**Karunya University**

**(Karunya Institute of Technology and Sciences)**

(Declared as Deemed to be University under Sec.3 of the UGC Act, 1956)

**Supplementary Examinations – June 2016**

**Subject Title: NANOSCALE DEVICES AND CIRCUIT DESIGN Time : 3 hours**

**Subject Code: 14EC3063 Maximum Marks: 100**

**Answer ALL questions (5 x 20 = 100 Marks)**

1. a. Using 1D MOS Electrostatics, derive an expression to determine how the charge in the semiconductor Qs varies with surface potential ψs. (12)

b. Explain some alternate Si MOS structures for nanoelectronic applications. (8)

**(OR)**

2. a. Discuss various Short channel effects in nanoscale transistors. (10)

b. Explain important High-K dielectrics used for sub 100 nm technology MOSFETs. Discuss the selection Criteria for High-K dielectric. (10)

3. Derive an expression of drain current of MOSFET in the presence of scattering. Also get the expression of drain current under low drain bias and high drain bias.

**(OR)**

4. Derive the expressions for the I-V characteristic of the ballistic MOSFET assuming that the electron gas is degenerate and nondegenerate.

5. Derive the expressions for the channel transmission coefficient of a MOSFET under low and high drain bias condition.

**(OR)**

6. a. Explain the energy band transitions in heterostructure quantum well. (10)

b. Analyze the subband energy Vs density of states in quantum wire. (10)

7. a. Explain Coulomb Blockade in a Quantum dot circuit. (10)

b. Explain single electron transistor concepts with neat diagrams. (10)

**(OR)**

8. Derive an I-V characteristics of a silicon nanowire MOSFET for the following.

a. nondegenerate carrier statistics.

b. degenerate carrier statistics.

**Compulsory:**

9. a. Draw and explain the architecture of a nanowire crossbar circuit. (10)

b. Explain the operating principle of any one circuit using Resonant tunneling diodes (RTD). (10)