1459 **Code : 20ME11T**

Register Number

I Semester Diploma Examination, Oct./Nov.-2021

MATERIALS FOR ENGINEERING

Time : 3 Hours] **[Max. Marks : 100**

Special Note : Students can answer for max. of **100** marks, selecting any sub-section from any main section.

SECTION – I

1. (a) Write down the types of crystal structures. Explain each giving examples. **10**

   (b) Define Mechanical property. Explain the different Mechanical properties. **10**

2. (a) Explain High Speed Steel (HSS). **10**

   (b) Select and explain the ferrous material used for making surgical & dental instruments. **10**

SECTION – II

3. (a) List the properties and uses of cast iron. **10**

   (b) What is alloying ? Explain the effect of alloying elements on the proportion of alloy steel. **10**

4. (a) Write the properties and applications of copper. **10**

   (b) Compare Brass & Bronze. List the varieties of Brass & bronze. **10**

SECTION – III

5. (a) Write down the properties and application of Aluminium. **10**

   (b) Explain plastics. Compare thermosetting & thermoplastics. **10**

6. (a) Compare metallic and non-metallic materials with examples. **10**

(b) Explain composite materials with its properties and applications. **10**

SECTION – IV

7. (a) List the properties and applications of Biomaterials. **10**

(b) Sketch iron-carbon equilibrium diagram for mild steel. **10**

8. (a) Define heat treatment. List the purposes of heat treatment & types of heat treatment processes. **10**

(b) Explain case hardening with examples. **10**

SECTION – V

9. (a) Explain hardening process. Write down the purposes and applications of hardening. **10**

(b) Explain corrosion with examples. List the reasons for corrosion. How corrosion is protected ? **10**

10. (a) Explain the construction and working of electro-chemical cell. **10**

(b) Compare electrolytes and non-electrolytes. List the types of electrolytes. **10**

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SECTION-I

1. (a) Writing types of crystal structures = 1m, Explain each=3X3 =9m = 10m

(b) Define=1m, Explain 9 mech prop=9x1 = 9 m =1+9 = 10 m

2. (a) Explain HSS = 1+3+3+3 = 10 m

(b) For selecting= 4m Explanation = 6m

SECTION-II

3. (a) Any 5 properties of cast iron = 5m 5+5 = 10m

Any 5 uses of cast iron = 5m

(b) Defn of alloying = 3m Explain any 7 =1X7 = 7m

4 (a) Any 5 properties of copper = 1X5 = 5m

Any 5 applications of copper = 1X5 =5m

(b) Comparison = 2 ½ + 2 ½ = 5m

Varieties = 2 ½ + 2 ½ = 5m

SECTION-III

5 (a) List any 5 properties Aluminium = 1x5 = 5m

List any 5 applications of Aluminium = 1x5 = 5m

(b) Explain plastics= 5m

Write any 5 Comparison =1X5 = 5m

6 (a) Comparison 2 ½ + 2 ½ = 5m

Examples 2 ½ + 2 ½ = 5m

(b) Explanation = 4 m

Any 3 Properties = 1X3 =3m

Any 5 applications = 1X3 = 3m

SECTION-IV

7 (a) List any 5 properties = 1x5 = 5m

List any 5 applications = 1X5 = 5m

(b) For Sketch = 5m

For labelling =5m

8 (a) Defn. = 2 m

List purposes = 1X4 m = 4m

Types = 1X4 m = 4m

(b) Explanation = 5m, + Examples =5 = 5+5 = 10 m

SECTION-V

9. (a) Explain= 2m

Purposes = 1x 4 = 4m

Applications = 1 X4 = 4m

(b) Expalain= 2m

List any 4 Reasons = 1x4 = 4m

List any 4 protection = 1x4 = 4m

10.(a) Explain construction= 5m

Explain working = 5m

(b) Comparison (Any 5) = 5m

List 5 types= 5m

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SECTION-I

1. (a) Write down the types of crystal structures, Explain each giving example 10

ANS. Types of crystal structures

1.Body centered cubic structure

2.Face centered cubic structure

3.Hexagonal Packed structure

1.Body centered cubic structure

In BCC type of structure, the unit cell contains one atom at each of its 8 corners and another atom at the body centre as shown in fig. In this case, each unit cell shares 8 atoms one on each of its corners in addition to one atom, at the body centre. Fig. shows a unit cell indicating only the lattice points.

Examples: a-iron (below 910°C), 8-iron (1400°C to 1839°C). tungston, vanadium, molybdenum, chromium and alkali metals.

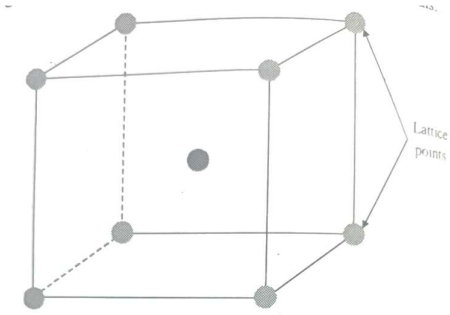


Fig. 1 Unit cell indicating only lattice points

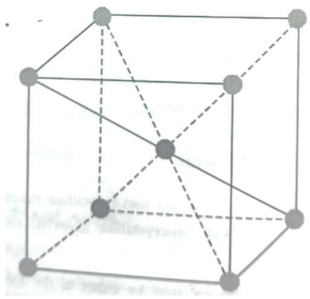


Fig.2 BCC Structure

2. Face Centred Cubic (FCC) Structure :

In FCC type of structure, the unit cell contains one atom at the centre of its each face, in addition to one atom at each of its 8 corners as shown in fig. This type of structure do not contain any atom at the centre of the unit cell. Therefore, each unit cell shares 14 atoms. Fig. 1shows a three-dimensional model of FCC structure.

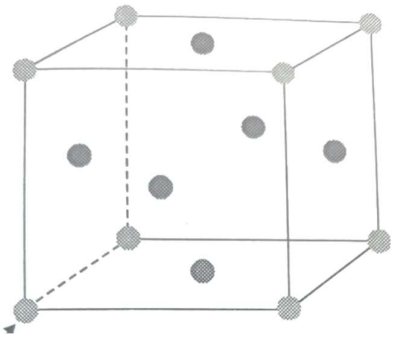


Fig. 1 FCC Unit cell

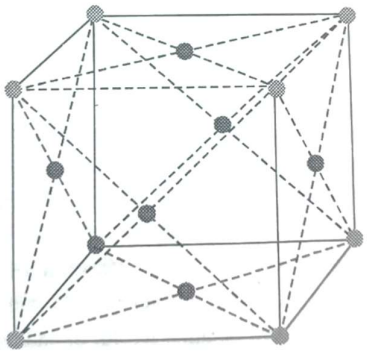
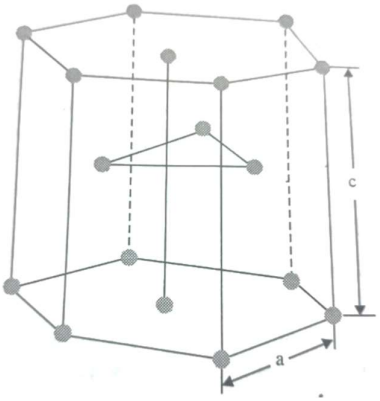
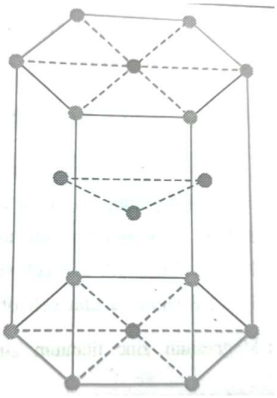


Fig.2 FCC Structure

Examples : y-iron (910° C to 1400° C), copper, silver, gold, aluminium, nickel lead and platinum etc

Hexagonal Closed Packed (HCP) Structure:





In HCP type of structure, the unit cell contains one atom at each corner of the hexagonal prism, one atom at the centre of the hexagonal faces and three more atoms within the body of the cell as shown in fig. Therefore, each unit cell shares 14 atoms and contains 3 atoms. Fig. shows a unit cell of a HCP structure.

Examples : Magnesium, zinc, titanium, zirconium, beryllium, cadmium etc.

(b) Define Mechanical property. Explain the different Mechanical property 10

ANS: Mechanical Properties:

Mechanical properties are physical properties that a material exhibits upon the application of forces. These include: Elasticity, plasticity, ductility, brittleness, hardness, toughness, stiffness, resilience, creep, endurance, strength, etc

Mechanical Properties of Metals:

These properties include the nature and behaviour of metals under the action of external forces. These are:

1. Elasticity :

It is that property of the metal by virtue of which the metals are able to regain their original shape and size after removal of the load,

2. Plasticity :

It is that property of the metal by virtue of which a metal takes place permanent deformation without fracture whenever it is subjected to the action of external forces. Ex : rolling of structural steel or forging of metals, etc.

3. Ductility :

It is that property of the metal by virtue of which a metal can be drawn into wires orelongated before rupture takes place.

4. Brittleness :

It is that property of the metal by virtue of which a metal will fracture suddenly without any appreciable deformation.

5. Hardness :

It is that property of the metal by virtue of which a metal resists abration, indentation and scratching by relatively harder materials.

6. Toughness :

It is defined as that property by virtue of which a metal can absorb maximum energy before fracture takes place.

7.Stiffness :

It is defined as that property by virtue of which a metal will not deform or deflect when load is applied.

8. Resilience :

It is defined as that property by virtue of which a metal stores energy and resists shock or impact loads.

9. Malleability :

It is the ability of metal to be hammered into thin sheets. Gold and silver are highlymalleable.

10. Creep :

It is defined as that property by virtue of which a metal deforms continuously and slowly under a steady load.

11. Endurance :

It is defined as that property of a metal by virtue of which it can withstand varying stresses (same or opposite nature).

12. Strength :

Strength may be defined as the property of a metal by virtue of which it can withstands or support an external force or load without rupture.

2. (a) Explain High Speed Steel (HSS). **10**

ANS: High Speed Steel (HSS):

High speed steels are used for cutting metals, at a much higher cutting speed than ordinary carbon tool steel. These steels have a valuable property of retaining their hardness even when heated to red hot. Most of the high speed steels contain tungsten as the chief alloying element and other alloying elements such as vanadium, chromium etc., may also be present in some proportions.

Types of HSS:

1. 18-4-1 High Speed Steel:

This steel contains 18% tungsten, 4% chromium and 1% vanadium. It is considered to be one of the best of all purpose tool steels. It is widely used for drills, lathes, planer and shaper tools,milling cutters, reamers, threading dies, punches etc.

2. Molybdenum High Speed Steel:

This steel contains 6% tungsten, 6% molybdenum, 4% chromium and 2% vanadium. It has an excellent toughness and cutting ability. The molybdenum high speed steels are better and cheaper than other types of steels. It is particularly used for drilling and tapping operations.

3. Super High Speed Steel:

This steel is also called cobalt high speed steel, because cobalt is added from 2% to 4% in order to increase the cutting efficiency especially at high temperatures. This steel contains 20% tungsten, 4% chromium, 2% vanadium and 12% cobalt. Since the cost of this steel is more, therefore it is principally used for heavy cutting operations, which impose high pressures and temperatures on the tool.

(b) Select and explain the ferrous material used for making surgical & dental instruments. **10**

ANS: The majority of surgical instruments are made of stainless steel. There are many different types of stainless-steel alloys, with varying amounts of nickel & chromium to increase resistance to corrosion.

Stainless steel (sometimes referred to as inox steel) is one of the most commonly used metal alloys in the manufacture of surgical implements. Austenitic 316 steel is a type of stainless steel used often, and is referred to as “surgical steel”. This is because it is a tough metal that is very resistant to corrosion.

Selection = Martenisic Stainless Steels:

These steels usually contain 11% to 14% chromium and 0.35% of carbon. These steels can be hardened by suitable heat treatment and have a good corrosive resistance qualities. These steels can be welded and machined.

Types of stainless steel:

Ferritic stainless steel

Martensitic stainless steel

Austenitic stainless steel

SECTION-II

3(a) List the properties and uses of cast iron. 10

ANS: Following are the **properties of cast iron:**

1. It is a brittle material.
2. It has a good casting characteristic
3. High compressive strength.
4. Good wear resistance.
5. Excellent machinability.
6. Its melting point is about 1200° C.
7. Its tensile strength varies from 100 to 200 MPa.
8. Its compressive strength varies from 400 to 1000 MPa.
9. Its shear strength is 120 MPa.
10. Fluidity of molten cast iron is very good

Uses of cast iron.

1. Use for machine tool beds
2. Automobile cylinder blocks
3. Pipes and pipe fittings
4. Agricultural implements
5. Car wheels
6. Doors, hinges, locks,

(b)What is alloying? Explain the effect of alloying elements on the properties of alloy steel. 10

ANS: Alloy is mixtures of several elements-because these have properties superior to pure metals. Alloying is done for many reasons, typically to increase strength, increase corrosion resistance, or reduce costs.

Alloy Steel :Definition :

The alloy steel can be defined as the steel in which elements other than carbon are added in sufficient quantity in order to obtain special properties is known as alloy steel.

Effects of Alloying elements on Properties of Alloy Steel :

1.Nickel:

Steel sheets contain 2% to 5% nickel and 0.1% to 0.5% of carbon. In this range, nickel improves tensile strength, elastic limit, hardness, toughness and reduces rust formation. It is used for boiler plates, automobile engine parts, large forgings, crankshafts, connecting rods etc. If nickel

is added about 25% results in higher strength steels with improved shock and fatigue resistance. It is used for boiler tubes, valves for gas engines, spark plugs etc.

A nickel steel contains about 36% nickel and 0.5% of carbon is known as invar. It can be rolled, forged, turned and drawn. It is used for pendulums of clocks, precision measuring instruments etc.

2.Chromium:

Addition of chromium increases the strength, hardness and corrosion resistance of steel. A chrome steel contains 0.5% to 2% chromium and it is used for balls, rollers and races for bearings, dies, rolls of rolling mills, etc. A nickel-chrome steel containing 3.25% of nickel, 1.5% chromium and 0.25% carbon imparts high tensile strength with great resistance to shock and it is used for motor car crankshafts, axles, gears, etc.

3. Vanadium:

It is added in low and medium carbon steels to increase their yield and tensile strength. It also improves harden ability of steel

The chrome-vanadium steel contains about 0.5% to 1.5% chromium, 0.15% to 0.3% vanadium and 0.13% to 1.1% carbon. It makes the steel very tough and strong and are used for spring steels, high speed tools, steel crank- shafts, locomotives and wagon axles etc.

4. Tungsten :

Addition of tungsten increases the critical temperature of steel and increases the strength of alloyed steel at high temperatures. It imparts cutting hardness and abrasion resistance properties of steel. When added upto 5% to 6% gives good magnetic properties to the steel.

Steel containing 18% tungsten, 4% chromium, 1% vanadium 0.7% carbon is called tool steel or high speed steel. These steels have an ability to maintain its sharp cutting edge even at high temperature, hence they are used for cutting tools like drills, dies, cutters, etc.

5. Manganese :

Addition of manganese makes the steel hard, tough and wear resisting one. Manganese alloy steels containing 1.5% manganese and 0.4% to 0.55% carbon are widely used for gears, axles, shafts etc. A steel containing manganese from 10% to 14% and carbon 1% to 1.3% is very hard, tough and high wear resistance and is used for mining, rock crushing and railway equipments.

6.Silicon :

It increases the strength and hardness of steel without decreasing the ductility. The silicon steel containing 1% to 2% silicon and 0.1% to 0.4% carbon have a good magnetic permeability, and high electrical resistance and these are used for generator and transformers in the form of laminated cores.

7.Cobalt :

It is added to high speed steels from 1 to 12% to give red hardness by retention of hard carbides at high temperatures. It increases hardness and strength. It also increases residual magnetism in steel for magnets. Too much cobalt decreases the impact resistance of steel.

4.(a) Write the properties and applications of copper. 10

ANS: Properties

Following are the properties of copper

1. Good conductor of electricity.
2. Good conductor of heat
3. High ductile material.
4. Malleable Material
5. Specific gravity is 8.9.
6. Low hardness with moderate strength.
7. Melting point is 1083° C and boiling point is 2595C.
8. Easily casted, forged, rolled and drawn into wires.
9. Good resistance to corrosion.
10. Good non-magnetic properties.
11. Easily alloyed with other metals

Uses:

Copper can be used for following purposes

1. For making coins and electroplating.

2. For making thin sheets, water pipes, tanks, taps, etc.

3.Used for hardware fittings, washers etc.

4. Telephone cables, electrical cables, electrical equipment's like bushes, solders, switch gears, coils.

5. Heat exchangers, etc.

(b) Compare Brass & Bronze. List the varieties of Brass & bronze. 10

ANS: Brass :

Brass is an alloy of **copper and zinc**, in which zinc is the principle alloying metal. There are various types of brasses depending on the proportion of copper and zinc. This is fundamentally a binary alloy of copper with zinc each 50%, by adding small quantities of other elements, the brass material properties can be changed. For example, addition of lead from 1% to 2% improves the machining qualities of brass. It has a greater strength than the copper, but lower thermal and electrical conductivity. It has a good corrosion resistance and can be easily fabricated.

Bronze:

Bronze is an alloy of **copper and tin**. The composition of

Bronze is as follows :

Copper - 75 to 95%

Tin - 5 to 25%.

By adding other elements its properties can be changed.

Varieties of Brass

1. Cartridge brass
2. Yellow brass
3. Leaded brass
4. Admiralty brass
5. Naval brass
6. Nickel brass

Varieties of Bronze

1. Phosphor bronze
2. Silicon bronze
3. Beryllium bronze
4. Manganese bronze
5. Aluminium bronze

SECTION-III

5. (a) Write down the properties and application of Aluminium. **10**

ANS: Properties of Aluminium :

1. It is a good conductor of heat & electricity.

2. Greater resistance to corrosion.

3. Non-toxic.

4. Non-magnetic and ductile.

5. Light in weight.

6.Specific gravity is 2.7.

7.Good conductor of heat.

8.It is a good reflector.

9. It can be forged, formed, blanked, casted, drawn, turned and die casted

Applications:

1. It is used for overhead cables.

2. Used for cooking utensils.

3. Used for aircraft and automobile components.

4. Used in furniture, rail road and trolley cars.

5. Aluminium foils are used for food protection elements.

(b) Explain plastics. Compare thermosetting & thermoplastics. 10

ANS: Difference between Thermoplastics and Thermosetting Plastics :

S.No	Thermoplastics	Thermosetting plastics
1	These are composed of chain molecules	These are composed of cross linked molecules.
2	They are produced by addition polymerization	They are produced by condensation polymerization.
3	They undergo no chemical no change in the moulding operation	They undergo chemical change in the moulding operation
4	They can be mechanically deformed and softened at high temperatures.	They cannot be mechanically deformed and softened at high temperatures.
5	Their plasticity increases increases with increase in temperature	Their plasticity does not with increase in temperature.
6	They can be easily moulded and remoulded into any shape	They cannot be moulded into any new shape.

6 (a) Compare metallic and non-metallic materials with examples 10

S.No	Metallic Materials	Non-Metallic Materials
	Metallic Materials include elemental metal and compound or alloy. There are 86 metals with distinct characteristic properties, and a limited number of these metals have	Non-metallic materials are any materials, both synthetic and natural, which do not contain metal. These materials are able to retain their unique

	engineering importance. Steel accounts for about 80% of all metallic materials used in different applications	chemical properties during the machining process. There are a wide variety of non-metallic materials,
	Ferrous metals Pig iron Wrought iron Cast iron Steels (Dead Mild steels, Low carbon steels, Medium carbon steels and High carbon steels) **Non-Ferrous Metals** Copper Aluminium Nickel Cobalt Lead	1.Plastics (Thermoplastics & thermosettings) 2.Ceramic materials 3.Rubber 4.Plaster of paris (POP) 5.Glasses 6.Wood (Timber)

(b) Explain composite materials with its properties and applications.

Composite Materials:

Sometimes two or more materials are combined together to produce a new material, which possesses much superior properties than any one of the constituent materials. Such a material is known as composite material.

The common example of a natural composite material is wood, which consists of long cellulose fibre held together by amorphous lignin. Some of the artificial (or synthetic) composite materials are cement concrete, glass reinforced plastic plywood etc. A composite material is a combination of two or more materials having compositional variations depicting properties distinctively different from those of the individual materials of the composite. The composite material is generally better than any of the individual components as regards their strength, heat resistance or stiffness.

The compound materials are incorporated into the composites to take advantage of their properties and their applications.

Properties of Composite Materials:

1. High strength to weight ratio.

2. High stiffness to weight ratio.

3. Good wear resistant.

4. Superior magnetic properties.

5.. High modulus of elasticity.

6. Superior mechanical properties.

7. High resistance to thermal expansion.

8. Good corrosive resistivity.

9. Excellent fatigue resistance.

10. Improved toughness.

Applications or Uses of Composite Materials :

1. High temperature structures.

2. Aerospace applications where light weight, stiffness and fatigue resistance are essentially required.

3. Used in gas turbines.

4. Storage battery plates.

5. High temperature engine parts.

6. Structural walls, shells, cylinders, pipes, etc.

7. Used in reactors.

8. Electrical components

9. Used in pressure vessels.

10. Used in deep sea mining equipments.

11. Used in aircrafts.

SECTION- IV

7.(a) List the properties and applications of Biomaterials. **10**

Properties of Biomaterials:

Following are the important properties of biomaterials:

1. These materials must not produce toxic substance.

2. Must be compatible with body tissues.

3. They should not cause adverse biological reactions.

4. It should not be biodegradable.

5. Material should be mechanically sound.

6. They should be reliable and durable.

7. They should have a desirable strength, elastic modulus and ductility

Applications of Biomaterials:

Following are the important applications of biomaterials:

1. Used for joint replacement.

2. Used for bone plates.

3. For intracular lenses for eye surgery.

4. For bone cement.

5. For dental inplants for tooth fixation.

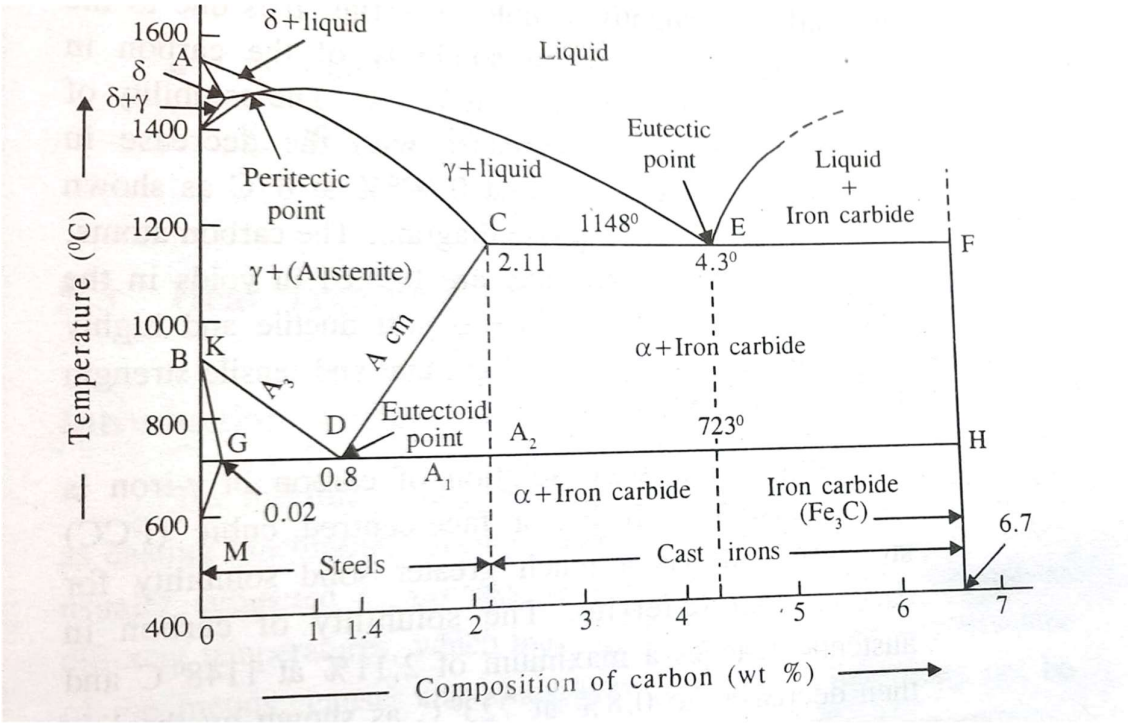
6. Used for artificial ligaments and tendons.

7. Used for nerve conduits.

8. Used for skin repair devices (artificial tissue).

9. Used for cancer therapy etc.

(b) Sketch iron-carbon equilibrium diagram for mild steel.



8. (a) Define heat treatment. List the purposes of heat treatment & types of heat treatment processes **10**

Definition :

The heat treatment can be defined as an operation or combination of operations involving the heating and cooling of a metal/steel or its alloy in solid state for the purpose of obtaining certain required structures and desirable properties or a combination of properties suitable for the particular applications.

Purpose of Heat Treatment (Objectives):

Heat treatment process is carried out for the following purposes:

1. To relieve internal stresses, which are set up in the metal due to cold or hot working.

2. To soften the metal.

3. To improve hardness of the metal surface.

4. To improve machinability.

5. To refine grain structure.

6. To improve mechanical properties like tensile strength, ductility and shock resistance etc.

7. To improve electrical and magnetic properties.

8. To increase the resistance to wear, tear, heat and corrosion etc.

Types of Heat Treatment Processes:

Following are the important heat treatment processes:

1. Annealing

2. Normalizing

3. Spheroidising

4. Hardening

5. Tempering

6. Carburizing

7. Nitriding

8. Cyaniding

9. Induction hardening

10. Flame hardening.

(b) Explain case hardening with examples.

Case Hardening or Surface Hardening :

Case hardening consists of heating a steel in the presence of a solid, liquid or gas rich in carbon in order to enable the surface to be hardened, while retaining a tough ductile core. In many engineering applications, it is desirable that the **steel to be used should have the hardened surface to resist wear and tear, at the same time, it should have soft and tough interior or core, so that it is able to absorb any shock while working.** This can be achieved by hardening the surface layers of the steel while the rest of it is left as it is.

Following are the purposes of case hardening process:

1.To obtain a hard and wear resistance surface in machine parts with enrichment of the surface layer with carbon to concentration of 0.75 to 1.2%.

2. To obtain a tough core.

3. To obtain close tolerances in machining parts.

4. To obtain a higher fatigue limit and high mechanical properties in the core.

Applications of Case Hardening:

This type of treatment is usually carried out for:

gears

ball bearings

railway wheels etc.

cutting tools

die-casting dies and wire drawing dies.

Types of Case Hardening:

1. Carburizing
2. Nitriding
3. Cyaniding

SECTION- V

9.(a) Explain hardening process. Write down the purposes and applications of hardening **10**

Hardening :

The process of hardening consists of heating the metal up a temperature of 30°C to 50° C above the upper critical temperature for the hypoeutectoid steels and by the same temperature above the lower critical point for hypereutectoid steels. The metal is held at this temperature for a **considerable time depending** upon its thickness and then quenched (cooled suddenly) in a suitable cooling medium. The hardness obtained from a given treatment depends up the rate of cooling, the carbon content and the work size. A very rapid cooling is necessary to harden low and medium plain carbon steels. The quenching in a water or brine solution in a method rapid cooling, which is commonly used. For high carbon and all steels, mineral oil is generally used as the quenching media because its action is not so severe as that of water. Certain alloy steels can be hardened by air cooling. But for ordinary steel, such cooling rate is too slow to give an appreciable hardening effect.

Large parts are, usually, quenched in an oil bath. The temperature of the quenching medium must be kept uniform to achieve uniform results. Any quenching bath, used in production work, should provided with some means for cooling,

A rapid cooling from the hardening temperature causes the austenite to be transformed into another constituent called martensite, which is very hard and brittle. The hardening of steel depends entirely upon the formation of martensite, because austenite is comparatively soft and ductile.

Purposes or Objects of Hardening:

The main purposes or objects of hardening are

1.To increase the hardeness of the metal.

2.To increase the wear resistance capacity of the meta

3. To enable to cut the other metals i.e. to make it suitable for cutting tools.

(b) Explain corrosion with examples. List the reasons for corrosion. How corrosion is protected? 10

Corrosion

Corrosion is a gradual chemical or electro-chemical attack on a metal by its surroundings when the metal is exposed to the environment containing liquids and gases etc., so that the metal is converted into an oxide, salt or some other compound.

The rusting of iron takes place, when it is exposed to atmospheric conditions. During this exposure, a layer of reddish scale and powder of oxide is formed and the iron becomes weak. The formation of green film on the surface of the copper takes place, when it is exposed to moist-air containing carbon dioxide. The metals may be corroded as the result of electro-chemical or chemical reactions between a metal surface and the environment.

Various Types of Corrosion and the Reasons :

The corrosion may be broadly classified into following:

1. Direct chemical corrosion (Dry corrosion)

2. Electro-chemical corrosion (Wet corrosion).

1. Direct Chemical Corrosion (Dry Corrosion) :

The corrosion, which involves direct combination between metals and dry gases is known as direct chemical corrosion.

Reason for Dry Corrosion :

Chemical or dry corrosion occurs mainly through the chemical reaction of gases such as oxygen, sulphur vapour, halogens and nitrogen with metal or alloy surfaces in immediate proximity. Some organic and anhydrous inorganic liquids as well as liquid metals may attack directly solid metals. In all these cases the extent of corrosion depends on the chemical affinity between the corrosive environment (either gas or liquid) and solid metals and also upon the ability of metal to form a protective film.

2. Electro-chemical Corrosion (Wet Corrosion) :

The corrosion, which involves the flow of electric current between two dissimilar metals is known as Electrochemical corrosion.

Reason for Wet Corrosion :

This type of corrosion occurs :

i) Where the liquid with metal is conducting

ii) When there exits a difference of potentials either between two dissimilar metals or between different areas on the surface of the metal or alloy.

It progresses due to the existence of anodic and cathodic areas separated by the finite distances between which the current flow

Protection from Corrosion OR Prevention

Control of Corrosion:

The following methods are generally adopted to prevent or control the corrosion of metals :

Suitable Design and Fabrication Procedure:

The corrosion can be prevented by selecting the suitable design and fabrication procedure for a particular shape of the component so that the dissimilar metal contacts should be prevented avoid the presence of cracks avoid sharp corners and recesses proffering the welded joints.

Use of Inhibitors:

An inhibitor is a substance which is added to the electrolyte in small quantity to reduce the rate of corrosion. The inhibitors may organic or inorganic.

Modification of Corrosive Environment:

The rate of corrosion can be greatly reduced by small changes the corroding environment such as changes in **composition, nature temperature. For** example small decrease in temperature causes considerable decrease in the rate of corrosion.

Use of Protective Coating:

Sometimes the protective coating is applied on the base metal prevent the rate of corrosion. The protective coating may be;

Metallic coatings: These can be done by means of the following:

1. Electroplating
2. Dipping
3. Spraying
4. Cladding

5. Cementation.

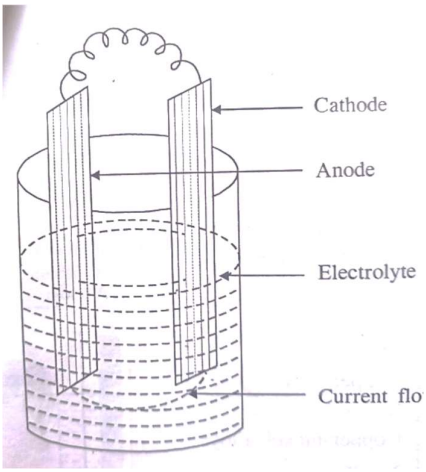
ii) Non-metallic coatings: These can be done by means of the following:

1. Paints and lacquering 2. Plastic coating 3. Vitreous coating 4. Oxide coating 5. Chemical dip coating.6. Use of Cathode Protection

10. (a) Explain the construction and working of electro-chemical cell. 10

Electro-chemical Cell:

The type of corrosion, which involves the flow of electric current between two dissimilar metals, is known as electrochemical corrosion. It takes place at or near the room temperature, because of the react ion of metals which takes place with water or aqueous solution of acids and bases. This phenomenon may be explained with the help of an electrochemical cell as shown in fig.



Construction :

An electrochemical cell, in its simplest form, consists of a vessel containing electrolyte (liquid), two dissimilar electrodes (known as anode and cathode) and a metallic wire connecting the two electrodes as shown in the figure.

Working:

In this cell, the two principal reactions take place one at the cathode and another at the anode. The reactions taking place at the anode (known as anodic reaction) are always oxidation reactions These reactions always tend to destroy the anode metal by causing

it to dissolve in the electrolyte and gets deposited over the cathodic metal and forms the coating over that metal. The reactions taking place at the cathode (known as cathodic reaction) are always reductions reactions. These reactions, usually, do not affect the cathode metal, because most of the metals cannot be reduced further. The electrons, which are produced by the anodic reaction flow through the metal, are used up in the cathodic reaction,

(b) Compare electrolytes and non-electrolytes. List the types of electrolytes. 10

Electrolytes :

Electrolytes are the salts or molecules that ionize completely in solution. As the result, electrolyte solutions are readily conduct electricity.

When electrolyte dissolved in solution, will give that solution the ability to conduct electricity. This is because when a salt dissolves, its dissociated ions can move freely in solution, allowing a charge to flow

Electrolytes are the substances whose aqueous solutions are conductors of electricity and they provide free moving ions to water.

Non-electrolytes:

The substances whose aqueous solutions do not conduct electricity are called non electrolytes. Non-electrolytes do not dissociate into ions in solution

Therefore, non-electrolyte solution do not conduct electricity. Organic compounds are usually non-electrolytes. These compounds do not provide free moving ions to water.

Types of Electrolytes:

Following are the different types of electrolytes:
1. Sodium
2. Potassium
3. Calcium
4. Bicarbonate
5. Magnesium
6. Chloride and phosphate etc.

NOTE: The model answers given for reference to valuers for valuation the valuers may also consider most relevant and suitable sketches and explanations from other prescribed reference books/Text books.

Certified that the Model answers prepared by me for code No.20ME11T are from prescribed text book and model answers and scheme of valuation prepared by me are correct.