Birla Institute of Technology & Science, Pilani, Rajasthan 333 031

Second Semester, 2021-2022

Course Number: CHEM F343 Course Title: Inorganic Chemistry III Marks: 60

Time: 90 min MIDSEM Test (Closed Book) Date: March 12, 2022

Instructions

1. Answer all the questions
2. Answers must be pointed
3. All the answers in a question should be in the same place

[Useful values: h = 6.62 x 10^{-34}J-s; c = 3 x 10^{10}cm/s; 1 eV = 1.6 x 10^{-19}J; Bohr magneton of electron = 9.24 x 10^{-24}Am^2; electronic charge = 1.602 x 10^{-19}coulomb; mobility of electron, μ_e = 180cm^{2}V^{-1}s^{-1}; Atomic No. Fe, 26;

Q1. (a) Show that $n = k^{1/2}$ (n = refractive index of a materials; k = low frequency dielectric constant of that material).

(b) Sunglasses darkens in sunlight, but become transparent in dark – explain.

(c) Describe the working principle of LEDs.

(d) In a block, the light is falling on the front surface with intensity I_0. Show that the intensity of reflected light from the back surface on the same block is $R(1 - R)I_0\exp(-\alpha x)$ (R = reflectivity; α = extinction coefficient; x = thickness of the block).

(e) The intensity of a phosphorescent material is reduced to 90% of its original intensity after 1.95 x 10^{-7}s. Determine the time required for the intensity to decrease to 1% of its original intensity.

(f) What type of electromagnetic radiation (ultraviolet, infrared, visible) is produced on a material of germanium doped with phosphorous (band gap for the germanium doped with phosphorous = 0.012eV)?

4 x 2 + 4 + 3 = 15M

Q2 (a) Define converse photoelectric effect with example.

(b) Define electronic polarization with example.

(c) Write down the expression of conductivity for an intrinsic semiconductor.

(d) Draw the band structure of aluminium metal in the light of band theory.

(e) A ZnO crystal is produced in which one interstitial Zn atom is introduced for every 500 Zn lattice sites. Estimate (a) the number of charge carriers per cubic centimeter and (b) the electrical conductivity at 25°C. Assume that the lattice parameter for ZnO is 4.757 Å (ZnO is FCC crystal lattice; Cell parameter of ZnO = 4.758 x10^{-8} cm).

4 x 2 + 7 = 15M

Q3. (a) Define the domain and bloch wall of a ferromagnetic material.

(b) Differentiate ferromagnetic and antiferromagnetic materials with examples.

(c) Define magnetic induction and magnetization and their relationship.

(d) Plot the magnetization vs applied magnetic field for a ferromagnetic material. Label the following things: remanance, coercivity, initial permeability.
(e) An Fe–49% Ni alloy has a maximum permeability of 64,000 when a magnetic field of 9.947 A /m is applied. What inductance is obtained and what current is needed to obtain this inductance in a 200-turn, 3-cm long coil?
(f) Calculate the maximum magnetization we would expect in iron (BCC crystals; cell parameter = 2.866 x 10^{-10}m).

4 x 2 + 4 + 3 = 15M

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Q4. (a) The storage protein, ferritin takes up iron as divalent metal – explain.
(b) State the chemical structure of the active site of transferritin and the role of bound carbonate ion.
(c) What is Na-K ion pump? Describe the importance of it.
(d) What is valinomycin? Why is it selective to K^+ than Na^+?
(e) How the small molecules and the ions get transported across the cell membrane?

3 x 5 = 15M

END