NOTE: Answer any four of the following questions

1. (a) Describe different methods for evaluating cytotoxicity of nanoparticles. [7]
   (b) Define different methodologies for bulk synthesis of nanoparticles. [8]

2. (a) Differentiate between targeted and non-targeted drug delivery. [8]
   (b) Describe in detail the principle and application of Biosensors. [7]

3. (a) What are cell surface receptors? Discuss different type of cell surface receptors. [8]
   (b) Explain the respiratory system in human with labelled diagram of the lungs. [7]

4. (a) What properties of Quantum dots make them molecular labels. [8]
   (b) Explain the role of nanoparticles in MRI Imaging. [7]

5. Write short note any three of the followings
   (a) Nephrons [5 X3]
   (b) Central Nervous System
   (c) Induced-fit model of antigen antibody interaction
   (d) Blood brain barrier
WINTER-II SEMESTER END-SEM 2017-18 EXAMINATION
M.TECH. (NANOTECHNOLOGY)

INC 616: PROPERTIES OF NANOMATERIALS

Maximum Marks: 60 Credits: 04 Duration: Two Hours

Answer all questions. Symbols have their usual meanings

1(a) What do you mean by diffusion in a semiconductor? By taking recombination of excess carriers into consideration, obtain time dependent diffusion equations for electrons and holes and solve one of the equation under steady state condition to discuss excess carrier variation.

OR

1(a') What is integral quantum Hall effect and what are the conditions to observe it? Obtain an expression for quantized Hall resistance.

[5.5]

1(b) Calculate electrical conductivity and mean free time for copper at room temperature if mobility of an electron in copper is 44.0 cm²/V.s. [Given: Density of Cu=8.96 g/cm³, Atomic mass=63.5 g/mol and Avogadro No.=6.023×10²³ mol/atoms]

[3.5]

2(a) What is the condition for a conductor to be ballistic? By taking ballistic conductor in between source and drain, Obtain an expression for conductance and discuss its dependence on number of modes.

[5.0]

2(b) What do you mean by Coulomb blockade? By considering capacitance of 1 femto farad, show that Coulomb blockade will be observable at extremely low temperature. Discuss application of Coulomb blockade in single electron transistor.

[3.5]

3(a) Why is applied field considered as local applied in a gaseous dielectric? What are different contributions to the local electric field (E_loc) in a solid dielectric? Obtain an expression of local electric field for a solid dielectric having cubic symmetry.

[5.0]

3(a') What is the effect of time varying field on dielectric properties? Derive an expression for complex electronic polarizability in the presence of an alternating field and discuss the behaviour of real and imaginary parts with frequency with the help of dispersion curves.

[5.0]

3(b) The polarizability of ammonia molecule in gaseous state from measurement is found to be 3.0×10⁻³⁹ F.m² and 2.5×10⁻³⁹ F.m² at 300 K and 400 K respectively. Calculate the contribution to the polarizability because of deformation of molecules and contribution because of permanent dipole moment at each temperature. Also evaluate permanent electric dipole moment.

[3.5]

4(a) What is the effect of magnetism on nonmaterial? Describe the spontaneous magnetization and saturation magnetization.

4(b) What is the Kautsky effect? Explain the fluorescence and phosphorescence with the help of diagram.

[4]

5(a) What is electroluminescence and how electroluminescence work?

5(b) Describe the absolute negative photoconductivity and magnetic photoconductivity with prominent examples.

[4.5]
6 Discuss any two of the following:
(a) Heat released or absorbed during chemical reaction and its effect on
enthalpy of reaction.
(b) Draw the energy diagrams for endothermic and exothermic reactions citing
suitable example.
(c) Specific heat and its effect on the nanocomposites.

7 Explain briefly any three of the followings:
   i. Engineering stress and strain
   ii. Plasticity
   iii. Yield strength and ultimate tensile strength
   iv. Draw the stress-strain curve for mild steel.
WINTER-II SEMESTER END-SEM 2017-2018 EXAMINATION
M.TECH.(NANOTECHNOLOGY)
INC-617: NANOCOMPOSITES

Maximum Marks: 60  Credits: 04  Duration: Two Hours

NOTE: Answer ALL the Questions.

1. (a) What is a nanocomposite material? Write four differences between an alloy and a nanocomposite material.  [7]
   (b) Write a fabrication technique of CNT/metal-oxide nanocomposite material. Discuss an application of the nanocomposite in detail.  [8]

2. (a) Write a simple material hardness measurement technique.  [3]
   (b) Describe a method to measure hardness of a film of nanocomposite.  [7]
   (c) Is it possible to fabricate nanocomposite materials that are harder than a diamond? Write a short note on superhard-nanocomposite.  [5]

3. (a) What is fractal growth? Write a note on such growth patterns observed in nature.  [7]
   (b) Discuss electro-deposition method of fractal growth of nanocomposite materials. Usually which type of nanocomposite is synthesized with this method?  [8]

4. Write notes on any two of the followings:  [7.5x2=15]
   (a) Fabrication methods of nanocomposites and their general flow chart.
   (b) Differentiate between copolymer and diblock copolymer.
   (c) Describe the functionalization of carbon nanotubes and its nanocomposites.
NOTE: Answer ALL the Questions.

1. (a) Why chemical synthesis methods are most widely used in the fabrication of nanoparticles, in comparison to the solid state techniques. [5]
   (b) Write a short note on:
       I. Clusters [2x 5]
       II. Self-assembly strategies

2. (a) What do you understand by melting point of a semiconductor nanoparticle? Derive an expression for it. [5]
   (b) Discuss single particle conductance in brief. [5]
   (c) Write a short note on excitons. [5]

3. (a) What is a quantum dot? Why are they important? Discuss a surface trap passivation technique to enhance the yield of a quantum dot. [7]
   (b) Discuss detailed working mechanism of a Light-Emitting-Diode (LED), starting from carrier injection at electrodes. [8]

4. (a) Explain the importance of semiconductors. Discuss the intrinsic and extrinsic semiconductors. [7.5]
   (c) Describe the vapor liquid solid (VLS) mechanism and differentiate between the vertical and horizontal nanowires. [7.5]