (any two 2m) 1. Casting pipes 2. Bushings 3. Gears 4. Flywheel	2
	vii)	Types of dies (any four 2m) 1. Simple die 2. Compound die 3. Combination die 4. Progressive die 5. Transfer die 6. Multiple die 7. Inverted die	2
	viii)	Color coding on pattern To identify the different surfaces of patterns color coding is provided on pattern.	2
	b)	**Attempt any TWO of the following**	8
	i)	Rolling (Definition 1m, Types 2m and any two application 1m)	4

		Rolling is a metal forming process in which metal stock is passed through one or more pairs of rolls to reduce the thickness and to make the thickness uniform. Types of rolling- 1. Two high rolling 2. Three high rolling 3. Four high rolling 4. Cluster mill 5. Tandem mill 6. Ring rolling Applications of rolling- Pipes, Tanks, Railway cars, Bicycle frames, Ships, Engineering and military equipment, Automobile and truck wheels frames and body parts.	
	ii)	Electron beam welding (Figure 2m and explanation 2m)  Electron Beam Welding is a welding process utilizing a heat generated by a beam of high energy electrons. The electrons strike the work piece and their kinetic energy converts into thermal energy heating the metal so that the edges of work piece are fused and joined together forming a weld after Solidification. The process is carried out in a vacuum chamber at a required pressure. Such high vacuum is required in order to prevent loss of the electrons energy in collisions with air molecules. The electrons are emitted by a cathode (electron gun). Due to a high voltage (about 150 kV) applied between the cathode and the anode the electrons are accelerated up to 30% - 60% of the speed of light. Kinetic energy of the electrons becomes sufficient for melting the targeted weld. Some of the electrons energy transforms into X-ray irradiation. Electrons accelerated by electric field are then focused into a thin beam in the focusing coil. Deflection coil moves the electron beam along the weld.	4
	iii)	Nomenclature of Single point cutting tool	4

			
2		**Attempt any FOUR of the following**	16
	a)	Closed die forging (Figure 2m and explanation 2m)  The workpiece is deformed between two die halves which carry the impressions of the desired final shape. The workpiece is deformed under high pressure in a closed cavity. The process provide precision forging with close dimensional tolerance. Closed dies are expensive.	4
	b)	Working principal of resistance welding (1m) It consists of a welding head, which holds the metal between its electrodes and applies pressure, and a welding power supply, which applies electric current to the metal to be welded. Spot welding (Figure 1m and explanation 2m)	4

		 Spot welding is a process in which contacting metal surfaces are joined by the heat obtained from resistance to electric current. Work-pieces are held together under pressure exerted by electrodes. Typically the sheets are in the 0.5 to 3 mm (0.020 to 0.118 in) thickness range.	
	c)	Thread cutting operation on lathe machine (Figure 2m and explanation 2m)  It is an operation that uses a single point tool to produce a thread form on a cylinder or cone. The tool moves linearly while the precise rotation of the workpiece determines the lead of the thread. The process can be done to create external or internal threads (male or female). In external thread cutting, the piece can either be held in a chuck or mounted between two centers. With internal thread cutting, the piece is held in a chuck. The tool moves across the piece linearly, taking chips off the workpiece with each pass. Usually 5 to 7 light cuts create the correct depth of the thread.	4
	d)	Drawing operation on press machine (Figure 2m and explanation 2m)	4

		 The drawing operation is very similar to the forming operation except that the drawing operation undergoes severe plastic deformation and the material of the part extends around the sides. A metal cup with a detailed feature at the bottom is an example of the difference between formed and drawn. The bottom of the cup was formed while the sides were drawn.	
	e)	Types of forging operations (2m and explanation of any one 2m) 1. Types according to the temperature of the workpiece (cold, warm and hot forging) 2. Types according to arrangements of dies (Open die forging and closed die forging) 3. Types according to forging equipments (Hammer forging and Press forging) Cold forging- Forging is carried out at or near room temperature (below the recrystallization temp.) of the metal. Carbon and standard alloy steels are most commonly cold forged. Cold forging is generally preferred when the metal is already a soft, like aluminum. This process is usually less expensive than hot forging and the end product requires little or no finishing work. Cold forging is also less susceptible to contamination problems, and the final component features a better overall surface finish.	4
	f)	Pit moulding • It is used for very large and heavy castings moulded in a pit. • The pit is formed in the foundry floor itself • Pit acts as the drag part of the mould. • Core part is made separately and assembled with the pit. • As usual, gates, runners, sprue and pouring basin are made in the cope. • The sides of the pit are lined with refractory bit • Sweep patterns are mostly used.	4

3	**a**	**Classification of press machine** A) According to source of power: a) Mechanical press b) Hydraulic press B) According to number of slides: a) Single action press b) Double action press c) Triple action press C) According to type of frame: a) Open frame press b) Closed frame press D) According to operation : a) Punching b) Blanking c) Drawing d) Bending	1 marks each
	b	**Extrusion** It is metal working process in which stock of metal enclosed in container is pushed to flow through the opening of a die. **Types** i) Direct extrusion ii) Indirect extrusion **Application** i) Tubes, pipes, rods, aircraft parts ii) Chanel section, I-section, Z-section iii) To produce variety of cross sectional shapes such as circular, square, hexagonal, rectangular	1 mark 1 mark 2 marks

c

a) Partial penetration.

Reason- It is occurring due to incorrect welding technique.

b) Partial fusion.

Reason- This defect occurs due to incomplete fusion between weld metal and base metal and due to insufficient heat.

C) Porosity or blow holes.

Reason- this defect occur due to trapping of gas during welding process.

D) Cracks

Reason- due to improper welding technique.

1 marks each

d

Notching	lancing
This is the operation of removing small amount of metal from edge of the work piece.	It is the special form of piercing operation in which the entire contour is not cut, the blanked material remains attached with sheet.
Bending and cutting is separate.	Bending and cutting is combined.
More cutting force is required.	Less cutting force is required.
Cost of die is less.	Comparatively cost of die is more.

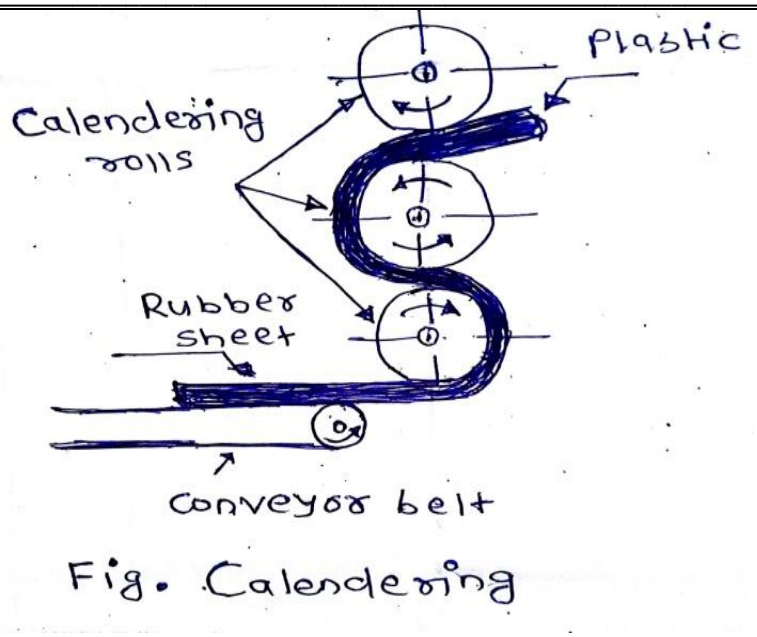
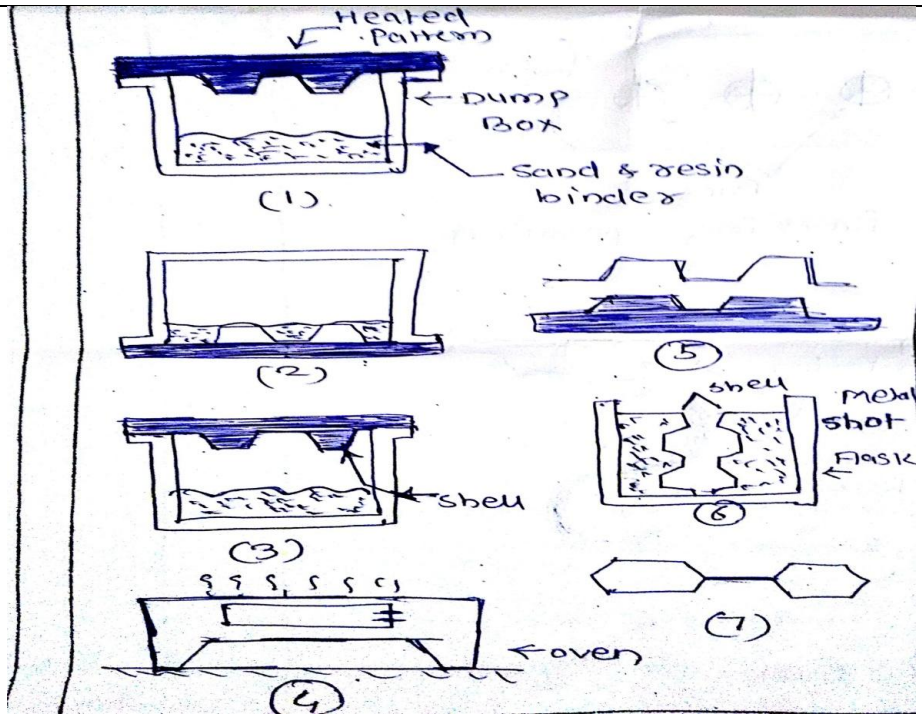
(Any four)

4marks

e

Calendaring is a process in which heat and pressure are applied to a fabric by passing it between heated rollers, imparting a flat, glossy, smooth surface. During calendaring process rolls of the materials are passed between several pairs of heated rollers, to give shiny surface. Luster (i.e. finishing) increases when the degree of heat and pressure is increased. Calendaring is applied to fabrics in which a smooth, flat surface is desirable, such as most cotton. Many linens and silks and various man made fabrics. Calendaring is also used for polymer materials. Extruded PVC Sheets are produced by this method.

2marks

		 Fig. Calendering	2marks
	f	 **Fig. Steps in shell moulding**	2 marks

Shell moulding is process of metal casting process in which the mould is thin harden shell of sand thermosetting resin binder backed up by some other material. First shell is manufactured and sand use for shell moulding is of smaller grain size. This grain sand

Is mixed with resin binder. The sand mixture is then poured over the hot casting pattern due to reaction of the resin with the hot metal pattern, a thin shell forms on the surface of the pattern. The excess loose sand is then removed, leaving the shell and pattern.

The shell and pattern are then placed in an oven for short period of time which causes shell to harden on to the casting pattern. — 2 marks

Once the baking phase of the manufacturing process is complete, hardened shell is separated from the casting pattern by way of ejector pins built into the pattern. Two of these hardened shells, each representing half the mould for the casting, are assembled together either by gluing or clamping. The manufacturing of the shell mould is now complete and ready for the pouring of the metal casting.

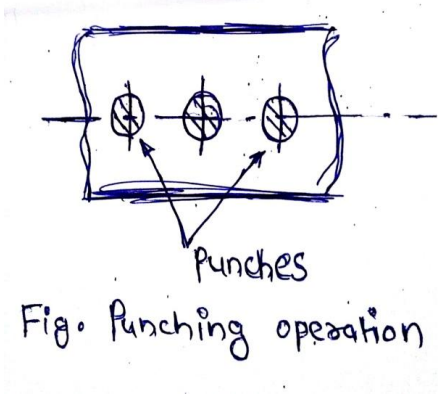
4 a

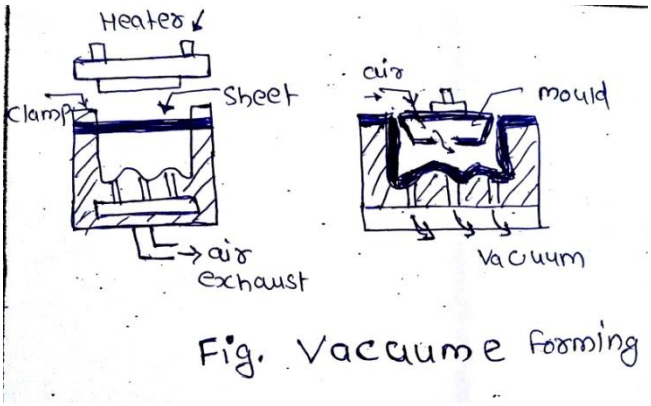
Hot Rolling	Cold Rolling
It is carried out above the recristalisation temperature.	It is carried out below the recrystalisation temperature.
Improved Mechanical properties.	Process leads in to distortion of grains.
It requires less power for rolling.	It requires more power for rolling.
No internal or residual stresses are set up	Residual or internal stresses are setup in the metal.
No cracks and blow holes are present in the metal.	Existing cracks propagates and new cracks may developed.
Close dimensions cannot be maintained.	Superior dimensional accuracy can be Obtained.
It is used for plates, bars, structural sections, channels production.	It is used for rods, sheets, plates bar etc.

(Any4) 4marks

b **Types of press operation** — 2marks

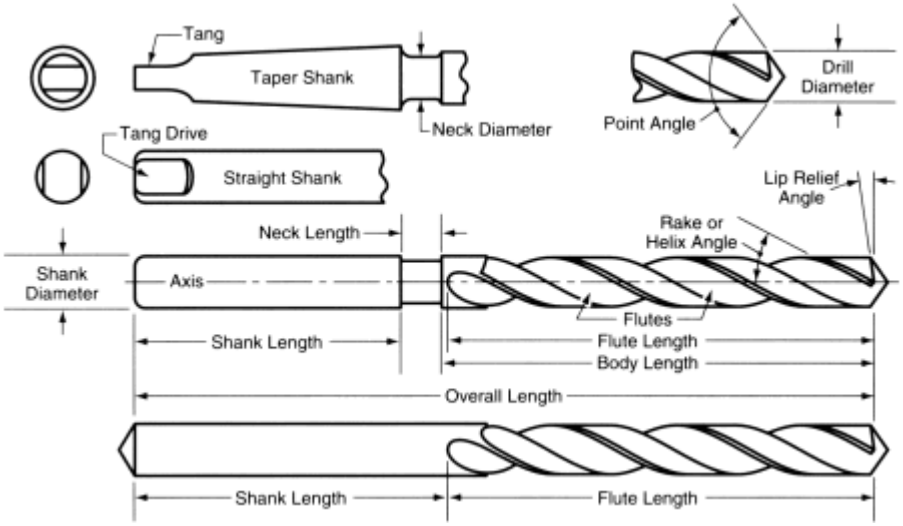
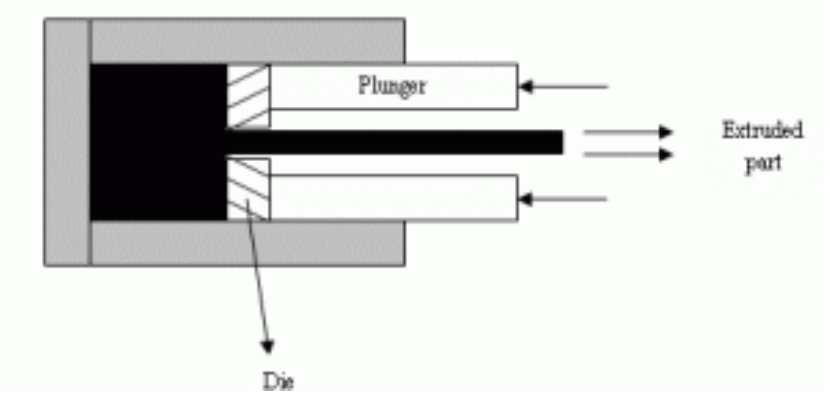
a) Punching b) Blanking c) Notching d) Lancing e) Shearing

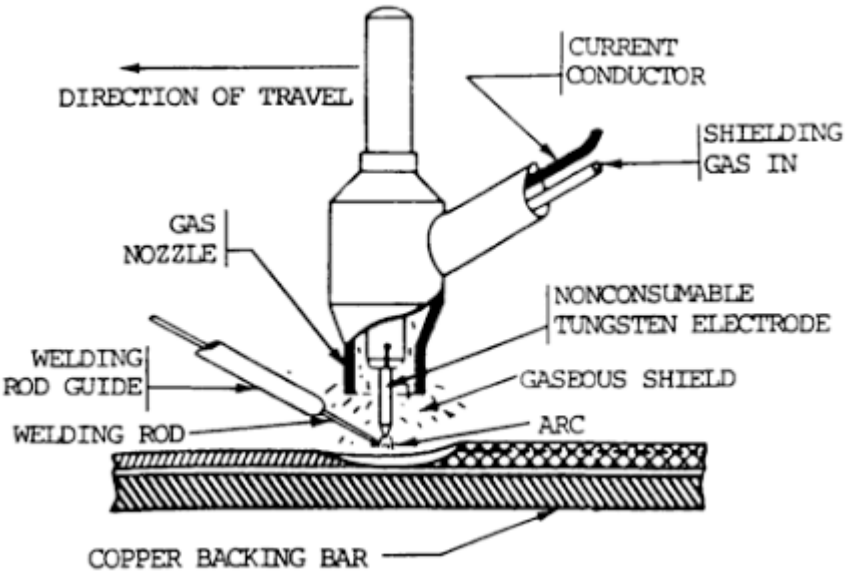
		 Fig. Punching operation Punching is the operation of production of hole in a sheet metal by the punch and the die. The material punched out to form the hole constitutes the waste. The punch point diameter in the case of piercing is less than or equal to the work material thickness. The punch governs the size of the hole and the clearance provided on the die. The spacing of hole on the plate is actuated by the stop. The stripper plate attached to the die body prevents the sheet metal from being lifted along with the punch after shearing operation.	1mark 1 mark
	c	**Cutting Speed** In Lathe, cutting speed is defined as the speed at which the metal is removed by a tool from the work piece. It is the circumferential speed of the work against the cutting tool. It is expressed in meters per minutes. **Feed (f)** In lathe, it is the advancement of tool per revolution of job parallel to the surface being machined. It is given in mm/rev of the job. **Depth of Cut** It is the perpendicular distance measured between machined surface and unmachined surface in case of lathe machine. Let, D1-diameter of the work before machining D2- diameter of the machined surface. Then, Depth of Cut= D1-D2 /2	1 mark 1 mark 2 marks
	d	Intricate shapes are easily formed by the application of pressure or vacuum on the plastic sheet draped over the mould. The operation consist of stretching the sheet over the mould cavity to form a seal, heating it by suitable means and then drawing the air out of the space between the sheet and the mould. A few typical vacuum forming examples are illustrated in figure. At (a)	

		only vacuum is used for drawing the heated sheet in the mould .At (b) the formed mould presses down the heated sheet, forming it partially, followed by pulling the vacuum through the mould to complete the forming a cored plug is used to push the heated sheet into the mould, followed by applying air pressure through the plug to complete the process.  Fig. Vacuume Forming	2marks 2marks
	e		(Any4) 4marks

Brazing	Soldering
Temperature of filler metal is above 420^{o}C.	Temperature of filler metal is below 420^{o}C.
Strength of joint is more.	Strength of joint is Less.
Filler metals Copper or Silver.	Filler metals Tin and lead alloy.
Cost is more.	Cost is less.
Used in refrigeration systems.	Used in electrical and electronics Systems.

	f	1) Pattern making. 2) Moulding and core making 3) Melting and casting 4) Fettling. 5) Testing and inspection.	1 Mark each

5		**Attempt any FOUR of Following: (16 Marks)**	
	a	**Draw a neat sketch of twist drill and show it's nomenclature.**	**4**
			**(sketch 2 Marks, nom. 02 Marks)**
		Figure : Twist Drill	
	b	**Describe back-ward extrusion process with neat sketch.**	**4**
			**(sketch 2 Marks, expl. 02 Marks)**
		Figure : Back-ward Extrusion Process	
		• In this process, the metal flows in the opposite direction of the ram. • The ram in this process is hollow one. Die is mounted over hollow ram which is referred as punch. • The die is attached to the ram and pushed into the billet which is stationary inside the container. During process there is less friction between the metal billet and cylinder walls as compared to direct extrusion. • Extrusion force required less as compared to direct extrusion but the press machine is complicated as compared to direct extrusion. • As compared to direct extrusion, this method finds limited application.	**4**

	c)	**Explain TIG welding with neat sketch.**  **Figure: TIG Welding** • TIG stands for Tungsten Inert Gas welding process. • Also referred to as GTAW (Gas Shielded Tungsten Arc Welding) • In TIG welding, a tungsten electrode heats the metal you are welding and gas (most typically Argon) protects the weld from airborne contaminants • TIG welding uses a non-consumable tungsten • Filler metal, when required, is added by hand • Shielding gas protects the weld and tungsten • The electrode is held in a special type electrode holder which is so designed that apart from holding it also carries a passage around the electrode for flow of inert gas to provide a protective shield around the arc.	**(sketch 2 Marks, expl. 02 Marks)** **4**
	d)	**With sketch explain progressive die in case of press machine.** **------- (sketch 2 Marks, explanation 02 Marks)**	

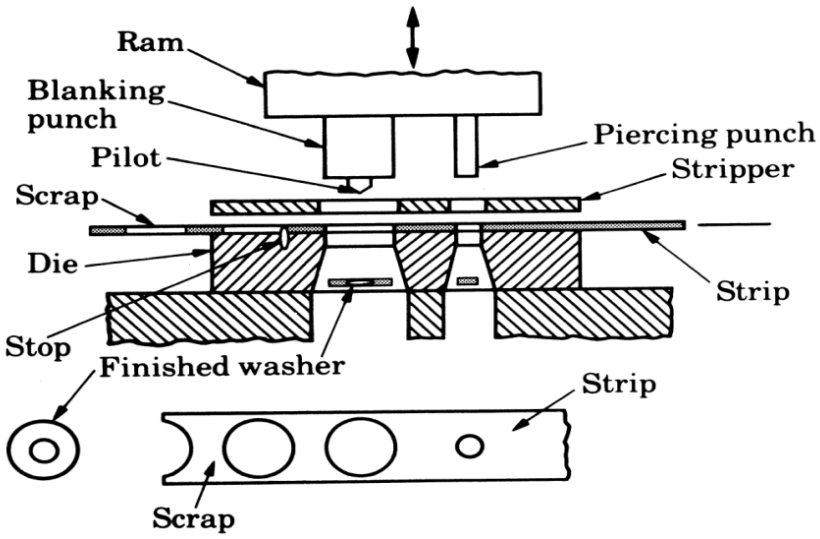


Figure: Progressive Die

In progressive die, two or more operations are performed simultaneously at a single stroke of the press by mounting separate sets of dies and punches at two or more different stations. The metal is progressed from one station to the other till the complete part is obtained. The sheet metal is fed in to the first die where a hole is pierced by the piercing die set in the first cutting stroke of the ram. Plate is then advanced in the next station and the correct spacing is obtained by the stop. In the second cutting stroke of the ram, pilot enters in to the pierced hole and correctly locates it. While the blanking punch descends and shears the plate to form a washer. By the time the blanking operation is performed, the hole for the next washer is also pieced at the first station. Thus although two strokes are required to complete a washer, each piece of washer is discharged on every strokes of the ram due to the continuity on operation. **4**

e **How lathe Machine are classified? Write in brief.**

Though the fundamental principle of operation of all lathes is same and perform the same function, yet they are classified according to the design, types of drive, arrangement of gears, and purpose. The following are important types of lathes.

1. **Speed lathe:** It is one of the simplest type of all laths. It is driven by power and consists of a bed, a headstock, a tail stock and an adjustable slide for supporting the tool. The speed lathe is used mainly for wood working, centering, centering, and metal spinning.
2. **Engine or centre lathe:** It is general purpose lathe and is widely used in workshops. It differs from a speed lathe that it has additional mechanism for controlling the spindle speed and for supporting and controlling the feed of the fixed cutting tool. The Engine lathe, depending upon the design of headstock for receiving power, may be classified as belt driven lathe, motor driven lathe and general head lathe. **4**
3. **Bench lathe:** The batch lathe is so small that it can be mounted on a bench. All the types of operation can be performed on this lathe that may be done on an ordinary speed.
4. **Tool room lathe:** The tool room lathe is similar to an engine lathe and is equipped with all the accessories needed for accurate tool work.

		5. **Capstan and turret lathe:** Capstan and turret lathe are the modification of engine lathe and is particularly used for mass production of identical parts in the minimum time. 6. **Automatic lathe:** The automatic lathes are so designed that the tools are automatically fed to the work an withdrawn after all the operations are complete to finish the work. 7. **Special purpose lathe:** The works which cannot be conveniently accommodated or machined on a standard lathe, the special purpose lathe are used.	**(types 2 Marks, expl.02 marks)**
6	f	**What are the different allowances provided on pattern? Describe any one.** **Shrinkage Allowance**: - as metal solidifies and cools, it shrinks and contracts in size. To compensate for this, a pattern is made larger than the finished casting by means of shrinkage or contraction allowance. In laying measurements for the pattern the patternmakers allows for this by using shrink or contraction rule which is slightly longer than the ordinary rule of the same length. Different metals have different shrinkages, therefore there is a shrink rule for each type of metal used in a casting. i) **Draft allowance**: - When a pattern is drawn from a mould, there is always some possibility of injuring the edges of the mould. This danger is greatly decreased if the vertical surface of a pattern is tapered inward slightly. This slight taper inward on the vertical surface of a pattern is known as draft. Draft may be expressed in millimeter per meter on a side or in degrees. ii) **Machining or Finishing Allowance**:-Rough surfaces of castings that have to be machined are made to dimensions somewhat over those indicated on the finished working drawings. The extra amount of metal provided on the surfaces to be machined is called machine finish allowance and the edges of these surfaces are indicated by a finish mark V or F. the amount that is to be added to the pattern depends upon:- 1) the kind of metal to be used. 2) the size and shape of the casting. 3) method of moulding. iii) **Distortion or camber allowance**: - some castings because of their size, shape and type of metal tend to warp or distort during the cooling period. This is a result of uneven shrinkage and is due to uneven metal thickness or to one surface being more exposed than another, causing it to cool more rapidly. The shape of the pattern is thus bent in the opposite direction to overcome this distortion. This feature is called distortion. iv) **Rapping or shaking allowance**: - when a pattern is rapped in the mould before it is withdrawn, the cavity in the mould is slightly increased. In every cases where casting must be uniform and true to pattern, rapping or shake allowance is provided for by making the pattern slightly smaller than the actual size to compensate for the rapping of the mould.	**8**
	a	**Attempt any <u>TWO</u> of Following: (16 Marks)** **Explain with neat sketch 'Injection Moulding'. Give it's advantages, limitations and applications.** **------ (Sketch 02marks, Explanation 02 marks, advantages 02 marks, limitations 01, applications 01 marks)**	

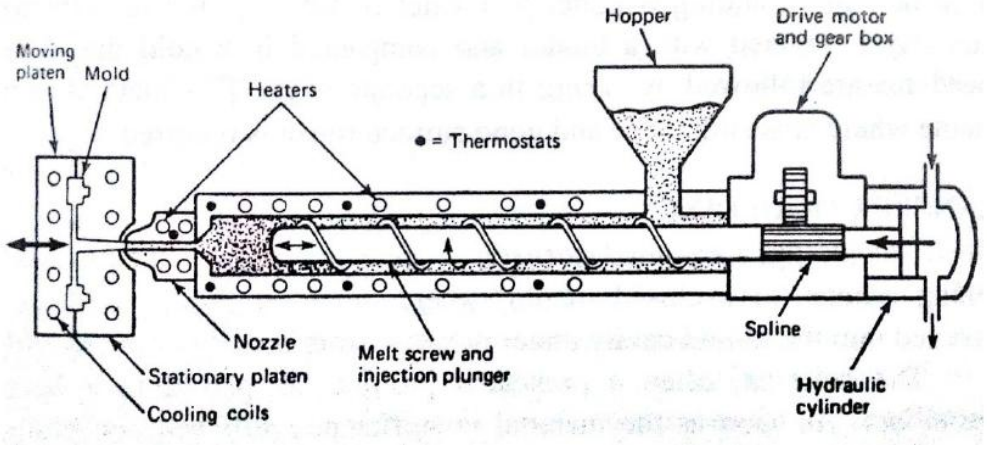


Figure: Injection Moulding

Injection Molding produces plastic parts by forcing molten material into a mold where it cools and hardens. The molded shape produced is a reverse image of the mold tool. Injection molding is low cost moulding for simple and complex parts. The pressure of injection is high, dependant on the material being processed.

Injection Molding is commonly used for thermoplastics. The powder compound is first heated to drive moisture and then feed into the hopper. When the rain is drawn back, some of the powder drops into the chamber. Close the mold and ram is moved forward applying pressure behind the powder. This compresses the material and forces it forward through thin space left around the heated torpedo. The material will come in contact with heated source and solution. The material during heating in the chamber rises the temperature between 175^0 c to 275^0 c. This heated material is forced into the mold then the mold is cooled and it is opened. The part is knocked out by knockout pins.

Advantages

- It is a faster process and best suitable for mass production
- Intricate shapes can be produced
- Good dimensional accuracy can be obtained
- Material and colour flexibility
- Low labour costs
- Design Flexibility
- Low waste.

Limitations

- High initial tooling cost
- Part design restrictions
- Mould design is complicated and costlier

Applications

- Plastic jugs
- knobs
- tool handles
- electrical equipment components etc

How drill machines are classified? And draw neat sketch of radial drill machine.

8

(clas. 4 marks, sketch 04

	b		**marks)**

Drilling Machine are classified according to the construction and the work performed as follows

i) Portable drilling machines
ii) Sensitive drilling machine
iii) Up right or column drilling machine
iv) Radial drilling machine
v) Gang drilling machine
vi) Multi-spindle drilling machine
vii) Vertical turret type drilling machine
viii) Automatic drilling machine
ix) Deep-hole drilling machine
x) Turret drilling automatics
xi) Special turret drilling automatics
xii) Drill mill centre
xiii) Two way drilling machine with pneumatic rotary indexing table

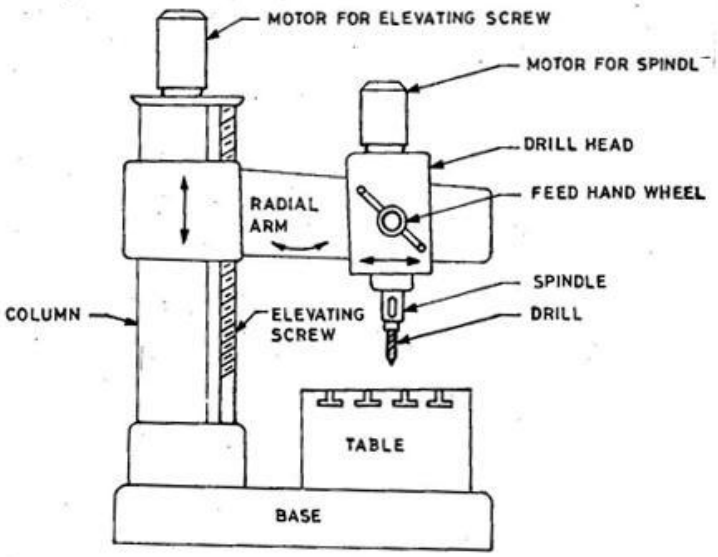


Figure: Radial Drill Machine

8

c **Write any four casting defects and write it's causes and remedies.**

------- (Any four defects, 01 mark for each defects and 01 mark for concerned causes)

A large number of defects are produced in sand casting due to various faults in moulding and core making materials, moulding techniques, impurities in molten metal casting process. Same of common defects found in casting are as below.

1. **Blow holes:** It is smooth sound cavities produced in a casting due to entrapped bubbles of gases, steam.
   Causes:-
   i) Excessive moisture in the sand. ii) low permeability of sand
   iii) Sand grains are too fine iv) Sand is rammed too hard

v) Venting is insufficient

Remedies:-

i) Moisture content of the sand must be well. ii) use Sand of proper grain size
iii) Ramming should not be too hard. iv) Vent holes should be provided.

2. **Mis-run and cold shut:-** When molten metal fails to fill the entire cavity of the mould, incomplete casting is obtained. This defeat is called mis-run and imperfect fusion of two stream of molten metal in the mould cavity results in a discontinuity called cold-shut.

Causes:-

i) Too thin sections and wall thickness. ii) Improper gating systems.
iii) Damaged pattern. iv) Slow and intermediate pouring.
v) Pour fluidity of metal. vi) Improper ally composition.

Remedies:-

i) Use hotter metals ii) Frequent inspection and replacement of pattern.
iii) Proper design of gating and raiser iv) Use of chills and padding.

3. **Drop: -** This is an irregular deformation of the casting produced when a portion of the sand drops into the molten metal.

Causes:-

i) It is caused due to low strength ii) soft ramming
iii) Insufficient reinforcement of hanging section

Remedies:

i) These can be controlled by adopting proper moulding, gating and melting techniques.

4. **Dirt: -** Presence of particles of dirt and sand in the casting.

Causes:-

i) improper handling of mould ii) Presence of slag particles in molten metal

Remedies:-

i) Proper handling of mould ii) proper technique of moulding,gating and melting.
iii) Proper design of gating and raiser iv) Use of chills and padding

5. **Shifts: -** It is a misalignment of top and bottom parts of mould at parting line. This results in mismatch of the casting, incorrect dimension, incorrect location of holes.

Causes:-

i) misalignment of pattern parts, due to worn or damaged patterns
ii) misalignment of moulding box or flask equipment

Remedies:-

i) ensuring proper alignment of the pattern, moulding boxes
ii) correct mounting of pattern on pattern plates etc

6. **Fins and flash: -** It is a thin metal projection on casting.

Causes:-

i) incorrect assembly of moulds and cores ii) Improper clamping of the mould
iii) excessive rapping of the pattern iv) insufficient weight on the top of mould

Remedies:-

i)These can be controlled by adopting proper moulding, gating and melting techniques.
ii) insufficient weight should be placed on the top part of the mould

7. Swell: - It is un-intentional enlargement found on the casting surface due to liquid metal pressure.

Causes:-

i) improper ramming ii) low strength of mould

iii) Pouring the metal too rapidly

Remedies:-

i) Proper ramming of sand

ii) uniform flow of molten metal into the mould

8. **Run-out: -** This defect occurs when molten metal leaks out to the mould during pouring. It results in incomplete casting.

Causes:-

i) defective moulding boxes ii) inadequate mould weights

iii) excessive pouring pressure

Remedies:-

i) The corrective measures taken in respect of the above reasons will prevent this defect.

9. **Warpage: -** This is unintentional and undesirable deformation of casting produced during solidification of metal.

Causes:-

i) inadequate and improper gating, runners and risers

ii) continuous large flat surface on casting, indicate a poor design

Remedies:-

i) This defect can be eliminated by modifying the casting design and proper directional solidification.

10. **Hot tears (Hot Cracks):-** These are internal or external cracks resulting immediately after the solidification of metal.

Causes:-

i) abrupt changes in section

ii) poor design

iii) incorrect pouring temperature

Remedies:-

i) abrupt change in section should be avoided

ii) Pouring temperature should be correct

iii) there should be even rate of cooling

11. Core shift 12.Sand wash 13. Shrinkage 14. Core blow 15.Scabs 16. Pour short 17. Metal penetration 18.Rough surface finish 19.Crush