2013-14
M.TECH. II SEMESTER (WINTER SEMESTER) EXAMINATION
NANOTECHNOLOGY
NANOBIOENGINEERING
AP-615

Maximum Marks: 60  Credits: 04  Duration: Three Hours

Answer all the questions.

1(a) Draw the structure of a typical animal cell and explain its cellular organization. [06]
1(b) What is BBB? Write its properties and function. [05]
1(c) Write the names of typical sensing techniques used in bioelectronic devices. Write
the useful properties of a bioelectronic device. [04]

2(a) Describe the protocol of nanoparticles/nanomaterials toxicity using Microtox test. [06]
2(b) Describe the mechanistic aspect of the glucose biosensor. [09]

OR

2(b') Illustrate the silver nanorod fabrication using polypeptide/proteins. [09]

3(a) Define the natural nanomaterials and give ten examples of different types. [05]
3(b) What is spider silk? Discuss nanostructure of spider silk fiber. [05]
3(c) What are mineralized bionanomaterials and discuss the carbonate chemistry
involved in the formation of carbonated materials. [05]

4(a) Explain how nanodevices can be used in sensing and therapy? [05]
4(b) What is MRI? Write its working principle and discuss the procedure involved. What
is the role of nanoparticles in MRI? [07]
4(c) Write a note on Nanoparticles as contrast agents. [03]
1(a) What are metal-matrix nanocomposite materials? Explain their properties and importance in detail. [6.0]

(b) Describe the properties of ceramic/metal nanocomposites and give three examples. [5.0]

(b') Describe synthesis of nanocomposites by sol-gel method. Name commonly used ceramic matrix materials. [5.0]

(c) Write the critical parameters for thermal spray method. [4.0]

2(a) Discuss the superhard nanocomposite materials in detail. Give design methodology for nanocomposite coatings. [8.0]

(b) Explain one of the methods for synthesis of superhard nanocomposites. Write in brief mechanical properties and applications of these materials. [7.0]

3 Write short notes on:
   (i) Mechanical interlocking of CNT-polymer nanocomposites.
   (ii) Hardening mechanism of C_60 matrix.
   (iii) Prediction of SWNT time-dependent behaviour.
   (iv) Electrical properties of polymer-graphite nanocomposites. [15.0]

4(a) What are the magnetic-polymer nanocomposites? Discuss their important properties and applications. [6.0]

(b) What is fractal based glass-metal nanocomposites? Explain electrical properties of fractal based nanocomposites. [5.5]

(c) Explain and categorise core-shell nanocomposites. [3.5]

OR

(c') Discuss the important properties and applications of ferrofluids. [3.5]
M.TECH. (WINTER SEMESTER) EXAMINATION
NANOTECHNOLOGY
SEMICONDUCTOR NANOSTRUCTURES & NANO PARTICLES
AP723

Maximum Marks: 60        Credits: 04        Duration: Three Hours

Answer ALL the questions. Notations used have their usual meaning.

1(a) What is quantum confinement effect? Why clusters have different properties as compared to its bulk form? [2.0+2.0]

(b) With the help of suitable diagram, explain the principle, construction and working of RF and DC sputtering. Give the comparison between evaporation and sputtering. [5.0+2.0]

(c) Describe any TWO of the following methods with suitable examples to synthesize nanostructures.
   (i) Spin coating
   (ii) Growth termination
   (iii) Micelle method [4.0]

2(a) Describe in detail the homogeneous melting and growth model for nanoparticles. [6.0]

(b) State the conditions for the observation of Coulomb blockade. [3.0]

(c) Determine the nanoparticle radius for the observation of quantum confinement effects from three different quantum mechanical concepts. [6.0]

3(a) Explain the linear optical absorption and emission properties of semiconductor nanoparticles with suitable examples. [7.0]

OR

(a') What do you understand by the ultrafast time-resolved laser technique? Briefly describe the chemiluminescence in CdTe nanoparticles. [5.0+2.0]

(b) Mention six unique features of semiconductor nanoparticles. Discuss the applications of these particles in photochemistry and photocatalysis. [3.0+5.0]

4(a) What is quantum conductance? Derive the Landauer formula and show that the resistance of a device is the sum of quantized contact resistance and the resistance due to scattering from barriers in the channel. [6.5]

(b) Discuss the VLS mechanism of growth of nanowires. [5.5]

(c) Mention the special features of porous silicon and its applications. [3.0]