(vi) Define degenerory and non-degenerary.

(vii) Find the surface (s) to volume (v) ratio of a quantum dot of radius 3 nm.

(viii) Define nanoclusters.

(ix) Show that the surface to volume ratio of a nanoparticle increases with decrease in the size of the naonparticles.

(x) Name the characterization technique of the nano particle.

(xi) What are the applications of nanotechnology ?

(xii) Write value of 0.67^{o} of a diffraction peak in radians.

10×1=10

NTK/KW/15/5886

Bachelor of Science B.Sc. Semester–V (C.B.S.) (New) Examination

QUANTUM MECHANICS, NANOMATERIALS AND NANOTECHNOLOGY

Paper—II (Physics)

Time—Three Hours] [Maximum Marks—50

N.B. :— (1) All questions are compulsory.

(2) Draw neat diagrams wherever necessary.

EITHER

1. (A) (i) Discuss the wave-nature of matter briefly and obtain de'Broglie's relation for material particle. 3

(ii) Calculate the de-Broglie's wavelength associated with electron, when it is accelerated from rest through a potential difference of 40 kV.

Given $h = 6.63 \times 10^{-34}$ J.S, $m = 9.1 \times 10^{-31}$ kg, $e = 1.9 \times 10^{-19}$C. 2

OR

(C) Explain eigen function and eigen value of an eigen equation. 2½

(D) Find the lowest energy of a neutron confined to a nucleus of size 10^{-14} m. (Given : Mass of neutron = 1.67×10^{-27} kg., h = 6.63×10^{-34} J.S. 2½

(E) What is well behaved wave function ? State the conditions for it. 2½

(F) State the postulates of Quantum mechanics. 2½

EITHER

3. (A) Explain Top-down and Bottom-up approaches for the synthesis of nanomaterials. 5

(B) (i) The block of nanomaterial has a surface area 36 m^2 and volume of 1 m^3. Calculate the surface to volume ratio of the block system. 2

(ii) Explain 3D, 2D, 1D and 0D materials. 3

OR

(C) Differentiate between nano materials and bulk materials. 2½

(D) Why surface to volume ratio is very high for nano particles compared to bulk materials ? Explain with a simple example. 2½

(E) What would be the surface to volume ratio of a quantum dot of radius 2nm ? 2½

(F) Discuss the physical and chemical properties of nanomaterials. 2½

EITHER

4. (A) What is Sol-Gel method ? Explain the synthesis of Nanomaterials by this method. State its advantages over the conventional processes. 5

(B) (i) Explain how particle size can be determined by using Debye-Scherer's is equation. What is the other technique for determination of particle size ? 3

(ii) In the X-ray diffraction pattern a maximum peak of a certain compound is located at 25.90° having 0.1224° full-width at half maximum (FWHM). The wavelength of X-ray radiation λ = 1.5418 Å and Scherrer's constant K = 0.94. Find the grain size of a particle. 2

(B) Describe Davison and Germer experiment from electron diffraction. How does this experiment exhibit wave nature of an electron ? 5

OR

(C) Discuss black body radiation spectrum by experimental curves at different temperatures. 2½

(D) Explain dual nature of light. 2½

(E) What is Compton Effect ? Discuss experimental arrangements of Compton Effect. 2½

(F) A beam of X-rays is scattered by loosely bound electron at 90^o from the direction of the beam. The wave length of the scattered X-rays is 0.25 A^o.What is the wavelength of X-rays in the direct beam ? 2½

EITHER

2. (A) Derive Schrodinger's time independent wave equation. 5

(B) (i) What is wave function ? Give the physical interpretation of wave function. 3

(ii) Calculate the energy of the lowest three levels for an electron in a square well of width $3A^o$. 2

OR

(C) Explain the Wet Chemical method of synthesis of nanomaterials. 2½

(D) What is BET ? How BET technique is used for the determination of specific surface ? 2½

(E) Calculate wavelength of X-ray differacted from nano material having interplaner distance from 0.89 Å It an angle of 30ºC in first order. 2½

(F) Distinguish between SEM and TEM. 2½

5. Attempt any **TEN** (**1** mark each) :—

(i) State uncertainty principle.

(ii) Calculate energy of a photon of wavelength 5000Å, given, $h = 6.63\times10^{-34}$ JS, $C = 3 \times 10^8$ m/s.

(iii) What is wavepacket ?

(iv) What do you understand by normalised wave function ?

(v) Using momentum operator, find an operator for kinetic energy of a particle.