

Model Question Paper
Qualifying Examination for Submission of PhD
Center for Nanotechnology
Applied Nanotechnology

Time: 3hrs

Max Marks: 100

Answer any **FIVE** from the remaining
All Questions carry equal marks
Assume suitable data if required

1.
 - a) What is basic difference between Quantum dots and nanoparticles? What is exact size of these? Explain in detail about quantum dot LASER and principle behind quantum cascade LASER?
 - b) What is the effect of temperature on conductivity of semiconductor? Explain in detail about superconductivity and the effect of magnetic field on superconductors? Write the significance of quantum dots and quantum wells in nanotechnology?
2.
 - a) Write in detail about Physical, Chemical, Electrical, Mechanical & Functional properties of nanomaterials
 - b) Why electrodeposition process is needed to grow nanowires/ rods through the alumina nano – pores? “Template – assisted synthesis is a very efficient tool to grow highly ordered nano wires/ roads” explain?
3.
 - a) Discuss about Zero dimensional nano structures and write about quantum conductance of zero dimensional nanostructures?
 - b) Explain with neat sketch about Auto-catalytic deposition, Physical and chemical vapour deposition, Ion-beam techniques? Give example in each case?
4.
 - a) Suggest two simple methods for increasing the resolving power of an optical microscope? Use Bragg law to find out the indices of the first three reflections in a powder diffraction pattern taken from a simple cubic crystal and FCC.
 - b) What is green synthesis? Describe the various biological ingredients for synthesis of Zero, One, Two and Three Dimensional nano systems?

- 5.
- a) “Bottom – up is more convenient for nano fabrication” Explain? What are the different processes that control the subsequent growth of nuclei during the nanoparticle synthesis? Discuss any one of them in terms of growth of uniform sized particles?
 - b) Describe the synthesis of gold nanoplate and nanoparticle using bacteria *Rhodospirillum rubrum* & fungus *R. Qryzac Mycelia*, also illustrate the plausible mechanism for the formation of gold nanoparticles?
- 6.
- a) Mention the conditions to produce destructive and constructive interference in Thin Films? Drive an expression for the path difference produced in a thin film of thickness t and of refractive index μ and hence obtain the condition for constructive interference?
 - b) Deduce an expression for air – wedge to find the thickness of a thin sheet of paper and hence explain an experimental method to find the thickness of thin sheet of paper using air – wedge experiment?
- 7.
- c) Discuss in detail about AFM, Instrumentation, parameters measured and imaging modes? What is an electron microscope and how is it superior to optical microscope? Name different types of electron microscopes and how do TEM differ SEM?
 - d) What is the difference between UV – vis and FT – IR spectroscopy? How can one make the samples for FT – IR for solid and liquid samples? What difference one can see in the spectrum if NaCl is used instead of KBr.
- 8.
- a) Describe the stress strain diagram for a composite material? Discuss in detailed about different fabrication techniques and mechanical properties of nano composites materials?
 - b) What are the different modeling techniques for fabrication and analysis of nano composites and explain each in detail?