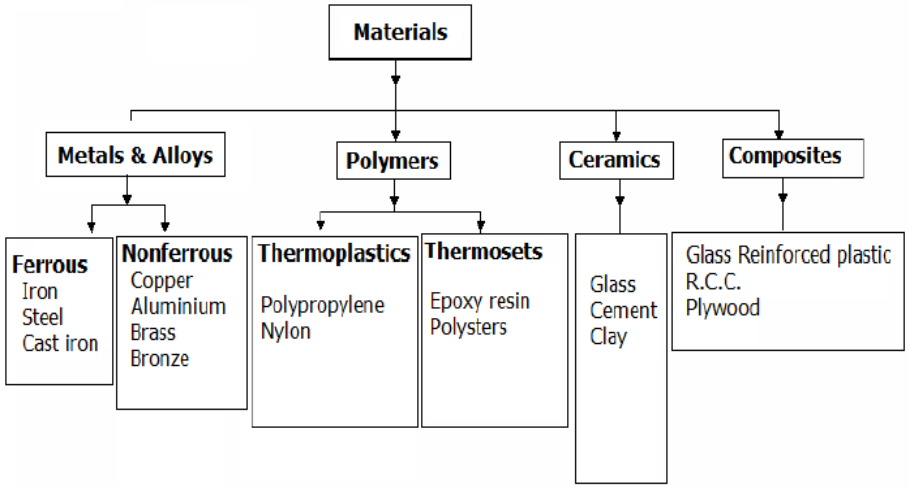
MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2005 Certified)
WINTER– 17 EXAMINATION
Model Answer

Subject: Materials and Manufacturing Processes **Subject Code: 17306**

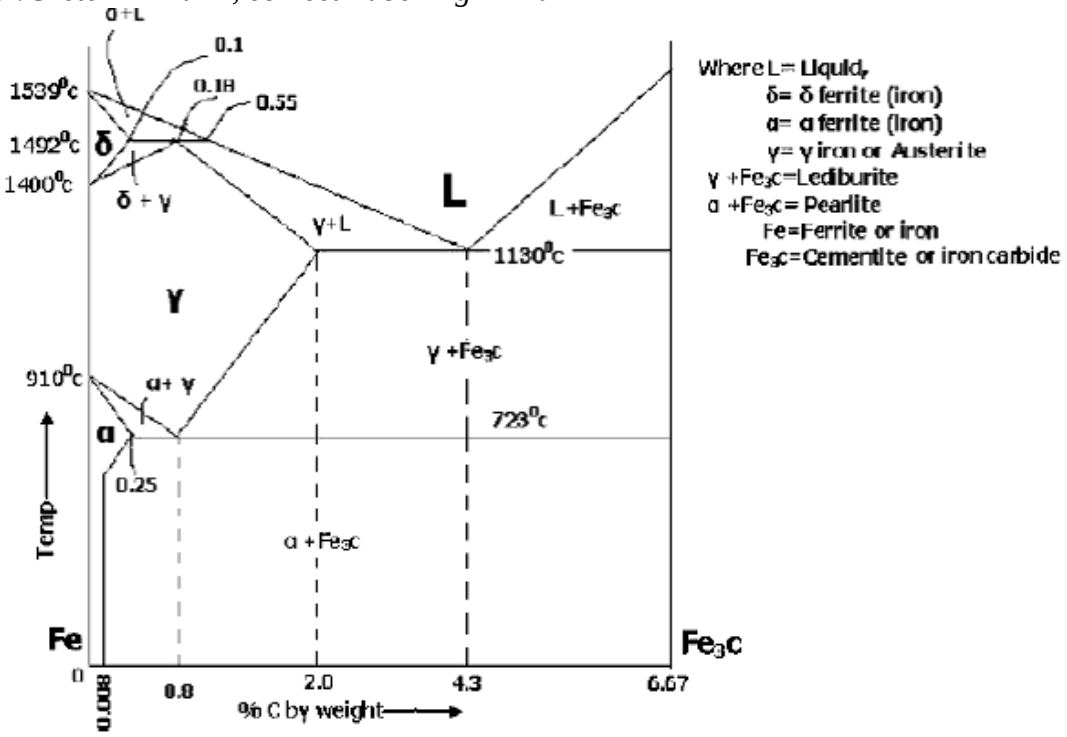
Important Instructions to examiners:

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	(A)	**Attempt any SIX**	**12**
	(a)	**How engineering material are classified?**	**02**
		Answer: Engineering materials are classified as below: *(Classification - 2 Marks & Examples – 2 Marks)* 	**02**
	(b)	**Write composition and use of Grey cast iron**	**02**
		Answer: Grey Cast Iron **Composition of grey cast iron** (1 mark)	

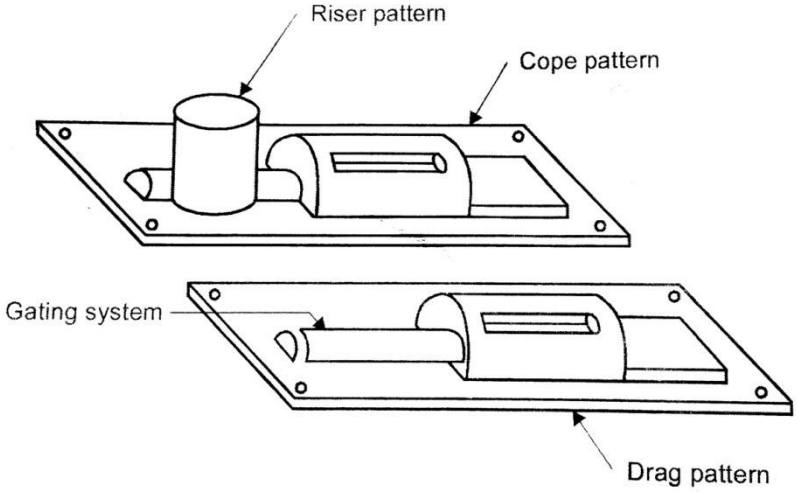
		Carbon = 2.5 - 3.7 %, Silicon = 1 - 2.5 %, Mn = 0.4 - 1 %, Sulphur = 0.06 – 0.12 % , Phosphorus = 0.1- 1% **Applications of grey cast iron:** (Any two – ½ mark each) (i) Machine structure, (ii) Engine frames, (iii)Drainage pipes, (iv) Piston of I.C. engines, (v) Bed of lathe machine. (v) Cylinder block & heads (vi) Flywheels (vii) Pump housings (viii) Frames of electric motors	**02**
	(c)	**What is Babbit metal? Where it is used?**	**02**
		Babbits metal are alloys of lead and tin. Better corrosion resistance. Low compressive strength and not suitable above 120 ^{o} C temperature **Used: for journal bearing**	**02**
	(d)	**Write properties of duralumin. State its applications.**	**02**
		Answer: **Duralumin:** Composition: 3.5-4.5%Cu, 0.4-0.7%Mn, 0.4-0.7%Mg and aluminum **.** **Properties:** It is a very hard alloy. These alloys are used in places where hard alloys are required, for example in the vehicle arm or that is used in the defence industry. Duralumin is a hard, but a light weight alloy of aluminium. It has a typical yield strength of 450 Mpa, and there are certain other variations, that depend on the composition, type and temper **Application: any two** 1. It is widely used in wrought condition for forging, 2.stampings 3. Bars 4.sheets 5.tubes 6.rivets.	**02**
	(e)	**State two properties of Nylon.**	**02**
		Answer: - majority of nylons tend to be semi-crystalline - It tends to absorb moisture from their surroundings. - Nylons tend to provide good resistance to most chemicals; however can be attacked by strong acids, alcohols and alkalis. -Tensile Strength 90 - 185 N/mm²	**02**
	(f)	**List two applications of ceramic materials in automotive industry**	**02**
		Answer: Applications of ceramic materials: i) Insulators, ii) Semi-conductors, iii) Filters iv) Variety of glasses. v) Catalytic convertor v) Electronic control devices vi)Thermistors vii) Sensors vii) Spark plug	**02**

	(g)	**Compare Natural rubber with Synthetic rubber.(Any Two points)**	**02**
		Natural rubber 1) It occurs in nature and can be extracted. 2)It is comparatively less elastic, less oil resistance and can be affected by low and high temperature 3) It is more resistant to cutting and abrasion. 4) Examples of natural rubber are silk, wool, DNA, cellulose and proteins. **Synthetic rubber:** 1)Synthetic rubbers are derived from petroleum oil, and made by scientists and engineers 2) It has high elasticity, oil resistance, air tightness, insulation, resistance to low or high temperature. 3) It is less resistant to cutting and Abrasion 4) Examples of synthetic rubber include nylon, polyethylene, polyester, Teflon, and epoxy	**02**
	(h)	**What is phase transformation? Give one example**	**02**
		Phase transformation – Formation of a new phase having a distinct physical/chemical character and/or a different structure than the parent phase. For example, a liquid may become gas upon heating to the boiling point, resulting in an abrupt change in volume.	**02**
1	**(B)**	**Attempt any TWO**	**08**
	(a)	**Write effect Nickel and Chromium on properties of alloy steel.**	**04**
		Answer: Effect of Nickel and chromium as alloying Element **Nickel :-** Provides toughness, corrosion resistance, and deep hardening. Increases resistance to impact Improves tensile strength	**02**
		Chromium:- Improves corrosion resistance, toughness and harden ability Improves resistance to abrasion and wear	**02**
	(b)	**Write composition, properties and applications of Y-alloy**	**04**
		Answer: **Y' alloy**: It is called a copper Aluminium alloy. An alloy of aluminium with one or more elements like silicon, manganese, magnesium & Nickel etc **Composition:** 92.5 % Al, 4%Cu, 2%Ni and 1.5%Mg. **Application: (any four points)** Piston and other components of aero engines. Piston cylinder head of IC engines Dies casting Pump rods etc. It is also largely used in the form of sheets and strips etc	**04**

	(c)	**What is thermosetting plastic? write properties and use of Epoxy resins**	**04**
		Answer: Thermosetting plastic(any four) i) Once hardened and set they do not softened with application of heat ii) They are formed by condensation polymerization. iii) They have three dimensional network structure. iv) They are usually hard, strong and more brittle. v) They are insoluble in almost all organic solvents. vi) They cannot reused and do not have resale value vii) They can be used at comparatively higher temperature without damage.	**02**
		Properties of Epoxy (Any two :- ½ mark each) i. It is very tough ii. Chemical resistant iii. Electrical resistant iv. Low shrinkage v. Good adhesion to metal and glass vi. Good resistance to wear and impact vii. Dimensionally stable viii. Transparent with creamy color	**01**
		Applications of Epoxy (Any two :- ½ mark each) i. Electrical moulding ii. Sinks iii. Laminated tooling iv. Adhesives v. Protective coatings vi. Housing for electrical parts vii. In transformer as an insulating material	**01**
2.		**Attempt any FOUR**	**16**
	(a)	**Draw a neat sketch of Fe Fe3C equilibrium diagram and show various phases and critical temperatures on it.**	**04**
		Answer: *Sketch -2 mark , correct Labelling -2 mark*  	**04**

	(b)	**Write purpose and process sequence of annealing.**	**04**
		Answer: **Purpose of Annealing process:(Any four ½ mark each)** i. To soften the metal to improve machinability. ii. To refine grain size and structure to improve mechanical properties. iii. To relieve internal stresses. iv. To improve gases. v. To modify electrical, magnetic and physical properties. vi. To increase ductility of metal. vii. To prepare the steel for further treatment **Process of sequence of annealing** Annealing is a heat process whereby a metal is heated to a specific temperature above critical temperature, holding at this temperature for a sufficient time and then allowed to cool slowly. This softens the metal which means it can be cut and shaped more easily. OR It is a process of heating a metal which is in metastable or distort structural state to a temperature which will remove instability or distortion and then cooling usually at a slow rate so that at room temperature structure is stable and strain free.	**02** **02**
	(c)	**Explain nitriding process and state its advantages over carburising**	**04**
		Nitriding: The heat treatment process which produces a hard-wear resistant layer of nitrides on a tough core of low carbon steel is known as nitriding. The process consists of heating machined and heat treated components to a temperature of 500 ^{o} C for 40 to 90 hours in a gas tight box through which ammonia gas is circulated. The component is allowed to cool in the furnace after switching of the supply of ammonia. When ammonia vapours come in contact with the steel, they get dissociated and nascent nitrogen so produced diffuses into the surface of the work piece forming hard nitrides. **Advantages of Nitriding Process:** 1. Very high surface hardness can be obtained. 2. Minimum distortion or cracking 3. Good corrosion and wear resistance 4. Good fatigue resistance 5. No machining is required after nitriding. 6. Economical for mass production.	**04**
	(d)	**Explain advantages, limitations and use of cyaniding**	**04**
		Answer: method of case hardening involving the diffusion of carbon and nitrogen into the surface layer of s teel in cyanide-salt bath temperatures of 820°–860°C (medium-temperature cyaniding) or 930°–950°C (high- temperature cyaniding). Its principalpurpose is to increase the hardness, wear resistance, and fatigue limit of steel products. During cyaniding, the cyanide salts are oxidized with the liberation of atomic carbon and nitrogen, which diffuse into the steel.In medium-temperature cyaniding, the cyanide layer formed, containing 0.6–0.7 percent C and 0.8–1.2 percent N, has athickness of 0.15 to 0.6 mm, while in high-temperature cyaniding (a method often used instead of carburizing), the cyanidelayer, containing 0.8–1.2 percent C and 0.2–0.3 percent N, has a thickness of 0.5 to 2 mm. After cyaniding, a productundergoes hardening and low-temperature tempering.	**04**

		Disadvantages of cyaniding are high cost and the toxicity of the cyanide salts.	
	(e)	**Write factors governing selection of pattern materials. List any four pattern materials.**	**04**
		Answer: *any 4 types – ½ mark each, any 4 factors – ½ mark each* **Factors governs the selection of pattern material:(Any Four)** 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**
		Various Materials used for making Patterns: (Any four) The wide variety of pattern materials in use 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 and alloys: 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	**02**
	(f)	**Write advantage and disadvantages of foundry process.**	**04**
		Advantages of foundry process: (Any Two – 1 mark each) i. It one of the most versatile manufacturing process. ii. Castings provide uniform directional properties. iii. Intricate shaped parts can be produced. iv. Very complicated parts can be cast in one piece. **Disadvantages of foundry process**: (Any Two – 1 mark each) i. It is only economical for mass production. ii. Sand casting process cannot produce parts in accurate sizes. iii. Special casting processes are expensive. iv. In some casting process, skilled operators are required. v. Internal defects are not identified easily	**04**

3		**Attempt any FOUR of the following:**	**16**
	a	**Explain color coding of pattern. State its importance.**	**04**
	ANS:	*(Meaning of any four color codes-1/2 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**. **The colour coding of pattern is important** . To identify main part of the pattern from remaining part . To identify loose pieces, core prints etc . To show the part to be machined . To show the part to be left unmachined. . To identify the type of metal mo be casted.	**02** **02**
	b	**Explain cope and drag pattern with sketch.**	**04**
	ANS:	**Cope and Drag Pattern:** A cope and drag pattern is a split pattern having the cope and drag portions each mounted on separate match plate. These patterns are used when in the production of large castings, the complete moulds are too heavy and unwieldy to be handled by single worker. The patterns are accurately located on the plates, so that when the two separately made mould halves are assembled together, the mould cavity is properly formed. For a higher rate of production each half of the pattern is mounted on a separate moulding machine, one operator working on the cope and part of the mould and other on the drag part of the mould.  **OR**	**02** **02**

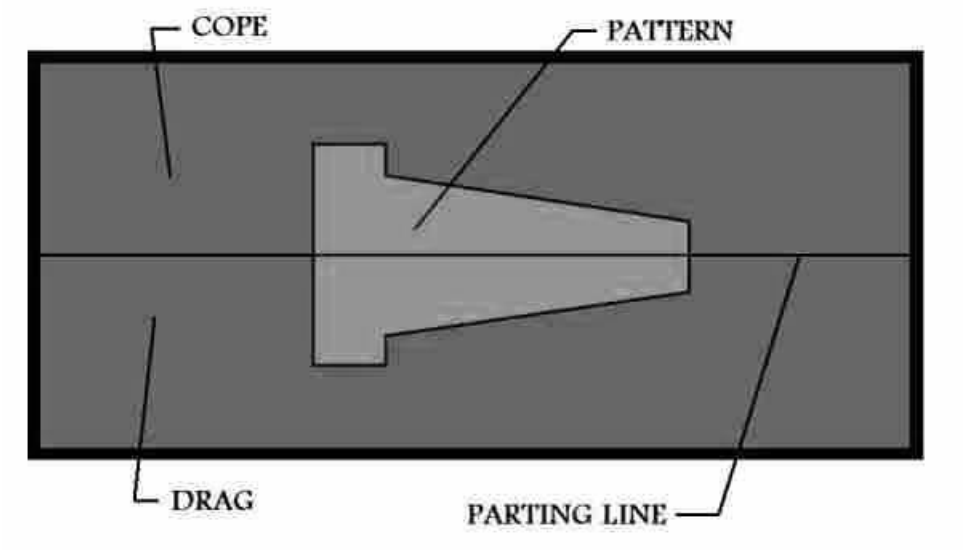
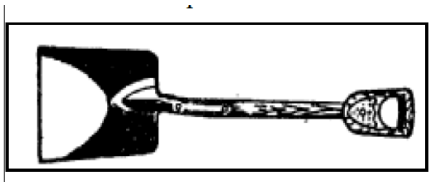
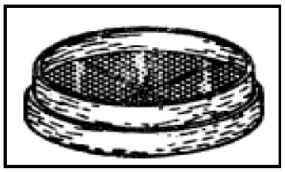
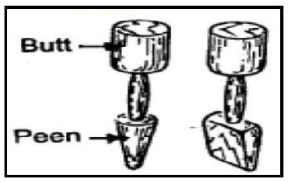
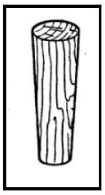
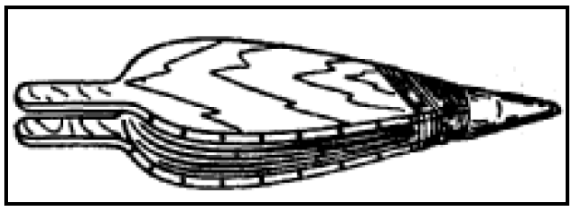


Figure: Cope and Drag Pattern

	c	**List any five moulding tools and explain any two of them with sketch.**	**04**
	ANS:	**Ans: any 5 moulding tools – 2 marks , explanation - 2 marks (1mark each)** Hand moulding tools used in foundry: i) Shovel ii) Riddle iii) Rammer iv) Trowel v) Sprue pin vi) Bellow vii) Moulding boxes viii) Strike off bar ix) Mallet x) Draw spike xi) Vent rod xii) lifters Foundry tool & equipments may be classified into three groups namely, hand tools, flasks and mechanical tools. **Hand Tools:** The hand tools a moulder uses are fairly numerous. A brief description of the most important tools is given here. **Shovel:** A shovel (Fig.1) is used for mixing and tempering moulding sand and for moving the sand from the pile to the flask.  (Fig. 1)  (Fig. 2) **Riddle:** A riddle, sometimes called a screen, consists of a circular or square wooden frame fitted with a standard wire mesh at the bottom as shown in Fig. 2. It is used for removing	**02** **(1 mark each for Any 2)** **½ mark for description**

		foreign materials such as nails, shot metal, splinters of wood, etc., from the moulding sand. **Rammer:** A hand rammer (Fig.3) is a wooden tool used for packing or ramming the sand into the mould. One end, called the peen, is wedge shaped, and the opposite end, called the butt, has a flat surface.  (Fig. 3)  (Fig. 4)  (Fig. 5) **Trowel:** A trowel consists of a metal blade fitted with a wooden handle (Fig.4). Trowels are employed in order to smooth or sleek over the surfaces of moulds. A moulder also uses them in repairing the damaged portions of a mould. **Sprue pin:** A sprue is a tapered peg (Fig.5) 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. **Bellow:** Bellows are used to blow loose particles of sand from the pattern and the mould cavity. A hand blower is shown in (Fig.6). Moulding machines are also provided with a compressed air jet to perform this operation.  (Fig. 6)	**and ½ mark for sketch**
	d	**Write sand composition for typical green sand moulding with function of ingredients.**	**04**
	ANS:	**Moulding Sand Composition:** The main ingredients of any moulding sand are: 1. Base sand, 2. Binder, and 3. Moisture **1. Base Sand** Silica sand is most commonly used base sand. Other base sands that are also used for making mould are zircon sand, Chromite sand, and olivine sand. Silica sand is cheapest among all types of base sand and it is easily available. **2. Binder** Binders are of many types such as: • Clay binders, • Organic binders and • Inorganic binders •	**01** **01**

Clay binders are most commonly used binding agents mixed with the moulding sands to provide the strength. The most popular clay types are:
Kaolinite or fire clay (Al_2O_3 2 SiO_2 2 H_2O) and Bentonite (Al_2O_3 4 SiO_2 nH_2O)
Of the two the Bentonite can absorb more water which increases its bonding power.

3. Moisture

Clay acquires its bonding action only in the presence of the required amount of moisture. When water is added to clay, it penetrates the mixture and forms a microfilm, which coats the surface of each flake of the clay. The amount of water used should be properly controlled. This is because a part of the water, which coats the surface of the clay flakes, helps in bonding, while the remainder helps in improving the plasticity. A typical composition of moulding sand is given in following table **01**

Table A Typical Composition of Moulding Sand

Moulding sand Constituents	Weight Percent
Silica Sand	92
Clay (sodium Bentonite)	8
Water	**01**

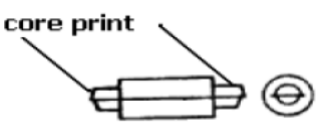
e **Explain core and core prints used in moulding.** **04**

ANS: **Answer: Core:** A core is a predetermined shaped mass of dry sand which is made separately from mould. It is positioned in a mould to obtain a shape in the castings which can't be readily obtained by the mould. Core box pattern equipment, baking equipment and handling facilities are required for making cores. Cores should be of sufficient thickness and free of fragile or overhanging projections which might be easily broken during the necessary handling and transportation involve in production.
Core is used to obtain the desired cavities and recesses which otherwise could not be obtained by normal moulding operation. **02**

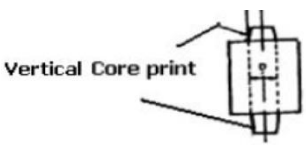
Following types of cores are used in moulding

1. Horizontal cores
2. Vertical cores
3. Balanced core
4. Hanging and cover core:

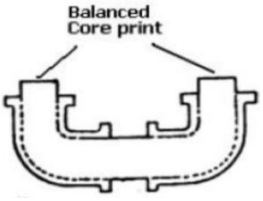
Core print: For supporting the cores in the mould cavity, an impression in the form of a recess is made in the mould with the help of a projection suitably placed on the pattern. This projection on the pattern is known as the core print. A core print is, therefore, an added projection on a pattern, and it forms a seat which is used to support and locate the core in the mould. There are several types of core prints, viz., horizontal or parting line core print, vertical or cope and drag core print, balancing core print, cover or hanging core-print, wing or drop core-print **01**



OR



OR

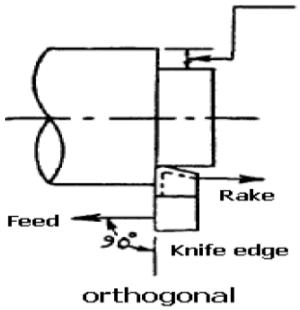
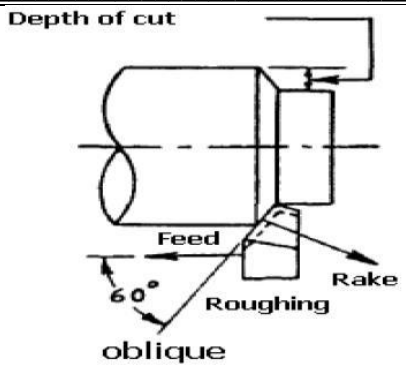
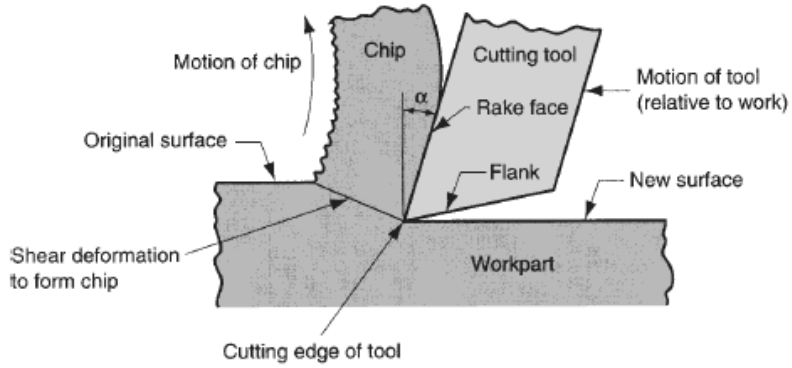


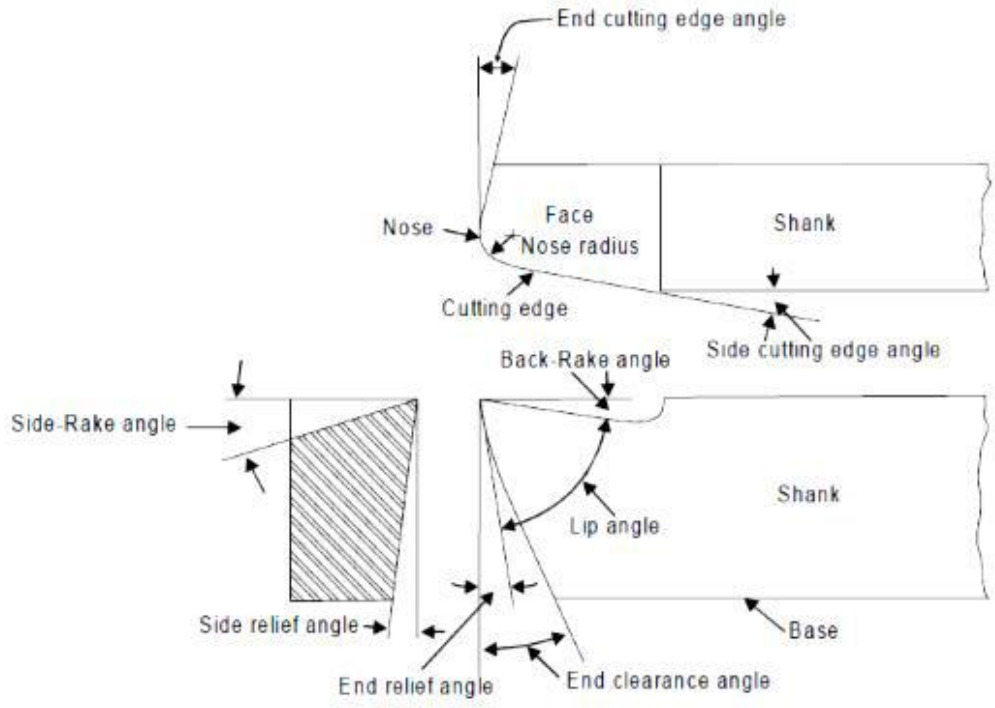
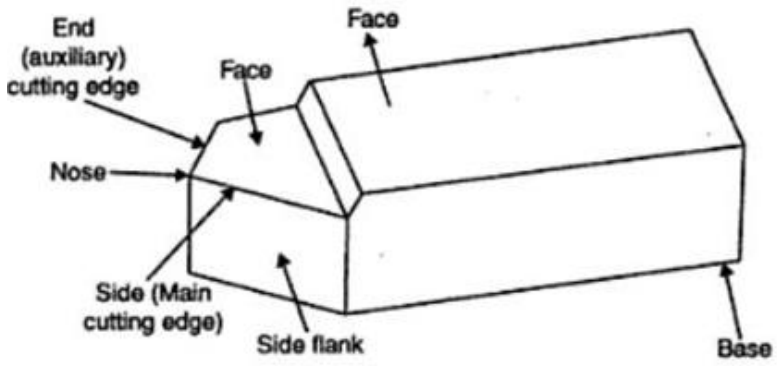
01

	f	**Write causes and remedies for 'blow holes' and 'cold shut' in casting.**	**04**
	ANS:	**Blow holes** **Causes:** 1. Excessive moisture content 2. Poor venting of moulds 3. Insufficient drying of moulds and core 4. Cores not properly vented 5. High gas content of the molten metal 6. Low pouring temperature 7. Incorrect feeding of the castings	**01**
		Remedies: 1. Control moisture content. 2. Use clean and rust free chills, chaplets and metal insert. 3. Bake cores properly. 4. Proper use of organic binders. 5. Cores and moulds should be properly vented. 6. Moulds should not be rammed excessively hard.	**01**
		Cold shut: **Causes:** 1. Inadequate metal supply 2. Too low mould or melt temperature 3. Improperly designed gates or length to thickness ratio of casting is too large	**01**
		Remedies 1. Adjust proper pouring temperature 2. Modify design 3. Modify gating system.	**01**
4		**Attempt any four:**	**16**
	a	**Explain pressure die casting principle and state its applications in automobile industry.**	**04**
	ANS:	**Principle of Pressure Die Casting:** In the pressure die casting process, molten or semi-molten metal is forced under high pressure (20 to 2000 kgf/cm^2) into the cavities of the steel mould. Dies are two part moulds that are made of alloy tool steel. The fixer die half and the ejector die half. The die or mould is fabricated with the impression of the component that is to cast. The molten metal is injected into the die under high pressure and high speed, which helps in producing a casting that is smooth and precise as the original mould. The pressure is maintained on the mould until the hot metal solidifies. When the metal is hardened, the die is opened to remove the casting.	**02**
		Applications: 1. Wheels, 2. Engine blocks, 3. Cylinder heads,	**(any 4)** **02**

		4. Manifolds etc.	
	b	**Write function of gating and risering system.**	**04**
	ANS:	**Functions of Gating system in casting**: (Any 02 functions 01 mark each) 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. **Functions of Risering system in casting**: (Any 02 functions 01 mark each) . To feed molten metal into the main casting cavity to compensate for shrinkage as the casting solidifies. . It establishes temperature gradients within the castings so that the casting solidifies directionally towards the riser. . It is used to eject steam, gas and air from the mould cavity while filling the mould with the molten metal.	**02** **02**
	c	**Compare orthogonal cutting and oblique cutting.**	**04**
		Answer: (Any 04 points 01 mark each) **Comparison between orthogonal cutting and oblique cutting.**	**04**

Sr. No.	Orthogonal Cutting	Oblique Cutting
1	Cutting face of the tool is perpendicular to the line of action of tool	Cutting face of the tool is less than 90° to the line of action or path of the tool
2	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.
3	The chip flows over the tool face. Chip formation in the form of coils ,in tight ,flat, spiral	The chip flows on the tool face. Chip formation is long curl
4	Only two components of the cutting forces are acting on the tool.	Only three components of the cutting forces are acting on the tool.
5	Tool is perfectly sharp.	Tool is not perfectly sharp.
6	Tool contacts the chip on rake face only.	The tool may not generate a surface parallel to workface.
7	The maximum chip thickness occurs at the middle.	The maximum chip thickness may not occur at the middle.

			8			
	d	**Explain mechanism of chip formation with sketch.**				**04**
	ANS	**Answer:** (Description – 2 Mark, sketch – 2 Mark) **Mechanism of chip formation** 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.  **Mechanism of chip formation**			**02** **02**
	e	**Discuss properties and types of cutting fluids.**				**04**
	ANS:	**Properties of cutting fluid:**(any four ½ mark each) 1. High heat absorption 2. Good lubricating qualities to produce low coefficient of friction 3. Low viscosity to permit free flow of liquid 4. Non-corrosive to the work or the machine 5. High flash point so as the eliminate the hazards of fire 6. Odourless ,so as not to produce any bad smell 7. Harmless to the skin of operator 8. Transparency so that the cutting action of the tool may be observed **Types Of Cutting Fluids:**(any four ½ mark each) 1) Water 2) Soluble oil			**2 marks for any four properties**

		3) Emulsions 4) Chemical Fluids 5) Semi-chemical Coolants 6) Straight Cutting Oils 7) Inactive Straight Cutting Oils 8) Active Straight Cutting Oils 9) Mixed oil 10) Solid Lubricants :- stick waxes & bar soaps	**2 marks for any four types**
	f	**Sketch single point cutting tool and write tool signature.**	**04**
		 Figure Single Point Cutting Tool **OR**  Figure Single Point Cutting Tool	**03**

		Tool signature: 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 in mm	**01**

5		**Attempt Any FOUR**	**16**
	a	**How the cutting tool is selected? Compare single point tool with multipoint tool.**	**04**
	Ans.	*(Any two characteristics = 01 Mark each, Any two points of comparison = 01 Mark each)* **The materials having following the characteristics/ properties are selected for Cutting Tool:** **1. Hot hardness:** The material must remain harder than the work material at elevated operating temperatures. **2. Wear resistance:** The material must withstand excessive wear even though the relative hardness of the tool-work materials changes. **3. Toughness:** The material must have sufficient toughness to withstand shocks and vibrations and to prevent breakage. **4. Cost and easiness in fabrication:** The cost and easiness of fabrication should have within reasonable limits.	**02**

Single Point Tool	**Multipoint Tool**
1. This tool is used on lathe machine, planning machines and boring machines.	1. This tools are used on milling machines, grinding machines, Drilling Machine, etc.
2. This tool has only one cutting point.	2. This tool has more than one cutting point.
3. This tools are mostly tipped tools.	3. This tools may be lugged or solid tools
4. Example: Turning Tool, Boring Tool,	4. Example: Reamer, End Milling Cutter, Grinding wheel, Drill, etc.
5. Shank of single point tool is made flat or square to hold it in the tool post or tool holder.	5. Shank of multipoint tools are usually round or tapered shaped.

02

	b	**Explain taper turning on lathe machine by any one method.**	**04**
	Ans.	*(Any one of the following with neat sketch= 04 Marks)* **Taper Turning Operation** :- I. By a Broad Nose Form Tool II. By swiveling the compound rest III. By Setting Over the Tailstock Centre IV. By a Taper Turning Attachment V. By Combining Longitudinal and Cross Feed **I) By Broad Nose Form Tool** :-	04

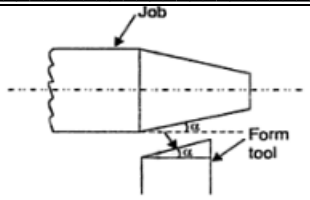


Figure: Taper Turning by Broad Nose Form Tool

It is a method of taper turning shown in fig. a broad nose tool having straight cutting edge is set on to the work at half taper angle and is fed straight into the work to generate a tapered surface.
With this method, tapers of short length only can be turned. This form tool taper turning method not adversely used. It is limited to short external tapers. The edge tool must be exactly straight for accurate work

II) Taper Turning Method by Swiveling the Compound Rest:

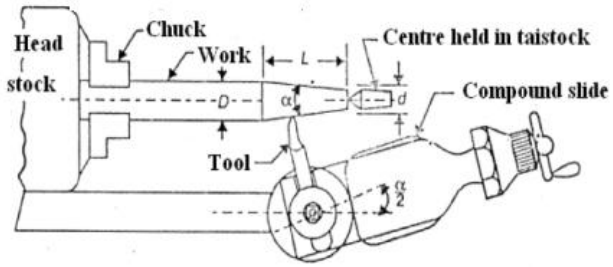


Figure: Taper Turning Method by Swiveling the Compound Rest

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.

(III)By Setting Over the Tailstock Centre:-

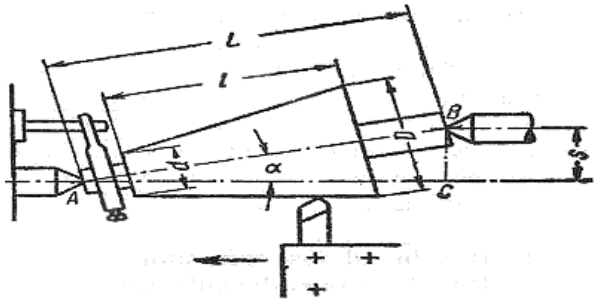


Figure: Taper Turning Method by Setting Over the Tailstock Centre

The principle of turning taper by this method is to shift the axis of rotation of the workpiece, at an angle to the lathe axis, and feeding the tool parallel to the lathe axis. The angle at which the axis of rotation is shifted is equal to half angle of taper. This is done when the body of tailstock is made to slide on its base towards or away from the operator by a set over screw. The amount of set over screw being limited, this method is suitable for turning

small taper on long jobs.

(IV) By a Taper Turning Attachment:-

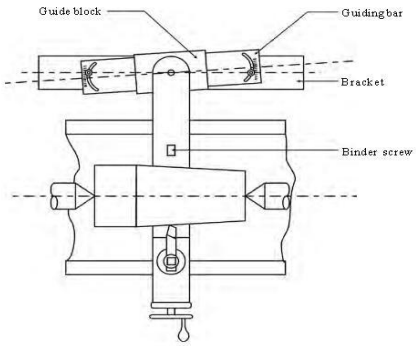


Figure: Taper Turning Method by Taper Turning Attachment in Lathe

The principle of turning taper by a taper attachment is to guide the tool in a straight path set at an angle to the axis of rotation of the work piece, while the work is being revolved between centres or by a chuck aligned to the lathe axis. It consists of a bracket or frame which is attached to the rear end of the lathe bed and support guide bar pivoted at the centre. The bar having graduations in degrees may be swiveled on either side of zero graduations and is set at the desired angle with lathe axis.

When taper turning attachment is used, the cross slide is first made free from lead screw. The rear end of cross slide is then tightened with the guide block by means of bolt. When longitudinal feed is engaged, the tool mounted on cross slide will follow the angular path, as the guide block will slide on the guide bar set at an angle to the lathe axis. The required depth of cut is given by the compound slide. The guide bar must be set at half taper angle and taper on the work must be converted in degrees.

(V)By Combining Longitudinal and Cross Feed:-

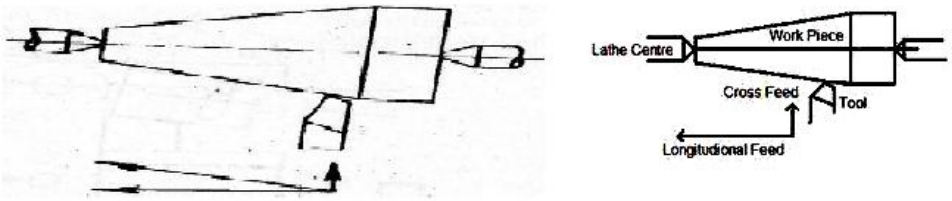
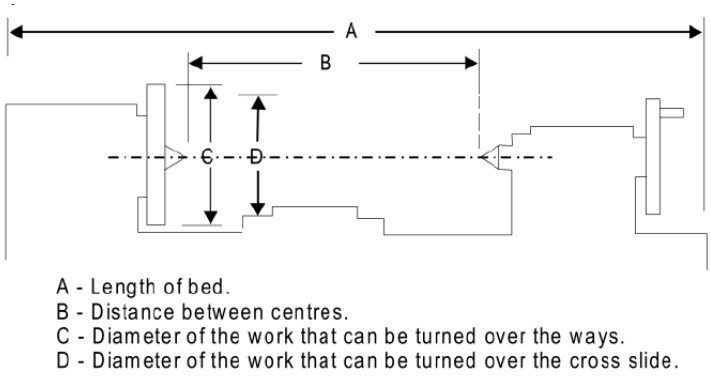
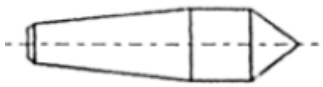
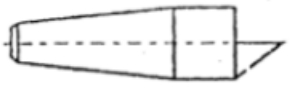


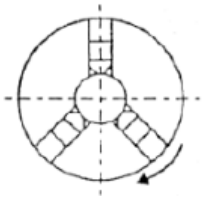
Figure: Taper Turning by Combining Longitudinal and Cross Feed

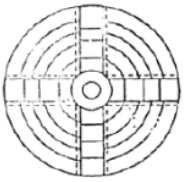
This is a more specialized method of turning taper .In certain lathes both longitudinal and cross feeds may be engaged simultaneously causing the tool to follow a diagonal path which is the resultant of the magnitude of the two feeds. The direction of the resultant may be varying the rate of feeds by change gears provided inside the apron.

	c	**How a centre lathe is specified?**	**04**
	Ans.	**Lathe Machine Specification:** *(Any 4 points - 1 mark each)* ***or*** *(Appropriate sketch with description 04 Marks)* The lathe is generally specified by the following means: a) Swing or maximum diameter that can be rotated over the bed b) Maximum Swing over carriage c) Maximum length of the job that can be held between head stock and tailstock centers d) Length of bed	04

		e) Height of centers over bed f) Maximum swing in gap- in case of gap bed lathes only **OR**  A - Length of bed. B - Distance between centres. C - Diameter of the work that can be turned over the ways. D - Diameter of the work that can be turned over the cross slide. Figure : Lathe Machine Specification.	
	d	**List any four lathe accessories and write their functions.**	**04**
	Ans.	*Listing any 4 accessories 02 mark (½ mark each) & their functions 02 marks(½ mark each)* **Accessories of lathe:** 1. Centre 2. Chuck 3. Face plate 4. Angle plate 5. Mandrel 6. Rests 7. Carriers 8. Catch plates 9.Collets **1. Centre:** a. There are two types of centre i.e., live centre and dead centre. b. A centre which fits into the headstock spindle and revolves with the work is called live centre. c. The centre which is used in a tailstock spindle and does not revolve is called dead centre.   (a) Standard Centre (b) Half Centre **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 centre 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, and vii) air or	02

hydraulic chuck





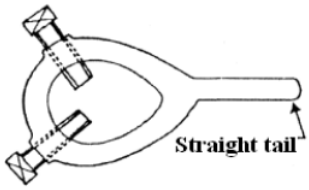
(a)Three Jaw Chuck (b) Four Jaw Chuck

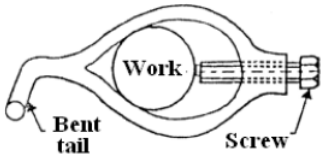
3. Lathe Dog or Carrier:

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

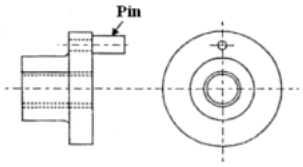


Figure: Drive Plate

5. 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't be conveniently held in a chuck.

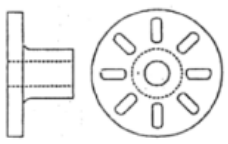
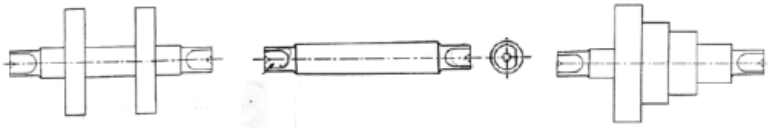
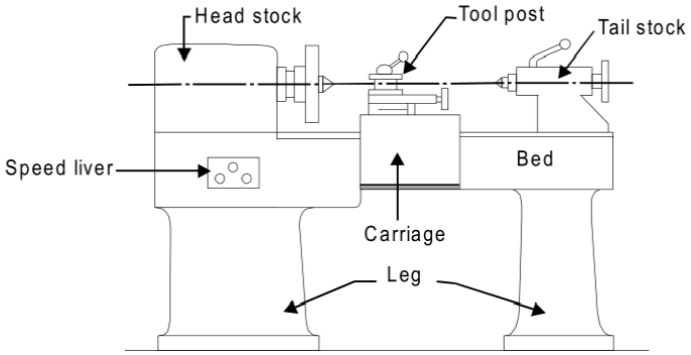
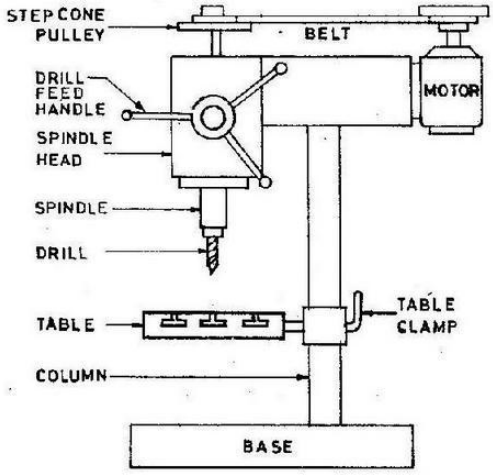
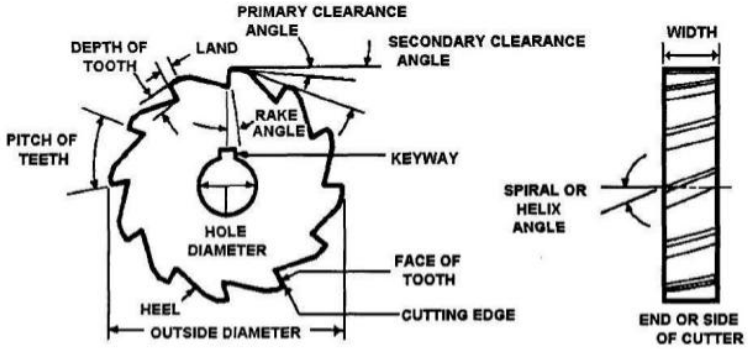


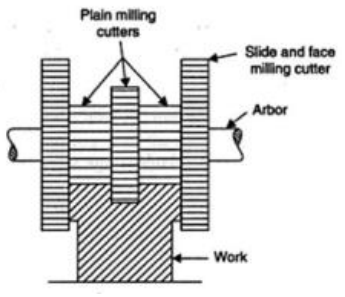
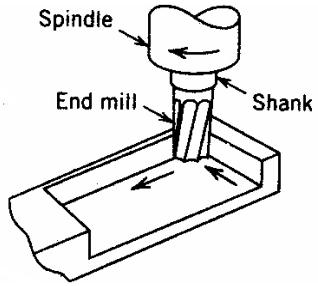
Figure: Face Plate

		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.  (1) Collar Mandrel (2) Plain Mandrel (3) Step Mandrel	02
	e	**Draw a block diagram of lathe machine and show major parts.**	**04**
	Ans.	*(Block Diagram= 03 marks, Labeling= 01mark)*  Figure : Block Diagram of Lathe Machine	**04**
	f	**How the drilling machines are classified?**	**04**
	Ans.	***Classification of drilling machine (any 8)= 04 marks (½ mark each)*** **Classification of Drilling Machine:** 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	**04**

		10. Deep hole drilling machine	
6		**Attempt Any FOUR**	**12**
	a	**Explain bench drilling machine with block diagram.**	**04**
	Ans.	***(Diagram=02mark, Labeling=01mark,function of any 2 parts =01mark)*** **Major Parts of Bench Drilling Machine** *:* **Functions of Parts**: (Any 02) **i. Base:** It supports the column, which in turn, support the table and head etc. **ii. Spindle:** It is made up of alloy steel. It rotate as well as moves up and down in a sleeve **Iii. Drill Chuck :** It is held at the end of the drill spindle and in turns it holds the drill bit or tool. **iv. Head :**it contains the electric motor ,V pulley & v-belt which transmit rotary motion to drill spindle at number of speeds **v. Adjustable Table:** It is supported on the column of the drilling machine and can be moved vertically and horizontally. It also carries slot for bolt clamping **vi. Column:** It is vertical round or box section, which rests on the base and supports the head and the table.  Figure: Bench Drilling Machine	**02** **02**
	b	**Sketch a standard milling cutter and show its nomenclature. State the functions of various angles.**	**04**
	Ans.	***(Sketch = 01 Mark, Nomenclature= 01 Mark, function of any four angle=02 Mark)***  Figure: Nomenclature of Milling Cutters.	**02**

		Various Angles and Their Functions: **(i) Helix Angle**: To provide more contact of cutting edge with workpiece, to get better surface finish. **(ii) Primary Clearance Angle**: To form the flutes and make a room for the chips. **(iii) Secondary Clearance Angle:** To maintain the strength of the tooth. **(iv) Rake Angle:** To form the cutting edge at cutting face. **(v) Gash Angle:** Evacuation of Chips from the cutting edge to the flutes.	**02**
	c	**Name major parts of universal milling machine and write their functions.**	**04**
	Ans.	***(Name of any eight parts = 02Marks, Function of any two parts = 01 Mark each)*** **(i) Base:** It is the foundation part of a milling machine. All other parts are jointed on it. It carries the entire load so it should have high compressive strength so it is made by cast iron. It also works as reservoir of cutting fluid. **(ii) Column:** Column is another foundation part of milling machine. It is mountain vertically on the base. It supports the knee, table etc. Work as housing for the all the other driving member. It is a hollow member which contains driving gears and sometimes motor for spindle and the table. **(iii) Knee:** Knee is the first moving part of milling machine. If is mounted on the column and moves along the slideways situated over the column. It is made by cast iron and moves vertically on slideways. It moves up and down on sideways which change the distance between tool and workpiece It is driven by mechanically or hydraulically. **(iv) Saddle:** It is placed between table and the knee and work as intermediate part between them. It can moves transversally to the column face. It slides over the guide ways provided situated on the knee which is perpendicular to the column face. The main function of it is to provide motion in horizontal direction to work piece. It is also made by cast iron. **(v) Table:** Table is situated over the knee. It is the part of machine which holds the work piece while machining. It is made by cast iron and have T slot cut over it. The work piece clamp over it by using clamping bolts. The one end of clamping bolt fix into this slot and other is fix to work piece which hold the work piece. It can provide three degree of freedom to work piece. It provides vertical motion by moving the knee up and down. It provides horizontal motion by the feed screw. It provides horizontal (transverse) motion by moving the saddle. ***Along with above three movements, the table of UNIVERSAL MILLING MACHINE, can be swiveled horizontally and can be fed at angle to the milling machine spindle***. **(vi) Overhanging arm:** It is situated over the column on horizontal milling machine. It is	**04**

		overhang over the column surface and other end supports the arbor. It is made by cast iron. **(vii) Spindle:** Spindle is the main part of the machine which hold tool at right place in vertical milling machine and hold arbor in horizontal milling machine. It is a moving part which is in rotary motion. It is motor driven and drives the tool. It has a slot on the front end of it. The cutting tool fix in that slot. **(viii) Arbor:** It is a mechanical part on which is used as extension part of the spindle in horizontal milling machine. It is fitted on the spindle whenever required. It holds the tool and moves it in correct direction. **(ix) Arbor Supports:** This are used to support arbor at right place. One end of this support is jointed at the overhanging arm and another is jointed with arbor. **(x) Milling head:** It is upper section of vertical milling machine. It consist spindle, driving motor and other controlling mechanism. **(xi) Ram:** Ram is work as overhanging arm in vertical milling machine. One end of the arm is attached to the column and other end to the milling head.	
	d	**How the milling machines are classified?**	**04**
	Ans.	*(Detailed Classification= 04 Marks)* **Classification of Milling Machine:-** ***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 e. Omniversal 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**
	e	**Explain gang milling and end milling with sketch.**	**04**
	ANS:	*(Figure 01 mark each, Explanation 01 mark each)* **(1) 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.	

		  Figure: Gang Milling Operation Figure: End Milling Operation **(2) End Milling Operation:** End milling operation produces flat vertical surfaces, flat horizontal surfaces and other flat surfaces making an angle from table surface using milling cutter named as end mill. This operation is preferably carried out on vertical milling machine.	
	f	**You are going to carry following operations on milling. Give which cutter you will use for them:** (i) **Gear tooth** (ii) **Parting off** (iii) **Keyway** (iv) **Rounding of corner**	**04**
		Answer: Cutter used for the following operations on milling: (01 mark for each) (v) **Gear tooth:** Form milling cutter, Gear cutter (vi) **Parting off:** Slitting cutter (vii) **Keyway:** End mill cutter and special type cutter (viii) **Rounding of corner**: Profile milling cutter	**04**