

PART A

- 1) Schematically present the different steps of nanoparticle preparation in a Gas-phase reactor. [6]
- 2) Present the probable reaction pathway of gas-phase reaction of an organometallic compound ((CH₃)₃M) with NH₃, which leads to the formation of a metal nitride (Note: in the reaction pathway show the intermediates, which are formed during this reaction). [6]
- 3) Present a Flow chart presentation showing the different steps of the Sol-Gel Process. [6]
- 4) Write (i) three major limitations of the sol-gel process, and (ii) three advantages of co-precipitation method. [6]
- 5) A material possesses a bandgap of 2.26 eV, and the carrier recombination across the bandgap of this material results in the emission of light with the wavelength of 'X' nm. What is the value of X? [6]

PART B

- Q1. (i) What is Hall effect? [3]
- (ii) Show how we can calculate the concentration of majority carriers for a p-type semiconductor using Hall effect. [4]
- (iii) Explain the phenomena of superconductivity using BCS theory [3]
- Q2 (i) Explain how the conductivity changes with increase in temperature for conductors and for semi-conductors: Give reasons in support of your answer. [4]
- (ii) Predict the magnetic behavior of oxygen (O₂). Draw the molecular orbital diagram to support your answer. [4]
- Q3 Define the following and show them on a hysteresis loop (M Vs H curve) drawn for an arbitrary material. [6]
- (i) Remanence
 - (ii) Coercivity
 - (iii) Saturation Magnetization
- Q4. Define following [6]
- (i) Superconductor
 - (ii) Piezoelectric material
 - (iii) Electro-rheological materials