2017

PHYSICS

Paper : 403

CONDENSED MATTER PHYSICS-III

Full Marks: 80

Time: 3 hours

The Figures in the margin indicate full marks for the questions

1. Answer the following 1×5=5

(a) Band gap of a material can be estimated considering

(i) Diffraction spectra

(ii) Absorption spectra

(iii) Debye-Scherrer's method

(iv) Williamson-Hall plot 1

(b) In Quantum wire, the electrons

(i) Momentum is localized.

(ii) Confined in 1D.

(iii) Can move only in one direction.

(iv) None of the above. 1

(c) The crystallite size of the material is increased

(i) Due to grain boundary movement

(ii) Due to lattice strain

(iii) Due to band gap is increased

(iv) None of the above 1

(d) Which one of the following technique is not a physical deposition technique?

(i) Electron beam evaporation

(ii) Spray pyrolysis

(iii) DC magnetron sputtering

(iv) Molecular beam epitaxy 1

(e) The grain size of thin film increases with

(i) the decreases of deposition time

(ii) the increase of the film thickness

(iii) the increase of pressure

(iv) none of the above 1

2. Answer the following 2×5=10

(a) Explain the effect of substrate temperature on the growth of thin film? 2

(b) Explain the various nucleation processes. 2

(c) Define strong and weak confinement. 2

(d) Explain *'super surface activity'* of the nano materials 2

(e) Explain the term homogeneous and hetrogeneous nucleation. 2

3. Answer the following (any five) 5x5=25

(a) Explain the high surface-to -volume ratio in nanostructured materials? Find the surface-to -volume (A/V) ratio of sphere, cylinder and cube. 2+3

(b) What is zero dimensional state of electrons? Find the total energy expression of zero dimensional state. 1+4

(c) Discuss the superparamagnetic and super-hydrophobicity property of the nanomaterials. 5

(d) Discuss the various spin dependent scattering in multilayered GMR structure. 5

(e) Explain the various processes of formation of continuous thin film from initial stage. 5

(f) Draw a neat diagram of construction of vacuum system and hence explain the processes of creating vacuum. 5

4. Answer the following (any four) 10x4=40

(a) Define quantum wire? Show that the total energy of infinitely deep rectangular quantum wire is described by the two principle quantum number. 2+8

(b) What is magnetoresistance? Discuss the origin of GMR and show how the resistance vary in Fe/Cr/Fe multilayered GMR structure with the size of Cr. 2+6+2

(c) What is spintronic? Explain the principle of spin transistors. Discuss the opportunities of spintronic in nanotechnology? 2+5+3

(d) How does nanosize influence the electronic band gap? Discuss change in the optical absorption spectra as the size of the material is reduced. Define absorption coefficient and explain how band can be calculated from absorption spectra. 3+3+4

(e) Explain the term direct and indirect exchange interaction. Discuss the exchange interaction of two electrons and explain the exchange interaction criteria for ferromagnetism. 2+8

****