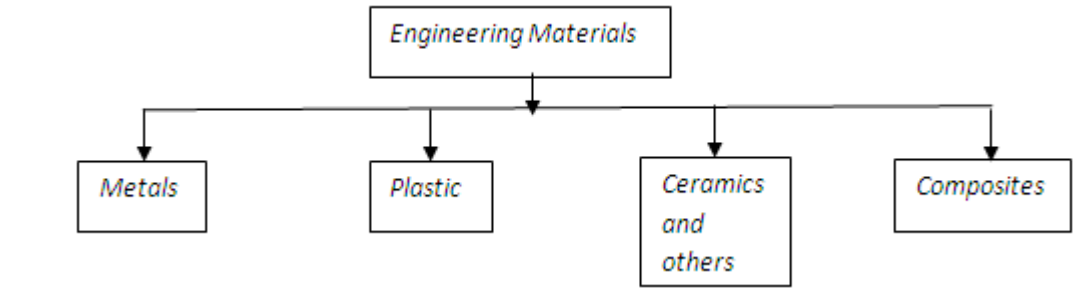
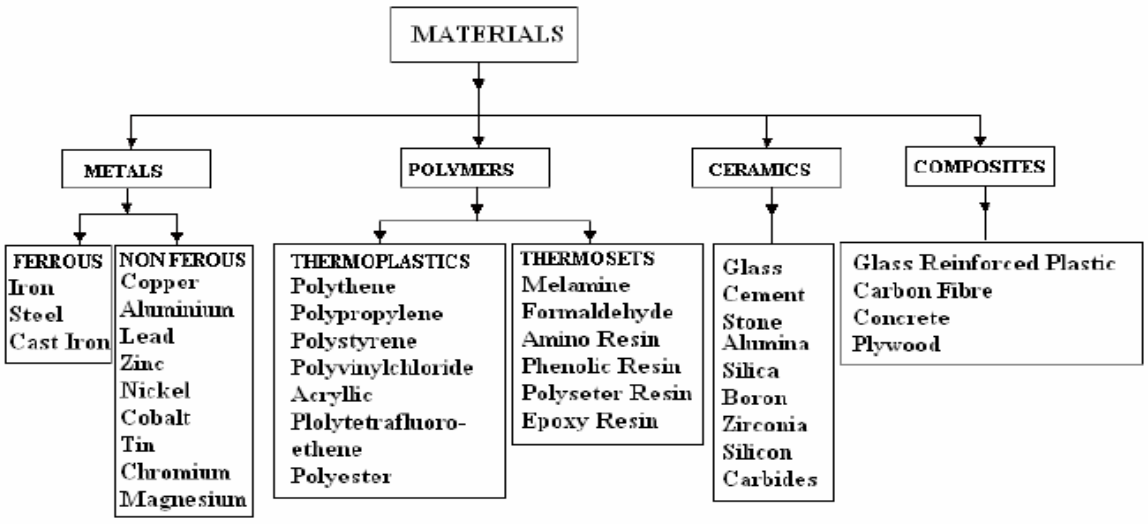
Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No	Sub Q.N.	Answer	Marking Scheme
1	(A)	**Attempt any SIX of the following**	12
	(a)	**State any four types of Engineering Materials.**	02
		Types of Engineering Materials: (Any four type – ½ mark each)  **OR**  	02

	(b)	**Give the composition of grey cast iron. State any two application of it.**	**02**
		Composition of grey cast iron (1 mark) Carbon = 2.5 - 3.7 %, Silicon = 1 - 2.5 %, Mn = 0.4 - 1 %, Sulphur = 0.06 – 0.12 % , Phosphorus = 0.1- 1% **Applications of grey cast iron:** (Any two – ½ mark each) (i) Machine structure, (ii) Engine frames, (iii)Drainage pipes, (iv) Piston of I.C. engines, (v) Bed of lathe machine. (v) Cylinder block & heads (vi) Flywheels (vii) Pump housings (viii) Frames of electric motors **(Note: credit should be given for any other applications)**	**1** **1**
	(c)	**State any four properties of Aluminum.**	**02**
		Properties of Aluminum (Any four – ½ mark each) i. It is light in weight (Specific gravity 2.7) ii. It has very good thermal and electrical conductivity. iii. It has excellent corrosion and oxidation resistance. iv. It is ductile and malleable. v. Nonmagnetic vi. It may be rolled, readily worked, drawn, extruded, cast, & forged vii. Powerful grain refinerNon toxicity	**02**
	(d)	**Give the composition of bronze with any two applications**	**02**
		Composition of Bronze (1 mark) Cu= 88%, Sn=12%, Mn=0.05-1% **Applications of grey cast iron:** (Any two – ½ mark each) (i) Springs, (ii)Bearings, (iii) Welding rods, (iv) Bolts, screws, (v)Locomotive hub liners (vi) Bushings (vii) Pump parts (viii) coins & medals (ix) Valve seats (x) propeller shafts (**Note: credit should be given for composition of any type of bronze & also any other suitable applications)**	**01** **01**
	(e)	**State any two properties of Epoxy. Give any two application of it.** **Properties of Epoxy** (Any two :- ½ mark each) i. It is very tough, ii. Chemical resistant iii. Electrical resistant iv. Low shrinkage v. Good adhesion to metal and glass vi. Good resistance to wear and impact vii. Dimensionally stable viii. Transparent with creamy color **Applications of Epoxy** (Any two :- ½ mark each) i. Electrical moulding ii. Sinks iii. Laminated tooling iv. Adhesives v. Protective coatings vi. Housing for electrical parts vii. In transformer as an insulating material	**02** **01** **01**

	(f)	**What is the basic type of rubber? Give one application of each**	**02**
		Basic types of rubber with application (01 mark each) 1. Natural rubber Applications :- 1. Belts, 2. Shoe, 3. Coatings, 4. Packaging, 5. Soles, 6. Automobile tyres, 7. Seals and gaskets, 8. Chemical tank linings	**01**
		2.Synthetic rubber Applications :- 1. Flooring 2. Electric wire insulation 3. Tubing for food and medical uses 4. Chemical, gasoline and oil hoses 5. O- rings 6. Shock mounts 7. Tubeless tire liners, Inner tubes 8. Stoppers for glass bottles 9. Medicine bottles, and pharmaceuticals	**01**
	(g)	**State any four applications of ceramic material**	**02**
		Applications of ceramic (Any four :-1/2 mark each) i. Tiles, ii. Sanitary ware, iii. Insulators, iv. Semi-conductors, v. Fuel elements in nuclear power plant, vi. Cutting tools, vii. Filters viii. Variety of glasses. ix. Catalytic convertor x. Aerospace field xi. Electronic control devices xii. Computers xiii. Structure xiv.Thermistors xv. Sensors xvi. Spark plug	**02**
	(h)	**Define Phase Diagram**	**02**
		Ans:-Phase Diagram (Definition -02 marks) Phase diagrams are the diagrams which indicate the phase existing in the system at any temperature and composition. In this diagram Y- axis of phase diagram indicates temperature and X-axis indicates weight percent of second element as abscissa.	**02**
Q.1	**(B)**	**Attempt any TWO of the following**	**08**
	(a)	**What is alloy steel? Give composition of any one alloy steel with its properties and application.**	**04**
		Alloy steel (Defination -01 mark) Alloy steel is defined as steels to which elements other than carbon are added in sufficient amounts to produce improvements in properties. **Composition ,properties ,application of any one alloy steel** (1 mark each) **A) Stainless Steel :-Composition (01 mark)** 1) Austenitic stainless steel **:** Chromium-nickel-iron alloys with chromium 16-26%, nickel 6-22% (Ni), and low carbon content, **or** "18/8" (18% chromium 8% nickel), is the most commonly used grade or composition. **OR** 2) Martensitic stainless steel**:** Chromium 12-18% ,Mn 1% , Silicon 1% ,C 0.15-1.2 % **OR**	**01** **01**

		3)Ferritic Stainless steel**:** Chromium- 11-27% chromium, Si 1% , Mn 1-1.5 % and low carbon content, with **Properties**:-(Any two ½ mark each) 1.High corrosion resistance 2.High ductility and formability 3.Creep resistance 4.Weldability is good 5.Oxidation resistance 6.Excellent surface finish and good machinability **Applications** :-(Any two ½ mark each) 1. Screw and fittings 2. Pumps and valve parts 3. Surgical instruments 4.Springs 5. Ball bearings 6. Nuts and bolts 7. Heat exchanger 8. Household utensils 9.Wheel discs 10.Petrol caps 11.Dairy equipments 12.Wrist watch 13.Razor blades 14.Pots and pans	**01** **01**
		OR **B) Tool steel** **Composition** (01 mark) 1) 18-4-1 High Speed Steels : - It Contains 18 % Tungsten, 4 % Chromium, 1 % Vanadium With 0.75 % Carbon & Remaining Iron **OR** 2) Cobalt High Speed Steels : - It Contains 20 % Tungsten, 4 % Chromium, 2 % Vanadium, 12 % Cobalt With 0.80 % Carbon & Remaining Iron **OR** 3) Vanadium High Speed Steels : - It contains 0.70 % Carbon & More Than 1 % Vanadium & Remaining Iron **OR** 4) Molybdenum High Speed Steels : - It contains 6 % Molybdenum, 6 % Tungsten, 4 % Chromium, 2 % Vanadium, 0.85 % Carbon & Remaining Iron **Properties**:-(Any two ½ mark each) 1.Red Hardness i.e. resistance to softening on heating. 2. Corrosion resistance 3. Wear resistance 4. Cutting ability 5. Heat resistance 6. Good machinability 7. Resistance to decarburization 8. Little risk of cracking during hardening 9. Definite cooling rate during hardening **Applications :-(**Any two ½ mark each) 1.Blanking die ,threading die, extrusion die 2. Drills ,hammer ,chisels 3.Knives and razors 4.Shear blades 5.Cutting tools and gauges 6.Saws 7.Lathe tool 8.Milling cutters 9.Taps 10. Reamers **Note:-Credit should be given to composition ,properties and applications of other suitable types of alloy steel)**	

(b) **List any four alloys of Copper. Explain any two with its composition and applications** — 04

Ans:- Copper alloys (Any four –List -02 mark) — 02

1. Brass :- Cap copper ,gliding metal , Cartridge brass ,Admiralty brass , Muntz metal ,Naval brass, Leaded brass, Brazing brass
2. Bronze :-Aluminum bronze ,Phosphor bronze ,Silicon bronze ,Manganese bronze
3. Gun metal
4. Babbitt metal

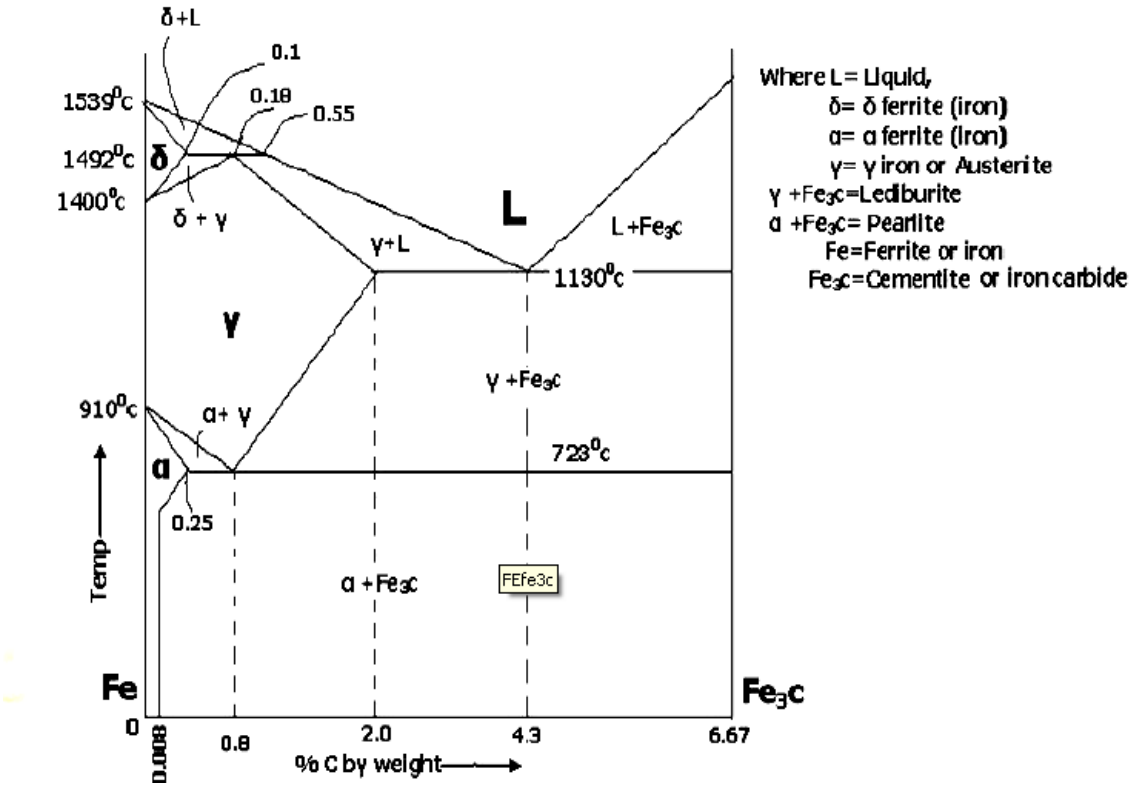
Any two copper alloy (Composition ½mark each ,Application ½ marks each) — 02

S. N.	Alloys of Copper	Composition	Applications
1	Brasses	Alpha brass Cu=70%& Zn=30% Alpha-Beta brass = Zn=40% copper=60%	Nut, bolt, washer, coins, medals, condenser tubes, radiator fins, Pump impellers
2	Bronze	Cu= 88%, Sn=12%, Mn=0.05-1%	Bearings ,gears , pump part ,Plungers, worm gears ,bushes, coins .medals
3	Gun metal	Cu =88 % , Sn =10 % ,Zn =2%	Bearings ,bush , glands, pumps and valves ,boiler fittings etc
4	Babbitt metal	Pb =75 % , Sb =15% ,Sn=10% Cu =3.5% or Sn=88 % , Sb=8% ,Cu=4%	Heavy duty bearing , high speed engine, steam turbine ,crankshaft etc.
5	Cupro Nickels	Cu=80% & Ni=20%	piping ,high pressure systems ,condenser tubes, tubular heat exchanger etc.

(c) **Differentiate between thermosetting plastic and thermoplastic** — 04

Ans: Difference between thermosetting plastic and thermoplastic (Any four -1 mark each) — 04

S. N.	Thermosetting Plastics	Thermoplastic
1	Once hardened and set, they do not soften with the application of heat	They can be repeatedly softened by heating and hardened by cooling.
2	These are usually harder, stronger and more brittle than thermoplastics.	These are comparatively softer and less stronger.
3	Not reused	Repeatedly used
4	Used at comparatively higher temperature without damage	Can't be used at comparatively higher temperature as they will tend to soften under heat.
5	These are cross linked polymers.	These are linear and branched linear polymers.
6	Insoluble in organic solvent	Soluble in some organic solvent

Q No 2			
		Attempt any FOUR of the following:	16
	(a)	**Draw the iron-iron carbide phase equilibrium diagram and show critical temperature on it.**	04
		Iron and Iron-carbide phase equilibrium diagram: (Credit should be given to suitable figure showing all details such as temperature percentage of carbon and state) 	04
	(b)	**Define heat treatment. State any four types of heat treatment. State any four general purposes of heat treatment.**	04
		Definition of Heat Treatment: (1 mark) It is defined as an operation or combinations of operations involving heating and cooling of metals or alloys in its solid state with the purpose of changing the properties of the material. **OR** It is defined as an operation or combinations of operations involving heating and cooling of metals or alloys in its solid state to obtain desirable properties of the material. **Types of heat treatment** (Any four 1 mark) 1) Annealing :- Full annealing ,process annealing ,isothermal annealing , subcritical annealing ,spherodise annealing etc. 2) Normalizing 3) Hardening by quenching 4) Tempering 5) Case hardening :- Carburizing , Cyniding , Nitriding 6) Surface Hardening :- Induction hardening ,Flame hardening 7) Martempering	01 01 02

8) Austempering

Following are the purposes of Heat Treatment: (Any Four – 1/2 Mark each)

1. To improve machinability
2. To improve mechanical properties e.g. tensile strength, ductility, hardness, shock resistance, resistance to corrosion etc.
3. To relieve internal stresses induced during hot or cold working.
4. To change or refine grain size.
5. To improve magnetic and electrical properties.
6. To improve heat resistance, wear resistance.
7. Remove gases, Harden and strengthen the metal.
8. Homogenize the structure.
9. Change the chemical composition

(c) **What is the need of tempering? Explain the process of tempering in brief.** 04

Ans:-Need Of Tempering (2 Marks) 02

Quench hardening produces structure martensite & retained austenite. The martensite formed in quench hardened steel is brittle, hard & slightly stressed so, cracking and distortion may occur after quenching.
Secondly, quench hardened steel contain retained austenite which is also an unstable phase as it changes with time & hence, dimension may change So, tempering is done:

i. To reduce internal stresses developed during previous heating,
ii. To reduce the hardness developed during hardening,
iii. To give the metal a right structural condition (To stabilize the structure).

Process of Tempering: (2 Marks) 02

The process involves
1) Re-heating of the metal below critical point i.e 727 ˚C
2) then holding it for a considerable time and
3) Then cooling it slowly .It is desired that the temperature of the steel shall be maintained for not less than 4 to 5 minutes for each mm of cross-section.

Tempering processes are classified as:
i. Low temperature tempering. (100 – 200 ˚C)
ii. Medium temperature tempering (200 – 500 ˚C)
iii. High temperature tempering (500 – 700 ˚C)

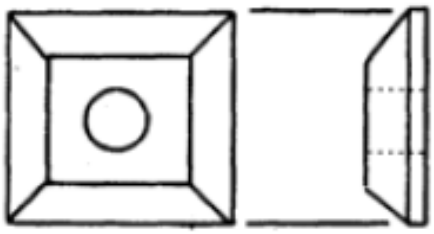
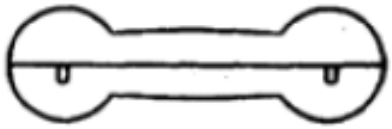
(d) **Differentiate between flame hardening and induction hardening.** 04

Ans:-Difference between flame hardening and induction hardening (Any four -1 mark each) 04

S. N.	Flame Hardening	Induction Hardening
1	Material is heated with oxyacetylene flame at a required temperature, and then it is followed by water spraying.	Material is heated by using high frequency induced current and then it is followed by water spraying.
2	Low equipment and maintenance cost	High equipment and maintenance cost

		3	Holding time is required.	Due to very fast heating, no holding time is required.	
		4	Oxidation & decarburization is minimum.	No scaling & decarburization.	
		5	Overheating can damage parts	Damage of overheating of metal can be avoided.	
		6	Irregular shape parts can be flame hardened.	Irregular shape parts are not suitable for induction hardening.	
		7	Skilled labor is required	It can be carried out with unskilled labor	
		8	Flame hardening requires more care in control of temperature.	Easy control of temperature by control of frequency of supply voltage.	

	(e)	**What are the advantages and disadvantages of foundry process?**	04
		Advantages of foundry process: (Any Two – 1 mark each) i. It one of the most versatile manufacturing process. ii. Castings provide uniform directional properties. iii. Intricate shaped parts can be produced. iv. Very complicated parts can be cast in one piece. **Disadvantages of foundry process**: (Any Two – 1 mark each) i. It is only economical for mass production. ii. Sand casting process cannot produce parts in accurate sizes. iii. Special casting processes are expensive. iv. In some casting process, skilled operators are required. v. Internal defects are not identified easily	02 02
	(f)	**What is pattern? State any six desired properties of pattern material**	04
		Definition of Pattern: (1 Mark) It is a true scale model of the desired product (casting), constructed in such a way that it can be used for forming an impression called mould (cavity) in damp sand. **OR** It is the model of anything which is so constructed that it may be used for forming an impression or cavity in the damp sand or other suitable material. Pattern is principle tool during the casting process. **Properties of Pattern Material:** (Any 6 Properties = 1/2 Mark each) i. It should be cheap and readily available. ii. It should be light in weight. iii. It should be able to withstand rough handling. iv. Its surface should be smooth and wear resistant. v. It should have high strength and long life. vi. It should retain its dimensions and rigidity during the definite service life. vii. It should be easy to manufacture. viii. It should secure the desired shape and size of the casting.	01 03

		ix. It should be easy to store. x. It should hold varnishes and paints require for color coding.	
Q.3		**Attempt any FOUR of the following**	16
	(a)	**Sketch any two types of patterns and explain each in brief.**	04
		Types of patterns (Any two – Sketch 1 mark each , Explanation 1mark each) 1. Solid or single piece pattern: It is made in one piece and carries no joints, partition or loose pieces.  Figure :- Solid piece pattern 2. Split or two piece patterns: They are made in two parts and these two parts of the pattern are joined together with the help of dowel pins.  Figure :- Split piece pattern 3. Gated pattern: They are used in mass production for such castings multi – cavity moulds are prepared by gate former.  Figure :- Gated pattern 4. Match plate pattern: A match plate pattern is a split pattern having the cope and drags portions mounted on opposite sides of a plate (usually metallic), called the "match plate".	01 01 01 01

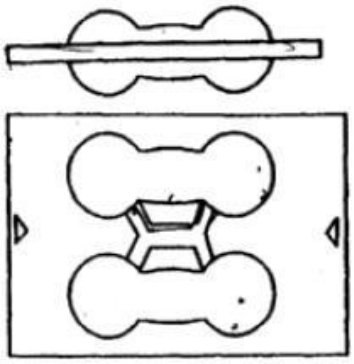


Figure :- Match plate pattern

5. Skeleton pattern: These are simple wooden frames that outline the shape of the part to be cast.

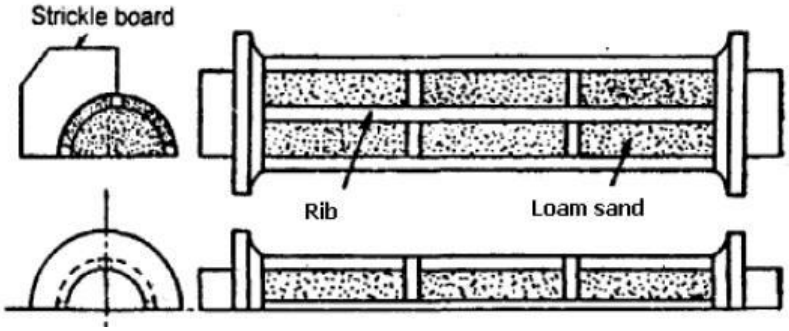


Figure :- Skeleton pattern

6. Sweep pattern: A sweep is a section or board (wooden) of proper contour that is rotated about one edge to shape mould cavities having shapes of rotational symmetry.

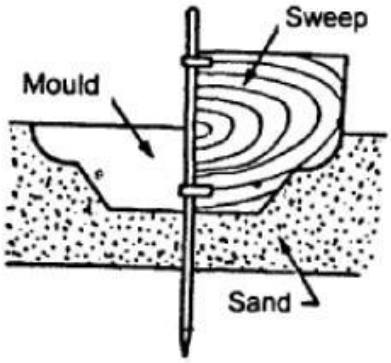


Figure :- Sweep pattern

7. Loose piece pattern: Some patterns usually single piece are made to have loose pieces in order to enable their easy with drawl from the mould.

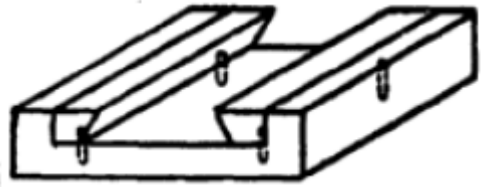


Figure :-Loose piece pattern

8. Segmental pattern: The segmental pattern is in the form of a segment, and is used for Molding parts having circular shapes

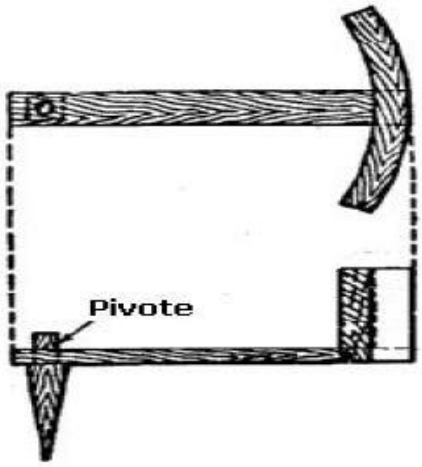


Figure :-Segmental pattern

	(b)	**State different allowances provided on pattern. Explain any two in brief**	04
		Allowances provided on pattern :- (Listing Any four -1/2 mark each) 1. Shrinkage allowance 2. Draft allowance 3. Machining allowance 4. Distortion or camber allowance 5. Shake allowance / rapping allowance **Allowances provided on pattern** (Any two :- Explanation -1 mark each) **1. 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 a shrinkage or contraction allowance. To provide an allowance, a patternmaker uses 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. **2. Draft allowance provided on pattern:** 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 surfaces of a pattern are tapered- inward slightly. This slight taper inward on the vertical surfaces of a pattern is known as the draft. Draft may be expressed in millimeter per meter on a side, or in degrees, and the amount needed in each case depends upon the length of vertical side, intricacy of the pattern, and method of moulding.	02 01 01

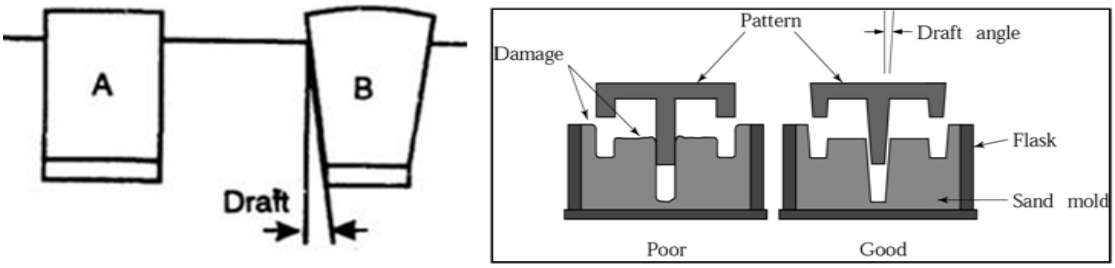


Figure : -Draft Allowance

3. Machining 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 and
(3) Method of moulding.

4. 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 or camber allowance.

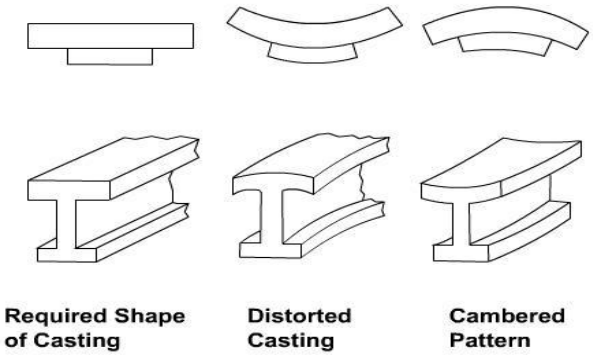


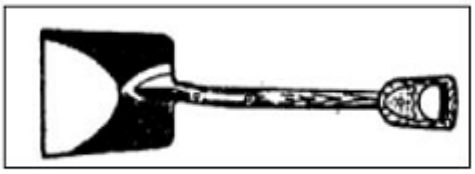
Figure :- Distortion Allowance

5. Rapping or Shake allowance
While withdrawing the pattern from the sand mould, the pattern is rapped all around the vertical faces .So that mould cavity get enlarge slightly, which facilitate its removal.
Hence shake allowance must be considered by making the pattern slightly smaller.
(Note :- Suitable credit must be given to the sketch)

	(c)	**Classify moulding process. Explain any one in detail.**	04
		Classification of moulding process (Any 4 types – ½ mark each) **A.** Moulding process may be broadly classified as 1) Hand moulding 2) Machine moulding	02

		B. According to the method used: 1) Floor moulding 2) Bench moulding 3) Pit moulding 4) Plate moulding 5) Sweep moulding **C**. According to the type of material: - 1. Green sand moulding 2. Skin dried moulding 3. Dry sand moulding 4. Core sand moulding 5. Loam moulding **Explanation of moulding process** (Any one – 2 mark) **1. Hand moulding :-** Moulds are preapeard by hand tools.This process is used for small lot production foundry practices. This process is slow process and it requires skill to produce good castings**.** **2.Machine moulding** This method of moulding is commonly used for preparing the mould of heavy and large size of jobs. Machine moulding method is preferred for mass production of identical casting as most of the moulding operations such as ramming of sand, rolling over the mould, and gate cutting etc. are performed by moulding machine. Therefore, this method of moulding is more efficient and economical in comparison to hand moulding. **B. According to the method used:** **1. Floor moulding:-** In Floor moulding, the floor itself acts as a drag. It is preferred for such rough type of casting where the upper surface finish has no importance. **2. Bench moulding:** - Bench moulding is done on a work bench of a height convenient to the moulder. It is best suited to the mould of small and light items which are to be casted by non- ferrous metals. **3. Pit moulding:-**Large sizes of jobs which cannot be accommodated in moulding boxes are frequently moulded in pits. Here, the pit acts as a drag. Generally, one box, i.e. cope is sufficient to complete the mould. Runner and rise , gates and pouring basin are cut in it. **4. Plate moulding** :- In this the pattern is divided into half across the parting and mounted in the halves onto the plate with parallel sides of the same shape as the parting. **C. According to the type of material: -** **1) Green sand moulding:-** These are prepared with natural moulding sand or eith mixture of silica sand ,bonding clay and water. Procedure involved in making green sand moulds is first the pattern is placed on a flat surface with the drag box enclosing it .Parting sand is sprinkled on the pattern surface to avoid green sand mixture sticking to the pattern. The drag box is filled with green sand mixture and rammed manually till its top surface. The drag box is now inverted so that the pattern faces the top .Parting sand is sprinkled over the mould surface of the drag box.. The cope box is placed on top of the drag box and the sprue and riser pin are placed in suitable locations. The green sand mixture is rammed to the level of cope box.The sprue and the riser are removed from the mould. The cope box is lifted and placed aside, and the pattern in the drag box is withdrawn by knocking it carefully so as to avoid damage to the mould. Gates are cut using hand tools to provide passage for the flow	02

		of molten metalThe mould cavity is cleaned and finished. Cores, if any, are placed in the mould to obtain a hollow cavity in the casting. The cope is now placed on the drag box and both are aligned with the help of pins. Vent holes are made to allow the free escape of gases from the mould during pouring. The mould is made ready for pouring. **2.Dry sand moulding:-** Here, in the preparation of the mixture for dry sand moulding, special binding material such as resin, molasses, flour, or clay are mixed to give strong bond to the sand. All parts of mould are completely dried before casting. Dry sand moulding is widely used for large size of work such as parts of engine, large size of fly wheel and rolls for rolling mill. This process is costlier than green sand moulding but much superior in quality. **3. Loam sand moulding :-** Loam sand moulding are prepared with coarse grained silica sand, clay, coke, horse manure and water. This process of moulding is performed in different way. First, a rough structure of desired shape is made by hand by using bricks and loam sand. The surface of structure are blackened and dried before being casted. **4. Core sand moulding:-**For core sand moulding, mixture is prepared with silica sand, olivine, carbon and chamotte sands. Sand that contains more than 5% clay may not be used as core sand. For core making by hand, the core sand is filled and rammed in the core box properly. The Whole operation takes a short time after the core box is withdrawn and the core removed.	
	(d)	**State and explain the desired properties of moulding sand.**	04
		Properties of moulding sand: (Any 04- 01mark each) **1) Porosity/Permeability**: It is the property of the sand which allows the gases or steam to escape through the sand mould. **2) Flow ability**: Flow ability of moulding sand refers to its ability to behave like a fluid, so that, when rammed, it will flow to all portions of a mould and pack all-around the pattern and take up the required shape. **3) Collapsibility:** After the molten metal in the mould gets solidified, the sand mould must be collapsible so that free contraction of the metal occurs, and this would naturally avoid the tearing or cracking of the contracting metal. **4) Adhesiveness**: The sand particles must be capable of adhering to another body, i.e., they should adhere to the sides of the moulding boxes. It is due to this property that the sand mass can be successfully held in a moulding box and it does not fall out of the box when it is removed. **5) Cohesiveness or strength**: This is the ability of sand particles to stick together. It is the property of the sand due to which rammed particles bind together firmly, so that pattern withdrawn from mould without damaging the mould surfaces or edges. **6) Refractoriness**: The sand must be capable of withstanding the high temperature of the molten metal without fusing.	01 01 01 01
	(e)	**Explain any two hand moulding tools with simple sketch.**	04
		Hand moulding tools (Any 02 Sketch -1 mark each ,explanation -1 mark each) **1) Shovel:** A shovel is used for mixing and tempering moulding sand and for moving the sand from the pile to the flask.	01 01



Shovel

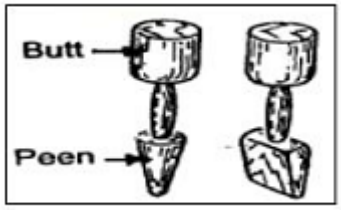
01

01

2) Riddle: It is used for removing foreign materials such as nails, shot metal, splinters of wood, etc., from the moulding sand.

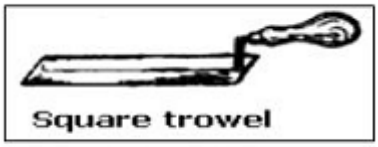
Riddle

3) Rammer: A hand rammer is a wooden tool used for packing or ramming the sand into the mould.



Rammer

4) Trowel: It is used to finish the flat surfaces of the mould. A moulder can also uses them in repairing the damaged portions of a mould.



Trowel

5) Sprue pin: A sprue is a tapered peg pushed through the cope to the joint of the mould. As the peg is withdrawn it removes the sand, leaving an opening for the metal. This opening is called the sprue through which the metal is poured. The sprue pin forms the riser pin.

Sprue pin

6) Bellow: Bellows are used to blow loose particles of sand from the pattern and the mould cavity. A hand blower is shown in Moulding machines are also provided with a compressed air jet to perform this operation.

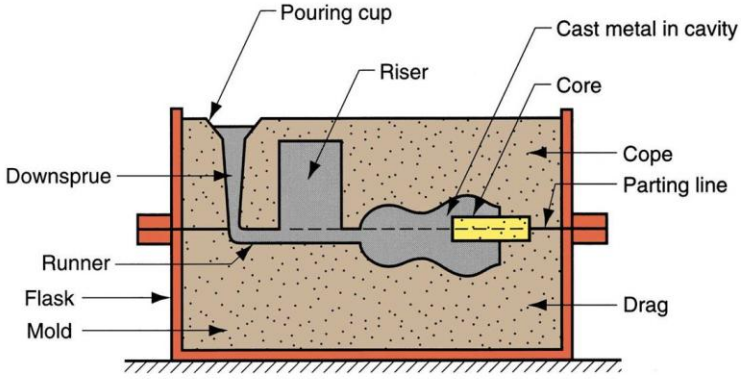
Bellow

(f) **What are the functions of gating system in casting? Draw and show four components of gating system** — 04

Functions of Gating system in casting: (Any 02 functions 01 mark each) — 02

1. To provide continuous, uniform feed of molten metal, with as little turbulence as possible to the mould cavity.
2. To supply the casting with liquid metal at best location to achieve proper directional solidification and optimum feeding of shrinkage cavities.
3. To fill the mould cavity with molten metal in the shortest possible time to avoid temperature gradient.
4. To provide with a minimum of excess metal in the gates and risers. Inadequate rate of metal entry, on the other hand, will result many defects in the casting.
5. To prevent erosion of the mould walls.
6. To prevent slag, sand and other foreign particles from entering the mould.

Components of gating system (Sketch -01 mark Labeling -01 mark) — 02



OR

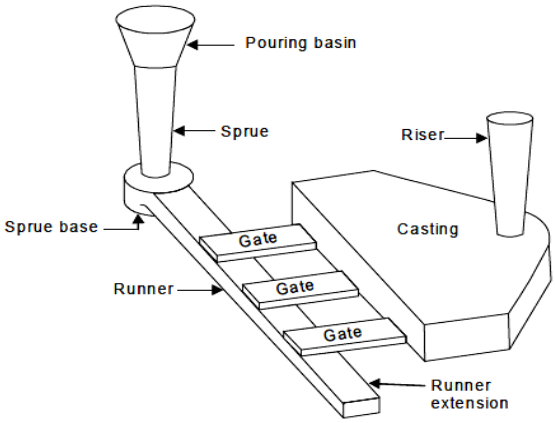
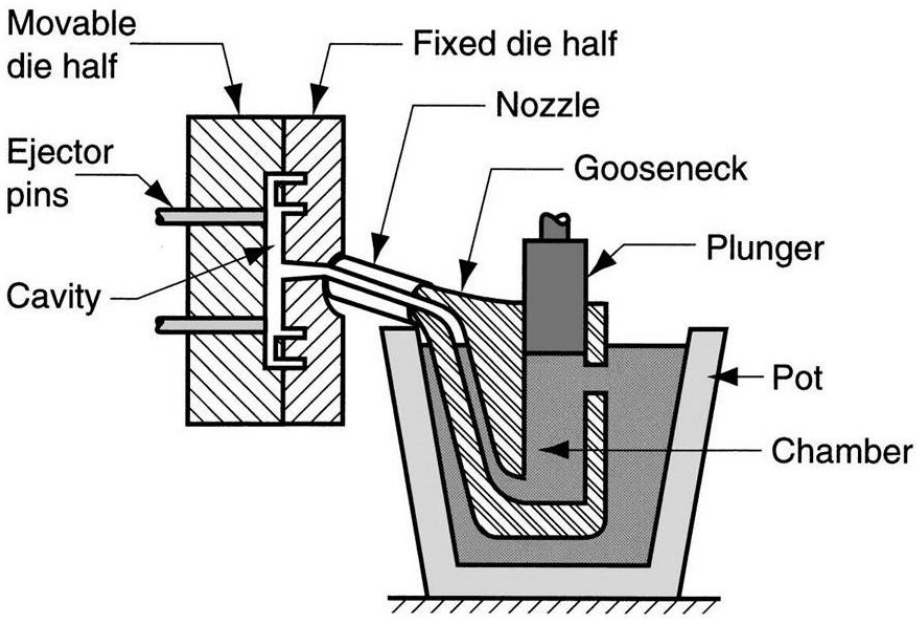


Figure-Gating system in casting

Q.4		Attempt any FOUR of the following	16
	(a)	**What is Pressure die casting? Explain hot chamber die casting with neat sketch.**	04
		Definition of Pressure die casting (1 mark) It is the art of rapidly producing accurately dimensioned parts by forging molten metal under pressure into split metal dies which resemble a common type of permanent mould. **Hot chamber die casting**(Sketch 02 mark, Explanation 1 marks) In a hot chamber submerged plunger-type machine, the plunger operates in one end of a gooseneck casting which is submerged in the molten metal. With the plunger in the upper position, metal flow by gravity into this casting through holes, just below the plunger and the entrapped liquid metal is forced into the die through the gooseneck channel and in-gate . As the plunger retracts, the channel is again filled with the right amount of molten metal. The plunger made of refractory material may be actuated manually or mechanically and hydraulically. Heating is continued throughout the operation to keep the molten metal sufficiently liquid.  Figure :- Hot chamber die casting	01 01 02
	(b)	**Give any two defects in casting with its causes and remedies.**	04
		Defects in casting (Any two -01 marks for cause & 01 mark for remedies for each defect) **1. Shifts:** Cause: Due to core misplacement or mismatching of top and bottom parts of the casting usually at a parting line. Misalignment of flasks is another likely cause of shift. Remedy: By ensuring proper alignment of the pattern or die part, moulding boxes, correct mounting of patterns on pattern plates, and checking of flasks, locating pins, etc. before use.	01 01 01

		2. Warpage:. Cause: Due to different rates of solidification different sections of a casting, stresses are set up in adjoining walls resulting in warpage in these areas. Large and flat sections or intersecting sections such as ribs are particularly prone to warpage. Remedy: Is to produce large areas with wavy, corrugated construction, or add sufficient ribs or rib-like shapes, to provide equal cooling rates in all areas; a proper casting design can go a long way in reducing the warpage of the casting. **3. Swell:**. Cause: This is caused by improper or defective ramming of the mould. Remedy: To avoid swells, the sand should be rammed properly and evenly. **4. Blowholes:** Cause: Excessive moisture in the sand, or when permeability of sand is low, sand grains are too fine, sand is rammed too hard, or when venting is insufficient. Remedy: To prevent blowholes, the moisture content in sand must be well adjusted, sand of proper grain size should be used, ramming should not be too hard and venting should be adequate. **5. Drop :**. Cause: This is caused by low strength and soft ramming of the sand, insufficient fluxing of molten metal and insufficient reinforcement of sand projections in the cope. Remedy: Provide harder ramming , provide adequate reinforcement to sand projection ,modify sand composition for increased strength. **(Note :-Credit should be given to other suitable defects)**	01
	(c)	**What is the mechanism of chip formation during metal cutting?**	04
		Mechanism of chip formation (Description – 2 Mark, sketch – 2 Mark) In Fig. the tool is considered stationary, and the work piece moves to the right. The metal is severely compressed in the area in front of the cutting tool. This causes high temperature shear and plastic flow if the metal is ductile. When the stress in the work piece just ahead of the cutting tool reaches a value exceeding the ultimate strength of the metal, particles will shear to form a chip element which moves up along the face of the work. The outward or shearing movement of each successive element is arrested by work hardening and the movement transferred to the next element. The process is repetitive and a chip is formed.	02 02

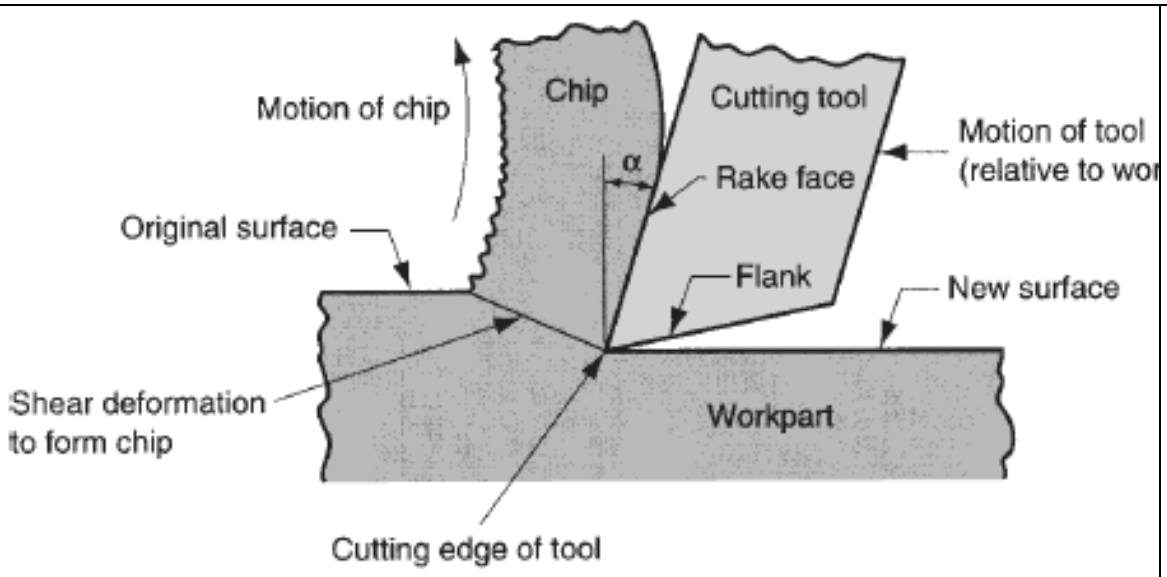
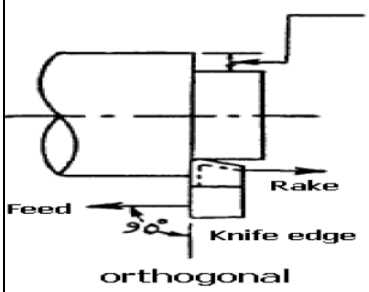
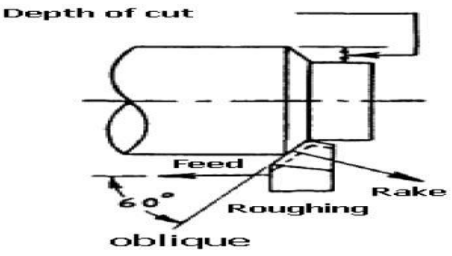
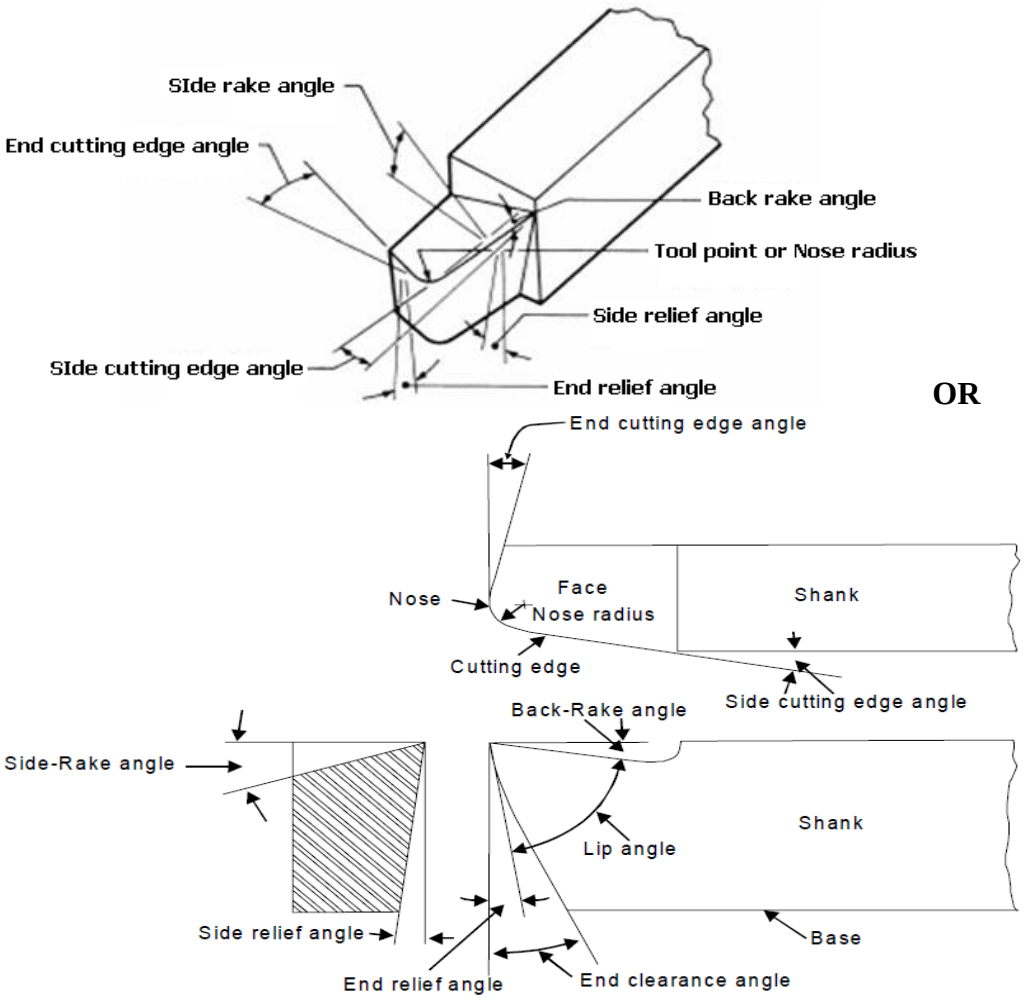


Figure :- Mechanism of chip formation

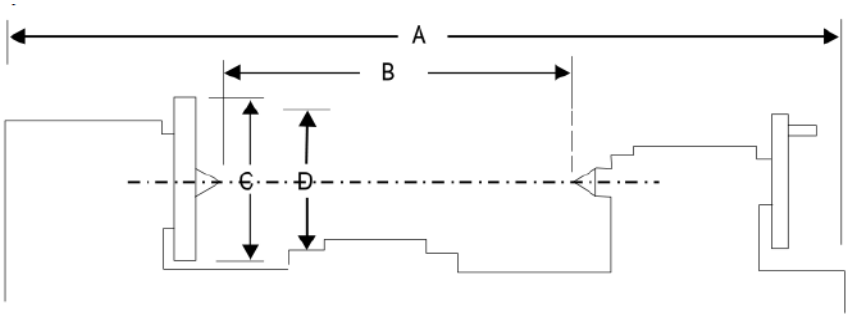
(d) Differentiate between orthogonal and oblique cutting — 04

Comparison of orthogonal and oblique cutting: (Any 04- 01 mark each) — 04

Sr.	Orthogonal Cutting	Oblique Cutting
01	The cutting edge of the tool is perpendicular to the cutting velocity factor	The cutting edge is inclined at an Angle with the the cutting velocity factor
02	The cutting edge clears the width of the workpiece on either ends.	The cutting edge may not clear the width of the workpiece on either ends.
03	The chip flows over the tool face.	The chip flows on the tool face.
04	Only two components of the cutting forces are acting on the tool.	Only three components of the cutting forces are acting on the tool.
05	Tool is perfectly sharp.	Tool is not perfectly sharp.
06	Tool contacts the chip on rake face only.	The toll may not generate a surface parallel to workface.
07	Relatively short tool life	Longer tool life
08	Only one cutting edge in action.	More than one cutting edges are in action
09		

	(e)	**State and describe the desired properties of cutting tool material.**	04
		Answer :-Cutting tool material properties (Any four -01 mark each) **1. Hot hardness:** The material must remain harder than the work material at elevated operating temperatures. **2. Wear resistance:** The material must withstand excessive wear even though the relative hardness of the tool-work materials changes. **3. Toughness:** The material must have sufficient toughness to withstand shocks and vibrations and to prevent breakage. **4. Cost and easiness in fabrication:** The cost and easiness of fabrication should have within reasonable limits.	01 01 01 01
	(f)	**Draw a neat sketch of single point cutting tool and show the different nomenclature on it.**	04
		Single point cutting tool nomenclature (2 marks sketch and 2 marks Labeling)  Figure :- Single point cutting tool nomenclature	04

Q.5		**Attempt any FOUR of the following.**	**16**
	(a)	**What is the effect of positive rake angle and negative rake angle on the performance of single point cutting tool?**	**04**
		Answer: Effect of positive rake angle and negative rake angle on the performance of single point cutting tool:(2 marks each & credit should be given to sketch**)** **Effect of positive rake angle:** (Any two points -02 mark) 1) A tool has a positive rake can work against a very low and high cutting speed. 2) Low heat generated in positive rake turning. 3)Long life of positive rake tool. 4) The cutting force and the power required are decreased by 10 to 15 percent of that required negative rake machining under similar condition. When we use positive rake angle, the force on the tool is directed towards the cutting edge, tending to chip or break it. Carbide being brittle lack shock resistance and will fail if positive rake angles are used with it. **Effect negative rake angle:** (Any two points -02 mark) 1)It can work against a very high cutting speed. 2) It decreases tool wear and consequently increases the tool life. 3) Negative rake increases the lip angle of the tool permitting it to take heavier depth of cut. 4) Using negative rake angles, direct the force back into the body of the tool away from the cutting edge, which gives protection to the cutting edge. 5)Increase the strength of cutting tool point 6) Give better finish 7) Decrease temperature rise.	02 02
	(b)	**How the lathe machine is specified?**	**04**
		Answer: Lathe machine specification: (Sketch - 1mark, Any 3 points - 1 mark each) The lathe is generally specified by the following means: a) Swing or maximum diameter that can be rotated over the bed b) Maximum Swing over carriage c) Maximum length of the job that can be held between head stock and tailstock centers d) Length of bed e) Height of centers over bed f) Maximum swing in gap- in case of gap bed lathes only .	03 01



A - Length of bed.
B - Distance between centres.
C - Diameter of the work that can be turned over the ways.
D - Diameter of the work that can be turned over the cross slide.

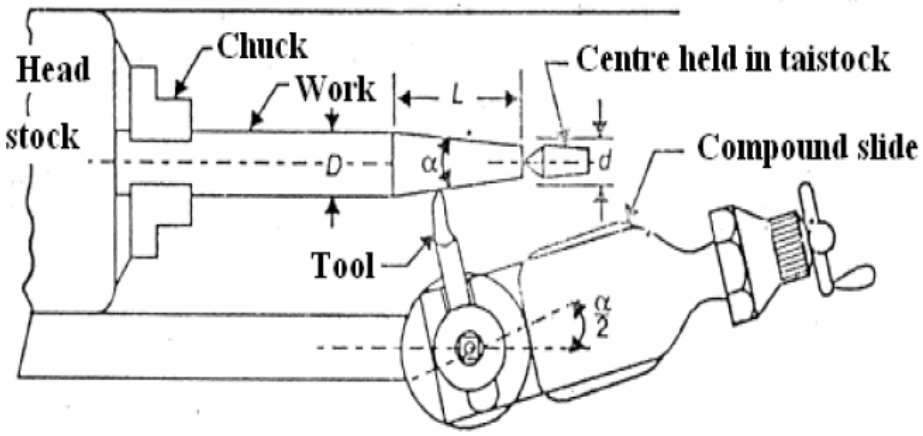
Figure :- Specification of lathe machine

(c) **Explain taper turning by swiveling compound rest with neat sketch.** **04**

Answer: Taper turning by swiveling compound rest (Description -2 marks, sketch-2 marks and Equivalent credit should be given to any other suitable sketch**.)**

Taper turning method by swiveling the compound rest**:** This method employs the principle of turning taper by rotating the work piece on the lathe axis and feeding the tool at an angle to the axis of rotation of the work piece. The tool mounted on the compound rest is attached on a circular base (Swivel plate), graduated in degree, which may be swiveled and clamped at any desired angle. Once the compound rest is set at the desired angle half the taper angle, rotation of the compound slide screw will cause the tool to be fed at the angle and generate a corresponding taper. The movement of tool is controlled by hand. 02

.



02

Figure: Taper turning method by swiveling the compound rest

(d) **List the principle parts of centre lathe. State the function of any two parts.** **04**

Answer:

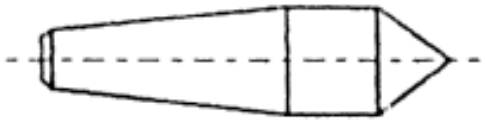
Parts used in lathe machine (Any 04- ½ mark each)

1. Bed

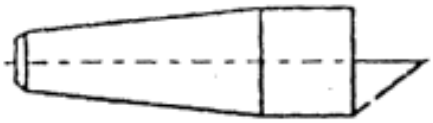
		2. Headstock 3. Main Spindle 4. Tailstock 5. Carriage a. Saddle b. Apron c. Cross-slide d. Compound rest e. Compound slide f. Tool post 6. Feed mechanism 7. Lead screw 8. Feed rod 9. Thread cutting mechanism **Function of principle parts of centre lathe** (Any 02- 1 mark each) 1. **Bed:** The lathe bed forms the base of the machine on which different fixed and operating parts are mounted. Bed absorb vibration and resist the twisting stresses. .The headstock and the tailstocks are located at either end of the bed and the carriage rests over the bed and slides on it. The lathe being main guiding member of the tool. 2. **Headstock:** It supports the main spindle in the bearing and aligns it properly. It also houses necessary transmission mechanism with speed changing levers to obtain different speeds. 3. **Main Spindle:** It is a hollow cylindrical shaft and long slender jobs can pass through it. The morse taper in spindle is used to accommodate lathe centre or collet chuck and threaded portion for chuck or face plate. **4. Tailstock:** It supports the other end of the work when it is being machined between centres.And it holds a tool for performing operations such as drilling, reaming, tapping etc. 5. **Carriage:** The carriage of a lathe has several parts that serve to support, move and control the cutting tool. 6. **Feed mechanism:** The feed mechanism has different units through which motion is transmitted from the headstock spindle to the carriage.	02 02
	(e)	**State any four accessories used on lathe .Explain any one with neat sketch.**	**04**
		Answer: Accessories of lathe:(Any 04-1/2 mark each) 1. Centre 2. Chuck 3. Face plate 4. Angle plate 5. Mandrel 6. Rests 7. Carriers 8. Catch plates 9. Collets	02

The lathe accessories: (Explanation -01 mark Sketch -1 marks)

1. Centres:
   a. There are two types of centres i.e., live centre and dead centre.
   b. A centre which fits into the headstock spindle and revolves with the work is called live centre.
   c. The centre which is used in a tailstock spindle and does not revolve is called dead centre.



(a) Standard centre

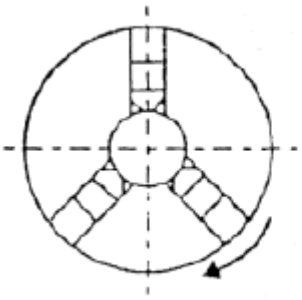


(b) Half centre

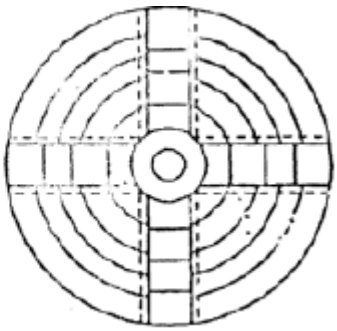
02

2.Chucks:
   a. It is an important device used for holding and rotating the workpiece in lathes.
   b. The work pieces which are too short to be held between centres are clamped in a chuck.
   c. It is attached to the lathe spindle by means of two bolts with the back plate screwed on to the spindle nose.
   d. There are many types of the chuck, but the following two are commonly used.

i. Three jaw universal chuck: The three jaw universal chuck, as shown in Fig. (a) is also called self-centering chuck or scroll chuck. Thus chuck is used for holding round and hexagonal work.



a) Three jaw chuck

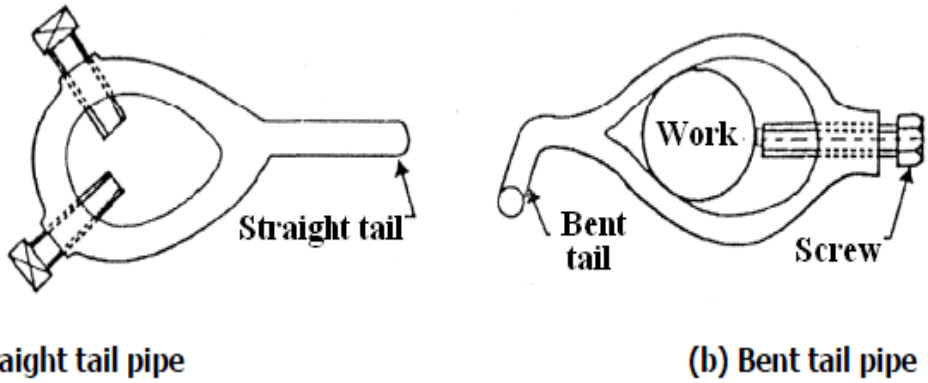


b) Four jaw chuck

ii. Four jaw independent chuck: 1. The four jaw independent chuck, as shown in Fig. (b) has four reversible jaws, each of which may be independently adjusted to accommodate the work it supports. 2. This type of chuck can hold square, round and irregular shape of work in either a concentric or eccentric position.
The other types of the chucks are iii) combination chucks, iv) magnetic chuck, v) collect chuck, vi) drill chuck ,and vii) air or hydraulic chuck

3.Lathe dog or carrier:
   a. The work placed on a mandrel or held between centres is rotated positively by clamping the dog or carrier to the end of the work.
   b. This is engaged with a pin attached to the drive plate or face plate.

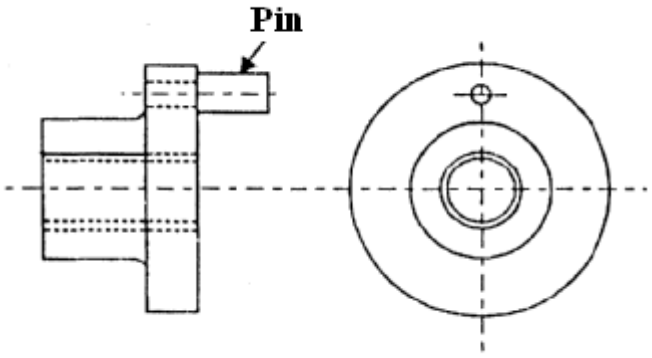
c. The lathe dog or carrier may be of straight type or bent type as shown in Fig. (a) and (b) respectively.



(a) Straight tail pipe (b) Bent tail pipe

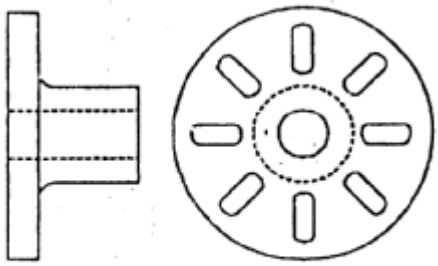
Figure :- Lathe dog

4. Drive plate:
   a. The drive plate, as shown in Fig. is a circular plate which is bored out and threaded so that it can be attached to the spindle nose.
   b. It also carries a hole for the pin which is used only when the work is held in a lathe dog having straight tail. When bent-tail dog is used, this pin is taken out and the bent portion of the tail is inserted into the hole



Drive plate

5. Faceplate:
   a. The face plate, as shown in Fig. is similar to drive plate except that it is larger in diameter.
   b. It contains more open slots or T-slots so that bolts may be used to clamp the workpiece to the face of the plate.
   c. The face plate is used for holding work pieces which cannot be conveniently held in a chuck.



Face plate

6. Mandrels:
   a. The lathe mandrel is a cylindrical bar with centre hole at each end. It is used to hold hollow work pieces to machine their external surface.
   b. The work revolves with the mandrel which is mounted between the centres of the lathe. The various types of mandrels used for different classes of work are shown in Fig.

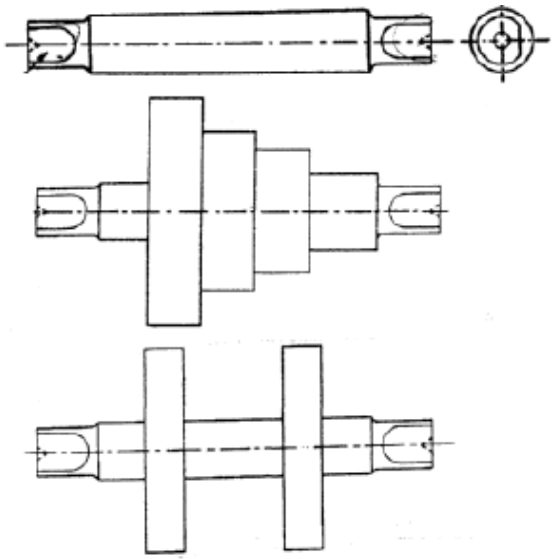
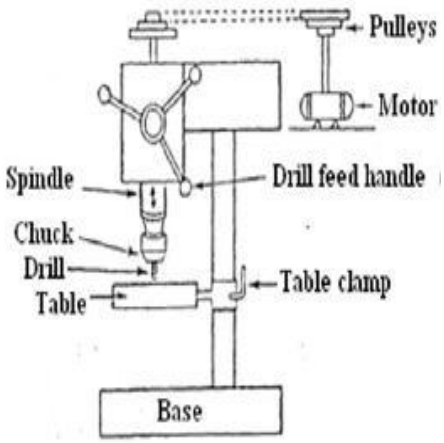


Figure:Plain, step and collar Mandrels

(Note:-Credit should be given to other suitable accessories)

	(f)	**Draw neat sketch of bench drilling machine and name its parts. Write functions of any two parts in brief.**	**04**
		Answer: Bench Drilling machine:(Sketch -02 mark ,Function of two parts -01mark each)	

		 Fig :- Bench Drilling Machine Functions of parts: (Any 02 parts-01 mark each) i. Base: It supports the column, which in turn, support the table and head etc. ii. Spindle: It is made up of alloy steel. It rotate as well as moves up and down in a sleeve iii. Drill chuck: It is held at the end of the drill spindle and in turns it holds the drill bit or tool. iv. Head: it contains the electric motor, V pulley & v-belt which transmit rotary motion to drill spindle at number of speeds. v. Adjustable Table: It is supported on the column of the drilling machine and can be moved vertically and horizontally. It also carries slot for bolt clamping. vi. Column: It is vertical round or box section, which rests on the base and supports the head and the table.	02 02
Q.6		**Attempt any FOUR of the following.**	**16**
	a)	**List any four operations that can be performed on drilling machine. Explain any one with sketch.**	**04**
		Answer: Drilling machine operations (List of operation – 2 marks , explanation with sketch - 2marks) **Operations performed on drilling machine:** (Any 04 - ½ mark each) 1. Drilling 2. Tapping 3. Counter sinking 4. Counter boring 5. Spot facing 6. Boring 7. Reaming **Drilling operation:** It is the operation of producing a cylindrical hole by removing metal by the rotating edge of a cutting tool called the drill. The drill bit is usually a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute.	02 1

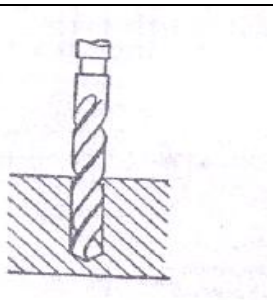


Figure :- Drilling operation

1

Tapping : Tapping is the process by which internal threads are formed. It is performed either by hand or by machine

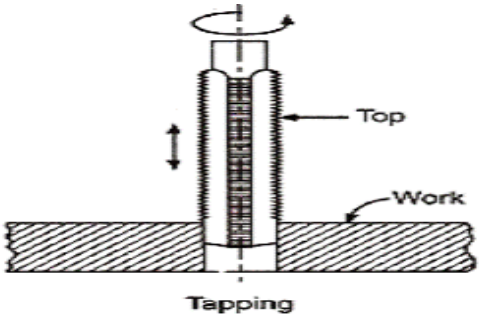
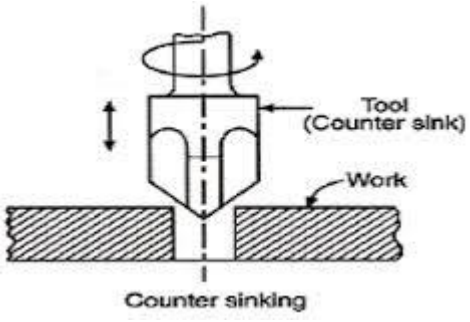
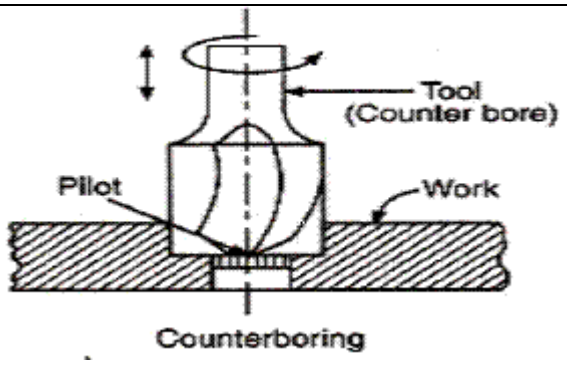


Figure :- Tapping

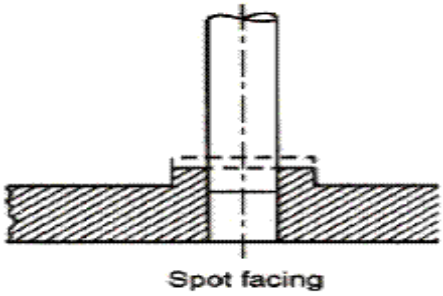
Counter sinking: This is the operation of making a cone shaped enlargement of the end of a hole, as for the recess for a flat head screw. This is done for providing a seat for counter sunk heads of the screws so that the latter may flush with the main surface of the work.



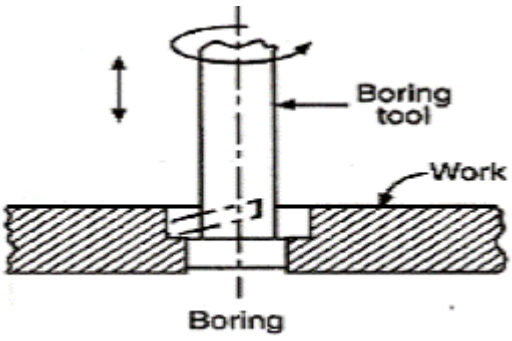
Counter boring: Counter boring is the process of enlarging the entrance of a hole with a counter bore, or other similar tool to a specified diameter and depth. Counter bores (below) provide a square shoulder so that a cap screw or bolt head may sit flush or below a surface.



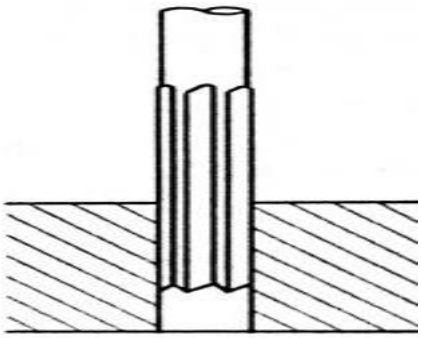
Spot facing: A spot face or spot face is a machined feature in which a certain region of the work piece (a spot) is faced, providing a smooth, flat, accurately located surface.



Boring: Boring is a process of enlarging an existing hole by a single point cutting tool. In machining, boring is the process of enlarging a hole that has already been drilled (or cast), by means of a single-point cutting tool (or of a boring head containing several such tools), for example as in boring a gun barrel or an engine cylinder.



Reaming: Reaming is a process of improving the quality of already drilled holes by means of cutting tools called reamers. Drilling and reaming are performed on a drilling press, although other machine tools can also perform this operation, for instance lathes, milling machines, machining centers.

		 Figure :- Reaming	
	(b)	**Give detailed classification of milling machine.**	**04**
		Answer: **Classification of milling machine:** (Any four -01 mark each) 1. Column and knee type milling machine a. Plain or horizontal milling machine b. Hand milling machine c. Vertical milling machine d. Universal milling machine 2. Manufacturing or fixed bed type milling machine a. Simplex milling machine b. duplex milling machine c. triplex milling machine 3. Planer type milling machine 4. Special purpose milling machine a. Cam milling machine b. Planetary milling machine c. Profile milling machine d. Drum milling machine e. Duplicating milling machine	04
	(c)	**Draw neat sketch of column and knee type milling machine and explain function of any two parts in brief.**	**04**
		Answer: **Column and knee type milling machine:** (sketch -2 marks and function- 2 marks) **Function of parts:(**Any 02- 01 mark each) 1. Base: It is a heavy casting on which column and other parts are mounted. It may be bolted to floor strongly. 2. Column: there are guide ways on the front face of the column, on which the knee slides. It houses power transmission units such as gears, belt drives and pulleys to give rotary motion to the arbor. The drive mechanisms are also	02

used to give automatic feed to the handle and table.

3. Knee: It supports the saddle, table, work piece and other clamping devices. It moves on the guide ways of column. It resists the deflection caused by the cutting forces on the work piece.
4. Saddle: It is mounted on the knee and can be moved by hand wheel or by power. The direction of travel of the saddle is restricted towards or away from the column face.
5. Table: It is mounted on the saddle and can be moved by a hand wheel or by power. Its top surface is machined accurately to hold the work piece and other holding devices. It moves perpendicular to the direction of saddle movement.
6. Arbor: Its one end is attached to the column and the other end is supported by an over arm. It holds and drives different types of milling cutters.
7. Spindle: It gets power from the gears, belt drives, to drive the motor. It has provision to add or remove milling cutters on to the arbor.

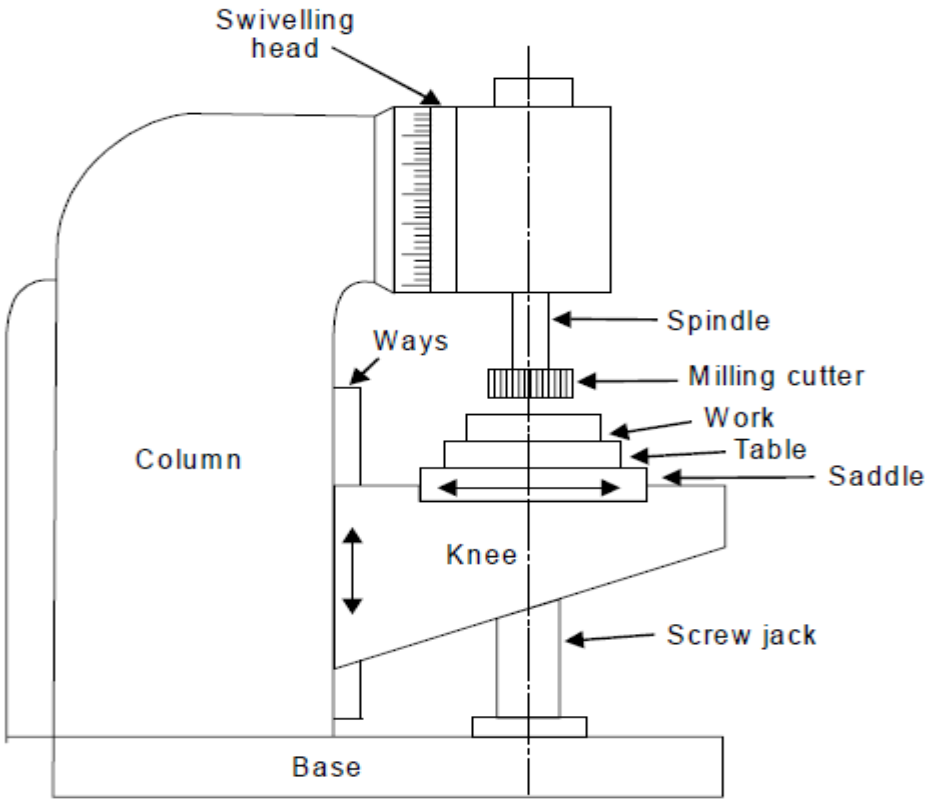
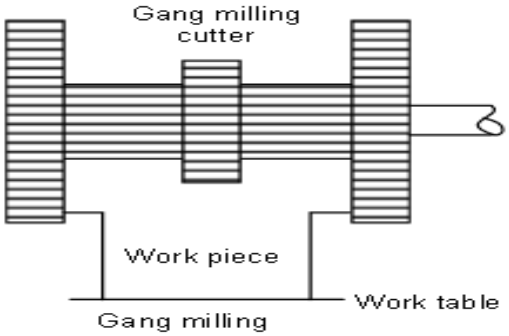
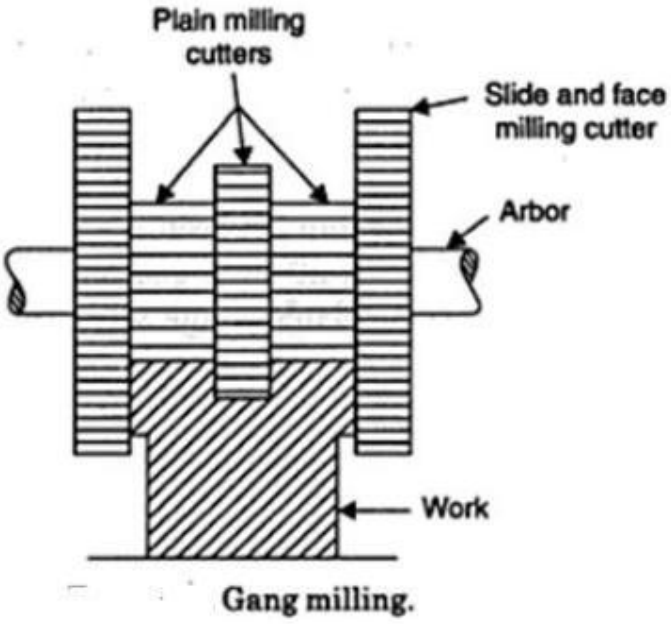


Figure: Column and Knee type milling machine.

01

01

	d)	**What is gang milling? Explain with neat sketch.**	**04**
		Answer: Gang milling operation: (description 2 mark, sketch 2 mark) It involves the use of a combination of more than two cutters, mounted on a common arbor, for milling a number of flat horizontal and vertical surfaces of a work piece simultaneously. This method saves much of machining time and is widely used in	02

		repetitive work. The cutting speed of a gang of cutters is calculated from the cutter of the largest diameter.  **Gang Milling Operation** **OR**  **Gang milling.**	02
	(e)	**State any four types of milling cutters. Explain any one with simple sketch.**	**04**
		Ans: **Types of milling cutter**:(Any 04-1/2 mark each) 1) Plain milling cutter a) Light duty b) Heavy duty c) Helical 2) Side milling cutter a)Plain b) Staggered teeth c) Half d) Interlocking 3) Metal slitting saw a) Plain b)Staggered teeth 4) Angle milling cutter a) Single b) Double 5) End milling cutter	02

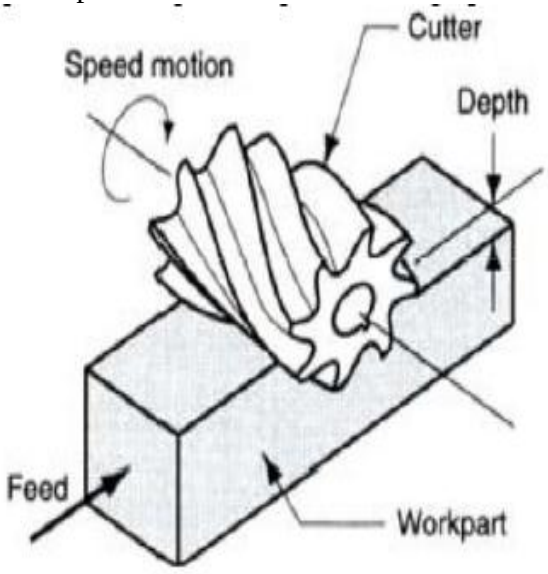
a) Taper shank b)Straight shank c)Shell

6) T-slot milling cutter
7) Woodruff key slot milling cutter
8) Fly cutter
9) Formed cutter
   a) Convex b)concave c)corner rounding d) gear cutter e) thread milling cutter
10) Tap & reamer cutter
11) Face milling cutter

Explanation of milling cutter (Any one –Sketch 01 mark , Explination -01 mark)

Plain milling cutter:

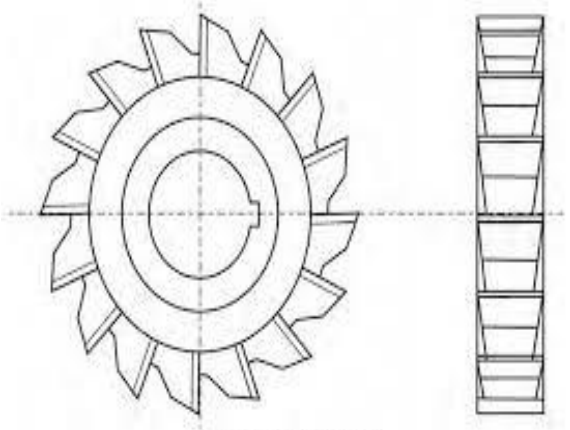
It has straight or helical teeth cut on the periphery of disc or a cylindrical surface.it may be of solid inserted blade or tipped type, and is usually profile sharpened but may be form relieved also. Generally helical teeth are used if the width of the cutter exceeds 15 mm.it is used for milling flat surfaces parallel to cutter axis. 01



Peripheral or Plain milling 01

Side milling cutter:

This cutter is similar to plain cutter except that it has teeth on the side. However, the side milling cutter may have teeth on the periphery and on one or both sides of the tool. These cutters may have straight, spiral or staggered teeth.



Side Milling Cutter

Metal slitting saw cutter:

These cutters resemble a plain to side cutter except that these are made very thin. These are usually profile sharpened and may be either solid or tipped. These are used for cutting off and slotting operations and somewhat similar to the circular saw blades.

Figure :- Metal slitting saw

Angle milling cutter:

Any cuter, angle shaped, comes under this classification. These may have cutters either on only one conical surface(single angle cutter)or on two conical surfaces (double angle cutter).Angle cutters are used for cutting ratchet wheel, dovetails, flute on milling cutters and reamers and Vs of 30^0 45^0 60^0 90^0

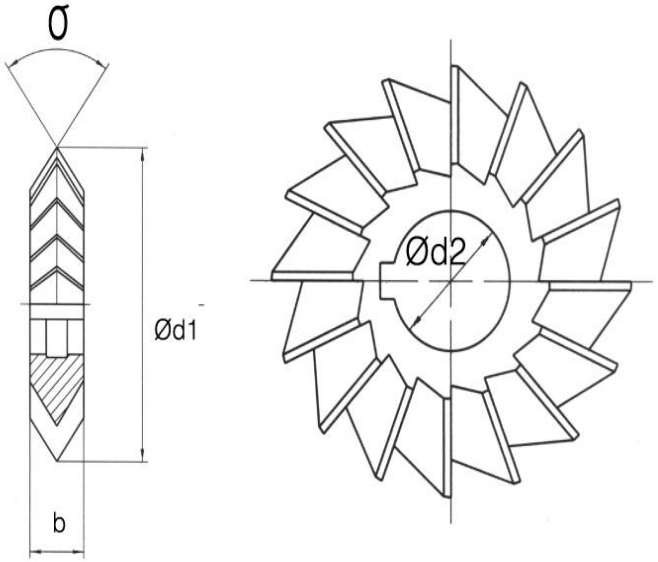
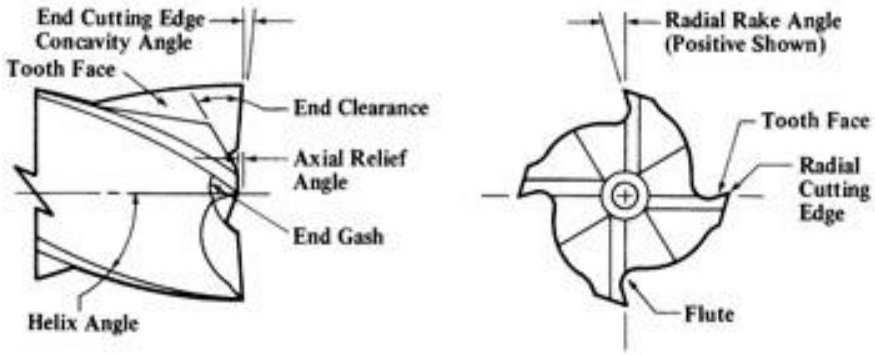


Figure :- Angle milling cutter

End milling cutter:
These cutters have an integral shaft for driving and have teeth on both periphery and ends. These are the cutters with teeth on the periphery and end integral with a shank for holding and driving. These are used to mill flat, horizontal, vertical, bevel, chamfer, grooves etc.



Enlarged Section of End Mill

T-slot milling cutter:
These are used for milling T-slot in one operation and are available in special sizes for standard T-slots. These resemble plain or side milling cutters which have an integral straight or tapered shaft for driving.

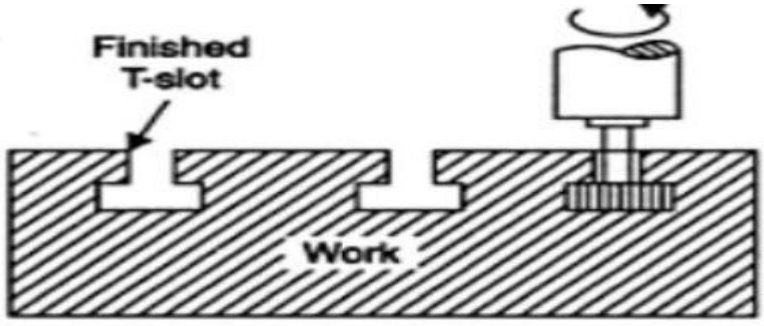


Figure :- T-Slot milling cutter

Form cutter:
These cutters are sharpened on the face of the tooth, thus preserving the original profile. These are, therefore, very suitable for complicated shapes as they can be sharpened again and again easily until the teeth are too slender to be used.

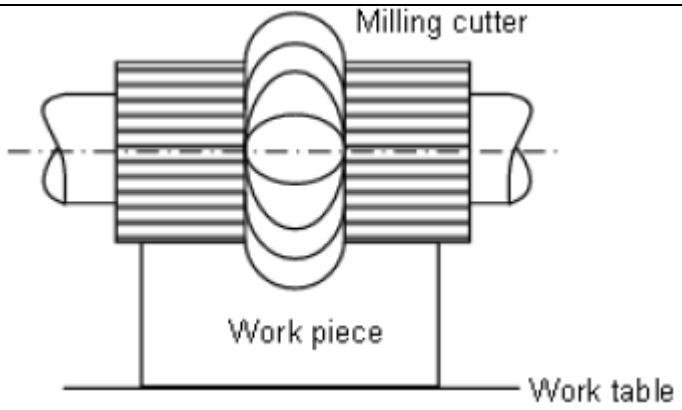


Figure :-Form milling cutter

Face milling cutter:

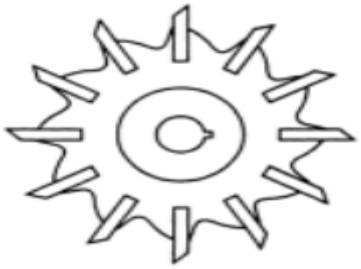


Figure: Face milling cutter.

It is used for milling flat surface using teeth on its face. The cutter may be mounted on arbor or rigidly clamped on the nose of the machine spindle Face milling cutter of shell – end –mill type is as shown in fig. It has teeth on both face and periphery .It is a general purpose facing tool. For facing bigger surfaces ,inserted tooth facing cutter is employed which has cutting edge made of superior cutting tool material and inserted in the steel shank .These teeth project a little outside the body so that cutter end has cutting edges .These cutter has tapered shank and it is mounted directly on to the spindle.

(Note: Any other equivalent figures shall be considered)

	(f)	**Suggest appropriate milling cutter for following operations:** **i. Gear tooth** **ii. Cutting of narrow slot & grove** **iii. T-slot** **iv. Key seat sunk key.**	**04**
		Ans: i. Gear tooth: Form milling cutter, Gear cutter ii. Cutting of narrow slot & grove: Saw milling cutter, Angle milling cutter, End milling cutter iii. T-slot: T-slot milling cutter iv. Key seat sunk key: Woodruff key slot milling cutter, End mill cutter, Key way cutter.	04