(c) What is the difference between Fullerene and Carbon nanotubes? Discuss about their structures, electronic and mechanical properties.

Or

What is the difference between SEM and TEM? Discuss the working principle of one of them with a clear diagram.

(d) Name five techniques for the synthesis of nanomaterials. Describe any two of them in detail with appropriate example using proper schematic diagram.

Or

Solve the time independent Schrödinger equation for a particle in a box. Hence find out the energy levels and wave function.

(e) What do you understand by quantum well, quantum wire and quantum dot? Give example of each. Describe the techniques in details for their formation.

Or

Describe pulse laser deposition technique for the formation of nanomaterials. What are the advantages and shortcomings of this method?

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B. Tech.

(Semester III) Theory Examination, 2011-12

NANO SCIENCES

Time : 3 Hours   *Total Marks : 100*

Note : The figures in the right hand side indicate marks assigned to a question. Answer *all* questions. Only internal choice within a question is there.

Section-A

1. Answer *all* parts of this question. $2 \times 10 = 20$

   (a) Define Fermi energy and density of state.

   (b) For which discovery, in year 1996 chemistry Nobel prize was awarded to H. Kroto, R. Curl and R. Smalley?

   (c) What do you understand by nanomaterials? Define briefly.

   (d) What do you understand by quantum dots?

(e) What is the magic number in metal nanoclusters? Explain briefly.

(f) Is it possible to do scanning tunneling microscopy for non-conducting sample? Explain briefly.

(g) How metal oxide nanoparticles can be formed by sol-gel technique?

(h) Name three synthesis methods for the fabrication of carbon nanotubes.

(i) What do you mean by Stokes and anti-Stokes lines?

(j) Name all the seven lattice systems.

Section-B

Answer any *three* parts of this question : 10×3=30

2. (a) Describe the method for vapour-liquid-solid (VLS) for the formation of nanowires.

(b) What is the number of hexagons and pentagons in C60? Why the transition of hexagons to pentagons is required for the formation of C60?

(c) Optical absorption spectrum of gold nanoparticles embedded in glass shift to shorter wavelength when the nanoparticle size decreases. How will you explain it?

(d) Explain briefly the meaning of dimensionality effect in quantum mechanics.

(e) Write a short note on molecular beam Epitaxy.

Section-C

Answer *all* parts of this question. Internal choice is given. 10×5=50

3. (a) Discuss the structures of armchair, zig-zag and chiral single walled carbon nanotubes. Explain one synthesis method for CNT in detail and also discuss their important applications.

Or

Give the examples of "top-down" and "bottom-up" approaches to produce nanostructures. Discuss the various stages involved in the formation of quantum dots by electron beam lithography.

(b) Discuss the basic principle and fabrication of AFM and STM.

Or

What do you understand by Raman Effect? Why Raman spectroscopy is suitable for the characterization of nanostructured materials? Explain it with one example.