

Birla Institute of Technology & Science-Pilani, K. K. Birla Goa Campus

First Semester 2022-23

Course No & Course Title

CHEM F333 , Chemistry of Materials

Mid Semester Exam (**Closed Book**)

Date: 01/11/22

Total Marks: 60

Time: 90 min

Answer all the questions.

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### PART A

**Important information:**  $1\text{eV} = 94.48\text{ kJ mol}^{-1}$ , energy of free electron =  $4.5\text{ eV}$

	1 <sup>st</sup> ionization energy ( $\text{kJ mol}^{-1}$ )	1 <sup>st</sup> Electron affinity energy ( $\text{kJ mol}^{-1}$ )
Co	760	63.898
Fe	759	14.745
O	1313	140.976

1) Considering the band gap energy of  $\text{CoFe}_2\text{O}_4$  is  $1.38\text{ eV}$ , calculate the values of  $E_{\text{VB}}$  (the valence band edge potential) and  $E_{\text{CB}}$  (the conduction band edge potential) in eV unit. **[6]**

2) Draw a schematic diagram presenting a possible S-Scheme Mechanism for the formation of a hetero junction when two semiconductor nanoparticles "A" (having  $E_{\text{VB}}$  and  $E_{\text{CB}} = 1.71$  and  $0.91\text{ eV}$  respectively vs NHE) and "B" (having  $E_{\text{VB}}$  and  $E_{\text{CB}} = 1.57$  and  $-1.13\text{ eV}$ , respectively vs NHE) come in contact and form a nanocomposite (in the diagram show all the three steps before contact, after contact, light irradiation). Will this nanocomposite can show water splitting reaction when irradiated by visible light at  $\text{pH} = 7$ ? Give your answer only by (**Yes or No**) and show the Potential of  $\text{H}^+/\text{H}_2$  and Potential  $\text{O}_2/\text{H}_2\text{O}$  in the S scheme diagram. **[8]**

3) Draw a Schematic presentation showing different steps of nanoparticle preparation in a Gas phase reactor in different chambers of the reactor. **[6]**

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First Semester 2021-22, (Closed Book), **PART B**

**COURSE TITLE:** Chemistry of Materials

**COURSE NO:** CHEM F333

**TOTAL MARKS:** 30

**Duration:** 90 min

**Date:** 1/11/22

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Answer all the parts of a question together.

Marks will be awarded only for completely correct answers.

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- Q1 Define following [4]  
(i) Coercivity  
(ii) Remanence
- Q2 (i) Which type of superconductors show Vortex region? Explain what is a vortex region. [1+2]  
(ii) Draw the pictorial representation of magnetic domains in Copper metal, Magnetite and MnO. [3]
- Q3 What is the difference in the following [2+4]  
(i) Strength and Toughness  
(ii) Melting point and Glass transition temperature (Two differences)
- Q4 (i) How stiffness of a polymer can be determined? [1]  
(ii) Stiffness of an amorphous polymer decreases significantly at T<sub>g</sub>. Why? [3]
- Q5 When the grain size of a ferromagnetic material, hematite is decreased it's coercivity increases and beyond a critical diameter it starts decreasing with further decrease in grain size. Give reason for this observation. [4]
- Q6 What do you understand by Meissner effect? [1]
- Q7 What are the three different forces responsible for formation of domains in magnetic materials? [3]
- Q8 A coil of wire is 0.32 m long and has 300 turns. It carries a current of 14 A. Find the magnitude of magnetic field strength. Also, compute the flux density, B, if the coil is in vacuum. Given that  $\mu_0 = 4\pi \times 10^{-7}$ . [2]

**END**