



Indian Institute of Technology Patna

Patliputra Colony, Patna – 800 013, India

DEPARTMENT OF PHYSICS

MID-SEMESTER EXAMINATION DATE: 21-09-2017

Time: 2 hours

Full Marks: 30

COURSE NO: PH401 COURSE TITLE: Introduction to Nanomaterials Attempt all Questions

1. A Sodium lamp has been used as the electromagnetic radiation in an optical microscope. Find the resolution limit of the microscope by using oil immersion lens. What are the technological difficulties to achieve the theoretical resolution limit in an optical microscope? What is the minimum size of device can be fabricated by employing the above set-up. (Optical Lithography method). [4]
2. What is the confinement length in the semiconductor? What are the confinement lengths (weak, Intermediate and strong) of a GaAs semiconductor ($m_e \approx 0.06m_0$ and $m_h \approx 0.5m_0$). Calculate the Bohr radius of exciton in semiconductor? (ϵ = Dielectric constant- 9.7 and 1st Bohr radius (a_0) $\approx 0.0528\text{nm}$). Explain your answer. [4]
3. Define Bulk, Quantum well, Nanowire and quantum dot. [2]
4. Write a short note on Top-Down method for generating nanomaterials. Explain Ball-mill and laser ablation methods to prepare nanomaterials? [4]
5. Explain the steps of lithography. What are differences between optical and electron lithography method. [4]
6. Give complete definition of nanomaterials. [2]
7. Why does the butterfly "Morpho peleides Limpida" make them interesting to nanoscience? How does it help to develop the nanotechnology (which technology)?
(or)
Why was the Damascus sword very famous in the 10th to 18th centuries? Is there any connection to nanotechnology to these swords? If yes, what is that? If no, why did we study it? [3]
8. Define the crystallographic grain boundary in a material. Why is it so important in Nanoscience and Nanotechnology? [2]
9. Find out the 10 magic numbers for a FCC crystal structure? Also calculate the surface to volume ratio (s/v) for these 10 magic numbers. Why is it very important in Nanoscience and Nanotechnology? [5]

-----BEST OF LUCK-----