

Roll No. ....

**EC-803(N)****B. E. (Eighth Semester) EXAMINATION, June, 2011****(Electronics and Communication Engg. Branch)****NANOELECTRONICS****[EC-803(N)]***Time : Three Hours**Maximum Marks : 100**Minimum Pass Marks : 35*

**Note :** All questions are compulsory. Each question contains internal choice. All questions carry equal marks.

1. Give brief notes on the following :

- |   |   |
|---|---|
| (i) Top down and bottom up approaches                           | 8 |
| (ii) Applications of nanotechnology                             | 6 |
| (iii) Effect of size on electronic properties of nano materials | 6 |

*Or*

- |   |   |
|---|---|
| (i) How energy bands are formed ?   | 8 |
| (ii) Why energy discreteness occurs in nano materials ?                               | 7 |
| (iii) How does electrical conduction in metals, insulators and semiconductor differ ? | 5 |

2. What is a Tunneling Diode (TD) ? With appropriate circuit diagram, explain the implementation of any *one* of the following application using single TD : Counter/Frequency

divider/A/D converter (If needed use other components such as NAND, NOR, transistor, etc). 5, 15

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When will you call a semiconductor as bulk, quantum well, quantum wire, quantum dot or nanoparticle ? Discuss in terms of density of states, electronic properties, optical properties, energy level structure etc. 8, 12

3. What is Coulomb blockade ? How Coulomb diamond structure is used to design a single electron transistor ?

8, 12

Or

Show that the condition for an electron to tunnel from positive terminal to negative terminal in a capacitor is  $V < qe/2C$ . 20

4. Obtain an expression for current flow in a ballistic conductor. Consider a 20 nm length of a ballistic conductor carrying  $N = 4$  electron modes. Determine the current that will flow if a 0.3 V potential difference is applied across the length of conductor. Assume low temperature and  $T_n = 1$ . 20

Or

With appropriate sketch, explain your understanding on the following :

- (i) Fullerene 6
- (ii) Diamond Like Carbon (DLC) 8
- (iii) Molecular shift register using biomolecules 6

5. Describe the following nanomaterial fabrication technologies : 10 each

- (i) Plasma Enhanced Chemical Vapor Deposition (PECVD)
- (ii) Pulsed Laser Deposition (PLD)

Or

To fabricate a semiconductor heterostructure (example GaAs/GaAlAs), suggest a lithographic and a non-lithographic technique. Discuss with suitable diagram of various steps involved in fabricating the heterostructure. 10, 10

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