INTERNATIONAL CENTRE FOR APPLIED SCIENCES
MAHE, MANIPAL

B.Sc. (Applied Sciences) in Engg.

End – Semester Theory Examinations – Nov./ Dec. 2020

III SEMESTER - MATERIAL SCIENCE AND ENGINEERING (IMET 233)

(Branch: Mechatronics)

Time: 3 Hours **Date: 27 November 2020** **Max. Marks: 50**

- ✓ **Answer ALL the questions.**
- ✓ **Missing data, if any, may be suitably assumed**

1A. Consider a parallel-plate capacitor having an area of 3225 mm^2, a plate separation of 1 mm, and with a material having a dielectric constant of 3.5 positioned between the plates. **(a)**What is the capacitance of this capacitor? **(b)** Compute the electric field that must be applied for 2×10^{-8} C to be stored on each plate. Permittivity of free space is 8.85×10^{-12} F/m **04**

1B. With the help of a diagram, explain sputtering process. **04**

1C.
i. An iron bar magnet having a current of 12 Ampere is to be demagnetized. If the bar is inserted within a cylindrical wire coil 0.25 m long and having 150 turns, what is the magnetic coercivity? **02**

ii. Define Solid Solution.

2A. For the nonequilibrium conditions shown for the MgO – 65 wt% FeO ceramic, determine (a) the liquidus temperature, (b) the nonequilibrium solidus temperature, (c) the freezing range, (d) the composition of the first solid to form during solidification, (e) the composition of the last liquid to solidify, (f) the phase(s) present, the composition of the phase(s), and the amount of the phase(s) at 1800°C, and (g) the phase(s) present, the composition of the phase(s), and the amount of the phase(s) at 1600°C. (Refer Figure 2A) **07**

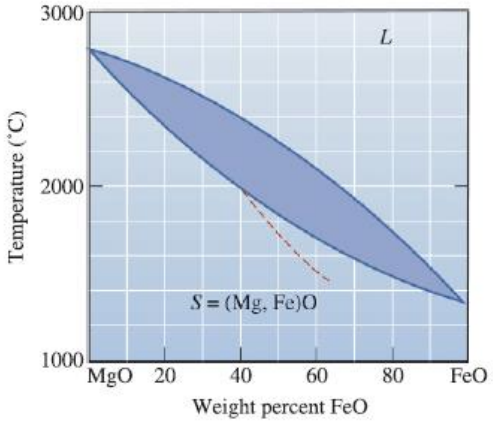

Figure 2A

2B. A typical paper clip weighs 0.59 g and consists of BCC iron. Calculate (a) the number of unit cells and (b) the number of iron atoms in the paper clip. The lattice parameter for BCC iron is 2.866×10^{-8} cm and density is 7.87 g/cm^3. **03**

3A. Discuss the heat treatment processes of 0.76% C steel where the end product is maximum amount of Martensite. Draw the heat treatment curve. **05**

3B. Define the following terms: **05**

i. Polymerization.
ii. Thin Film Deposition
iii. Hardenability
iv. Composite
v. Tempering

4A. Explain the dispersion strengthened composites and its influencing factors. **04**

4B. Determine the indices for the planes in the cubic unit cell shown in Figure 4B. **03**

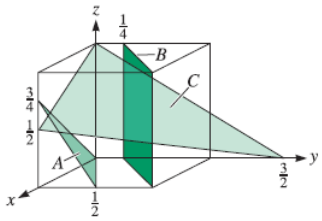

Figure 4B

4C. State the reasons for increase of electrical resistivity in metals. Also, write the equation of Mathiessen's Rule. **03**

5A. Figure 5A shows a cooling curve for a Pb–Sn alloy. Determine (a) the pouring temperature, (b) the superheat, (c) the liquidus temperature, (d) the eutectic temperature, (e) the freezing range, (f) the local solidification time. **06**

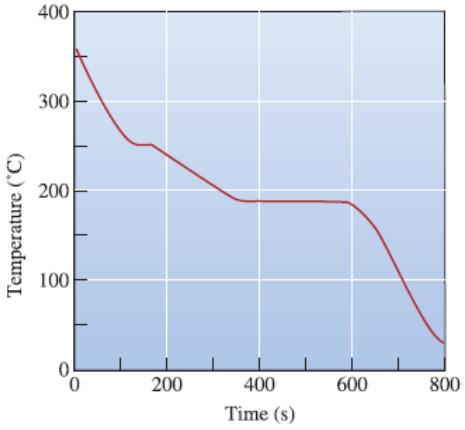

Figure 5A

5B. A metal having a cubic structure has a density of 2.6 g/cm^3, an atomic weight of 87.62 g/mol, and a lattice parameter of 6.0849 Å. One atom is associated with each lattice point. Determine the crystal structure of the metal. **02**

5C. Define Nucleation and Rate of Nucleation. **02**

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