Summer – 15 EXAMINATION

Subject Code: **17306** **Model Answer** Page No: 1/28

Important Instructions to examiners:
1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreimportance.(Not applicable for subject English and Communication Skills).
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constantvalues 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.

	Marks
1. A) Attempt anysix of the following :	**12**
a) List any four types of cast iron.	02
Answer : Types of cast iron:*(Any 04- ½ mark each)* 1. Cupola cast irons 2. Air furnace cast irons 3. Electric furnace cast irons 4. Duplex cast irons 5. Low carbon, low silicon cast irons 6. High carbon, low sulphur cast irons 7. Nickel alloy cast irons 8. Grey cast irons 9. White cast irons 10. Malleable cast irons 11. Nodular cast irons /Ductile Cast iron/Spheroidal cast iron 12. Mottled cast irons 13. Chilled cast irons 14. Meehanite cast	02
b) Classify plain carbon steel.	02
Answer: Classification of plain carbon steel: 1. Low Carbon Steels: Composition: 0.008% to 0.30% Carbon and remaining iron with impurities. 2. Medium Carbon Steels: Composition: 0.30% to 0.60% Carbon and remaining iron with impurities. 3. High Carbon Steels: Composition: 0.60% to 2.0% Carbon and remaining iron with impurities.	02

c)What is 18-4-1 H.S.S.?	02
Answer: 18-4-1 H.S.S. is a high speed tool steel. It contains 18 % Tungsten, 4 % Chromium, 1 % Vanadium With 0.75 % Carbon & Remaining Iron.	02
d) List two properties and applications of brass that makes it useful engineering material.	02
Answer: Properties and applications of brass:*(Any 02- 01 mark each)* 1. Very ductile, Easily worked in a cold condition - Cold rolled in sheets - Drawn into wires, tubes 2. Reduces strength at high temperature. But very plastic - Converted in sheets, tubes, foils, plats with the help of hot rolling, hot extrusion, hot stampings, casting 3. Highly Strong, Very Ductile -Used in Head lamp reflectors, radiator shells, tubes 4. Good resistance to corrosion - Easy for casting, rolling, extrusion, stamping, Casting pump parts, valves, taps 5. Corrosion resistance in sea water is improved - Used for cast & forged fittings for ships 6. Good resistance to sea water corrosion - It used for manufacturing sheets, tubes, bars, ship fittings, bolts, nuts, washers, other parts subjected to sea water corrosion, condenser plant 7. Colour varies red to bright yellow - For jewellery, decorative ornamental works 8. High corrosion resistance, Good tensile strength – used for hot worked, rolled, casted 9. Higher % of zinc gives headiness & brittleness, But it softens quickly when heated & melt at 870 ° C - Mainly used as a brazing solder (spelter)	02
e) What is thermoplastic? Give two examples.	02
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 Examples 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	01 01

f) Differentiate between natural rubber and synthetic rubber. — 02

Answer: Difference between natural rubber and synthetic rubber: *(Any 02- 01 mark each)* — 02

Sr. No.	Natural Rubber	Synthetic Rubber
01	Natural rubber occurs in nature and can be extracted.	Synthetic rubbers are derived from petroleum oil, and made by scientists and engineers.
02	It is comparatively less elastic, less oil resistance and can be affected by low and high temperature.	It has high elasticity, oil resistance, air tightness, insulation, resistance to low or high temperature.
03	It is more resistant to cutting and abrasion.	It is less resistant to cutting and abrasion.
04	Examples of natural rubber are silk, wool, DNA, cellulose and proteins.	Examples of synthetic rubber include nylon, polyethylene, polyester, Teflon, and epoxy.

(Note: Any suitable difference can be given due credit)

g) State any two properties of Epoxy resin. — 02

Answer: Properties of Epoxy resin:*(Any 02- 01 mark each)* — 02

1. It is very tough,
2. Chemical resistant and
3. Electrical resistant and
4. Low shrinkage
5. Good adhesion to metal and glass
6. Good resistance to wear and impact
7. Expensive
8. Transparent with creamy colour.

h) Give two different properties of ceramic materials and two industrial applications of it — 02

Answer:

Properties of Ceramic Material: *(Any Two- ½ Marks each)* — 01

1. Ceramics are inorganic in nature & non-metallic material.
2. Brittle material.
3. Insulation to flow of electric current
4. Withstand high temperature.
5. Rock like appearance
6. Hardness
7. Corrosion resistance
8. Opaque to light

Application of Ceramic Material: *(Any Two- ½ Marks each)* — 01

1. Tiles
2. Sanitary ware

3. Insulators 4. Semiconductors 5. Fuel elements in nuclear power plant 6. Cutting tools 7. Concrete 8. Variety of glasses 9. Nuclear engineering 10. Aerospace field 11. Electronic control devices 12. Computers 13. Structures 14. Catalytic converter	
1 B) Attempt any two of the following :	8
a) What is an alloy steel? Write the effect of any two alloying elements on steel.	04
Answer: Alloy steel: It contains iron & carbon as a main element. It also contains silicon, manganese, sulphur, phosphorus in different percentage. Some alloy steels contain Manganese varies up to 1 % & silicon up to 0.3 %. Some alloy steels contain manganese more than 1 % & silicon more than 0.3 %. It also contains nickel, chromium, molybdenum, vanadium in different %. These steels are called as "Alloy Steels". Effects of Alloying Element on steel:*(Any 02 - 01 Mark each)* 1) Nickel: i) It improves Toughness ii) It improves Tensile Strength iii) It improves Ductility iv) It improves Corrosion Resistance 2) Chromium: i) It improves Ductility ii) It is added in different proportions upto 18 % iii) Below 1.5 % addition increases Tensile Strength iv) 12 % addition gives high Corrosion Resistance v) It improves Hardenability & Toughness simultaneously 3) Cobalt: i) It improves Corrosion Resistance ii) It improves Thermal Resistance iii) It improves Magnetic Properties iv) It is act as a Grain Refiner 4) Manganese: i) Lower proportions from 1.0 to 1.5 % improves Strength & Toughness	02 02

ii) Higher proportions upto 5 % improves Hardness
iii) Very Higher proportions from 11 to 14 % improves very degree of Hardness

5) Silicon:
   i) It is act as a Ferritic Strengthener
   ii) It improves Elastic Limits
   iii) It improves Magnetic Property
   iv) It decreases Hysteresis Losses
6) Molybdenum:
   i) It improves Hardness
   ii) It improves Wear Resistance
   iii) It improves Thermal Resistance
   iv) It gives ability to maintain Mechanical Properties at Elevated Temperatures
7) Tungsten:
   i) It improves Hardness
   ii) It improves Wear Resistance
   iii) It improves thermal Resistance
   iv) It improves shock Resistance
   v) It improves Magnetic Properties
   vi) It gives ability to maintain Mechanical Properties at Elevated Temperatures
8) Vanadium:
   i) It improves Elastic Limit
   ii) It improves Shock Resistance
   iii) It act as a Degasser when added to Molten Metal
9) Boron:
   i) It improves Toughness
   ii) It improves Tensile Strength
   iii) It improves Ductility
   iv) It improves Corrosion Resistance
   v) It improves Hardenability
   vi) It is very useful when alloyed with Low Carbon Steels
10) Aluminium:
   i) It improves Tensile Strength
   ii) It improves Corrosion Resistance
   iii) It is used as a Deoxidizer
   iv) It improves growth of Fine Grains
   v) It improves Hardness by Nitriding to form Aluminum Nitrides
11) Titanium:
   i) It improves Corrosion Resistance
   ii) It is good Deoxidizer
   iii) It forms titanium carbides means improves hardness

12) Copper:
- i) It improves Toughness
- ii) It improves corrosion Resistance
- iii) It improves Strength
- iv) Its proportions varies from 0.2 % to 0.5 %

13) Niobium:
- i) It deceases Hardenability
- ii) It improves Impact Strength
- iii) It improves Fine Grain Growth
- iv) It is also called as ' Columbium '

b)Write composition and application of gun metal. 04

Answer: Composition of gun metal: 02

2 to 5% of zinc (Zn), 5 to 10% of tin (Sn) and remainder is copper.

Applications of Gun Metal: *(Any 04 – ½ mark each)* 02

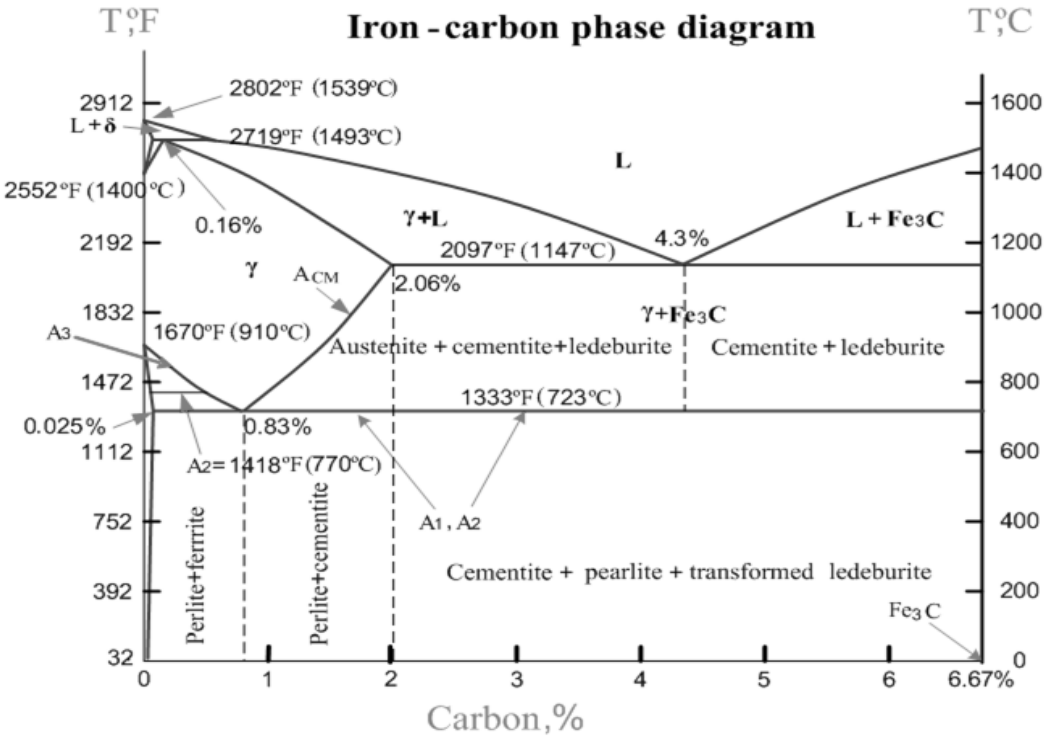
1. Gun barrels,
2. Ordnance parts,
3. Marine castings,
4. Gears,
5. Bearings
6. Steam pipe fittings
7. Small valves

c) Differentiate between thermoplastic and thermo-setting plastic. 04

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

Sr. No.	Thermoplastics	Thermosetting
01	They can be repeated softened by heat and hardened on cooling	once hardened and set they do not softened with application of heat
02	They are formed by addition polymerization only	They are formed by condensation polymerization
03	They consist of long chain linear polymers	They have three dimensional network structure
04	They are usually soft, weak and less brittle	They are usually hard, strong and more brittle
05	They are usually soluble in some organic solvents	They are insoluble in almost all organicsolvents
06	These can be repeatedly used and have resale value	They cannot reused and do not have resale value.
07	They cannot be used at higher temperature as they will tends to soft under heat	They can be used at comparatively higher temperature without damage.

2. Attempt any fourof the following :	16
a) Draw the Iron-Carbon equilibrium diagram and showing critical temperatures on it.	04
Answer: Iron-Carbon equilibrium diagram*(Credit shall be given to correct diagram showing critical temperatures)*	04



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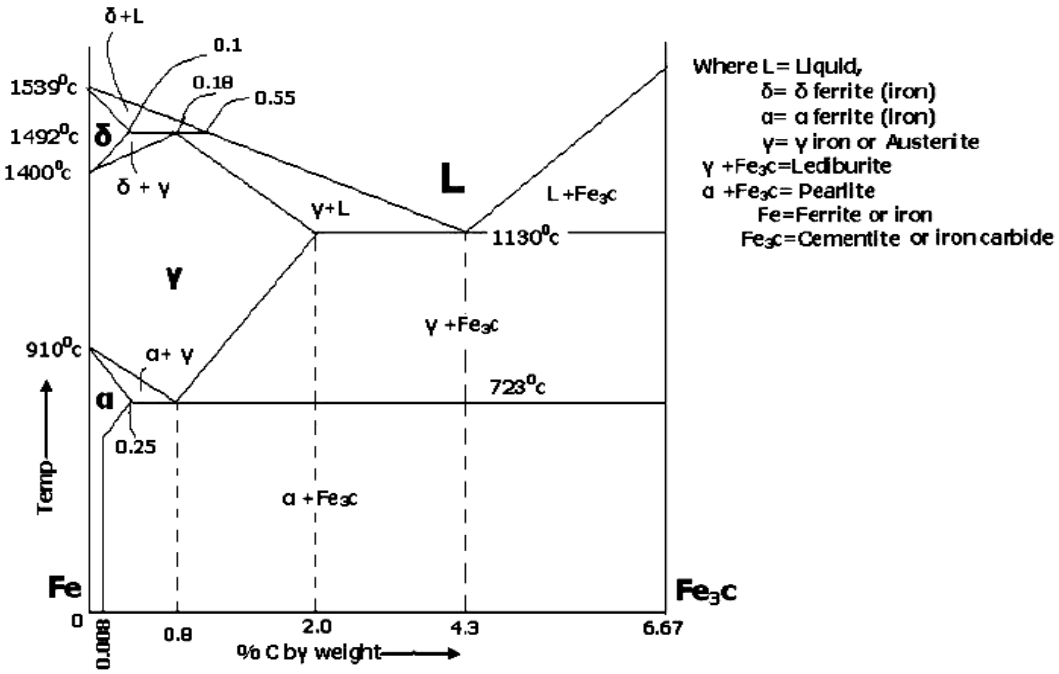


b) Differentiate between annealing and normalizing. — 04

Answer: Difference between annealing and normalizing:*(Any 04-01 mark each)* — 04

Sr. No.	Annealing	Normalizing
01	Less hardness, toughness.	Slightly more hardness, toughness.
02	For plain carbon steel the microstructure shows pearlite.	Microstructure shows more pearlite.
03	Pearlite is coarse and usually gets resolved by the optical microscope.	Pearlite is fine and appears unresolved with optical microscope.
04	Grain size distribution is more uniform.	Grain size distribution is slightly less uniform.
05	Internal stresses are least.	Internal stresses are slightly more

c) What is Nitriding ? Give advantages and limitations of nitriding. — 04

Answer:

Nitriding:

The heat treatment process which produces a hard-wear resistant layer of nitrides on a tough core of low carbon steel is known as nitriding. — 01

The process consists of heating machined and heat treated components to a temperature of 500^0c for 40 to 90 hours in a gas tight box through which ammonia gas is circulated. The component is allowed to cool in the furnace after switching of the supply of ammonia. — 01

When ammonia vapours come in contact with the steel, they get dissociated NH3 = 3H + N and nascent nitrogen so produced diffuses into the surface of the work piece forming hard nitrides.

Advantages of Nitriding Process:*(Any 02 – ½ mark each)* — 01

1. Very high surface hardness can be obtained.
2. Minimum distortion or cracking
3. Good corrosion and wear resistance
4. Good fatigue resistance
5. No machining is required after nitriding.
6. Economical for mass production.

Limitations of Nitriding Process:*(Any 02 – ½ mark each)* — 01

1. Long cycle time (40 to 100 hours)
2. The brittle case
3. This process is costly
4. Only special alloy steel (containing AL, Cr & V) can be nitride.

d) Compare flame hardening and induction hardening as surface hardening process — 04

Answer: Comparison of flame hardening and induction hardening:*(Any 04-01 mark each)* — 04

Flame Hardening	Induction Hardening
Material is heated with oxyacetylene flame at a required temperature, and then it is followed by water spraying.	Material is heated by using high frequency induced current and then it is followed by water spraying.
Holding time is required.	Due to very fast heating, no holding time is required.
Oxidation & decarburization is minimum.	No scaling & decarburization.
Irregular shape parts can be flame hardened.	Irregular shape parts are not suitable for induction hardening.
Flame hardening requires more care in control of temperature.	Easy control of temperature by control of frequency of supply voltage.

e) What are different types of foundries? Explain any one in brief. — 04

Answer: Types of foundries: *(any 04 – ½ mark each)* — 02

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

(Explanation of any 01)

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.
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.

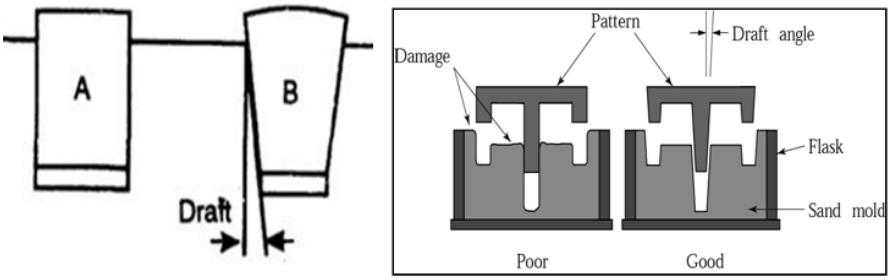
Ferrous components can further be broadly subdivided into

i) cast iron
ii) Steel.

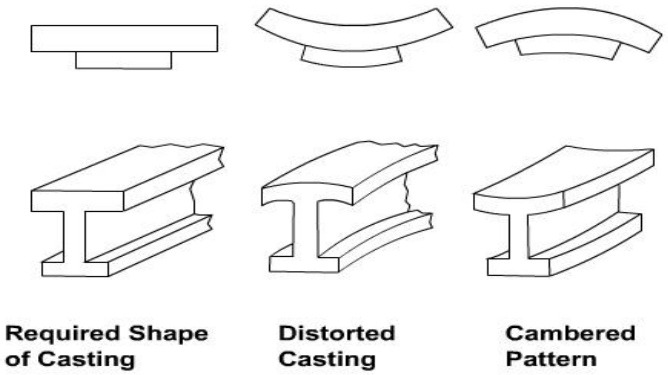
Cast iron can be further divided into grey cast iron, white C.I., Malleable C. I., Alloy C.I., Spheroidal graphite C. I. Steel is generally low carbon steel, medium carbon steel, high carbon steel, Alloy steel. — 02

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) Describe standard colour coding used in pattern.	04
Answer: Standard colour coding used in pattern:*(Any 04-01 mark each)* The colour codes are given for identification of the parts of patterns and core boxes. 1. Surface to be left unfinished are to be painted black 2. Surface to finished are painted by red colour. 3. Seats for loose pieces are marked by red strips on yellow background 4. Core prints are painted by yellow colour. 5. Stop-offs is marked by diagonal black strips on yellow background.	04
3. Attempt any fourof the following :	16
a) List any four types of pattern. State any four factors for the selection of pattern material.	04
Answer: Types of Patterns: *(Any 04 – ½ marks each)* 1. Single piece pattern 2. Split pattern 3. Match plate pattern 4. Cope and drag pattern 5. Gated pattern 6. Sweep pattern 7. Loose piece 8. Follow board pattern 9. Skeleton pattern 10. Segmental pattern 11. Shell pattern 12. Built-up pattern 13. Box-up pattern 14. Lagged-up pattern 15. Left & right hand	02
Factors for the selection of pattern material:*(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 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.	02

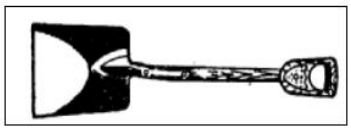
b) List various allowances provided on pattern. Explain any two in brief.	04
Answer: Allowances provided on pattern:*(Any 02- ½ mark each)* 1. Shrinkage allowance 2. Draft allowance 3. Machining allowance 4. Distortion or camber allowance 5. Shake allowance / rapping allowance 6.	01
(Suitable explanation and sketch should be considered)(Any 02- 1 ½ mark each) 1. Shrinkage allowance: As metal solidifies and cools, it shrinks and contracts in size. To compensate for this, a pattern is made larger than the finished casting by means of a shrinkage or contraction allowance. To provide an allowance, a patternmaker uses shrink or contraction rule which is slightly longer than the ordinary rule of the same length. Different metals have different shrinkages; therefore, there is a shrink rule for each type of metal used in a casting. 2. Draft allowance provided on pattern: When a pattern is drawn from a mould, there is always some possibility of injuring the edges of the mould. This danger is greatly decreased if the vertical surfaces of a pattern are tapered- inward slightly. This slight taper inward on the vertical surfaces of a pattern is known as the draft. Draft may be expressed in millimeter per meter on a side, or in degrees, and the amount needed in each case depends upon	03
 Figure: Draft allowance.	
3. Machining allowance:Rough surfaces of castings that have to be machined are made to dimensions somewhat over those indicated on the finished working drawings. The extra amount of metal provided on the surfaces to be machined is called machine finish allowance and the edges of these surfaces are indicated by a finish mark V, or F. The amount that is to be added to the pattern depends upon (1) the kind of metal to be used (2) the size and shape of the casting and (3) Method of moulding. 4. Distortion or camber allowance: Some castings, because of their size, shape and type of metal, tend to warp or distort during the cooling period. This is a result of uneven shrinkage and is due to uneven metal thickness or to one surface being more exposed than another, causing it	

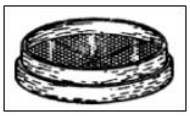
to cool more rapidly. The shape of the pattern is thus bent in the opposite direction to overcome this distortion. This feature is called distortion or camber allowance.

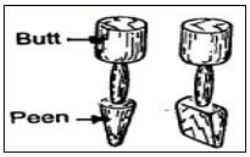


c) Draw any two moulding tools with simple sketch and explain its use. 04

Answer:*(Any 02 sketches- 01 mark each, 01 mark each for use)* 02


Shovel


Riddle



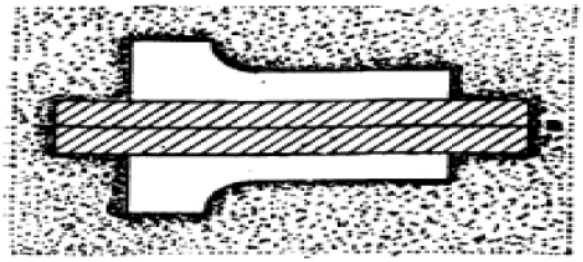
Rammer

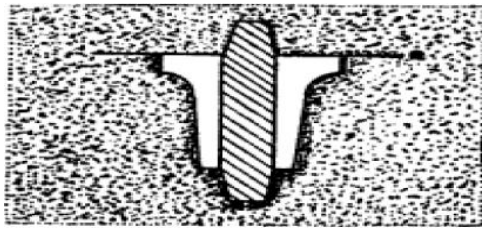
Trowel


Sprue pin

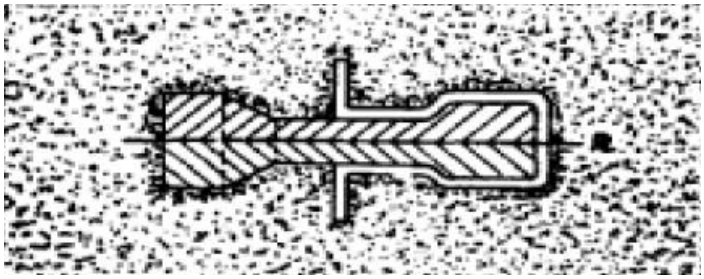

Bellow

1) Shovel: A shovel is used for mixing and tempering moulding sand and for moving the sand from the pile to the flask.
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 is a wooden tool used for packing or ramming the sand into the mould.
4) Trowel: A moulder also uses them in repairing the damaged portions of a mould.
5) 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.
6) 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. 02

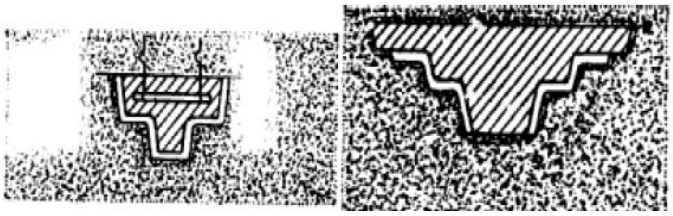
d) State the different properties of moulding sand.	04
Answer: Properties of moulding sand: *(Any 04-01 mark each)* 1. Porosity/Permeability: It is the property of the sand which allows the gases or steam to escape through the sand mould. 2. Flow ability: Flow ability of moulding sand refers to its ability 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.	04
e) What is core print? Explain any two types of core print with sketch.	04
Answer: 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. ***(Any 02 types of cores with sketch- 1 ½ mark each)*** 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.  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.	01 03



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



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.



f) Give advantages and limitations of shell moulding process. — 04

Answer:

Advantages of shell moulding process: *(Any 02-01 mark each)* — 02

1. Floor space required per ton of castings is less compared to conventional castings.
2. Operators can be trained easily, thus, providing more output per operator. Skilled operators are not required.
3. The process can be highly mechanised.

Disadvantages / limitations of shell moulding process: *(Any 02-01 mark each)* — 02

1. High pattern cost.
2. High resin cost.
3. High equipment cost.

4. Attempt anyfour of the following :	16
a) What is the purpose of Gating System in case of casting? Explain with sketch.	04

Answer: Purpose of Gating system in case of casting:*(Any 02))*

1. To provide continuous, uniform feed of molten metal, with as little turbulence as possible to the mould cavity.
2. To supply the casting with liquid metal at best location to achieve proper directional solidification and optimum feeding of shrinkage cavities.
3. To fill the mould cavity with molten metal in the shortest possible time to avoid temperature gradient.
4. To provide with a minimum of excess metal in the gates and risers. Inadequate rate of metal entry, on the other hand, will result many defects in the casting.
5. To prevent erosion of the mould walls.
6. To prevent slag, sand and other foreign particles from entering the mould.

02

Gating system:

The term gating system refers to all passageways through which the molten metal passes to enter the mold cavity. Various components of gating systems are shown in fig.

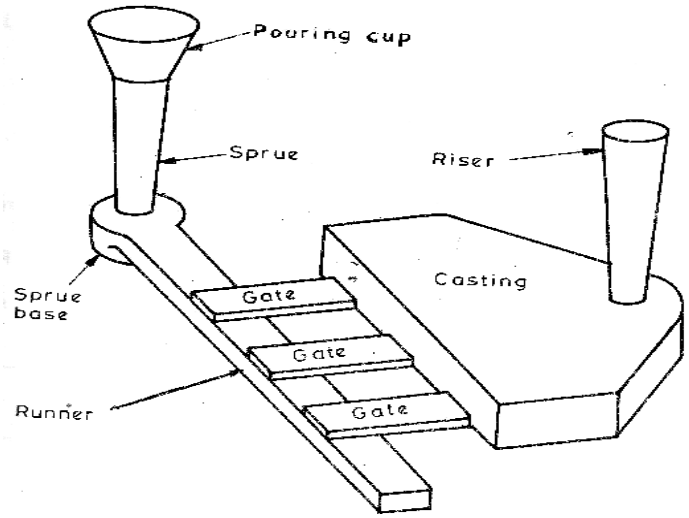


Figure: Gating system in casting.

02

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

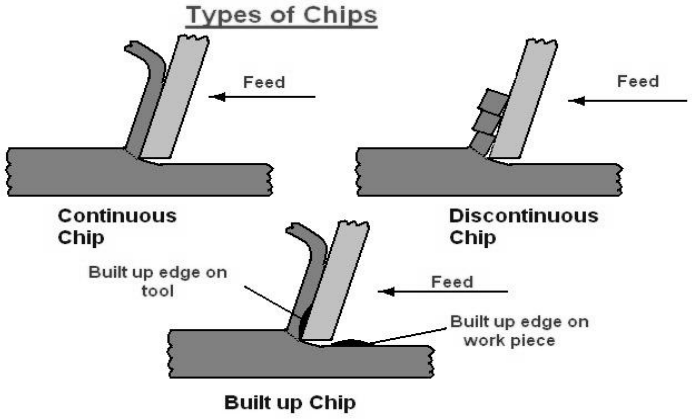
Sprue: The vertical passage that passes through the cope and connects the pouring basin with the runner or gate is called the sprue. The cross-section of a sprue may be square, rectangular, or circular.

Runner: In large castings, molten metal is usually carried from the sprue base to several gates around the cavity through a passageway called the runner. The runner is generally preferred in the drag, but it may sometimes be located in the cope, depending on the shape of the casting. **Gate:** A gate is a passage through which molten metal flows from the runner to the mould cavity. The gates should be located where they can be easily removed without damaging the casting.

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

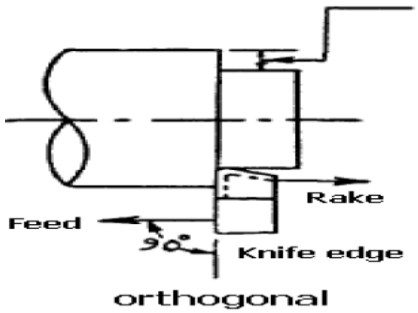
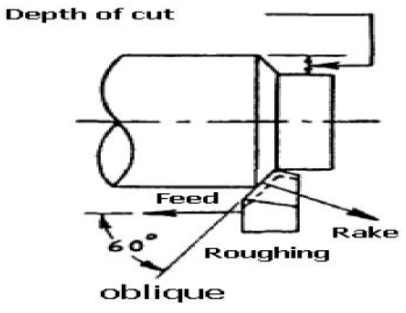
b) Explain any two defects in casting with its cause and remedies.	04
Answer: Defects in casting with its cause and remedies:*(Any 02- 02 marks each)* **1. Shifts:** This is an external defect in a casting. **Cause:** Due to core misplacement or mismatching of top and bottom parts of the casting usually at a parting line. Misalignment of flasks is another likely cause of shift. **Remedy:**By ensuring proper alignment of the pattern or die part, moulding boxes, correct mounting of patterns on pattern plates, and checking of flasks, locating pins, etc. before use. **2. Warpage:**Warpage is unintentional and undesirable deformation in a casting that occurs during or after solidification. **Cause:** Due to different rates of solidification different sections of a casting, stresses are set up in adjoining walls resulting in warpage in these areas. Large and flat sections or intersecting sections such as ribs are particularly prone to warpage. **Remedy:** Is to produce large areas with wavy, corrugated construction, or add sufficient ribs or rib-like shapes, to provide equal cooling rates in all areas; a proper casting design can go a long way in reducing the warpage of the casting. **3. Swell:** A swell is an enlargement of the mould cavity by metal pressure, resulting in localised or overall enlargement of the casting. **Cause:** This is caused by improper or defective ramming of the mould. **Remedy:** To avoid swells, the sand should be rammed properly and evenly. **4. Blowholes:** Blow holes are smooth, round holes appearing in the form of a cluster of a large number of small holes below the surface of a casting. These are entrapped bubbles of gases with smooth walls. **Cause:** Excessive moisture in the sand, or when permeability of sand is low, sand grains are too fine, sand is rammed too hard, or when venting is insufficient. **Remedy:** To prevent blowholes, the moisture content in sand must be well adjusted, sand of proper grain size should be used, ramming should not be too hard and venting should be adequate. 5.**Drop:** A drop occurs when the upper surface of the mould cracks, and pieces of sand fail into the molten metal. **Cause:** This is caused by low strength and soft ramming of the sand, insufficient fluxing of molten metal and insufficient reinforcement of sand projections in the cope. **Remedy:** The above factors are eliminated to avoid drop.	04
c) Explain different type of chips observed while machining.	04
Answer: Different types of chips observed while machining: 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. 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. 3. Continuous chips with built-up edge (BUE):	04

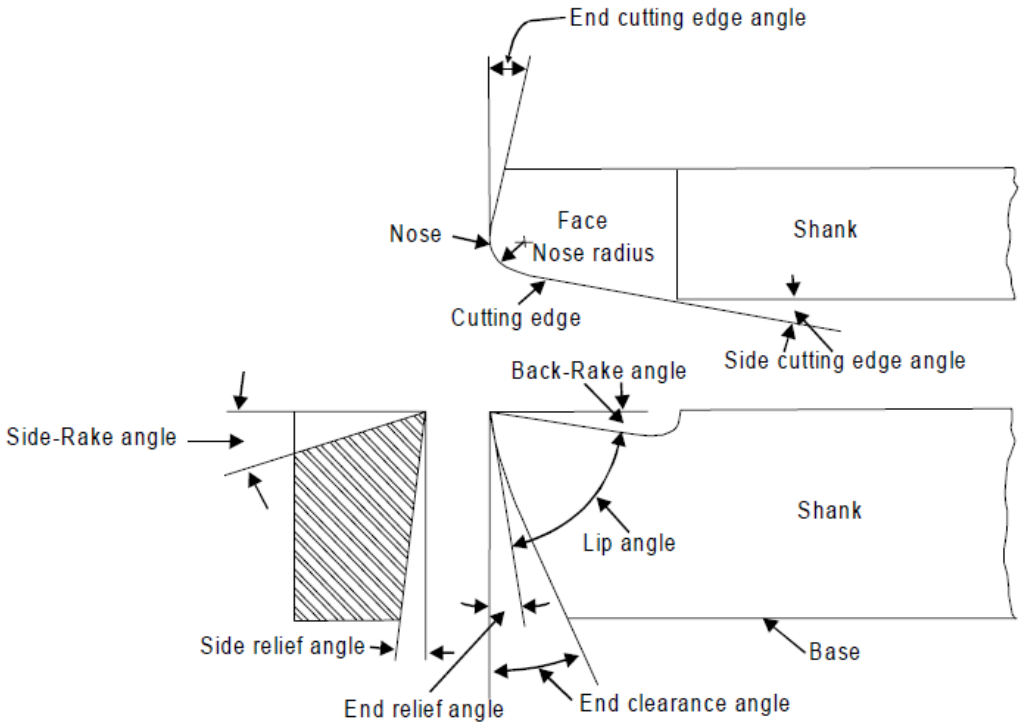
When machining ductile material, conditions of high local temperature and extreme pressure in the cutting zone and also high friction in the tool-chip interface, may cause the work material to adhere or weld to the cutting edge of the tool forming BUE. BUE changes its size during cutting operation. It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

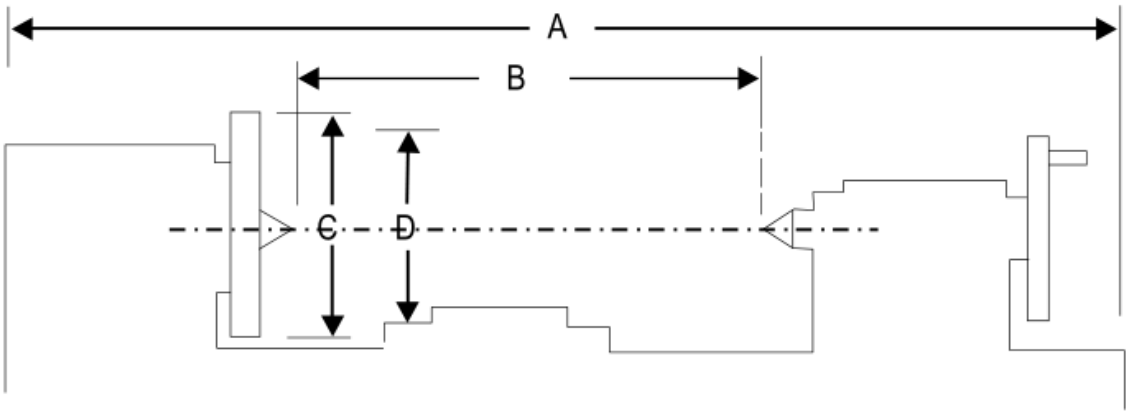


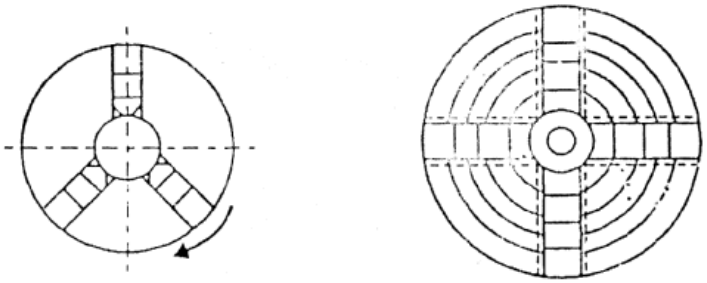
d) Compare "orthogonal and oblique cutting". 04

Answer:Comparison of orthogonal and oblique cutting:*(Any 04- 01 mark each)* 04

Sr. No.	Orthogonal Cutting	Oblique Cutting
01	The cutting edge of the tool is perpendicular to the cutting velocity factor	The cutting edge is inclined at an angle '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		

e) Draw a neat sketch of single point cutting tool and show the different pars and angles on it.	04
Answer:Sketch of single point cutting tool:*(02 marks for sketch and 02 marks for labeling)*  Figure: Single point cutting tool.	04
f) What is different type of tool materials? State their specific use.	04
Answer: Different types of tool materials: *(Any 02- 01 mark for material and 01 mark for use)* **1. High-speed steels:** These steels are called as HSS because these steels cut material at high speeds and retain their hardness even at high temperature. It consists of iron and carbon with differing amounts of alloying elements such as tungsten, chromium, vanadium and cobalt. Specific **use**: 18:4:1 HSS tool is used to manufacture drills, reamers, end mill cutters and taps. **2. Stellites**: Stellite is the trade name of a nonferrous cast alloy composed of cobalt, chromium and tungsten. It is shaped by casting from which it gets cutting properties. Specific **use**: Stellite is used in the manufacture of turning tools for lathes, slitting cutters. **3. Cemented carbides**: The basic ingredient of most cemented carbides is tungsten carbide which is extremely hard. Pure tungsten powder is mixed under high heat, at about 1500 0C, with pure carbon (lamp black) in the ratio of 94 per cent and 6 per cent by weight. The new compound, tungsten carbide, is then mixed with cobalt until the mass is entirely homogeneous. Specific use: Carbide tips for face mill cutters, carbide drills in VMC machines.	04

4. Diamond: The diamonds used for cutting tools are industrial diamonds, which are naturally occurring diamonds containing flaws and therefore of no value as gemstones. Alternatively they can be also artificial. Specific **use**: These are suitable for cutting very hard materials such as glass, plastics and ceramics.	
5. Attempt anyfour of following :	16
a) You are going to machine mild steel on lathe which type of tool material you will select considering following parameters? 1) Ease in machining 2) Long life of tool 3) Surface finish	04
Answer : 1. Ease in machining: Single point cutting tool brazed with carbide tips for easy machining of mild steel. Tool nomenclature should be proper. 2. Long life of tool: Same material as above can be used but there should be proper feed and speed for maintaining long life of tool. 3. Surface finish: H.S.S. and carbide tools can be used for mild steel to achieve good surface finish but depth of cut should be less. (0.1 mm to 0.3 mm)	04
b) How lathe machine is specified?	04
Answer**:** The lathe is generally specified by the following means: a) Swing or maximum diameter that can be rotated over the bed ways b) Maximum length of the job that can be held between head stock and tailstock centres c) Bed length, which may include head stock length also d) Maximum diameter of the bar that can pass through spindle or collect chuck of capstan lathe. Fig. illustrates the elements involved in specifications of a lathe. Thefollowing data also contributes to specify a common lathe machine.  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.	04

c) State any four accessories used on lathe. Explain with neat sketch the use of any two accessories.	04
Answer: Accessories of lathe:*(Any 04)* 1. Centre 2. Chuck 3. Face plate 4. Angle plate 5. Mandrel 6. Rests 7. Carriers 8. Catch plates 9. Collets	01
The lathe accessories: *(Any 02 with sketch -1 ½ marks each)* **1.** Centres: a. There are two types of centres i.e., live centre and dead centre. b. A centre which fits into the headstock spindle and revolves with the work is called live centre. c. The centre which is used in a tailstock spindle and does not revolve is called dead centre.  **(a) Standard centre (b) Half centre** **2.** Chucks: a. It is an important device used for holding and rotating the workpiece in lathes. b. The work pieces which are too short to be held between centres are clamped in a chuck. c. It is attached to the lathe spindle by means of two bolts with the back plate screwed on to the spindle nose. d. There are many types of the chuck, but the following two are commonly used. **i)** Three jaw universal chuck: The three jaw universal chuck, as shown in Fig. (a) is also called self-centering chuck or scroll chuck. Thus chuck is used for holding round andhexagonal work.  **(a) Three jaw chuck** **(b) Four jaw chuck**	03

ii) Four jaw independent chuck:

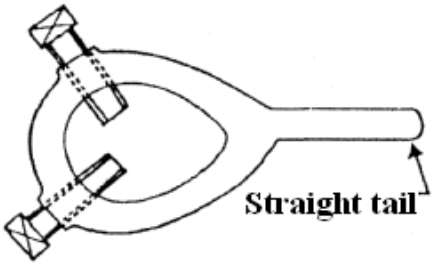
1. The four jaw independent chuck, as shown in Fig. (b) has fourreversible jaws, each of which may be independently adjusted toaccommodate the work it supports.
2. This type of chuck can hold square, round and irregular shape of work ineither a concentric or eccentric position.

The other types of the chucks are

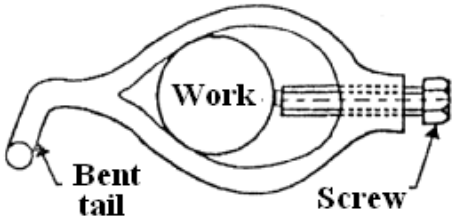
iii) combination chucks, iv) magnetic chuck, v) collect chuck, vi) drill chuck,and vii) air or hydraulic chuck

3. Lathe dog or carrier:

a. The work placed on a mandrel or held between centres is rotated positively by clamping the dog or carrier to the end of the work.
b. This is engaged with a pin attached to the drive plate or face plate.
c. The lathe dog or carrier may be of straight type or bent type as shown in Fig. (a) and (b) respectively.



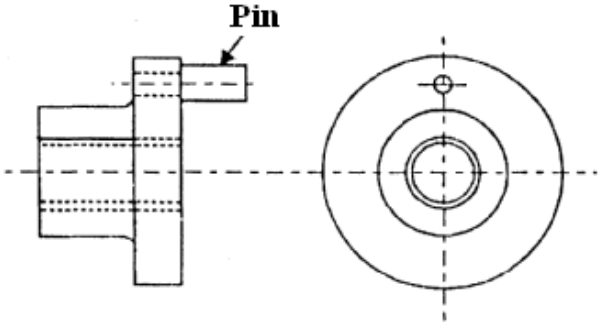
(a) Straight tail pipe



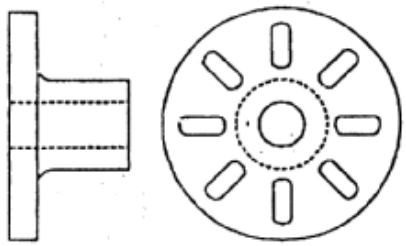
(b) Bent tail pipe

4. Drive plate:

a. The drive plate, as shown in Fig. is a circular plate which is bored out and threaded so that it can be attached to the spindle nose.
b. It also carries a hole for the pin which is used only when the work is held in a lathe dog having straight tail. When bent-tail dog is used, this pin is taken out and the bent portion of the tail is inserted into the hole



Drive plate



Face plate

5. Faceplate:

a) The face plate, as shown in Fig. is similar to drive plate except that it is larger in diameter.
b) It contains more open slots or T-slots so that bolts may be used to clamp the workpiece to the face of the plate.
c) The face plate is used for holding work pieces which can not be conveniently held in a chuck.

6. Angle plate:

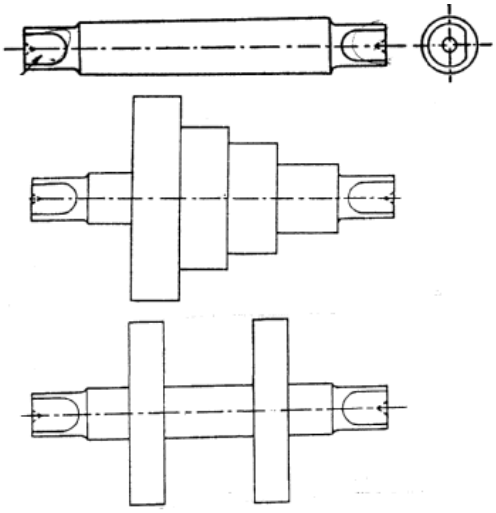
a. An angle plate is simply a cast iron plate with to faces planed at right angles to each other and having slots in various positions for the clamping bolts.

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

7. Mandrels:

a. The lathe mandrel is a cylindrical bar with centre hole at each end. It is used to hold hollow work pieces to machine their external surface.

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

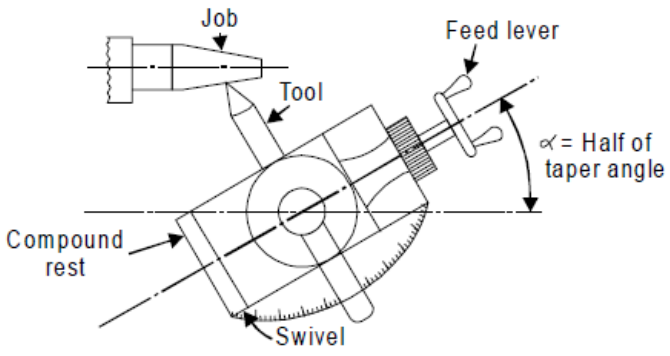


Plain mandrel, Step mandrel and Collar mandrel

d) Explain taper turning operation performed on lathe by swiveling the compound rest. 04

Answer: Taper turning on lathe by swiveling the compound rest:

It is an operation of producing an external conical surface on a workpiece. This method uses the principle of turning taper by rotating the workpiece on the latheaxis and feeding the tool at an angle to the axis of rotation of the workpiece. The tool ismounted on the compound rest which is attached to a circular base, graduated in degrees.The compound rest can easily be swiveled or rotated and clamped at any desired angle asshown in Fig. Once the compound rest is set at the desired half taper angle, rotationof the compound slide screw will cause the tool to be fed at that angle and generate acorresponding taper. 02

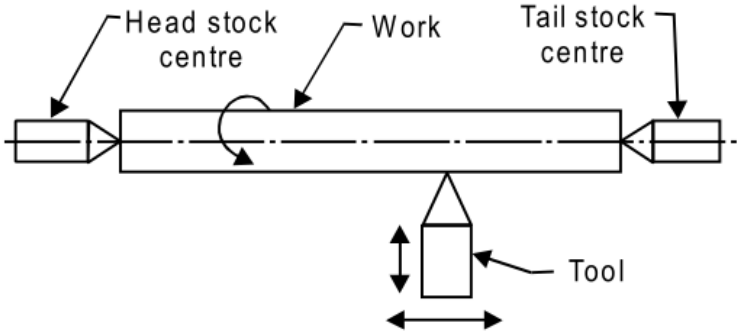


02

Figure: Taper turning by swiveling compound rest.

e) What is working principle of lathe? How lathe machine is classified?	04

Answer: Working Principle of a Lathe:

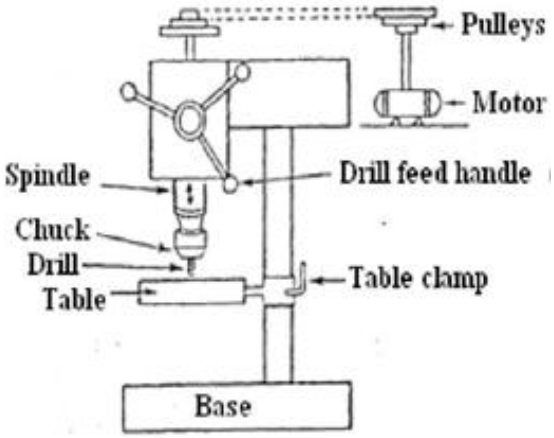
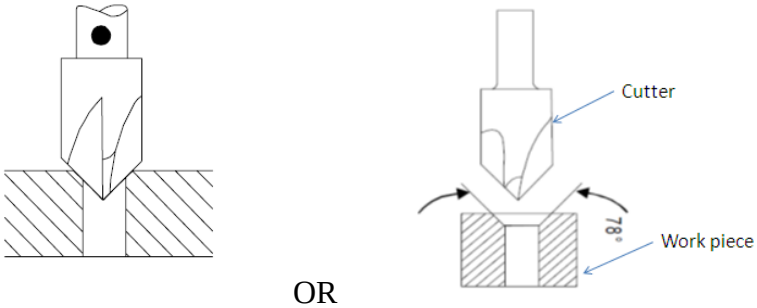


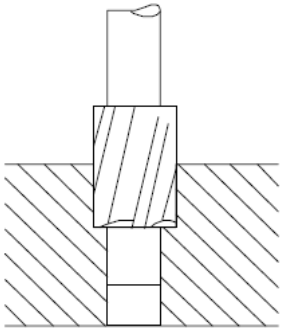
The working principle of a lathe is shown in Fig. 02

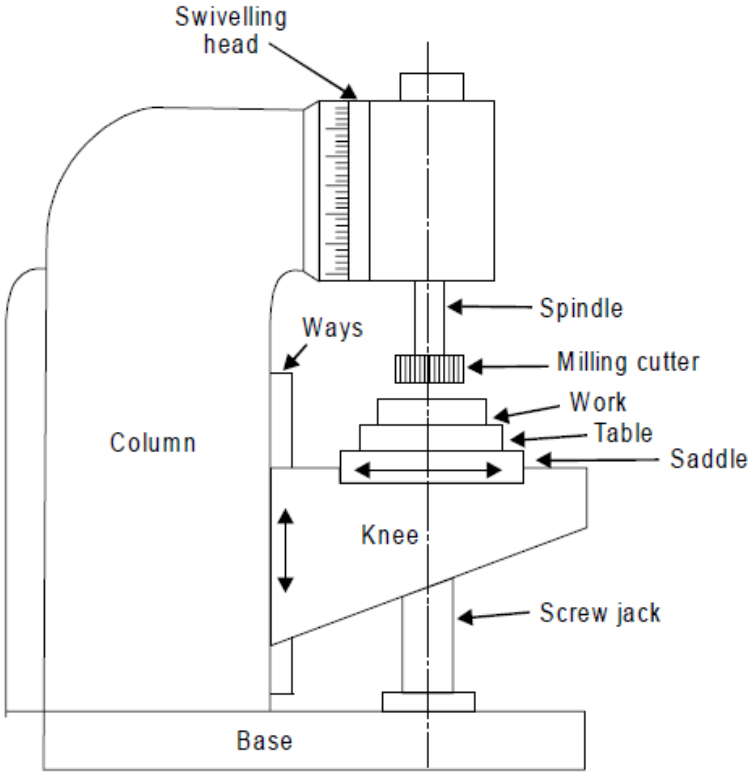
1. In a lathe, the workpiece is held in a chuck or between centres and rotated about its axis at a uniform speed.
2. The cutting tool held in the tool post is fed into the workpiece for a desired depth and in the desired direction (i.e., in the linear, transverse or lateral direction).
3. Since there exists a relative motion between the workpiece and the cutting tool therefore the material is removed in the form of chips and the desired shape is obtained.

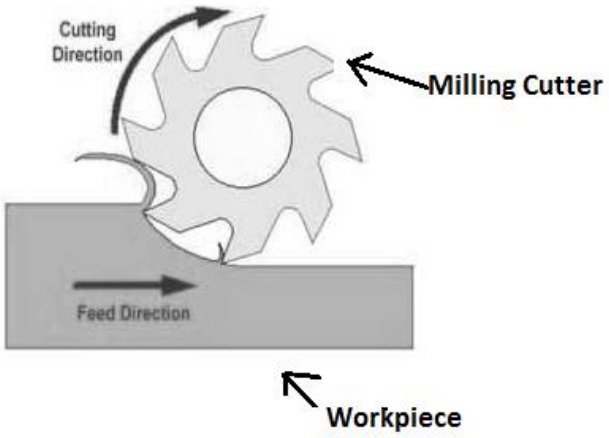
Lathes are classified according to: *(Any 04)* 02

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

f) Draw neat sketch of bench drilling machine and name its parts also write function of any two parts.	04
Answer: Bench Drilling machine:*(Sketch -02 mark ,Function of two parts -01mark 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.	02 02
6. Attempt any four of the following :	16
a) Explain counter sinking and counter boring operation with neat sketch.	04
Answer: Counter sinking: This is the operation of making a coneshapedenlargement of the end of a hole, as for the recess for a flat head screw. This is donefor providing a seat for counter sunk heads of the screws so that the latter may flush withthe main surface of the work.  OR Figure: Counter sinking.	01 01

Counter boring: It isthe operation of enlarging the end of a hole cylindrically,as for the recess for a counter-sunk rivet. The tool used isknown as counter-bore.  Figure: Counter boring.	01 01
b) How are the milling machines classified?	04
Answer: Classification of milling machine:*(Any 04 – 01 mark each)* 1) Column and knee type milling machine a. Plain or horizontal milling machine b. Hand milling machine c. Vertical milling machine d. Universal milling machine 2) Manufacturing or fixed bed type milling machine a. Simplex milling machine b. duplex milling machine c. triplex milling machine 3) Planer type milling machine 4) Special purpose milling machine a. Cam milling machine b. Planetary milling machine c. Profile milling machine d. Drum milling machine e. Duplicating milling machine	04
c)Draw a neat sketch of column and knee type milling machine and explain function of any two parts.	04
Answer: Column and knee type milling machine: Function of parts:*(Any 02- 01 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. 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	02

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.	02
d)What are the different standard milling cutters? Describe suitability of any two.	04
Answer: Classification of Standard milling cutter:*(Any 04)* 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	02

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)* 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.	02
e) What is the working principle involved in a 'Milling operations'? List various milling operations.	04
Answer: Working Principle of Milling Machine:  Figure: Working Principle of Milling machine. Milling is a metal removal process by means of using a rotating cutter having one or more cutting teeth as illustrated in figure Cutting action is carried out by feeding the work piece against the rotating cutter. In this, work is rigidly clamped on the table of the machine while revolving multi-teeth 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. List of various milling operations:*(Any 04)* 1. Plain milling or slab milling 2. Face milling 3. Side milling 4. Angular milling	02 02

5. Gang-milling 6. Form milling 7. End milling 8. Profile milling 9. Saw milling 10. T-slot milling 11. Keyway milling 12. Gear cutting milling 13. Helical milling 14. Flute milling	
f) Give which cutter you will use for carrying following operations on milling: i) Keyways ii) V-grooves iii) Parting off iv) Gear tooth	04
Answer: i. Keyways: End mill cutter, key way cutter ii. V-grooves: Angle milling cutter, Form milling cutter iii. Parting off: Metal slitting cutter iv. Gear tooth: Form milling cutter	04