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
	(i)	**Define fatigue and plasticity.**	02
		Answer: 1. **Fatigue:** The phenomenon of failure of material under fluctuating or repeated loading is called fatigue or endurance. 2. **Plasticity:** The plasticity of a material is the ability to its shape without destruction under the action of external loads and regain the shape given to it when the forces are removed.	01 01
	(ii)	**State the meaning of 18-4-1 H.S.S.? State it's properties.**	02
		Answer: **18-4-1 High Speed Steels : -** It Contains 18 % Tungsten, 4 % Chromium, 1 % Vanadium With 0.75 % Carbon & Remaining Iron. **Properties of 18-4-1 High speed steel:** ***(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	01 01

	(iii)	**State two engineering application of Brass and Aluminium.**	**02**
		Answer: **Applications of brass:(Any 02- ½ mark each)** 1. Cold rolled in sheets - Drawn into wires, tubes 2. Converted in sheets, tubes, foils, plats with the help of hot rolling, hot extrusion, hot stampings, casting 3. Used in Head lamp reflectors, radiator shells, tubes 4. Casting pump parts, valves, taps 5. Used for cast & forged fittings for ships 6. Used for manufacturing sheets, tubes, bars, ship fittings, bolts, nuts, washers, other parts subjected to sea water corrosion, condenser plant 7. For jewellery, decorative ornamental works 8. Used for hot worked, rolled, casted 9. Mainly used as a brazing solder (spelter) **Applications of Aluminium: (Any 02- ½ mark each)** 1.Cooking utensils 2.Reflectors 3.Electrical conductors 4.Mirrors 5.Food containers 6.Telescopes 7.Ashtrays 8. Trucks and buses 9.Bicycles 10. Aero planes 11.Motorcycle 12. Marine vessels	**01** **01**
	(iv)	**State the composition and properties of Babbit metal.**	**02**
		Answer: **Composition of Babbitt metal:** It is a tin base white metal and it contains : **Tin (Sn)** - 88%, **Antimony (Sb)** - 8% and **Copper(Cu)** -4%. **Properties of Babbit Metal:** *(Any two: ½ mark each)* 1) High thermal conductivity 2) Good Corrosion resistance 3) Soft & Nonmagnetic 4) High strength 5) Good Malleability 6) Good Ductility 7) Pleasing reddish colour 8) Easy to cast ,forged, rolled 9) Wear resistance 10) Good fatigue resistance 11) Light in weight	**01** **01**

	(v)	**State the properties and application of ceramics.**	**02**
		Answer: **Following are the properties of Ceramic Material: (Any Two- ½ Marks Each)** i. Ceramics are inorganic in nature & non metallic material. ii. Brittle material. iii. Insulation to flow of electric current iv. Withstand high temperature. v. Rock like appearance vi. Hardness vii. Corrosion resistance viii. Opaque to light **Following are the Application of Ceramic Material: (Any Two- ½ Marks Each)** i. Tiles, ii. sanitary ware, iii. insulators, iv. semiconductors, v. fuel elements in nuclear power plant, vi. cutting tools, vii. concrete and viii. Variety of glasses. ix. Nuclear engineering x. aerospace field xi. Electronic control devices xii. computers xiii. structures	**01** **01**
	(vi)	**List the basic types of rubber. Give one application of each.**	**02**
		Answer: **Basic types of rubber with application (01 mark each)** **A) Natural rubber** **Applications :-(Any one)** 1) Belts, 2. Shoe, 3. Coatings, 4. Packaging, 5. Soles, 6. Automobile tyres, 7. Seals and gaskets, 8. Chemical tank linings **B) Synthetic rubber** **Applications :- (Any one)** 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** **01**
	(Vii)	**List four polymeric materials.**	**02**

		(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**
	(viii)	**Define heat treatment process with two purposes.**	**02**
		Answer: **Answer: Definition of Heat Treatment:** 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. **Following are the purposes of Heat Treatment:***(Any Two – ½ 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. To improve weldability. 8. Remove gases, Harden and strengthen the metal. 9. Homogenize the structure. 10. Change the chemical composition	**01** **01**
1	**b**	**Attempt any TWO of the followings:**	**08**
	(i)	**State the effects of chromium and molybdenum on the properties of steel.**	**04**

Answer:

1) Chromium:(Any four Effects)

i) It improves Ductility
ii) It is added in different proportions upto 18 %
iii) Below 1.5 % addition increases Tensile Strength
iv) 12 % addition gives high Corrosion Resistance
v) It improves Hardenability & Toughness simultaneously

02

2) Molybdenum: (Any four Effects)

i) It improves Hardness
ii) It improves Wear Resistance
iii) It improves Thermal Resistance
iv) It gives ability to maintain Mechanical Properties at Elevated Temperatures

02

(ii) State two properties and applications of copper. **04**

Answer:

Properties :- (Any two 01 mark each)

1) Soft, ductile, malleable
2) Excellent resistance to corrosion
3) Non magnetic
4) Good machinability
5) Can be brazed ,soldered or welded
6) Resistance to fatigue and abrasion
7) High thermal and electrical conductivity
8) Has pleasing reddish colour

02

Applications (Any two 01 mark each)

1) Electrical parts / Electrical conductors
2) Heat exchanger / automobile radiator
3) Screw machine parts
4) Household utensils
5) Wires ,sheet ,tubes etc.

02

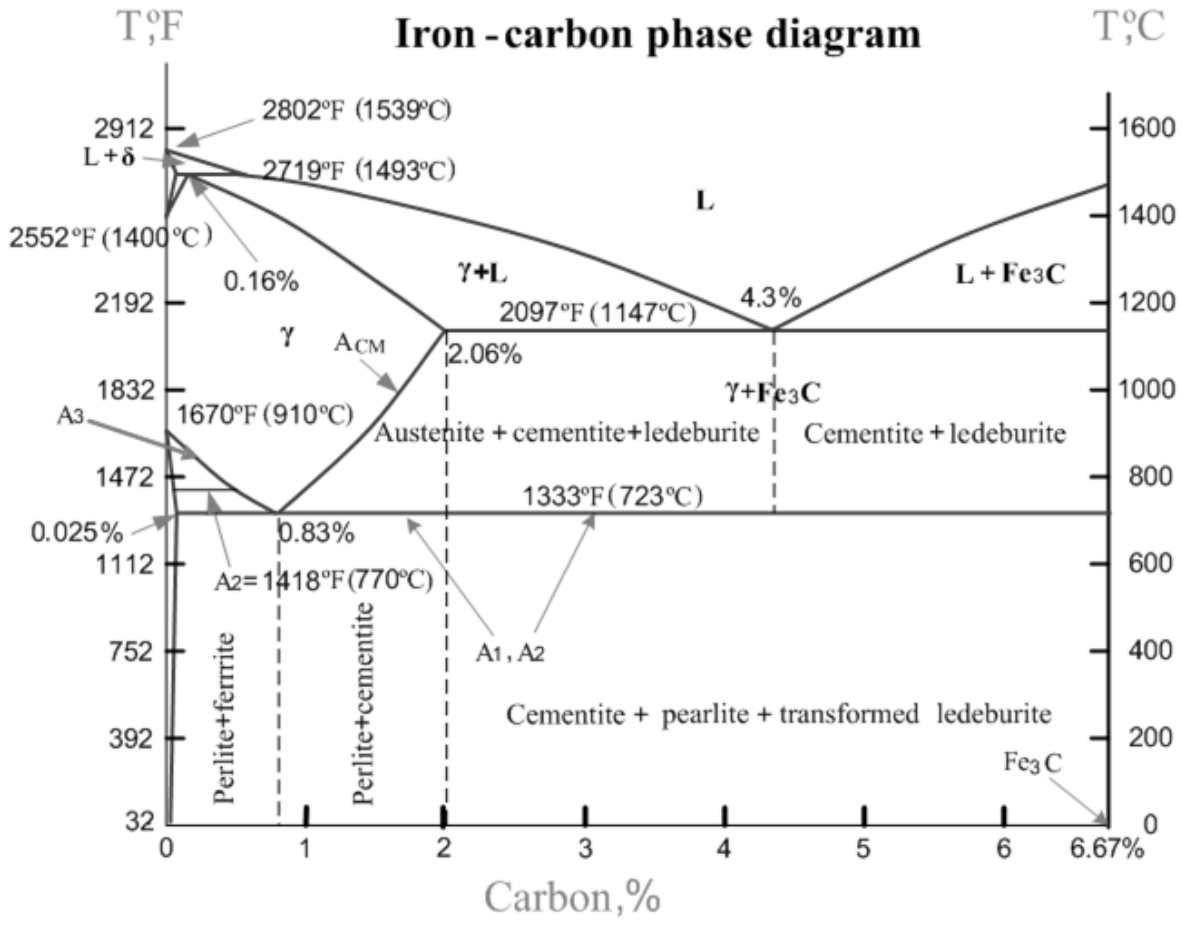
(iii) Compare between thermoplastic and thermosetting plastic. **04**

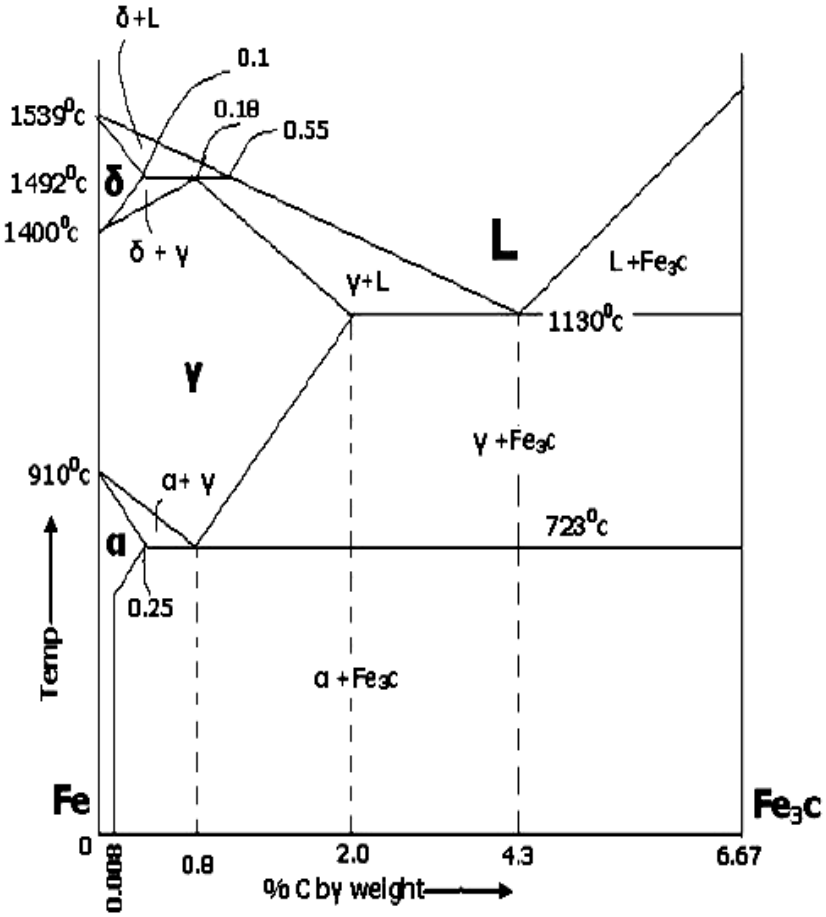
Answer:

Difference between thermoplastic and thermo-setting plastic: *(Any 04 – 01 mark each)*

Sr. No.	Thermoplastics	Thermosetting
01	They can be repeated softened by heat and hardened on cooling	Once hardened and set they do not softened with application of heat
02	They are formed by addition polymerization only	They are formed by condensation polymerization
03	They consist of long chain linear polymers	They have three dimensional network structure
04	They are usually soft, weak and less brittle	They are usually hard, strong and more brittle
05	They are usually soluble in some organic solvents	They are insoluble in almost all organic solvents
06	These can be repeatedly used and have	They cannot reused and do not have resale

04

			resale value	value.
		07	They cannot be used at higher temperature as they will tends to soft under heat	They can be used at comparatively higher temperature without damage.
2		**Attempt any FOUR of the following:**		**16**
	(a)	**Draw the Fe-C phase transformation diagram and show critical temperatures on it.**		**04**
		Answer:(Diagram 02 marks, temperature-02 marks) **Answer: Iron-Carbon equilibrium diagram***(Credit shall be given to appropriate diagram showing critical temperatures)*  **OR**	**04**



Where L = Liquid,
δ= δ ferrite (iron)
α= α ferrite (Iron)
γ= γ iron or Austenite
γ +Fe_3C=Ledlburite
α +Fe_3C= Pearlite
Fe=Ferrite or iron
Fe_3C=Cementite or iron carbide

Fig. Iron-Carbon Equilibrium Diagram

	(b)	**Explain induction hardening process.**	**04**
		Answer: 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.	**04**
	(c)	**Distinguish between annealing and normalizing process.**	**04**

Answer:

Answer: **Difference between annealing and normalizing:** *(Any 04 points - 1 mark each)*

Sr	Annealing	Normalizing
1	Less hardness, toughness	Slightly more hardness, toughness.
2	For plain carbon steel the microstructure shows pearlite	Microstructure shows more pearlite.
3	Pearlite is coarse and usually gets resolved by the optical microscope.	Pearlite is fine and appears unresolved with optical microscope
4	Grain size distribution is more uniform	Grain size distribution is slightly less uniform.
5	Internal stresses are least.	Internal stresses are slightly more

04

(d) Describe flame hardening process with neat sketch. **04**

Answer:

Answer: *(Note: Credit shall be given to the suitable sketch)*

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. **02**

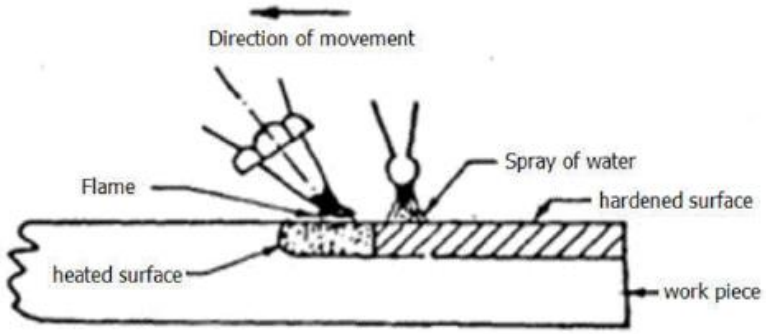


Fig: Principle of flame hardening **02**

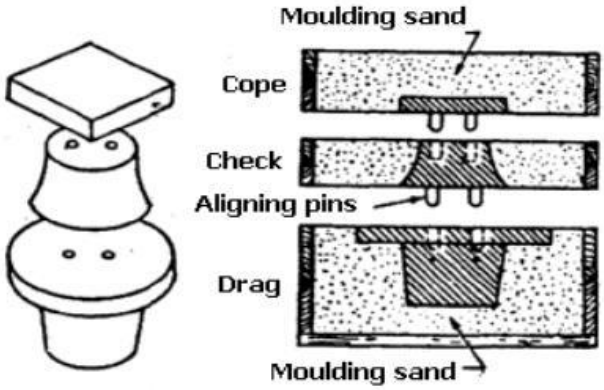
(e) State four advantages and disadvantages of foundry process. **04**

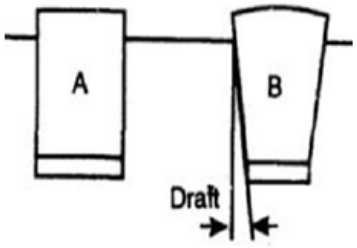
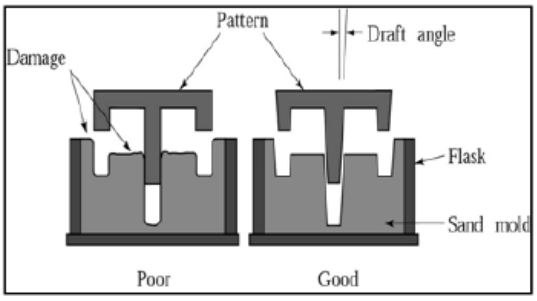
Answer:

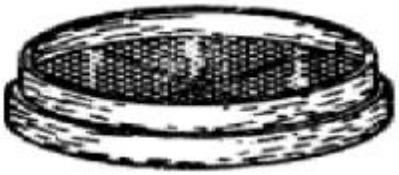
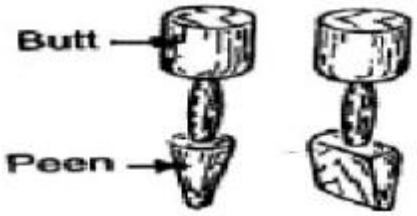
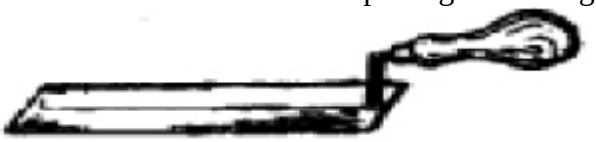
Following are the advantages of foundry process: (Any four – ½ mark each)

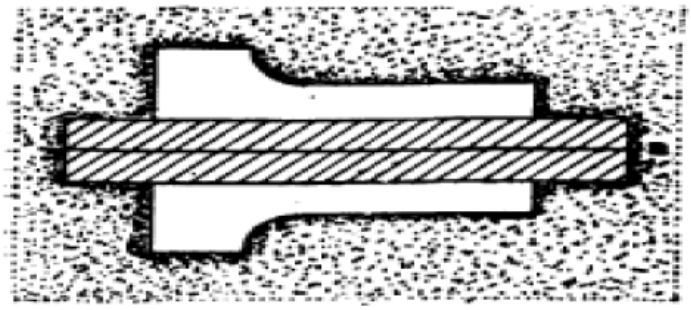
i. It one of the most versatile manufacturing process.
ii. Castings provide uniform directional properties.
iii. Intricate shaped parts can be produced.
iv. Very complicated parts can be cast in one piece. **02**

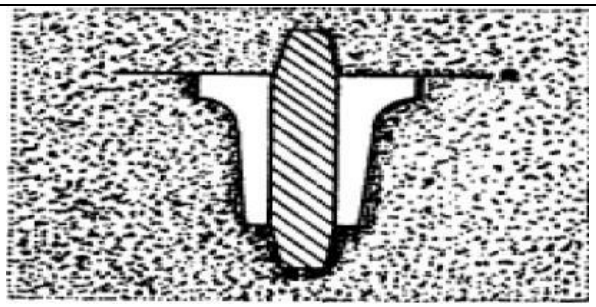
Following are the disadvantages of foundry process: (Any four – ½ mark each)

		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**
	(f)	**List four types of patterns and explain three piece pattern with neat sketch.**	**04**
		Answer: **any 4 types – 2 marks** 1. Single piece pattern 2. Split pattern 3. Match plate pattern 4. Cope and drag pattern 5. Gated pattern 6. Sweep pattern 7. Loose piece 8. Follow board pattern Skeleton pattern 9. Segmental pattern 10. Shell pattern 11. Built-up pattern 12. Box-up pattern 13. Lagged-up pattern 14. Left & right hand **Three Piece Pattern:** Sometimes castings have very difficult and complicated designs. In such difficult situations multi piece types of patterns are used. 3 or more patterns are included in multi piece pattern. For instance, if we consider three- piece pattern which comes under multi piece pattern. This three- piece pattern consists of top, bottom and middle parts. The bottom part is drag, top part is cope where the middle part is termed as check box.  Fig. 3 piece pattern	**02** **01** **01**
3		**Attempt any FOUR of the following:**	**16**
	(a)	**Explain the standard accepted colour codes for pattern.**	**04**
		Answer:	

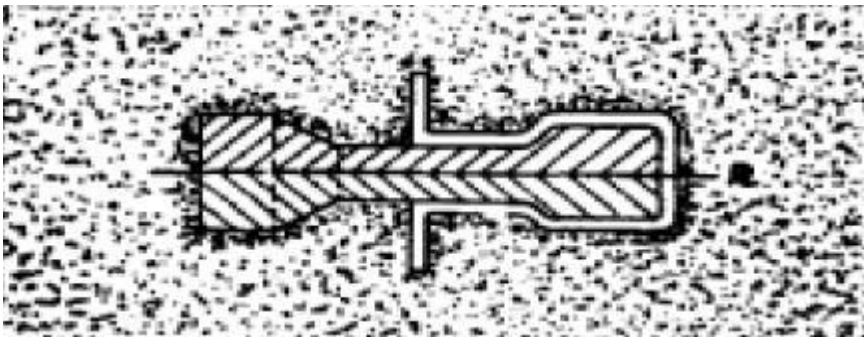
		(Meaning of any 04 color codes-01 mark each) **Standard colour coding used in pattern:** The colour codes are given for identification of the parts of patterns and core boxes. 1. Surface to be left unfinished are to be painted **black** 2. Surface to be finished are painted by **red** colour. 3. Seats 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**
	(b)	**List four pattern making allowances and explain draft allowance with neat sketch.**	**04**
		Answer: Answer: **Allowances provided on pattern:***(Any 04 - ½ mark each)* 1. Shrinkage allowance 2. Draft allowance 3. Machining allowance 4. Distortion or camber allowance 5. Shake allowance / rapping allowance **Draft allowance provided on pattern***: (Sketch -1 mark , Explanation -1 mark)* 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 millimetre 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.  **OR** 	**02** **01** **01**
	(c)	**State two moulding tools with neat sketches.**	**04**
		Answer: *(Moulding Tool = 01 Mark each, Sketch of same = 01 Mark each) (Any 02)* **i)** **Shovel:** A shovel is used for mixing and tempering moulding sand and for moving the sand from the pile to the flask.  **ii)** **Riddle:** It is used for removing foreign materials such as nails, shot metal,	

		splinters of wood etc., from the moulding sand.  **iii)** **Rammer:** A hand rammer is a wooden tool used for packing or ramming the sand into the mould.  **iv)** **Trowel:** A moulder also uses them in repairing the damaged portions of a mould.  **Fig. Square Trowel** **v)** **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.  **vi)** **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. 	**04**
	(d)	**State four properties of moulding sand.**	**04**
		Answer: (any 04 Properties- 04 marks) **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:**	

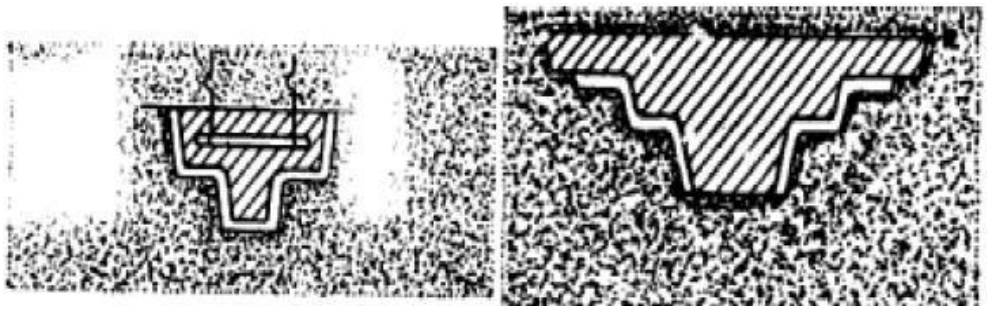
		Flow ability of moulding sand refers to its ability to behave like a fluid, so that, when rammed, it will flow to all portions of a mould and pack all-around the pattern and take up the required shape. **3) Collapsibility:** After the molten metal in the mould gets solidified, the sand mould must be 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 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)	**Explain two types of cores used in foundry process.**	**04**
		Answer: Answer: *(Any Two- Each type carries 1 mark for description and 1 mark for sketch)* 1. **Horizontal cores:** The most common type is the horizontal core. The core is usually cylindrical in form and is laid horizontally at the parting line of the mould. The ends of the core rest in the seats provided by the core prints on the pattern.  **2. Vertical core:** This is placed in a vertical position both in cope and drag halves of the mould. Usually top and bottom of the core are provided with a taper, but the amount of taper on the top is greater than that at the bottom.	**04** *(Any Two- Each type carries 1 mark for description and 1 mark for sketch)*



3.Balanced core: When the casting is to have an opening only one side and only one core print is available on the pattern a balanced core is suitable. The core print in such cases should be large enough to give proper bearing to the core. In case the core is sufficiently long, it may be supported at the free end by means of a chaplet

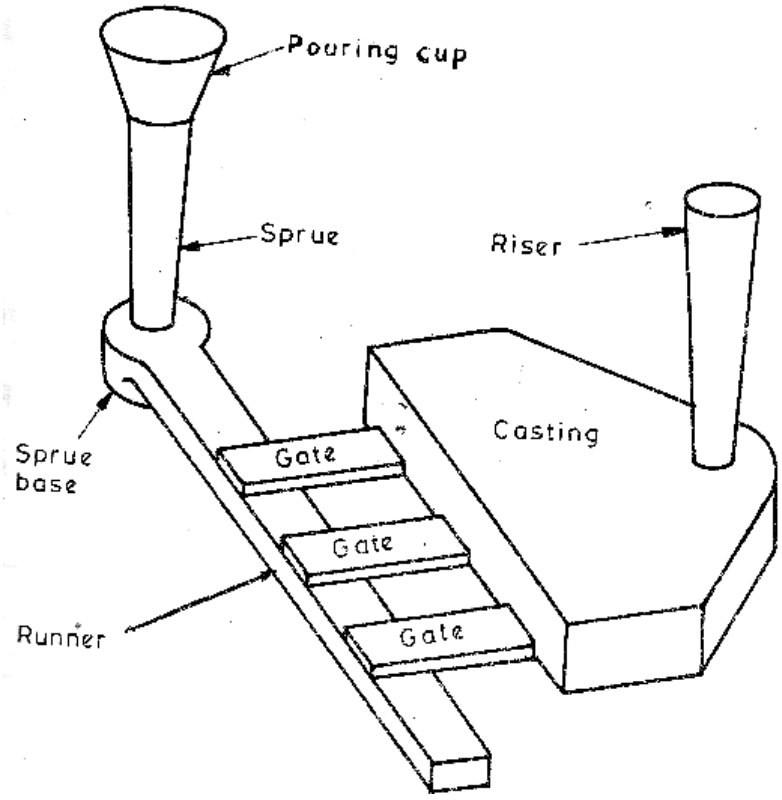


4.Hanging and cover core: If the core hangs from the cope and does not have any support at the bottom of the drag, it is referred to as a hanging core. In this case, it may be necessary to fasten the core with a wire or rod that may extend through the cope.



On the other hand, if it has its support on the drag it is called cover core. In this case, the core serves as a cover for the mould, and also as a support for hanging the main body of the core.

	(f)	**Draw a neat sketch of gating system and state function of pouring basin.**	**04**
		Answer:(01 marks- Sketch, 01mark-lebeling, 02 mark –functions)	

			02
		Pouring basins functions: a) Makes it easier to ladle operator to direct the flow of metal from crucible to sprue. b) Helps maintaining the required rate of liquid metal flow. c) Reduces turbulence and overtaxing at the sprue entrance. d) Helps separating dross, slag etc. from metal before it (i.e. metal) enters the sprue hole.	02
4		**Attempt any FOUR of the following:**	**16**
	(a)	**Explain two defects with causes and remedies of casting defects.**	**04**
		Answer:(Any two defects – explanation 01 marks, causes and remedies -1/2 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 localised 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.	**04**
	(b)	**Explain hot chamber die casting process with sketch.**	**04**
		Answer: (Sketch 02 mark, Explanation 1 marks) **Hot chamber die casting** 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.	**02**

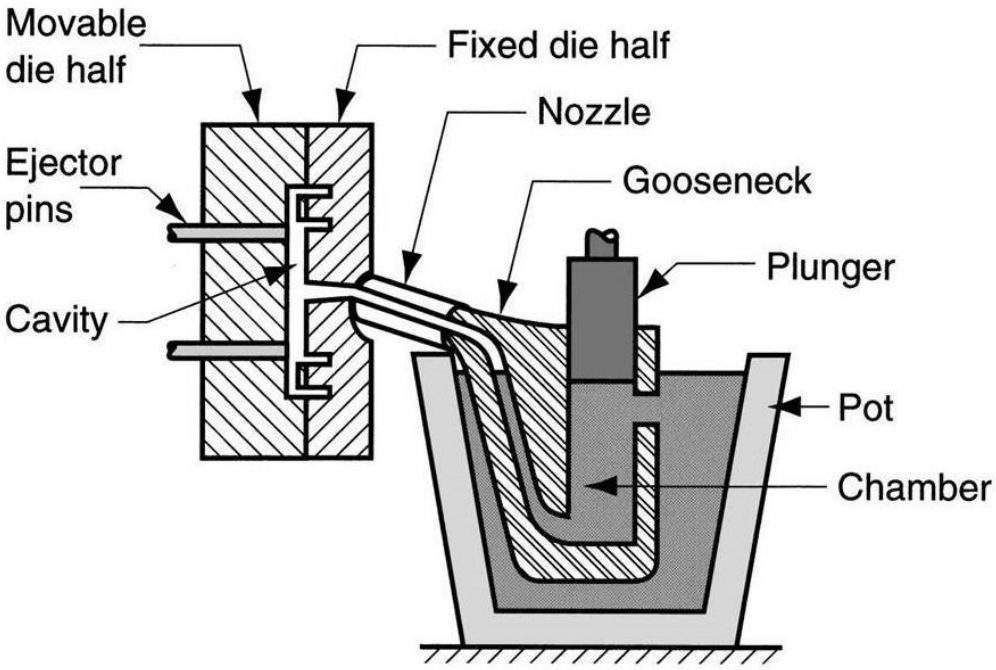


Fig. Hot chamber Pressures die casting — **02**

(c) State three types of chips with neat sketch. — **04**

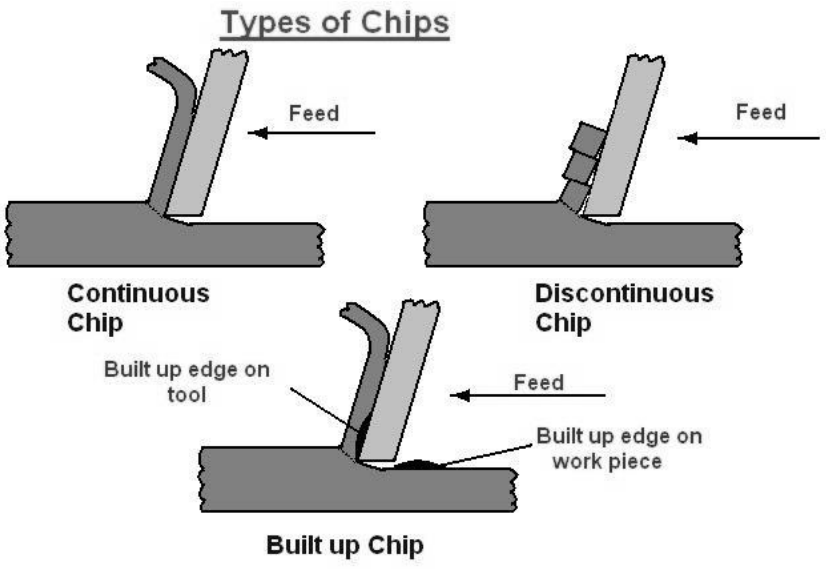
Answer:

Answer: *3types –02 marks each , sketch –02 marks,*

Types of chips:

1) Discontinuous or segmental chips
2) Continuous chips
3) Continuous chips with built-up edge

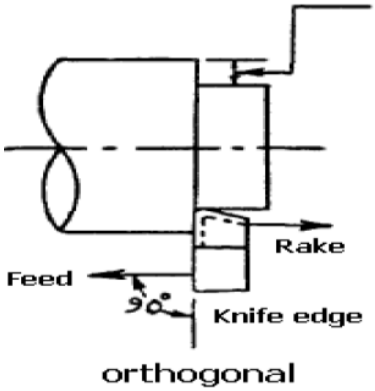
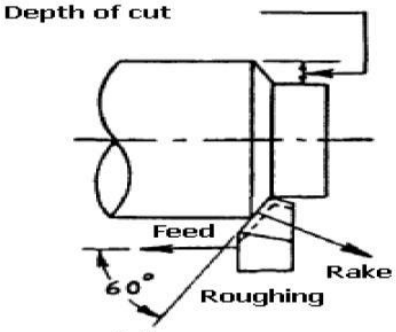
02



02

(d) Compare between orthogonal and oblique cutting. — **04**

Answer:(Any 04 points -01 mark each)

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 „i" with the normal to 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	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

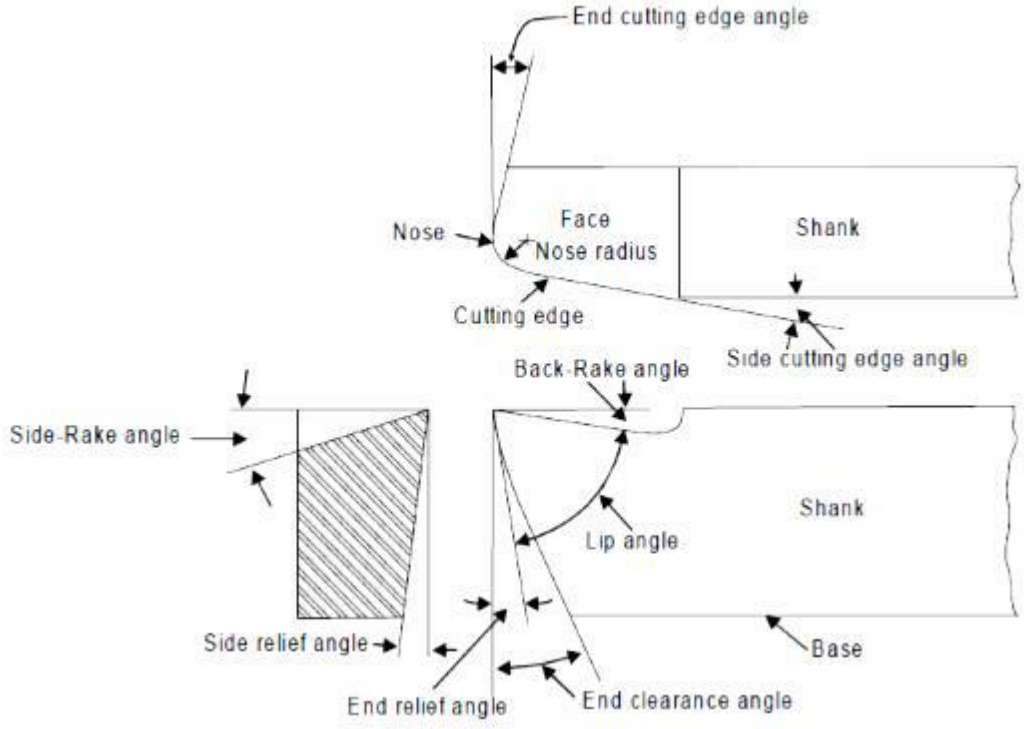
04

(e) Draw the nomenclature of single point cutting tool with neat sketch. **04**

Answer:

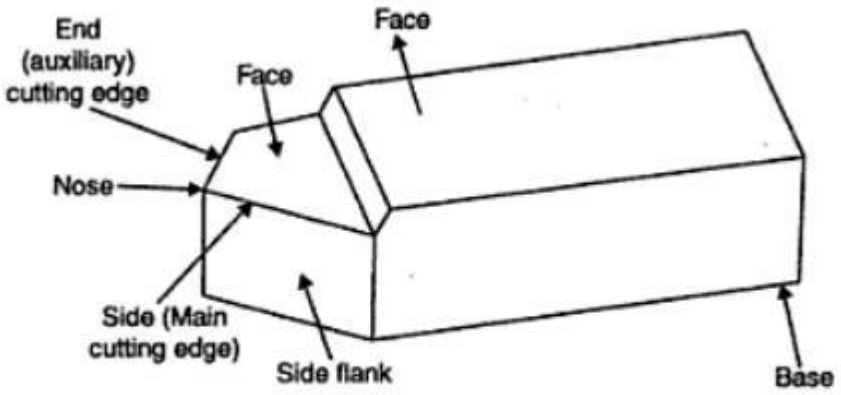
Answer:*(Sketch 2 marks, labelling of parts and angles-2 marks)*

Nomenclature of single point cutting tool



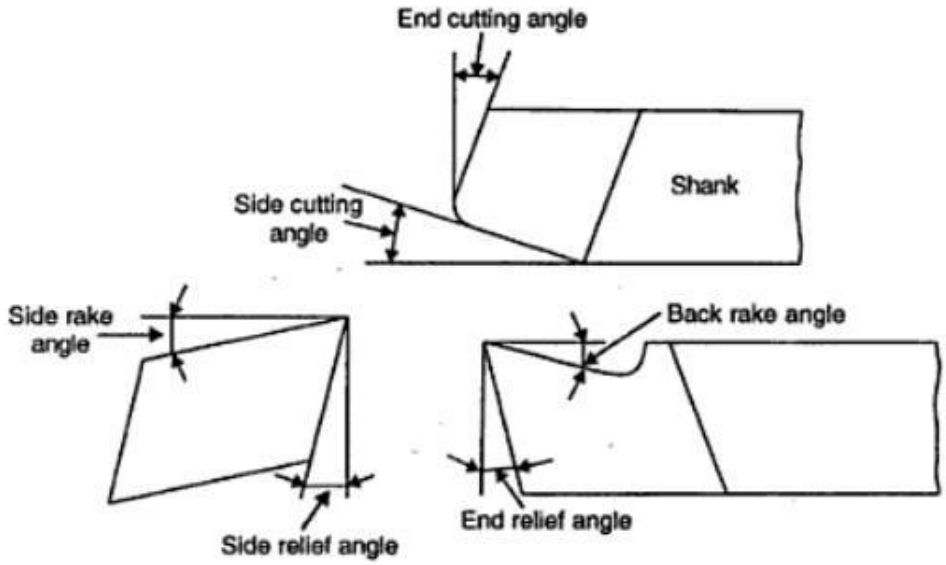
04

OR



(*a*) Elements of a Single Point Tool

OR



(*b*) Tool Angles

Figure: Single point cutting tool nomenclature.

	(f)	**List four cutting tool materials and explain any one.**	**04**
		Answer: (Any 04 tool materials-02 marks, explaination-02 marks(any 01)) **Types of cutting tool materials** **High-speed steels(HSS):** 1. Carbon Steels 2. Carbides 3.Silicon Nitride 4.High speed steel (H.S.S.) 5.Nonferrous cast alloys (Stellite) 6.Cemented carbides 7. Diamond Cubic boron nitride, or "CBN" 8. Polycrystalline diamond, or "PCD" 9. High carbide speed steels 10. Diamond **1. High-speed steels:** These steels are called as HSS because these steels cut material at high speeds and retain their hardness even at high temperature. It consists of iron and carbon with differing amounts of alloying elements such as tungsten, chromium, vanadium and cobalt. **2. Stellites**: Stellite is the trade name of a nonferrous cast alloy composed of cobalt, chromium and tungsten. It is shaped by casting from which it gets cutting properties. **3. Cemented carbides**: The basic ingredient of most cemented carbides is tungsten carbide which is extremely hard. Pure tungsten powder is mixed under high heat, at about 1500 0C, with pure carbon (lamp black) in the ratio of 94 per cent and 6 per cent by weight. The new compound, tungsten carbide, is then mixed with cobalt until the mass is entirely homogeneous. **4. Diamond:** The diamonds used for cutting tools are industrial diamonds, which are naturally occurring diamonds containing flaws and therefore of no value as gemstones. Alternatively they can be also artificial.	**02** **02**
5		**Attempt any FOUR of the following:**	**16**

	(a)	**Explain tool signature with example.**	**04**
		Ans: Tool signature – 2 marks, 2 marks - example The term tool signature or tool designation is used to denote a standardized system of specifying the principle tool angles of single point cutting tool. Tool signature (designation) under ASA (American Standards Association) System is given in the order α_b-α_s-θ_e-θ_s-C_e-C_s-R Where, α_b = Back rake angle; α_s = Side rake angle; θ_e = End relief angle; θ_s = Side relief angle; C_e = End cutting edge angle; C_s = Side cutting edge angle; R = Nose radius **Example** **e.g.: – 0 – 7 – 7 – 7 – 15 – 15 – 0.8** It means that back rake angle 0°, side rake angle 7°, end relief angle 7°, side relief angle 7°, end cutting edge angle 15°, side cutting edge angle 15°, nose radius 0.8 mm	**02** **02**
	(b)	**Write the classification of lathe machines.**	**04**
		Answer: any 4 types – 01 mark each. **Classification of lathe machines:** **1) Speed lathe.** i. Wood working ii. Centering iii. Polishing iv. Spinning **2) Engine or centre lathe.** i. Belt drive ii. Individual motor drive iii. Gear head lathe **3) Bench lathe.** **4) Tool room lathe.** **5) Capstan and turret lathe.** **6) Automatic lathes.** **7) Special purpose lathes.** i. Gap bed lathe ii. Wheel lathe iii. Duplicating lathe iv. T – lathe	**04**
	(c)	**State any four accessories used on lathe and explain any one with sketch.**	**04**
		Answer: **Ans:-Listing any 4 accessories 2 mark (½ mark each),** **(Any 01 -- sketch - 1 mark, explanation 1 mark)** **Accessories of lathe:-** i. Centre ii. Chuck iii. face plate iv. angle plate v. mandrel vi. rests vii. carriers	**02**

viii. catch plates
ix. collets

The lathe accessories: *(Any 01: sketch -1 mark , Description-01 mark)*

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.

02

(a) Standard centre (b) Half centre

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.

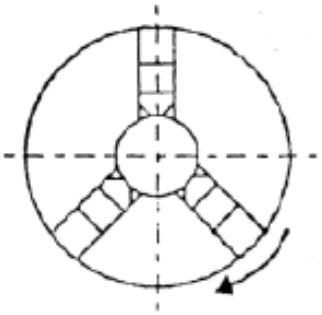
c. It is attached to the lathe spindle by means of two bolts with the back plate screwed on to the spindle nose.

d. There are many types of the chuck, but the following two are commonly used.

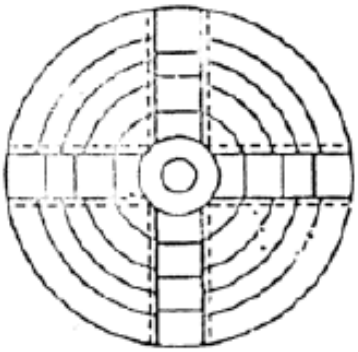
i) Three jaw universal chuck: The three jaw universal chuck, as shown in Fig. (a) is also called self-centering chuck or scroll chuck. Thus chuck is used for holding round and hexagonal work.

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,
vii) air or hydraulic chuck



(a) Three jaw chuck



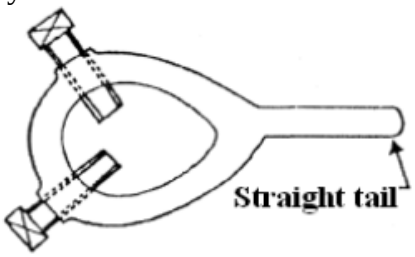
(b) Four jaw chuck

3. **Lathe dog or carrier:**

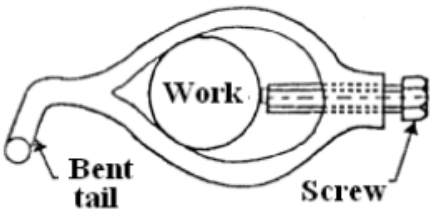
a. The work placed on a mandrel or held between centres is rotated positively by clamping the dog or carrier to the end of the work.

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

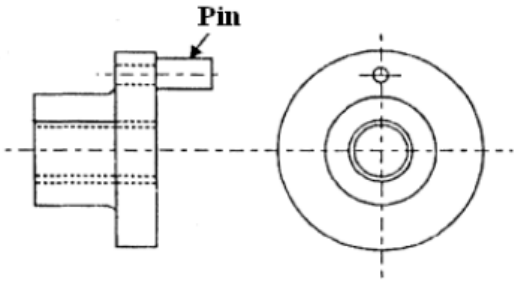


(b) Bent tail pipe

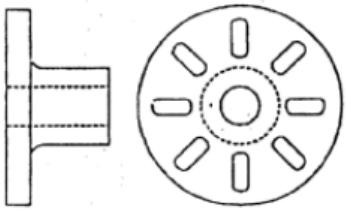
4. **Drive plate:**

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



Face 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 can not be conveniently held in a

chuck.

6. Angle plate:

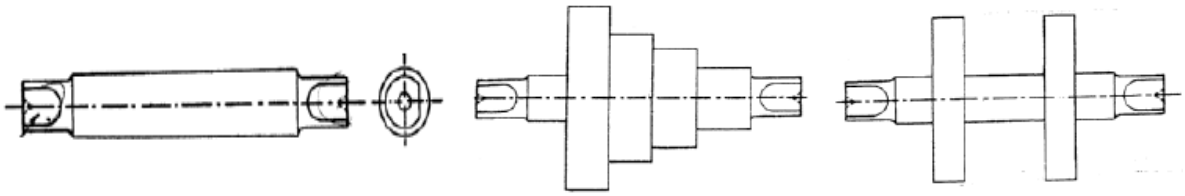
a. An angle plate is simply a cast iron plate with to faces planed at right angles to each other and having slots in various positions for the clamping bolts.

b. It. is always used with the face plate for holding such parts which can not be clamped against the vertical surface of the face plate.

7. 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.

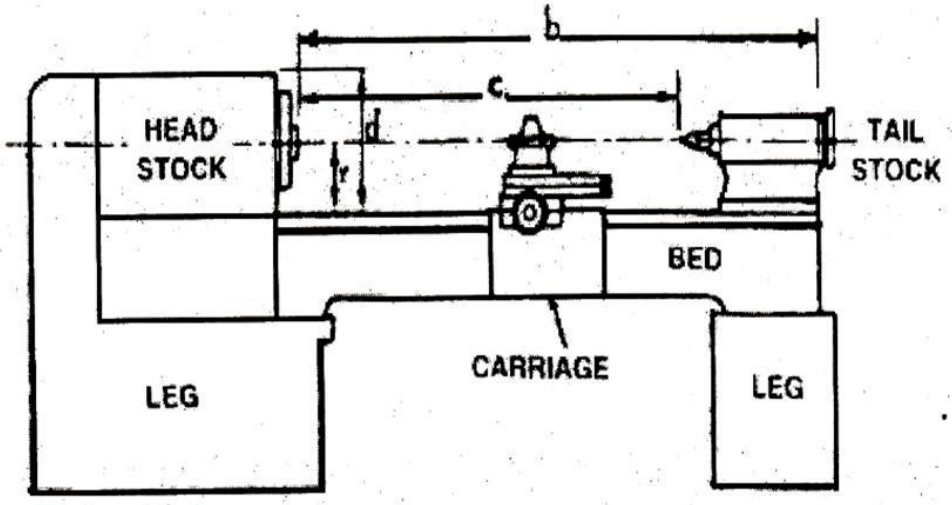
b. The work revolves with the mandrel which is mounted between the centres of the lathe. The various types of mandrels used for different classes of work are shown in Fig.



Plain mandrel Step mandrel Collar mandrel

(d) State lathe machine specification with neat sketch. **04**

Answer: *Description – 02 Marks, 02 marks for Sketch*



02

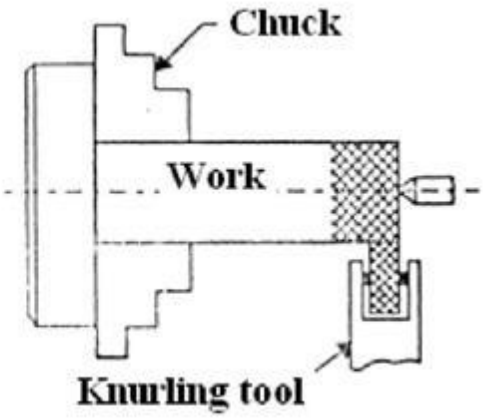
Fig. : SPECIFICATION OF A LATHE

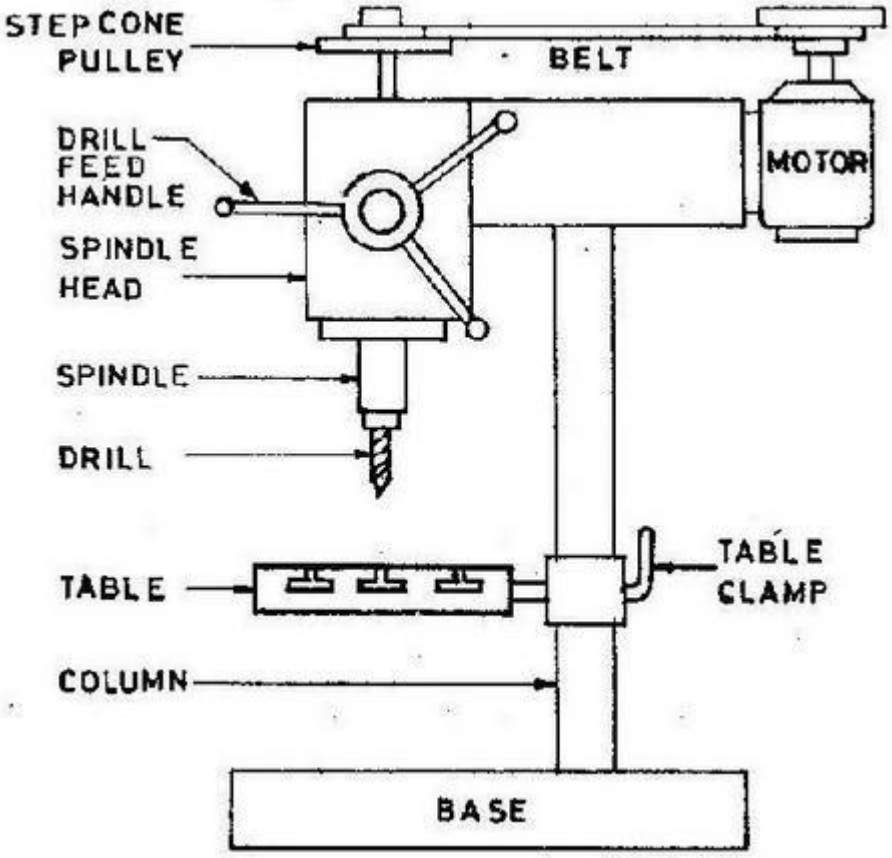
r - Centre height **c** - Length between centres

d - swing diameter over bed **b** - Length of bed.

The size of a lathe is expressed or specified by the following items and illustrated in Fig.

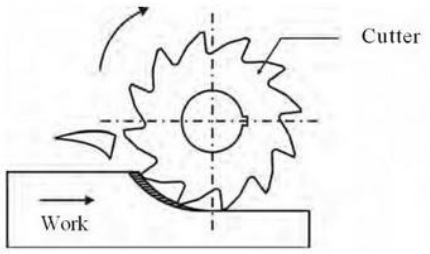
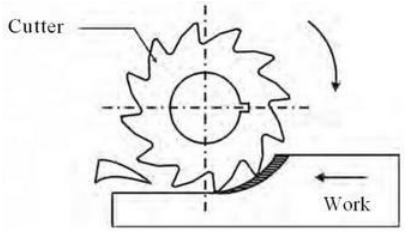
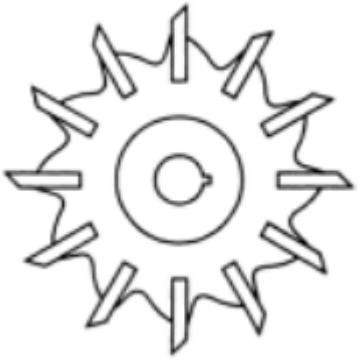
1. The height of the centers measured from the lathe bed.
2. The swing diameter over bed. This is the largest diameter of work that will revolve without touching the bed and is twice the height of the centre measured from the bed of the lathe.

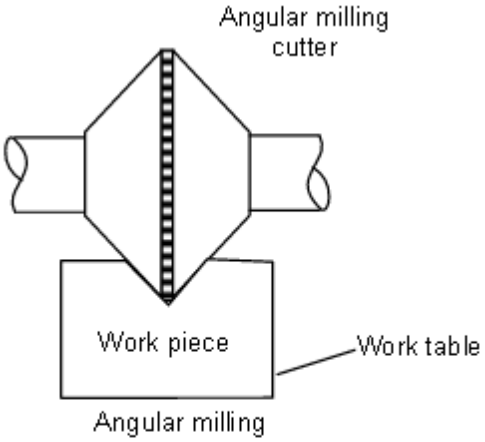
		3. The length between centers. This is the maximum length of work that can be mounted between the lathe centers. 4. The swing diameter over carriage. This is the largest diameter of work that over bed. 5. The maximum bar diameter. This is the maximum diameter of bar stock that will pass through hole of the headstock spindle.	**02**
	(e)	**List four operations performed on lathe machine and explain knurling operation with neat sketch.**	**04**
		Answer:(Any 04 operations-02 marks, sketch-01marks, explaination-01 mark) Operations performed on lathe machine 1. Facing, 2. Plain turning, 3. Step turning, 4. Taper turning, 5. Drilling, 6. Reaming, 7. Boring, 8. Undercutting, 9. Threading, 10. Knurling. **Knurling** Knurling is the process of embossing a diamond shaped pattern on the surface of workpiece. The purpose of knurling is to provide an effective gripping surface on a workpiece to prevent it from slipping when operated by hand. It is an operation of providing knurled surface on the workpiece. In this operation, as shown in Fig. a knurled tool is moved longitudinally to a revolving workpiece surface. The projections on the knurled tool reproduce depressions on the work surface.  Fig. Knurling Operation	**02** **01** **01**
	(f)	**Classify drilling machines.**	**04**
		Answer: Classification of drilling machine: *(Any 08 – ½ mark each)* 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	**04**
6		**Attempt any FOUR of the following:**	**16**
	(a)	**Draw neat sketch of bench drilling machine and name its parts. Write function of any two parts.**	**04**
		Answer: (Sketch – 01 mark, Labelling -01 mark, functions – 02 marks)  Fig. Bench Drilling Machine **Functions of parts: (Any 02 -02 marks)** 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	**02**

		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**
	(b)	**State classification of milling machine.**	**04**
		Answer: Classification of milling machine:*(Any 04 – 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)	**Compare between up milling and down milling.**	**04**
		Answer: Comparison between up milling and down milling:*(Any 04 – 01 mark each)*	**04**

Sr.	Up milling	Down milling
01	The cutter rotates against the direction in which the work is being fed	The cutter rotates in the same direction as that in which the work is being fed
02	It is known as conventional milling	It is known as climb milling
03	Job-tool motion is in the opposite direction	Job-tool motion is in the same direction
04	Cutting force vary from zero to maximum	Cutting force varies from maximum to zero
05	Chip thickness vary from minimum to maximum	Chip thickness vary from maximum to minimum
06	Surface finish is better. i.e no effect of backlash in screw nut system	Surface finish is better ,if it is free from backlash error as backlash affect process and product
07	Use of cutting fluid is difficult	Use of cutting fluid is easy
08	There is tendency to lift the job so more clamping forces are needed to fix the job on the table	Forces are sufficient on the job to press downward, so clamping problem is not so much
09	It is practicable	It is impracticable

		10	 **Upmilling**	 **Downmilling**	
	(d)	**Explain face milling cutter with neat sketch.**		**04**
		Answer:(Explaination-02 marks, sketch – 02marks) **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.  Figure: Face milling cutter. ***(Note: Any other equivalent figure shall be considered)***	**02** **02**
	(e)	**List four operations performed on milling machine. Explain angular milling with neat sketch.**		**04**
		Answer: 1. Plain Milling Operation 2. Face Milling Operation 3. Side Milling Operation 4. Straddle Milling Operation 5. Angular Milling Operation 6. Gang Milling Operation 7. Form Milling Operation 8. Profile Milling Operation 9. End Milling Operation 10. Slot Milling Operation 11. Gear Cutting Operation		**02Marks (Any four operations)**

		Angular Milling Operation: Angular milling operation is used to produce angular surface on the workpiece. The produced surface makes an angle with the axis of spindle which is not right angle. Production of "V" shaped groove is the example of angular milling operation.  **Angular Milling Operation**	**01** **01**
	(f)	**Draw a neat sketch of column and knee type milling machine. Explain function of knee and arbor.**	**04**
		Answer: (Sketch- 02 marks, functions -01 mark each) **Functions of Knee and Arbor: (1 mark for each)** 1. **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. 2. **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.	**02** **02**

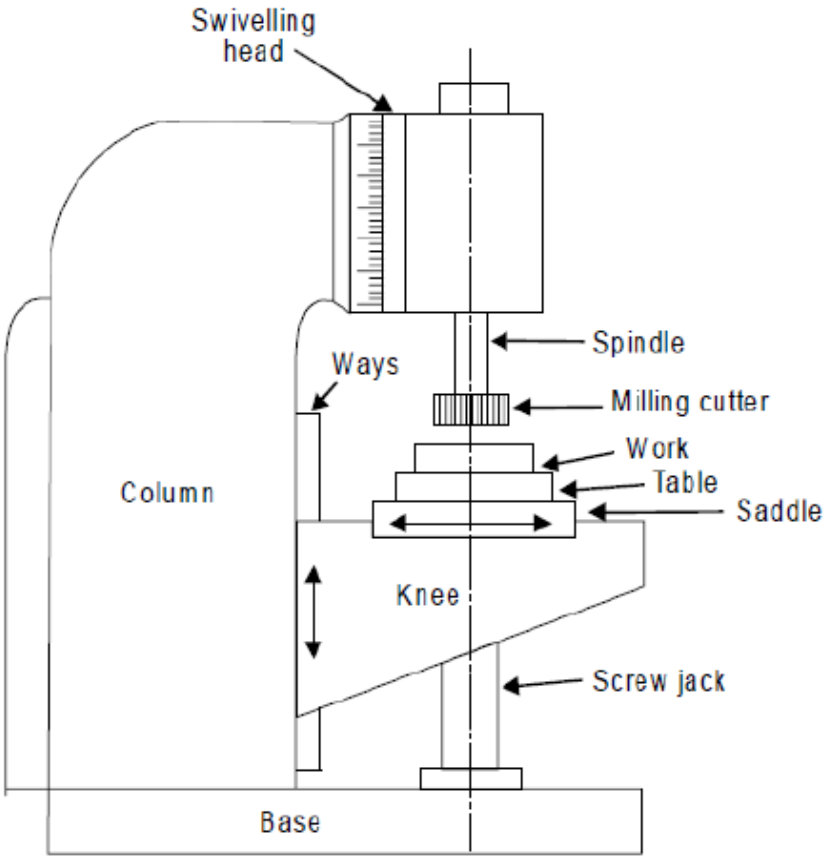


Figure: Column and Knee type milling machine