WINTER – 15 EXAMINATIONS

Subject Code: **17303** **Model Answer** Page No: ____/ N

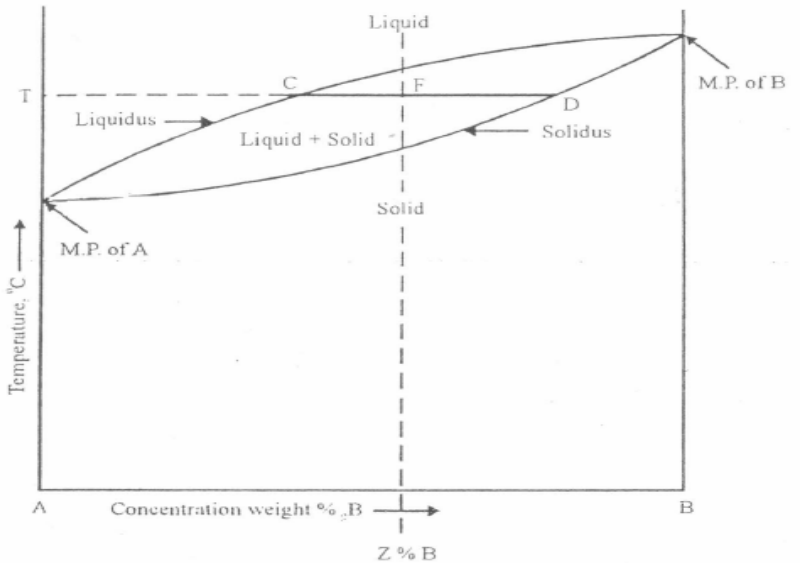
Important Instructions to examiners:

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. NO.	MODEL ANSWER	MARKS	TOTAL MARKS
1	**Attempt any TEN**		
a)	**Ductility:-** It is the property of material by virtue of which it can be drawn into thin wires. **Hardness:-** It is the property of material by virtue of which it can resist scratch, abrasion , wear of material.	**1M** **1M**	
b)	Corrosion:- It is an unintentional destruction of material because of chemical attack from the environment.	**2M**	
c)	Coeficient of linear expansion is nothing but a property that is indicative of the extent to which a material expands upon heating .	**2M**	
d)	It is primarily an alloy of iron & carbon. It is obtained in a cupola furnace by remelting pig iron with coke & limestone.	**2M**	
e)	1) Magnetic field 2) Magnetic Moment 3) Magnetic field strength 4) Magnetic Flux 5) Magnetic Permability	**2M (any 2)**	
f)	Heat treatment includes any heating and cooling process applied to any material in order to modify its internal structure or to alter its physical, mechanical or chemical properties.	**2M**	
g)	Nitriding involves the introduction of nitrogen into the surface of certain types of steels by heating it & holding it at a suitable temp in contact with partially dissociated ammonia or other suiable medium.	**2M**	
h)	1) It is ductile & may bent without breaking 2) The tensile strength of malleable Cast iron is much higher 3) It has excellent machining qualities.	**2M (any2)**	
i)	Gray cast iron is used to manufacture:- 1) Machine tool structure 2) Engine frames , Drainage pipes 3) Cylinder & piston, piston rings 4) Fly wheels, rolling mills etc	**2M (any 2)**	
j)	**Chemical composition:-** 60 % copper 39 % zinc 1 % tin **Applications:-** Used for welding rods, piston rods Mainly used for naval constructions It is used for propeller shaft	**1M** **1m**	

<table>
<tr><td>k)</td><td>A Polymer is a chemical substance made up of repetating units or molecules to form a long flexible chain.
Poly means many and mer means a unit.</td><td>2M</td><td></td></tr>
<tr><td>l)</td><td>It is aprocess of heating the hardened steel below its lower critical temperature holding at this temperature for 3 to 5 minutes for each mm of thickness or diameter , cooling it either rapidly or slowly .</td><td>2M</td><td></td></tr>
<tr><td>m)</td><td>Necessity:-

1) To impart toughness to an already hardened steel
2) To improve yield point of structural steel
3) To stabilize the structure of metal
4) To improve ductility and reduce hardnes.
5) To increase percentage elongation.</td><td>2M
(any 2)</td><td></td></tr>
<tr><td>n)</td><td>Flame hardening is the process of case hardening which produces a hard, wear resistant layer on a tough core of steel by the application of heat from a flame followed by quenching.</td><td>2M</td><td></td></tr>
<tr><td>2</td><td colspan="2">Attempt any FOUR</td><td></td></tr>
<tr><td>a)</td><td>
<table>
<tr><th>Sr.no</th><th>Dry Corossion</th><th>Wet Corossion</th></tr>
<tr><td>1</td><td>If the corrosion takes place due to direct chemical attack (in the absence of moisture), corrosion is known as dry corrosion.</td><td>If the corrosion takes place due to electrochemical attack in presence of moisture or a conducting medium ,corrosion is known as wet corrosion</td></tr>
<tr><td>2</td><td>Explained by absorption mechanism</td><td>Explained by electrochemical mechanism</td></tr>
<tr><td>3</td><td>It occurs on both heterogeneous and homogeneous surfaces.</td><td>It occurs only on heterogeneous metal surfaces.</td></tr>
<tr><td>4</td><td>Corrosion is uniform.</td><td>Corrosion is not uniform.</td></tr>
<tr><td>5</td><td>It is a slow process.</td><td>It is a fast process.</td></tr>
<tr><td>6</td><td>Corrosion products accumulate at the place where corrosion occurs.</td><td>Corrosion take place at anode but products accumulate near the cathode.</td></tr>
</table>
</td><td>4M
(any4)</td><td></td></tr>
</table>

b)	**Statement:-** Lever rule is used for finding out the amounts of phases existing in a binary system for a given alloy at any temperature under consideration. " **Explanation:-**  Let us consider an isomorphous system of two metals A and B (Fig, 5,14). Let Z be the composition of the alloy under consideration and T be the temperature at which the amounts of phases are to be found out. At this temperature, the phases are solid and liquid. Let the amount of solid be S and hence the amount of liquid (L) will be 1-S, if the total amount is assumed to be l. We know that, The amount of B in Alloy = Amount of B in solid + Amount of B in liquied **Then amount of liquied:-** Arm FD/ Arm CD **Amount of Solid:-** Arm CF/Arm CD	**1M (Statement)** **3M (explaination)**	

c)

Annealing	Normalising
It is a process of heating a steel to a temperature which remove distortion and cooling to a room temperature to get stable structure	It is a process of heating the steel to about fifty degrees centigrade above Ac3 line,holding and cooling to room temperature
Steels after annealing becomes very soft due to which lower strength & hardness	Steel after normalizing posses s better strength and hardness than annealing
Very slow cooling rate (furnace cooling)	Faster cooling rate (Air cooling)
Large time consuming process	Less time consuming process

4M (any4)

d)

Carburizing:
It is a method of introducing carbon into solid iron base alloys such as low carbon steels in order to produce a hard surface. It is also called as Cementation.
It increases the carbon content of the steel surface by a process of absorption and diffusion

2M

Advantages:-
1)Rapid heat transfer and hence process is quick.
2)Distortion of the component is small.
3)Work pieces of variety of shapes and sizes can be handled in a single bath.
4)After carburizing, parts can be directly quenched into water, oil or salt baths

2M (any2)

e)

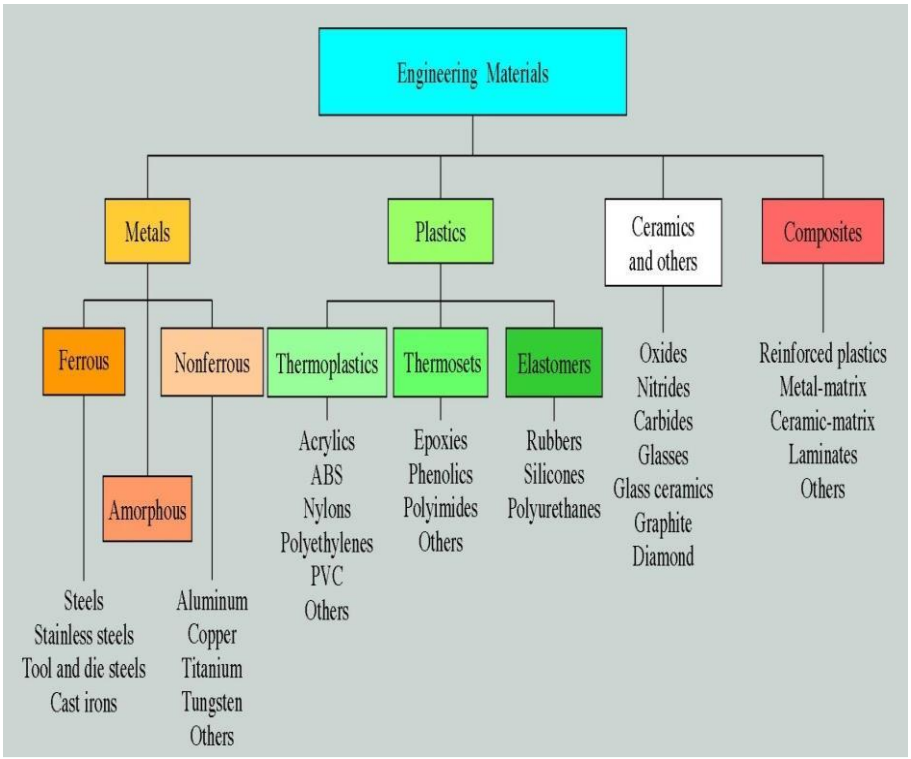
White Cast Iron	Gray Cast Iron
It shows a white fracture.	It shows gray fracture
It contains whole of the carbon in the form of carbide.	It contains whole of the carbon in the form of Graphite.
It is more hard	It is less hard
Hardness varies from 400 to 600 B.H.N	Hardness varies from 140 to 240 B.H.N
It cannot be machined	It cann be machined
Used in weaving plates pump lines, grinding balls etc.	Used in machine tool structure, frames for electric motors etc.

4M (any4)

f)	Classification Of steel:- **1)Mild or Low carbon steel:-** It contains 0.15 to 0.45% of carbon Applications:- They are used for wires, nails, rivets, screws, panels, welding rods, boiler plates, valves, railway axles, gears, blades etc. **2)Medium Carbon Steel:-** It contains 0.45 to 0.80% of carbon Applications:- They are used for bolts, axles, lock washers, large forging dies, springs, wheel spokes, hammers, rods, turbinr rotors, crank pins, railway tyres etc. **3) High Carbon steel:-** It contains 0.80 to 1.5% of carbon Apllications:- They are used for forging dies, punches, hammers, springs, chiesels, vice jaws, car bumpers, leaf springs, raor blades, files, knives, wire drawing dies, reamers, metal cutting saws.	**4M**	
3	**Attempt any FOUR**		
a)	**Composition of Gun Metal:-** 88 % Copper, 10 % tin & 2 % Zinc **Applications:-** It is used for Castings It is used for boiler fittings It is used for bushesh, bearings & glands It is used to manufacture gun barrels.	**2M** **2M (any2)**	
b)	**Properties of Bearing Metals:-** 1) The friction between the bearing and the rotating part should be as small as possible to reduce the power loss in transmission. 2) The affinity between the shaft and the shaft and the bearing material should be minimum. 3) It should be hard and wear resistant for longer life. However, it should not be harder than the shaft so as to avoid the damage of the shaft. 4) It should have sufficient load bearing ability i.e. the material should have good mechanical properties at ambient and elevated temperatures. 5) It should have sufficient plasticity and deformability to take care of large deflections and misalignment. 6) It should have high fatigue resistance. 7) It should have good resistance to galling and seizing. 8) It should have good thermal conductivity. 9) It should have a high oil retaining capacity. 10) It should have a good corrosion resistance.	**4M (any4)**	

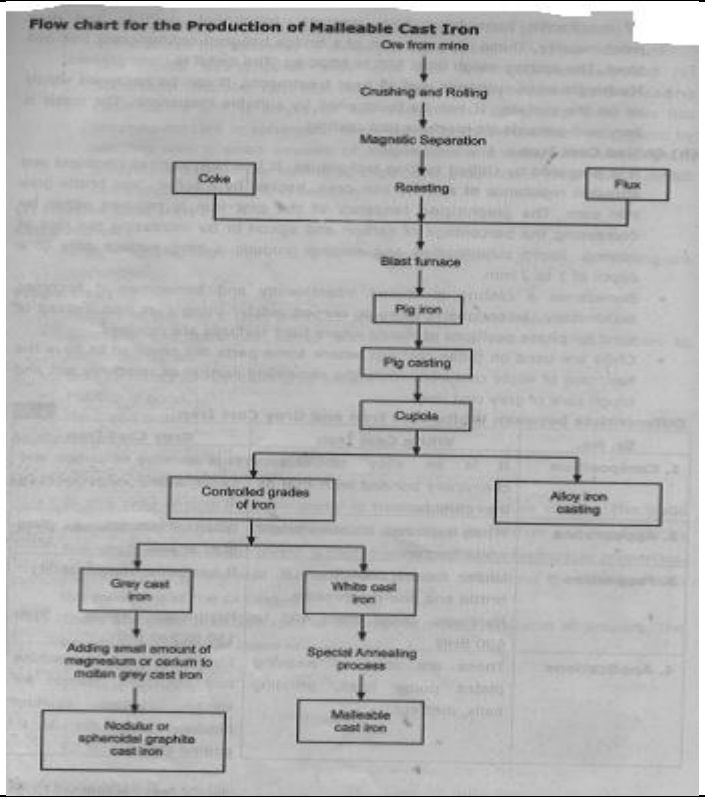
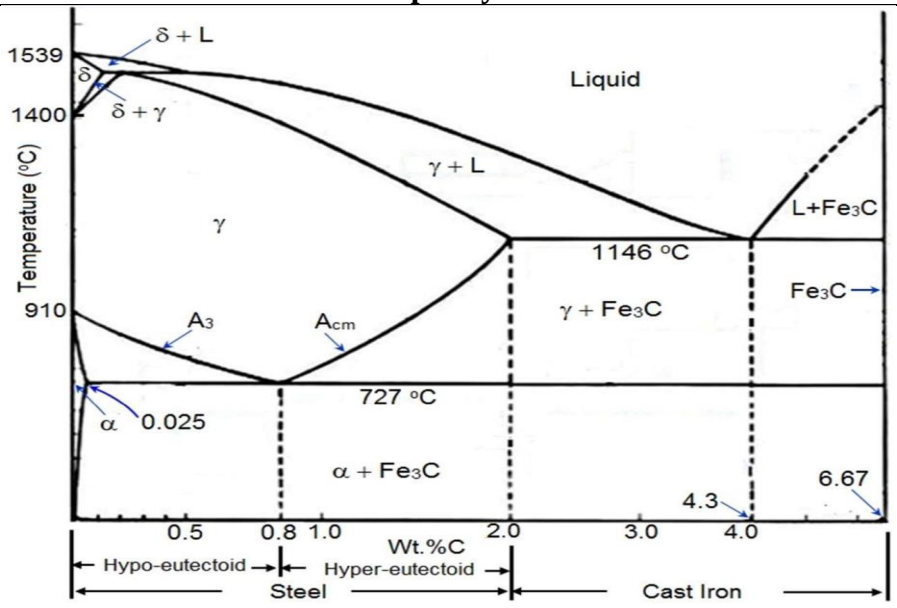
c)	**Properties of Ceramics**: 1. They are hard, strong and dense. 2. Have high resistance to the action of chemicals and to weather. 3. Possess high compression strength compared with tension. 4. Offer excellent dielectric properties. 5. Are good thermal insulators. 6. Are resistant to high temperature creep. 7. Have high fusion point at high temperature rigidity is high.	**4M (any 4)**	
d)	**1)Optical properties of nanoparticles** Nanoparticles also often possess unexpected optical properties as they are small enough to confine their electrons and produce quantum effects. One example of this is that gold nanoparticles appear deep red to black in solution. **2)Magnetization and other properties of nanoparticles** Other properties unique among nanoparticles are quantum confinement in semiconductor particles, surface plasmon resonance in some metal particles and superparamagnetism in magnetic materials. **3)Diffusion properties of nanoparticles** At elevated temperatures especially, nanoparticles possess the property of diffusion. **4)Physical properties of nanoparticles** Nanoparticles are unique because of their large surface area and this dominates the contributions made by the small bulk of the material. Zinc oxide particles have been found to have superior UV blocking properties compared to its bulk substitute. This is one of the reasons why it is often used in the preparation of sunscreen lotions **Applications:-** 1) Nanomedicine 2) Nanobiotechnology 3) Green nanotechnology 4) Energy applications of nanotechnology 5) Industrial applications of nanotechnology 6) Potential applications of carbon nanotubes 7) Nanoart.	**2M (any2)** **2M (any2)**	
e)	**1) Machining:-** This method is mainly used to produce filings, turnings, chipsetc. These can be pulverised by crushing & milling. Very coarse and bulky powders are obtained by this process.	**4M (any2)**	

	In this process irregular shaped partcles are produced. **2)Crushing**:- This method is used for disintegration of oxides and brittle materials. Various crushing instruments such as stamps, hammers, jaw crushers etc are used. The powder produced by this method is of angular shape for brittle material and of flasky shape for ductile materials. **3) Atomization** Atomization is accomplished by forcing a molten metal stream through an orifice at moderate pressures. A gas is introduced into the metal stream just before it leaves the nozzle, serving to create turbulence as the entrained gas expands (due to heating) and exits into a large collection volume exterior to the orifice. The collection volume is filled with gas to promote further turbulence of the molten metal jet. Air and powder streams are segregated using gravity or cyclonic separation. Most atomized powders are annealed, which helps reduce the oxide and carbon content. The water atomized particles are smaller, cleaner, and nonporous and have a greater breadth of size, which allows better compacting. The particles produced through this method are normally of spherical or pear shape. Usually, they also carry a layer of oxide over them. **4)Milling:-** This is one of the most useful method with which various fine grades of powders can be produced. Milling or grinding can be done by using ball milss, rod mills, impact mills etc> In ball milling the material to be disintegrated is tumbled in a container with a large number of hard wear resistant solid balls. This balls hits the materials and brak it.		
f)	**Advantages:** 1)A combination of metal and non-metallic powder is possible. 2)A close control on the amount of porosity is possible. 3)Components of any required compositions can be achieved. 4)Production of refractory metals and heavy metals is possible without melting. 5)High density parts can be produced. 6)Production of components from metals which are insoluble in each other duringmelting is possible. 7)Complicated shaped parts can be manufactured easily. 8)Elimination of scrap. 9)Production of cemented carbide tools is possible only by this method. 10)Fast and economical process for mass production. 11)Powder metallurgy parts can be welded, soldered or brazed easily. 12)Highly qualified or skilled operator is not required.	**2M (ANY 2)**	

	Limitations: 1)It is very difficult to produce high purity powder and also it is expensive to maintain purity. 2)Alloy powders are difficult to produce as simple method is not available. -Very large sized components cannot be produced. 3)Components of theoretical density cannot be produced. 4)Due to porosity, the specified mechanical properties are difficult to obtain. Porous metals tend to oxide rapidly. 5)Powder metallurgy parts show comparatively poor plastic properties.	**2M (ANY 2)**	
4	**Attempt any FOUR**		
a)	 **Note:- Explaination is not required only naming or this tree dia can be considered.**	**4M**	
b)	Some metals changes their crystal structure when there is change in temperature, pressure, chemical composition , this tendency of metals is called as allotrophy. Such as change of structure is also called as polymorphism.	**2M**	

	Allotropic change in pure iron:- 1. Iron is allotropic in nature 2. Iron is in the liquid form above 1539°C temperature 3. If it cools below 1539°C liquid is converted in δ-iron(ferrite) at 1400°C which is in the B.C.C structure (Body Centered Cubic structure) . 4. During cooling process at 1400°C δ-iron is in gamma-iron(γ-iron) which is in the F.C.C structure (Face Centered Cubic structure) . 5. Below 910°C, γ-iron (Austenite) is converted to α-iron (ferrite) which is again in the B.C.C structure 6. α-iron (ferrite) is non-magnetic (paramagnetic) upto768°C. If it cools below 768°C, it is in the B.C.C structure but magnetic (Ferromagnetic) in nature upto room temperature.	**2M (any2)**	
c)	**Austenite:** Austenite is an interstitial solid solution of carbon dissolved in gamma-iron(γ-iron). It has F.C.C structure. **Cementite**: It is an intermetallic compound of iron and carbon with a carbon content of 6.67% weight. It is also known as carbide or iron carbide.. **Bainite:** Bainite is a fine pearlite and contain very fine distribution of ferrite and cementite phase. The bainite formed just below the nose of TTT curve is called upper bainite and has feathery appearance. **Martensite:** Water quenching of a steel containing sufficient carbon produces an extremely hard, strong and brittle structure called martensite. Martensite is a supersaturated solid solution of carbon in BCC iron having BCT (Body Centered Tetragonal) structure.	**4M (each definati on 1m)**	
d)	Case hardening consists heating of a steel in the presence of solid, liquid or gas, rich in carbon nitrogen in order to enable the surface to be hardened, while retaining a tough ductile core.	**2M**	

	Advantages:- 1. To obtain a hard and wear resistant surface on workpiece. 2. To obtain tough core to resist shocks: 3. To obtain higher fatigue limit. 4. To obtain close tolerances on workpieces. 5. To rebuild worn or undersized parts	**2M (any2)**	
e)	**Subcritical Annealing** • In these processes of annealing, the cold worked steel is heated to some temperature below the critical temperature and hence they are classified as subcritical annealing processes. They are used after cold working of steels to relieve the internal stresses or to reduce the hardness or to refine and modify the structure. **Purposes:** 1. To relieve the internal stresses of the cold worked steel. 2. To reduce the hardness and improve machinability. 3. To refine the grain structure. 4. To reduce the risk of distortion in machining and increase corrosion resistance. 5. To make the steel, soft and ductile.	**2M** **2M (any2)**	

f)		**4M**	
5	**Attempt any FOUR**		
a)	 **Irron- Carbide Phase Dia**	**4M**	

b) **Martensite : -** — **4M**

1. Water quenching of a steel containing sufficient carbon produces an extremely hard, strong and brittle structure called martensite.
2. Martensite is a supersaturated solid solution of carbon in BCC iron having BCT (Body Centered Tetragonal) structure
3. The transformation of of austenite to martensite is diffusionless and there is no change in chemical composition
4. Austenite to martensite transformation never complete and unstable austenite present at room temperature is called as retained austenite
5. Martensite structure is obtained by very fast cooling rate (rapid quenching 350°C/sec)

c) — **4M (any4)**

Flame hardening	Induction hardening
Flame hardening is a heat treatment process in which the surface of medium carbon steel is heated rapidly above the transformation temperature i.e austenitic temperature by high temperature flame and then quenched by water spray to convert austenite into martensite.	Is a heat treatment process, which utilizes electric induction heating followed by quenching for producing a hard wear resistance layer or a tough core of a steel part, is known as induction hardening
In flame hardening, the high temperature flame is obtained by oxyacetylene flame which can generate temperature upto 3000°C	The component is heated by means of an inductor coil (heating coil) which consists of one or several turns of water cooled copper tube
This method useful for very large or irregular components	Irregular and large parts are not suitable for induction hardening
Cheaper method as compared to other method	Induction hardening equipment cost is high
Applications:-large gear shafts, lathe ways, spline shaft etc.	Applications:- piston rods, shafts, cams etc.

d) **Advantages of Nitriding :** — **2M (any 2)**

1. No other heat treatment is required after nitriding.
2. Nitrided steel parts possess very high hardness (about 60 to 70 Rc) and very (good wear resistance. .
3. It also possess higher fatigue life and good corrosion resistance.
4. Because of non-metallic nature of nitrides, nitrided surfaces

	have less coefficient of friction **Limitations of Nitriding**: 1. Because of long duration of the process, it is costlier. 2. Nitrided cases are usually thin i.e. less than 0.5 mm. 3. Cleaning of the part after nitriding process is difficult. 4. No heat treatment can be done after nitriding. Therefore, the core properties should be adjusted before the components are nitride	**2M (any 2)**	
e)	**Characteristics of grey cast iron** 1. When the carbon is present in the form of graphite (free carbon) in the form of flakes (whorl like shape) are called as grey cast iron 2. Hence these cast iron are brittle and relatively weak in tension 3. Good compressive strength 4. Excellent machinability 5. Easiest to cast due to their high castability resulting from low melting point, good flowability of melt. 6. Excellent damping capacity **Applications of nodular cast iron** 1. Used in tractor parts 2. Used in pumps and compressors 3. Used in internal combustion engine 4. Used in construction machinery	**2M (any2)** **2M (any2)**	
f)	**Composition of Naval brass** Its composition is 60% of copper, 39% zinc and upto 1% tin. **Application** 1. It is mainly used for naval construction 2. It is used for propeller shafts 3. It is used for valve stem, pump impellers, nuts and bolts 4. It is used for piston rods **Composition of Babbit metal** Babbits are either lead based or tin based babbit Lead based babbit:- it contains 80% lead, 10% antimony and 10% tin Tin based babbit :- it contains 90% tin, 5% antimony and 5% copper **Applications** High speed engines, steam turbines, rail roads, freight cars	**1M** **1M (any 2)** **1M** **1M (any2)**	

6	Attempt any FOUR		
a)	• It forms the basis of all cutting tool alloys. • The alloy are made up of very fine carbide particles of the refractory metals such as tungsten, tantalum, titanium, & cobalt • These materials have very high hardness & compressive strength • They are manufactured by powder metallurgy technique such as sintering. • In this process the powder of carbides of tungsten, tantalum,or titanium is prepared by mixing one or more of powders with binders, usually cobalt powder. • The blended powder particles are pressed into compacts of desired shape using necessary dies. • These steels are used for cutting fibreglass, phenolics resins & white cast iron. • They are used for drills, reamers, broaches, boaring tools etc.	**4M**	
b)	**Following are the types of cast iron:-** 1) Gray Cast Iron 2) White Cast Iron 3) Nodular Cast iron 4) Malleable cast Iron **Applications:-** **1) Gray C I:-** Machine tool structures, Engine frames, Drinage pipes, Cylinders & piston & piston rings, Fly wheels etc. **2) White Cast Iron:-** For manufacturing of pump liners, mill liners, grinding balls, wearing plates, road roller surface, malleable casting, structural parts. Etc. **3) Malleable Cast iron:-** Axles, gears, camshafts, crankshafts, switch gear parts, fittings for high & low voltage transmission etc. **4) Nodular Cast iron:-** Crankshafts, gears, punch dies, sheet metal dies, furnace doors, pistons, cylinder blocks & heads. Etc. **Note:- Kindly consider the relevant applications other than given**	**2M (for types)** **2M (for applications)**	

c)	**Composite material:-** Composite material are combinations of two or more different materials combined together to achieve certain properties which they can not achieve alone. Composite material development is very vast field still under extensive research. Examples:- 1) Cement Concrete 2) Reinforced Concrete 3) Wood 4) Fibre Reinforced Polyme 5) Coposite Ceramics	**2M** **2M (any2)**	
d)	**Definition:-** Powder metallurgy (PM) is a process for forming metal parts by heating compacted metal powders to just below their melting points. In other words, PM is a metal shaping process that creates near-net parts from powdered metal. **Concept:-** The powder metallurgy process consists of four basic steps: • Powder manufacture • Powder blending • Compacting • Sintering The high-precision forming capability of PM generates components with near-net shape, intricate features and good dimensional precision pieces. The unique flexibility of the PM process enables products to be made from materials that are tailored to users' specific needs. By using specially selected materials, this capability enables refinements to be engineered into the mechanical properties of the part. The PM process has the highest raw material utilization (over 95%) and the lowest energy requirement per kilogram of finished part, compared with other manufacturing processes. It is suitable for high-volume production with very little wastage of material. Secondary machining is virtually eliminated.	**2M (definat ion)** **2M**	
e)	**Applicatons of Brass:-** 1)It can be rolled into thin sheets 2)It can be used for marine castings 3)It is used for valves, plumbing, automobiles fittings, type writer parts, musical instruments 4)Navakl brass is used in naval construction **Application of Bronze:-** 1)They are widely used in foundry, for making propeleer blades 2) For making bearing in which wearing quilities are desired	**2M (any 2)** **2M (any 2)**	

	3) For making bushesh, cotter pins, clutch disck, springs, taps, marine pumps etc. 4) It is use for worm wheels, gears , vessels for storage of chemicals.		
f)	**Applications of Polysters:-** Polysters are used in the manufacturing of Bottles, Use & throw picnic utensils, toys, clothing, towels, curtains,blanckets etc. **Applications of Epoxy:-** They are used in the manufacturing of aircraft, automobiles parts, & domestic applications,adhesives.	**2M (any2)** **2M (any2)**	