1234 **Code : 20ME11T**

Register Number | | | | | | | | | | |

I Semester Diploma Examination, June/July-2023

MATERIALS FOR ENGINEERING

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

Instructions : (1) Answer **one** full question from each section.
(2) **One** full question carries **20** marks.
(3) Answer to be specific & precise.

SECTION – I

1. (a) Define the following Mechanical properties : **10**
   (i) Malleability
   (ii) Ductility
   (iii) Elasticity
   (iv) Toughness
   (v) Creep
   (b) Explain BCC and FCC crystal structures. **10**

2. (a) Select a suitable material for the following : **5**
   (i) Surgical instruments
   (ii) Cutting tools
   (iii) Hand bell
   (iv) Lathe bed
   (v) Kitchen utensils
   (b) List the steps involved in Metallographic specimen preparation. **5**
   (c) Illustrate the working of scanning electron microscope with a neat sketch. **10**

SECTION – II

3. (a) Select relevant cast iron with justification for the following application : 6

   (i) Crank shaft

   (ii) Railway track

   (iii) Cylinder block

   (b) List the desirable properties of Bearing Materials. 5

   (c) What is alloying ? Explain the effect of alloying elements on the proportion of alloy steel. 9

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

   (b) What characteristic features does the tool steel possess ? 4

   (c) How steels are designated ? Indicate the meaning of following designated materials : 6

   (i) Fe 350

   (ii) FG 200

SECTION – III

5. (a) Differentiate metals and non-metals. 8

   (b) Differentiate between brass and bronze. 6

   (c) State the properties & uses of (i) Duralium (ii) Hindalium. 6

6. (a) Which tool steel is used for piercing dies & coining dies ? 4

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

   (c) State the properties of smart materials. 6

SECTION – IV

7. (a) Sketch iron-carbon equilibrium diagram for mild steel. 10

   (b) Compare thermo plastics and thermoset plastics with examples. 10

8. (a) Define ceramics. List its types and state any four applications of it. 10

(b) List the properties and applications of Biomaterials. 10

SECTION – V

9. (a) Define heat treatment. 2

(b) List the purpose of heat treatment process. 8

(c) Explain corrosion with examples. 5

(d) State protection methods used to prevent corrosion. 5

10. (a) Distinguish between electrochemical series and galvanic series. 10

(b) Explain with sketch electroplating. 10

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MATERIALS FOR ENGINEERING

Instructions: (i) Answer one full question from each section.

(ii) One full question carries 20 marks.

SECTION -1

1. (a) 2 marks for each definition 2x5=10 m
   (b) Sketch of BCC 3m & FCC3m & Explanation 4m 3+3+4=10m

2. (a) Selection of suitable material 1m each 1x5= 5m
   (b) List of any five step 1x5= 5m
   (c) Sketch 6m +Explanation 4m 6+4=10m

SECTION -2

3. (a) Selection of suitable material 1m for each + justification 1m each 2x3 = 6m

   (b) Any five properties 1 mark each 1x5 =5m

   (c) Definition 2m +explanation of effect of any 7 alloying elements 7m

   2+7=10m

4. (a) Any 5 properties at 1 mark each +any 5 applications 1 mark each

   5+5=10m

   (b) Any 4 characteristics at 1mark each 1x4=4m

   (c) Steel designation 4m + indicate the meaning 1+1=2m 4+2=6m

SECTION -3

5. (a) Any four difference at 2mark each 2x4=8m

(b) Any 3 difference at 2 mark each 2x3=6m

(c) Any 3 properties at 1 mark each and 3 uses at 1mark each for both materials 3+3=6m

6. (a) 2marks for air hardening+ 2marks for high carbon 2+2=4

(b)Any 5properties at 1m each + any 5 applications at 1m each 5+5=10m

(c) Any 6properties at 1mark each 1x6=6marks

SECTION -4

7. (a) Sketch 7m and labelling 3marks 7+3=10m

(b) Any 5 comparison at 2 marks each 2x5=10 marks

8. (a) Definition 2 marks+ any 4 types at 1 mark each+ any 4 applications at 1mark each 2+4+4=10

(b) Any 5properties at 1 mark each+ any 5 applications at 1 mark each 5+5=10

SECTION -5

9.(a) Definition 2marks.

(b) Any 8 purposes at 1mark each 1x8=8m

(c) Explanation 3m +examples 2 marks 3+2=5m

(d) Any 5 protection methods at 1mark each 1x5 = 5m

10. (a) Any 5 differences at 2 mark each 2x5=10m

(b) Sketch 6marks +Explanation 4 marks 6+4=10m

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MATERIALS FOR ENGINEERING

Instructions: (i) Answer one full question from each section.

(ii) One full question carries 20 marks.

SECTION -1

1(a). Define the following Mechanical Properties. (2x5=10m)

- Malleability :

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

- Ductility

It is that property of the metal by virtue of which a metal can be drawn into wires or elongated

- Elasticity :

It is that property of the metal by virtue of which the metals are able to regain their original

- Toughness :

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

- Creep :

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

(b) Explain BCC and FCC crystal structures. (6+4=1 0m)

Body centered cubic (BCC): It is a Centered cube with 9 atoms of which 8 are located at the corners of the cube and the 9th at the center. This type of lattice is found in the following metals barium, chromium, columbium, iron, molybdenum, tungsten, vanadium.

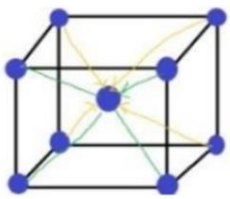


Fig: BCC

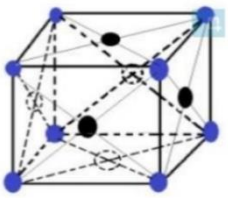


Fig: FCC

Face centered cubic (FCC): It has 14 atoms of which 8 are located at the corners of the cube and 6 at the centers of the six faces. This lattice has a more compact packing of the atoms than the preceding one. This type is typical of the metals are aluminum, Copper, Gold, lead, nickel, Platinum, silver.

2(a). Select the suitable material for the following: (1x 5=5m)

- Surgical instruments : Carbon steel , Stainless steel and Aluminum or titanium
- Cutting tools : high speed steel and diamond
- Hand Bell : Brass or Bronze and Copper , clay other hardware material
- Lathe Bed : Cast iron and Mild steel
- Kitchen utensils : Aluminum , Stainless steel and Glass

(b) List the steps involved in Metallographic specimen preparation (1x5=5m)

a. Sectioning

b. Mounting

c. Grinding

d. Polishing

e. Etching

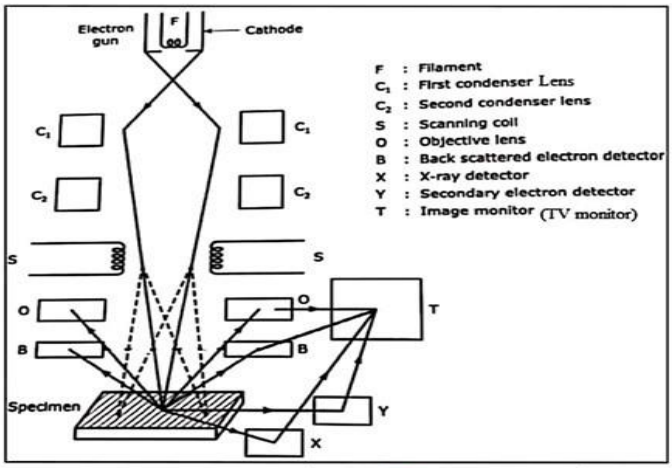
(c) Illustrate the working of scanning electron microscope with neat sketch.

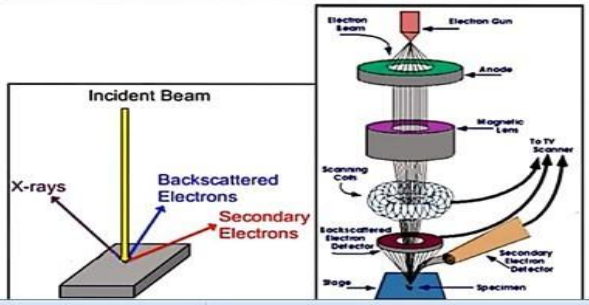
(6+4 =1 0m)

A scanning electron microscope(SEM) is a type of electron microscope which is used to produce images of a metallographic sample. These images are later studied and analyzed to interpret the topography, crystallographic structure, composition ofthe specimen basically consists of:

Electron gun Condenser
LensesScan coils
Detectors Sample
Chamber

A high energy beam is produced using an electron gun. Electron beam thusproduced is focused using a series of condenser lenses as it moves from the source towards the specimen. Focusing is essential to obtain a narrower electronbeam which helps in scanning the specimen.





SECTION – 2

3(a) Select the relevant cast iron with justification for the following application; (2 x3 =6)

- Crank shaft: Nodular cast iron, its ductile and good wear resistance and vibration damping capacity.
- Railway track: Malleable cast iron or white cast iron, they have high strength, resistance to wear and toughness .
- Cylinder block: Grey cast iron, it possesses the lowest melting point. It has no ductility

(b) List the desirable properties of bearing Materials.(1x 5= 5)

Properties of Bearing Materials

It should have low coefficient of friction.

It should have good wearing qualities.

It should have ability to withstand bearing pressures.

It should have ability of operate satisfactorily with suitable lubrication means at the maximum rubbing speeds.

It should have a sufficient melting point.

It should have high thermal conductivity.

It should have good casting qualities.

It should have minimum shrinkage after casting.

It should have non-corrosive properties.

It should be economical in cost.

(c) What is alloying? Explain the effect of alloying elements on the proportion of alloying steel. (2+7 =9m)

Alloy: Alloy may be defined as steel to which elements other than carbon are added in sufficient amount to produce an improvement in properties.

The various alloying elements affect the properties of steel as follows:

1. Silicon: The amount of silicon in the finished steel usually ranges from 0.05 to

0.30 %. Silicon is added in low carbon steels to prevent them from becoming porous. It removes the gases and oxides, prevent blow holes and thereby makes the steel tougher and harder. Higher % of silicon gives rise to corrosion resisting

2. Manganese: It serves as a valuable deoxidizing and purifying agent, in steel. Manganese also combines with sulphur and thereby decreases the harmful effect of this element remaining in the steel. When used in ordinary low carbon steels, manganese makes the metal ductile and of good bending qualities. In high speed steels, it is used to toughen the metal and to increase its critical temperature. The manganese content of carbon steels commonly ranges from 0.30 to 1.00 %.

3. Nickel: It improves toughness, tensile strength, and ductility and corrosion resistance.

4. Chromium: It increases strength, hardness, toughness, and corrosion resistance.

5. Cobalt: It improves hardness, toughness, tensile strength, thermal resistance, and magnetic properties.

6. Molybdenum: It increase wear resistance, thermal resistance, hardness ability to retain mechanical properties as elevated temperature. When added with nickel, it improves corrosion resistance.

7. Tungsten: It increases hardness, toughness, wear resistance, shock resistance, magnetic reluctance and ability to retain mechanical properties at elevated temperature.

8. Vanadium: It improves tensile strength, elastic limit, ductility, shock resistance and also acts as a degasser when added to molten steel. It is added in low and medium carbon steels in order to increase their yield tensile strength properties.

9. Boron: It increase hardenability and is therefore, very useful when alloyed with low carbon steels.

10. Aluminium: It is basically used as a deoxidizer. It improves the growth of fine grains and helps in providing a high degree of hardness through nitriding by forming

aluminium nitrides.

11. Titanium: It is fairly good deoxidizer and promotes grain growth. Also, forms titanium carbides but has no marked effect on the hardenability of the material.

12. Copper: It increases the strength and improves resistance to corrosion. Its proportion normally varies from 0.2% to 0.5%.

13. Niobium: It improves ductility, decrease hardenability and substantially increases the impact strength

4 (a) Discuss the properties and Applications of copper. (5+5=10)

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

Applications

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) what characteristic features does the tool steel possess ? (1x4=4m)

- Wear resistance
- Heat resistance
- Toughness
- High Hardness

(c) How steels are designated? indicate the meaning of following designated materials: (4+2=6m)

(i) Fe 350

(ii) FG 200

Steels are designated by a group of letters are numbers indicating anyone of the following three properties

1. Tensile strength
2. Carbon content
3. Composition of alloying elements.

Steel, which are standardized based on the tensile strength without detailed chemical composition are specified in two ways- a symbol Fe followed by the minimum tensile strength in N/mm^2. Another method is FeE steel followed by the yield strength in N/mm^2.

(i) Fe350-this indicates steel with a tensile strength of 350 Newton per mm square.

(ii) FG200-Grey cast iron with a minimum tensile strength of 200 N/mm^2

Section – 3

5. Differentiate metals and Non metal (4x2=8m)

Difference between Metals and Non Metals

Sl. No.	Property	Metals	Non-Metals
1.	Structure	All metals are having crystalline structure	All Non-metals are having amorphic & mesomorphic structure
2.	State	Generally metals are solid at normal temperature	State varies material to material. Some are gas state and some are in solid state at normal temperature.
3.	Valance electrons and conductivity	Valance electrons are free to move within metals which makes them good conductor of heat & electricity	Valence electrons are tightly bound with nucleus which is not free to move. This makes them bad conductor of heat & electricity
4.	Density	High density	Low density
5.	Strength	High strength	Low strength
6.	Hardness	Generally hard	Hardness is generally varies
7.	Malleability	Malleable	Non malleable
8.	Ductility	Ductile	Non ductile
9.	Brittleness	Generally non brittle in nature	Brittleness varies material to material
10.	Luster	Metals possess metallic luster	Generally do not possess metallic lustre (Except graphite & iodine)

(b) Differentiate between brass and bronze. (2x3=6m)

Sl. No.	Brass	Bronze
1	It is an alloy of copper and zinc	It is an alloy of copper and tin
2	Composition: 55 to 95% Copper 5 to 45% Zinc	Composition: 75 to 95% Copper Up to 12% Tin
3	It is golden yellowish in colour	It is reddish brown in colour
4	It has high malleability	It has high ductility
5	It is not ferromagnetic	It is non-magnetic
6	It is used in making musical instruments, Costume jewellary, fashion jewellary, etc	It is used in making sculpture, Bearings, bells, electrical connectors and springs
7	It possesses good mechanical properties and corrosion resistance.	It possesses superior mechanical properties and corrosion resistance to brass.

(c) state the properties & uses of (i) Duralium (ii) Hindalium. (3+3=6m)

1. Duralumin

It contains 3.5% to 4.5% copper, 0.4% to 0.7% manganese, 0.4% to 0.7% magnesium and remainder is Aluminium

Properties: Duralumin can be very easily forged, casted and worked because possesses low melting point. It has high tensile strength, comparable with mild steel combined with the characteristics lightness of Al. It however possesses low corrosion resistance and high electrical conductivity.

Uses: This alloy possesses higher strength after heat treatment and age hardening. After working, if this alloy is age hardened for 3 or 4 days. This phenomenon is known as age hardening. It hardens spontaneously when exposed to room temperature. This alloy is soft enough for a workable period after it has been quenched. It is light in weight as compared to its strength in comparison to other metals. It can be easily how worked at a temperature of 500°C. However after forging and annealing, it can also cold worked.

Hindalium

Properties: Hindalium is a common trade name of aluminium alloy. It is an alloy of aluminium, magnesium, manganese, chromium and silicon etc. In India, it is produced by Hindustan Aluminium Corporation Ltd., Renukoot (U.P.). Hindalium is commonly produced as a rolled

product in 16 gauges. Utensils manufactured by this alloys are strong and hard, easily cleaned, low cost than stainless steels, having fine finish, having good scratch resistance, do not absorb much heat etc.

Uses: Hindalium is mainly used for manufacturing anodized utensil. Utensils manufactured by this alloys are strong and hard, easily cleaned, low cost than stainless steels, having fine finish, having good scratch resistance, do not absorb much heat etc.

6. (A) which tool is used for piercing dies & coining dies? (2+2=4m)

AIR-HARDENING COLD-WORK STEELS (SYMBOL A):

- Air-hardening cold-work steels are hardened by air cooling.
- These steels contain Carbon (1.0%) with manganese, chromium & Molybdenum & tungsten.
- These are characterized by high wear resistance & high harden ability, fair Red hardness, good toughness & resistance to decarburization.
- Tempering temperature for these steels varies from 150- 425°C. Applications are Knives, Blanking & trimming dies and coining dies.

HIGH-CARBON, HIGH-CHROMIUM COLD-WORK STEELS (SYMBOL D):

- High-carbon, high-chromium cold-work steels are hardened by oil- or air hardening.
- These steels contain Carbon is 1.4-2.3% & Chromium is 12-14%, with Molybdenum, cobalt, vanadium.
- These are characterized by high hardness, wear & abrasion resistance.
- Tempering temperature for these steels varies from 150- 375°C.
- Applications are Mandrel for tube rolling by Pilger rolls, Blanking & piercing dies, Drawing dies.

(b) Explain composite materials with its properties and applications. (5+5=10m)

A composite material is made from two or more constituent materials with significantly different physical or chemical properties, that when combined, produce a material with

characteristics different from the individual components. The individual components remain separate and distinct within the finished structure.

Properties

The properties are

- High strength to weight ratio
- Higher stiffness to weight ratio
- Improved fatigue resistance
- Improved corrosion resistance,
- Higher resistance to thermal expansion
- Excellent optical and magnetic properties Combination wear resistance and fracture toughness
- Reduced space

Applications

Aerospace Thermoset composites are being specified for wings, fuselages, bulkheads, and other applications in commercial, civilian and military aerospace applications.

Thermoset composite are being used in frames, equipment panels, handles and trims in appliances, power tools, business equipment and many other applications

Thermoset composites for the appliance industry are used in washers, dryers refrigerators, freezers ranges, ovens, dishwashers for components that include control panels, handles, knobs, vent trims, side trims, motor housings, kick plates and many

Appliance/Business

Automotive/Transportation/Farm/Construction

Composites are now being used in vehicle and equipment applications, including, panels, frames, interior components and other parts.

Civil Infrastructure

Some composite infrastructure applications include buildings, roads, bridges and plings

Construction

Thermoset composites are replacing many traditional materials for home and offices architectural components including fixtures, doors, wall panels, roofing, window frames, moulding, vanity sinks, shower stalls and even swimming pools. Corrosive Environments

Composites are ideal for applications in corrosive environments, such as chemical processing plants, pulp and paper converting oil and gas refineries and water treatment facilities. Common applications include fans, grating tanks, ducts, hoods, pumps and cabinets. Electrical

With strong dielectric properties including are and track resistance. Thermoset components include substation equipment, microwave antennas, standoffs and pole line hardware and printed wiring boards. Applications and components include switchgear, motor controls, standoff insulators, control system components, circuit breakers, arc chutes, arc shields, terminal blocks, terminal boards, metering devices, bus supports and lighting components.

Marine

With their corrosion resistance and light-weighting attributes, Marine composite applications include boat hulls, bulkheads and other components for military, commercial and recreational boats and ships.

(c) state the properties of smart materials.(1x6=6m)

Smart materials are one of the unique materials and general characteristics of all this materials are common that is their behavior are significant property can be altered, reversed are controlled under the influence of external impetus. The smart material may be defined as the material which react to its environment on its own the reaction may exhibit itself as a changing volume, color, viscosity, odour and this may occur in response to a change in temperature, stress, electric current PH or magnetic field.

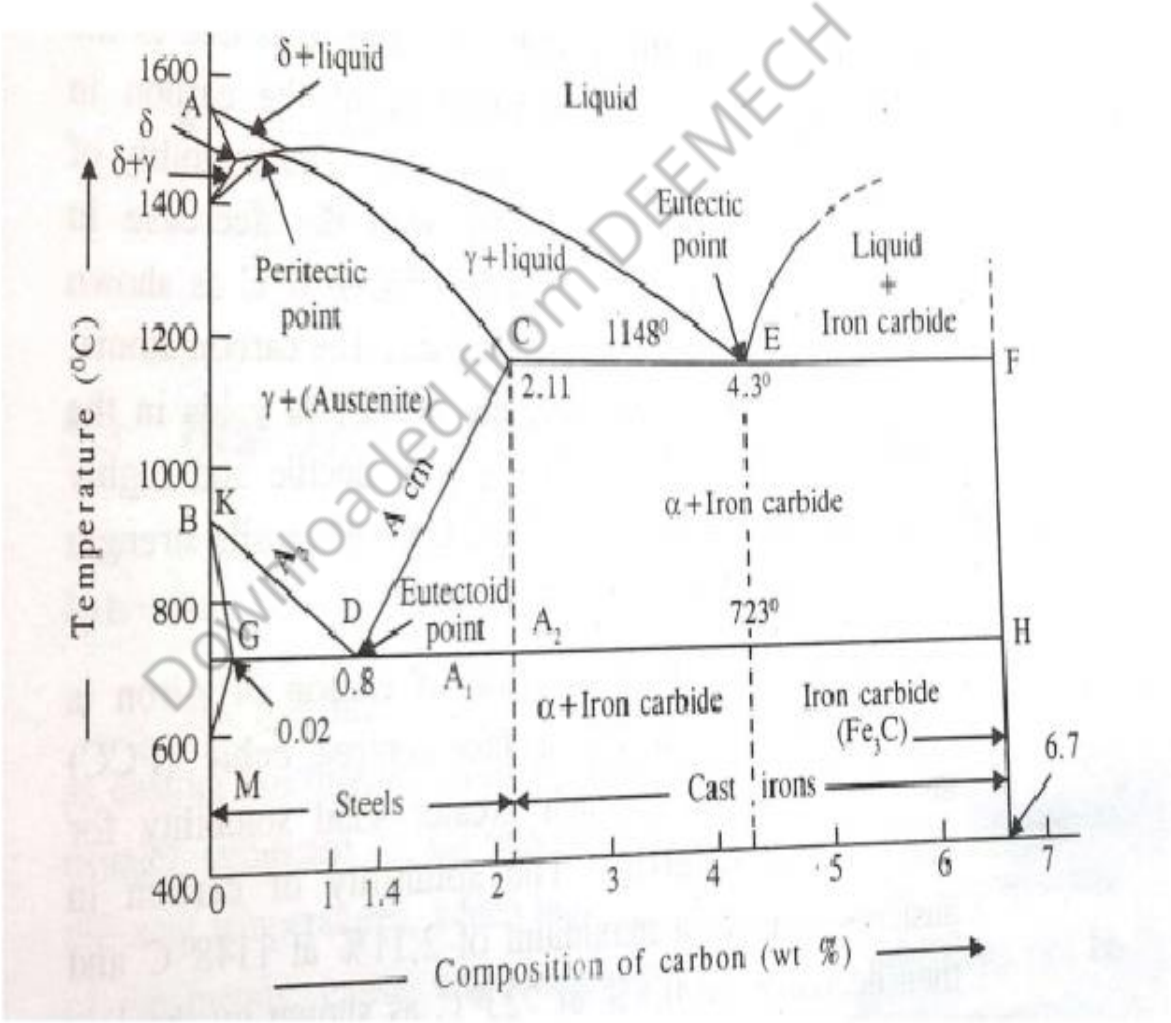
Properties

- Self-detection
- Self-diagnostic
- Self-corrective
- Self-controlled
- Self-healing
- Shock-absorbers and damage arrest

Section-4

7. (a) sketch iron-carbon equilibrium diagram for mild steel. (7+3=10m)

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



(b) compare thermos plastics and thermoset plastics with examples. (2x5=10m)

Property	Thermoplastics	Thermosetting plastics
Action of heat	They soften on heating and set on cooling every time	They set on heating and cannot be resoftened.
Type of bonding Between adjacent polymer chains	The polymer chains are held together by weak force called Vander Waal's force of attraction.	The polymers chains are linked by strong chemical bonds. (covalent bonds)
Solubility	They are soluble in organic solvents.	They are insoluble in organic solvents.
Expansion due to heating	They expand very much on heating.	Their expansion is only marginal due to heat.
Type of polymerisation	They are formed by addition polymerization	They are formed by condensation polymerization
Type of moulding	They are processed by injection moulding.	They are processed by compression moulding.
Scrap recovery	Scarp can be reused.	Scarp cannot be reused.
Example	Polythene, PVC, Nylon	Bakelite, Plaskon

8. (a) Define ceramics. List its types and state any four applications of it. (2+4+4=10m)

Ceramic materials are inorganic, non-metallic materials made from compounds of a metal and a nonmetal.

Types of ceramics: Classification of ceramics based on their specific applications and composition.

Based on their composition, ceramics are classified as:

1. Oxides,

2. Carbides,

3. Nitrides,

4. Sulphides

5. Fluorides, etc.

Based on their application, such as:

1. Glasses

2. Clay products

3. Refractories

4. Abrasives

5. Cements

6. Advanced ceramics

Applications of Ceramics:

Ceramic materials display a wide range of properties which facilitate their use in many different product areas.

1. Aerospace: space shuttle tiles, thermal barriers, high temperature glass windows, fuel cells.

2. Consumer Uses: glassware, windows, pottery, Corning“ ware, magnets, dinnerware, ceramic tiles, lenses, home electronics, microwave transducers.

3. Automotive: catalytic converters, ceramic filters, airbag sensors, ceramic rotors, valves, spark plugs, pressure sensors, thermistors, vibration sensors, oxygen sensors, safety glass windshields, piston rings.

4. Medical (Bio-ceramics): orthopedic joint replacement, prosthesis, dental restoration, bone implants.

5. Military: structural components for ground, air and naval vehicles, missiles, sensors.

6. Computers: insulators, resistors, superconductors, capacitors, ferroelectriccomponents, microelectronic packaging.

7. Other Industries: bricks, cement, membranes and filters, lab equipment.

8. Communications: fiber optic/laser communications, TV and and radio components, microphones.

(b) List the properties and applications of Biomaterials. (5+5=10m)

Properties

1. Biocompatibility

a. Non-toxic,

b. Non-allergenic,

c. blood compatible,

d. non-inflammatory tera Lomah od n

e. Non-carcinogenic,

f. Non-pyrogenic

2. Sterilizability 195

a. Not destroyed by typical sterilizing techniques such as autoclaving, dry heat, radiation, ethylene oxide

3. Physical characteristics

a. Strength,

b. elasticity,

c. durability

4. Manufacturability

a. Machinable

b. moldable

c. extrudable

Applications of Biomaterials

Biomaterials are used in:

1. Joint replacements

2. Bone plates

3. Bone cement

4. Artificial ligaments and tendons

5. Dental implants for tooth fixation

6. Blood vessel prostheses

7. Heart valves

8. Skin repair devices

9. Cochlear replacements

10. Contact lense

Section-5

9. (a) Define heat treatment. (2marks)

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.

(b) List the purpose of heat treatment process.(1x8=8)

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.

(c) Explain corrosion with examples. (3+2=5m)

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 electrochemical or chemical reactions between a metal surface and the environment.

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):

(d) State protection methods used to prevent corrosion. (1x5=5m)

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

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.

10. (a) Distinguish between electrochemical series and galvanic series. (2x5=10m)

Electrochemical series

1. Electrode potentials are measured by dipping pure metals in their salt solution of IM concentration, without any oxide films on them.

2. The position of a metal in electrochemical series is fixed.

3. It gives no information regarding the positions of alloys.

4. The position of metal is permanently fixed in this series.

5. This series comprises of metals and non-metals.

6. It predicts the relative displacement tendencies.

7. It is absolute.

8. It is quantitative.

9. it is a series only for pure metals.

10. It is used for theoretical calculations.

Galvanic series

1. This series was developed by studying corrosion of metals and alloys in unpolluted sea-water, without their oxide films, if any removed.

2. In galvanic series, the position of a given metal may shift.

3. Their corrosion can be studied from this series since alloys are included in galvanic series

4. The position of metal, when present in the form of an alloy, is different from that of pure metal.

5. This series comprises of metals and alloys.

6. It predicts the relative corrosion tendencies.

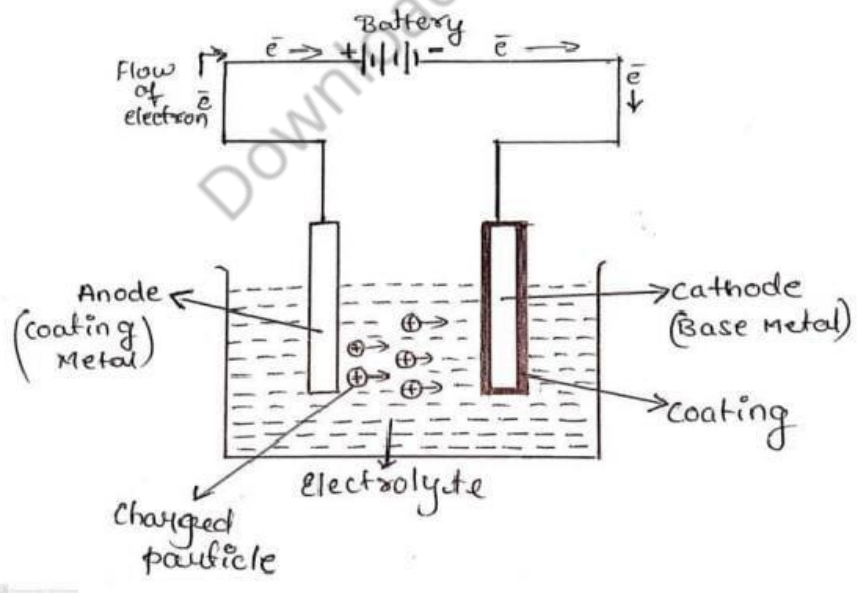
7. It is relative.

8. It is qualitative.

9. It is a series for pure metals and alloys also.

10. It is used for practical applications.

(b) Explain with sketch electroplating. (6+4=10m)



Electroplating is a process in which electric current is used to deposit a thin layer of metal coating over a base metal in an electrolyte solution containing dissolved salt of coating metal.

It consists of battery, electrolyte solution and two electrodes. The two electrodes are base metal electrode and coating metal electrode. Both the electrodes are dipped in electrolyte solution in which coating metal electrode act as anode and base metal electrode act as cathode. Anode is connected to positive terminal of the battery and cathode is connected to the negative terminal of the battery. When the current is passed metal at anode starts dissolving in the solution due to anodic reaction and the dissolved metal starts depositing on the cathode. The thickness of coating depends upon the time up to which the current is passed. Commonly used metals for coating are copper, nickel, silver, gold etc.

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