Register Number :

QP-Code : 20ME11T

Makeup Examination Nov/Dec - 2022

I Semester Diploma Examination

MATERIALS FOR ENGINEERING (20ME11T)

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

Instruction: i) Answer ONE full question from each section.

ii) One full question carries 20 marks.

SECTION – I

1. (a) List any five applications of Engineering materials. (5)
   (b) Explain Face Centre Cubic (FCC) structure. (5)
   (c) List any five Mechanical properties of metals. (5)
   (d) Show the various parts of Transmission Electron Microscope with the help of diagram. (5)

2. (a) List any five types of corrosion. (5)
   (b) Show any two differences between electrolyte and non-electrolyte also list any three types of electrolytes. (5)
   (c) Explain the working of electrochemical cell with the help of diagram. (5)
   (d) Analyze surface coating through electrolysis with the help of setup diagram. (5)

SECTION-II

3. **(a)** Mention the classification of Alloy steel. (6)

   (b) Indicate the meaning of following designations. (6)
   (i) FeE250 (ii) 65C4 (iii) Fe200

   (c) Mention the type of Steel used for following applications and justify your answer. (8)
   (i) Shaft (ii) Bolts & Nuts

OR

4. **(a)** List different types of Stainless steel. (4)

   (b) Explain Nodular Cast Iron with a sketch showing the graphite appearance. (6)

   (c) Suggest a type of tool steel for making following tools. Also mention their properties. (10)
   i) Lathe tools & Drill bits ii) Blanking dies

SECTION – III

5. (a) Difference between Ferrous and Non-Ferrous metals. **(10)**
   (b) State any five properties and uses of Brass. **(10)**

6. (a) List Nickel alloys and explain properties and applications of Nickel. **(10)**
   (b) Mention the types of bearing materials. Explain any six properties. **(10)**

SECTION – IV

7. a) List any four applications of smart materials **(4)**
   b) Differentiate between thermosetting and thermoplastic materials **(10)**
   c) Suggest an advanced material for medical application, justify **(6)**

8. a) List any four applications of nano materials **(4)**
   b) Sketch Iron-Carbon equilibrium diagram indicating various phases **(10)**
   c) What are the different types of heat treatment process **(6)**

SECTION – V

9. (a) State the purpose of heat treatment. **(6)**
   (b) Discuss Annealing and hardening heat treatment processes. **(8)**
   (c) Differentiate between Carburising and Nitriding heat treatment processes **(6)**

10. (a) List the different types of corrosion. **(5)**
    (b) With neat sketch explain Electroplating process. **(10)**
    (c) What are electrolytes? And mention different types of electrolytes. **(5)**

Makeup Examination November/December- 2022
I semester Diploma examination
MATERIALS FOR ENGINEERING (20ME11T)

Scheme and answer

Course: Materials for Engineering **Course Code: 20ME11T**

Q. NO.		QUESTION	MARKS
SECTION - 1			
1.	**a**	Any general five applications	5*1=5M
	b	Brief explanation Figure	3M 2M
	c	Any five properties	5*1=5M
	d	Simple diagram with labels	5M
2	**a**	Any five types	5*1=5M
	b	Two differences Three types	2M 3M
	c	Brief explanation Diagram	2M 3M
	d	Brief explanation Setup diagram	2M 3M
SECTION - 2			
3	**a**	Mention the classification of Alloy Steel	1*6=6M
	b	Writing the designation for (i) + (ii) + (iii)	2+2+2=6M
	c	i) Mentioning the Steel type + Justification ii) Mentioning the Steel type + Justification	(2+2) + (2+2) = 8M
4	**a**	Listing the different types of Stainless steel	1*4=4M
	b	Sketch + explanation for Nodular cast iron	3+3=6M
	c	(i) Mentioning the type of Tool steel + Properties (ii) (ii) Mentioning the type of Tool steel + Properties	(2+3) + (2+3) = 10M
SECTION - 3			
5	**a**	Any 5	5*2=10M
	b	Any 5 Properties 5 Any 5 Uses 5	5*1=5M 5*1=5M
6	**a**	List any 4 Any 4 Properties Any 4 Applications	1/2*4=2M 4*1=4M 4*1=4M

	b	Types of Bearing Materials Any 6 Properties of Bearing Materials	4*1=4M 6*1=6M
SECTION - 4			
7	**a**	Any four applications	1*4=4M
	b	Any 5 points of Thermosetting Any 5 points of Thermoplastics	1*5=5M 1*5=5M
	c	Suggest Justify	3M 3M
8	**a**	Any four applications	1*4=4M
	b	Sketch Iron-Carbon equilibrium diagram indicating various phases	5+5=10M
	c	Any 6 types	6M
SECTION - 5			
9	**a**	State the purpose of heat treatment.	6M
	b	Discuss Annealing and hardening heat treatment processes.	4+4=8M
	c	Differentiate between Carburising and Nitriding heat treatment processes.	3+3=6M
10	**a**	List the different types of corrosion.	5M
	b	With neat sketch explain Electroplating process.	4+6=10M
	c	Definition and mentioning different types of electrolytes.	5M

SECTION – 1

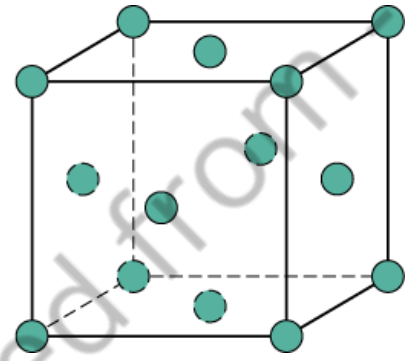
1(a) List any five applications of engineering materials.

Applications of Engineering Materials are as follows:

- Steel materials are used for production of bars, channels, machineries etc.
- Steel alloys are used for tools, dies, automobile parts etc.
- Copper is used in wires, heating element, etc.
- Aluminium is used for windows, frames, domestic articles etc.
- Used in construction.
- Used in vehicles, ships and airplanes.
- Used in electronic equipment.

1(b) Explain Face Centre Cubic (FCC) structure.

- In FCC type of structure, the unit cell which is in the shape of a cube contains one atom at each of its 8 corners and one atom at the centre of each of its face.
- This type of structure does not contain any atom at the centre of the unit cell.
- In this type each unit cell shares 14 (8+6) atoms, with the neighbouring unit cells.
- This type of unit cell is found in metals like γ-iron (910° C to 1440° C), Copper, Silver, Gold, Aluminium, Nickel, Lead and Platinum, etc.

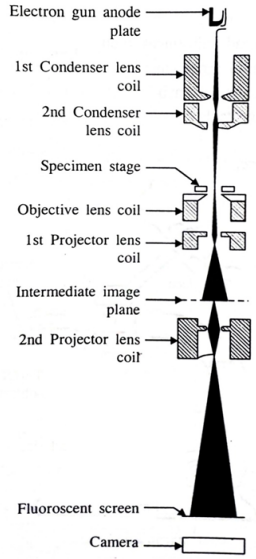


1(c) List any five Mechanical properties of metals.

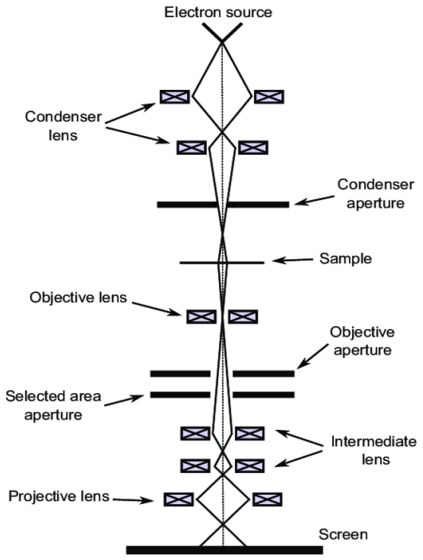
- Elasticity
- Plasticity
- Ductility
- Brittleness
- Hardness
- Toughness
- Stiffness
- Resilience
- Malleability
- Creep
- Endurance
- Strength

1(d) Show the various parts of Transmission Electron Microscope with the help of diagram.

Transmission Electron Microscope:



OR



2(a) List any five types of corrosion.

- Uniform corrosion
- Pitting corrosion
- Intergranular corrosion
- Stress corrosion
- Crevice corrosion
- Season corrosion
- Fatigue corrosion
- Atmospheric corrosion
- Erosion corrosion
- Under-ground corrosion
- Fretting corrosion
- Selective corrosion.

2(b) Show any two differences between electrolyte and non-electrolyte also list any three types of electrolytes.

Differences between electrolyte and non-electrolyte:

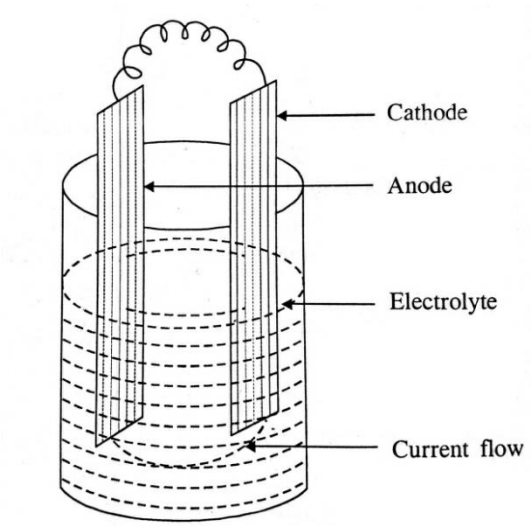
Sl No	Electrolyte	Non-electrolyte
1	Electrolytes are chemical compounds that conduct electricity when dissolved in an aqueous solution.	Non-electrolytes are chemical compounds that do not conduct electricity when dissolved in an aqueous solution.
2	They have ionic bond.	They have covalent bond.
3	Ions are present.	Ions are not present.
4	Example: Acids, Bases and Salts, etc.	Example: Sugar, glucose, ethyl alcohol, urea, etc.

Following are the different types of electrolytes:

- Sodium
- Potassium
- Calcium
- Bicarbonate
- Magnesium
- Chloride and phosphate etc.

2(c) Explain the working of electrochemical cell with the help of diagram.

Electrochemical cell:

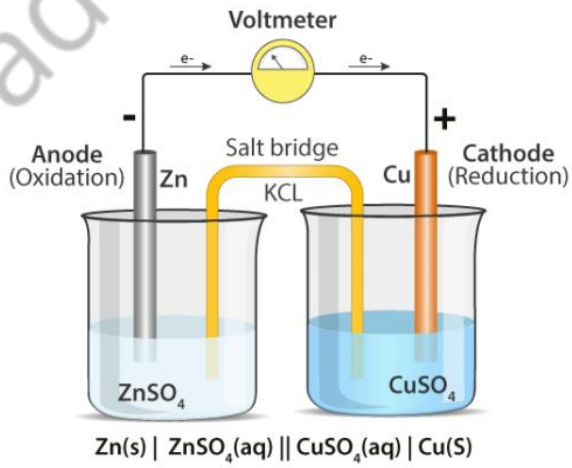


Working of an Electrochemical Cell:

- 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.

OR

Electrochemical cell:



Working of an Electrochemical Cell:

- Let us use the redox reaction given below to explain the construction of an Electrochemical Cell.

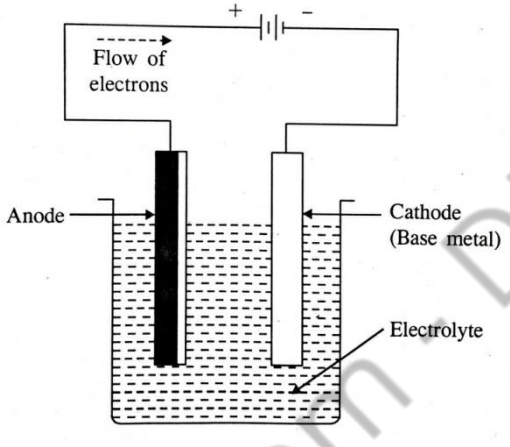
- $Zn(Solid) + CuSO^4(Aqueous) \rightarrow ZnSO^4(Aqueous) + Cu\ (Solid)$
- The ionic form of the reaction is: $Zn + Cu^2 + Zn^{2+} + Cu$

This reaction can be split into the following two half reactions.

i. Oxidation half reaction: $Zn \rightarrow Zn^{2+} + 2e^-$
ii. Reduction half reaction: $Cu^{2+} + 2e^- \rightarrow Cu$

- The oxidation reaction in the zinc rod releases two electrons.
- These two electrons are taken by the Copper ion in the copper sulphate solution.
- If these two half reactions can be separated, then the electrons can be made to move through a wire.
- In this manner we can produce electrical energy from chemical energy.
- The salt bridge is a concentrated solution of inert electrolytes.
- It is required for completing the circuit. It allows the movement of ions from one solution to the other.

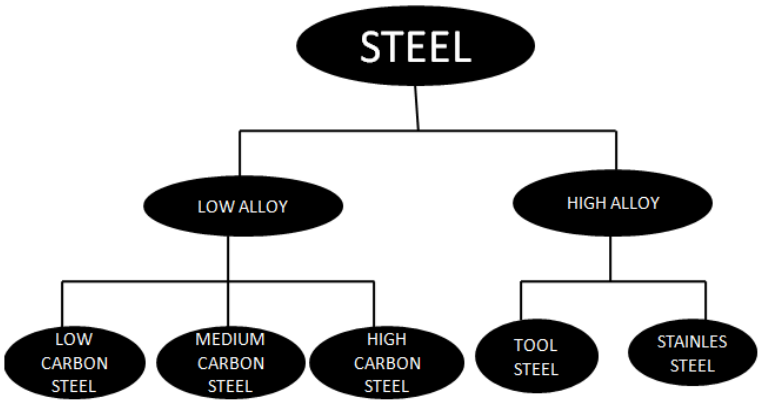
2(d) Analyze surface coating through electrolysis with the help of setup diagram.
Surface Coating through Electrolysis - Setup:



- It is a process of depositing a very thin layer of metal coating, on the base metal by passing the direct current through an electrolyte.
- Solution containing some salt of a coating metal.
- In this process, the component of base metal is made to act as a cathode whereas the coating metal as an anode in a solution containing some salt of coating metal i.e. electrolyte as shown in fig.
- Now direct is passed for a known time to obtain the coating of desired thickness on a base metal.
- When the current is passed the metal at the anode starts dissolving in the solution due to the anodic reaction, the dissolved metal (electrolyte) gets deposited over the base metal at the cathode.
- The thickness of coating is depends upon the time up to which the current is passing.
- The commonly used metals, which are used as a protective coating i.e. electrolyte are copper, nickel, silver, gold, chromium, cadmium and tungsten etc.

SECTION – 2

3 (a) Mention the classification of Alloy steel.



3 (b) Indicate the meaning of following designations.
(i) FeE250 (ii) 65C4 (iii) Fe200

(i) FeE250 : Steel with a Yield strength of 250 N/mm^2

(ii) 65C4 : Plain carbon steel with 0.65% Carbon and 0.04 % Manganese

(iii) Fe200 : Steel with Tensile strength of 200 N/mm^2

3 (c) Mention the type of Steel used for following applications and justify your answer.
(i) Shaft (ii) Bolts & Nuts

(i) Shaft

Mild or low-carbon steel is used for shafts.

Low carbon steel has following desirable properties for making Shafts.

- High fatigue strength.
- Good machinability.
- High Ductility
- Outstanding toughness.

(ii) Bolts & Nuts

Low carbon steel *OR* Stainless Steel is used for Bolts & Nuts.

Low carbon steel has following desirable properties for making **Bolts & Nuts**.

- High fatigue strength.
- Good machinability.
- High Ductility
- Outstanding toughness

Stainless Steel has following desirable properties for making Bolts & Nuts:

- Great resistance to corrosion
- Good Torsional strength
- Good surface hardness
- Superior strength and toughness

OR

4(a) List different types of Stainless steel.

Following are the different types of Stainless steel;

(i) Austenitic Stainless Steels

(ii) Martensitic Stainless Steels
(iii) Ferritic Stainless Steels
(iv) Low Chromium Stainless Steels

4(b) Explain Nodular Cast Iron with a sketch showing the graphite appearance.

Characteristics

- Graphite appears as rounded particles or Nodules or Spheroidal
- The properties of nodular cast iron depend upon the metal composition and the cooling rate.
- It possesses very good machinability
- Soft annealed grades of nodular cast iron can be turned at a very high feeds and speeds.
- Nodular cast iron contains
  - 3.2 - 4.2% Carbon (C)
  - 1.1 - 3.5% Silicon (Si)
  - 0.3 – 0.8% Manganese (Mn)
  - 0.08% Phosphorus (P) and
  - 0.2% Sulphur (s)
- It possesses excellent damping capacity, castability and wear resistance

Applications:

1. Crank Shaft
2. Pipes
3. Spindle
4. Hypoid axle gears
5. Tractors

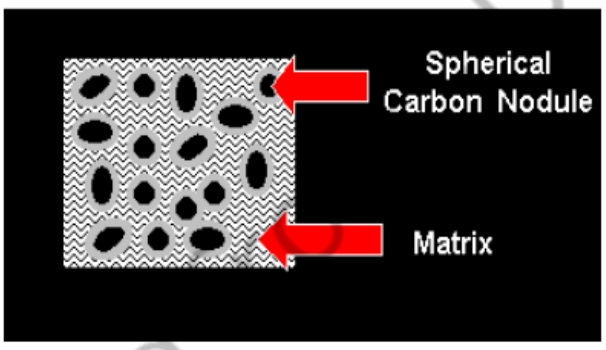


Figure: Nodular Cast Iron and the spherical carbon embedded into the matrix.

4 (c) Suggest a type of tool steel for making following tools. Also mention their properties.

i) Lathe tools & Drill bits ii) Blanking dies

Application	Type of Tool Steel	Properties
(i) Lathe tools & Drill bits	High-speed tool steels	High hardness High red hardness Wear resistance Reasonable toughness and good hardenability
(ii) Blanking dies	Cold work tool steels	very high abrasion and wear resistance higher toughness higher impact resistance

Section-3

5a. Difference between Ferrous & Non-Ferrous metals

Sl no	Ferrous Metals	Non-Ferrous metals
1	Ferrous indicates the presence of iron in a bivalent state.	Non-ferrous metals do not contain any iron.
2	As ferrous contains iron, it shows magnetic feature.	Non-ferrous metals don't show any magnetic feature which means it's non-magnetic.
3	Ferrous metals are less resistant to corrosion.	Non-ferrous metals are more resistant to corrosion
4	One special feature of ferrous metals is it possesses high tensile strength and durability.	One special feature of non-ferrous metals is their malleability.
5	Ferrous metals can be oxidized.	Non-ferrous metals cannot be oxidized.
6	Ferrous metal includes mild steel, carbon steel, stainless steel, cast iron and wrought iron.	Non-ferrous metals includes Aluminium, copper,Nickel, zinc etc.
7	Ferrous metals make up the most recycled materials in the world.	As per the recycling goes, many non-ferrous materials are relatively scarce.
8	Used where Strength is the Primary focal point.	Ideal for electronics & Electrical applications.
9	The price of ferrous metal tends to be lower.	Prices of non-ferrous metals are greater than ferrous metals.

5b. State any five properties and uses of Brass.

Brass is an alloy of copper and zinc, in which zinc is the principle alloying metal.

Properties of Brass:

i. Brass often has a bright gold appearance; however, it can also be reddish-gold or silvery-white. A higher percentage of copper yields a rosy tone, while more zinc makes the alloy appear silver.
ii. Brass has higher malleability than either bronze or zinc.
iii. Brass has desirable acoustic properties appropriate for use in musical instruments.
iv. The metal exhibits low friction.
v. The alloy has a relatively low melting point ranges from 800^0 C to 1000^0 C.
vi. It's a good conductor of heat & have low thermal and electrical conductivity
vii. Brass is easy to cast & can be easily fabricated.
viii. It has a greater strength than the copper.
ix. It has a good corrosion resistance.
x. It is soft and ductile.
xi. It is non-magnetic.

Applications/Uses of Brass:

i. It is used for hydraulic fitting and pump linings.
ii. Used for making utensils.
iii. Used for making bearings and bushes etc.
iv. Used for valves, automobile fittings, type writer parts.
v. Used for musical instruments.
vi. Used for cold rolled sheets, wire drawing pressing,
Vii For tube and plate manufacturing.

.

6a. List Nickel alloys and explain properties and applications of Nickel.

Nickel Alloys

i.Monel ii Iconel iii Nichrome iv Nimonic

Properties:

i. Nickel is a silvery white metal capable of taking a high polish.
ii. Its specific gravity is 8.85 and its melting point is 1452^0 C.
iii. It is hard material.
iv. When it contains small amount of carbon, it is malleable.
v. It can be easily rolled.
vi. It resists the attacks of most of the acids.
vii. It dissolves readily in Nitric acid.
i. Small amount of magnesium improves the ductility considerably.

Applications

- It is used as an alloying metal in steels and cast irons.
- It is used as a coating material for steel, copper, brass etc.
- It is used for decorative purposes.
- It is used for corrosion protection purposes.

6b. Mention the types of bearing materials. Explain any six properties.

Bearing Materials

Following are the widely used bearing metals

i. Copper-base alloys
ii. Lead-base alloys
iii. Tin-base alloys
iv. Cadmium-base alloys.

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.

SECTION – 4

7 a) List any four applications of smart materials.

i. Aerospace
ii. Mass transit
iii. Marine
iv. Automotive
v. Computers and other electronic devices
vi. Consumer goods applications
vii. Civil engineering
viii. Medical equipment applications
ix. Rotating machinery applications

b) Differentiate between thermosetting and thermoplastic materials

Sl. No.	Thermoplastic plastic	Thermosetting plastic
1	It is linear polymer.	It is cross linked polymer.
2	It is soft and flexible.	It is hard and brittle.
3	It is formed by addition polymerization.	It formed by condensation polymerization.
4	It has low molecular weight.	It has high molecular weight.
5	It is not fire proof.	It is fire proof.
6	It can be reused.	It cannot be reused.
7	They undergo no chemical change in the moulding operation.	They undergo chemical change in the moulding operation.
8	They can be softened again and again.	They cannot be re-softened once they are hard.
9	They are affected by certain solvents.	They are unaffected by any solvents.

c) Suggest an advanced material for medical application, justify.

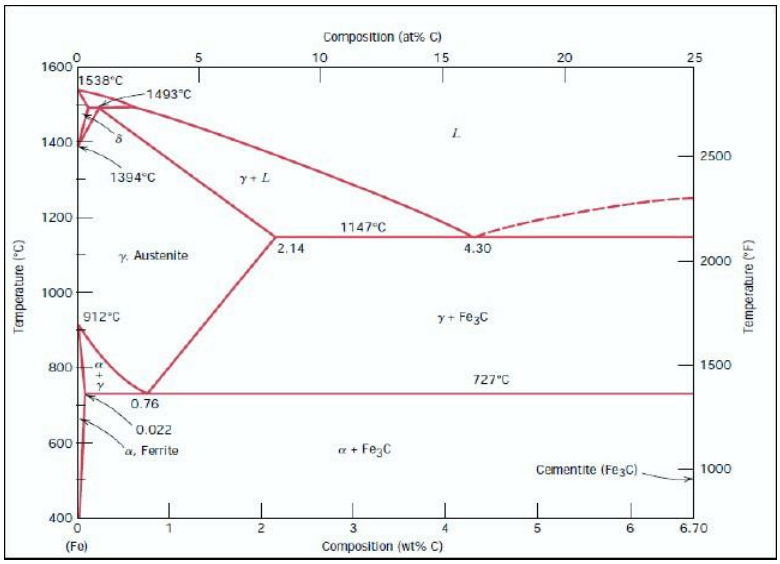
Biomaterials are suggested for Medical applications.

Biomaterials have following properties which are suitable for Medical applications;
1. They do not react with any tissue in the body.
2. They are non-toxic to the body.
3. Long term replacement won't be biodegradable.

8 a) List any four applications of nano materials.

a. Used in cell phones
b. Used in automobile industry
c. Used in 3-D printing parts
d. Used in paints
e. Used in sensors
f. Used in medicines

b) Sketch Iron-Carbon equilibrium diagram indicating various phases



c) What are the different types of heat treatment process

1. Annealing
2. Normalising
3. Hardening
4. Tempering
5. Case hardening.
    a) Carburising
    b) Cyaniding
    c) Nitriding
6. Surface hardening
    a) Induction hardening
    b) Flame hardening
7. Diffusion coatings.

Section-5

9. (a) State the purpose of heat treatment.

Answer: Heat treatment process is carried out for the following purpose.

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.
7. To improve electrical and magnetic properties.
8. To increase resistance to wear, tear, heat and corrosion.

8. **(b) Discuss Annealing and hardening heat treatment processes.**
Answer: (i) **Annealing process:** Annealing is a process of heating the steel to a temperature near or above the critical temperature and holding at that temperature for a certain suitable period and then cooling it slowly in the furnace itself. The important purpose of annealing process is to make steel soft. Annealing process is classified into two

types namely full annealing and process annealing. **Full annealing:** This process consists of heating the steel, 300 c to 500 c above the upper critical temperature for hypoeutectoid steel and by the same temperature above the lower critical temperature for hypereutectoid steels. The steel is then held at this temperature for some time to enable the internal changes to take place. The time allowed is approximately 3 to 4 minutes for each millimetre of thickness of the largest section, and then slowly cooled in the furnace. The rate of cooling varies from 300c to 200c per hour, depending upon the composition of steel.

Process Annealing: In this process the steel is heated to a temperature below or close to the lower critical temperature, held at this temperature for some time and then cooled slowly.

(ii) **Hardening process:** Hardening is a process of heating the steel up to a temperature of 300 c to 500 c above the upper critical temperature for the hypoeutectoid steels and by the same temperature above the lower critical point for hypereutectoid steels. The steel is held at this temperature for a considerable time and then quenching in a suitable medium. The quenching medium may be water, brine solution, mineral oils and cool air. This rapid cooling causes the steel surface very hard and brittle. The process of hardening is of four types. Working hardening, Age hardening, Air hardening and Hardening by heating and quenching.

9. (c) Differentiate between Carburising and Nitriding heat treatment processes.

	Carburising	Nitriding
1	Treating the surface of steel with carbon	Treating the surface of steel with nitrogen
2	Steels are heated in contact with carbonaceous material ,like $BaCo_3$	Steels are heated with the atmosphere of ammonia.(NH_3)
3	Steels are quenched directly in oil, due to process temperature(900^0c to 950^0c)	Steels does not require quenching, because of low temperature process(450^0c to 550^0c)
4	This Process gives case depth of 0.8 to 1mm	This Process gives case depth of 0.8 mm
5	Surface hardness ranges from 62 to 64 HRC	Surface hardness is greater than 67 HRC

10. (a) List the different types of corrosion.

Answer: The main types of corrosion are as follows

(i) Direct chemical corrosion (Dry corrosion)

(ii) Electro-chemical corrosion (Wet corrosion)

Various types of corrosion are:

· Uniform corrosion
· Pitting corrosion
· Intergranular corrosion
· Stress corrosion
· Crevice corrosion
· Season corrosion
· Fatigue corrosion
· Atmospheric corrosion
· Erosion corrosion
· Underground corrosion
· Fretting corrosion
· Selective corrosion

10. (b) With neat sketch explain Electroplating process.

Answer:

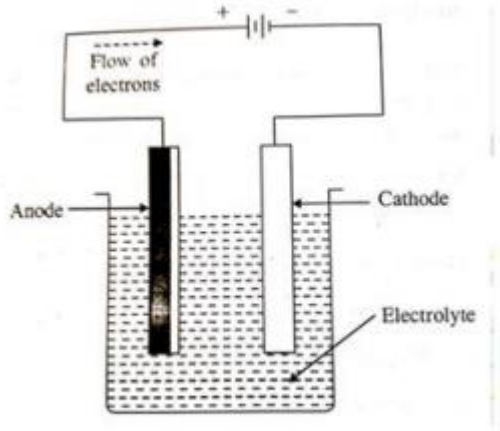


Fig: Electroplating

It is a process of depositing a very thin layer of metal coating, on the base metal by passing a direct current through an electrolytic solution containing some salt of the coating metal. Above figure illustrates a electroplating process here, the component of base metal is made to act as a cathode whereas the coating metal is an anode in a solution containing some salt of the coating metal i.e. electrolyte. A DC current is supplied to the anode that oxidizes the base metal atoms and dissolves them into the solution. The dissolved ions of base metal are deposited at the cathode and plated. The commonly used coating materials are copper, nickel, gold, chromium and tungsten

10. (c) What are electrolytes? And mention different types of electrolytes.

Answer: **Electrolytes:** An electrolyte is a substance that dissociates in water into charged particles called ions. Positively charged ions are called cations. Negatively charged ions are called anions. Simply, an electrolyte is a substance that can conduct an electric current when melted or dissolved in water. Ex: Acids, Bases and Salts are electrolyte.

Types of electrolytes:

(i)**Strong electrolyte:** The electrolytes that are almost completely disassociated into ions in solution are called strong electrolytes.

Ex: NaCl (Sodium chloride), KCl (Potassium Chloride), HCl (Hydro chloric acid), NaOH (Sodium hydroxide), etc.

(ii)Weak electrolyte: The electrolytes which do not completely disassociated into ions in solution are called weak electrolytes. Hence it is a poor conductor of electricity

Ex: H_2CO_3 (Carbonic acid), H_3PO_4 (Phosphoric acid), NH_3 (Ammonia), etc.

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**

I Semester Diploma Examination, Oct/Nov,2021

MATERIALS FOR ENGINEERING (Code:20ME11T)

Time: 3 Hours Max. Marks: 100

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

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

I Semester Diploma Examination, Oct/Nov,2021

MATERIALS FOR ENGINEERING (Code:20ME11T)

Time: 3 Hours Max. Marks: 100

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

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.

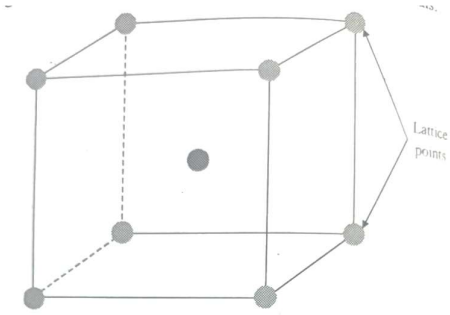


Fig. 1 Unit cell indicating only lattice points

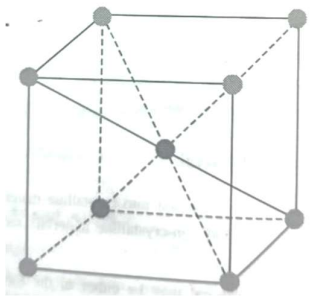


Fig.2 BCC Structure

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.

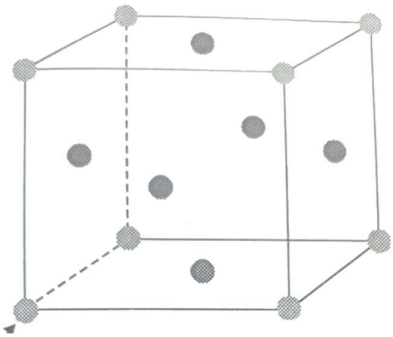


Fig. 1 FCC Unit cell

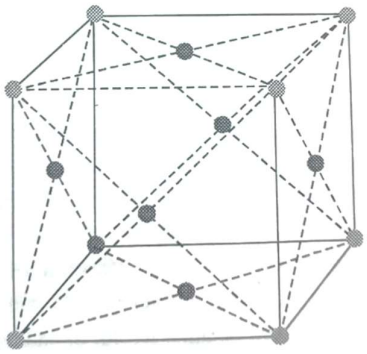
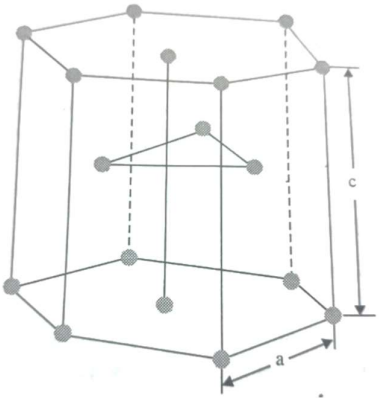
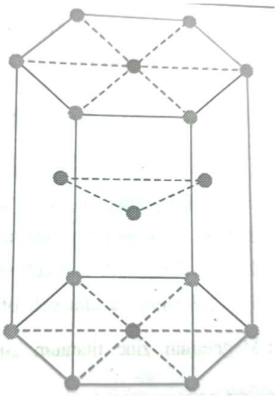


Fig.2 FCC Structure

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.

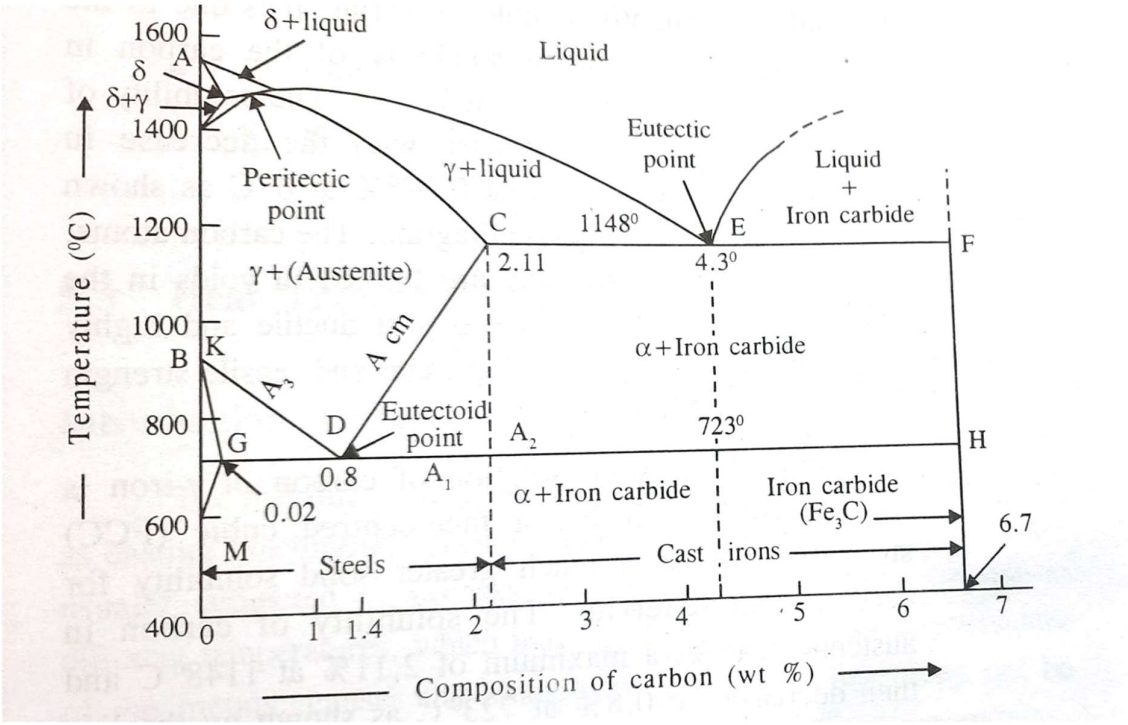
6. Used for artificial ligaments and tendons.

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.

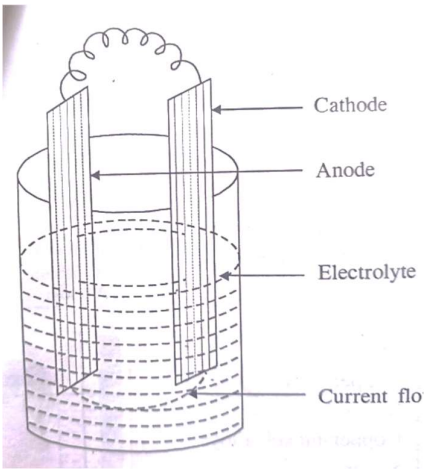
ii) Non-metallic coatings: These can be done by means of the following:

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.

2714 **Code : 20ME11T**

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

I Semester Diploma Examination, March/April-2022

MATERIAL FOR ENGINEERING

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

Instructions : (1) Answer **one** full question from each section.
(2) **One** full question carries **20** marks.

SECTION – I

1. (a) List Engineering Materials on basis of natural and man made existence. **5**
   (b) Name the crystal structures. Which structure is generally found in Zirconium & Beryllium ? **5**
   (c) Explain Malleability and Ductility with suitable examples. **5**
   (d) Explain briefly etching process of specimen preparation. **5**

2. (a) Explain any five mechanical properties of metal. **5**
   (b) Define Crystal Lattice and unit cell. **5**
   (c) Explain briefly scanning electron microscope. **5**
   (d) Compare crystalline material with non-crystalline material. **5**

SECTION – II

3. (a) Explain composition of Nodular CI characteristics and list uses of it. **10**
   (b) Which metal is used for manufacturing of helical spring and why ? **5**
   (c) Which steel is used in manufacturing of agricultural equipments ? Justify. **5**

4. (a) What are tool steels. Classify tool steels. **10**
   (b) Why drill bits are made up of high carbon steel ? Justify. **5**
   (c) Answer the following in Yes or No : **5**
   (i) Copper is an alloy.
   (ii) Steel wire is more elastic than rubber.
   (iii) Glass is brittle.
   (iv) Aluminum is heavier than iron.
   (v) Gun metal is a ferrous metal.

[Turn over

SECTION – III

5. (a) Transmission Gears, Railway track are made of which metal ? Justify the selection. **10**

(b) Develop short notes on Austentic Stainless Steel. **5**

(c) Analyse and infer the following designation of Steel/CI : **5**

(i) FG 200

(ii) 30C 8

6. (a) Which tool steel is used for piercing dies and coining dies ? Justify the selection. **10**

(b) Distinguish between Brass and Bronze. **5**

(c) Write the Nickel alloy used in the manufacturing of

(i) Costume Jewellery

(ii) Furnace geysers

(iii) Pump fitting, Steam turbine blades

(iv) Aircraft engine

(v) Turbine engine **5**

SECTION – IV

7. (a) List different Bearing materials Explain Cadmium based bearing material. **10**

(b) Compare Thermo-plastics and Thermoset plastics. **5**

(c) What type of smart materials used in Automotive industries & justify the application smart material ? **5**

8. (a) Explain Polymers & its characteristics and applications. **10**

(b) List different properties of ceramic materials and explain any one. **5**

(c) Wings of Aircraft is made of which composite material and why ? **5**

SECTION – V

9. (a) Cutting Edges of drill & saws are slowly accurately reheated & Quenched. Suggest suitable heat treatment process and list different types of Heat treatment process. **10**

(b) Write 5 differences between dry chemical corrosion and wet chemical corrosion. **5**

(c) What are the factors influencing corrosion ? **5**

10. (a) A product is manufactured by using GI-Iron sheet for good appearance and to avoid corrosion. Which process is adopted ? Explain **10**

(b) What are electrolytes ? Name different types. **5**

(c) Explain the construction and working of Electro chemical cell. **5**

I Semester Diploma Examinations March /April 2022

MATERIALS FOR ENGINEERING-20ME11T
SCHEME OF VALUATION

SECTION I			
1(a)	List Engineering Materials on basis of natural and man made existence	*1 marks for each materials (list five materials)(1*5=5)*	1*5=5M
1(b)	Name the crystal structures.which structure is generally found in Zirconium & Beryllium?	*Explanation 3 marks and 2 marks for sketch.))*	3+2=5M
1(c)	Explain Malleability and Ductility with suitable examples	*Malleability definition with examples 2.5marks and Ductility definition with examples 2.5marks*	2.5+2.5=5M
1(d)	Explain briefly etching process of specimen preparation	*Explanation*	5M
2(a)	Explain any five mechanical properties of metal	*1 marks for each properties (Any five properties)*	1*5=5M
2(b)	Define Crystal lattice and unit cell	*2 marks for crystal lattice 2 marks for unit cell and 1 marks for sketch*	2+2+1=5M
2(c)	Explain briefly scanning electron microscope	*Explanation 3 mark and 2 marks for the sketch.*	3+2=5M
2(d)	Compare crystalline material with non crystalline material	*2 marks for crystalline and 2 marks for non crystalline and 1 marks for examples*	2+2+1=5M
SECTION II			
3(a)	Explain the composition of Nodular CI characteristics and list uses of it.	*Explanation relevant to characteristics and composition 6marks and uses 4marks*	6+4=10M
3(b)	Which metal is used for manufacturing of helical spring and why	*Explanation 3marks and 2marks for composition .*	3+2=5M
3(c)	Which steel is used in manufacturing of agricultural equipments ?Justify	*list of carbon steel 2 marks 3 marks for Explanation relevant to characteristics and composition*	2+3=5M
4(a)	What are tool steels. Classify tool steels	*Tool steel explanation 2 marks and each classification 2 marks*	2+2*4=10M
4(b)	Why drill bits are made up of high carbon steel? Justify?	*Explanation relevant to characteristics and composition*	5M
4(c)	Answer the following in Yes or No	*1 marks for each answer*	1*5=5M
SECTION III			
5(a)	Transmission Gears, Railway track are which metal? Justify the selection	*Mention of material 2 marks explanation relevant to characteristics 3 marks and composition 5 marks*	2+3+5=10M
5(b)	Develop short notes on Austenitic Stainless	*Explanation relevant to characteristics and composition*	5M
5(c)	Analyse and infer the following designation el/CI:	*2.5 marks for FG200 and 2.5 marks for 30C8*	2.5+2.5=5M
6(a)	Which tool steel is used for piercing dies and coining dies? Justify the selection	*5 marks for Air hardening and 5 marks for High carbon .*	5+5=10M
6(b)	Distinguish between Brass and Bronze	*1 marks for each difference. (Any five difference)*	1*5=5M

6(c)	Write the Nickel alloy used in manufacturing of	*1 marks for each nickel alloy.*	1*5=5M
7(a)	List different Bearing materials? Explain Cadmium Bearing Material	*5 marks for list of bearing materials 2 marks for composition 3 marks for explanation*	(5+2+3=10)
7(b)	Compare Thermo plastics with Thermosetting plastics.	*1 marks for each difference. (Any five difference)*	1*5=5M
7(c)	What type of smart materials used in Automotive industries & justify the Application of smart material.	*2 marks for list of materials 3 marks for applications .*	2+3=5M
8(a)	Explain Polymers & list its characteristics and applications.	*2 marks for explanation of polymer, 3 marks for characteristics and 5 marks for applications (any 3 characteristics and any 5 applications)*	2+3+5=10M
8(b)	List different properties of ceramic materials and explain any one	*2 marks for list of properties , 3 marks for explanation of any one properties*	2+3=5M
8(c)	Wings of Aircraft is made of which composite material and why?	*2 marks for list of materials 3 marks for explanation.*	2+3=5M
SECTION V			
9(a)	Cutting edges of drill & saws are slowly accurately reheated & Quenched. Suggest suitable heat treatment process and list Different types of heat treatment process.	*2 marks for list of materials 3 marks for explanation 5 marks for list of heat treatment process(list any 5 heat treatment process)*	2+3+5M
9(b)	Write 5 differences between dry chemical corrosion and wet Chemical corrosion	*1 marks for each difference. (Any five difference)*	1*5=5M
9(c)	What are the factors influencing corrosion	*1 marks for each factors. (Any five factors)*	1*5=5M
10(a)	A product is manufactured using GI-Iron sheet for good appearance and avoids corrosion. Which process is adopted? Explain.	*5 marks for process 5marks for explanation.*	5+5=10M
10(b)	What are electrolytes? Name different types	*3 marks explanation 2 marks for types.*	3+2=5M
10(c)	Explain the construction and working of Electro chemical cell?	*3 marks explanation 2 marks for sketch.*	3+2=5M

CODE: 20ME11T

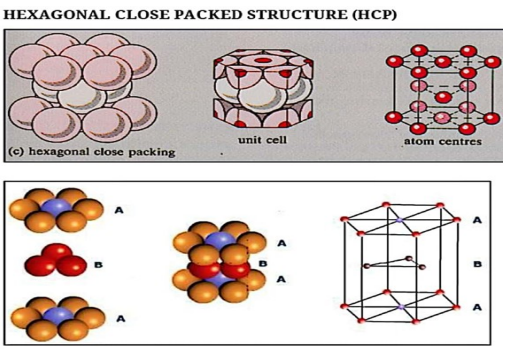
I Semester Diploma Examinations March /April 2022

MATERIALS FOR ENGINEERING

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

(ii) One full question carries 20 marks.

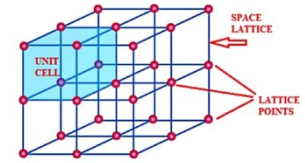
SECTION I

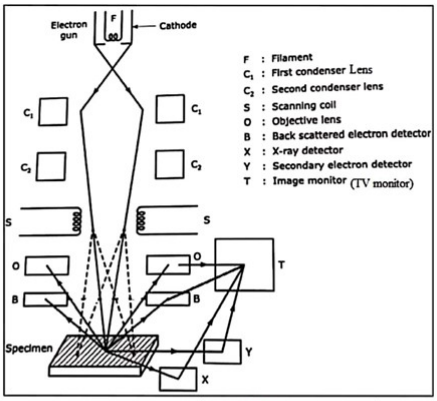
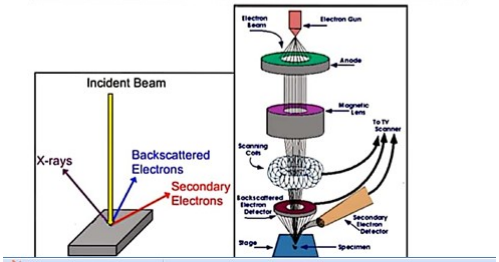
1	(a)	**List Engineering Materials on basis of natural and man made existence**	**05M**
		• Metals and alloys-ferrous metals & non ferrous metals Ferrous metals –carbon steels, stainless steel, tool steel. Non ferrous metals-brass, bronze, ,aluminum, copper, silver, gold • Ceramics and glasses-silica,soda lime,glass,concrete • Organic polymers-PVC,PTFE,nylon • Composites – Fiber reinforced plastic,Steel reinforced concrete. ***Scheme : 1 marks for each materials (list five materials)(1*5=5)***	1*5=5M
	(b)	**Name the crystal structures.which structure is generally found in Zirconium & Beryllium?**	**05M**
		In this type of structure, the unit cell, which is in the shape of hexagon,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 It is the obvious that each unit cell shares 14 atoms with the neighboring unit cells. This type of unit cell is found in metals like magnesium,zinc,titanium,zirconium,beryllium,and cadmium etc,  ***Scheme : Explanation 4 marks and 1 marks for sketch.)(4+1=5)*** ***Full marks can be given for good explanation without sketch also***	04M 01M

	(c)	**Explain Malleability and Ductility with suitable examples**	**05M**
		Malleability: It is the property of metal by virtue of the capability of being shaped into thin sheets Or extended by hammering, forging etc. Examples: Gold,iron,aluminium,copper,silver and lead.	

		Ductility: It is the property of metal by virtue of which it can be drawn into wires(or elongated) before rupture takes place.It depend upon the grain size of the metal crystals. Ductility of a metal can be measured by its percentage elongation and percentage ***Scheme : Malleability definition with examples 2.5marks and Ductility definition with examples 2.5marks(2.5+2.5=5)***	
	(d)	**Explain briefly etching process of specimen preparation**	**5M**
		A Finely polished specimen, under microscopic examination, Will reveal only a few structural features such as inclusions and cracks or other physical imperfections. But it will not reveal the required micro structural features or phases present in the material. This limitation of the polishing is overcome by employing the operation called etching. Etching is the operation carried out on the specimen to optically enhance Micro structural features of the material(grain size, phase features,etc) and the phases present in the material ***Scheme : Explanation 5mark¸*** ***Full marks can be given for good explanation***	
2	**(a)**	**Explain any five mechanical properties of metal**	**05M**
		Elasticity: It is the property of a metal by virtue of which it can retain its original shape and size after the removal of the load. In nature, no materials is perfectly elastic, over the entire range of stress, up to rupture. **Plasticity:** It is the property of a metal by virtue of which a permanent deformation(without fracture) takes place, whenever it is subjected to the action of external forces **Ductility:** It is the property of a metal by virtue of which it can be drawn into wires(or elongated) before rupture takes place **Brittleness:** It is defined as the property of a metal by virtue which it will fracture without any appreciable deformation. this property is opposite to the ductility of a metal. **Hardness**: It is defined as the property of a metal by virtue of which it can be resist abrasion, indentation(or penetration) and scratching by harder bodies. It is measured by the resistance of the metal which it offers to Scratching. **Toughness:** It is defined as the property of a metal by virtue of which it can absorb maximum energy before fracture takes place. The area under stress-strain curve indicates the toughness. **Stiffness:** It is defined as the property pf a metal by virtue of which it resists deformation. Stiffness of a metal is measured by its modulus of Elasticity. **Resilience**: It is defined as the property of a metal by virtue of which it stores	

		energy and resist shocks or impacts. The resilience of a metal is measured by the amount of energy that can be stored per unit volume, after it is stressed up to elastic limit. **Creep:** It is defined as the property of a metal by virtue of which it deforms continuously under a steady load. Generally, the creep occurs in steel at higher temperatures **Endurance:** It is defined as the property of metal by virtue of which it can withstand varying stresses(same or opposite nature). the maximum value of stress that can be applied for an indefinite time, without causing its failure, is known as endurance limit **Strength:** It is defined as the property of a metal by virtue which it can withstand or support an external force or load without rupture. The strength of a metal is the most important property, which plays a decisive role in designing various structures and components. ***Scheme : 1 marks for each properties (Any five properties)(1*5=5)***	

2	**(b)**	**Define Crystal lattice and unit cell**	**5M**
		Crystal Lattice: We know that crystals are made up of a regular, repetitive arrangement of their atoms in a three dimensional pattern. When each atom is replaced by a point, then such an arrangement of points in three dimensional pattern is known as crystal lattice or space lattice. Each point that replaces an atom is called lattice point. **Unit cell:** The metallic crystals can be considered as consisting of tiny blocks which are repeated in three dimensional pattern. This tiny block, which is formed by the arrangement of a small group of atoms is called, unit cell. as Bravais Lattices.  ***Scheme : 2 marks for crystal lattice 2 marks for unit cell and 1 marks for sketch(2+2+1=5)***	02M 02M 01M
2	**(c)**	**Explain briefly scanning electron microscope**	**05M**
		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 of the specimen basically consists of: Electron gun Condenser lenses Scan coils Detectors Sample Chamber A high energy beam is produced using an electron gun. Electron beam thus produced is focused using a series of condenser lenses as it moves from the	03M

		source towards the specimen. Focusing is essential to obtain a narrower electron beam which helps in scanning the specimen.   ***Scheme : Explanation 3 mark and 2 marks for the sketch.(3+2=5)*** ***Full marks can be given for good explanation without sketch also***	02M
2	**(d)**	**Compare crystalline material with non crystalline material**	**05M**
		Crystalline solids are those solids in which atoms are arranged in a regular and orderly pattern, resulting in a definite shape i.e., arrangement of atoms is in a periodically repeating pattern. Eg: All metals, Sodium chloride, Sodium nitrate, Diamond etc. Non-Crystalline solids are those solids in which atoms are not arranged in any specific order i.e., atoms are randomly scattered in space without showing any regular repeating pattern. Eg: Glass, Rubber, Gels etc ***Scheme : 2 marks for crystalline and 2 marks for non crystalline and 1 marks for examples (2+2+1=5)***	
		SECTION II	
3	**(a)**	**Explain the composition of Nodular CI characteristics and list uses of it.**	**10M**
		Unlike long flakes has in Gray cast iron graphite appears as rounded particles or or nodules or spheroid in nodular cast iron The properties of nodular cast iron depends upon the metal composition and the cooling rate Nodular cast iron possesses very good machinability Soft annealed grades of nodular cast iron can be turned at a very High feeds and speeds. Nodular cast iron contains 4.2% Carbon (co 2) 3.5% Silicon (Si) 0.3 – 0.8% Manganese (Mn) 0.08% Phosphorus (P) and 0.2% Sulphur (s) It possesses excellent damping capacity cast ability and wear resistance	

		USES: 1. Crank shaft 2. Pipes 3. Spindle 4. Hypoid axle gears 5. Tractors ***Scheme : Explanation relevant to characteristics and composition 6marks and uses 4marks (6+4=10)***	

3	**(b)**	**Which metal is used for manufacturing of helical spring and why**	**05M**
		Spring steel is a name given to a wide range of steels used in the manufacture of springs, prominently in automotive and industrial suspension applications. These steels are generally low-alloy manganese, medium-carbon steel or high-carbon steel with a very high yield strength. This allows objects made of spring steel to return to their original shape despite significant deflection or twisting. **Hyper-eutectoid spring steels.** This type of steel contains • C = 0.9 to 1.2%, Si = 0.3% (max) and Mn = 0.45 to 0.70%. • These steels are oil quenched and tempered at low temperature. • This type of steel is used for volute and helical springs. ***Scheme : Explanation 3marks and 2marks for composition . (3+2=5)***	
3	**(c)**	**Which steel is used in manufacturing of agricultural equipments ?Justify**	**05M**
		Steel used in the agriculture and farming industry. **Low carbon steel** (steel consists of less than 0.30% carbon): Used extensively in the construction of farm machinery. Frames and most of other members are made out of low-carbon steel. **Medium carbon steel** (Medium-carbon steel consists of 0.30% to 0.60% carbon) for greater strength and hardness‟ Low and carbon Steel is found in a variety of farming equipment ***Scheme : list of carbon steel 2 marks 3 marks for Explanation relevant to characteristics and composition (2+3=5)***	
4	**(a)**	**What are tool steels. Classify tool steels**	**10M**
		Tool steels are high-quality, carbon and alloy steels that are commonly used to make cutters, reamers, bits etc used for machining metals, plastics, and wood.The Carbon content in tool steel in the range of 0.1 -1.6%. Tool steel also contain alloying elements like, Chromium, Molybdenum and Vanadium. Tool steel offers better durability, strength, corrosion resistance and temperature stability, as compared to the Construction & Engineering. **Classification of tool steels:** 1) Cold work tool steels a) Oil-hardening cold-work steels b) Air-hardening cold-work steels c) High-carbon, high-chromium cold-work steels	

		2) Hot work tool steels a) Chromium hot work steels b) Tungsten hot work steels c) Molybdenum hot work steels 3) High-speed tool steels a) Molybdenum high-speed steels b) Tungsten high-speed steels 4) Other types of tool steels include: a) Water-hardening tool steels b) Shock-resistant tool steels c) Low-carbon tool steels d) Low-alloy special purpose tool steels ***Scheme : Tool steel explanation 2 marks and each classification 2 marks (2+2*4=8)=10 marks .***	

4	**(b)**	**Why drill bits are made up of high carbon steel? Justify?**	**05M**
		High carbon steel contains the following. Steel containing 0.7 to 1.5% carbon is known as high carbon steel. High C content provides high hardness and strength. Used in hardened and tempered condition Strong carbide formers like Cr, V, W are added as alloying elements to from carbides of these metals. it has the properties of High hardness, High strength, Least ductile, High wear resistance. so high carbon steel is used for manufacturing of drill bits ***Scheme : Explanation relevant to characteristics and composition 5marks***	
4	**(c)**	**Answer the following in Yes or No**	**05M**
		Explain the following processes (a). Copper is an alloy-**NO** (b). Steel wire is more elastic than rubber- **YES** (c). Glass is brittle- **YES** (d). Aluminum is heavier than iron- **NO** (e). Gun metal is a ferrous metal- **NO** ***Scheme : 1 marks for each answer (1*5=5)***	1*5=5M
		SECTION III	
5	**(a)**	**Transmission Gears, Railway track are which metal? Justify the selection**	**10M**
		Transmission gears and railway track are made of malleable cast iron . Malleable iron is cast as white iron, the structure being a metastable carbide in a pearlitic matrix. Through an annealing heat treatment, the brittle structure as first cast is transformed into the malleable form. Characteristics • Malleable iron starts as a white iron casting that is then heat treated at about 900oC • Malleable cast iron is obtained from the hard and brittle white iron through a	

		controlled heat conversion process • Malleable cast iron is one which can be hammered and rolled to obtain different shapes • Malleable cast iron possesses high yield strength • Malleable cast iron contains ➢ 2.3% Carbon (C) ➢ 0.6 - 1.3% Silicon (Si) ➢ 0.2 - 0.6 % Manganese (Mn) ➢ 0.15% Phosphorus (P) and ➢ 0.1% Sulphur (s) Solidification range of 2552 to 2065 F ***Scheme : Mention of material 2 marks explanation relevant to characteristics 3 marks and composition 5 marks .(2+3+5=10)***	
5	**(b)**	**Develop short notes on Austenitic Stainless Steel**	**5M**
		Austenitic Stainless Steels: • These contain at least 24% chromium and nickel combined. These are non hard enable and non-magnetic. • These are highly resistant to many acids, strong and scale less than any of the plain chromium alloys. • These are very useful for parts subjected to severe stress at elevated temperatures. • These find uses on food processing, dairy industry, textile industry, • Pharmaceuticals. ***Scheme:Explanation relevant to characteristics and composition 5marks*** ***Full marks can be given for good explanation***	
5	**(c)**	**Analyse and infer the following designation of Steel/CI:**	**5M**
		Designation Grey Cast iron: Grey cast iron specified by FG followed by its tensile strength. 1)FG200 that means grey cast iron with ultimate tensile strength 200 N/mm2. Cylinder block, brake drum, clutch plate etc. are made from Grey Cast iron . 2)30C8 Where, 30 = 100 times average % of Carbon 8 = 100 times average % of Manganese Average % of Carbon = 30/100 = 0.3% Average % of Manganese = 8/100 = 0.08% ***Scheme : 2.5 marks for FG200 and 2.5 marks for 30C8 (2.5+2.5=5)***	
6	**(a)**	**Which tool steel is used for piercing dies and coining dies? Justify the selection**	**10M**
		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 airhardening.
- 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.

Scheme : 5 marks for Air hardening and 5 marks for High carbon .
Full marks can be given for good explanation with suitable points(5+5=10)

6	**(b)**	**Distinguish between Brass and Bronze.**	**05M**

BRASS	**BRONZE**
Brass is a metal alloy composed of copper and zinc	Bronze is a metal alloy composed of copper and tin
Often bright golden in color	Reddish brown in colour
Brasses can undergo the process of casting ,hot forging,cold forging,cold rollinginto sheets,drawing into wires and extrusion for obtaining requiste special cross sectional bars	Bronze alloy can easily cold rolled into wires and rods and sheets
It has a high degree of malleability	Hard and Brittle
Mainly used for decorative purposes	Used in the production of boat and ship fittings.
Corrosion resistant, but not towards salt water	Resistant to corrosions that occur from salt and water
Brasses are used in musical instruments ,hydraulics fitting ,pump lining,utensils,bearing and bushes	Bronse is generally utilized in hydraulic fitting,bearing ,bushes,utensils,sheets.

Scheme : 1 marks for each difference. (Any five difference)(1*5=5)

6	**(c)**	**Write the Nickel alloy used in manufacturing of**	**5M**

(i) Costume Jewellery - **German silver**
(ii) Furnace geysers **- Nichrome**
(iii) Pump fitting, Steam turbine blades - **Monel metal**
(iv) Aircraft engine **- Inconel**
(v) Turbine engine **- Nimonics**

Scheme : 1 marks for each nickel alloy.(1*5=5)

SECTION IV

7	**(a)**	**List different Bearing materials? Explain Cadmium Bearing Material**	**10M**

(i). Babbit material
a. Tin based babbit
b. Lead based babbit
(ii).Copper based alloys
(iii).Cadmium based alloys
(iv).Aluminium based alloys
(v). Silver based alloys
(vi).Non-metallic bearing materials

Cadmium based alloys:

Composition: 97% Cadmium(Cd)
2% Nickel(Ni)
Silver(Ag),Copper(Cu)&Zinc(Zn) are added in Smaller percentage

These alloys aren't very popular because of high price of cadmium. These bearing alloy possess greater compressive strength than tin bearing alloys.
Cadmium based alloys possess (a) low coefficient of friction, (b) high Fatigue strength, (c) high load carrying capacity, (d) low wear, (e)fair Ability to embed dirt,and (f) poor corrosion resistance

Uses: Medium loaded bearing subjected to high temperature and used In automobile and aircraft industries.

Scheme : 5 marks for list of bearing materials 2 marks for composition 3 marks for explanation .(5+2+3=10)

7	**(b)**	**Compare Thermo plastics with Thermosetting plastics.**	**5M**

THERMO PLASTICS	**THERMOSETTING PLASTICS**
Thermoplastics are linear polymers	Thermo setting plastics are cross-Linked polymers
They undergo no chemical change in the molding operation	They undergo chemical change in the molding operation
They can be softened again and again	They cannot be re-softened once they hard
These plastics can be reused	These plastics cannot be reused
These are soft and Flexible	These are hard and brittle
They are affected by certain solvents	They are unaffected by any solvent
Thermo plastics are not fireproof	Thermosetting plastics are fireproof

Scheme : 1 marks for each difference. (Any five difference)(1*5=5)

7	**(c)**	**What type of smart materials used in Automotive industries & justify the Application of smart material.**	**5M**

Smart or intelligent materials are materials that have to respond to stimuli and environmental changes and to activate their functions according to those changes.
The stimuli like temperature, pressure, electric flow ,magnetic flow, light, mechanical etc. can originate internally or externally .
Thermo responsive Materials are used in Automotive industries.
Thermo responsive material has the ability to change properties in response to change in temperature .

		Application of smart materials are: (i) Aerospace (ii) Mass transit (iii) Marine (iv) Automotive (v) Computers and other electronic devices (vi) Consumer goods applications (vii) Civil engineering (viii) Medical equipment application (ix) Rotating machinery application ***Scheme : 2 marks for list of materials 3 marks for applications .(2+3=5)***	
8	**(a)**	**Explain Polymers & list its characteristics and applications.**	**10M**
		A polymer is a large molecule of which is formed by repeated linking of the small molecules called "monomers". Polymers can be natural or synthetic. All plastics are polymers, but not all polymers are plastic **Characteristics of polymers** (i) Low density (ii) Low co efficient of friction (iii) Good corrosion resistance (iv) Good mould ability (v) Excellent surface finish can be obtained (vi) Can be produced with close dimensional tolerances (vii) Economical (viii) Poor tensile strength (ix) Low mechanical properties (x) Poor temperature resistance (xi) Can be produced transparent or in different colours (xii) Low melting point **Applications of polymers** (i) These are used in adhesives, paints and textile coatings (ii) Used for bottles, trays, table wears (iii) Used fore wire insulation,floor coverings, water and drain pipes (iv) Polymers are used to prepare non stick surface and plumbing Tapes (v) Polymers are used for house hold products (vi) These are used to give chemical resistance coating in containers (vii) Used for gloves,rubber bands and conveyor belts (viii) Used in oil and gasoline resistance rubber (ix) Used for manufacturing the tires and fibres (x) Used for manufacturing the synthetic leather and food wrapper ***Scheme : 2 marks for explanation of polymer, 3 marks for characteristics and 5 marks for applications (any 3 characteristics and any 5 applications)(2+3+5=10)***	
8	**(b)**	**List different properties of ceramic materials and explain any one**	**5M**

		Properties of ceramic materials (i) Mechanical properties (ii) Electrical properties (iii) Thermal properties **(i) Mechanical properties** The compressive strength is several times more than the tensile strength Non-ductile/brittle Below recrystallization temperature,non-crystalline ceramics are fully brittle At high temperature rigidity is high The elastic modulus (young's modulus) of ceramics is usually higher than for metals, because ceramics are bounded either covalently or ionically. This bonding is stronger than metallic bonding. **(ii) Electrical properties** In contrast to metals, Ceramics have very low electrical conductivity Electrical Insulators fall into two general classification: (a) Classical Electrical Procelain-for both high and low Tension service (b) Special bodies such as rutile, high alumina - for high Frequency insulation. Most of the ceramics have dielectric strength,it is the ability of material to withstand Electrical breakdown (iii) **Thermal properties** The ceramic materials have a low thermal conductivity Thermal shock resistance is the ability of a material to resist Cracking or disintegration of the material under abrupt of Sudden change in temperature The co efficient of expansion is low. ***Scheme : 2 marks for list of properties , 3 marks for explanation of any one properties(2+3=5)***	
8	**(c)**	**Wings of Aircraft is made of which composite material and why?**	**5M**
		Wings of Aircraft is made in Sandwich panels. Because these composites are composed of two strong outer sheets or faces (typical face materials include aluminium alloys, fibre reinforced plastics, titanium steels and plywood), separated by a layer of less dense material or "core" (typical core materials include foamed polymers, synthetic rubbers, in organic cements and wood) which has lower stiffness and lower strength. The core, structurally perform following two functions (i) It separates the face and resists deformation perpendicular to the face plane (ii) It provides a certain degree of shear rigidity along planes Which are perpendicular to the faces ***Scheme :2 marks for list of materials 3 marks for explanation.(2+3=5)***	
		SECTION V	
9	**(a)**	**Cutting edges of drill & saws are slowly accurately reheated & Quenched. Suggest suitable heat treatment process and list Different types of heat treatment process.**	**10M**

Hardening is the heat process for cutting edges of drill & saws Accurately reheated and quenched.

Hardening is defined as heat treating process in which the steel is heated to a temperature within or above critical temperature, held at this temperature for considerable time to ensure penetration of temperature inside the component and then allowed to cool by quenching in water, oil or brine solution

Types of heat treatment process:

Annealing
Normalising
Hardening
Tempering
Case hardening
- a. Carbusing
- b. Cyaniding
- c. Nitriding

Surface hardening
- a. Induction hardening
- b. Flame hardening

Diffusion coatings

Scheme :2 marks for list of materials 3 marks for explanation 5 marks for list of heat treatment process(list any 5 heat treatment process)(2+3+5=10)

9 **(b)** **Write 5 differences between dry chemical corrosion and wet Chemical corrosion**

Dry chemical corrosion	Wet chemical corrosion
It occurs in dry condition	It occurs in the presence of moisture or electrolyte
It is due to the direct chemical attack of the metal by the environment	It is due to the formation of large number of anodic and cathodic areas
Even a homogeneous metal surface gets corroded	Heterogeneous(bimetallic) surface alone gets corroded
Corrosion products accumulate at the place of corrosion	Corrosion occurs at the anode while the products are formed elsewhere
It is a self controlled process	It is a continuous process
It adopts adsorption mechanism	It follows electrochemical reaction
Formation of mild scale on iron surface is an example	Rusting of iron in moist atmosphere is an example

Scheme : 1 marks for each difference. (Any five difference)(1*5=5)

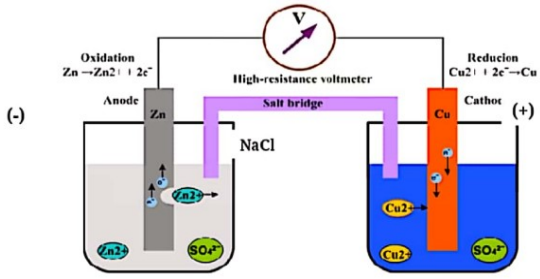
9 **(c)** **What are the factors influencing corrosion** **5M**

The factors influencing corrosion are:

(a) Nature of the metal

(i) Physical state

		(ii) Purity of metal (iii) Over voltage (iv) Nature of surface film (v) Relative areas of the anodic and cathodic parts (vi) Position in galvanic series (vii) Passive character of metal (viii) Solubility of corrosion products (ix) Volatility of corrosion products (b) Nature of the corroding environment (i) Temperature (ii) Humidity of air (iii) Presence of impurities in atmosphere (iv) Presence of suspended particles in atmosphere (v) Influence of pH (vi) Nature of ions present (vii) Conductance of the corroding medium (viii) Formation of oxygen concentration cell (ix) Flow velocity of process steam (x) Polarization of electrodes ***Scheme : 1 marks for each factors. (Any five factors)(1*5=5)***	
10	**(a)**	**A product is manufactured using GI-Iron sheet for good appearance and avoids corrosion. Which process is adopted? Explain.**	**10M**
		Galvanizing process is adopted for a product is manufactured Using GI- Iron sheet for good appearance and avoid corossion. The hot dip galvanizing process is relatively simple. It Involves cleaning steel and immersing it in molten zinc to Obtain a coating. Hot dip galvanizing is the process of Coating iron or steel with a layer of molten zinc at a .Temperature of around 450 C for good appearance. ***Scheme : 5 marks for process 5marks for explanation.(5+5=10)*** ***Full marks can be given for good explanation .***	
10	**(b)**	**What are electrolytes? Name different types**	**05M**
		An electrolyte is a substance that dissociates in water into Charged ions are called cations. Negatively charged ions are Called anions. Simply,an electrolyte is a substance that can Conduct an electric current when melted or dissolved in water.Ex:Acids,Bases and salts are electrolyte **Types of electrolyte** (i) Strong electrolyte (ii) Weak electrolyte ***Scheme :3 marks explanation 2 marks for types.***(3+2=5)	
10	**(c)**	**Explain the construction and working of Electro chemical cell?**	**5M**



ELECTRO CHEMICAL CELL

Electrochemical cells have two conductive electrodes, called the anode (denoted by negative sign) and the cathode (denoted by positive sign) dipped inside two separate containers. Zinc rod dipped in zinc sulphate solution acts as anode. Copper rod dipped in copper sulphate solution acts as cathode. Electrodes can be made from any sufficiently conductive materials, such as metals,semiconductors, graphite, and even conductive polymers. Electrodes are connected by wire, through which electron passes. An inverted U tube, whose either ends comes in contact with electrolyte of both the containers acts as a bridge.

Salt bridge is usually an inverted U-tube filled with concentrated solution of inert electrolytes. An inert electrolyte is one whose ions neither involved in any electrochemical change nor do they react chemically with the electrolytes in two half cells. Generally salts like KCI,KNO3,K2SO4 etc.

Scheme :3 marks explanation 2 marks for sketch.(3+2=5)

Code : 20ME11T

1399

Register Number

I Semester Diploma Examination, August/September-2022

MATERIALS FOR ENGINEERING

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

Instructions : (i) Answer any **one** full question from each Section.
(ii) **One** full question carries **20** marks.

SECTION – 1

1. (a) Classify Engineering materials with examples. **8**
   (b) List any six mechanical properties of metals. **6**
   (c) Sketch and explain FCC crystal structure. **6**

2. (a) Explain Ferrous and Non-ferrous metals with examples. **4**
   (b) Sketch and explain Transmission Electron Microscope (TEM). **8**
   (c) Sketch and label the parts of a Electro-Chemical cell. **8**

SECTION – 2

3. (a) List the different types of Cast Iron. **4**
   (b) Mention the types of metal used for making the following components and justify your answer : **8**
   (i) Agricultural Equipments
   (ii) Antifriction Bearings
   (c) Indicate the meaning of following designations : **8**
   (i) Fe 250 (ii) 55 C4
   (iii) FeE 300 (iv) BM 300

4. (a) Write the classification of steel. **6**
   (b) State the purpose of Alloying. **6**
   (c) Mention the type of stainless steel with its properties for following applications : **8**
   (i) Household utensils
   (ii) Surgical instruments

SECTION – 3

5.	(a)	Differentiate between Brass and Bronze.	6
	(b)	State any three (3) properties and two (2) uses of following metals :	10
		(i) Copper	
		(ii) Aluminium	
	(c)	Explain Self-lubricating bearings.	4
6.	(a)	Give classification of polymers.	10
	(b)	State any five properties of ceramics.	5
	(c)	Explain the designation of plastics.	5

SECTION – 4

7.	(a)	List any four (4) applications of Smart materials.	4
	(b)	Differentiate between Thermosetting and Thermoplastic materials.	10
	(c)	Suggest an advanced material for medical application. Justify your answer.	6
8.	(a)	Distinguish between interstitial and substitutional solid solution.	4
	(b)	Sketch Iron-Carbon Equilibrium diagram indicating various phases.	10
	(c)	List the different types of Heat treatment process.	6

SECTION – 5

9.	(a)	State the purpose of Heat treatment.	8
	(b)	Distinguish between Annealing and Normalizing.	8
	(c)	Suggest a suitable heat treatment process during the manufacturing of laminated springs. Justify your answer.	4
10.	(a)	List different types of corrosion.	4
	(b)	Differentiate between Electrolyte and Non-electrolyte.	6
	(c)	Explain with a neat sketch Electroplating process.	10

I SEM DIPLOMA EXAMINATION, AUGUST / SEPTEMBER 2022

MATERIALS FOR ENGINEERING (20ME11T)

SCHEME OF EVALUATION

Q. NO.		QUESTION	MARKS
SECTION - 1			
1.	**a**	Listing of 4 types of Engineering materials + any two examples for each type	(1*4)+(1*4)=8
	b	Listing of any Six (6) mechanical properties	1*6=6
	c	Sketch + explanation for FCC	3+3=6
2	**a**	Explanation + Examples for Ferrous and Non-ferrous metals	2+2=4
	b	Sketch + explanation for TEM	4+4=8
	c	Sketch + Labeling	4+4=8
SECTION - 2			
3	**a**	Listing of 4 types of Cast Iron	1*4=4
	b	i) Mentioning the metal name + Justification ii) Mentioning the metal name + Justification	(2+2) + (2+2) = 8
	c	Writing the designation for (i) + (ii) + (iii) + (iv)	2+2+2+2=8
4	**a**	Writing the classification of Steel	6
	b	Listing the purpose of Alloying	1*6=6
	c	(i) Mentioning the type of Stainless steel + Properties (ii) Mentioning the type of Stainless steel + Properties	(2+2) + (2+2) = 8
SECTION - 3			
5	**a**	Any 6 difference between Brass & Bronze	1*6 = 6
	b	(i) 3 properties + 2 uses of Copper (ii) 3 properties + 2 uses of Aluminium	(3+2) + (3+2) = 10
	c	Explanation	4
6	**a**	Mentioning the basis for classification + listing the types of Polymers	4+6 = 10
	b	Listing any 5 properties of Ceramics	1*5 = 5
	c	Explanation	5

SECTION - 4			
7	**a**	Listing any 4 application of Smart materials	1*4 = 4
	b	Differences between Thermosetting and thermoplastic **(Any 5)**	2*5 = 10
	c	Mentioning an Advanced material + Justification	3+3 = 6
8	**a**	Difference between Interstitial and Substitutional solid solution **(Any 2)**	2*2 = 4
	b	Iron carbon diagram sketch + Indication of various phases	5+5 = 10
	c	Listing of types of Heat treatment process **(Any 6)**	1*6 = 6
SECTION - 5			
9	**a**	Purpose of Heat treatment **(Any 8)**	1*8=8
	b	Differences between Annealing and Normalizing **(Any 4)**	2*4 = 8
	c	Suggestion of heat treatment process + justification	2+2 = 4
10	**a**	Listing of any 4 types of Corrosion	1*4 = 4
	b	Differences between Electrolyte and Non-electrolyte **(Any 3)**	2*3 = 6
	c	Sketch + Explanation	5+5 = 10

I SEM DIPLOMA EXAMINATION, AUGUST / SEPTEMBER 2022

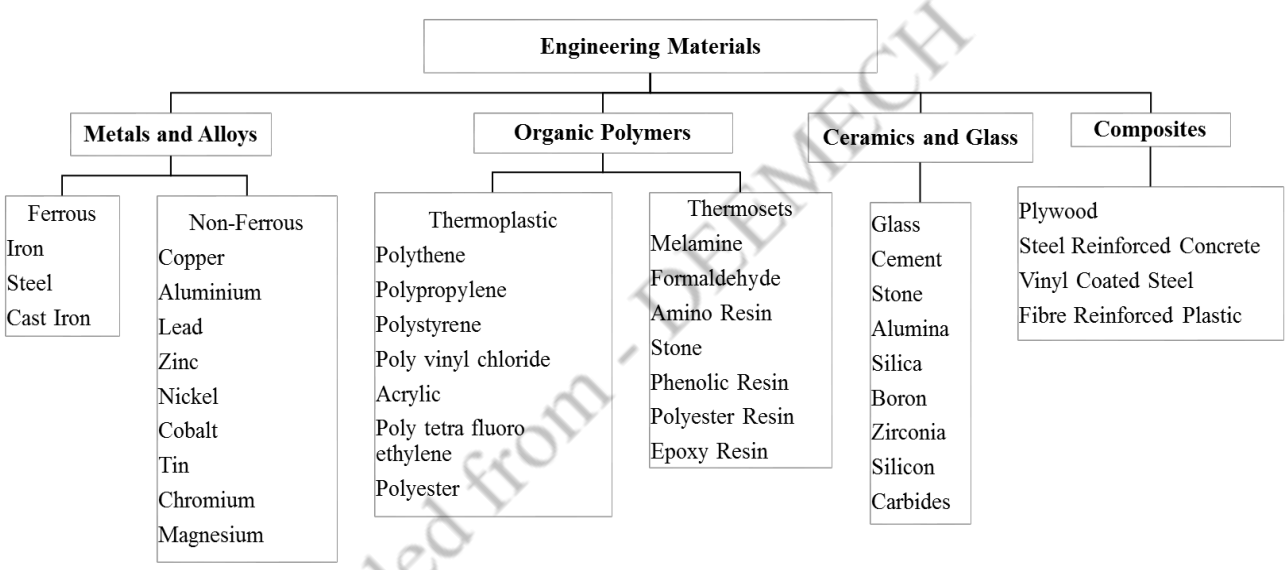
MATERIALS FOR ENGINEERING (20ME11T)

MODEL ANWERS

SECTION - 1

1. a) Classify Engineering materials with examples. (4+4=8 marks)

According to their nature, Engineering Materials are classified as follows:



1. b) List any six mechanical properties of metals. (Any 6) (1*6=6 marks)

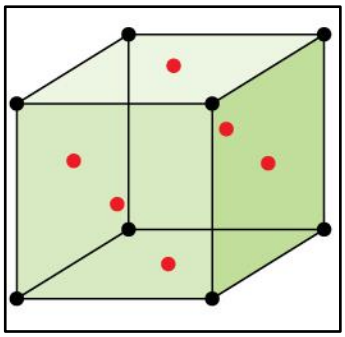
The Mechanical properties of metals are given below;

1. Elasticity
2. Plasticity
3. Ductility
4. Malleability
5. Brittleness
6. Hardness
7. Toughness
8. Stiffness
9. Resilience
10. Creep
11. Endurance
12. Strength

1.c) Sketch and explain FCC crystal structure. (3+3=6 marks)

In FCC type of structure, the unit cell which is in the shape of a cube contains one **atom at each of its 8 corners and one atom at the centre of each of its face**. This type of structure does not contain any atom at the centre of the unit cell.

In this type each unit cell shares **14 (= 8+ 6) atoms**, with the neighboring unit cells.



FCC crystal

This type of unit cell is found in metals like **γ-iron (910^0 C to 1440^0 C), Copper, Silver, Gold, Aluminium, Nickel, Lead and Platinum, etc.**

2. a) Explain Ferrous and Non-ferrous metals with examples. (2+2=4 marks)

Ferrous Metals: Ferrous metals are those metals which are **rich in iron**. Ferrous metals are magnetic and capable of little resistance to the corrosion.

Examples: Wrought Iron, Cast Iron etc.

Non-Ferrous Metals: Non-Ferrous metals are those metals which **do not contain iron as their composition** is called as non-ferrous metals. Lightweight, high conductivity, corrosion resistance and non-magnetic properties are the specialities of the non-Ferrous metals.

Examples: Aluminium, Copper, Lead, Nickel, Tin, Titanium, Zinc etc.

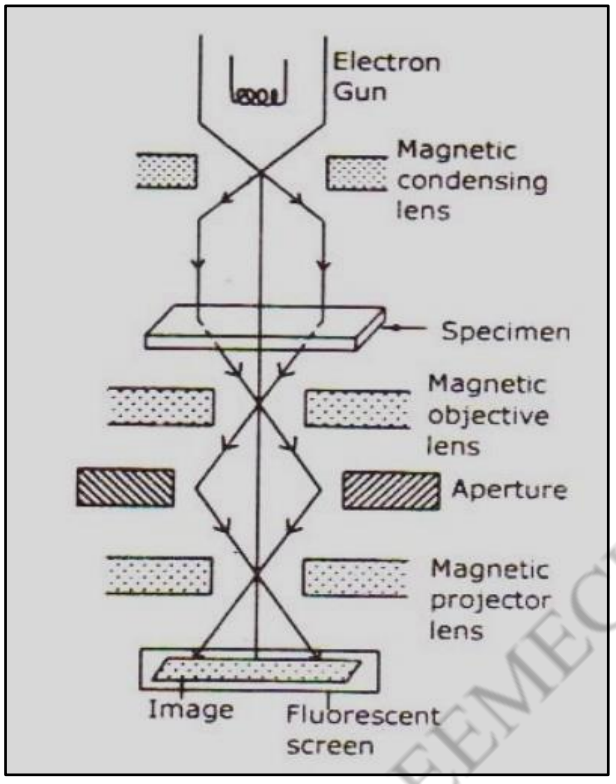
2. b) Sketch and explain Transmission Electron Microscope. (4+4 = 8 marks)

A Transmission electron microscope (TEM) is a type of electron microscope which is used to produce images of a metallographic sample. These Images are later studied and analysed to interpret the topography, crystallographic structure, and composition of the specimen.

The TEM operates on the same basic principles as the light microscope but uses electrons instead of light.

TEM basically consists of:

- An electron gun
- Condenser lens
- Objective lens
- Fluorescent screen or Viewing screen



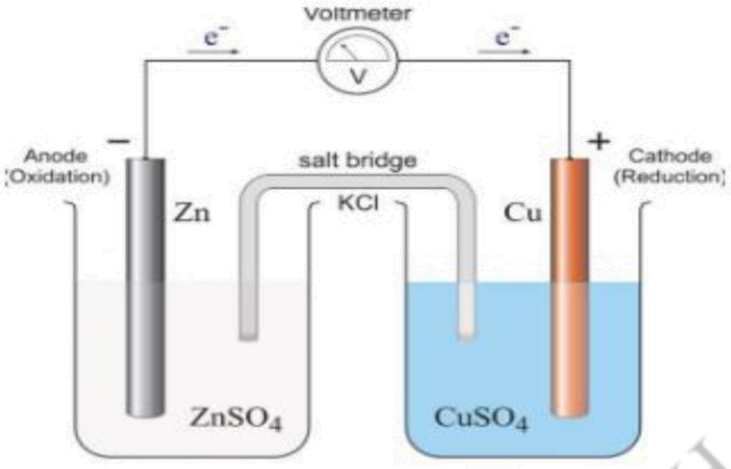
Transmission Electron Microscope

Stream of electrons are produced by an electron gun and is made to fall over the specimen using the magnetic condensing lens. The specimen is placed between the condensing lens and the objective lens as shown in the figure.

Magnetic condensing lens is used to condense the electrons and to adjust the size of the electron that falls on to the specimen. Based on the angle of incidence, the beam is partially transmitted and partially diffracted through the specimen. In order to obtain a high intensity and high contrast image of the specimen, it is essential to eliminate the diffracted electron beam. This is achieved by passing the resultant beam through magnetic objective lens and the aperture.

Thus, transmitted beam alone is made to pass through the projector lens for further magnification. The magnified image is recorded in fluorescent (Phosphor) screen. This high contrast image is called Bright Field Image, which gives the required information like surface topography, crystallographic structure, and composition of the specimen.

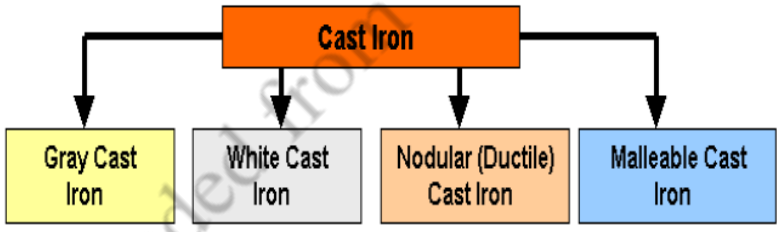
2. c) Sketch and label the parts of an Electro-chemical cell. (4+4=8 marks)



Electro-chemical cell

SECTION - 2

3. a) List the different types of Cast Iron. (1*4=4 marks)



3. b) Mention the type of metal used for making following components and justify your answer. (i) Agricultural equipments (ii) Antifriction bearings (4+4=8 marks)

(i) Agricultural equipments: Low carbon steel is used extensively in the making of Agricultural equipments.

Low carbon steel has following desirable properties for making Agricultural equipments;

- They possess good machinability.
- They possess excellent weldability.
- They have outstanding ductility.
- They have outstanding toughness.
- Most abundant grade of steel
- Least expensive.

(ii) Antifriction bearings: **Chromium steel** (1% carbon, 0.3% manganese, 1.5% chromium remainder substantially iron) is used to make Antifriction bearings.

Chromium steel has following desirable properties for making Antifriction bearings;

- Hard, clean and wear resistant.
- It can functions at temperatures up to 120°C, upon heat treatment can work at 220°C.

3.c) Indicate the meaning of following designations. (2*4=8 marks)

(i) Fe250 (ii) 55C4 (iii) FeE300 (iv) BM300

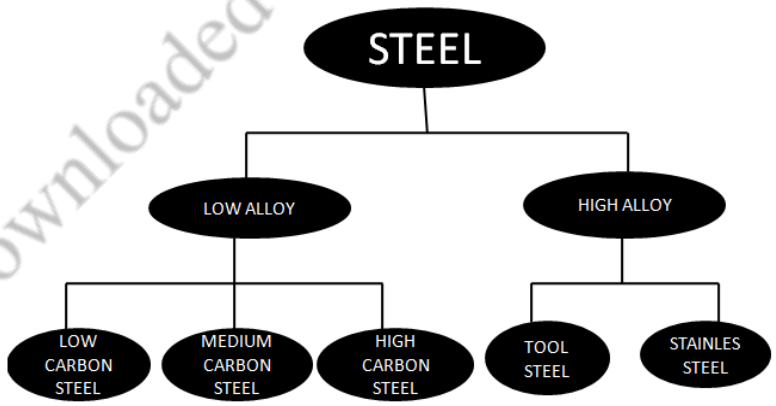
(i) Fe250 : Steel with a Tensile strength of 250 N/mm^2

(ii) 55C4 : Plain carbon steel with 0.55% Carbon and 0.04 % Manganese

(iii) FeE300 : Steel with Yield strength of 300 N/mm^2

(iv) BM300 : Blackheart Malleable Cast iron with a 300 N/mm^2 minimum tensile strength

4. a) Write the classification of Steel. (6 marks)



4. b) State the purpose of alloying? (Any 6) (1*6=6 marks)

The purpose of alloying steel is,

1. To improve hardness
2. To improve Strength
3. To improve toughness

4. To improve corrosion resistance
5. To improve wear resistance
6. To improve machinability
7. To improve high or low temperature stability
8. To control grain size
9. To improve ductility

4. c) Mention the type of Stainless steel with its properties for following applications

(i) Food processing (ii) Surgical and dental instruments (4+4=8 marks)

Application	Type of Stainless steel	Properties
(i) House hold utensils	Ferritic Stainless Steels	Good Cold-Formability, Good resistance to corrosion, Magnetic and non-hardenable, Low carbon content
(ii) Surgical and dental instruments	Martensitic Stainless Steels	Very hard and possess strain-resisting properties, magnetic, poor weldability

SECTION - 3

5. a) Differentiate between Brass and Bronze. (1*6=6 marks)

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.

5. b) State any three (3) properties and two (2) uses of following metals (i) Copper (ii) Aluminium (5+5=10 marks)

(i) Copper:

Properties: (any 3)

- High Thermal Conductivity
- High Electrical Conductivity
- Good Corrosion Resistance
- High Ductility
- Melting point is 1084^0C
- Boiling point of copper is 2562^0C
- Specific gravity of Copper id 8.9.
- The tensile strength of copper varies from 150MPa to 400MPa under different conditions.
- Good Malleable properties because of FCC Structure
- Addition of tellurium to copper results in increased machinability.

Uses: (any 2)

- Copper is used in **electrical conductor, Electrical wires, Electrical tubes etc**
- It is used in **Kitchen appliances, automotive radiators, Heat exchangers, heating vessels** etc.
- It is used for providing **coating on steel prior to nickel and chromium plating.**
- It is largely used in **electroplating.**
- It is widely used for **making coins**.

(ii) Aluminium

Properties: (any 3)

(1) Aluminium is a light metal & easily machinable

(2) It has good surface finish

(3) Good electrical and thermal conductivities

(4) Highly reflective to heat and light

(5) Versatile metal

(6) Aluminium can be riveted, welded, brazed, or resin bonded.

(7) Corrosion resistant

(8) Aluminium and its alloys provide high strength-to-weight ratio (high specific strength) due to low density.

(9) High Ductility: Aluminium is ductile and has a

(10) Low melting point and density.

(11) Melting point of aluminium is 658^0C.

(12) The tensile strength of the metal varies from 90 MPa to 150 MPa.

(13) Boiling point of aluminium is 2057^0C.

Uses: (any 2)

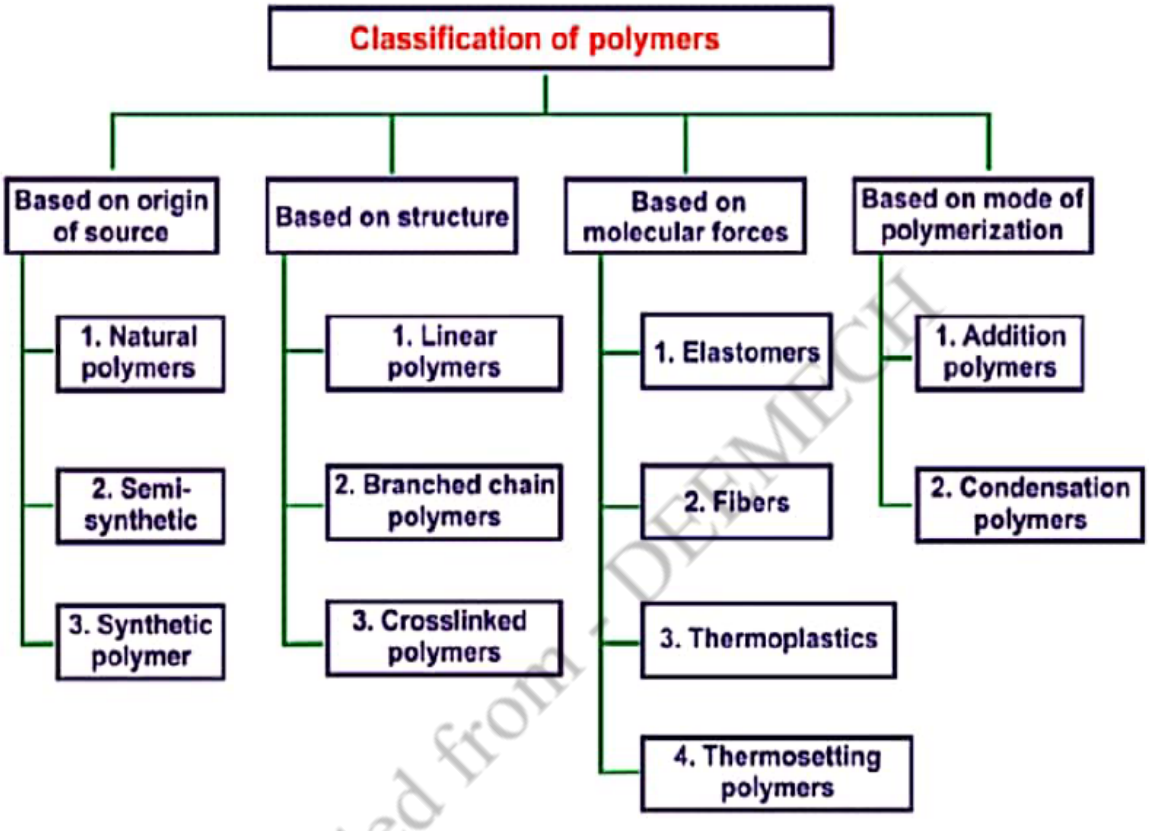
- Aluminium is used in **Computer Motherboards and LED Lights, Overhead Cable etc**.
- **Light Fittings or Rescue Blankets**.
- **Cool roofs** made of coated aluminium
- It is used to produce **Sheets, Foil, Geometrical Configurations, Tubes, Rods or Wires etc**.
- **Aerospace and Automotive** Applications.
- **Cooking Utensils and Thin Foils** for wrapping food items.

5.c) Explain Self-lubrication bearings. (4 marks)

- Self-lubricating bearings provide their own lubrication during operation without requiring application of grease or oil lubricants**.**
- These bearing have following properties
    - High load capacity,
    - Impact resistance,
    - High temperature withstand,
    - Self-lubricating ability and other characteristics, especially for heavy load and low speed.
- These are widely used in metallurgical continuous Casting Machine, Rolling Equipment, Mining Machinery, Moulds, Lifting Machinery, Textile Machinery, Wind Power Generation, Ships, Steam Turbines, Turbines, Injection Moulding Machines and Equipment Production Lines.

- Bronze, Lead, Copper & Aluminium alloys And Sintered Iron & Copper etc are the common materials used for making self-lubricating bearings.

6. a) Give classification of Polymers. (4+6=10 marks)



6. b) List any five properties of Ceramics. (1*5=5 marks)

Following are the properties of Ceramics;

1. It has high hardness.
2. It has high brittleness
3. It has high melting point
4. It has high compressive strength
5. It has good corrosion resistance
6. It is a bad conductor of electricity
7. It has low thermal conductivity

6. c) Explain the designation of Plastics. (5 marks)

"1" signifies that the product is made out of polyethylene terephthalate (PET) (Beverage bottles, cups, other packaging, etc.)

"2" signifies high-density polyethylene (HDPE) (bottles, cups, milk jugs, etc.)

"3" signifies polyvinyl chloride (PVC) (pipes, siding, flooring, etc.)

"4" signifies low-density polyethylene (LDPE) (plastic bags, six-pack rings, tubing, etc.)

"5" signifies polypropylene (PP) (auto parts, industrial fibers, food containers, etc.)

"6" signifies polystyrene (PS) (plastic utensils, Styrofoam, cafeteria trays, etc.)

"7" signifies other plastics, such as acrylic, nylon, polycarbonate and poly lactic acid (PLA).

SECTION - 4

7. a) List any four applications of Smart material. (1*4=4 marks)

Following are the application of smart materials;

1. Aerospace
2. Mass transit
3. Marine
4. Automotive
5. Computers and other electronic devices
6. Consumer goods applications
7. Civil engineering
8. Medical equipment applications
9. Rotating machinery applications

7. b) Differentiate between Thermosetting and Thermoplastic materials.

(2*5=10 marks)

Sl. No.	Thermoplastic plastic	Thermosetting plastic
1	It is linear polymer.	It is cross linked polymer.
2	It is soft and flexible.	It is hard and brittle.
3	It is formed by addition polymerization.	It formed by condensation polymerization.
4	It has low molecular weight.	It has high molecular weight.

5	It is not fire proof.	It is fire proof.
6	It can be reused.	It cannot be reused.
7	They undergo no chemical change in the molding operation.	They undergo chemical change in the molding operation.
8	They can be softened again and again.	They cannot be re-softened once they are hard.
9	They are affected by certain solvents.	They are unaffected by any solvents.

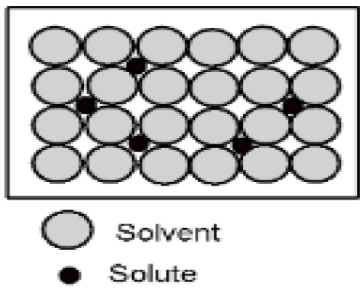
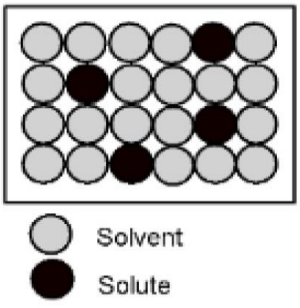
7. c) Suggest an advanced material for Medical application. Justify your answer. (3+3=6 marks)

Biomaterials are suggested for Medical applications.

Biomaterials have following properties which are suitable for Medical applications;

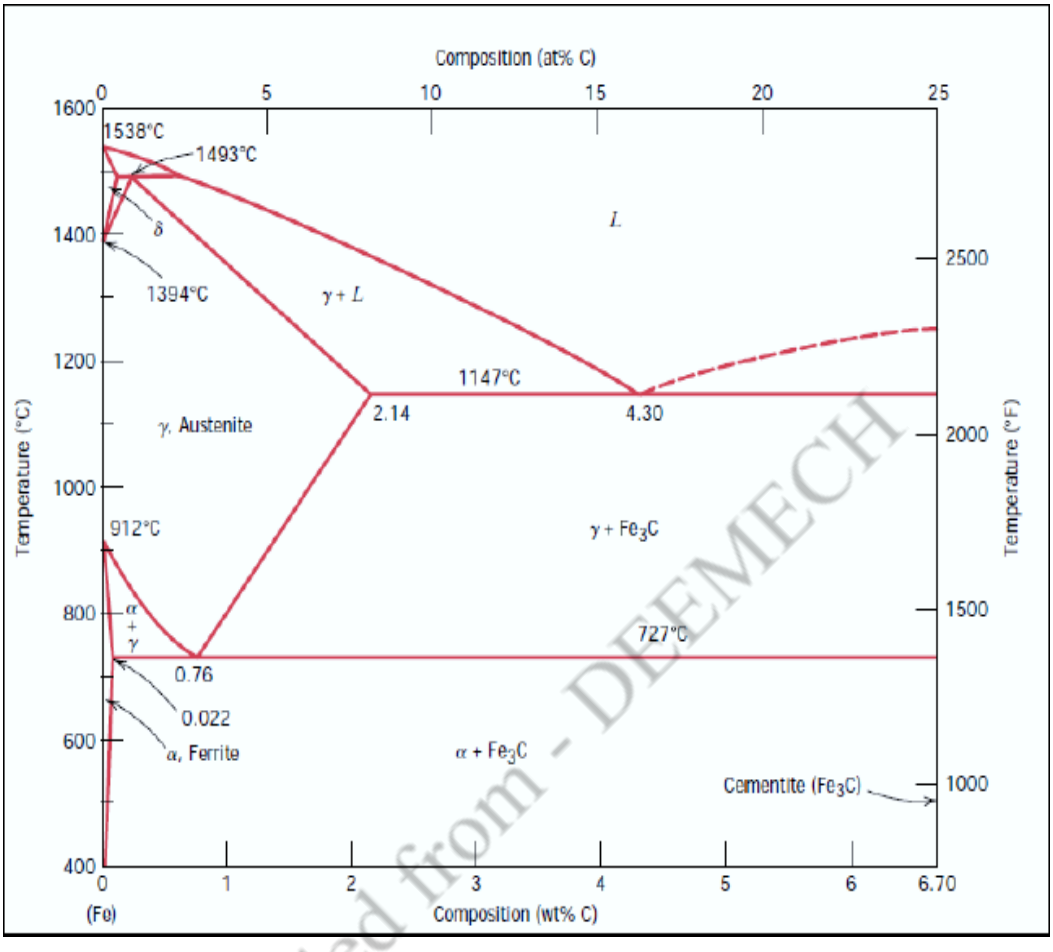
1. They do not react with any tissue in the body.
2. They are non-toxic to the body.
3. Long term replacement won't be biodegradable.

8. a) Distinguish between Interstitial and Substitutional solid solution. (2*2=4 marks)

Sl. No.	Interstitial solid solution	Substitutional solid solution
1	Interstitial solid solutions are formed when the solute atoms found in the holes or interstices between the solvent atoms.	Substitutional solid solutions are formed when the solute metal atoms substitute the solvent atoms in a crystal structure.
2	The solute atoms are very small in comparison with the solvent (matrix) atoms.	The solvent metal atoms and solute metal atoms are of same size.
3		

8. b) Draw Iron-Carbon Equilibrium diagram indicating various phases.

(5+5=10 marks)



Iron-Carbon Equilibrium diagram

8. c) List the different types of Heat treatment process. (Any 6) (1*6=6)

Following are the different types of Heat treatment process;

1. Annealing
2. Normalising
3. Hardening
4. Tempering
5. Case hardening.
   a. Carburising b. Cyaniding c. Nitriding
6. Surface hardening
   a. Induction hardening
   b. Flame hardening
7. Diffusion coatings.

SECTION - 5

9. a) State the purpose of Heat treatment. (1*8=8 marks)

Following are the purpose of Heat Treatment;

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
9. To removes trapped gases, etc

9. b) Differentiate between Annealing and Normalizing. (Any 4)

(2*4=8 marks)

Sl. No.	Annealing	Normalizing
1	It consists of heating of Steel parts to a temperature at or near the critical temperature (900^0C), holds it at that temperature for a suitable time and then allowed to cool slowly in the Furnace itself.	It consists of heating the Steel 50^0C above its upper critical temperature (810^0C to 930^0C). It is held at this temperature for about 15 minutes and then allowed to cool down in still air.
2	Steel parts are gradually cooled in a Furnace.	Steel parts are gradually cold in still Air.
3	Comparatively lower yield point, ultimate tensile strength and impact Strength.	Comparatively higher yield point, ultimate tensile strength and impact Strength.
4	Comparatively soft and easily Machinable.	Comparatively lesser soft
5	Low hardness	Relatively harder
6	Highly ductile and percentage of elongation is more	Less ductile and relatively percentage of elongation is less

9. c) Suggest a suitable heat treatment process during manufacturing of Coils & Laminated springs. Justify the answer. (2+2=4 marks)

Medium Temperature Tempering (heating to 250℃ to 350℃) is suitable during the manufacturing of Coils & Laminated springs.

Medium Temperature Tempering **provides the highest elastic limit with ample toughness**.

10.a) List different types of Corrosion. (Any 4) (1*4=4 marks)

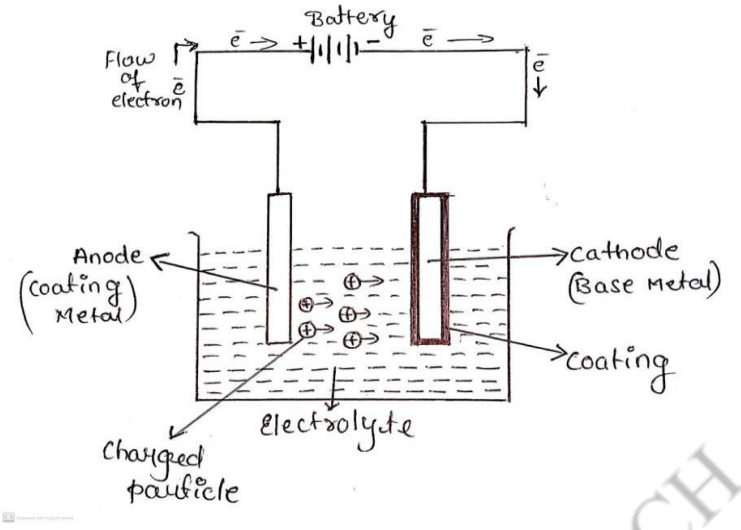
Following are the different types of Corrosion;

1. Dry or chemical corrosion
2. Wet or Electrochemical corrosion
3. Galvanic corrosion
4. Uniform corrosion
5. Pitting corrosion
6. Intergranular corrosion
7. Stress corrosion
8. Crevice corrosion
9. Atmospheric corrosion
10. Selective corrosion
11. Underground corrosion
12. Erosion corrosion

10.b) Differentiate between Electrolyte and Non-electrolyte. (2*3=6 marks)

Sl. No.	Electrolyte	Non-electrolyte
1	Electrolytes are chemical compounds that conduct electricity when dissolved in an aqueous solution.	Non-electrolytes are chemical compounds that do not conduct electricity when dissolved in an aqueous solution.
2	They have ionic bond.	They have covalent bond.
3	Ions are present.	Ions are not present.
4	Example: Acids, Bases and Salts, etc	Example: Sugar, glucose, ethyl alcohol, urea, etc

10.c) Explain with a neat sketch Electroplating process. (5+5=10 marks)



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.

7292

Code : 20ME11T

Register Number

I Semester Diploma Examination, February/March-2023

MATERIALS FOR ENGINEERING

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

Instructions : (i) Answer any **one** full question from each Section – **I, II, III, IV & V.**

(ii) Each one full question carries 20 marks.

SECTION – I

1. (a) Mention any four Engineering materials used in daily life application. **4**

(b) Explain the crystal structure of Diamond with a neat diagram. **6**

(c) Define Mechanical Property. **2**

(d) Name the mechanical property for the below listed conditions : **8**

(i) The property that enables a metal to resist deformation under load.

(ii) The property that helps to resist scratch.

(iii) Glass bottle breaks immediately when dropped to floor.

(iv) Spring and rubber come back to their original position after deformation.

(v) Mild steel, Copper, Aluminium can be drawn out into thin wire.

(vi) The property of the material which enables it to withstand shock or impact.

(vii) Tin can be hammered or rolled into sheets.

(viii) Clay materials undergo permanent deformation.

2. (a) Explain Electron Microscope with neat sketch. **10**

(b) Explain the effect of various elements used for alloying. **5**

(c) Write a note on tool steel. **5**

SECTION – II

3. (a) Name the Cast Iron with its composition and properties used for making machine tool bodies. 7

(b) Select relevant stainless steel with justification for the following application : 6

(i) Knife blade

(ii) Dairy equipment

(iii) Textile

(c) Explain Plain Carbon steels. 7

4. (a) Differentiate between Ferrous and Non-Ferrous metals. 6

(b) Name the following metals (or) alloys : 5

(i) Metal alloyed with Iron to make stainless steel.

(ii) A metal which is an alloy of Copper and Zinc.

(iii) An alloy of Aluminium used for making kitchen utensils.

(iv) A metal used for making Jewellery.

(v) A metal which is an alloy of Copper and Tin.

(c) Give reasons for the following : 6

(i) School bells are made up of metals.

(ii) Electric wires are made of Copper.

(iii) Electric wires are covered with rubber like material.

(d) A metal "X" acquires a green colour coating on its surface when exposed to air. 3

(i) Identify the metal "X".

(ii) Name the process responsible for change.

(iii) List two important methods to prevent the process.

SECTION – III

5. (a) Write the properties and application of Aluminium. 8

(b) Differentiate between Thermoplastic and Thermosetting plastic by giving one example for each. 8

(c) State two uses of Bakelite & Nylon. 4

6. (a) Explain composite materials with its properties and applications. 8

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

(i) 30C8

(ii) FG200

(c) Write a note on Spring Steel. 6

SECTION – IV

7. (a) List any eight applications of Biomaterials. 8

(b) Write a note on intelligent materials with reference to changes in the environment. 6

(c) Explain mechanism of heat treatment. 6

8. (a) Sketch Iron-Carbon diagram for mild steel by indicating all phase transformation. 10

(b) What is a solid solution ? Explain different types of solid solution. 5

(c) State objectives of the following : 5

(i) Carburizing

(ii) Nitriding

SECTION – V

9. (a) List the purpose of heat treatment. 8

(b) Which process is used to soften the mild steel ? Explain. 6

(c) Explain with sketch Electroplating. 6

10. (a) State the factors influencing corrosion. 4

(b) What are the methods of surface treatment ? 8

(c) Explain the construction and working of electrochemical cell. 8

SCHEME OF VALUATION

MATERIALS FOR ENGINEERING

Ist SEMESTER **CODE: 20ME11T**

TIME: 3 HRS **MAX MARKS: 100**

SECTION-I			
1	a	Any four relevant engineering materials/applications	1 x 4 =4
	b	Sketch=3M + Explain=3M	3 + 3 =6
	c	Definition	2
	d	Name the mechanical property	1 x 8 =8
2	a	Sketch=4M + Label =2M + Explain=4M	4 +2 +4 =10
	b	Any 05 elements with any 01 effect	1 x 5 =5
	c	Short notes	5
SECTION-II			
3	a	Composition=2M + any 5 Properties=5M	2 +5 =7
	b	Steel name=1M + Justification=1M	2 x 3 =6
	c	(any04)Properties=4M+Types=2M+(any01)Application=1M	4 +2 +1 =7
4	a	Any Six difference	1 x 6 =6
	b	Name the metal	1 x 5 =5
	c	Any One reason	2 x 3= 6
	d	i. Identify=1M ii.Process name=1M iii.Any two methods=1M	1+1+1 = 3
SECTION-III			
5	a	04 Properties=4M + 04 Application=4M	4 +4=8
	b	Any Six difference=6M + Each example=2M	6 +2 =8
	c	Any Two uses	2 x 2=4
6	a	Define=2M+(any03)Properties=3M+(any03)Application=3M	2 +3 +3=8
	b	Designation condition for Steels=2M + Meaning=2M+2M	2 +4=6
	c	Short notes	6
SECTION-IV			
7	a	Any eight applications	1 x 8=8
	b	Identification=1M+(any03)Properties=3M+(any02)Application=2M	1+ 3 +2 =6
	c	Mechanism	6
8	a	Plot graph=5M + Indication(Phases, Temperatures)=5M	5 + 5=10
	b	Solid solution=1M + 2Types=2+2=4M	1+2+2 =5
	c	Carburizing=3M + Nitriding=2M	3 + 2=5
SECTION-V			
9	a	Any Eight purpose	1 x 8 =8
	b	Identification =2M + Explain/Purpose= 4M	2 + 4=6
	c	Sketch 2M + Label 1M+ Explain 3M	2 +1 +3=6
10	a	Any Four factors	1 x 4=4
	b	List any Eight methods	1 x 8 =8
	c	Sketch 3M + Label 2M+ Working 3M	3 +2 +3 =8

SECTION I

1. (a) Mention any Four Engineering materials used in daily life application (Each material/application, 1x4=4M)

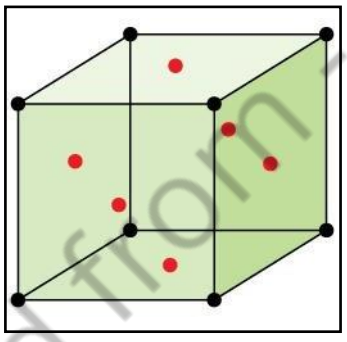
Ans: Engineering materials used in daily life application are as follows:

- Metals and alloys
- Ceramics and glasses
- Organic polymers
- Composites

Note: Any examples for the above materials should also be considered for valuation.

1. (b) Explain the crystal structure of Diamond with a neat diagram (Sketch=3M + Explain=3M)

Ans: **FACE CENTRED CUBIC STRUCTURE** (FCC)



- In this type of structure, the unit cell, which is in the shape of a cube, contains one atom at each of its 8 corners and one atom at the centre of each of its face.
- This type of structure does not contain any atom at the centre of the unit cell.
- Each unit cell shares 14 (= 8+ 6) atoms, with the neighboring unit cells.

1. (c) Define Mechanical Property (2M)

Ans: The Mechanical properties of a metal are those properties, which completely define its behavior under the action of external loads or forces.

1. (d) Name the mechanical property for the below listed conditions: (1x8=8M)

(i) The property that enables a metal to resist deformation under load- Ans: **Stiffness/Stress(though not a property)**

(ii) The property that helps to resist scratch- Ans**: Hardness**

(iii) Glass bottle breaks immediately when dropped to floor- Ans: **Brittleness**

(iv) Spring and rubber come back to their original position after deformation-Ans: **Elasticity**

(v) Mild steel, Copper, Aluminium can be drawn out into thin wire- Ans: **Ductility**

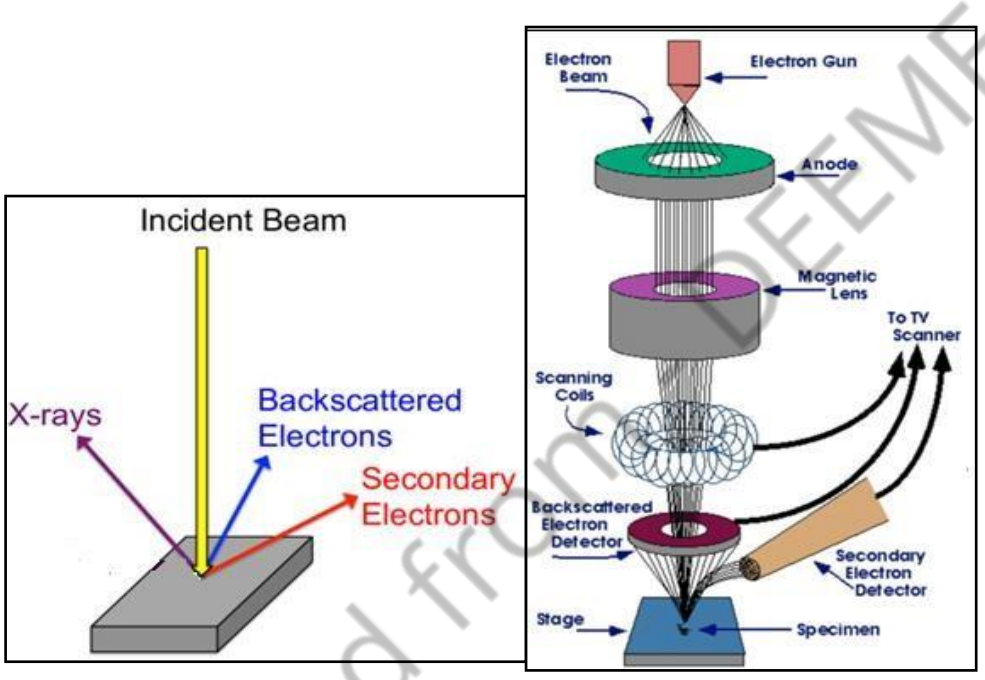
(vi) The property of the material which enables it to withstand shock or impact-Ans: **Toughness**

(vii) Tin can be hammered or rolled into sheets- Ans**:** **Malleability**

(viii) Clay materials undergo permanent deformation- Ans: **Plasticity**

2. (a) Explain Electron Microscope with neat sketch

Ans: **SCANNING ELECTRON MICROSCOPE (SEM) (Sketch=4M + Label =2M + Explain=4M)**



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 analysed to interpret the topography, crystallographic structure, and composition of the specimen.

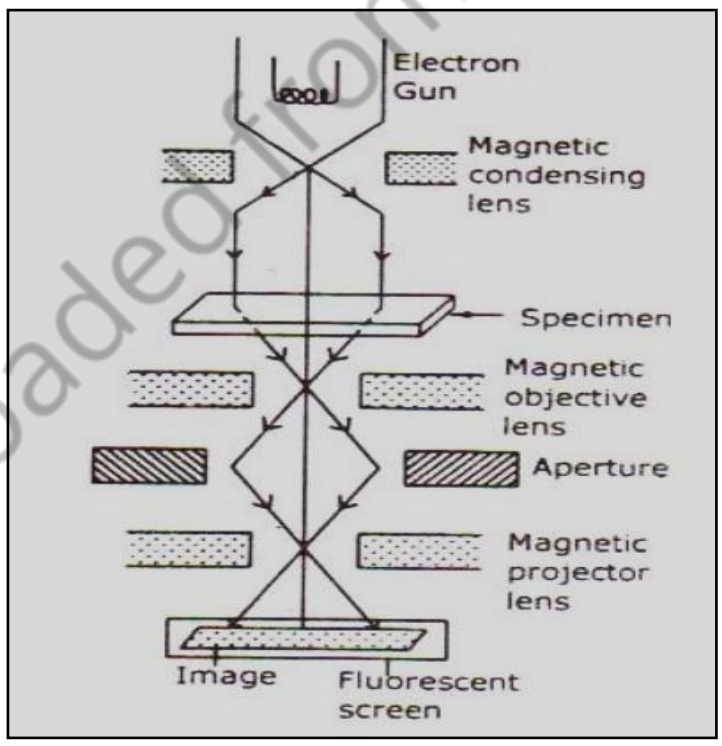
SEM basically consists of:

- Electron gun
- Condenser lenses
- Scan coils
- Backscattered, Secondary electron and X-ray Detectors, and
- Sample Chamber
  - A high energy electron beam is produced using an electron gun.
  - Electron beam thus produced is focused using a series of condenser lenses to obtain a narrower electron beam.
  - After the beam is focused, scanning coils are used to deflect the beam in the X and Y axes so that it scans over the surface of the sample.

- A high vacuum is required to operate an SEM and the sample is placed inside the microscope's vacuum chamber through an air tight door.
- When the high energy electron beam strikes the surface, the following are generated:
  - Secondary electrons
  - Back scattered electrons
  - X-rays
- These electrons and X-rays are detected using various types of detectors like secondary electron detector, back scattered electron detector and x-ray detector.
- Signals from these detectors are then amplified and required information like surface topography, structure, and composition of the metallographic specimen will be displayed on TV monitor.

OR

Ans: **TRANSMISSION ELECTRON MICROSCOPE (TEM) (Sketch=4M + Label =2M + Explain=4M)**



A Transmission electron microscope (TEM) is a type of electron microscope which is used to produce images of a metallographic sample. These Images are later studied and analysed to interpret the topography, crystallographic structure, and composition of the specimen.

TEM basically consists of:

- An electron gun
- Condenser lens
- Objective lens
- Projector lens
- Fluorescent screen or Viewing screen

- Stream of electrons are produced by an electron gun and is made to fall over the specimen using the magnetic condensing lens.
- The specimen is placed between the condensing lens and the objective lens as shown in the figure.
- Based on the angle of incidence, the beam is partially transmitted and partially diffracted through the specimen.
- In order to obtain a high intensity and high contrast image of the specimen, the beam is passed through magnetic objective lens and the aperture to eliminate the diffracted electron beam.
- Thus, transmitted beam alone is made to pass through the projector lens for further magnification.
- The magnified image is recorded in fluorescent screen.
- This high contrast image is called Bright Field Image, which gives the required information like surface topography, crystallographic structure, and composition of the specimen.

Note: Any one of the above electron microscope should be considered for valuation.

2.b. Explain the effect of various elements used for alloying (1each, 1x5=5M)

Ans:

Elements	**Effect**
Nickel	. Increase Toughness . Improve response to heat treatment .Large amounts improves electrical and magnetic properties
Chromium	.Increases Corrosion resistance .Increase Strength .Increase hardness

Vanadium	. Increases Corrosion resistance .High strength at high temperature
Tungsten	. Increases strength due its high melting point .Improves chemical, physical and mechanical properties at all temperatures
Silicon	. Improves electrical properties . Increase Strength
Copper	. Good heat conductivity . Good electrical conductivity
Molybdenum	. Increases Strength .Increases hardness
Manganese	. Increases abrasion resistance . Increases hardness
Aluminium	. Helps in cost reduction .Improves corrosion resistance
Cobalt	. Improves high temperature strength .Improves magnetic properties
Note: Any ONE effect written for any relevant FIVE elements (not listed above but relevant as well) should be considered for valuation	

2.c. Write a note on tool steel (5 M)

Ans: .Tool steels are high quality, carbon alloy steels.

.These steels are used for making cutters, reamers, bits.

.These tool steels are used as shaping, cutting forming and blanking materials for machining.

.These tool steels are used for machining metals, plastics woods and other suitable materials.

.Tool steels should possess properties like durability, high strength, corrosion resistance, temperature stability, high hardness, good wear resistance and high toughness.

.Tool steels may be broadly classified as Cold worked and Hot worked.

SECTION II

3. a. Name the Cast Iron with its composition and properties used for making machine tool bodies (Composition=2M + any 5 Properties=5M)

Ans: **GREY CAST IRON**

It has the following compositions:

Carbon 3-3.5%

Alloying elements like Manganese, Silicon, Phosphorous, and Sulphur.

Properties used for making machine tool bodies:

1. The grey color of the cast iron is due to the carbon which is present in the form of free graphite flakes which acts as a lubricant.
2. It is suitable for parts which require sliding action.
3. It has high compressive strength
4. It can be easily machined.
5. Due to its fluidity it can be cast to intricate shapes.
6. Better thermal conductivity
7. Vibration dampening capacity
8. It has low tensile strength
9. It is not ductile

3.b. Select relevant stainless steel with justification for the following application: (Steel name=1M + Justification=1M) (2x3=6 M)

(i) Knife Blade:

Ans: **MARTENSITIC STAINLESS STEEL**

These steels can be hardened by suitable heat treatment and have a good corrosive resistance qualities.

(ii) Dairy equipment:

Ans: **AUSTENITIC STAINLESS STEEL**

It has good resistance to corrosion. It is easy to clean and does not react with milk (acids).

(iii) Textile

Ans: **AUSTENITIC STAINLESS STEEL**

It has good resistance to corrosion. It is non-magnetic. It has good tensile strength.

3. (c) Explain Plain Carbon steels (Properties=4M +Types=2M +Application=1M)

1. These have very low carbon content.
2. Carbon varies from 0.06% to 1.4% and alloying elements.
3. These steels are strong, tough and ductile
4. Plain carbon steels have poor atmospheric corrosive resistance
5. These steels can be protected by painting, enamling or galvanizing.
6. They can be easily machined and welded
7. They can be easily forged.

Types of plain carbon steels are:

a) Dead Mild Steel
b) Low carbon or Mild Steel
c) Medium Carbon steel
d) High Carbon steel

Application of Plain carbon steels are:

Nails, Rivets, Chains, Axles, Connecting rods, Gears, Cams, Clutch Plates, Files, Punches.

4.a. Differentiate between Ferrous and Non-Ferrous metals (Any 6 = 6M)

Ferrous Metals	Non Ferrous Metals
It contains Iron	Does not contain any Iron
As it contains Iron, it is magnetic	It is non-magnetic
Less resistant to corrosion	More resistant to corrosion
The price of most of the ferrous metals is lower	The price of most of the metals is higher than ferrous metals
It includes Mild steel, carbon steel, stainless steel cast iron and wrought iron	It includes Aluminium, copper, nickel, zinc
Special feature of ferrous metals is it possess strength and durability	Special feature of Non Ferrous metals is malleability
Used where strength is required	Used for electrical and electronics applications
Note: Any other relevant difference should be considered for valuation	

4.b. Name the following metals (or) alloys: (1x5=5M)

(i) Metal alloyed with Iron to make stainless steel –**Ans: Chromium**

(ii) A metal which is an alloy of Copper and Zinc - **Ans: Brass**

(iii) An alloy of Aluminium used for making kitchen utensils - **Ans: Hindalium**

(iv) A metal used for making Jewellery – **Ans: Silver/ Gold/ Copper/ Platinum**

(v) A metal which is an alloy of Copper and Tin – **Ans: Bronze**

4.c. Give reasons for the following: (2x3=6M)

(i) School bells are made up of metals

Ans: **Metals produce good sound.**

The Vibration causes Sound when bell is strike.

(ii) Electric wires are made of Copper

Ans: **Copper is a good conductor of electricity.**

The copper metal allows the movement of electrons through the metal.

(iii) Electric wires are covered with rubber like material

Ans: **Rubber is good insulator.**

Rubber does not allow electric current to pass through them.

Note: Any other relevant reasoning should be considered for valuation

4.d. A metal "X" acquires a green colour coating on its surface when exposed to air. (3M)

(i) Identify the metal "X" (1M)

Ans: **X is Copper**

(ii) Name the process responsible for change (1M)

Ans: **Corrosion**

(iii) List two important methods to prevent the process (1M)

Ans: i. **It Should be coated with tin/coating**. ii . **It should be mixed with other metals to form alloys/alloying**

Note: Any other methods to prevent process if found appropriate should also be considered for valuation.

SECTION III

5.a. Write the properties and application of Aluminium (4 Properties=4M + 4 Application=4M)

Ans: Properties: .

1. It is good conductor of electricity
2. Good resistance to corrosion
3. Non Toxic
4. Non Magnetic
5. Light in weight
6. Ductile and Malleable
7. Good conductor of heat
8. Good reflection
9. It can be blanked, forged, formed, turned, forged and die casted

Application:

1. It is used for overhead cables
2. Used for cooking utensils
3. Used for aircraft and automobile components
4. Used in furniture, rail roads and trolley cars
5. Aluminium foils are used for food protection elements

5.b. Differentiate between Thermoplastic and Thermosetting plastic by giving one example for each (Difference=6M + one example for each=2M)

Ans:

Thermoplastics	Thermosetting Plastics
It is linear Polymer	It is cross link Polymer
It is Soft and Flexible	It is hard and brittle
It is formed by addition Polymerization	It is formed by Condensation Polymerization
It has low molecular weight	It has high molecular weight
It is not fire proof	It is fire proof
It can be reused	It cannot be reused
They undergo no chemical change in the molding operation	They undergo chemical change in the molding operation

They can be softened again and again	They cannot be resoftened once they are hard
They are affected by certain solvents	They are unaffected by any solvents
Examples: Polythene, Nylon, Teflon, Bottles, bags	Examples: Polyester, Printed Circuit Boards, Instrument dials
Note: Any other relevant examples and difference should be considered for valuation	

5c. State two uses of Bakelite & Nylon (2x2 = 4M)

Ans: Bakelite : .

- Manufacture of non-conducting parts of radio
- Electric devices such as sockets, wire insulation, switches
- Automobile distribution caps.

Nylon : .

- Clothing – Shirts, Foundation garments, lingerie, raincoats, swimwear and cycle wear.
- Industrial uses – Conveyer and seat belts, parachutes, airbags, nets and ropes, tarpaulins, thread, and tents.
- It is used to make a fishnet.
- It is used as plastic in manufacturing machine parts

6.a. Explain composite materials with its properties and applications (Define=2M +

3 Properties=3M + 3 Application=3M)

Ans: Composites are combination of two or more materials that are mixed or joined on a macroscopic level to produce a new material which processes much superior properties than any of the constituent material.

→Natural composites - wood - long fibre held together by Lignin

→Artificial composites – Fibre reinforced composite, Structural composite, Metal Matrix Composite, Sandwich panels, cement, concrete, plywood, etc.

Properties

1. High strength to weight ratio
2. High durability
3. High stiffness
4. High damping property
5. Good resistance to corrosion
6. High wear impact and fire resistance
7. High compressive strength
8. Low thermal expansion Coefficient
9. Good appearance and high rigidity
10. Good resistance to wear and tear

11. Resistance to moisture
12. Less liability to wrap

Applications

1. In automobile Tyres
2. Filament wound rocket casting
3. Filament wound high pressure hoses
4. Used for automobile parts, storage tanks, plastic pipes etc,.
5. Park benches
6. Aircraft and military applications
7. Space applications and Sporting goods
8. Marine applications
9. Used for floor, roof, wall of the building.
10. Used for furniture.
11. Used in kitchen, bathroom.
12. Used for cabinet shutters.
13. Interiors of heavy vehicles.

6.b. How steels are designated? Indicate the meaning of following designated materials: (Steels designation condition=2M + Meaning=2+2=4M)

Ans: Steels are designated by grouping of letters or numbers indicating based on below conditions:

a. Tensile Strength/Yield Strength
b. Carbon Content
c. Composition of alloying elements

(i) **30C8 -** 0.3 % C & 0.08% of Manganese

(ii) **FG200 –** Grey Cast Iron having tensile strength of 200 N/mm^2

6.c. Write a note on Spring steel (6M)

Ans:

1. Suitable material for making spring which stores maximum amount of energy without permanent deformation.
2. Should be highly elastic, highly deflective, return to their original shape without permanent deformation
3. Should possess maximum strength against fatigue effects and shocks.

Applications:

1. Automobile applications
2. Industrial applications
3. Aerospace applications

SECTION IV

7.a. List any eight application of Biomaterials. (any 8 =8M)

Ans. Applications of Biomaterial

1. Used for joint replacement
2. For bone plates
3. Lenses for eye surgery
4. Bone cement
5. Dental implants for tooth fixation
6. For Artificial ligaments and tendons
7. Used for skin repair devices
8. For cancer therapy

Note: Any relevant application apart from above listed should be considered for valuation

7. b.Write a note on intelligent materials with reference to changes in the environment. (Identification=1M + Properties=3M + Application 2M)

Ans. **SMART MATERIALS** are the intelligent materials that respond to stimuli and environmental changes and to activate their functions according to the changes.

Properties of smart materials

1. Sensing material and devices
2. Actuation material and devices
3. Control devices and techniques
4. Self-detection and self-Diagnostic
5. Self-corrective, self-control and self-healing
6. Excellent shock absorber or damage arrester
7. Excellent response to change in their environment

Applications of smart materials

1. Used in composite materials embedded with fibre optics
2. Used for actuators and sensors
3. Micro-electro mechanical systems
4. Electronic display units, data storage units
5. Insulin pumps, ultrasonic therapy and ultrasonic cataract removal devices
6. Computer, micro-actuator for hard discs
7. Automotive Wheel Balance, seat belt buzzers etc.
8. Inkjet printing head, strain gauges, ultrasonic welders etc.

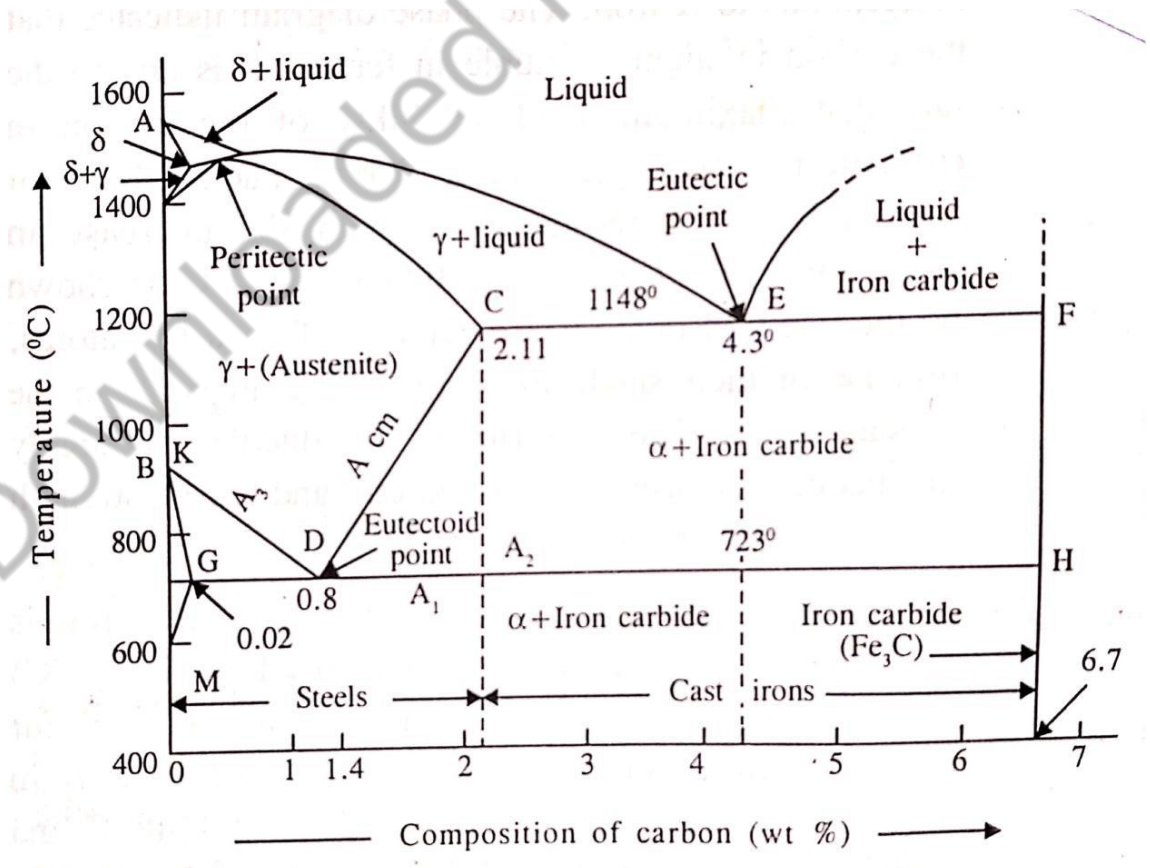
7.c. Explain Mechanism of Heat Treatment (6M)

Ans. Heat treatment process consists of:

1. Heating the metal to specified temperature.
   - The temperature to which a metal or an alloy heated depends upon its grade, grain size as well as type and shape.
   - In general the metal is never heated much beyond its upper critical temperature.
2. Holding the metal at increased temperature for a specified period.
   - The metal or alloy is now held at the increased temperature to ensure uniformity of temperature throughout the mass.
   - The period of heating depends upon the size and shape of the component.
3. Cooling the metal according to specified process.
   - The main transformation in the properties of a component takes place in the cooling process of the metal.
   - It depends mostly upon the rate at which the cooling takes place.
   - It also depends upon the medium in which the cooling takes place. In these days only five quenching medium adopted are caustic soda solution, brine, water, oil and air.

8.a. Sketch Iron-Carbon diagram for mild steel by indicating all phase transformation (Plot graph=5M + Indication(Phases, Temperatures)=5M)

Ans.



8b. What is a solid solution? Explain different types of Solid solution. (1M +2M+2M (2Types)= 4M)

Ans. Any solution is composed of two parts: a solute and a solvent. The solute is the minor part of the solution, while the solvent constitutes the major portion of the solution. *A solid solution is simply a solution in the solid state and consists of two kinds of atoms combined in one type of space lattice.*

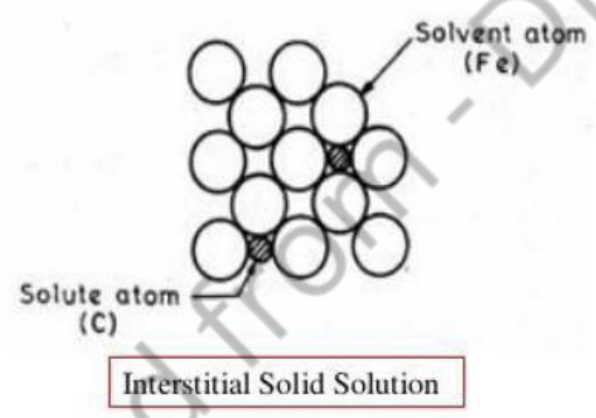
The two kinds of solid solutions are formed

1. Interstitial solutions.
2. Substitutional solutions.

Interstitial solid solution:

Interstitial solid solutions are formed when the solute atoms are very small in comparison with the solvent (matrix) atoms and solute atoms are found in the 'holes' or interstices between solvent atoms as shown in figure. In general hydrogen, carbon, nitrogen and Boron which have small atomic diameters can form interstitial solid solutions with the transition metals.

-OR-

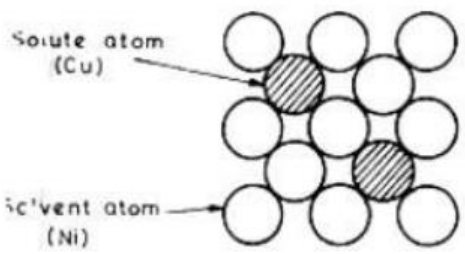


Interstitial Solid Solution

Substitutional solid solutions

Substitutional solid solutions form when the solute atoms take up the positions in the crystal lattice of the solvent metal. Solid solubility is governed by the comparative size of the atoms of the two elements. Copper-Nickel and copper-zinc are example of substitutional solid solution

- OR -



Substitutional Solid Solution

8.c. State objective of the following: (3M + 2M)

(i). CARBURIZING (3M)

Ans. **Objectives of carburizing are:**

1. To obtain a hard and wear resistant surface on 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 higher fatigue limit and high mechanical properties in the core

(ii). NITRIDING (2M)

Ans. **Objectives of nitriding are:**

1. It requires no further heat treatment.
2. It does not give any scaling, cracking and distortion, since quenching is not required.
3. It gives very high hardness.
4. No machining is required after the process.
5. Structure and properties of the metal are not affected.
6. The surface effectively resists corrosive action of water, salt-water spray, alkalies, crude oil and natural gas.
7. To increase wear resistance of surface and increased fatigue limit.

SECTION V

9.a. List the purpose of heat treatment. (any 8 =1x 8M)

Ans.

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.
9. To produce a hard surface on a ductile material

9.b. Which process is used to soften the mild steel? Explain. (Identification=2M+ Explain/Purpose=4M)

Ans: **ANNEALING**:

1. The steel parts produced by the mechanical operations such as casting, rolling, or drawing, extruding etc. develop internal stresses and change their internal structure. This renders them hard and brittle.
2. Annealing is carried out for such parts to remove the internal stresses and make them more ductile and less brittle.
3. Annealing consists of heating of Steel parts to a temperature at or near the critical temperature (9000C), hold it at that temperature for a suitable time and then allowed to cool slowly in the Furnace itself.

Purpose of Annealing

1. To soften the Steel, so that it may be more easily machined or cold worked.
2. To refine the grain-size and structure to improve mechanical properties like strength and ductility.
3. To relieve internal stresses which may have been caused by hot or cold working or by unequal contraction in casting.
4. To alter electrical, magnetic or other physical properties.
5. To remove the gases, trapped in the metal, during initial casting.

9.c. Explain with neat sketch Electroplating. (Sketch 2M + Label 1M+ Explain 3M)

Ans: . It is the process of depositing a very thin layer of metal coating, on the base metal by passing a direct current through an electrolyte solution containing some salt of the coating metal. In this process, the component of base metal is made to act as a cathode whereas the coating metal is an anode in a solution containing some salt of the coating metal i.e., electrolyte as shown in fig. Now the direct current is passed for a known time to get the coating of desired thickness. The commonly used coating materials are: copper, nickel, silver, gold, chromium and tungsten etc.

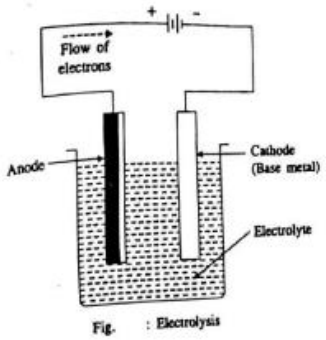


Fig. : Electrolysis

10.a. State the factors influencing corrosion. (4M)

Ans: .

1. Reactivity of metal: If metal is more reactive then it undergoes corrosion more readily.
2. Strain in metal: Corrosion takes place readily at cuts and bends area of metal.
3. Presence of impurities: If impurities present in the pure metal then metal undergoes corrosion more readily.
4. Presence of electrolyte: In saline water (electrolyte) metal readily corrodes.
5. Air and moisture: Best example rusting of Iron.
6. pH < 7 is more corrosive than basic or neutral medium.
7. Temperature: At higher temperature rate of corrosion become increased

10.b. What are the methods of surface treatment? (any 8 methods = 8M)

Ans: Surface of the metals can be protected by

. i. Metallic coating

a. Electroplating
b. Dipping
c. Spraying
d. Cladding
e. Cementation.

.ii. Non-metallic coating

f. Paints and lacquering
g. Plastic coating
h. Vitreous coating
i. Oxide coating
j. Chemical dip coating.

10.c. Explain the construction and working of electrochemical cell (Sketch 3M + Label 2M+ Working 3M)

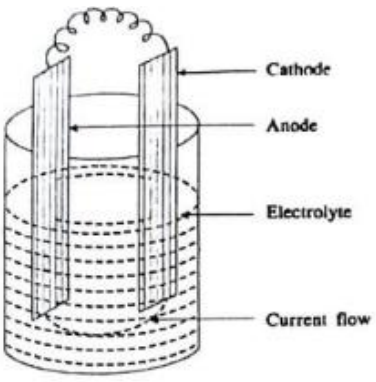


Fig. : Electrochemical cell

Construction:

An electrochemical cell, in its simplest form, consists of a vessel containing electrolyte (liquid), two dissimilar electrodes (knows 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 get deposited over the cathodic metal and form 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.

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

I Semester Diploma Examinations June /July2023 CODE: 20ME11T

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

I Semester Diploma Examinations June /July2023 CODE: 20ME11T

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.

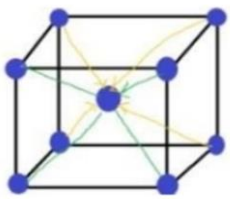


Fig: BCC

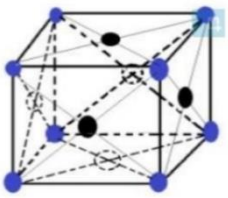


Fig: FCC

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

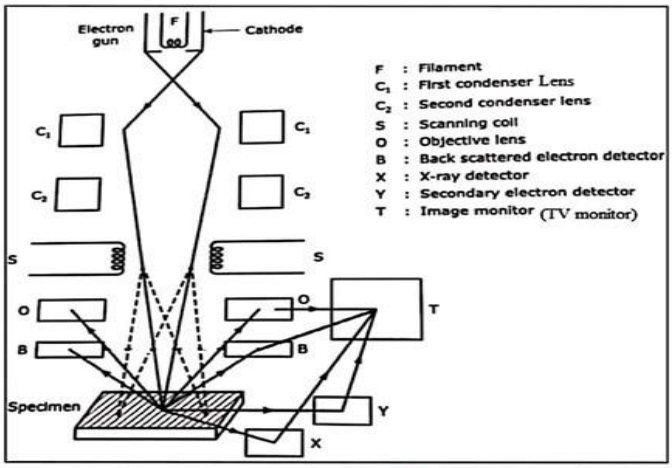
(c) Illustrate the working of scanning electron microscope with neat sketch.

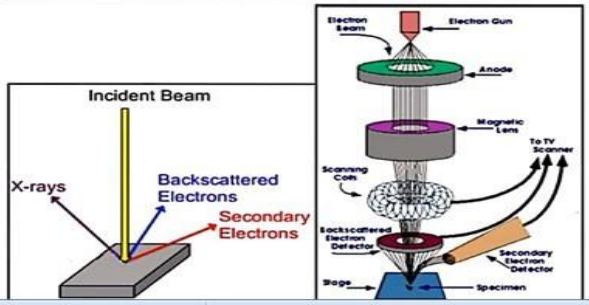
(6+4 =1 0m)

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.

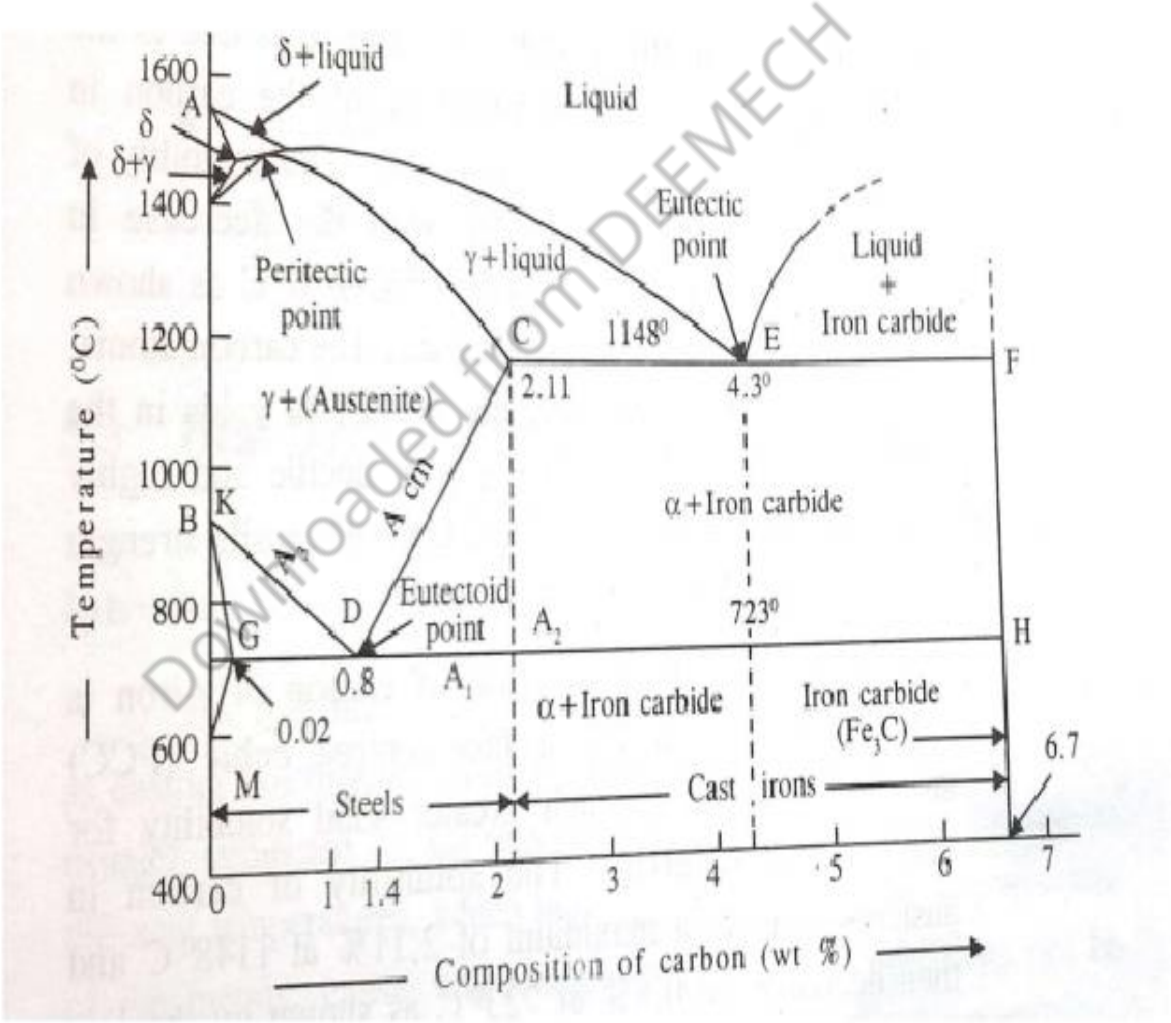
Properties

- 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.

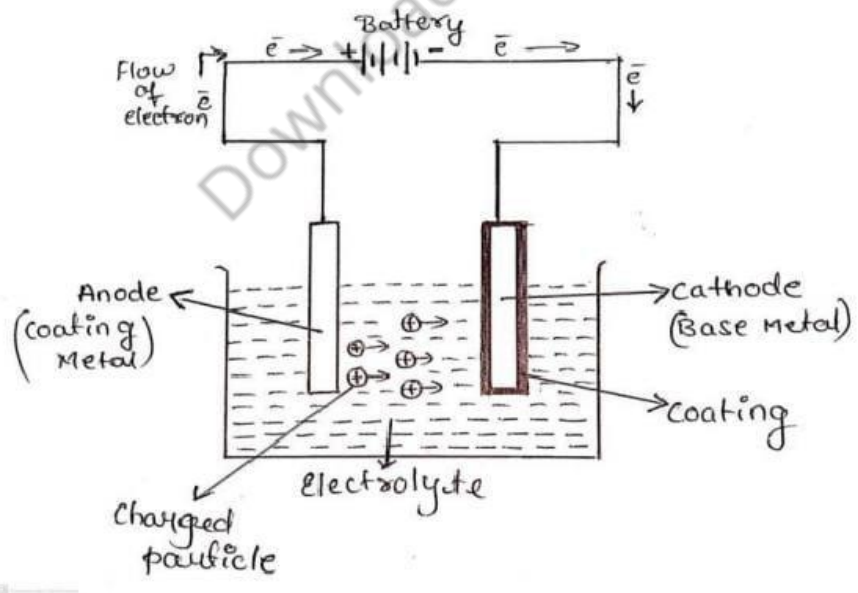
7. It is relative.

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.

****