Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech(ECE-VLSI)/SEM-2/MVLSI-204A/2011

2011

QUANTUM & NANO-SCIENCE

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Attempt all questions.

All the questions carry equal marks.

1. i) Fullerene is a nano-particle of Si. (*Yes* / *No*) 1

ii) Bacteria is a nano-particle (*Yes* / *No*) 1

iii) How many quantum confinements are there in a quantum dot ? 1

iv) What are the two main structural factors controlling the properties of carbon nanotube (CNT) ? 2

v) Why a CNT does not fracture even if they are bent severely ? 3

vi) Give a concept of a nano-computer made out of CNT. 3

vii) What is Jellium model of nano-cluster ? 3

2. What is quantum size effect ? How is the electron energy modified in a system where the electron is confined in one direction ? Write down the expressions for the electron densities and density of states in bulk, 2D, 1D and 0D systems. 3 + 3 + 8

3. a) Describe single electron tunneling process with the help of appropriate QD circuit arrangement. Hence explain Coulomb blockade.

b) What is magnetoresistance ? Describe the physical reasoning of fall of resistance of CNT in dc magnetic field. 6 + 4 + 4

4. a) What is allotropy ? Name the allotropes of carbon. How a carbon nanowire is physically realized in different configurations with reference to its chirality ?

   b) What is bulk nanostructured material ? How such a disorderd structure can be fabricated by electrodeposition process ? 2 + 1 + 6 + 5

5. Write short notes on the following : 7 + 7

   a) Separation of metallic and semiconducting CNTs from a cluster of synthesized Nanotubes.

   b) Electrophoresis.