Q1. Distinguish the materials with respect to the symmetry considerations. Describe an experiment to determine crystal structure of crystalline materials. (4)

Q2. Compare and contrast the close packed crystal structures. (3)

Q3. Calculate the number of atoms in a 2 nm diameter Ɛ – cobalt if its unit cell contains 20 atoms and has a cubic structure with lattice constant 6.097Å. Find inter energy level spacing if Fermi Energy of that material is 3.5 eV. (3)

Q4. Explain qualitatively, the concept of charge carrier confinement in low dimensional systems and its effect. (3)

Q5. Define concept of "length scale". Calculate an expression relevant length scale for semiconductors for optical properties. (4)

Q6. Calculate the length scale for GaAs for optical property. Given that $m_e = 0.067\ m_o$, $m_h = 0.45\ m_o$, and Ɛ= 12.4. (3)

Q7. Derive an expression for binding energy of an exciton in a semiconductor. (4)

Q8. Calculate the physical size ranges for CdSe material for strong, intermediate and weak confinements. Relevant parameters are: $m_e = 0.13\ m_o$, $m_h = 0.45\ m_o$ and Ɛ= 9.4. (3)

Q9. How Coulomb and carrier confinement competes in an exciton for bulk and nano materials? (3)

Q10. Describe an experiment to understand the phenomenon of colours exhibited by metallic nanoparticles. Distinguish different size and shape nanoparticles. (4)

Q11. Describe the importance of Graphene in Carbon nanostructures. (3)

Q12. Explain importance of "Scanning Probe microscopy" in nano-science research. (3)

Q13. Explain "Quantum Tunnelling" and how it is being utilised to characterise the nanostructured materials. (4)

Q14. Can non-metals be characterised by scanning tunnelling microscopy? Explain. (3)

Q15. How scanning probe microscopy be utilised to manipulate atoms on a surface? (3)