Important Instructions to examiners:

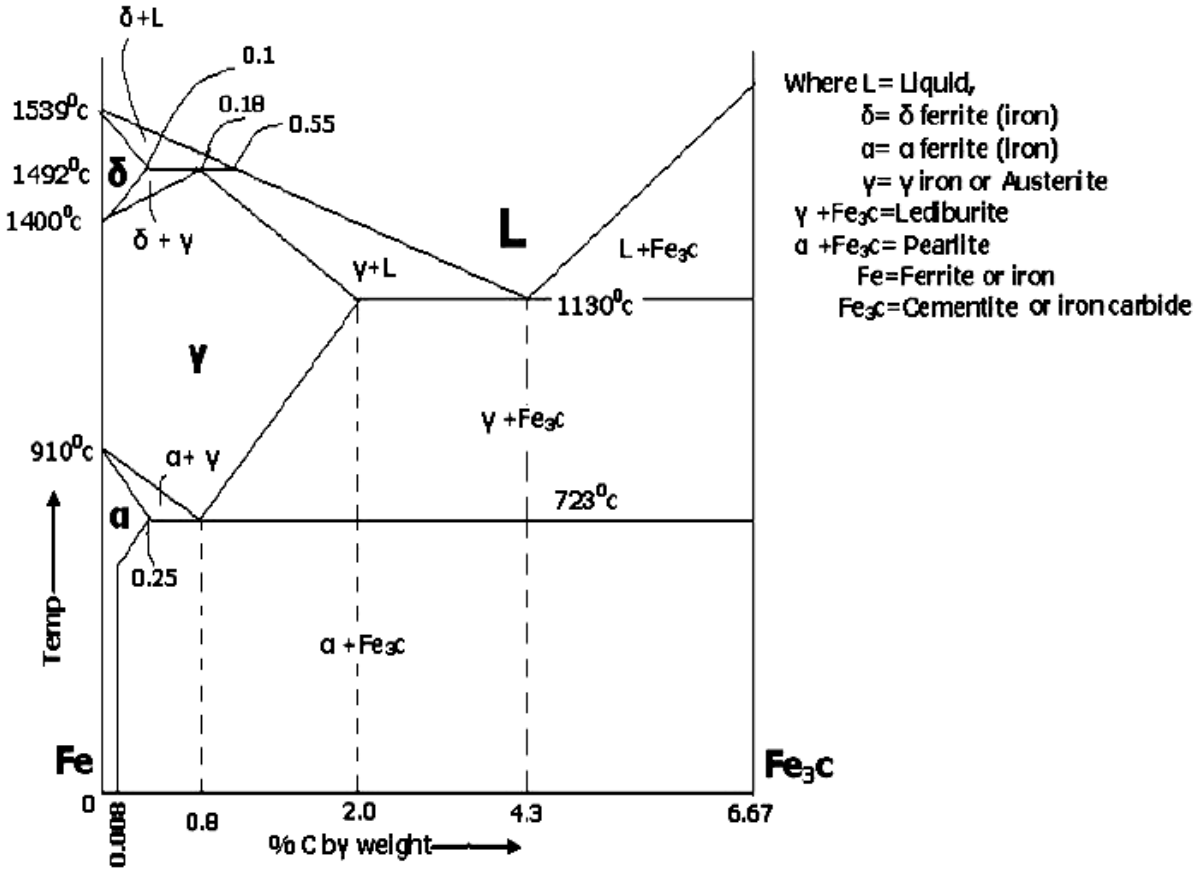
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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.

Model Answer	Marks
Q. 1. (A) Attempt any SIX of the following:	12
a) What is cast Iron? State its two applications.	02
Answer: *(Definition -1 mark, two applications-1/2 mark each)* **Cast iron:** It is basically an alloy of iron and carbon having carbon varies between 2.00 % to 6.67%. **Applications:** *(Any two)* 1. Machine tool structure (Bed, frame, table etc) 2. Cylinder blocks 3. Frames of electric motor 4.Piston rings 5.Flywheels 6.Engine frames 7. Pump housings 8.Pump liners 9.Wearing plates 10.Extrusion dies 11.Automotive crankshaft 12.Bearing block 13.Gearwheels 14.Axle 15.Camshaft 16.Farm equipments & tractors 17. Valve bodies 18.Worm wheel 19. Power transmission equipments 20.Earth moving machinery. 21. Connecting rods 22. Transmission gears 23. Differential cases 24.Cylinder heads of I.C.engine	2
b) List any four characteristics of ferrous metals.	02
Answer: Characteristics of ferrous metal *(Any four ½ mark each)* 1. Hardness 2. Toughness 3. Good thermal & Electrical conductivity 4. Strength 5. Ductility 6. Wear resistance 7. Malleability 8. Machinability 9. Shock resistance 10. Brittleness 11. Corrosion resistance 12. Excellent damping capacity 13. Fatigue resistance. 14. high tensile strength 15. Weldablity 16. Cutting ability	02

c) What is effect of Nickel and chromium as alloying elements?	02
Answer: Effect of Nickel and chromium as alloying Element: *(Any one effect 1 mark each*) 1.Nickel :- *(Any one effect 1 mark each)* i) Provides toughness, corrosion resistance, and deep hardening. ii) Increases resistance to impact iii) Improves tensile strength 2.Chromium:- *(Any one effect 1 mark each)* i) Improves corrosion resistance, toughness and harden ability ii) Improves resistance to abrasion and wear	2
d) State composition of tool steels.	02
Answer**: Composition of tool steel**: *(Any one composition – 2 marks)* 1) 18-4-1 High Speed Steels : - It Contains 18 % Tungsten, 4 % Chromium, 1 % Vanadium With 0.75 % Carbon & Remaining Iron 2) Cobalt High Speed Steels : - Cobalt is added from 5 to 8 % to increases hot hardness & wear resistance than 18-4-1 HSS. Generally it Contains 20 % Tungsten, 4 % Chromium, 2 % Vanadium, 12 % Cobalt With 0.80 % Carbon & Remaining Iron 3) Vanadium High Speed Steels : - It contains 0.70 % Carbon & More Than 1 % Vanadium & Remaining Iron 4) Molybdenum High Speed Steels : - It contains 6 % Molybdenum, 6 % Tungsten, 4 % Chromium, 2 % Vanadium, 0.85 % Carbon & Remaining Iron	2
e) State any four application of plain carbon steels	02
Answer: Applications of Plain Carbon steel *(any four ½ mark each)* Building bars, grills, beams, angles, channels, bolts, axles, lock washers, large forging dies, springs, wires, wheel spokes, hammers, rods, turbine rotors, crank pins, cylinder liners, railway rails ,forging dies, punches, hammers, chisels, vice jaws, shear blades, drills, knives, razor blades, balls and races for ball bearings, mandrels, cutters, files, wire drawing dies, reamers, and metal cutting saws.etc.	2
f) What is stainless steel? Where is used?	02
Answer: **Stainless steel:** *(Definition 1 mark, Uses - 1 mark each)* It is also called as corrosion resistance steel .The principle alloying element is chromium with other elements such as nickel, Mn etc. It contains more than 12% Cr. The Cr reacts with oxygen to form strong layer of chromium oxide on the surface of metal which offer resistance to corrosion. Uses *(any two ½ mark each)* 1. Screw and fittings 2. Pumps and valve parts 3. Surgical instruments 4.Springs 5. Ball bearings 6. Nuts and bolts 7. Heat exchanger 8. Household utensils 9.Wheel discs 10.Petrol caps 11.Dairy equipments 12.Wrist watch 13.Razor blades 14.Pots and pans	2

g) List any four advantages of alloy steel.	02
Answer: Advantages of Alloy steel *(Any four ½ mark each)* 1. Greater hardenability 2. Less distortion and cracking 3. Greater high temperature strength 4. Better mach inability at high temperature 5. Improved cutting ability 6. Improved ductility ,wear resistance & toughness	2
h) Give chemical composition of gun metal.	02
Answer: Chemical Composition of gun metal: Cu 88 % Sn 10% Zn 2% & remainder is copper	2
Q. 1. (B) Attempt any TWO of the following :	08
a) What is copper? State its properties and applications	04
Answer: **Copper:** Copper is nonferrous metal and it is distinguished from all other metal on account of its red colour. Copper is extracted from copper ores i.e Copper pyrites	1
Properties :- (Any three ½ mark each) 1) Soft, ductile, malleable 2) Excellent resistance to corrosion 3) Non magnetic 4) Good machinability 5) Can be brazed ,soldered or welded 6) Resistance to fatigue and abrasion 7) High thermal and electrical conductivity 8) Has pleasing reddish colour	1½
Applications (Any three ½ mark each) 1) Electrical parts 2) Heat exchanger 3) Screw machine parts 4) Household utensils 5) Wires ,sheet ,tubes etc.	1½
b) Explain what is y –alloy and duralumin with their chemical composition.	04
Answer: **Y-alloy:** Composition: Aluminum with 3.5 to 4.5 %Cu, 1.8 to 2.3 %Ni and 1.2 to 1.7 %Mg. Properties: This alloy has the characteristic of retaining good strength at high temperatures. Application: Piston and other components of aero engines. It is also largely used in the form of sheets and strips.	2
Duralumin: Composition: 3.5-4.5%Cu, 0.4-0.7%Mn, 0.4-0.7%Mg and aluminum the remainder. Properties: High tensile strength, high electric conductivity, very hard and can be easily forged. Application: It is widely used in wrought condition for forging, stampings, bars, sheets, tubes and rivets.	2

c) What is thermoplastic? State its properties.	04
Answer: **Thermoplastic:** These are composed of linear and long chain straight or slightly branched molecules. They can be resoftened and remelted by application of heat and pressure. The materials which can be remelted to manufacture fresh new products are called as thermoplastics **Properties** *(Any four 1/2 mark each)* 1) They are highly plastic 2) They are easily moulded or shaped. 3) They have low melting point 4) As they can be repeatedly used so they have good resale value 5) Relatively soft and ductile i.e not more stronger and harder 6) Cannot be used at high temperature as they tend to soft under heat 7) Usually soluble in some organic solvents.	2 2
Q. 2. Attempt any Four of the Following	16
a) Draw neat labeled sketch of Iron and Iron-carbide phase equilibrium diagram.	4
Answer: **Iron and Iron-carbide phase equilibrium diagram:** *(Credit should be given to suitable figure showing all details such as temperature percentage of carbon and state)*	4



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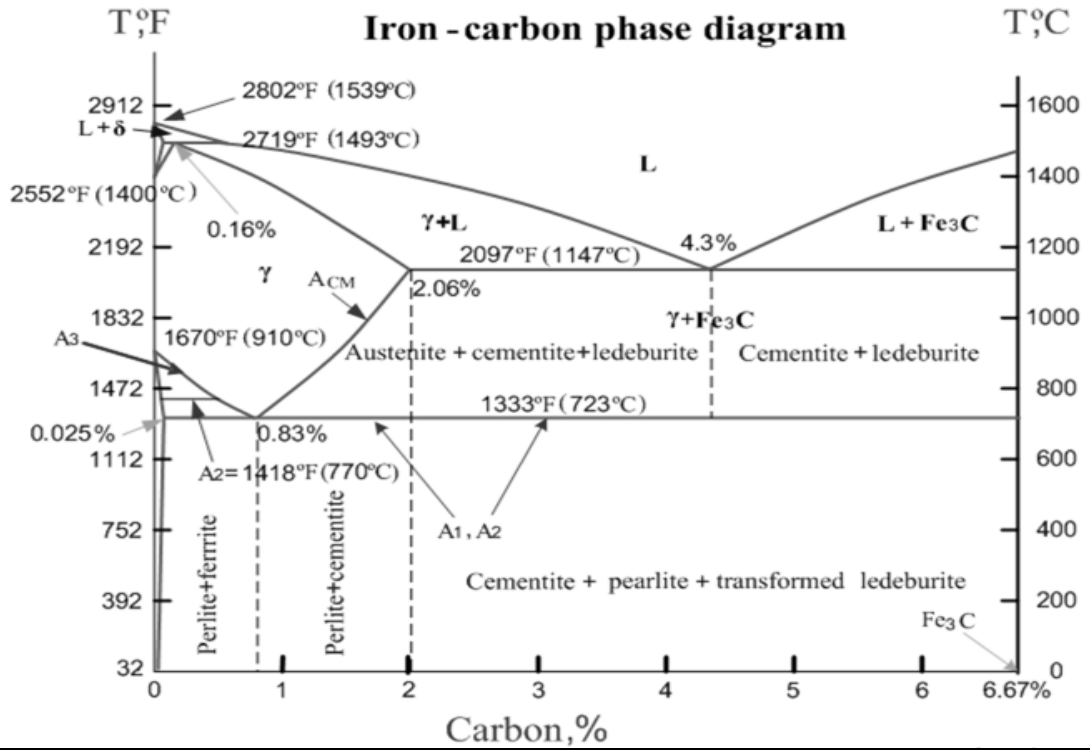


b) Explain Flame Hardening. 4

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

Flame Hardening:

The surface to be case hardened is heated by means of an oxyacetylene torch for sufficient time and Quenching is achieved by sprays of water which are integrally connected with the heating device. The heating is generally accomplished for sufficient time so as to raise the temperature of the surface of the specimen above the critical temperature. As the temperature desired is achieved immediately, spraying of water is started. In mass production work, progressive surface hardening is carried out where it is arranged to have the flame in progress along with quenching. 2

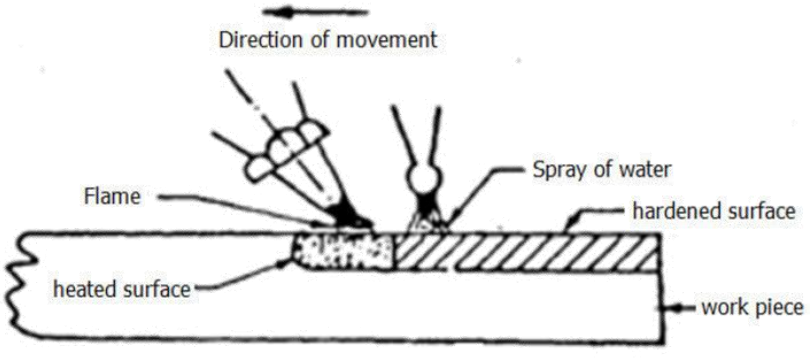


Fig: Principle of flame hardening 2

Advantages:

i. Selective surface can be hardened even on very large components.
ii. There is less distortion than in ordinary methods.

Disadvantages:

i. Temperature cannot be precisely controlled.
ii. Hardening is restricted to parts which are affected by wear.

Applications: Gear teeth and slideways of lathe beds are heat treated by this method.

c) Define Annealing. State its objectives.	4
Answer: (Definition or Explanation - 2 Marks, Objectives – 2 Marks) 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. Objectives 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.	2 2
d) What is tempering? Why it is necessary?	4
Answer: *(Definition or Explanation - 2 Marks, Necessity – 2 Marks)* **Tempering**: The process involves re-heating of the metal below critical point, then holding it for a considerable time and then slowly cooling it. Tempering should be done immediately after hardening by quenching in order to relieve hardening strains. The temperature at which tempering is done varies with the carbon content of the metal and mechanical properties desired in the finished article. Three types of tempering processes are classified as: i. Low temperature tempering. ii. Medium temperature tempering iii. High temperature tempering **Necessity of Tempering** Quench hardening produces structure martensite & retained austenite.The martensite formed in quench hardened steel is brittle, hard & slightly stressed so, cracking and distortion may occur after quenching. Secondly, quench hardened steel contain retained austenite which is also an unstable phase as it changes with time & hence, dimension may change So, tempering is done: i. To reduce internal stresses developed during previous heating, ii. To reduce the hardness developed during hardening, iii. To give the metal a right structural condition (To stabilize the structure).	2 2
e) What is case carburizing? State its four applications.	4
Answer: Case Carburizing: (2 Marks) Carburizing is a method of depositing carbon on the surface layer of low carbon steel in order to produce a hard case. Process:- Low carbon steel is heated at 870°C to 925°C in contact with gases, solid ,liquid carbon	2

containing substances for several hours. The high carbon steel surface thus obtained is hardened by quenching from above 727°C Following are the application of case carburizing processes: (Any Four – ½ Marks each) i. Gears ii. Ball Bearings iii. railway wheels iv. wear resistant bushings v. cam shafts vi. Sprocket vii. Piston pin viii. Spindle ix. Shafts	2
f) State advantages and disadvantages of foundry processes.	4
Answer: Following are the 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. Following are the 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.	2 2
Q. 3. Attempt any FOUR of the following:	16
a) What are different types of foundries and explain one in brief.	4
Answer: types – 2 marks(any 4 – ½ mark each), explanation – 2 marks According to the type and framework of the organization, foundries can be classified as a) Jobbing foundry b) Production foundry c) Semi-production foundry d) Captive foundry Depending upon the materials being produced, foundries can also be classified under two main headings. a) Ferrous foundries b) Non-ferrous foundries a) Jobbing foundry: It is the foundry based on job orders. It produces a small number of castings of a given type by customers. b) Production foundry: It produces casting on a mass scale. It is a highly mechanized foundry. c) Semi-production foundry: It is a combination of jobbing foundry and production foundry. It accepts both production and job work.	2 2

d) 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.

a) 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.

a) Non-Ferrous foundries

In addition to ferrous metal, many nonferrous materials are also cast. Nonferrous materials that are cast are copper & its alloys.

b) Draw neat sketch of any two moulding tools and state their use. 4

Answer:–

Moulding Hand Tools: *(Any Two) sketch– 2 marks (1mark each), uses - 2 marks (1mark each)* 4

1. 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)

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

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

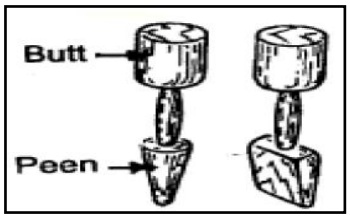
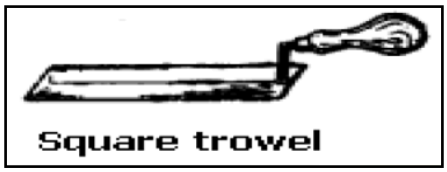
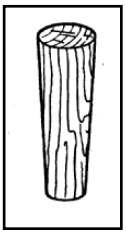


Fig. 3)



(Fig.4)

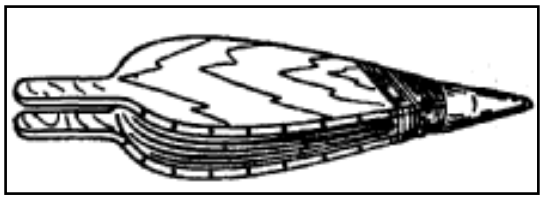


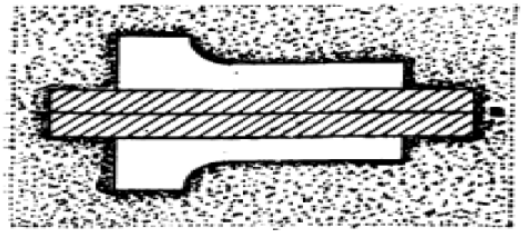
(Fig. 5)

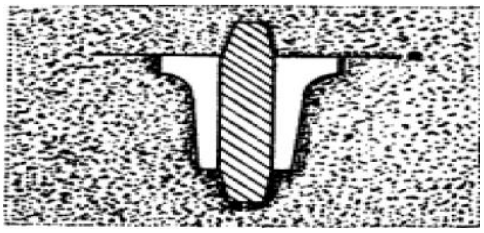
4. Trowel:. A moulder also uses them in repairing the damaged portions of a mould.

5. 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.

6. 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)	
c) List various pattern materials. State any four factors which governs selection of pattern materials.	4
Answer: *any 4 types – ½ mark each, any 4 factors – ½ mark each* Various Materials used for making Patterns: (Any four) The wide variety of pattern materials in use may be classified as wood and wood products; metals and alloys; plasters; plastics and rubbers; and waxes. **i.** Wood: wood used are teak, sal, shisam, pine and deodar. **ii.** Metal: Commonly metals used for patterns are cast iron, brass, aluminium alloy, magnesium alloy and white metal. **iii.** Plastic **iv.** Waxes: The waxes used are paraffin, shellac, bees wax and ceresin wax. **v.** Rubber **vi.** plaster of Paris / Gypsum cement Factors governs the selection of pattern material:(Any Four) The selection of pattern material depends on following factors: i. design of casting ii. quality of casting iii. shape (intricacy) of casting iv. types of moulding process v. types of production of castings vi. moulding material to be used vii. possibility of design changes viii. Possibility of repeat orders. ix. Casting design parameters x. Number of castings to be produced xi. Shape ,complexity & size of casting xii. Type of moulding materials xiii. service requirements, e.g. quantity, quality and intricacy of castings, minimum thickness desired, degree of accuracy and finish required	2 2
d) State properties of moulding sand. Explain any two properties of sand.	4
Answer: List any 4 properties – ½ mark each, explanation (any 2) – 1 mark each Following are the Properties of moulding sand:(List any four ½ mark each) 1) Porosity/Permeability 2) Flow ability 3) Collapsibility 4) Adhesiveness 5) Cohesiveness or strength 6) Refractoriness	2

Explain any two properties (1 Mark each) **1)** Porosity/Permeability: It is the property of the sand which allows the gases or steam to escape through the sand mould.	1
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.	1
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.	
e) Explain with neat sketch any two types of cores used in moulding.	4
Answer: *(Any Two- Each type carries 1 mark for description and 1 mark for sketch)* Horizontal cores: The most common type is the horizontal core. The core is usually cylindrical in form and is laid horizontally at the parting line of the mould. The ends of the core rest in the seats provided by the core prints on the pattern.	1
	1
Vertical core: This is placed in a vertical position both in cope and drag halves of the mould. Usually top and bottom of the core are provided with a taper, but the amount of taper on the top is greater than that at the bottom.	1



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Balanced core:

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

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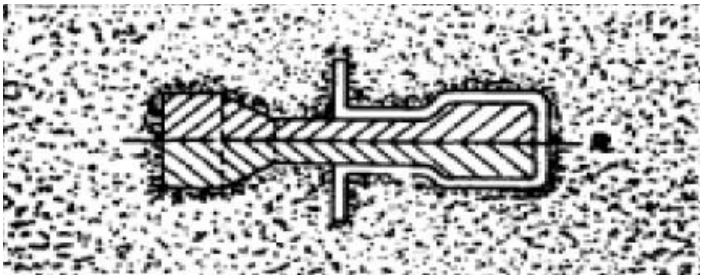

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Hanging and cover core:

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

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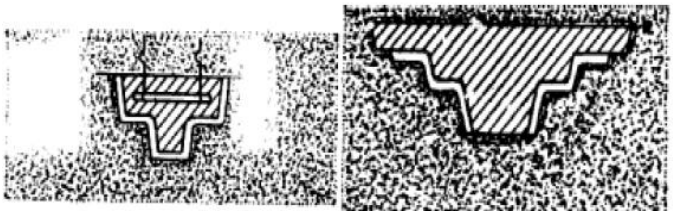

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On the other hand, if it has its support on the drag it is called cover core. In this case, the core serves as a cover for the mould, and also as a support for hanging the main body of the core.

f) State any eight casting defects. State remedies of any two defects. 4

Answer: *Any four – 1/2 Marks each, any 2 remedies – 1 mark each*

Listing of casting defects are as below:(Any four ½ mark each)

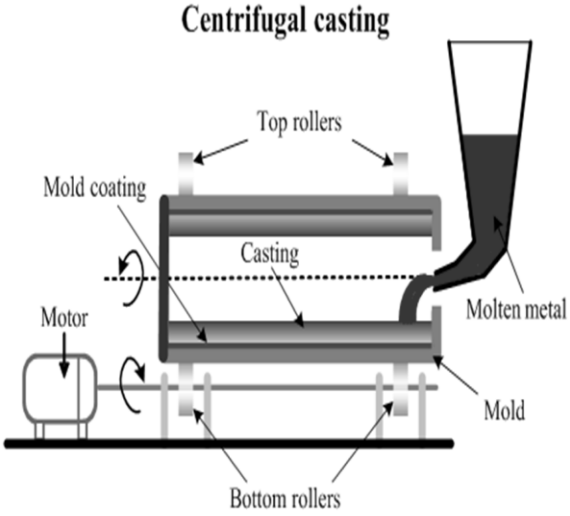
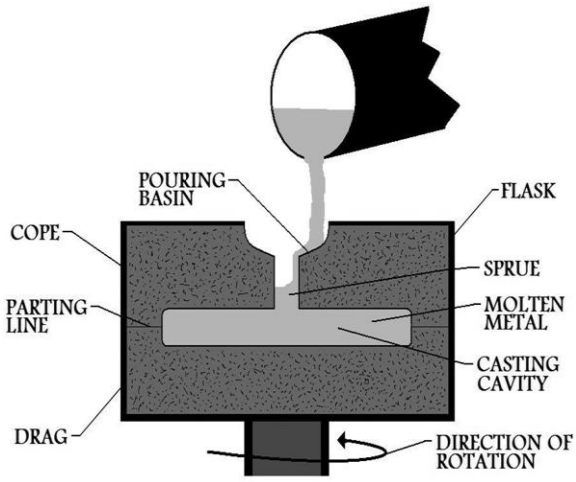
1. Blow Holes
2. Porosity
3. Shrinkage
4. Misruns and cold shuts
5. Inclusions
6. Hot Tears
7. Cuts and Washes
8. Metal Penetration
9. Drop
10. Fusion
11. Shot metal

12. Shift
13. Rat Tails or Buckles
14. Swells
15. Hard Spots
16. Run outs
17. Crushes
18. Warpages

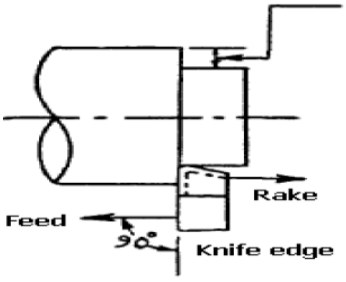
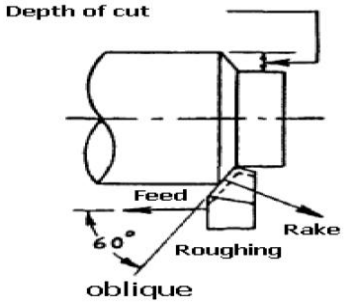
Remedies of casting defects are described below.(Any TWO- 1 Marks each)

1. Blow Holes:
   Remedies :
   - Control moisture content.
   - Use clean and rust free chills, chaplets and metal insert.
   - Bake cores properly.
   - Proper use of organic binders.
   - Cores and moulds should be properly vented.
   - Moulds should not be rammed excessively hard.
2. Porosity
   Remedies :
   - Increase flux proportion
   - Ensure effective degassing
   - Reduce moisture and increase permeability
3. Shrinkage:
   Remedies :
   - Ensure proper directional solidification by modifying risering and chilling.
4. Misruns and cold shuts
   Remedies :
   - Adjust proper pouring temperature
   - Modify design
   - Modify gating system.
5. Inclusions :
   Remedies :
   - Improve or modify gating and pouring
   - Use a superior sand
   - Provide harder ramming
   - Use proper flux
6. Hot Tears
   Remedies :
   - Improve collapsibility
   - Modify design
   - Provide soft ramming
7. Cuts and Washes :
   Remedies :
   - Improve collapsibility
   - Modify design
   - Provided soft ramming

8. Metal Penetration
   Remedies :
   - Use sand having finer grain size
   - Provide harder ramming
   - Increase the strength of sand
   - Adjust the proper pouring temperature
9. Drop
   Remedies :
   - Modify sand composition to increase the strength.
   - Provide hander ramming
   - Provide adequate reinforcement to sand projection.
10. Fusion
    Remedies :
    - Improve refractoriness
    - Modify refractoriness
    - Use lower pouring temperature
    - Improve quality of facing sand
11. Shot Metal
    Remedies :
    - Use higher pouring temperature
    - Reduce sulphur content
    - Modify gating system.
12. Shift
    Remedies :
    - Repair or replace the pins
    - Provide adequate support to cores
    - Locate the core properly
    - Repair or replace the core boxes
13. Rat rails or Buckles
    Remedies :
    - Reduce mould hardness
    - Break continuity of large surface by grooving or depressions.
14. Swells
    Remedies :
    - Provide harder ramming
    - Increase strength of mould and core
    - Provide adequate support to mould.
15. Shard Spots
    Remedies :
    - Suitable change in the metal composition
    - Modify the casting design
16. Run outs
    Remedies :
    - Improve moulding technique
    - Change the defective moulding boxes.
17. Crushes
    Remedies :
    - Repairs or replace core boxes

• Repairs or replace core prints • Proper setting of cores. 18. Warpage Remedies : • Facilitate proper directional solidification • Modify the casting design to break continuity.	
Q. 4. Attempt any FOUR of the following:	16
a) Explain with neat diagram what is centrifugal casting.	04
Answer: Description – 02 Marks, Sketch – 02 Marks (Any One Sketch) In centrifugal casting, centrifugal force plays a major role in shaping and feeding of the casting. In this process mould is rotated rapidly about its central axis as the metal is poured into it. Centrifugal force is utilized to distribute liquid metal over the outer surface of the mould. Hollow cylinders and other annular shapes are formed in this way. Centrifugal force tends the poured metal and the freezing metal to fly outward, away from the axis of rotation, and this tendency creates high pressure on the metal or casting while the lighter slag, oxides, and other inclusions being lighter, get pushed towards the centre. The axis may be horizontal, vertical, or inclined. Casting cools and solidifies from outside towards the axis of rotation; so it results in good directional solidification. Hence castings are free from shrinkage. It may be produced in metal or sand lined mould, depending largely upon the quantity desired.  OR 	4
b) What is riser in sand casting? State its advantages.	04
Answer: Riser in sand casting :-*Description – 02 Marks, advantages -02 marks* A riser or a feeder head is a passage of sand made in the cope through which molten metal rises after the mould is filled up . Risers serve a dual function: they compensate for solidification shrinkage which is a very common casting defect, and are a heat source so that they freeze last and promote directional solidification. Risers provide thermal gradients from a remote chilled area to the riser. Besides, they enable the pourer to see the metal as it falls into that the mould cavity. If the metal does not appear in the riser, it indicates that the mould cavity has not been completely filled up.	2

<table>
<tr><td>Advantages:(Any two 1 mark each)
1) Reduces shrinkage
2) Produces partial vacuum which reduces shrinkage.
3) It supplies constant metal to the metal.
4) Riser allows escaping of air and mould gases.
5) Riser full of molten metal indicates that the mould cavity has already is being filled with the molten metal.
6) Riser promotes directional solidification.</td><td>2</td></tr>
<tr><td>c) Give classification of moulding processes.</td><td>04</td></tr>
<tr><td>Answer: Any 8 types – ½ mark each
A. Moulding process may be broadly classified as (1 mark)
1) Hand moulding
2) Machine moulding
B. According to the method used: Any two (1 marks)
1) floor moulding
2) bench moulding
3) pit moulding
4) plate moulding
5) Sweep moulding
C. According to the type of material: -Any four (2 marks)
1) sand moulding:
• green sand moulding
• skin dried moulding
• dry sand moulding
• core sand moulding
• loam moulding
• cement bonded sand moulding
• carbon dioxide moulding
2) plaster moulding
3) metallic moulding</td><td>4</td></tr>
<tr><td>d) Differentiate between orthogonal and oblique cutting.</td><td>04</td></tr>
<tr><td>Answer: any 4 differences – 01 mark each
<table>
<tr><th>Orthogonal Cutting</th><th>Oblique Cutting</th></tr>
<tr><td>Cutting face of the tool is perpendicular to the line of action of tool</td><td>Cutting face of the tool is less than 90° to the line of action or path of the tool</td></tr>
<tr><td>The cutting edge clears the width of the workpiece on either ends.</td><td>The cutting edge may not clear the width of the workpiece on either ends.</td></tr>
<tr><td>The chip flows over the tool face. Chip formation in the form of coils ,in tight ,flat, spiral</td><td>The chip flows on the tool face. Chip formation is long curl</td></tr>
<tr><td>Only two components of the cutting forces are acting on the tool.</td><td>Only three components of the cutting forces are acting on the tool.</td></tr>
<tr><td>Tool is perfectly sharp.</td><td>Tool is not perfectly sharp.</td></tr>
<tr><td>Tool contacts the chip on rake face only.</td><td>The toll may not generate a surface parallel to workface.</td></tr>
<tr><td>The maximum chip thickness occurs at the middle.</td><td>The maximum chip thickness may not occur at the middle.</td></tr>
</table></td><td>4</td></tr>
</table>

Only one cutting edge in action.	More than one cutting edges are in action
Relatively short tool life	Longer tool life
 orthogonal	 oblique

e) State types of chips formed during machining. With neat sketch explain any one type. 04

Answer: *3types – ½ marks each , sketch – 1½ marks, Description – 1 mark (any One)*

Types of chips:

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

❖ Discontinuous or segmental chips

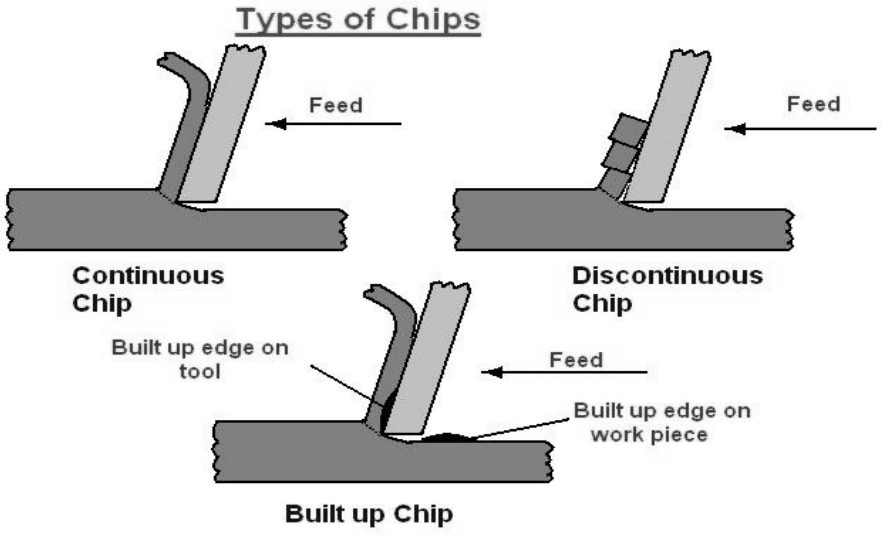
Machining of brittle materials produce these types of chips. Small fragments are produced because of lack in ductility of material. Friction between tool and chip reduces, resulting in better surface finish.

❖ Continuous chips

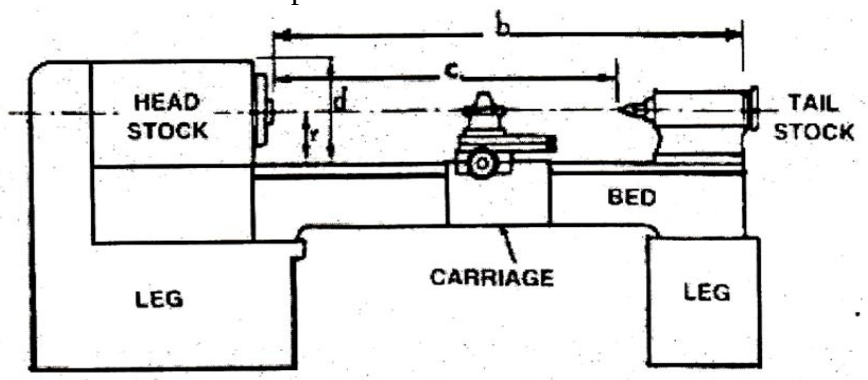
Machining of ductile materials produce these types of chips. Continuous fragments are produced because of high ductility of material. Chips are difficult to handle.

❖ Continuous 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.

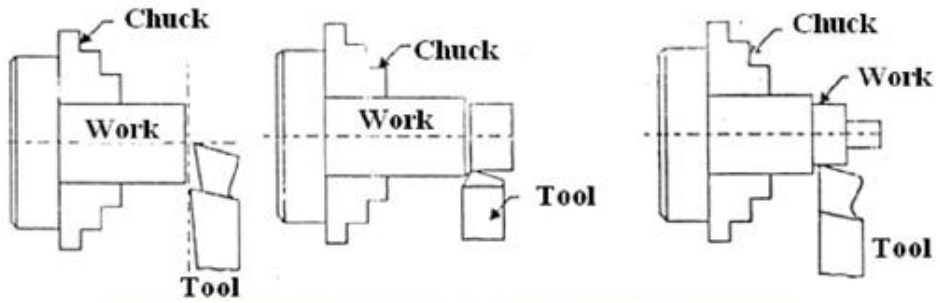


f) What is tool signature?	04
Answer:-Description 3 mark ,example 1 mark Tool signature (designation) under ASA (American Standards Association) System is given in the order α_b-α_s-θ_e-θ_s-C_e-C_s-R Where, α_b = Back rake angle; α_s = Side rake angle; θ_e = End relief angle; θ_s = Side relief angle; C_e = End cutting edge angle; C_s = Side cutting edge angle; R = Nose radius in mm Example :- 0 – 7 – 7 – 7 – 15 – 15 – 0.8 It means that back rake angle 0°, side rake angle 7°, end relief angle 7°, side relief angle 7°, end cutting edge angle 15°, side cutting edge angle 15°, nose radius 0.8 mm	4
Q. 5. Attempt any four of the following:	16
a) What are the purposes of cutting fluid? State types of cutting fluids.	04
Answer: any 4 purposes – ½ mark each, any 4 types – ½ mark each ❖ Purposes: (any four ½ mark each) i. To cool the tool: cooling the tool is necessary tom prevent metallurgical damage & to assist in decreasing friction at the tool – chip interface & at the tool – work piece interface. ii. To cool the work piece: the role of the cutting fluid in cooling the work piece is to prevent its excessive thermal distortion. iii. To lubricate & reduce friction. iv. To improve surface finish. v. To cause the chips break away from the tool vi. To protect the finished surface from corrosion ❖ Types Of Cutting Fluids:(any four ½ mark each) 1) Water 2) Soluble oil 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 2
b) Give classification of lathe machines.	04
Answer: any 4 types – 01 mark each. ❖ Lathes are classified according to 1) Speed lathe. i. Wood working ii. Centering iii. Polishing iv. Spinning 2) Engine or centre lathe.	4

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	
c) Explain terms used in lathe specifications.	04
Answer: *Description – 02 Marks, 02 marks for Sketch* The size of a lathe is expressed or specified by the following items and illustrated in Fig. • The height of the centers measured from the lathe bed. • The swing diameter over bed. This is the largest diameter of work that will revolve without touching the bed and is twice the height of the centre measured from the bed of the lathe. • The length between centers. This is the maximum length of work that can be mounted between the lathe centers. • The swing diameter over carriage. This is the largest diameter of work that over bed. • The maximum bar diameter. This is the maximum diameter of bar stock that will pass through hole of the headstock spindle.  **Fig. : SPECIFICATION OF A LATHE** **r** - Centre height **c** - Length between centres **d** - swing diameter over bed **b** - Length of bed.	4
d) Explain with neat diagram any two lathe operations.	04
Answer: Any two operations – *Description 01 Mark each, 01 mark for Sketch* The most common operations which can be carried out on a lathe are 1) Facing, 2) Plain turning, 3) Step turning, 4) Taper turning,	

5) Drilling,
6) Reaming,
7) Boring,
8) Undercutting,
9) Threading,
10) Knurling.

These operations are discussed as follows;



Facing Plain turning step turning

1) Facing

This operation is almost essential for all works. In this operation, as shown in Fig. the workpiece is held in the chuck and the facing tool is fed from the centre of the workpiece towards the outer surface or from the outer surface to the centre, with the help of a cross-slide.

2) Plain turning

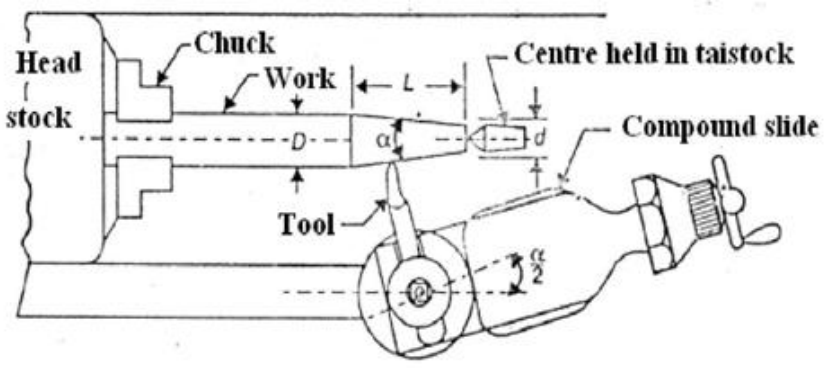
It is an operation of removing excess amount of material from the surface of the cylindrical workpiece. In this operation, as shown in Fig. the work is held either in (lie chuck or between centres and the longitudinal feed is given to the tool either by hand or power.

3) Step turning

It is an operation of producing various steps of different diameters in the workpiece, as shown in Fig. This operation is carried out in the similar way as plain turning.

4) Taper turning

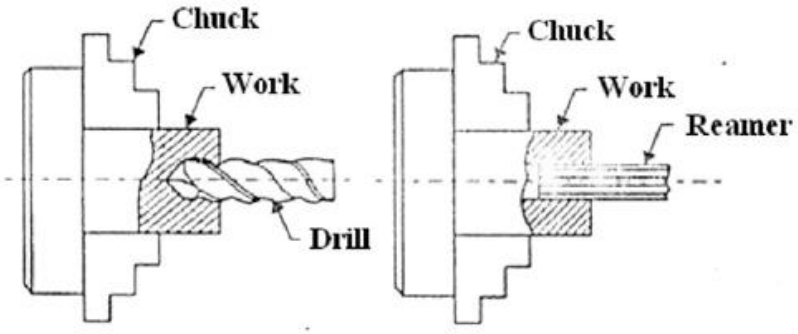
It is an operation of producing an external conical surface on a workpiece. A small taper may be produced with the help of a forming tool or chamfering tool, but the larger tapers are produced by swiveling the compound rest, as shown in Fig.5.17 at the required angle or by offsetting the tailstock or by taper turning attachment.



Taper turning

5) Drilling

It is an operation of making a hole in a workpiece with the help of a drill. In this operation, as shown in Fig.5.18 the workpiece is held in a chuck and the drill is held in the tailstock. The drill is fed manually, into the rotating workpiece, by rotating the tailstock hand wheel.



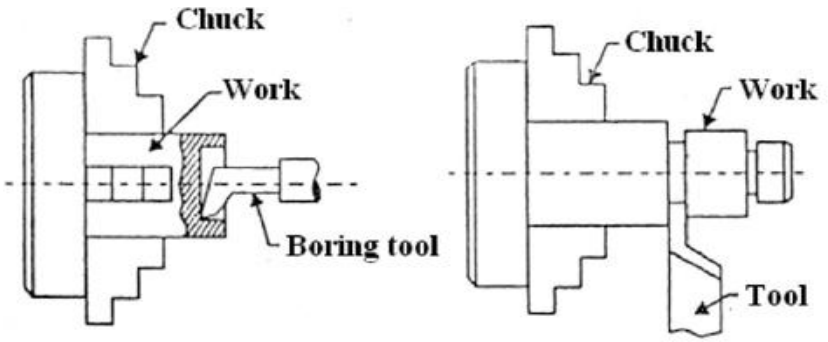
Drilling Reaming

6) Reaming

It is an operation of finishing the previously drilled hole. In this operation, as shown in Fig.5.19 a reamer is held in the tailstock and it is fed into the hole in the similar way as for drilling.

7) Boring

It is an operation of enlarging of a hole already made in a workpiece. In this operation, as shown in Fig.5.20 a boring tool or a bit mounted on a rigid bar is held in the tool post and fed into the work by hand or power in the similar way as for turning.



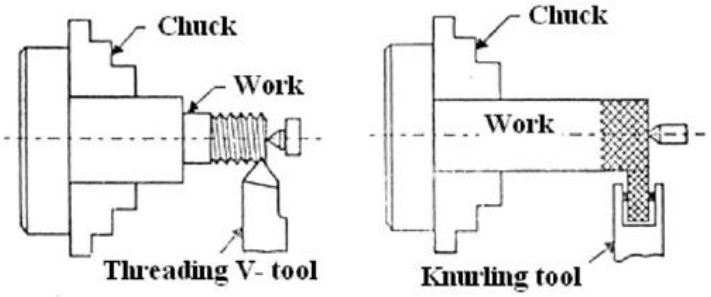
Boring Under Cutting

8) Undercutting or Grooving

It is an operation of reducing the diameter of a workpiece over a very narrow surface. In this operation, as shown in Fig.5.21 a tool of appropriate shape is fed into the revolving work up to the desired depth at right angles to the centre line of the workpiece

9) Threading

It is an operation of cutting helical grooves on the external cylindrical surface of workpiece. In this operation, as shown in Fig.5.22 the work is held in a chuck or between centers and the threading is fed longitudinally to the revolving work. The longitudinal feed is equal to the pitch of the thread be cut.



Threading Knurling

10) Knurling
It is an operation of providing knurled surface on the workpiece. In this operation, as shown in Fig.5.23 a knurled tool is moved longitudinally to a revolving workpiece surface. The projections on the knurled tool reproduce depressions on the work surface.

e) What is mandrel? State its types. 04

Answer: *Mandrel (Explanation: 1 mark) – types (Any three) – 1 mark each*

Mandrel:(1 mark)

It is a device for holding and rotating a hollow piece of work that has been previously drilled or bored. These are employed for that job which has finished holes which is concentric with the outer surface that is to be machined. The end of mandrel is slightly smaller in diameter and flattened to provide effective gripping surface. 1

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.

Different types of mandrels used are (Any three)(1 mark each)

1) Plain mandrel:-This mandrel is used when large numbers of identical pieces having standard size holes are required to mount on it.
2) Step Mandrel:-These are used to drive different work piece having different size hole.
3) Collar mandrel :- Used for turning work piece having holes of larger diameters above 100 mm
4) Screwed mandrel :- used to drive work pieces having internal threads 3
5) Gang mandrel: - Used to hold set of hollow work pieces between two collars by tightening the nut.
6) Expansion mandrel: In this tapered pin is pressed from the end into the sleeve and sleeve expand gripping the work.
7) Cone mandrel :-Used for holding work piece having different hole diameters by placing work piece on two cones and tightening the nut.

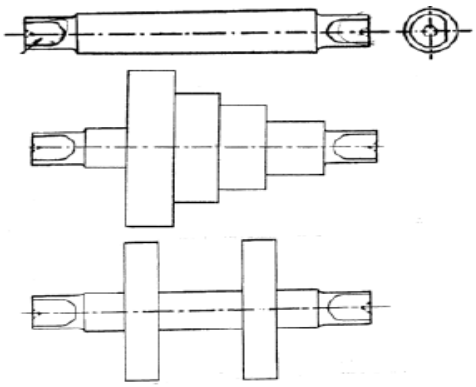
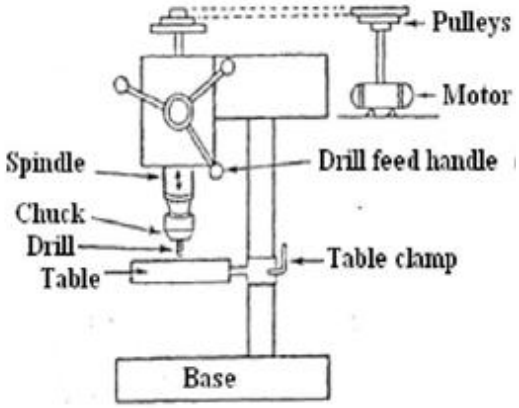
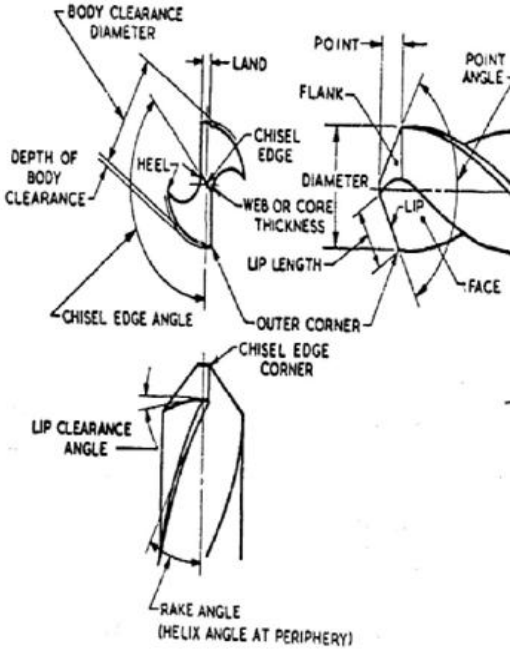
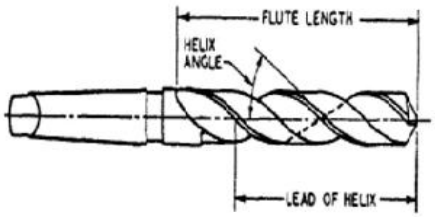
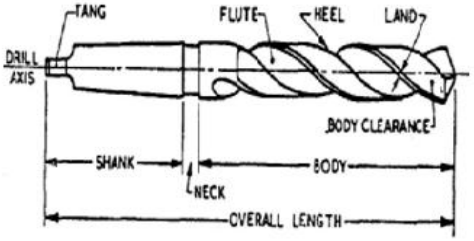


Figure. – a) Plain mandrel, b) Step mandrel and c) Collar mandrel

f) State types of drilling machines.	04
Answer: Any 8 types – ½ mark each *(Note:- Marks should be given to appropriate answer if 4 types explained)* 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	4
Q. 6. Attempt any FOUR of the following	16
a) Draw neat labelled diagram of bench drilling machine. State function of any two parts.	4
Answer: Bench Drilling machine *(Sketch -2 mark ,Function of two parts -1mark each)*  Fig :- 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.	4
b) Draw neat sketch labelled diagram of twist drill.	04
Answer: Twist Drill sketch - 4 marks	







OR

c) With neat diagram explain working principle of milling machine. 04

Answer:

Working Principle of Milling Machine :- (Working principle 2 Mark sketch 2 mark)

Milling is a metal removal process by means of using a rotating cutter having one or more cutting teeth as illustrated in figure Cutting action is carried out by feeding the work piece against the rotating cutter. Thus, the spindle speed, the table feed, the depth of cut, and the rotating direction of the cutter become the main parameters of the process. Good results can only be achieved with well balanced settings of these parameters. 2

In this work is rigidly clamped on the table of the machine while revolving multiteeth cutter mounted either on spindle or on arbor. The cutter revolves at high speed and the work is fed slowly past the cutter .The work can be fed vertical, longitudinal or cross direction. As the work advances, the cutter teeth remove the metal from the work surface to produce desired shape.

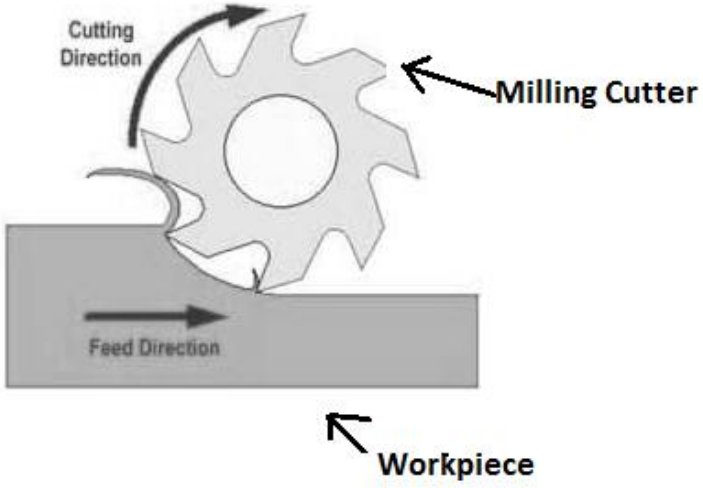


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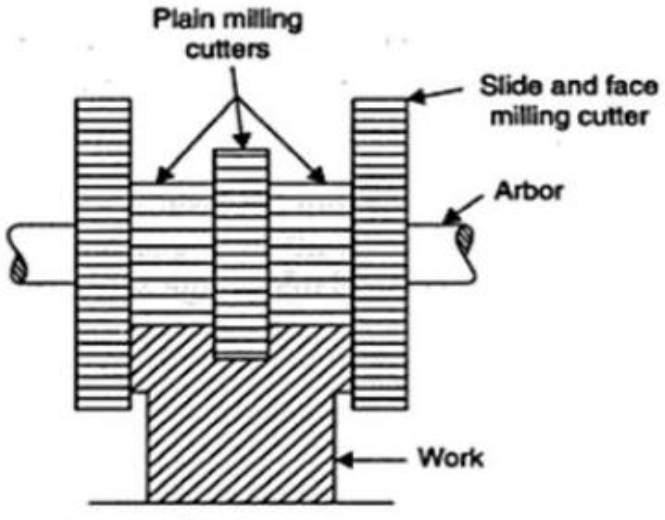
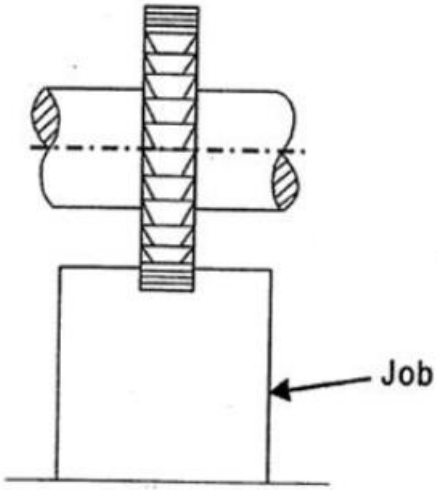
Fig :-Working Principle of Milling machine

d) Classify standard milling cutters.	04
Answer: Classification of Standard milling cutter *(Any four 1 mark each)* 1) Plain milling cutter a) Light duty b) Heavy duty c) Helical 2) Side milling cutter a)Plain b) Staggered teeth c) Half d) Interlocking 3) Metal slitting saw a) Plain b)Staggered teeth 4) Angle milling cutter a) Single b) Double 5) End milling cutter 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	4
e) Explain what is gang milling?	04
Answer: 2 mark sketch, 2 mark description 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.	2
 Gang milling.	2

f) Explain keyway milling operation.	04
Answer: *2 mark sketch, 2 mark description* Keyway milling operation: This milling process produce keyway slot. The cutter use if thin size. This operation suited for long keyways. The position of the cutter is shown in figure. Standard keyways are cut on shafts by using side milling cutters or end mills. The cutter is exactly at the center line of the work piece and then the cut is taken. Woodruff key is produced by using a woodruff key slot cutter.	2
 Figure: Keyway milling	2