(b) Describe the growth of nanowires using electrochemical deposition technique. **4**

### Unit III

**6.** Describe the basic principle and instrumentation involved in photoluminescence spectroscopy. Discuss how photoluminescence spectroscopy is used in characterization of nanomaterials. **10**

**7.** Discuss the basic principle and working of a UV-visible spectrometer. Explain how UV-visible spectroscopy is employed for determination of optical band gap energy ($E_g$) and type of optical transitions occurring in that material. Also differentiate between UV-visible and photoluminescence spectroscopy. **10**

### Unit IV

**8.** Discuss the applications of nanotechnology in electronics and device fabrication. Explain how nanomaterials and nanoscale techniques are revolutionizing modern electronic systems. **10**



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## B.Sc. Hons (NEP-2020)

## EXAMINATION, 2025

(Fourth Semester)

B23-PHY-405

PHYSICS OF NANOMATERIALS

*Time :* 3 *Hours*] [*Maximum Marks :* 50

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

**Note** : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. **1** is compulsory. All questions carry equal marks.

### Compulsory Question

**1.** (a) A spherical nanoparticle of a certain material has a diameter of 20 nm. **3**

(i) Calculate the surface-to-volume ratio (S/V) of the nanoparticle in units of $nm^{-1}$.

(ii) Compare this value with a bulk particle of the same material that has a diameter of 2 mm.

(iii) By what factor is the surface-to-volume ratio of the nanoparticle larger than that of the bulk particle ?

(b) Discuss briefly how a quantum well structure of $Al_{0.4}$ $Ga_{0.6}As$/ GaAs/ $Al_{0.4}$ $Ga_{0.6}As$ is fabricated using MOCVD. **2**

(c) A PL experiment is performed on CdSe Quantum dots and it is found that emission takes place at 696 nm. Find the radius of CdSe quantum dots, you are provided with $m_e^*$ = $0.13m_0$, $m_h^*$ = $0.45m_0$ and band gap of Bulk CdSe i.e. $E_g^{cdse}$ = 1.74 eV. **3**

(d) Briefly explain *one* application of nanotechnology in IT sector. **2**



## Unit I

**2.** Discuss the structure, types, properties, and few important applications of Carbon Nanotubes (CNTs). **10**

**3.** (a) What is the quantum size effect ? Explain its origin, significance at the nanoscale, and how it influences the properties of nanomaterials. **7**

(b) Briefly explain Quantum Dots. **3**

## Unit II

**4.** (a) Discuss the process of nano-particle production by Mechanical/Ball milling route. List the contamination issues that arise in the processing of nanoparticles by mechanical milling process. **6**

(b) Describe the formation of nanowires using lithography technique. **4**

**5.** (a) What do you understand by the term Sol-gel process ? Explain the basic steps and chemistry involved in this method. Give a list of nanomaterials that can be synthesized by this method. **6**

**9.** Write detailed notes on application of nanotechnology in the following areas : **10**

(i) Chemical and Bio-sensors

(ii) Environmental Remediation.

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**9.** Write detailed notes on application of nanotechnology in the following areas : **10**

(i) Chemical and Bio-sensors

(ii) Environmental Remediation.

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