MODEL ANSWER

Summer – 17 EXAMINATION

Subject Title: Materials & Manufacturing process Subject Code: 17306

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills).

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by 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.

……

Q	Bit No.		Marks
1	(A)	**Attempt any SIX of the following.**	**12**
	(a)	**Classify plain carbon steel.**	02
	Ans	**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*
	(b)	**State the effect of Nickel & Silicon as alloying elements.**	02
	Ans	**Effect of Nickel and Silicon as alloying Element:** **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. Silicon:-** *(Any one effect 1 mark each)* i) It is act as a Ferritic solid solution Strengthener ii) It improves Elastic Limits iii) It improves Magnetic Property iv) It decreases Hysteresis Losses v) It increases strength without decreasing ductility and resists high temp. oxidation.	*01* + *01*

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	(c)	**State any two properties & applications of copper.**	02
	Ans	**Properties:** *(Any two properties - ½ mark for each)* 1. It has good ductility and malleability. 2. It has high electrical and thermal conductivity. 3. It is non-magnetic and has a pleasing reddish colour. 4. It has fairly good corrosion resistance to general atmospheric conditions. Applications of copper: (Any two applications - ½ mark for each) 1. Electrical conductors 2. Automobile radiators 3. Pressure vessels 4. Bus bars 5. Utensils 6. Roofing 7. kettles & utensils 8.Electrical parts 9.wires & tubes	01 + 01
	(d)	**State the necessity of tempering.**	02
	Ans	**(***Necessity any two – 2 Marks)* **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).	02
	(e)	**Define Heat treatment. Give its objective.**	02
	Ans	*(Definition =01 mark, Any Two Objectives - 1/2 Marks each)* **Definition of Heat Treatment:** It is defined as an operation or combinations of operations involving heating and cooling of metals or alloys in its solid state with the purpose of changing the properties of the material. **OR** It is defined as an operation or combinations of operations involving heating and cooling of metals or alloys in its solid state to obtain desirable properties of the material. **Following are the objectives of Heat Treatment:** i. To improve machinability ii. To improve mechanical properties e.g. tensile strength, ductility, hardness, shock resistance, resistance to corrosion etc. iii. To relieve internal stresses induced during hot or cold working. iv. To change or refine grain size. v. To improve magnetic and electrical properties. vi. To improve heat resistance, wear resistance. vii. To improve weldability.	1 + ½ + ½
	(f)	**List out any four properties of polymeric materials.**	02
	Ans	*(Any four Properties=½ mark each)* 1) Low density 2) Low coefficient of friction 3) Good mouldability 4) Excellent surface finish 5) Poor tensile strength	

		6) Good corrosion resistance 7) Poor temperature resistance 8) Can be produced transparent or in different colours 9) They have good insulating properties 10) Easy formation in different shapes is possible	
	(g)	**Write the chemical composition of gun metal.**	02
	Ans	*(Correct Answer = 02 Marks)* Composition of gun metal: 2 to 5% of zinc (Zn), 5 to 10% of tin (Sn) and remainder is copper. OR Gun metal contains 10% tin, 88% copper & 2% zinc.	02
	(h)	**Differentiate between natural rubber & synthetic rubber.**	02
	Ans	Difference between natural rubber and synthetic rubber:	*01 + 01*

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.

B		**Attempt any <u>TWO</u> of the following:**	**08**
	(a)	**Classify various aluminum alloys. Write composition & applications of any two AL alloys.**	**04**
	Ans	*(Classification & Composition = 01 Mark each, Any two Application of each = ½ Marks each)* **Classification** aluminum alloys are classified as a cast (Y-alloy) or wrought alloy (Duralumin) **1.Y -alloy:** Composition: Aluminum with 3.5 to 4.5 %Cu, 1.8 to 2.3 %Ni and 1.2 to 1.7 %Mg. OR 92.5 % Al, 4%Cu, 2%Ni and 1.5%Mg **Application:** i. Piston and other components of aero engines. ii. Piston, iii. Cylinder head of IC engines, iv. Dies casting, v. Pump rods etc. vi. It is also largely used in the form of sheets and strips	

		etc **2. Duralumin:** Composition: 3.5-4.5%Cu, 0.4-0.7%Mn, 0.4-0.7%Mg and aluminum the remainder. **Application:** 1. It is widely used in wrought condition for forging, 2.stampings, 3.bars, 4.sheets, 5.tubes and 6.rivets.	04
	(b)	**Differentiate between thermoplastic & thermosetting plastics.**	**04**
	Ans	*(Any 04 points – 01 mark each)* **Difference between thermoplastic and thermo-setting plastic:**	

S N	Thermoplastics	Thermosetting plastics	
01	They can be repeated softened by heat and hardened on cooling	once hardened and set they do not softened with application of heat	01 +
02	They are formed by addition polymerization only	They are formed by condensation polymerization	01 +
03	They consist of long chain linear polymers	They have three dimensional network structure	01 +
04	They are usually soft, weak and less brittle	They are usually hard, strong and more brittle	01 +
05	They are usually soluble in some organic solvents	They are insoluble in almost all organic solvents	01
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.	

	(c)	**What are tool steels? Give any two applications of tool steels.**	04
	A ns	*(Definition of Tool Steel = 02 Marks , Any two applications = 02 Marks)* **Tool steels-** they are employed in tool manufacture in cases when the tool life provides by carbon steel is insufficient. These steels are used as a cutting tool. **Applications of tool steels :-** *(Any 02- 01 mark each)* 1.Water hardening tool steels: These are used for files, twist drills, chisels, hammers, etc 2. Shock resistant tool steel: These steels are used for coal cutter picks, cold chisels, pneumatic chisels and punches, Leaf and coil springs. 3. Cold working tool steels: These are used in master tools, gauges, dies. They are also for twist drills, taps milling cutters, drawing dies, boring tools 4.Hot working steels: It is used for hot drawing, hot forging and extrusion dies for casting aluminum, brass, zinc, and their alloys 5.Special purpose tool steels: These steels are used for special purposes like stainless and heat resisting components	02 + 02

		6. Heat Resisting Steels are used in Furnace Parts And Annealing Boxes.	
2.		**Attempt any FOUR of the following:**	**16**
	(a)	**Write the advantages of alloy steel over plain carbon steel.**	04
	Ans	*(Any four 1 mark each)* **Advantages of Alloy steel** 1. Greater hardenability 2. Less distortion and cracking 3. Greater high temperature strength 4. Better machinability at high temperature 5. Improved cutting ability 6. Improved ductility ,wear resistance & toughness	04
	(b)	**Explain: (i) Tempering, (ii) Normalizing.**	**04**
	Ans	*(Explanation of each = 02 Marks)* **1. 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** 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. Normalizing:-** Normalizing is heating of steel to a point 40 to 500C above upper critical temperature, hold at that temperature for a short duration and subsequently cooling in still air at a room temperature. Following are the objectives of Normalizing processes: i. Normalizing raises the yield point, ultimate tensile strength and impact strength values of steel. ii. To eliminate coarse-grained structure. iii. To remove internal stresses that may have been caused by previous working processes. iv. To improve the mechanical & electrical properties of the steel. v. To increase the strength of medium carbon steels to a certain extent (in comparison with annealed steels) vi. To improve the machinability of low carbon steels	02 + 02

	(c)	**Compare Flame Hardening & Induction Hardening.**	**04**
	Ans	*(Any four points – 1marks each)*	

S N	Flame Hardening	Induction Hardening	
1	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.	01 + 01
2	Holding time is required.	Due to very fast heating, no holding time is required.	+
3	Oxidation & decarburization is minimum.	No scaling & decarburization.	01
4	Irregular shape parts can be flame hardened.	Irregular shape parts are not suitable for induction hardening.	+ 01
5	Flame hardening requires more care in control of temperature.	Easy control of temperature by control of frequency of supply voltage.	

	(d)	**Draw Fe-C Phase transformation diagram & show critical temperature on it.**	**04**
	ANS	**Answer:** *(Credit should be given to suitable figure showing all details such as temperature percentage of carbon and state)*	04

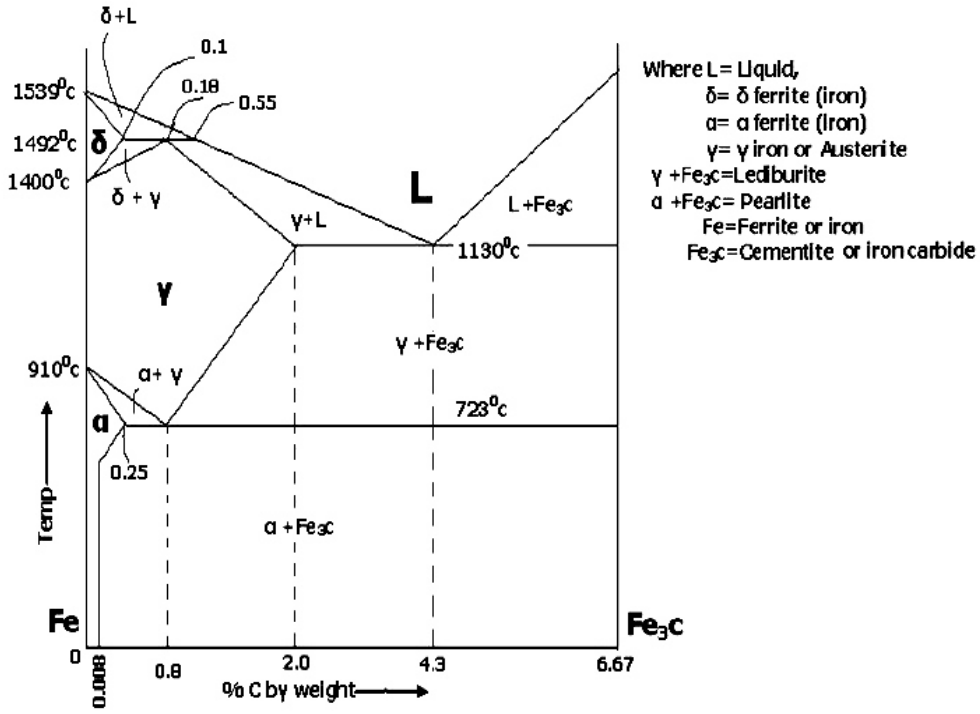

Figure: Fe-C Phase transformation

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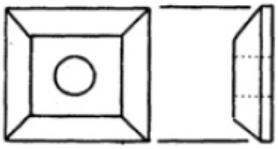
	(e)	**What is nitriding? Write advantages and limitations of nitriding.**	04
	Ans	*(Definition of Nitriding = 02 Mark, Any two advantages– ½ mark each, Any two limitations= ½ mark each)* **Nitriding:** The heat treatment process which produces a hard-wear resistant layer of nitrides on a tough core of low carbon steel is known as nitriding. The process consists of heating machined and heat treated components to a temperature of 5000c for 40 to 90 hours in a gas tight box through which ammonia gas is circulated. The component is allowed to cool in the furnace after switching of the supply of ammonia. When ammonia vapours come in contact with the steel, they get dissociated $NH_3 = 3H + N$ and nascent nitrogen so produced diffuses into the surface of the work piece forming hard nitrides. **Advantages of Nitriding Process:** 1. Very high surface hardness can be obtained. 2. Minimum distortion or cracking 3. Good corrosion and wear resistance 4. Good fatigue resistance 5. No machining is required after nitriding. 6. Economical for mass production. **Limitations of Nitriding Process:** 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.	04
	(f)	**Explain Colour coding of patterns**	**04**
	Ans	*(Meaning of any four color codes-01 mark each)* **Standard colour coding used in pattern:** The colour codes are given for identification of the parts of patterns and core boxes. 1. Surface to be left unfinished are to be painted **black** 2. Surface to be finished are painted by **red** colour. 3. Seats for loose pieces are marked by **red strips on yellow background** 4. Core prints are painted by **yellow** colour. 5. Stop-offs is marked by diagonal **black strips on yellow background**.	04
3		**Attempt any FOUR of the following**	**16**
	a	**Enlist the types of patterns. Explain any one with neat sketch**	**04**
	ANS	*(Any 4 types of patterns= 02 Marks, Sketch & Explanation of same= 01 Mark each)* **Types of patterns:** 1. Single piece pattern 2. Split pattern 3. Match plate pattern 4. Cope and drag pattern 5. Gated pattern 6. Sweep pattern 7. Loose piece 8. Follow board pattern Skeleton pattern 9. Segmental pattern 10. Shell pattern 11. Built-up pattern 12. Box-up pattern 13. Lagged-up pattern 14. Left & right hand **1. Solid or single piece pattern:** It is made in one piece and carries no joints, partition or loose pieces.	02 +

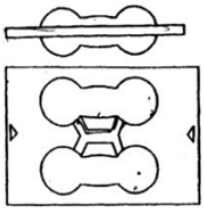


01 + 01

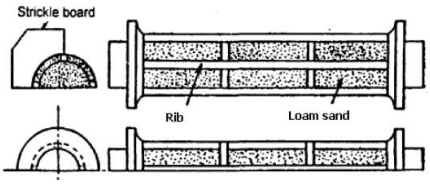
2. Split or two piece patterns: They are made in two parts and these two parts of the pattern are joined together with the help of dowel pins.

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

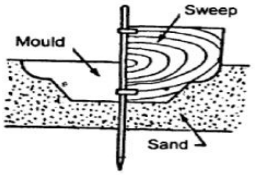
4. Match plate pattern: A match plate pattern is a split pattern having the cope and drags portions mounted on opposite sides of a plate (usually metallic), called the "match plate".



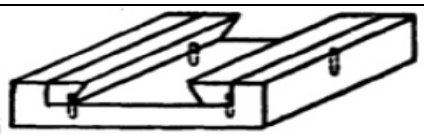
5. Skeleton pattern: These are simple wooden frames that outline the shape of the part to be cast.



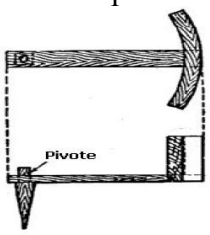
6. Sweep pattern: A sweep is a section or board (wooden) of proper contour that is rotated about one edge



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



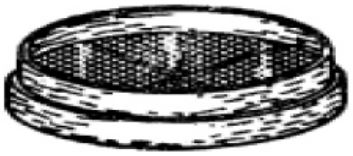
8. Segmental pattern: The segmental pattern is in the form of a segment, and is used for Molding parts having circular shapes



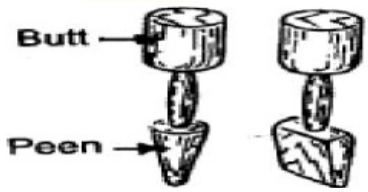
	b	**Explain any two moulding tools with neat sketch**	04
	ANS	*(Explanation = 01 Mark each, Sketch of same = 01 Mark each)*	

i) Shovel: A shovel is used for mixing and tempering moulding sand and for moving the sand from the pile to the flask. 01 + 01

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



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



01 + 01

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

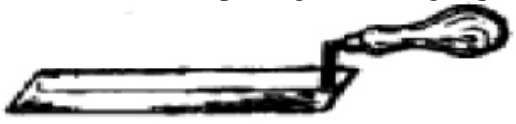
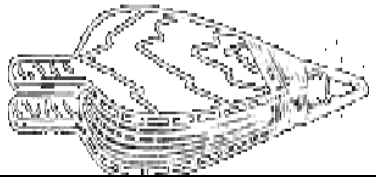
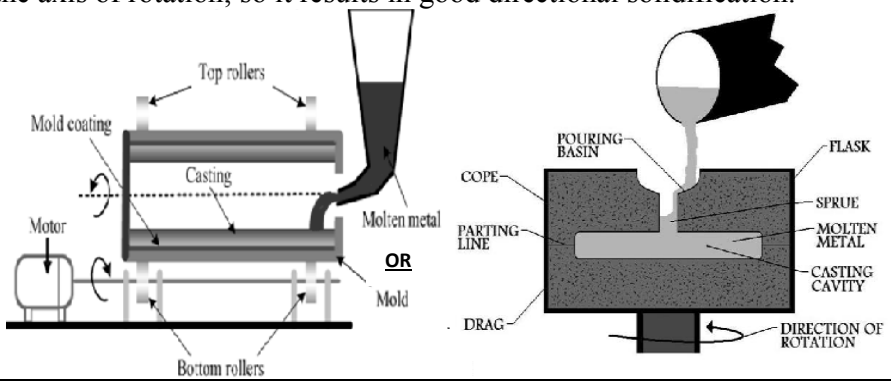


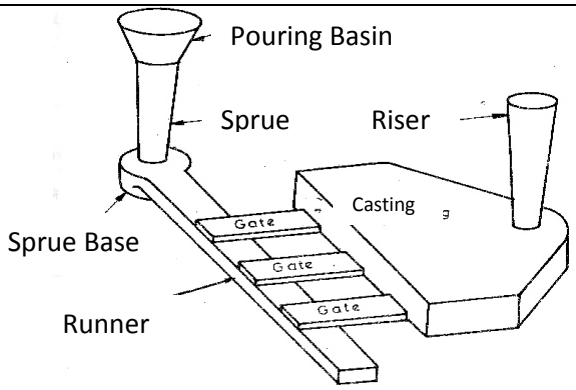
Fig. Square Trowel

v) Sprue pin: A sprue is a tapered peg pushed through the cope to the joint of the mould. As the peg is withdrawn it removes the sand, leaving an opening for the metal. This opening is called the sprue through which the metal is poured. The sprue pin forms the riser pin.

vi) Bellow: Bellows are used to blow loose particles of sand from the pattern and the mould cavity. A hand blower is shown in Moulding machines are also provided with a compressed air jet to perform this operation.



	c	**Explain centrifugal casting with neat sketch**	04
	ANS	*(Explanation =02 Marks, Labeled Sketch = 02 Marks)* **True centrifugal 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. 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.  	04
	d	**Explain different elements of gating system with neat sketch**	
	Ans	*(Sketch = 02 Marks, Explanation= 02 Marks)* The term gating system refers to all passageways through which the molten metal passes to enter the mold cavity. The gating system is composed of 1) Runner 2) Pouring cups and basins 3) Sprue 4) Gates 5) Risers Various components of gating systems shown in fig.	



04

i. 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.

ii. Pouring cups or basins: 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.

iii. Sprue:

1) A sprue feeds metal to the runner which in turn reaches the casting through the gate.

2) A sprue is tapered with its bigger end at the top to receive the liquid metal. The smaller end is connected to the runner.

iv. Gates: 1) A gate is a channel which connect a runner with the mold cavity and through which molten metal flows to fill the mold cavity. 2) A gate should feed liquid metal to the casting at the rate consistent with the rate of solidification. 3) The size of the gate depends upon the rate of solidification. 4) A small gate is used for a casting which solidifies slowly and vice versa.

v. Risers: Risers are reservoirs of molten material. They feed this material to sections of the mold to compensate for shrinkage as the casting solidifies.

	e	**State the types of cores. Explain any one with neat sketch.**	04
	Ans	*(Types of Cores= 02 Marks, Sketch and Explanation & sketch = 01 Mark each)*	

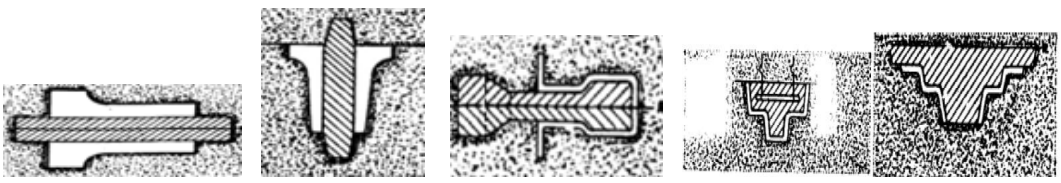


Figure: 1 *Figure: 2* *Figure: 3* *Figure: 4*

(1) Horizontal cores: (*Figure: 1)*

The most common type is the horizontal core. The core is usually cylindrical in form and is laid horizontally at the parting line of the mould. The ends of the core rest in the seats provided by the core prints on the pattern.

(2) Vertical cores: *(Figure:2)*

This is placed in a vertical position both in cope and drag halves of the mould. Usually top

02 + 02

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.

(3) Balanced cores: ***(Figure: 3)***

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

(4) Hanging and cover cores: (*Figure: 4)*

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 **Write any four casting defect, their causes & remedies.** 04

Ans *(Four Casting Defects, it's causes & it's remedies= 01 Mark each.)* 04

SN	Casting Defects	Causes	Remedies
1	**Shifts**	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.	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**	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.	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**	This is caused by improper or defective ramming of the mould.	To avoid swells, the sand should be rammed properly and evenly.
4	**Blowhole**	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.	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**	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.	The given factors are eliminated to avoid drop.

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<table>
<tr><td>4</td><td></td><td>Attempt any FOUR of the following</td><td>16</td></tr>
<tr><td></td><td>a</td><td>Write down the basic steps of the casting process.</td><td>04</td></tr>
<tr><td></td><td>Ans</td><td>(Correct Answer = 04 Marks)
Following steps are used in the casting process;
1. Pattern Making: Patterns are the replica of casting. Patterns are manufactured using wood, metals, wax, plaster of Paris etc. For preparation of patterns various tools and equipments are used.
2. Moulding and Core making: Prepare a mould cavity by using patterns and use the core for making hollow parts in casting.
3. Melting and Casting: Melt the metal in the furnace and pour it in the mould cavity. Wait until it solidifies. As the casting get solidify, remove the casted part from the sand.
4. Cleaning of Casting: After removing the casting from the sand cut the runners and risers, also trim the flash appears at parting line of mould.
5. Testing of Casting: Test the casting for various defects.</td><td>04</td></tr>
<tr><td></td><td>b</td><td>State any four types of moulding sands & enlists their properties</td><td>04</td></tr>
<tr><td></td><td>ANS</td><td>(Four types of Molding Sand = 02 Marks, Any four Properties= 02 Marks)
➢ According to composition:
Natural or Green sand: It is obtained from river bed, dug from pits, crushing & milling of rocks etc. The requirements of these sands are satisfied by IS: 3343-1965, which has classified them into three grades A, B and C according to their clay content and sintering temperature.
<table><tr><td rowspan="2">Clay Percentage</td><td>Grade A</td><td>Grade B</td><td>Grade C</td></tr><tr><td>5-10</td><td>10-15</td><td>15-20</td></tr><tr><td>Sintering Temp. in ^{0} C</td><td>1350-1450</td><td>1200-1350</td><td>1100-1200</td></tr></table>Synthetic or high silica sand:
It is obtained from crushing quartzite sandstone and then washing to get requisite shape and grain distribution. It is also obtained from sedimentary origin. Bentonite and water can be added to get desired strength and bonding properties.
Special sand:
Zircon, Olivine, Chromite and Chrome-magnesite are often used as special sands. Zircon sands are suitable for cores of brass and bronze casting. Olivine sands are suitable for non- ferrous castings of an intricate shape. Chamotte is suitable for heavy steel casting.
➢ According to use:
Green sand:
It is a mixture of silica sand with 18 to 30 per cent clay, having a total water of from 6 to 8 per cent. The clay and water furnish the bond for green sand. Moulds prepared in this sand are known as green sand moulds.</td><td>02
+
02</td></tr>
</table>

		Dry sand: Green sand that has been dried or baked after the mould is made is called dry sand. They are suitable for larger castings. Moulds prepared in this sand are known as dry sand moulds. **Loam sand:** Loam sand is high in clay, as much as 50 per cent or so, and dries hard. This is particularly employed for loam moulding usually for large castings. **Facing sand:** Facing sand forms the face of the mould. It is used directly next to the surface of the pattern and it comes into contact with the molten metal when the mould is poured. It is made of silica sand and clay, without the addition of used sand. **Backing sand:** Backing sand or floor sand is used to back up the facing sand and to fill the whole volume of the flask. Old, repeatedly used moulding sand is mainly employed for this purpose. The backing sand is sometimes called black sand because of the fact that old, repeatedly used moulding sand is black in colour due to the addition of coal dust and burning on coming m contact with molten metal. **System sand:** The used-sand is cleaned and reactivated by the addition of water, binders and special additives. This is known as system sand. Since the whole mould is made of this system sand the strength, permeability and refractoriness of the sand must be higher than those of backing sand. **Parting sand:** Parting sand is used to keep the green sand from sticking to the pattern and also to allow the sand on the parting surface of the cope and drag to separate without clinging. This is clean clay-free silica sand which serves the same purpose as parting dust. **Core sand:** Sand used for making cores is called core sand, sometimes called, oil sand. This is silica sand mixed with core oil which is composed of linseed oil, resin, light mineral oil and other binding materials. Pitch or flours and water may be used in large cores for the sake of economy. ❖ **Properties** 1) Porosity/Permeability 2) Flow ability 3) Collapsibility 4) Adhesiveness 5) Cohesiveness or strength 6) Refractoriness	
	c	**Name the different allowances provided on patterns. Explain any one.**	04
	ANS	*(Name of any four allowances = 02 Marks, Explanation of any one = 02 Marks)* i. Shrinkage allowance ii. Draft allowance iii. Machining allowance iv. Distortion or camber allowance v. Shake allowance / rapping allowance **i. Shrinkage Allowance:** As metal solidifies and cools, it shrinks and contracts in size. To compensate for this, a	02

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. + 02

It is also called as contraction allowance
When liquid metal starts to cool shrinkage is possible
Gets shrink & reduces size of the component
To reduce above problem, allowance are provided on the pattern
Patterns are made larger than actual size
Different metal have different shrinkage
It has three forms
(a) Liquid Contraction (b)Solidifying Contraction (c)Solid Contraction

- First two are reduced by gets & risers
- Solid contraction can be reduced by providing more allowance on pattern

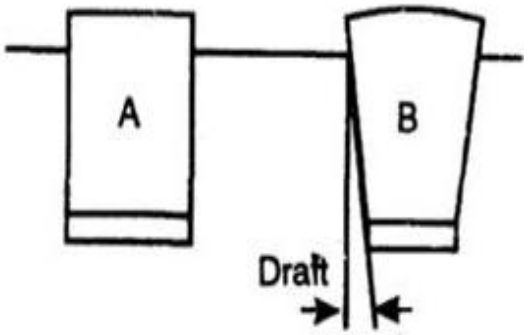
04

➢ Following points causes shrinkage :

- Pouring Temperature Of Molten Metal Is Low
- Type Of Mould Materials
- Design & Dimensions Of Castings
- Type Of Molten Metal

ii. 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
1) length of the vertical side
2) Intricacy of the pattern, and
3) The method of moulding.

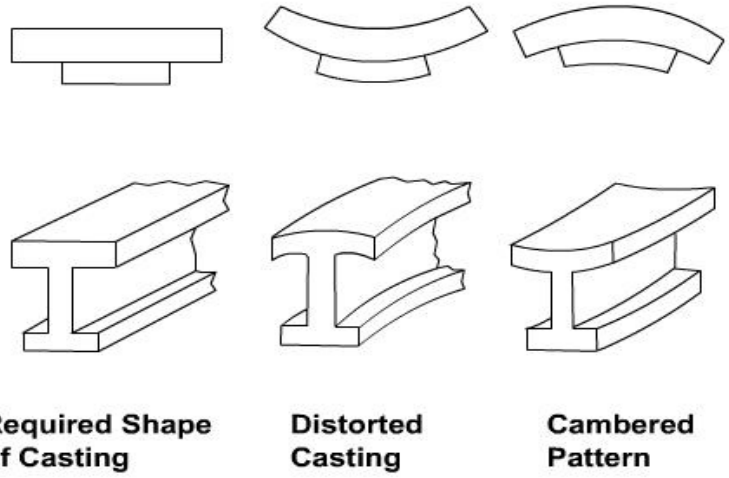
iii. Machining Allowance:

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.

iv. 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.



	d	**What is tool signature? Explain with example.**	04
	ANS	*(Definition of tool Signature= 02 Marks, Explanation with suitable example= 02 Marks)*	

Tool Signature:

The term tool signature or tool designation is used to denote a standardized system of specifying the principle tool angles of single point cutting tool. Tool signature (designation) under ASA (American Standards Association) System is given in the order

$$\alpha_b - \alpha_s - \theta_e - \theta_s - C_e - C_s - R$$

02

Where,

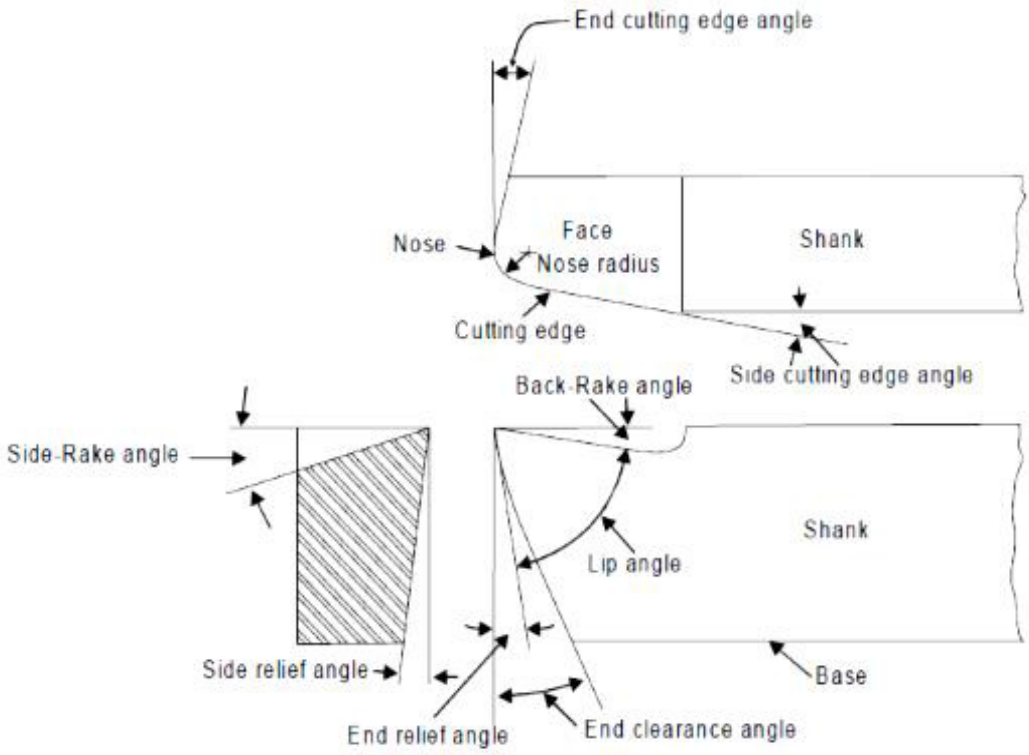
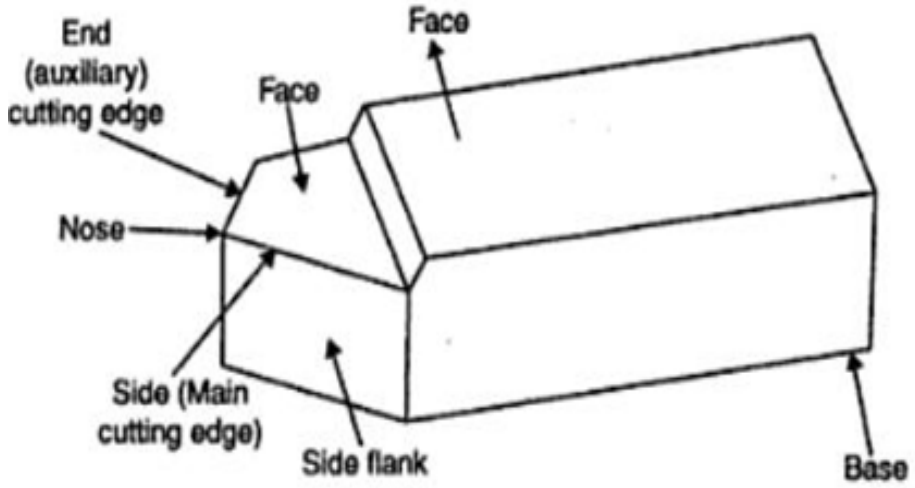
α_b = Back rake angle; α_s = Side rake angle; θ_e = End relief angle; +
θ_s = Side relief angle; C_e = End cutting edge angle; C_s = Side cutting edge angle;
R = Nose radius 02

Example

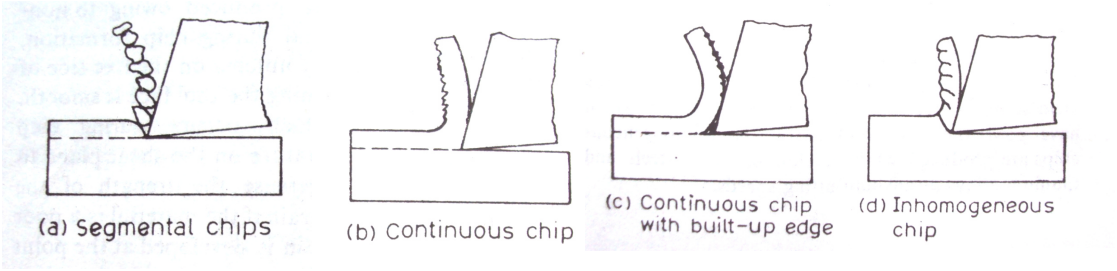
e.g.: – 0 – 7 – 7 – 7 – 15 – 15 – 0.8

It means that

back rake angle 0°, side rake angle 7°, end relief angle 7°,
side relief angle 7°, end cutting edge angle 15°, side cutting edge angle 15°,
nose radius 0.8 mm

	e	**Draw the neat labeled sketch of single point cutting tool nomenclature.**	04
	ANS	*(Neat labeled Sketch = 04Marks)*  **OR** 	04

	f	**Write the name of any four cutting fluids & any four properties of cutting fluids.**	04
	ANS	**(***Any four names of Cutting Fluids= 02Marks, Any four Properties= 02 Marks***)** **Types of Cutting Fluids:** (1) Water (2) Soluble oils (3) Straight oils (4) Chemical compounds (5) Solid lubricants (6) Chemical additive oil **Properties of cutting fluid:** 1. High heat absorption 2. Good lubricating qualities to produce low coefficient of friction 3. Low viscosity to permit free flow of liquid 4. Non-corrosive to the work or the machine 5. High flash point so as the eliminate the hazards of fire 6. Odourless ,so as not to produce any bad smell 7. Harmless to the skin of operator 8. Transparency so that the cutting action of the tool may be observed	02 + 02
5		**Attempt any <u>FOUR</u> of the following:**	**16**
	a	**Name the different types of chips formed during machining. Explain any one with neat sketch**	
	Ans	*(Types – 01 mark, Explanation of any one type - 02 mark, sketch -01 mark)* **Different types of chips:** **1. Discontinuous or segmental chips:** These types of chips are usually produced when cutting more brittle material like grey cast iron, bronze and hard brass. 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:** This type of chip is the most desirable, since it is stable cutting, resulting in generally good surface finish. 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):** 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. **4. Non homogeneous chip:** • The temperatures generated in the machining zone control the rate of tool wear, the practical cutting speed and the MRR • It is important to understand the factors which influence the generation of heat,	04

		flow of heat and the temperature distribution in the tool and work material near the cutting edge • Temperature is developed in three types of zones as 1. *Shear zone* 2. *Tool-chip interface* 3. *Tool-work interface*  	
	b	**State different types of cutting tool materials. Write selection criterion for cutting tools.**	04
	Ans	**(***Any four-2 marks, Selection Criterion any four- 2 marks)*** **Types of cutting tool materials** **High-speed steels(HSS)** 1. Carbon Steels 2. Carbides 3.Silicon Nitride 4.High speed steel (H.S.S.) 5. Nonferrous cast alloys (Stellite) 6.Cemented carbides 7. Diamond Cubic boron nitride, or "CBN" 8. Polycrystalline diamond, or "PCD" 9. High carbide speed steels 10. Diamond **Selection criterion for cutting tools:** • The starting and finished part shape • The material's tensile strength • The material's Hardness • The power and speed capacity of the machine tool • Machining applications • Workpiece dimensions • Type of operation • Type of cutting fluid	
	c	**State any four accessories used on lathe and state their uses.**	04
	Ans	*(Name of any four Accessories = 02 Mark Use of any 02 with sketch -1 mark each))* **Accessories of lathe:** 1. Centre 2. Chuck 3. Face plate 4. Angle plate	

5. Mandrel
6. Rests
7. Carriers
8. Catch plates
9. Collets

1. 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.

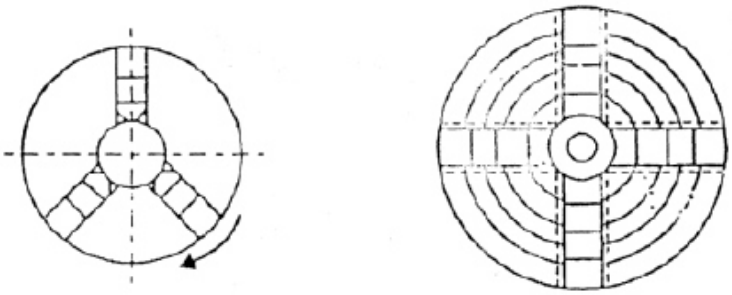
(a) Standard centre (b) Half centre

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 and hexagonal work.

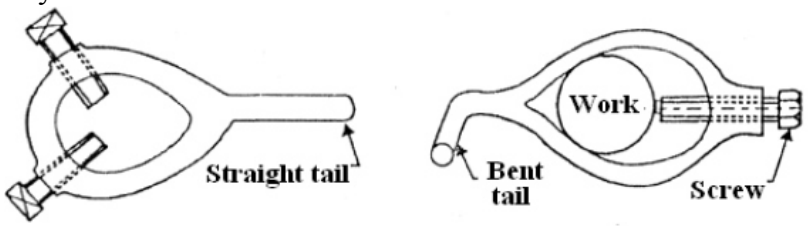
ii) Four jaw independent chuck: 1. The four jaw independent chuck, as shown in Fig. (b) has four reversible jaws, each of which may be independently adjusted to accommodate the work it supports. 2. This type of chuck can hold square, round and irregular shape of work in either a concentric or eccentric position. The other types of the chucks are iii) combination chucks, iv) magnetic chuck, v) collect chuck, vi) drill chuck, and vii) air or hydraulic chuck



(a) Three jaw chuck (b) Four jaw chuck

3. Lathe dog or carrier:

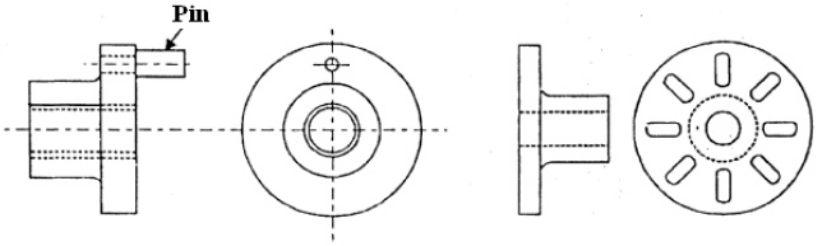
a. The work placed on a mandrel or held between centres is rotated positively by clamping the dog or carrier to the end of the work.
b. This is engaged with a pin attached to the drive plate or face plate.
c. The lathe dog or carrier may be of straight type or bent type as shown in Fig. (a) and (b) respectively.



(a) Straight tail pipe (b) Bent tail pipe

4. Drive plate:

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



Drive plate Face plate

5. Faceplate:

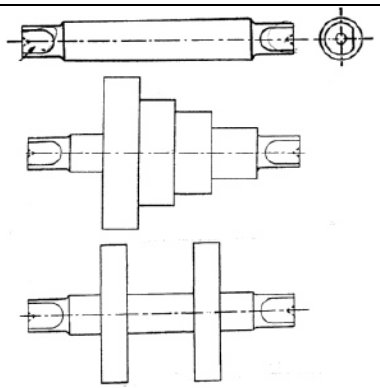
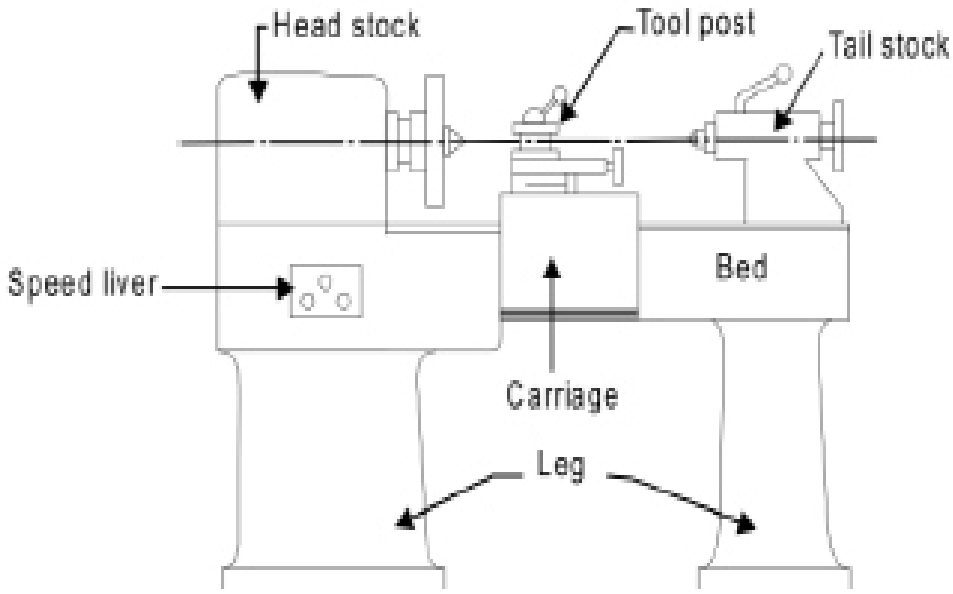
a) The face plate, as shown in Fig. is similar to drive plate except that it is larger in diameter.
b) It contains more open slots or T-slots so that bolts may be used to clamp the workpiece to the face of the plate.
c) The face plate is used for holding work pieces which can not be conveniently held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

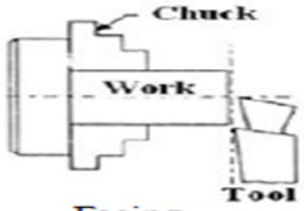
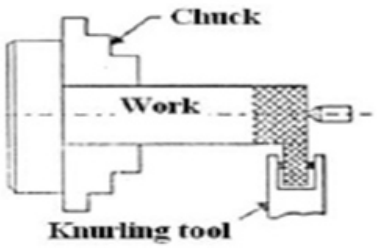
6. Angle plate:

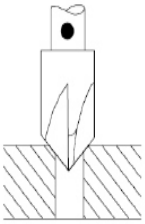
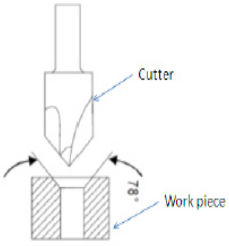
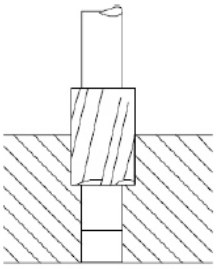
a. An angle plate is simply a cast iron plate with to faces planed at right angles to each other and having slots in various positions for the clamping bolts.
b. It. is always used with the face plate for holding such parts which can not be clamped against the vertical surface of the face plate.

7. Mandrels:

a. The lathe mandrel is a cylindrical bar with centre hole at each end. It is used to hold hollow work pieces to machine their external surface.
b. The work revolves with the mandrel which is mounted between the centres of the lathe. The various types of mandrels used for different classes of work are shown in Fig.

		 Plain mandrel, Step mandrel and Collar mandrel	
	d	Draw the block diagram of Centre lathe. Show major parts on it.	*04*
	Ans	*(Neat Labeled Sketch = 04 Marks)*  Figure: Block diagram of Lathe machine.	
	e	**What is taper? How taper angle is calculated?**	*04*
	Ans	*(Taper meaning-2 marks & Taper calculation -2 marks)* **Taper:** The uniform increase or decrease in diameter of workpiece along the length is called taper. OR A taper may be defined as a uniform increase or decrease in diameter of a piece of work measured along its length.	*02* +

		Taper angle calculation The angles for swiveling the guide bar can be determined by the Formula: - $\theta = \tan^{-1} \frac{D-d}{2L}$ Where D = End dia big, d = End dia small and L = length of taper in mm.	*02*
	f	**Explain with neat sketch following operations: (i) Facing, ii) Knurling**	*04*
	Ans	Answer*:(explanation – 1 marks & sketch-1 marks for each operation)* **1. Facing:** Facing is the operation of machining the ends of a piece of work to produce a flat surface square with the axis. This is also used to cut the work to the required length. The operation involves feeding the tool perpendicular to the axis of rotation of the workpeice. 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.  Facing **2. Knurling** Knurling is the process of embossing a diamond shaped pattern on the surface of workpiece. The purpose of knurling is to provide an effective gripping surface on a workpiece to prevent it from slipping when operated by hand. It is an operation of providing knurled surface on the workpiece. In this operation, as shown in Fig. a knurled tool is moved longitudinally to a revolving workpiece surface. The projections on the knurled tool reproduce depressions on the work surface.  Knurling	*02* + *02*
6		**Attempt any FOUR of the following**	***16***
	a	How drilling machines are classified? State major parts of bench drilling machine.	*04*
	Ans	**Classification of drilling machine:** *(Any four -2 marks)* 1. Portable drilling machine	*02*

		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 Major parts of bench drilling machine *(Any four -2 marks)* i. Base ii. Spindle iii. Drill chuck iv. Head v. Adjustable Table vi. Column	+ *02*
	b	**Explain with neat sketch: (i)Counter Sinking (ii) Counter boring**	***04***
	Ans	*(explanation – 1 marks & sketch-1 marks for each operation)* (i)Counter Sinking: This is the operation of making a cone shaped enlargement of the end of a hole, as for the recess for a flat head screw. This is done for providing a seat for counter sunk heads of the screws so that the latter may flush with the main surface of the work.  OR  Figure: Counter sinking.  Figure: Counter boring. (ii) Counter boring: It is the operation of enlarging the end of a hole cylindrically, as for the recess for a counter-sunk rivet. The tool used is known as counter-bore.	
	c	**Draw the neat sketch of Taper shank Twist Drill.**	***04***
	Ans	*(Neat Labeled Sketch = 04 Marks)*	*04*

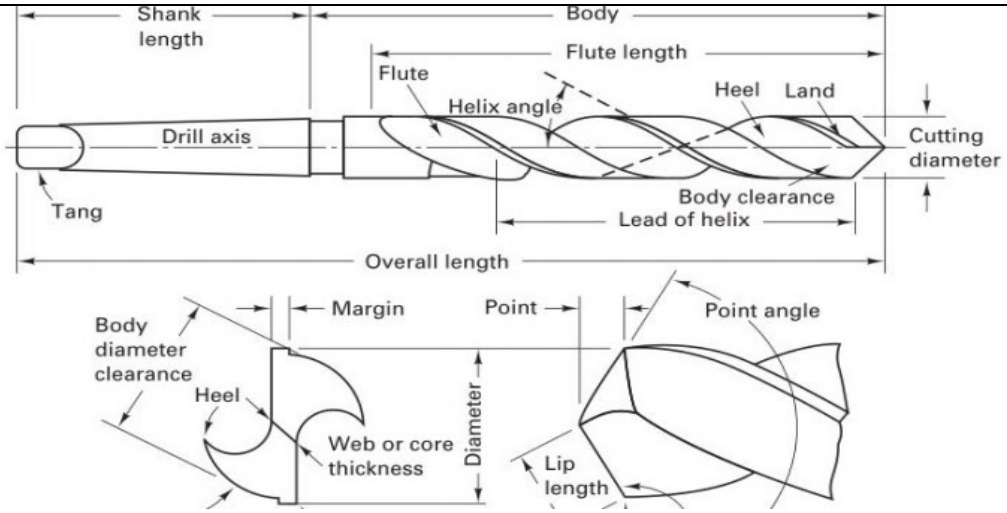
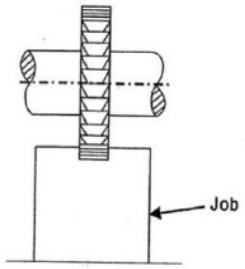


Figure: Taper shank Twist Drill

	d	**Explain with neat sketch Key-way milling operation.**	***04***
	Ans	(*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.  Figure: Keyway milling	*02* + *02*
	e	**Enlist the major part of column & knee type milling machine. State their functions.**	***04***
	Ans	*(Name of any four Parts -02 marks Function of Any two parts: 02 mark)* **List the major part of column & knee type milling machine** 1. Base 2. Column 3. Knee 4. Saddle 5. Table 6. Arbor 7. Spindle **Function of parts:** ***(Any 02- 02 mark)*** 1. **Base:** It is a heavy casting on which column and other parts are mounted. It may be	*02* + *02*

		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 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.	
	f	**Which cutter you will use for carrying following operations on milling** **(i)Gear Tooth (ii) Parting off (iii) Key way (iv) V-Grooves**	***04***
	Ans	*(Each Correct answer = 01 Mark)* i) **Gear tooth:** Form milling cutter ii) **Parting off:** Metal slitting cutter iii) **Keyways:** End mill cutter, key way cutter **iv) V-grooves:** Angle milling cutter, Form milling cutter	*01* + *01* + *01* + *01*