# **Question Paper**

Exam Date & Time: 22-Nov-2019 (02:00 PM - 05:00 PM)



## MANIPAL ACADEMY OF HIGHER EDUCATION

#### INTERNATIONAL CENTRE FOR APPLIED SCIENCES END SEMESTER THEORY EXAMINATIONS NOVEMBER 2019 III SEMESTER B.Sc.(Applied Sciences) in Engineering MATERIAL SCIENCE AND ENGINEERING [IMET 233]

Marks: 100

3)

4)

A)

#### Answer 5 out of 8 questions.

- 1)
   Discuss the heat treatment processes of 0.76% C steel where the end (10) product is:
   (10)

   A)
   I. Maximum amount of Martensite
   (10)
  - II. 100% Bainite

Draw the heat treatment curve for both. (5+5 = 10)

- <sup>B)</sup> A. Define the following terms:
  - 1. Polymerization.
  - 2. Thin Film Deposition
  - 3. Hardenability
  - 4. Composite
  - 5. Tempering

B. Beryllium has an HCP unit cell for which the ratio of the lattice parameters c/a is 1.568. If the radius of the Be atom is 0.1143 nm, (a) determine the unit cell volume, and (b) calculate the theoretical density of Be. (Assume atomic weight of Be = 9.0 gm/mol) (5+5 = 10)

- Draw Iron Iron Carbide equilibrium diagram and explain the reaction taking <sup>(10)</sup> place at 1147°C.
  - B) Explain carburizing and nitriding diffusion surface heat treatment processes. <sup>(10)</sup> (5+5=10)
    - 1. Discuss the Matthiessen's rule. Also, state the reasons for increase of <sup>(10)</sup> electrical resistivity in metals.
    - 2. Explain Snell's law of light refraction. (6+4=10)
  - B) 1. Rhodium has an atomic radius of 0.1345 nm and density of 12.41 (10) g/cm<sup>3</sup>. Determine whether it has an FCC or BCC crystal structure. (Avogadro's Number = 6.023×10<sup>23</sup> atoms/mol)
    - 2. Describe the dispersion strengthened composites and its influencing factors. **(6+4=10)**

1 State the issues related to thin film denosition

Duration: 180 mins.

(10)

- . State the issues related to third him deposition.
- 2. Consider an Al-4% Si alloy in Figure Q4A. Determine:
- A. If the alloy is hypoeutectic or hypereutectic;
- B. The composition of the first solid to form during solidification;
- C. The amounts and compositions of each phase at 578°C.(6+4=10)



- Draw and explain annealing and normalizing heat treatment process. <sup>(10)</sup>
   Differentiate between thermoset and thermoplastic polymers. (5+5=10)
- 1. How Burger's rule is applied to determine the dislocation in case of an <sup>(10)</sup> edge dislocation? Explain with a diagram.
- 2. Represent the following Miller Indices in a unit cell cubic structure:
- A. (101)
- B. (110)
- C. (100)
- D. (011) (6+4=10)
- B) Discuss the slow cooling and rapid cooling of an isomorphous alloy. (10)
   (5+5=10)
  - A. State and explain the rules for the formation of a solid solution.
     B. Explain the phenomena of magnetism. Mention its applications.(4+6=10)
    - In Fe FeC diagram, determine the packing factor, coordination (10) number and effective number of atoms for α - ferrite.
      - 2. With the help of a diagram, explain sputtering process.(6+4=10)
- A. Consider a specimen of ice that is at -10°C and 10 atm pressure. Using (10)
   Figure Q7A, the pressure-temperature phase diagram for H2O, determine the pressure to which the specimen must be raised or lowered to cause it (a) to melt, and (b) to sublime. At a pressure of 0.1 atm, determine (a) the melting temperature for ice, and (b) the boiling temperature for water.

5)

A)

B)

6)

A) B)



B. Define heat treatment. State the objectives of heat treatment and stages involved in it. **(6+4=10)** 

### <sup>B)</sup> Explain dendritic and planar growth mechanism in crystalline materials. <sup>(10)</sup>

- 1. Define nucleation and rate of nucleation. Derive an expression for (10) critical radius of nucleation.
- Outline the factors on which heat treatment of metals depends (6+4=10)
- <sup>B)</sup> Draw and explain the TTT diagram for eutectoid steel with the phases. <sup>(10)</sup>

-----End-----

8)

A)