Maximum Marks : 60
Duration : Three hours

Note : Answer any four questions.
(Students governed by the old ordinance will be examined out of 75 marks and their obtained marks shall be proportionally raised.)

1.(a) Differentiate between targeted and non targeted drug delivery. 8  
(b) Explain the usefulness of nanoparticles in biomedical applications. 7  

2.(a) Discuss the general properties of BBB. 7  
(b) Write short notes on any two of the following: 8  
   (i) Tissue engineering  
   (ii) Quantum dots as a molecular labels  
   (iii) Biochips  

3.(a) Write the advantages of natural synthesis of nanoparticles by microbes. 5  
(b) What are the characteristics of a good biosensor? Describe the mechanism of a glucose biosensor. 10  

4. Classify the types of bioelectronic devices based on their properties and write their applications in different fields. 15  

5.(a) What do you understand by natural nanomaterials? Write examples of inorganic natural nanomaterials and nanomaterials from animal kingdom. 3  
(b) What is spider silk? Discuss the nanostructure of the spider silk fibre. 5  
(c) Discuss nano scale architecture of biomaterials like single-celled-organisms, plants and animals. Explain how carbonate nanostructures are used by nature in shell growth and exoskeletons. 7

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"Students governed by the old ordinance will be examined out of 75 marks and their obtained marks shall be proportionately raised."

Answer all questions. The symbols used have their usual meanings.

1 (a) What are classical and quantum Hall effects? Obtain quantum condition of Hall resistance in case of two dimensional channel. 7.0

OR

(a)' Derive an expression for electrical conductivity in metals by using Sommerfeld model. In what way Sommerfeld model is different from Drude model. 7.0

(b) Show that $L_P$ is the average distance which a hole diffuses before recombination in a semiconductor. 3.0

2 (a) What is ballistic conductor? By taking source, one level channel and drain into consideration obtain an expression for current $I$ in terms of couplings $\gamma_1$ and $\gamma_2$. 5.0

(b) Starting with the current $I$ of one level channel and considering the effect of the broadening of the level, establish the relation $G=q^2/\hbar$. 5.0

3 (a) What are different contributions to local electric field in a solid? Obtain Lorentz formula for local electric field in case of a solid dielectric having cubic symmetry. 6.0

OR

(a)' What do you understand by dipolar relaxation? Obtain an expression for time dependent orientational polarization and show its behavior graphically. 6.0

(b) The polarizability of NH$_3$ molecule in gaseous state from the measurement of dielectric constant is found to be $2.5\times10^{-39}$ F.m$^2$ and $2.0\times10^{-39}$ F.m$^2$ at temperatures 300 K and 400 K respectively. Calculate the contribution due to the polarizability because of deformation of molecules and also the contribution because of permanent dipole moment at each temperature. Also evaluate its permanent electric dipole moment. (Given: $k_B=1.38\times10^{-23}$ J/K) 4.0

4 (a) What is superparamagnetism? Discuss the behavior of an antiferromagnetism in different temperature regions. 6.0

OR

(a)' Obtain the relation $M=N\beta \tanh \left( \frac{\mu B H}{kT} \right)$ for paramagnetic systems. Discuss the result in different temperature regions. 6.0

(b) List four soft and hard magnetic materials and give their respective compositions and applications. 4.0
5 (a) Explain the mechanisms of thermal and electrical conduction in metals. Write down Widemann-Franz law and mention its significance. Calculate the Lorentz number.

(b) What is the Debye model of solids? Apply it to explain specific heats of metals in low and high temperature regions.

6 (a) Explain photoconductivity. Obtain an expression for gain of a photoconductor.

(b) A tensile stress is to be applied along the long axis of a cylindrical brass rod that has a diameter of 10 mm. Determine the magnitude of the load required to produce a $2.5 \times 10^{-3}$ mm change in diameter if the deformation is entirely elastic. The Poisson's ratio for brass is 0.34 and modulus of elasticity is 97 GPa.

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M. Tech. II SEMESTER EXAMINATION  
(NANOTECHNOLOGY)  
(NANOCOMPOSITES)  
(AP-617)

Maximum Marks: 60  
Duration: Three Hours

Note: Answer ALL questions.

1. (a) What are nanocomposites? How do they differ from normal materials?  
(b) How does an increase in the surface to volume ratio of nano-materials affect its properties? 

2. (a) What is Vicker hardness?  
(b) Write a short note on metal-ceramic composite. 
(c) What are metal-metal nanocomposites? Discuss techniques for their preparation. 
(d) Discuss mechanical, electrical and magnetic properties of nanocomposites.

3. (a) What are core-shell structured nanocomposites. Elaborate various kinds of core shell nanocomposites and give their applications. 

Or

3’. Describe polymer based nanocomposites. Discuss the mechanical properties of CNT-reinforced composites.

4. (a) Discuss Fullerene/carbon nanotubes composites. How to prepare these composites. Write processing scheme of C\textsubscript{60}/CNT composites.  
(b) What are magnetic polymer nanocomposites. Write down the properties and application of these nanocomposites.  
(c) Write short note on fractal based glass-metal nanocomposites and discuss its electrical properties.
2011-2012
II SEMESTER EXAMINATION
M. Tech. (Nanotechnology)
Semiconductor Nanostructures & Nanoparticles
(AP-723)

Maximum Marks : 60
Duration : Three hours

Note : Answer all the questions.
(Student governed by the old ordinance will be examined out of 75 marks and their obtained marks shall be proportionately raised.)

1. (a) Why clusters have different properties as compared to its bulk materials? Give the comparison between evaporation and sputtering techniques. 6
   (b) Describe any three of the following methods of synthesis of nanoparticles in brief.
       (i) Atomic layer deposition
       (ii) Spray pyrolysis
       (iii) Aerosol technique
       (iv) Template based synthesis

2. (a) Determine the minimum particle diameter of a gold nanoparticle to work as a single electron transistor using the Coulomb blockade at room temperature. 2½
   (b) Mention the four main differences in a solid to liquid transition of nano systems with respect to bulk behavior. How is the melting point of Nano systems experimentally observed? 2½
   (c) What is the empirical Lindemann criterion used in simulations? 1
   (d) Differentiate between thermodynamic reaction control and kinetic reaction control. 2
   (e) What is an exciton? Discuss the three cases of confinement with regard to the crystallite radius R of excitons. 7

3. (a) Describe energy level and density of states for semiconductors and metals in nano and bulk forms. 5
   (b) Explain charge carrier trapping in semiconductor nanoparticles and describe the optical properties of metal sulphide and metal oxide nanoparticles with their applications. 10

OR

3’. (a) Explain photoluminescence and electroluminescence in semiconductor nanoparticles with suitable examples. 9
   (b) Give the applications of semiconductor nanomaterials in photovoltaic solar cells and optical filters. 6

4. (a) Write the Landauer formula and give the value of quantum of resistance? 1
   (b) What is a Nanospring? Discuss the VLS mechanism of growing Nanosprings including the phenomenon of Contact Angle Anisotropy. 7
   (c) Mention the two factors on which the growth of Nanobelts depends? Describe the VS mechanism of growing Nanobelts. 7

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