Summer – 16 EXAMINATION

Subject Code: **17306** **Model Answer**

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 judgment 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.

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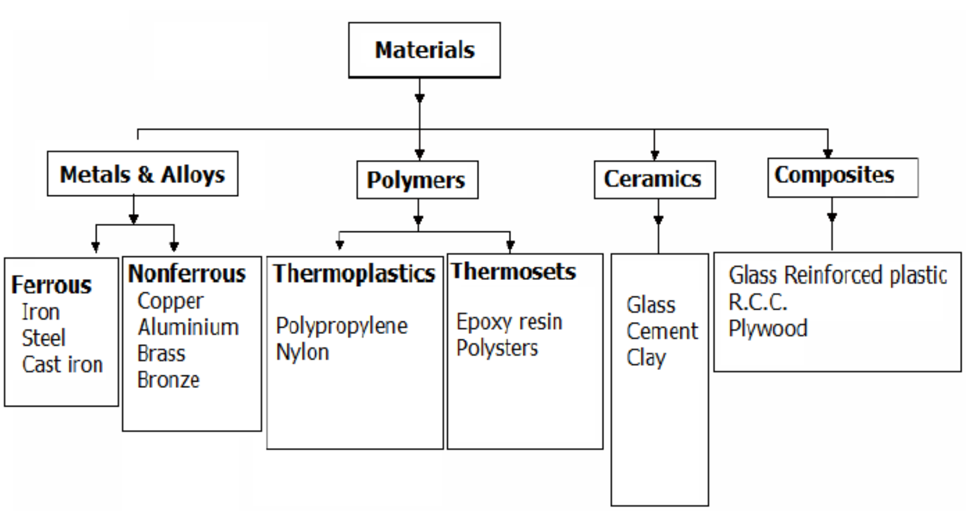
	Marks
1. A) Attempt any six of the following:	12
a) State any four properties of tool steel material	2
Answer: **Properties of tool steel material:** *(Any four – ½ mark each)* 1. Red Hardness i.e. resistance to softening on heating. 2. Corrosion resistance 3. Wear resistance 4. Cutting ability 5. Heat resistance 6. Good machinability 7. Resistance to decarburization 8. Little risk of cracking during hardening 9. Definite cooling rate during hardening	2
b) Explain the meaning of C.I. Give one example with its composition.	2
Answer: **Cast iron:** It is basically an alloy of iron and carbon in which carbon content varies between 2 % to 6.67 %	1
Example: *(Any one* -- ½ mark, Composition - ½ mark*)* **1) Grey cast iron-** Composition :- C = 2.5 - 3.7 %, Si = 1 - 2.5 % , Mn = 0.4 - 1 %, S = 0.06 – 0.12 % ,P = 0.1- 1% **2) White cast iron-** Composition: C = 1.75 - 2.3%, Si = 0.85 - 1.2%, Mn = 0.1 - 0.4%, S = 0.12 - 0.35%, P = 0.05 - 0.2% **3) Malleable cast iron-** Composition: C = 2.2 - 3.6%, Si = 0.4 - 1.1%, Mn = 0.1 - 0.4%, S = 0.03 – 0.3%, P = 0.1 - 0.2% **4) Ductile /Nodular/spheroidal cast iron –** Composition: C= 3.2 - 4.2 % , Si = 1.1 - 3.5 % , Mn = 0.3 - 0.8 % ,S =0.2 %, P = 0.08%	1

c) State two engineering applications of aluminum and copper.	2
Answer: **Applications of aluminum:** *(Any two applications - ½ mark for 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 **Applications of copper:** *(Any two applications - ½ mark for each)* 1. Electrical conductors 2. Automobile radiators 3. Pressure vessels 4. Bus bars 5. Utensils 6. Roofing	1 1
d) What is Y- alloy and where it is used?	2
Answer: **Y' alloy**: It is called a copper Aluminum alloy. An alloy of aluminum 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 Two – ½ Marks each)*** i. Piston and other components of aero engines. ii. Piston, iii. cylinder head of IC engines, iv. dies casting, v. Pump rods etc. vi. It is also largely used in the form of sheets and strips etc	1 1
e) What is a thermoplastic? State types of thermoplastics.	2
Answer: **Thermoplastic:** These are composed of linear and long chain straight or slightly branched molecules. They can be re-softened and re-melted by application of heat and pressure. The materials which can be re-melted to manufacture fresh new products are called as thermoplastics. **Types of Thermoplastic:*(Any 02- ½ mark each)*** 1. Polythene 2. Polypropylene 3. Polystyrene 4. Nylon 5. Acrylics 6. Polycarbonates 7. Acrylonitrile butadiene styrene 8. Polyvinylchloride (PVC)	1 1
f) What is ceramic? Give its properties.	2
Answer: Ceramic: A ceramic is "an inorganic, nonmetallic solid that is prepared from powdered materials and is fabricated into products through the application of heat".	1

Properties of Ceramic Material: *(Any Two- ½ mark each)* i. Inorganic & 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	1
g) State any four non-metallic materials.	2
Answer: Non-metallic materials: (*Any four- ½ mark for one material*) 1. Plastic /Polymers a) Thermoplastic: Nylon , PVC,ABS ,Polypropylene, Acrylics etc b) Thermosets: Epoxy resin, polyester, Phenolic, Polyamides etc. 2. Rubber 3. Ceramics 4. Glass 5. Cement 6. Clay 7. Wood	2
h) What is phase – transformation diagram?	2
Answer: Phase transformation Diagram: Phase diagrams are the diagrams which indicate the phase existing in the system at any temperature and composition. Y- axis of phase diagram indicates temperature and X-axis indicates weight percent of second element as abscissa. These diagrams are used to find out the amount of phases existing in a given alloy with their composition at any temperature. It also helps in understanding the phenomenon that occur during rapid heating and cooling of the alloy.	2
B) Attempt any two of the following:	8
a) How engineering materials are classified? Give one example of each.	4
Answer: **Engineering materials are classified as below:** *(Classification - 2 Marks & Examples – 2 Marks)* 	4

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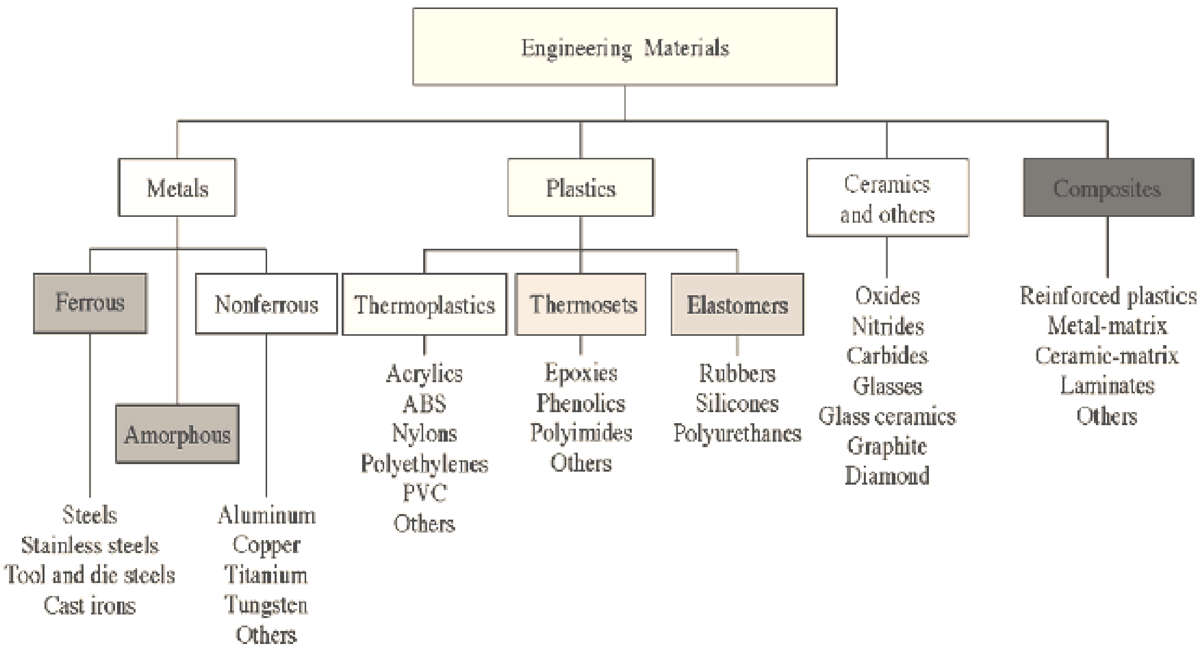


b) What are different alloys of copper? State its important properties. 4

Answer:

Alloys of Copper *(Any 2 of the followings - ½ mark each)*

1) Brass (Copper –zinc)
   a) α-brass: Cap copper ,Gliding metal , Cartridge brass, Admiralty brass 1
   b)α-β brass: Muntz metal ,Naval brass , High tensile brass, Leaded brass ,Brazing brass
2) Bronze: Phosphor bronze ,Aluminum bronze , silicon bronze ,Tin bronze, Manganese bronze
3) Gun metal
4) Babbitt metal (Copper-tin –Antimony)

Properties of Copper Alloys: *(Any three 01 mark each)*

1) High thermal & Electrical conductivity
2) Good Corrosion resistance
3) Soft & Nonmagnetic 3
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

c) Define Rubber. Give its types , properties & applications 4

Answer: Definition -1 mark, Types -1 mark, Properties -1 mark & Applications -1 marks.

Rubber: A rubber defined as an organic polymer, which elongates on stretching and regains its original shape after the removal of the stress. Major property of rubber is its high elasticity. 1

Following are the types of Rubber: (*Any Two – ½ Marks Each)* 1. Natural rubber (NR) 2. Synthetic rubber, 3. Different types of synthetic rubbers are: i. Styrene-butadiene rubber (SBR) ii. Butyl rubber iii. Nitrile rubber. iv. Silicone (SIL) v. Neoprene (CR) vi. Butadiene (NBR) **Properties of rubber:** (*Any Two – ½ Marks Each)* 1) Elasticity 2) Electrical insulators 3) Resistance to water 4)Abrasion resistance 5) Tear resistance 6) Wear resistance 7) Shock dampening properties. 8) Resistance to oil, solvents, oxygen, ozone, and certain chemicals **Applications of rubbers:** (*Any Two – ½ Marks Each)* *1.* Automobile tyres 2. Belts 3. Shoe 4. Soles 5. Flooring 6. Electric wire insulation 7. Coatings 8. Packaging 9. Tubing for food and medical uses 10. Seals and gaskets 11. Chemical tank linings 12. Chemical, gasoline and oil hoses 13. O- rings 14. Shock mounts 15. Tubeless tire liners, Inner tubes 16. Stoppers for glass bottles 17. Medicine bottles, and pharmaceuticals 18. Carburetor and fuel pump diaphragms	1 1 1
2. Attempt any four of the following:	16
A. Draw iron- carbon equilibrium diagram and label it.	4
Answer: *Sketch -3 mark , correct Labeling -1 mark* *(Credit should be given to suitable figure showing all details such as temperature percentage of carbon and state)*	4

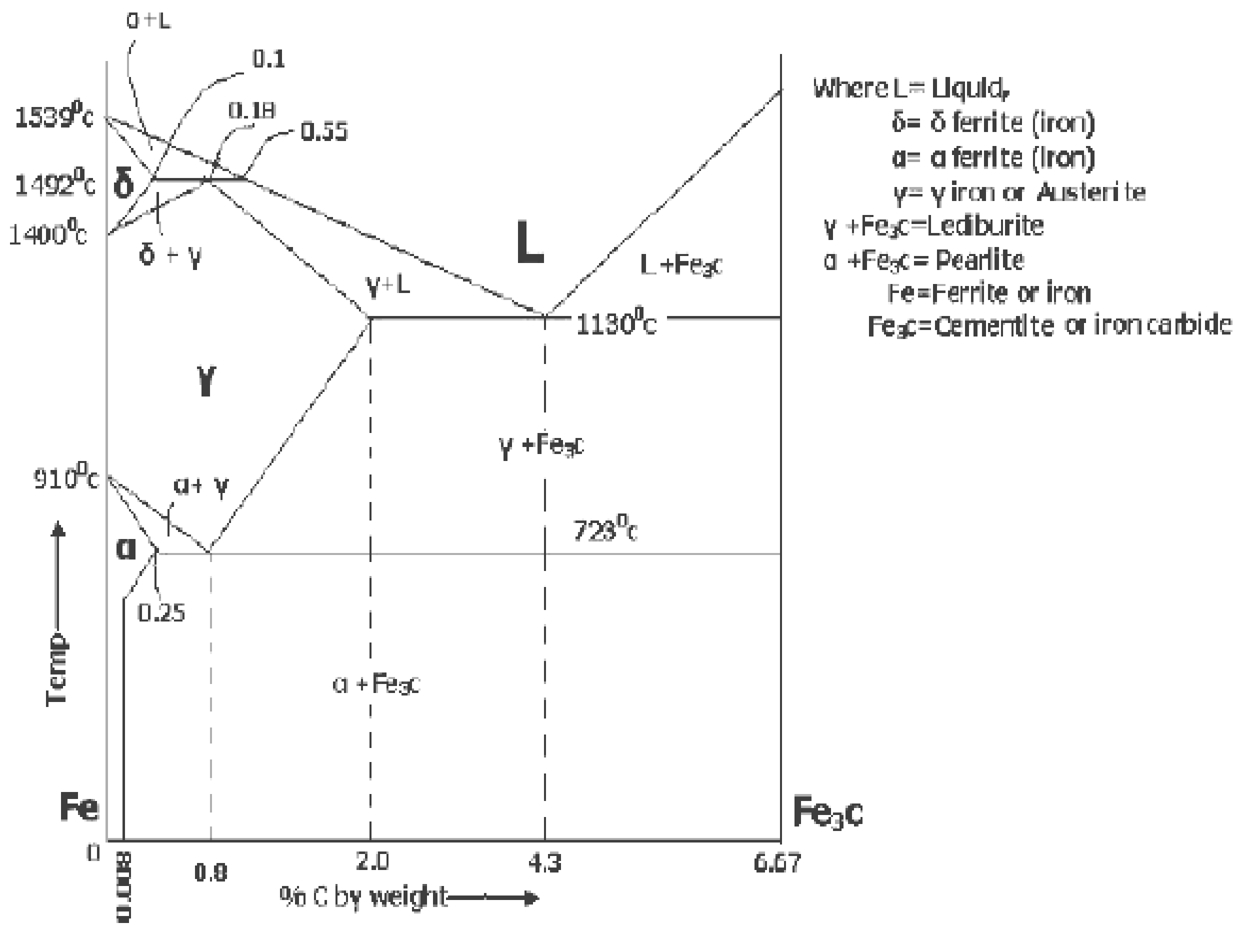


Figure: Iron- carbon equilibrium diagram

B. Define heat treatment. State the any three purposes of heat treatment process.	4

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. 1

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 Three - 1 Mark each)* 3

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

C. Differentiate between annealing with normalizing.	4
Answer: **Difference between annealing and normalizing:** *(Any four points - 1 mark each)*	4

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

d) Explain the principle of carburizing with automobile components application. 4

Answer: **Principle of Carburizing:**

Carburizing is the case hardening process to obtain hard wear resistant and shock resistant case /surface and tough core inside, by introducing carbon on the steel surface by heating it in contact with solid, liquid, gaseous carbon containing substances to a temperature of 870-925ºC for several hours by absorption and diffusion. The high carbon steel surface is hardened by quenching from above the lower critical temperature. 2

Applications of carburizing: *(Any Two - 1 mark each)* 2

1) Gears
2) Camshafts
3) Bearings
4) Shafts

e) What are different types of foundries? Explain one in brief. 4

Answer: **Types of foundries:** *(any 4 – ½ mark each, explanation of any 01- 2 marks)*

1. Jobbing foundry
2. Production foundry
3. Semi-production foundry
4. Captive foundry
5. Ferrous foundries
6. Non-ferrous foundries

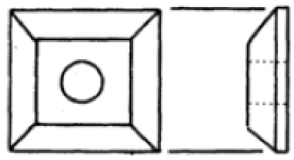
2

1. **Jobbing foundry:** It is the foundry based on job orders. It produces a small number of castings of a given type by customers.
2. **Production foundry:** It produces casting on a mass scale. It is a highly mechanized foundry. 2
3. **Semi-production foundry:** It is a combination of jobbing foundry and production foundry. It accepts both production and job work.
4. **Captive foundry:** This type of foundry is an integral part of some manufacturing organization and produces casting for the organizational setup for further processing only.
5. **Ferrous foundries:** These are the foundries in which components are cast with iron as the main constituent. Ferrous components can further be broadly subdivided into - i) cast iron, ii) Steel. Cast iron can be further divided into grey cast iron, white C.I., Malleable C. I., Alloy C.I., Spheroidal graphite C. I. Steel is generally low carbon steel, medium carbon steel, high carbon steel, Alloy steel.
6. **Non-Ferrous foundries:** In addition to ferrous metal, many nonferrous materials are also cast. Nonferrous materials that are cast are copper & its alloys.

f) Explain types of pattern (any four).	4

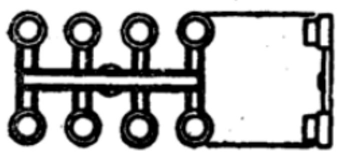
Answer: Types of patterns *(Any four – Sketch ½ mark ,explanation ½ mark each)*

1. Solid or single piece pattern: It is made in one piece and carries no joints, partition or loose pieces. 1

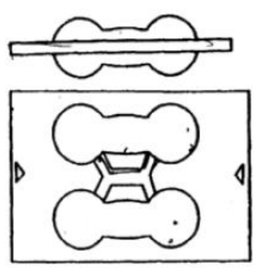


2. Split or two piece patterns: They are made in two parts and these two parts of the pattern are joined together with the help of dowel pins. 1

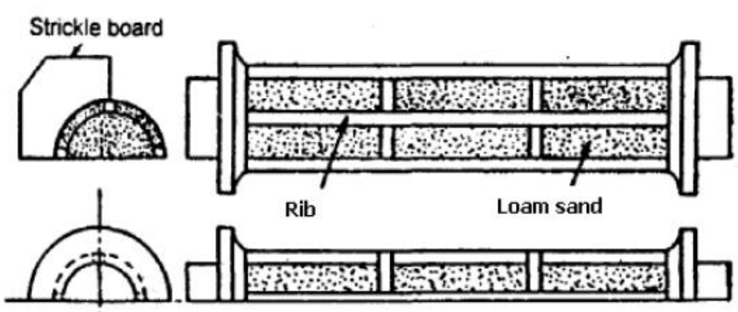
3. Gated pattern: They are used in mass production for such castings multi – cavity moulds are prepared by gate former. 1



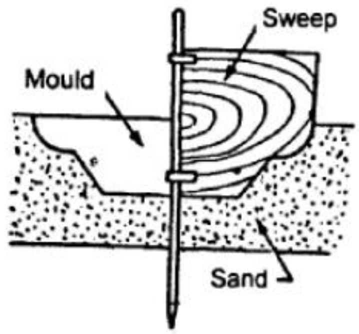
4. Match plate pattern: A match plate pattern is a split pattern having the cope and drags portions mounted on opposite sides of a plate (usually metallic), called the "match plate". 1



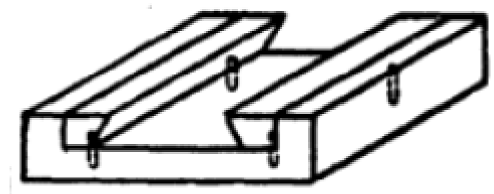
5. Skeleton pattern: These are simple wooden frames that outline the shape of the part to be cast.



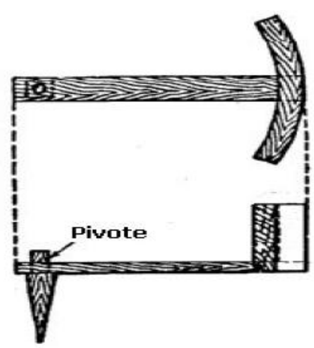
6. Sweep pattern: A sweep is a section or board (wooden) of proper contour that is rotated about one edge to shape mould cavities having shapes of rotational symmetry.



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



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



3. Attempt any four of the following:	16
a) What are the common allowances provided on pattern and describe draft allowance with neat sketch.	4

Answer: **Allowances provided on pattern:***(Any 04 - ½ mark each)*

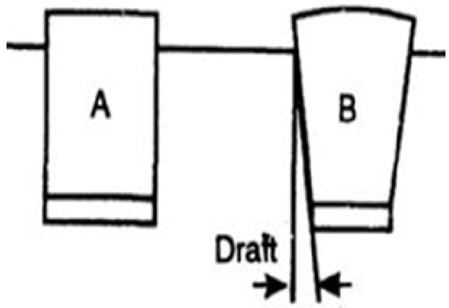
1. Shrinkage allowance
2. Draft allowance
3. Machining allowance
4. Distortion or camber allowance
5. Shake allowance / rapping allowance

2

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 millimeter per meter on a side, or in degrees, and the amount needed in each case depends upon the length of vertical side, intricacy of the pattern, and method of moulding.

1



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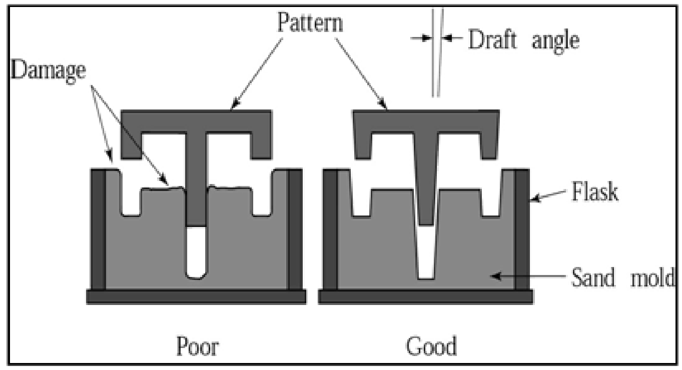


(figures above)	1
b) State the common materials used for pattern making and how they are selected?	4

Answer: *(Note: list of materials – 2 marks & factors of material selection – 2 marks)*

Common materials used for pattern making: *(any four- ½ mark each)*

The wide variety of pattern materials in use may be classified as wood and wood products; metals and alloys; plasters; plastics and rubbers; and waxes. — 2

1. **Wood**: wood used are teak, sal, shisam, pine and deodar.
2. **Metal**: Commonly metals used for patterns are cast iron, brass, aluminium alloy, magnesium alloy and white metal.
3. Plastic
4. Waxes: The waxes used are paraffin, shellac, bees wax and ceresin wax.
5. Rubber
6. Plaster of Paris / Gypsum cement

The selection of pattern material is depends upon following factors:*(Any 04 – ½ marks each)*

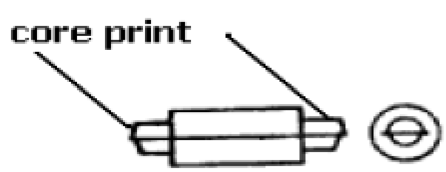
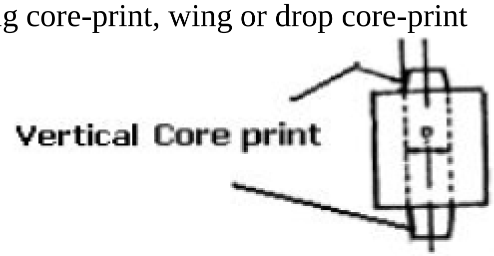
1. Design of casting
2. Quality of casting
3. Shape (intricacy) of casting
4. Types of moulding process
5. Types of production of castings
6. Moulding material to be used
7. Possibility of design changes — 2
8. Possibility of repeat orders.
9. Casting design parameters
10. Number of castings to be produced
11. Shape, complexity and size of casting
12. Type of moulding materials
13. Service requirements, e.g. quantity, quality and intricacy of castings, minimum thickness desired, degree of accuracy and finish required.

c) List different tools and equipments used in foundries and its application.	4

Answer: **Hand moulding tools used in foundry:** *(Any 04 with application – 1 mark each)*

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. — 4

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. 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.	
d) Explain properties of moulding sand.	4
Answer: **Properties of moulding sand:** *(Any 04 - 01 mark each)* 1. Porosity/Permeability: It is the property of the sand which allows the gases or steam to escape through the sand mould. 2. 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.	4
e) State meaning of core print and core-boxes used in foundry.	4
Answer: Core prints and Core – boxes: *(Sketch -1 mark ,Explanation 01 mark)* **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  **OR**  **OR**	01

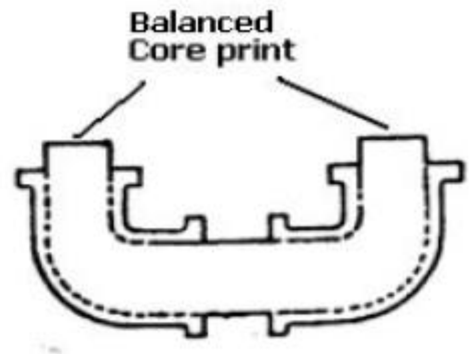


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Fig:- Core print

Core-boxes: *(Any one –Sketch 1 mark, explanation -1 mark)*

A core box is essentially a type of pattern made of wood or metal into which sand is rammed or packed to form a core. The types of core boxes, in common use, in foundry work, are described below.

1) Half box: A half box, is used to form two identical halves of a symmetrical core. After they are shaped to form and baked, the core halves are pasted together to form a completed core.

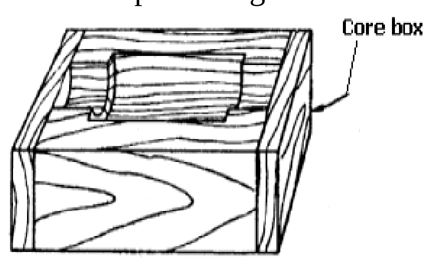

Fig:-Half box

2) Dump box: A dump box, is designed to form a complete core that requires no pasting. If the core thus made is in the shape of a slab or rectangle, it is called a rectangular box. The box is made with open one side and the sand is rammed up level with the edges of this opening.

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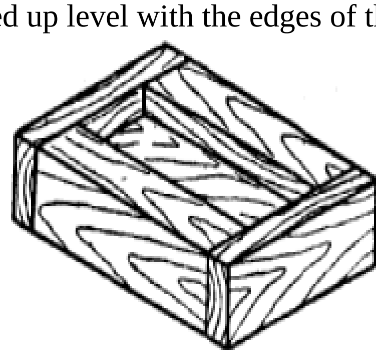

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Fig:-Dump box

3) Split box: It consists of two halves which are clamped together. One half of the box has two or more dowels to hold the parts in correct alignment. It is arranged with opening at one or both ends for filling and ramming the sand. After ramming and striking off the excess sand, the core box is unclamped and rapped. This type of core box moulds the entire core.

A booked type core box is somewhat similar to a split core box. It consists of two halves, hinged together, opening and closing like a book to form a complete core.

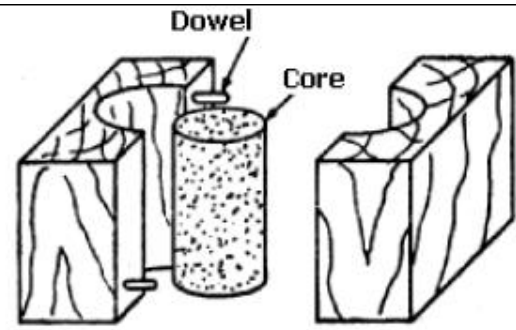


Fig:-Split box

4) Gang box: In instances where large number of cores is to be made, a gang core box, in which several core cavities are rammed in a single operation, is employed.

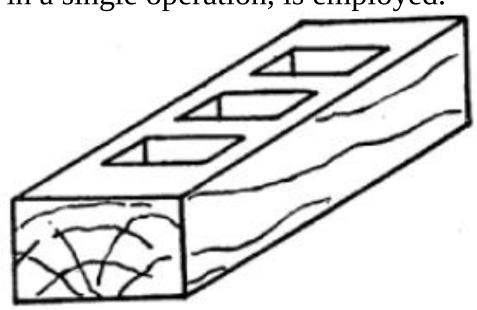
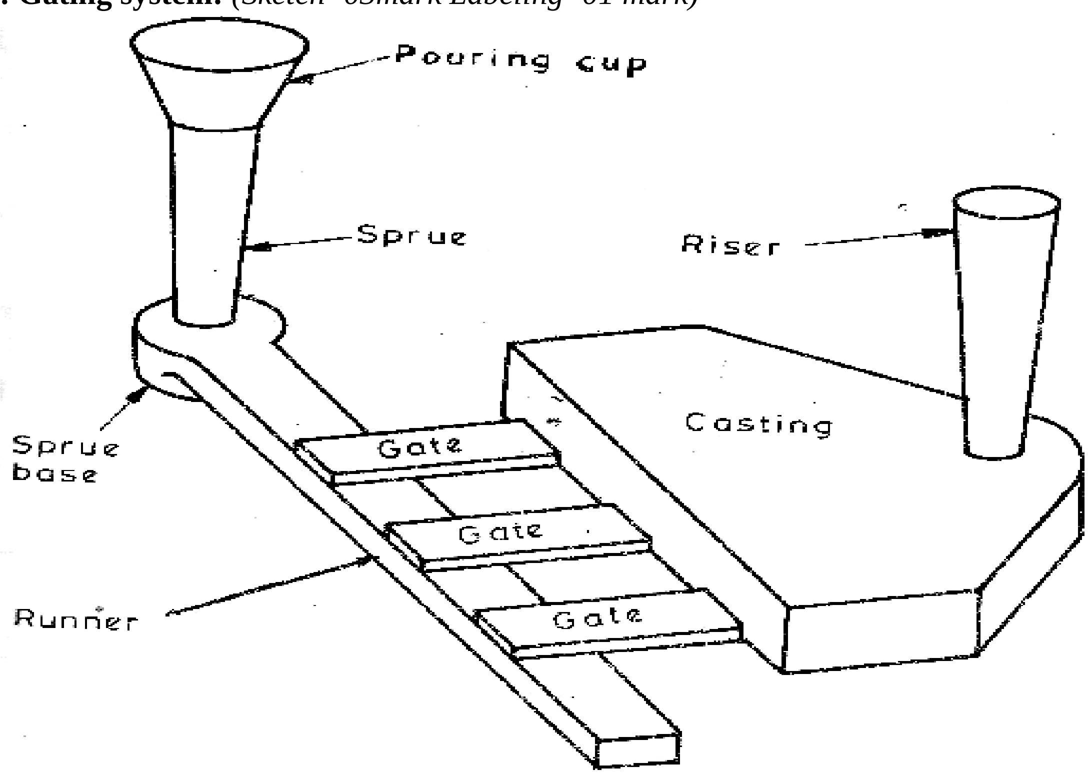


Fig:- Gang box

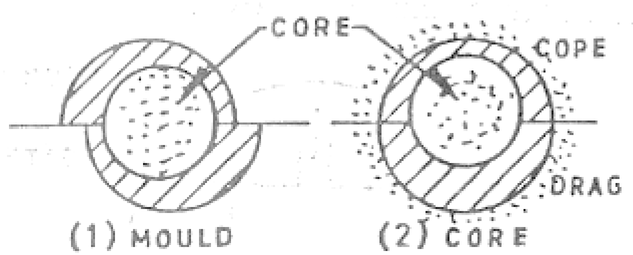
f) Draw a neat sketch of Gating system and label it.	4
Answer: Gating system: *(Sketch -03mark Labeling -01 mark)*	4



4. Attempt any four of the following:	16
a) What are the common defects of castings? State their causes and remedies.	4

Answer: *(Credit should be given if appropriate sketch is drawn)*
Defects in casting with its cause and remedies: *(Any 02- 02 marks each)*

1. Shifts:



Cause: Due to core misplacement or mismatching of top and bottom parts of the casting usually at a parting line. Misalignment of flasks is another likely cause of shift. 01

Remedy: By ensuring proper alignment of the pattern or die part, moulding boxes, correct mounting of patterns on pattern plates, and checking of flasks, locating pins, etc. before use. 01

2. Swell:

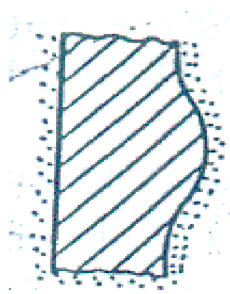


Figure: Swell.

Cause: This is caused by improper or defective ramming of the mould. 01
Remedy: To avoid swells, the sand should be rammed properly and evenly. 01

3. Blowholes:

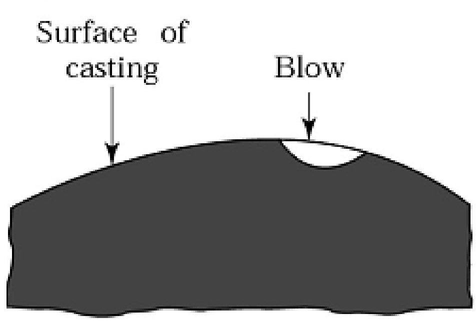
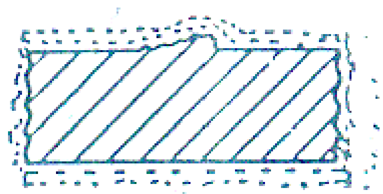
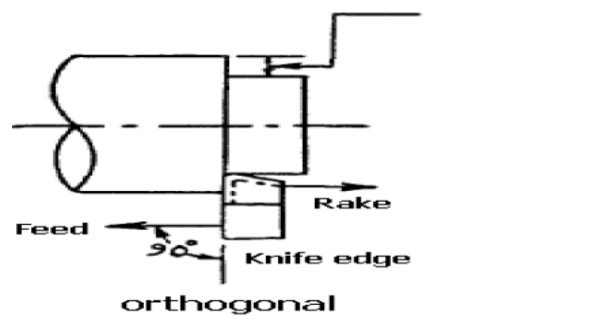
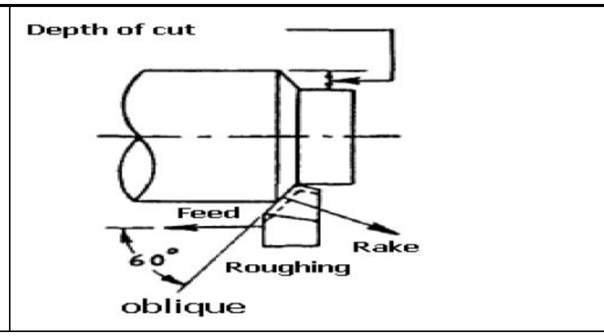


Figure: Blow hole.

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.

4. Drop:  Figure: Drop **Cause:** This is caused by low strength and soft ramming of the sand, insufficient fluxing of molten metal and insufficient reinforcement of sand projections in the cope. **Remedy:** The above factors are eliminated to avoid drop.	
b) State the advantages of shell moulding process.	4
Answer: **Advantages of shell moulding process:** ***(Any 04-01 mark each)*** 1. The walls of the molds are relatively smooth 2. This offers low resistance to flow of the molten metal 3. Producing castings with sharper corners 4. Thin wall thickness and complex castings can be produced. 5. Shell-mold casting may be more economical than other casting processes 6. The high quality of the finished casting can significantly reduce cleaning, machining, and other finishing costs 7. Complex shapes can be produced with less labor, and the process can be automated fairly easily. 8. Has improved flexibility in design than die casting 9. Less manpower and Moulding skill requirement 10. Less foundry space required 11. Good surface quality 12. Reduced machining 13. This process can be mechanized	4
c) Differentiate between orthogonal and oblique cutting (any four)	4
Answer: Comparison of orthogonal and oblique cutting:*(Any 04- 01 mark each)*	4

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		

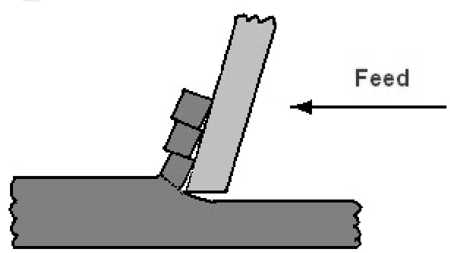
d) What are different types of chips formed during machining? Explain any one with sketch.	4

Answer: **Different types of chips***(Listing 2 mark)*

1. Discontinuous or segmental
2 .Continuous
3.Continuous with Built -up edge BUE — 02

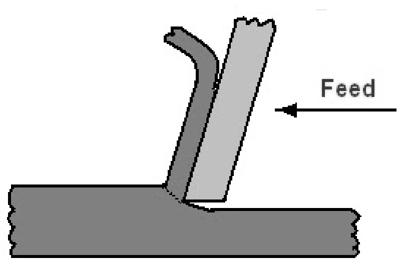
Different types of chips*(**Any one** –Sketch 1 - mark, Explanation - 1mark)*

1. **Discontinuous or segmental chips**: Machining of brittle materials produce these types of chips. Small fragments are produced because of lack in ductility of material. Friction between tool and chip reduces, resulting in better surface finish. — 01



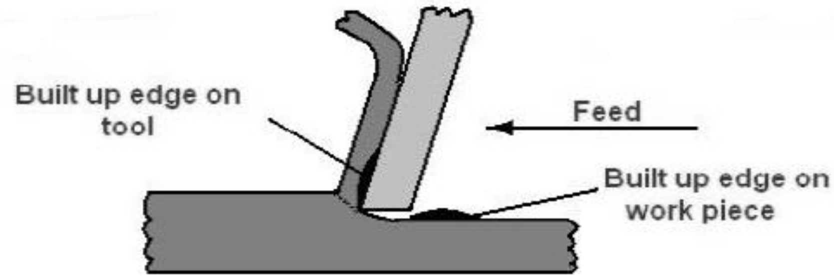
Discontinuous Chip — 01

2. **Continuous chips**: Machining of ductile materials produce these types of chips. Continuous fragments are produced because of high ductility of material. Chips are difficult to handle.



Continuous Chip

3. **Continuous chips with built-up edge** (BUE): When machining ductile material, conditions of high local temperature and extreme pressure in the cutting zone and also high friction in the tool-chip interface, may cause the work material to adhere or weld to the cutting edge of the tool forming BUE. BUE changes its size during cutting operation. It protects the cutting edge but it changes the geometry of the tool.



Built up Chip

e) Why cemented carbide is considered as an useful tool material?	04
Answer: Cemented carbides: *(Any four points 01 mark each)* 1. The basic ingredient of most cemented carbides is tungsten carbide which is extremely hard. 2. Cemented carbides have very high heat & wear resistance 3. Cemented carbide tipped tools can machine metals even when their cutting elements are heated to a temperature of 1,000 ºC 4. They can withstand cutting speed 3 to 4 times higher than H.S.S tools 5. They have high compressive strength 6. They must be very rigidly supported to prevent cracking **7.** They are capable of retaining their red hardness upto 1200 ºC	04
f) What are different types of cutting fluid? State any four properties of cutting fluid.	
Answer: **Types of Cutting fluid :** *(Any 04- ½ mark each)* **1) Water**: Water, plain or containing an alkali, salt or water-soluble additive but little or no oil or soap are sometimes used only as a coolant. **2) Soluble oils**: Soluble oils are emulsions composed of around 80 per cent or more water, soap and mineral oil. **3) Straight oils**: The straight oils may be (a) straight mineral (petroleum) oils, kerosene, low-viscosity petroleum fractions, such as mineral seal, or higher-viscosity mineral oils, (b) straight fixed or fatty oils consisting animal, vegetable, or synthetic equivalent, lard oil, etc. **4) Chemical compounds**: These compounds consist mainly of a rust inhibitor, such as sodium nitrate, mixed with a high percentage of water. **5) Solid lubricants**: Stick waxes and bar soaps are sometimes used as a convenient means of applying lubrication to the cutting tool. **6) Chemical additive oil**: Straight oil or mixed oil is mixed up with sulphur or chlorine. It is used for machining tough, stringy, low carbon steel.	2
Properties of cutting fluid: *(Any 04- 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. Odorless ,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	2

5. Attempt any four of the following:	16
a) Classify the following as single point cutting tool or multi- point cutting pool i. Turning tool ii. Reamer iii. End mil cutter iv. Boring tool	4
Answer: *Each carries 01 mark*	4

Single point cutting tool	**Multipoint cutting tool**
Turning tool	Reamer
Boring tool	End mill cutter

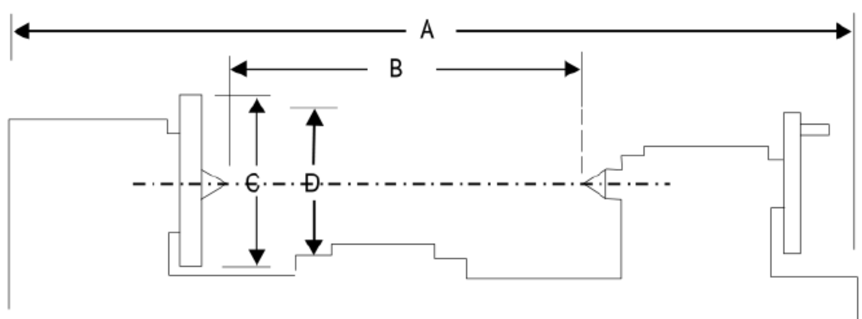
b) How lathe machine are classified? Write a name of parts used in lathe machine (any four)	4

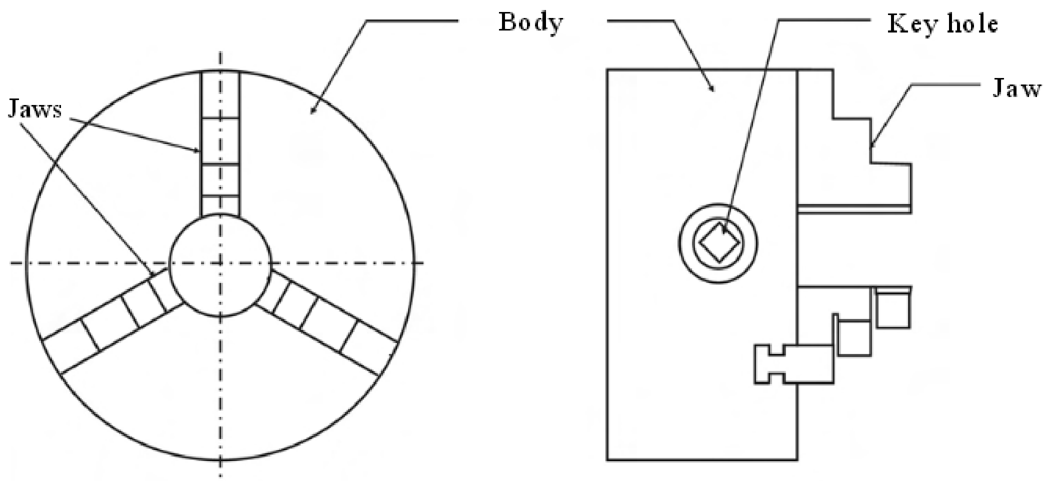
Answer: Lathe machine Classification :*(Any 04- ½ mark each)* — 2

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

Parts used in lathe machine *(Any 04- ½ mark each)* — 2

1. Bed
2. Headstock
3. Spindle
4. Tailstock
5. Carriage
a. Saddle
b. Apron
c. Cross-slide
d. Compound rest
e. Compound slide
f. Tool post
6. Feed mechanism
7. Leadscrew
8. Feed rod
9. Thread cutting mechanism

c) How a lathe machine is specified.	4
Answer: **Lathe machine specification:** *(Sketch - 1mark, Any 3 points - 1 mark each)* The lathe is generally specified by the following means: a) Swing or maximum diameter that can be rotated over the bed b)Maximum Swing over carriage c) Maximum length of the job that can be held between head stock and tailstock centers d) Length of bed e) Height of centers over bed f) Maximum swing in gap- in case of gap bed lathes only  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.	3 1
d) Why chucks are used? List various types chucks used in lathe. Describe any one in brief.	4
Answer : Use of Chuck : *(1 mark)* It is used for holding and rotating the workpiece in lathes. Workpieces of short length, large diameter and irregular shapes, which can not be mounted between centers, are held quickly and rigidly in chuck. **Types of chucks** *(Any two -1 mark)* i) Three jaw chuck ii) Four jaw chuck iii) Combination chucks, iv) Magnetic chuck, v) Collect chuck, vi) Drill chuck vii) Air or hydraulic chuck **Type of chucks***(Any one: Sketch - 1 mark, explanation -1 mark)* **i) Three jaw self-centering chuck:** The three jaws fitted in the three slots may be made to slide at the same time by an equal amount by rotating any one of the three pinions by a chuck key. This type of chuck is suitable for holding and rotating regular shaped workpieces like round or hexagonal rods about the axis of the lathe. Workpieces of irregular shapes cannot be held by this chuck.	1 1 1



1

Fig Three jaw chuck

ii) Four jaw independent chuck:

The four jaw independent chuck, as shown in Fig. has four reversible jaws, each of which may be independently adjusted to accommodate the work it supports. This type of chuck can hold square, round and irregular shape of work in either a concentric or eccentric position.

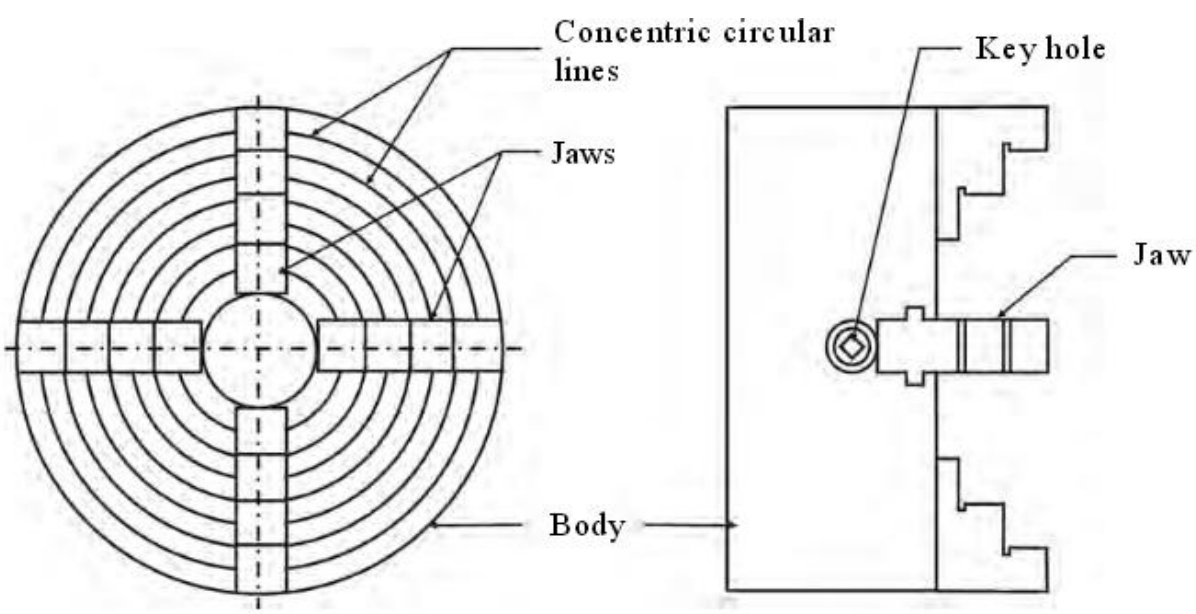


Fig Four jaw chuck

iii) Magnetic chuck:

The holding power of this chuck is obtained by the magnetic flux radiating from the electromagnet placed inside the chuck. Magnets are adjusted inside the chuck to hold or release the work. Workpieces made of magnetic material only are held in this chuck. Very small, thin and light works which cannot be held in a ordinary chuck are held in this chuck.

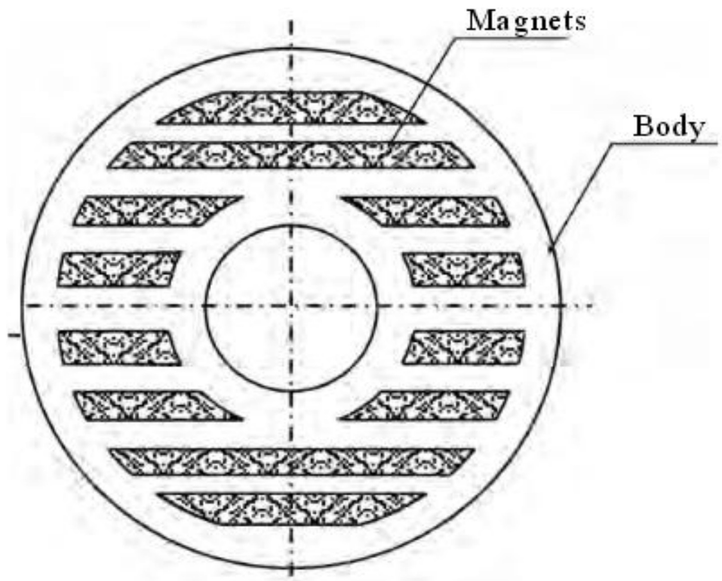


Fig . Magnetic chuck

iv) Collet chuck:

Collet chuck has a cylindrical bushing known as collet. It has slots cut lengthwise on its circumference. So, it holds the work with more grip. Collet chucks are used in capstan lathes and automatic lathes for holding bar stock in production work.

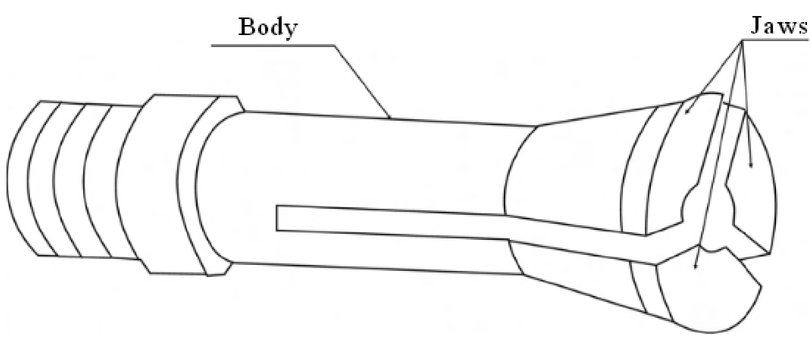


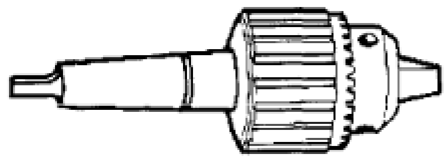
Fig Collet chuck

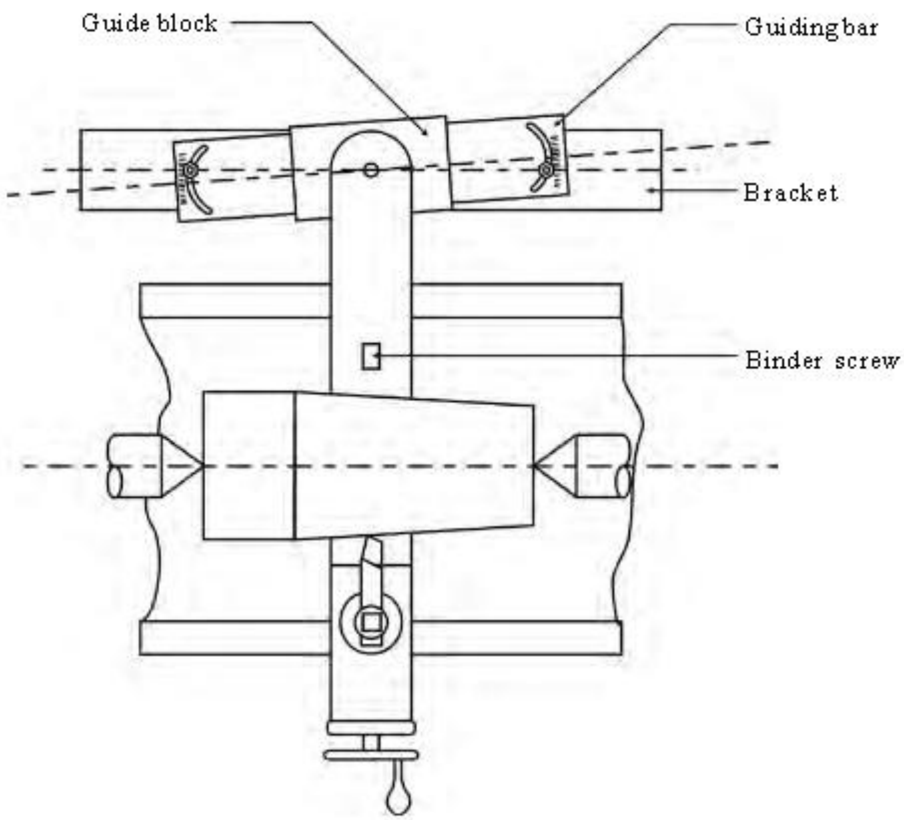
v) Combination chuck:

A combination chuck combines the features of the independent chuck and the universal scroll chuck and can have either three or four jaws. The jaws can be moved on a scroll for automatic centering or can be moved individually if desired by separate adjusting screws.

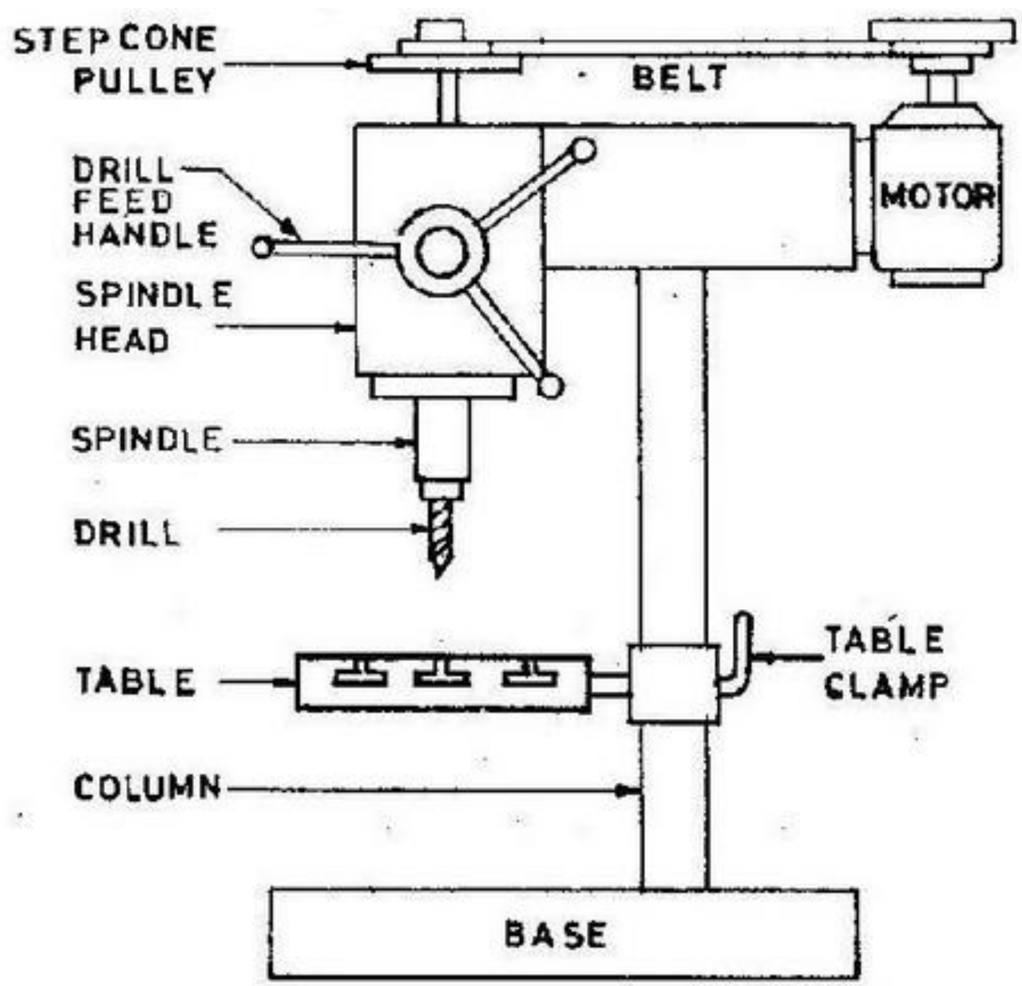
vi) Drill chuck:

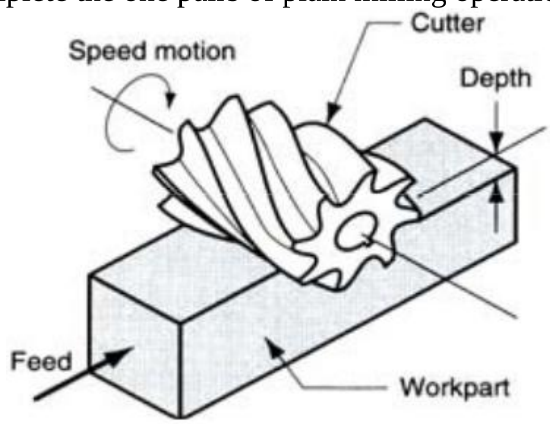
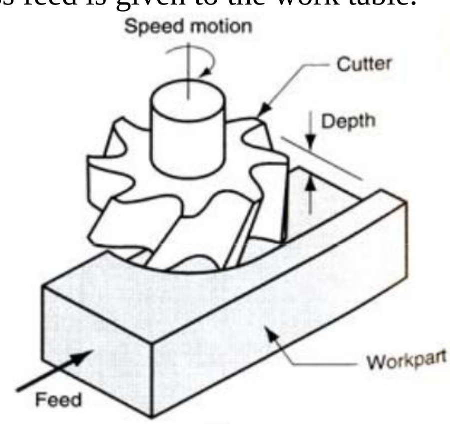
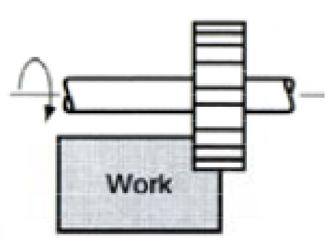
The drill chuck, is a small universal chuck which can be used in either the headstock spindle or the tailstock for holding straight-shank drills, reamers, taps, or small diameter workplaces. The drill chuck has three or four hardened steel jaws which are moved together or apart by adjusting a tapered sleeve within which they are contained. The drill chuck is capable of centering tools and small- diameter workplaces to within 0.002 or 0.003 inch when firmly tightened



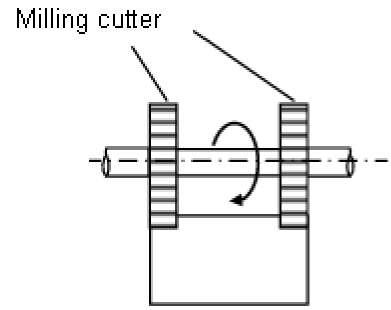
e) Draw a neat sketch of Taper turning attachment in a lathe.	4
Answer: **Taper turning attachment in lathe:** *(Sketch -3 marks ,labeling -1 mark)* 	4
f) How drilling machines are classified? State various operation preformed on drilling machine.	4
Answer: **Classification of drilling machine:** *(Any four -2 marks)* 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	2

Operation performed on drilling machine: *(Any Two -2 marks)* **1) Drilling operation:** It is the operation of producing a cylindrical hole by removing metal by the rotating edge of a cutting tool called the drill **2) Reaming operation:** It is accurate way of sizing and finishing a hole which has been previously drilled. **3) Boring:** Boring is a process of enlarging an existing hole by a single point cutting tool. **4) Counter Bore:** This operation uses a pilot to guide the cutting action to accommodate the heads of bolts. **5) Countersink:** Special angled cone shaped enlargement at the end of the hole to accommodate the screws. **6) Tapping:** Tapping is the process by which internal threads are formed. It is performed either by hand or by machine.	2
6.Attempt any FOUR of the following:	16
a) Draw a neat sketch of bench drilling machine and label it.	4
Answer**: Bench Drilling Machine:** (*Sketch - 2 marks, Correct Labeling -2 marks)*	4



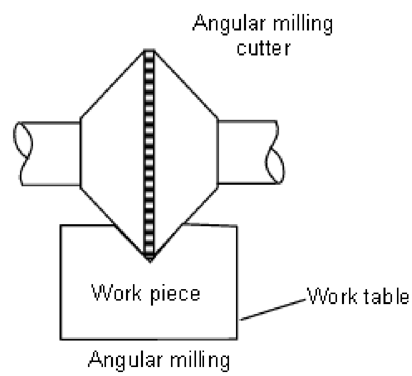
b) Explain different operation performed in a milling machine (any four)	4
Answer: **Operations Performed on milling Machine:** *(Any Four – 1mark each)* *(Suitable credit shall be given to sketches if drawn)* **1) Plain Milling Operation:** This is also called slab milling. This operation produces flat surfaces on the workpiece. Feed and depth of cut are selected, rotating milling cutter is moved from one end of the workpiece to other end to complete the one pairs of plain milling operation.  Peripheral or Plain milling **2) Face Milling Operation:** This operation produces flat surface at the face of the workpiece. This operation is performed by face milling cutter mounted on stub arbor of milling machine. Depth of cut is set according to the need and cross feed is given to the work table.  Face milling **3) Side Milling Operation:** This operation produces flat and vertical surfaces at the sides of the workpiece. In this operation depth of cut is adjusted by adjusting vertical feed screw of the workpiece.  Side Milling	1 1 1

4) Straddle Milling Operation: This is similar to the side milling operation. Two side milling cutters are mounted on the same arbor. Distance between them is so adjusted that both sides of the workpiece can be milled simultaneously. Hexagonal bolt can be produced by this operation by rotating the workpiece only two times as this operation produces two parallel faces of bolt simultaneously. 1



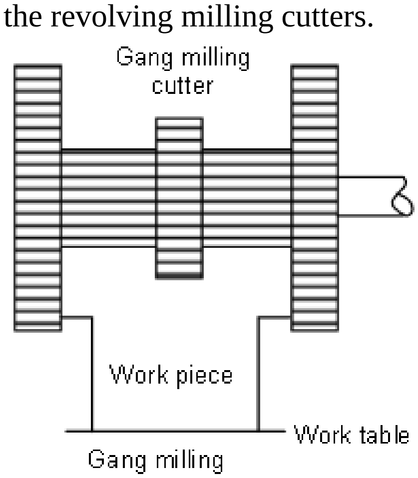
Straddle Milling

5) 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.



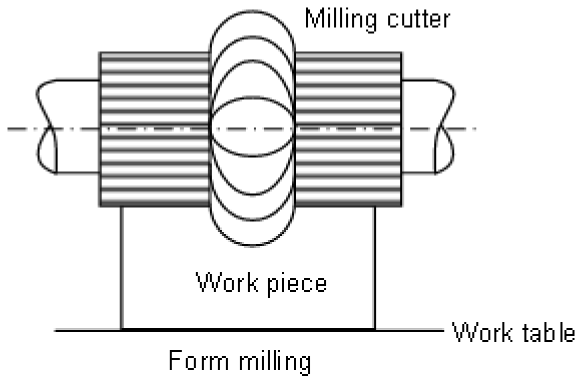
Angular Milling Operation

6) Gang Milling Operation: As the name indicates, this operation produces several surfaces of a workpiece simultaneously using a gang of milling cutters. During this operation, the workpiece mounted on the table is fed against the revolving milling cutters.



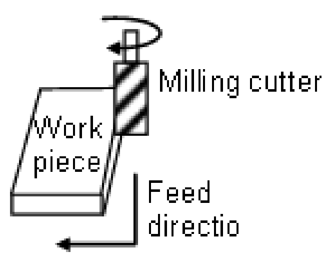
Gang Milling Operation

7) Form Milling Operation: This operation produces irregular contours on the work surface. These irregular contours may be convex, concave, or of any other shape. This operation is done comparatively at very low cutter speed than plain milling operation



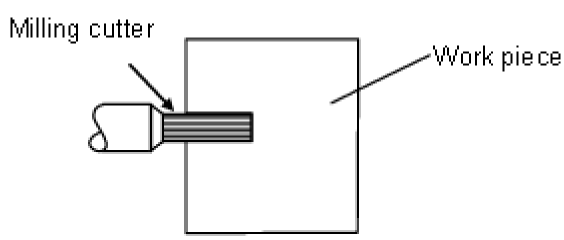
Form Milling Operation

8) Profile Milling Operation: In this operation a template of complex shape or master die is used. A tracer and milling cutter are synchronized together with respect to their movements. Tracer reads the template or master die and milling cutter generates the same shape on the workpiece. Profile milling is an operation used to generate shape of a template or die.



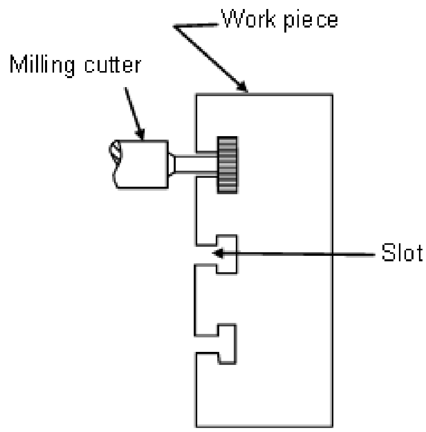
Profile Milling

9) 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



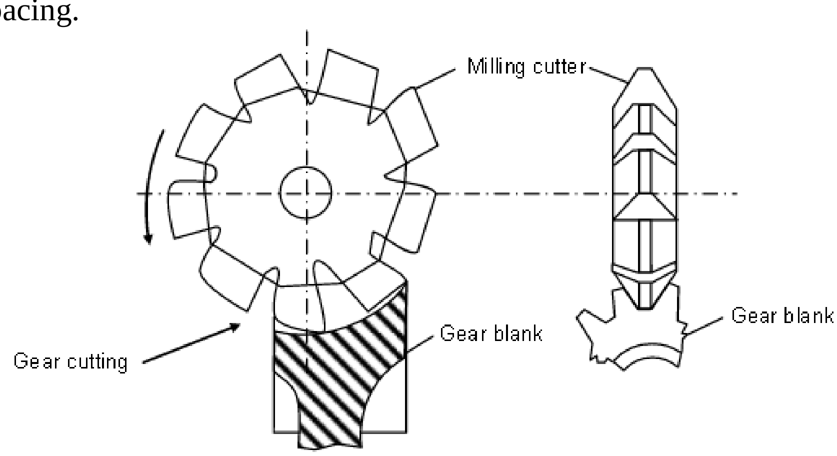
End Milling Operation

10) Slot Milling Operation: The operation of producing keyways, grooves, slots of varying shapes and sizes is called slot milling operation. Slot milling operation can use any type of milling cutter like plain milling cutter, metal slitting saw or side milling cutter. Selection of a cutter depends upon type and size of slot or groove to be produced. Right placement of milling cutter is very important in this operation as axis of cutter should be at the middle of geometry of slot or groove to be produced.



Slot Milling Operation

11) Gear Cutting Operation: The operation of gear cutting is cutting of equally spaced, identical gear teeth on a gear blank by handling it on a universal dividing head and then indexing it. The cutter used for this operation is cylindrical type or end mill type. The cutter selection also depends upon tooth profile and their spacing.



Gear Cutting Operation

c) What are the different standard milling cutters? Describe suitability of each cutter.	4

Answer: **Classification of Standard milling cutter:** *(Any 04 -2 marks)* — 2

1) Plain milling cutter
   a) Light duty b) Heavy duty c) Helical
2) Side milling cutter
   a) Plain b) Staggered teeth c) Half d) Interlocking
3) Metal slitting saw
   a) Plain b) Staggered teeth
4) Angle milling cutter
   a) Single b) Double
5) End milling cutter
   a) Taper shank b)Straight shank c)Shell
6) T-slot milling cutter
7) Woodruff key slot milling cutter
8) Fly cutter

9) Formed cutter
   a) Convex b)concave c)corner rounding d) gear cutter e) thread milling cutter
10) Tap & reamer cutter
11) Face milling cutter

Suitability of milling cutter: *(Any 02 – 2 marks)*

1) Plain milling cutter: Suitable for face milling operation.
2) Side milling cutter: Suitable for machining of side faces.
3) Metal slitting saw: Suitable for parting off surfaces.
4) Angle milling cutter: Suitable for producing angular surfaces.
5) End milling cutter: Suitable for producing slots in work piece.
6) T-slot milling cutter: Suitable for T-slot operation.
7) Woodruff key slot milling cutter: Suitable for machining keyway

2

d) Classify milling machines and list them accordingly. How milling differs from lathe. 4

Answer: **Milling Machine Classification:**

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

2

Difference between Lathe and milling: *(Any four points - 2marks)*

Sr.	Lathe Machine	Milling Machine
1	Lathe produces cylindrical/tapered parts.	Milling machines use cylindrical cutting tools.
2	Single point cutting tool is used.	Multi point cutting tool is used
3	In this operation job rotate and tool is in feed action.	In this operation the work is fix on table and tool is rotate through the job with feed.
4	In this machine the operations performed like turning, facing, threading and grooving etc.	In this machine the operations performed like plane milling, end milling, slotting and profile milling etc.

2

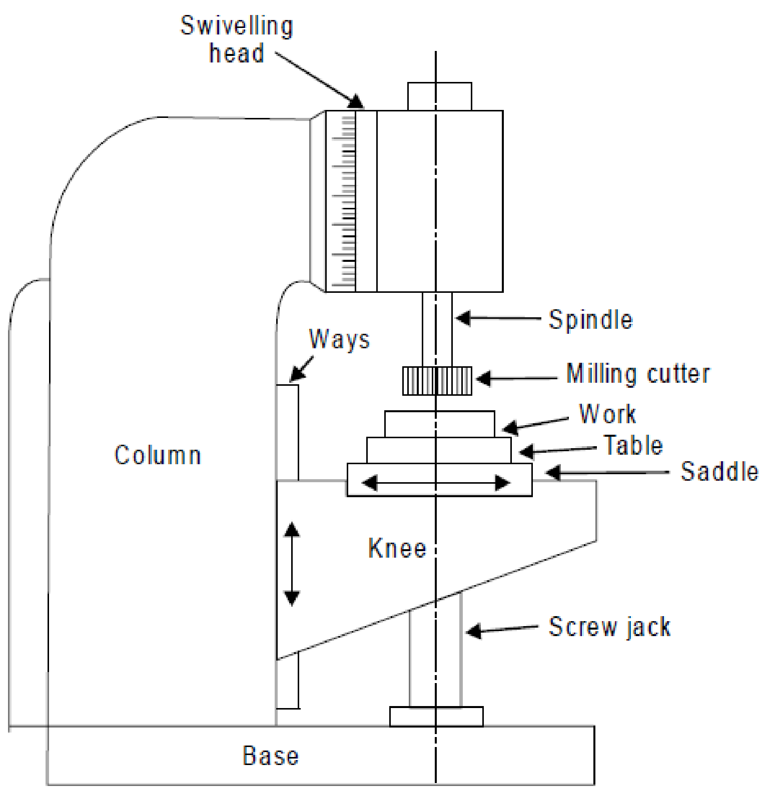
e) Draw a neat sketch of column and knee type milling machine and explain functions of any two parts in brief. 4

Answer**: Column and Knee type milling machine: (***Functions - 2 marks, Sketch - 2 marks)*

Function of Parts: *(Any 02 - 1 mark each)*

1. **Base**: It is a heavy casting on which column and other parts are mounted. It may be bolted to floor strongly.
2. **Column**: there are guide ways on the front face of the column, on which the knee slides. It houses power transmission units such as gears, belt drives and pulleys to give rotary motion to the arbor. The drive mechanisms are also used to give automatic feed to the handle and table.
3. **Knee:** It supports the saddle, table, work piece and other clamping devices. It moves on the guide ways of column. It resists the deflection caused by the cutting forces on the work piece.

2

4. **Saddle**: It is mounted on the knee and can be moved by hand wheel or by power. The direction of travel of the saddle is restricted towards or away from the column face. 5. **Table**: It is mounted on the saddle and can be moved by a hand wheel or by power. Its top surface is machined accurately to hold the work piece and other holding devices. It moves perpendicular to the direction of saddle movement. 6. **Arbor**: Its one end is attached to the column and the other end is supported by an over arm. It holds and drives different types of milling cutters. 7. **Spindle**: It gets power from the gears, belt drives, to drive the motor. It has provision to add or remove milling cutters on to the arbor  Figure: Column and Knee type milling machine	2
f) You are going to carry following operations on milling. Give which cutter you will use for them i. Key way milling ii. "T" slot milling iii. Gear cutting iv. Rounding of corner	4
Answer: **Selection of cutter for milling operations:** **1) Keyway milling:** Woodruff key slot milling cutter, End mill cutter, Key way cutter **2) T slot milling:** T-slot milling cutter **3) Gear cutting:** Form milling cutter, Cylindrical type or End mill type. **4) Rounding of corner:** Formed cutter, Corner Rounding Milling Cutters.	 1 1 1 1