MODEL ANSWER

SUMMER– 18 EXAMINATION

Subject Title: Materials and Manufacturing Processes Subject Code: 17306

Important Instructions to examiners:

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

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any TEN of the following.**	**20**
	(a)	**Define elasticity and malleability of materials.**	**02**
	Ans	**Elasticity:** It is the property of material due to which the material regains it's original size and shape after removal of external force. **Malleability:** It is the property of metal due to which the metal can be formed into thin sheet under the action of compressive force.	**01** **01**
	(b)	**Name any two corrosive metals which are added in any metals.**	**02**
	Ans	Name of anti corrosive metals which are added in metals: i) Chromium ii) Molybdenum iii) Titanium iv) Zinc and v) Magnesium *(if student is attempted to solve give appropriate marks)*	**02**
	(c)	**State the meaning of 35 Mn 6 Mo 3.**	**02**
	Ans	Meaning of 35 Mn 6 Mo 3: The steel is designated as per IS:1762-1974 as 35 Mn 6 Mo 3, which means steel consists of 35% carbon, 1.5 % Manganese and 0.3 % Molybdenum.	**02**
	(d)	**What are the types of cutting tools? Give two examples of each.**	**02**
	Ans	(Types -1 mark and examples 1 mark) i) Single point cutting tool – tools employed on lathes, boring machines, shaper, planer etc. ii) Multi-point cutting tool – twist drill, tap, reamer, milling cutter, broach, end	**02**

		mill cutters etc.	
	(e)	**State the purpose of normalizing.**	**02**
	Ans	**Purpose of Normalising process: (Any Four) (½ mark each)** i. Normalizing raises the yield point, ultimate tensile strength and impact strength values of steel. ii. To eliminate coarse-grained structure. iii. To remove internal stresses that may have been caused by previous working processes iv. To improve the mechanical & electrical properties of the steel. v. To increase the strength of medium carbon steels to a certain extent (in comparison with annealed steels) vi. To improve the machinability of low carbon steels	**02**
	(f)	**Give the four applications of ABS.**	**02**
	Ans	(*Any 4- ½ marks for each)* 1) Drain-waste-vent pipe systems. 2) Musical instruments. 3) Golf club heads. 4) Automotive trimmed components. 5) Automotive bumper bars.	**02**
	(g)	**Define the term casting.**	
	Ans	**Casting** means pouring molten metal poured into a refractory mold cavity and allows it to solidify. The solidified object is taken out from the mold either by breaking or taking the mold apart. The solidified object is called casting. The technique followed in method is known as casting process.	**02**
	(h)	**What are the different types of foundaries?**	**02**
	Ans	Types of foundries: *(any 04 – ½ mark each)* 1. Jobbing foundry 2. Production foundry 3. Semi-production foundry 4. Captive foundry 5. Ferrous foundries 6. Non-ferrous foundries	**02**
	(i)	**Write any four types of drilling machine.**	**02**
	Ans	(Any 4- ½ Mark each)	**02**

		1) Portable drilling machine **2)** Bench drilling machine **3)** Sensitive drilling machine **4)** Upright or column drilling machine. **5)** Radial drilling machine. **6)** Gang drilling machine **7)** Multi-spindle drilling machine **8)** Vertical drilling machine **9)** Automatic drilling machine **10)** Deep hole drilling machine	
	(j)	**List the different polymeric materials.**	**02**
	Ans	*(Any four materials=½ mark each)* **Two types of polymeric materials are :** **A) Thermo plastic and B) Thermosetting plastic** A) Thermoplastics are- 1. Polythene 2. Polypropylene 3. Polystyrene 4. Nylon 5. Acrylics 6. Polycarbonates 7. Acrylonitrile butadiene styrene 8. Polyvinylchloride B) Thermosetting plastic: Plastics using thermosetting resins (i) Phenol-formaldehyde resins (ii) Urea-formaldehyde resins (iii) Melamine-formaldehyde resins (iv) Polyester resins (v) Epoxy resins (vi) Silicone resins	**02**
	(k)	**List the various operations performed on lathe machine**	
	Ans	Operations performed on lathe machine (any 4 – ½ marks for each) 1. Facing, 2. Plain turning,	

		3. Step turning, 4. Taper turning, 5. Drilling, 6. Reaming, 7. Boring, 8. Undercutting, 9. Threading, 10. Knurling.	
	(l)	**State the classification of milling machine.**	**02**
	Ans	Classification of milling machine:*(Any 04 – 1/2 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	**02**
2		**Attempt any <u>FOUR</u> of the following.**	**16**
	a)	**Name the various alloys of copper and comment on their importance in industry.**	**04**
	Ans	Alloys of Copper *(Any 2 of the followings - ½ mark each)* 1) Brass (Copper –zinc) a) α-brass: Cap copper ,Gliding metal , Cartridge brass, Admiralty brass b)α-β brass: Muntz metal ,Naval brass , High tensile brass, Leaded brass, Brazing brass 2) Bronze: Phosphor bronze ,Aluminum bronze , silicon bronze ,Tin bronze, Manganese bronze 3) Gun metal 4) Babbitt metal (Copper-tin –Antimony) Importance of Copper Alloys: *(Any three 01 mark each)* 1) Due to High thermal & Electrical conductivity is important material for making electrical conductors and wires.	

		2) Due to Good Corrosion resistance it can be used in ammunition. 3) Due to it's properties like High strength, Good Malleability, Good Ductility , and Pleasing reddish colour it is used for making machine parts, utensils, parts of chemical plants, etc. 8) Due to copper being Easy to cast ,forged, rolled, Soft & Nonmagnetic it find wide application for making parts of complex shape. 9) Due to its Wear resistance, Good fatigue resistance, Light in weight it is used as bearing matal.	
	b)	**What is thermosetting plastics? List the various four non-metals used in industry with their applications.**	**04**
	Ans	**Thermosetting plastics:** Those plastics which are hardened by heat, effecting a non-reversible chemical change, are called thermo-setting. These have three dimensional networks of molecules and will not soften when heated and thereby it can not be reused again. Alternatively these plastics materials acquire a permanent shape when heated and pressed and thus cannot be easily softened by reheating. **Four non-metals used in industry with their applications:** 1) Wood- for body of vehicle, pattern material, packing boxes etc. 2) Glass – wind or front screen of automobile, window panes, mirrors etc. 3) Plastic- body parts of automobile, body of various appliances, packing material etc. 4) Plaster of Paris:- pattern material, interior decoration etc 5) Asbestos- heat and electrical insulation material .	**02**
	c)	**What is heat treatment? What is the purpose of heat treatments on steel?**	**04**
	Ans	**Heat Treatment: (2 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. **Purpose of Heat Treatment: (Any four - 1/2 Marks each)** i. To improve machinability ii. To improve mechanical properties e.g. tensile strength, ductility, hardness, shock resistance, resistance to corrosion etc. iii. To relieve internal stresses induced during hot or cold working. iv. To change or refine grain size. v. To improve magnetic and electrical properties. vi. To improve heat resistance, wear resistance. vii. To improve weldability.	**02** **02**
	d)	**Explain with neat sketch hot chamber die casting.**	**04**

Ans

Hot chamber die casting (Sketch 02 mark, Explanation 2 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.

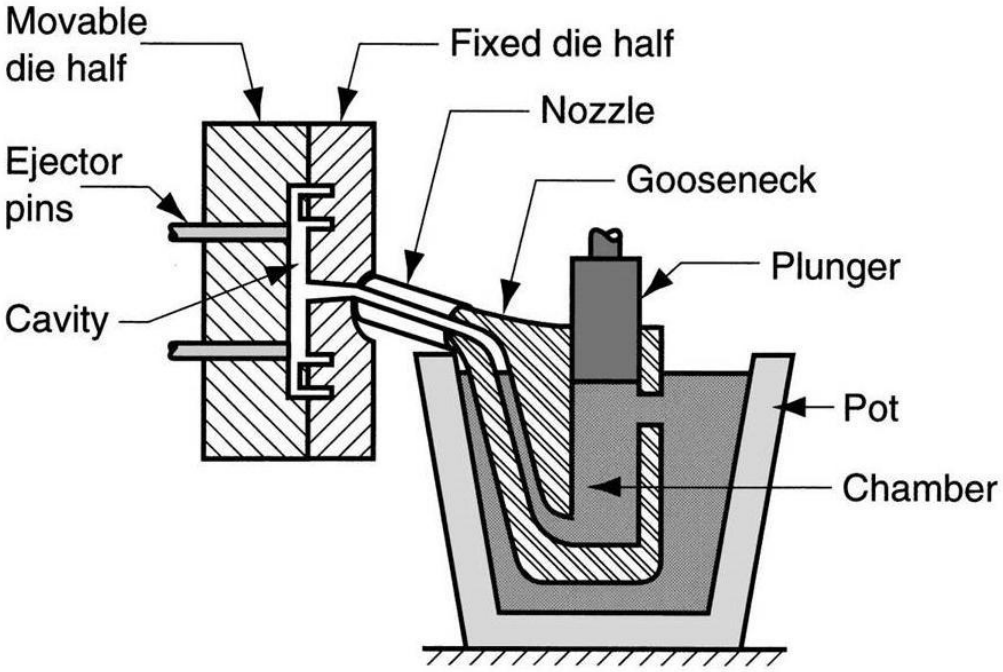
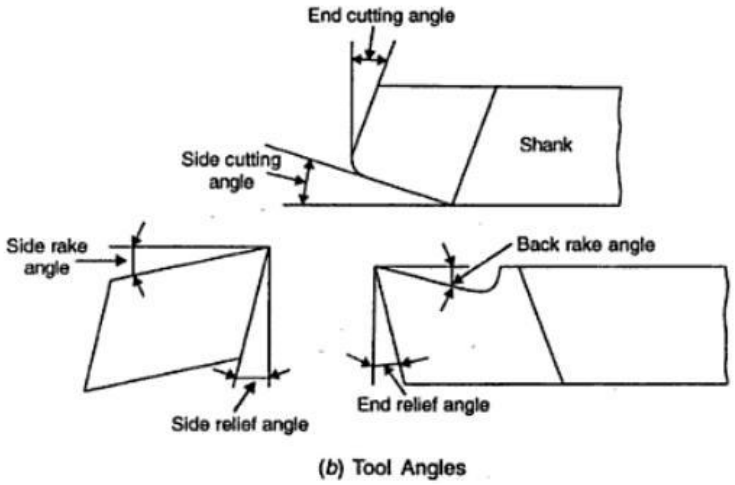
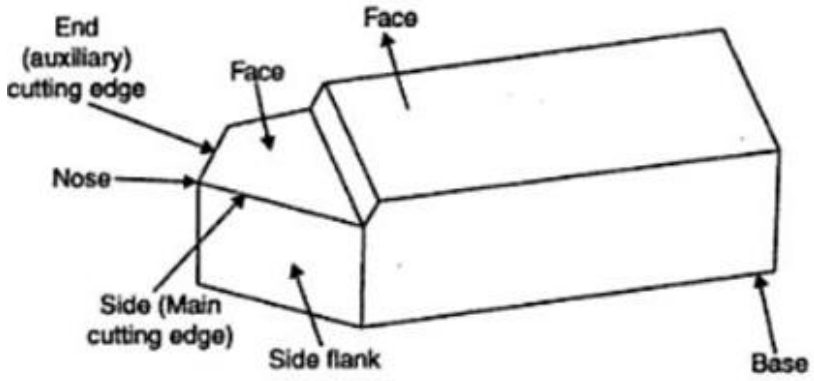
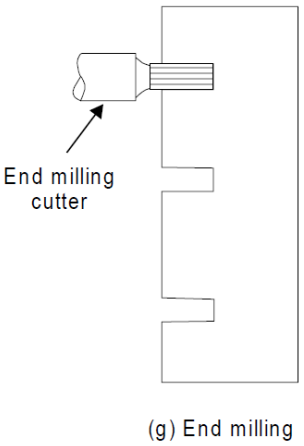
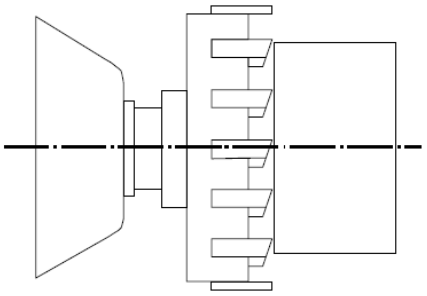
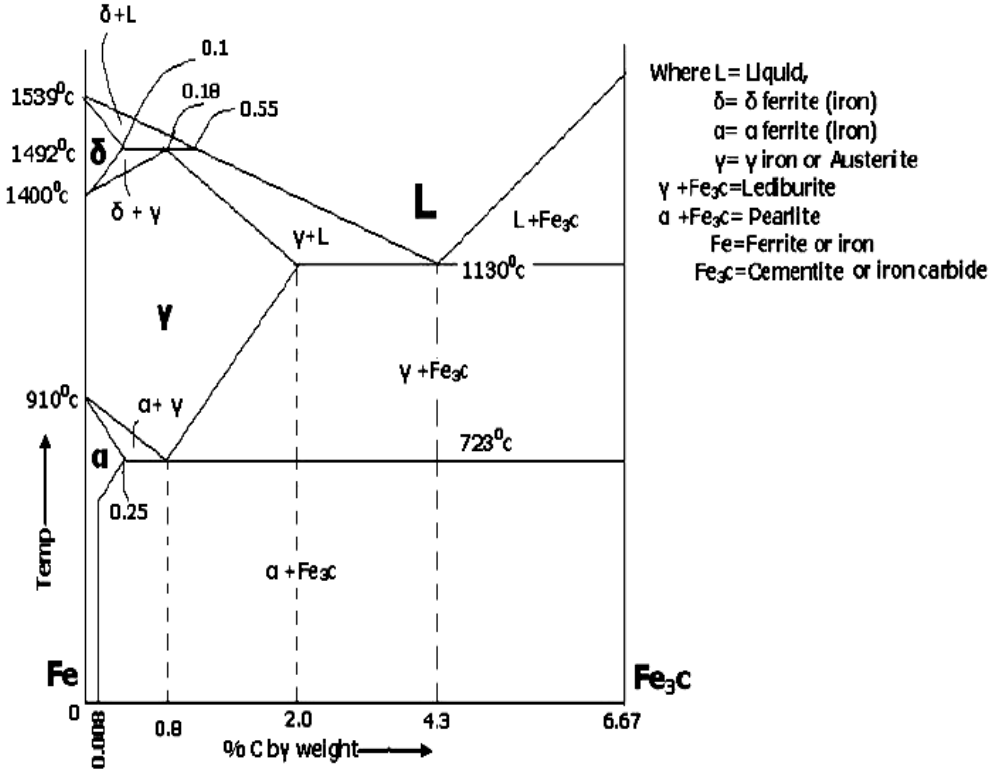


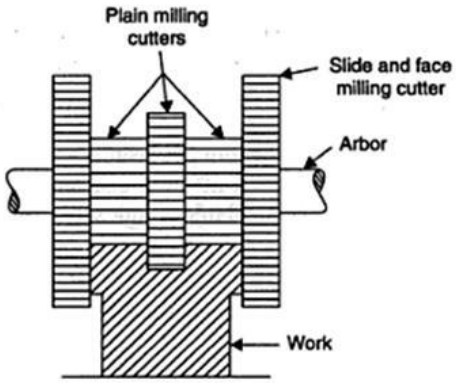
Figure: Hot chamber die casting

	e)	**With neat sketch, show the single point cutting tool nomenclature.**	**04**
	Ans	*(Sketch 2 marks, labeling of parts and angles-2 marks)* **Nomenclature of single point cutting tool;**  (*b*) Tool Angles Figure: Single point cutting tool nomenclature. OR  	
	(f)	**Differentiate between end milling and face milling with neat sketch.**	**04**
	Ans		

Sr. no		**End milling**	**Face milling**
1	Purpose	It is operation for making slot, groove or cut profile.	It is operation for machining flat surface.
2	Tool	End mill cutter	Face milling cutter
3	Direction of	Axis of cutter may be parallel, perpendicular or inclined to the table	Axis of cutter is perpendicular to surface being machined.

				axis	surface.	
			4	Figure	 (g) End milling	 (b) Face milling
			5	Tool life	Life is short.	Life is long.
			6	Cutter size	Cutter diameter is less than work width.	Cutter diameter is more than work width.
3.		**Attempt any FOUR of the following.**				**16**
	a)	**State compositions & properties of tool steels.**				**04**
		Answer: Composition of tool steel: *(Any one composition – 2 marks)* 1) 18-4-1 High Speed Steels : - It Contains 18 % Tungsten, 4 % Chromium, 1 % Vanadium With 0.75 % Carbon & Remaining Iron 2) Cobalt High Speed Steels : - Cobalt is added from 5 to 8 % to increases hot hardness & wear resistance than 18-4-1 HSS. Generally it Contains 20 % Tungsten, 4 % Chromium, 2 % Vanadium, 12 % Cobalt With 0.80 % Carbon & Remaining Iron 3) Vanadium High Speed Steels : - It contains 0.70 % Carbon & More Than 1 % Vanadium & Remaining Iron 4) Molybdenum High Speed Steels : - It contains 6 % Molybdenum, 6 % Tungsten, 4 % Chromium, 2 % Vanadium, 0.85 % Carbon & Remaining Iron **Properties of tool steel material:** *(Any four – 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				**02** **02**

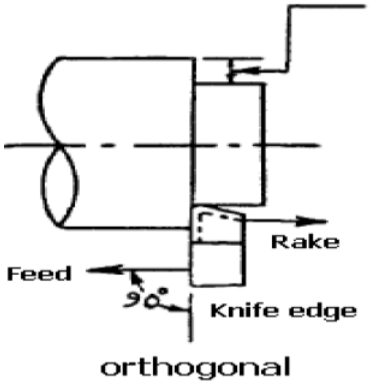
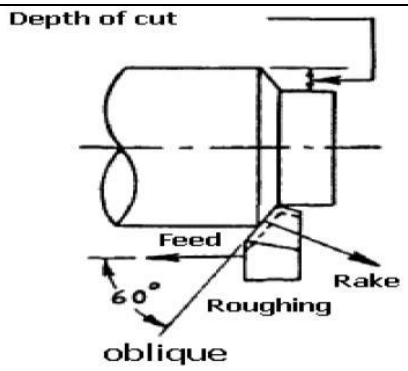
		9. Definite cooling rate during hardening	
	b)	**Draw the iron carbon equilibrium diagram showing various phases and critical temperatures**	**04**
	Ans		**04**
	c)	**Explain with suitable sketch Gang milling operation**	**04**
	Ans	**Answer:** ***(Explanation – 2 marks)*** **Gang milling operation:** 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 repetitive work. The cutting speed of a gang of cutters is calculated from the cutter of the largest diameter.	**02**

		 Gang milling.	**2**
	d)	**State the different properties required in moulding sand.**	**04**
	Ans	Properties of moulding sand: *(Any 04-01 mark each)* **1. Porosity/Permeability:** It is the property of the sand which allows the gases or steam to escape through the sand mould. **2. Flowability:** 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 cling 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.	**04**
	e)	**Write the procedure of heat treatment used for gears**	**04**
	Ans	**(Any two processes-4 marks)** Gear teeth are subjected to severe stresses when in use. Thus they must possess high strength to withstand large torques combined with very high wear resistance to protect them from wearing away in service. Fundamentally the heat treating process consists of changing the micro structure. There are following methods of heat treatment for gears.	

		1. Carburizing- Carburizing is the case hardening process to obtain hard wear resistant and shock resistant case /surface and tough core inside, by introducing carbon on the steel surface by heating it in contact with solid, liquid, gaseous carbon containing substances to a temperature of 870-925ºC for several hours by absorption and diffusion. The high carbon steel surface is hardened by quenching from above the lower critical temperature. **2. Induction hardening -** The process of the surface hardening by inductive heating is known as induction hardening. A high frequency current is passed through the inductor blocks which surround the gear to be hardened without actually touching it. The inductor block current induces current in the surface of the metal which the block surrounds. The induced eddy current and hysteresis losses in surface material effect the heat required. When the surface, to be hardened, is heated upto a proper length of time, the circuit is opened and water is sprayed immediately on the surface for quenching. **3. Flame hardening-**The surface to be case hardened is heated by means of an oxyacetylene torch for sufficient time and Quenching is achieved by sprays of water which are integrally connected with the heating device. The heating is generally accomplished for sufficient time so as to raise the temperature of the surface of the specimen above the critical temperature. As the temperature desired is achieved immediately, spraying of water is started. In mass production work, progressive surface hardening is carried out where it is arranged to have the flame in progress along with quenching.	**04**
	f)	**What is a composite material? state its properties**	**04**
	Ans	A composite material is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components. **OR** The materials produced by combining two or more materials are known as	**02**

		composites. Examples: Vinyl coated steels, steel reinforced concrete, fiber reinforced plastics, carbon Reinforced rubber, Glass fibres or resins, Carbon fiber reinforced plastics etc. Properties:- (Any two properties – 1 mark each) 1. They possess lesser density, 2. good strength, 3. fatigue resistance 4. Impact resistance 5. High corrosion resistance. 6. They can be fabricated easily & in number of ways.	**02**
04		**Attempt any FOUR of the following:**	**16**
	a)	**State the advantages and disadvantages of centrifugal casting.**	**04**
	Ans	**Answer:-** *(Any two advantages and disadvantages – 1 mark each)* **Advantages of centrifugal casting-** 1. Castings acquire high density, high mechanical strength and fine grained structure 2. Inclusions and impurities are lighter 3. Gates and risers are not needed 4. High output 5. Formation of hollow interiors without cores 6. Directional solidification. **Disadvantages of centrifugal casting:_** 1. Only several shapes can be generated through this casting. 2. Trained labours are required for this method 3. An inaccurate diameter of the inner surface of the casting. 4. Not all alloys can be cast in this way. 5. High investment	**02** **02**
	b)	**Differentiate between orthogonal and oblique cutting. .**	**04**
	Ans	**Answer:** (any 4 differences – 01 mark each)	**04**

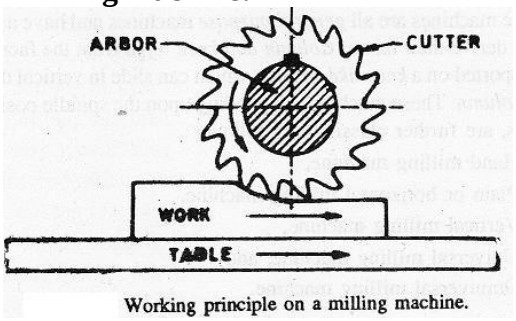
Sr. no	**Orthogonal Cutting**	**Oblique Cutting**
01	The cutting edge of the tool is perpendicular to the cutting velocity factor	The cutting edge is inclined at an angle‟ with the normal to the cutting velocity factor
02	The cutting edge clears the width of the work piece on either ends.	The cutting edge may not clear the width of the work piece on either ends.

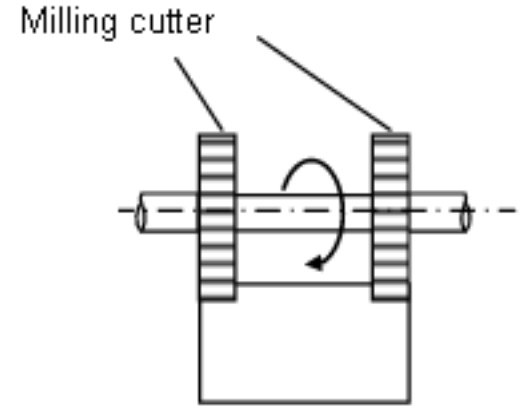
		03	The chip flows over the tool face.	The chip flows on the tool face.	
		04	Only two components of the cutting forces are acting on the tool.	Only three components of the cutting forces are acting on the tool.	
		05	Tool is perfectly sharp.	Tool is not perfectly sharp.	
		06	Tool contacts the chip on rake face only.	The toll may not generate a surface parallel to workface.	
		07	The maximum chip thickness occurs at the middle.	The maximum chip thickness may not occur at the middle.	
		08	Only one cutting edge in action.	More than one cutting edges are in action	
		09	 orthogonal	 oblique	
	c)	**State the common defects in casting. State their causes and remedies of any one of them.**			**04**
	Ans	**Answer:** Listing of common casting defects are as below:(Any four ½ mark each) 1. Blow Holes 2. Porosity 3. Shrinkage 4. Misruns and cold shuts 5. Inclusions 6. Hot Tears 7. Cuts and Washes 8. Metal Penetration 9. Drop 10. Fusion 11. Shot metal 12. Shift 13. Rat Tails or Buckles 14. Swells 15. Hard Spots 16. Run outs 17. Crushes 18. Warpages			**02** **02**

		(One Casting Defect, it's causes & it's remedies= 01 Mark each.) **1. Shifts :** This is an external defect in a casting. **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. **2. Warpage :** Warpage is unintentional and undesirable deformation in a casting that occurs during or after solidification. **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:** A swell is an enlargement of the mould cavity by metal pressure, resulting in localized or overall enlargement of the casting. **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:** Blow holes are smooth, round holes appearing in the form of a cluster of a large number of small holes below the surface of a casting. These are entrapped bubbles of gases with smooth walls. **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:** A drop occurs when the upper surface of the mould cracks, and pieces of sand fail into the molten metal. **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:** The above factors are eliminated to avoid drop.	
	d)	**Explain the green sand moulding process used for making mould.**	**04**

	Ans	**Answer:** It's a six step procedure to make a green sand mould. 1. Moulding-Use a pre-existing pattern to create a sand mould. 2. Gating system-Add your gating system (to control the liquid metal). 3. Clamping-Clamp the mould halves together. 4. Pouring-Pour in the metal. 5. Cooling-Allow the molten metal to cool off. 6. Removal & Trimming-Take out the casting from the mould and remove excess material. ***Mold-making*** **-** The first step in the sand casting process is to create the mold for the casting. In an expendable mold process, this step must be performed for each casting. A sand mold is formed by packing sand into each half of the mold. The sand is packed around the pattern, which is a replica of the external shape of the casting. When the pattern is removed, the cavity that will form the casting remains. Any internal features of the casting that cannot be formed by the pattern are formed by separate cores which are made of sand prior to the formation of the mold. The mold-making time includes positioning the pattern, packing the sand, and removing the pattern. The mold-making time is affected by the size of the part, the number of cores, and the type of sand mold. **Gating system-**The term gating system refers to all passageways through which the molten metal passes to enter the mold cavity. The main function of gating system is to provide continuous, uniform feed of molten metal, with as little turbulence as possible to the mould cavity. The gating system is composed of 1) Runner 2) Pouring cups and basins 3) Sprue 4) Gates 5) Risers **Clamping -** Once the mold has been made, it must be prepared for the molten metal to be poured. The surface of the mold cavity is first lubricated to facilitate the removal of the casting. Then, the cores are positioned and the mold halves are closed and securely clamped together. It is essential that the mold halves remain securely closed to prevent the loss of any material. **Pouring -** The molten metal is maintained at a set temperature in a furnace. After the mold has been clamped, the molten metal can be ladled from its holding container in the furnace and poured into the mold. The pouring can be performed	**04**

		manually or by an automated machine. Enough molten metal must be poured to fill the entire cavity and all channels in the mold. The filling time is very short in order to prevent early solidification of any one part of the metal. **Cooling -** The molten metal that is poured into the mold will begin to cool and solidify once it enters the cavity. When the entire cavity is filled and the molten metal solidifies, the final shape of the casting is formed. The mold can not be opened until the cooling time has elapsed. The desired cooling time can be estimated based upon the wall thickness of the casting and the temperature of the metal. Most of the possible defects that can occur are a result of the solidification process. If some of the molten metal cools too quickly, the part may exhibit shrinkage, cracks, or incomplete sections. **Removal -** After the predetermined solidification time has passed, the sand mold can simply be broken, and the casting removed. This step, sometimes called shakeout, is typically performed by a vibrating machine that shakes the sand and casting out of the flask. Once removed, the casting will likely have some sand and oxide layers adhered to the surface. Shot blasting is sometimes used to remove any remaining sand, especially from internal surfaces, and reduce the surface roughness. **Trimming -** During cooling, the material from the channels in the mold solidifies attached to the part. This excess material must be trimmed from the casting either manually via cutting or sawing, or using a trimming press. The time required to trim the excess material can be estimated from the size of the casting's envelope. A larger casting will require a longer trimming time. The scrap material that results from this trimming is either discarded or reused in the sand casting process. However, the scrap material may need to be reconditioned to the proper chemical composition before it can be combined with non-recycled metal and reused.	
	e)	**Write the standard accepted colour codes used for pattern**	**04**
	Ans	**Answer:** Standard accepted colour coding used for pattern: *(Any 04-01 mark each)* The colour codes are given for identification of the parts of patterns and core boxes. 1. Surface to be left unfinished are to be painted black 2. Surface to be finished is painted by red colour. 3. Seats for loose pieces are marked by red strips on yellow background 4. Core prints are painted by yellow colour. 5. Stop-offs is marked by diagonal black strips on yellow background.	**04**
	f)	**What are different pattern materials? State any four factors for the selection of pattern materials**	04

	Ans	**Answer:** (*any 4 types – ½ mark each, any 4 factors – ½ mark each)* Various Materials used for making Patterns: (Any four) The wide variety of pattern materials in use may be classified as wood and wood products; metals and alloys; plasters; plastics and rubbers; and waxes. **i.** Wood: wood used are teak, sal, shisam, pine and deodar. **ii.** Metal: Commonly metals used for patterns are cast iron, brass, aluminium alloy, magnesium alloy and white metal. **iii. Plastic** **iv.** Waxes: The waxes used are paraffin, shellac, bees wax and ceresin wax. **v. Rubber** **vi.** plaster of Paris / Gypsum cement **Factors governs the selection of pattern material:** The selection of pattern material depends on following factors: i. design of casting ii. quality of casting iii. shape (intricacy) of casting iv. types of moulding process v. types of production of castings vi. moulding material to be used vii. possibility of design changes viii. Possibility of repeat orders. ix. Casting design parameters x. Number of castings to be produced xi. Shape ,complexity & size of casting xii. Type of moulding materials xiii. service requirements, e.g. quantity, quality and intricacy of castings, minimum thickness desired, degree of accuracy and finish required	**02** **02**
5		**Attempt any FOUR of the following:**	16
	a)	**What is the working principle of milling machine? Explain with neat sketch.**	**04**
	Ans	**Working principle 2 mark, fig 2 mark** **Working principle of milling machine:-**  Working principle on a milling machine. Milling is a metal removal process by means of using a rotating cutter having one or more cutting teeth as illustrated in figure Cutting action is carried out by feeding the work piece against the rotating cutter. Thus, the spindle speed, the table feed, the depth of cut, and the rotating direction of the cutter become the main parameters of the process. Good results can only be achieved with well balanced settings of these parameters.	02

		In this work is rigidly clamped on the table of the machine or between centers, and revolving multi teeth cutter mounted either on spindle or on arbor. The cutter revolves at high speed and the work fed slowly past the cutter. The work can be fed vertical, longitudinal or cross direction. As the work advances, the cutter-teeth remove the metal from the work surface to produce desired shape.	02
	b)	**Explain with neat sketch the straddle milling operation.**	**04**
	Ans	**Straddle Milling Operation:** This is similar to the side milling operation. Two side milling cutters are mounted on the same arbor. Distance between them is so adjusted that both sides of the workpiece can be milled simultaneously. Hexagonal bolt can be produced by this operation by rotating the workpiece only two times as this operation produces two parallel faces of bolt simultaneously.  Straddle Milling	02 02
	c)	**What are the different allowances provided on pattern?**	**04**
	Ans	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. ➢ It is also called as contraction allowance ➢ When liquid metal starts to cool shrinkage is possible ➢ Gets shrink & reduces size of the component ➢ To reduce above problem, allowance are provided on the pattern ➢ Patterns are made larger than actual size ➢ Different metal have different shrinkage ➢ It has three forms : ➢ Liquid Contraction ➢ Solidifying Contraction ➢ Solid Contraction ➢ First two are reduced by gets & risers ➢ Solid contraction can be reduced by providing more allowance on pattern	

- Following points causes shrinkage :
- Pouring Temperature Of Molten Metal Is Low
- Type Of Mould Materials
- Design & Dimensions Of Castings
- Type Of Molten Metal

2) Draft allowance provided on pattern:

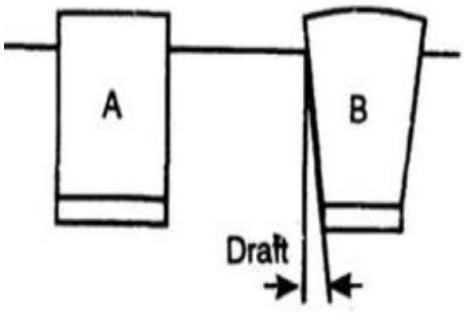
When a pattern is drawn from a mould, there is always some possibility of injuring the edges of the mould. This danger is greatly decreased if the vertical surfaces of a pattern are tapered-inward slightly.
This slight taper inward on the vertical surfaces of a pattern is known as the draft. Draft may be expressed in millimeter per meter on a side, or in degrees, and the amount needed in each case depends upon
1) length of the vertical side
2) Intricacy of the pattern, and
3) The method of moulding.

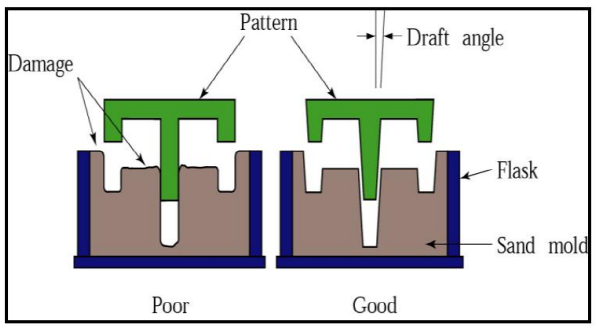
3) Machining allowance:

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.

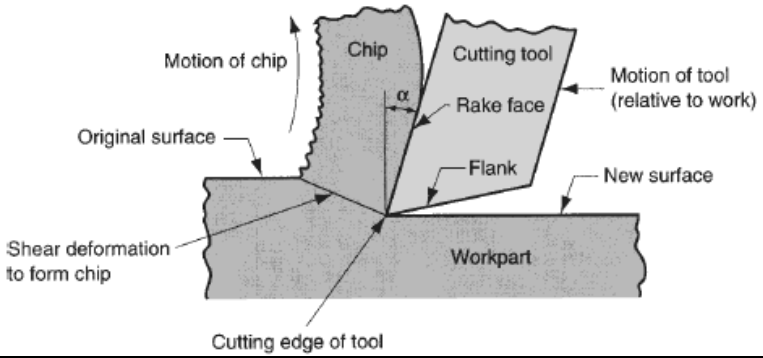
4) **Distortion or camber allowance:**

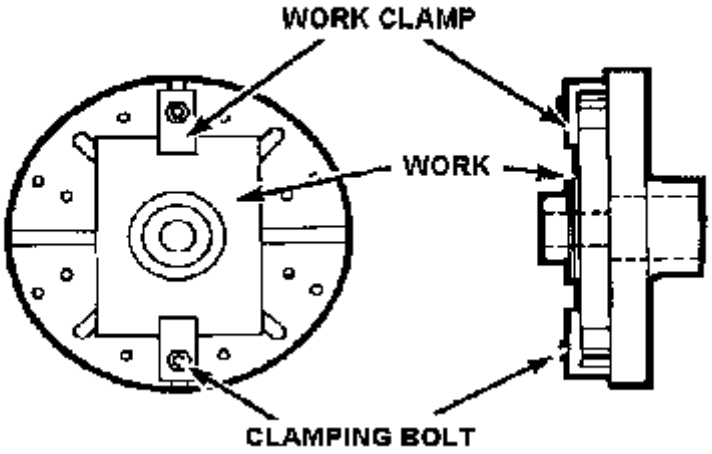
Some castings, because of their size, shape and type of metal, tend to warp or distort during the cooling period. This is a result of uneven shrinkage and is due to uneven metal thickness or to one surface being more exposed than another, causing it to cool more rapidly. The shape of the pattern is thus bent in the opposite direction to overcome this distortion. This feature is called distortion or camber allowance





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.	
	d)	**Write the compositions and applications of babbit materials.**	04
	Ans	**Composition of Babbitt metal:** It is a tin base white metal and it contains : **Tin (Sn) -** 88%, **Antimony (Sb) -** 8% and **Copper(Cu)** -4% **Application of Babbitt metal:***(Any 02)* i. Fine Bearings for light & medium load rail road freight cars. ii. bush Bearings iii. bearings in railway iv. Locomotive slide valves. v. Aircraft industries vi. Turbine bushings	**02** **02**
	e)	**Explain the mechanism of chip formation during metal cutting**	**04**
	Ans	**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  	
	f)	**State any four accessories used on lathe. Explain with neat sketch the use of face plate.**	**04**
	Ans	**Listing any 4 accessories 2 mark (½ mark each),** **sketch of face plate 1 mark, use 1 mark** **Accessories of lathe:-** i. Centre ii. Chuck	

		iii. face plate iv. angle plate v. mandrel vi. rests vii. carriers viii. catch plates ix. collets **Sketch of Face plate:**  **Use of Face plate:** 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 can not be conveniently held in a chuck.	
6		**Attempt any FOUR of the following:**	**16**
	a)	**What is the purpose of tempering and how it is done?**	**04**
	Ans	**Tempering**: The process involves re-heating of the metal below critical point, then holding it for a considerable time and then slowly cooling it. Tempering should be done immediately after hardening by quenching in order to relieve hardening strains. The temperature at which tempering is done varies with the carbon content of the metal and mechanical properties desired in the finished article. Three types of tempering processes are classified as: i. Low temperature tempering. ii. Medium temperature tempering iii. High temperature tempering **Purpose of Tempering** 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).	
	b)	**What is alloy steel? Classify it broadly.**	**04**
	Ans	Alloy steel: It contains iron & carbon as a main element. It also contains silicon, manganese, sulphur, phosphorus in different percentage. Some alloy steels contain Manganese varies up to 1 % & silicon up to 0.3 %. Some alloy steels contain manganese more than 1 % & silicon more than 0.3 %. It also contains nickel, chromium, molybdenum, vanadium in different %. These steels are called as "Alloy Steels". **Classification of alloy steel:** 	**02** **02**
	c)	**What is the purpose of gating system in case of casting? Explain with neat sketch**	**04**
	Ans	**Purpose of Gating system in case of casting**:*(Any 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. **Gating system:** The term gating system refers to all passageways through which the molten metal passes to enter the mold cavity. Various components of gating	

systems are shown in fig.

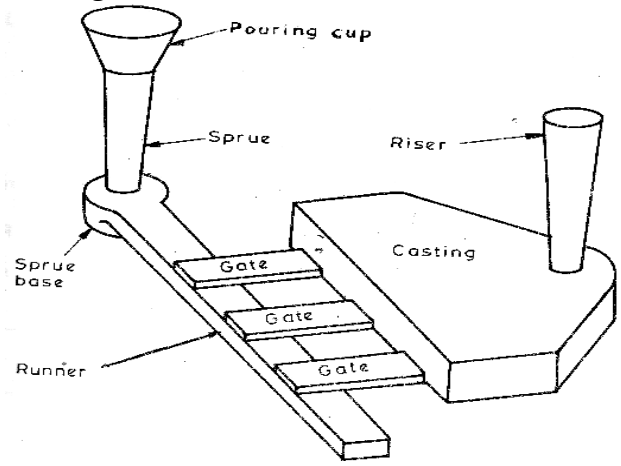


Figure: Gating system in casting.

Pouring basin: This part of the gating system is made on or in the top of the mould. Sometimes, a funnel-shaped opening which serves as pouring basin is made at the top of the sprue in the cope.

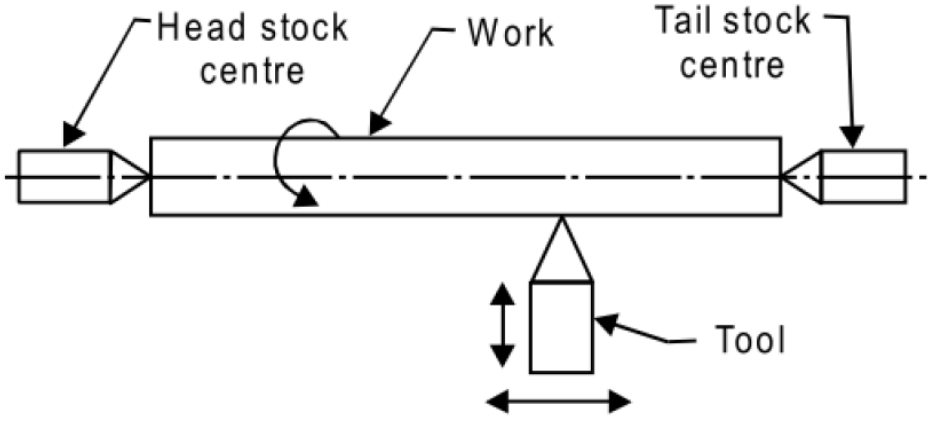
Sprue: The vertical passage that passes through the cope and connects the pouring basin with the runner or gate is called the sprue. The cross-section of a sprue may be square, rectangular, or circular.

Runner: In large castings, molten metal is usually carried from the sprue base to several gates around the cavity through a passageway called the runner. The runner is generally preferred in the drag, but it may sometimes be located in the cope, depending on the shape of the casting.

Gate: A gate is a passage through which molten metal flows from the runner to the mould cavity. The gates should be located where they can be easily removed without damaging the casting.

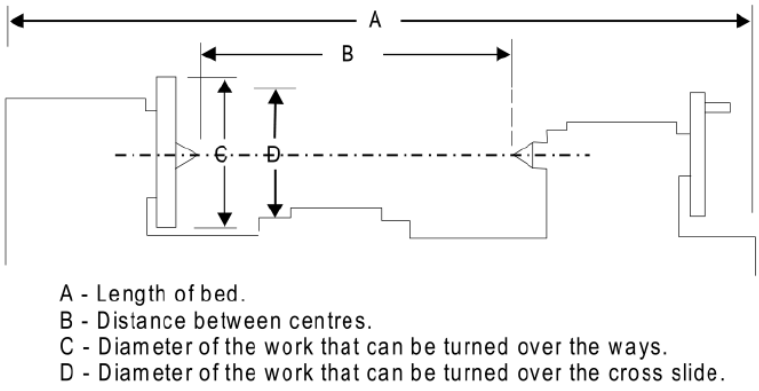
Risers: A riser is a passage of sand made in the cope to permit the molten metal to rise above the highest point in the casting after the mould cavity is filled up.

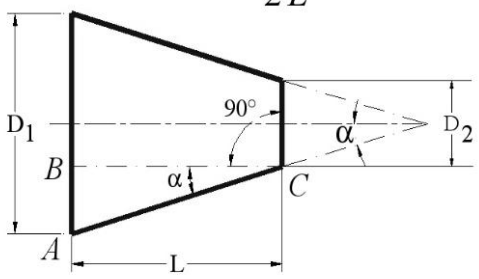
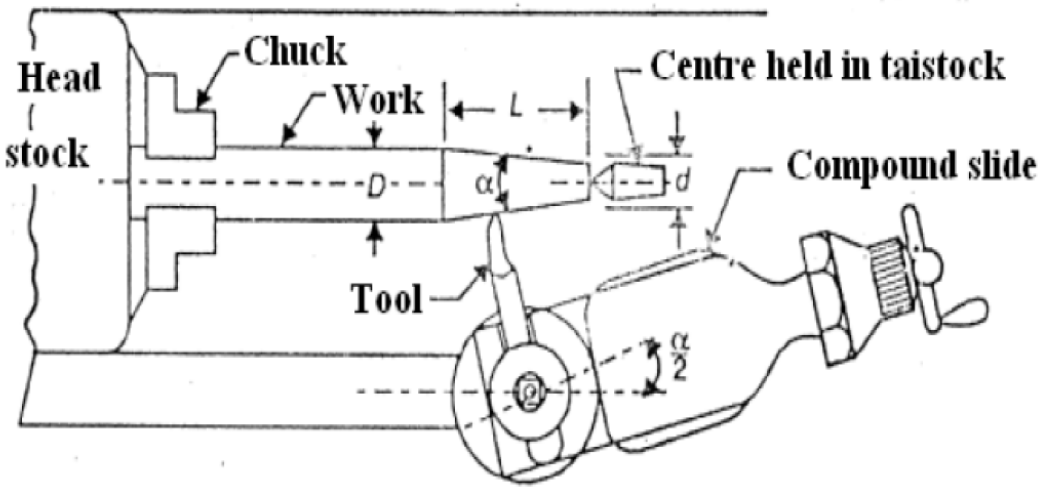
	d)	**What is the working principle of lathe? How lathe machine is specified?**	**04**
	Ans	Working Principle of a Lathe:	



The working principle of a lathe is shown in Fig.

1. In a lathe, the workpiece is held in a chuck or between centres and rotated about

		its axis at a uniform speed. 2. The cutting tool held in the tool post is fed into the workpiece for a desired depth and in the desired direction (i.e., in the linear, transverse or lateral direction). 3. Since there exists a relative motion between the workpiece and the cutting tool therefore the material is removed in the form of chips and the desired shape is obtained. The lathe is generally specified by the following means: a) Swing or maximum diameter that can be rotated over the bed ways b) Maximum length of the job that can be held between head stock and tailstock centres c) Bed length, which may include head stock length also d) Maximum diameter of the bar that can pass through spindle or collect chuck of capstan lathe.  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. Fig. illustrates the elements involved in specifications of a lathe. The following data also contributes to specify a common lathe machine.	
	e)	**What is carburizing? Give four applications of case carburizing.**	**04**
	Ans	**Case Carburizing: (2 Marks)** Carburizing is a method of depositing carbon on the surface layer of low carbon steel in order to produce a hard case. The machined parts of the low carbon steel are packed with carburizing mixture in a steel box as shown in Fig. The carburizing mixture contains 70% charcoal, 10% barium carbonate, 10% calcium carbonate and 10% sodium carbonate. A layer of the carburizing mixture of nearly 25 mm thickness is placed at the bottom. Then the components are so placed that no component touches one another or even the sides of the box. The box is covered and the lid tightly sealed with fireclay to avoid the entry or escape of gases. **Following are the application of case carburizing processes: (Any Four – ½ Marks each)** i. Gears ii. Ball Bearings iii. railway wheels iv. wear resistant bushings v. cam shafts	
	f)	**Explain the taper turning method by swiveling the compound rest method.**	**04**

	Ans	**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. Following formula is used for calculation of taper turning. Taper: $\tan\alpha = \frac{D_1 - D_2}{2L}$   Figure: Taper turning method by swiveling the compound rest	**02** **02**