Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**End Semester Examination – Nov/Dec – 2018**

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| **Code :** | **18EC3052** | **Duration :** | **3hrs** |
| **Sub. Name :** | **NANOSCALE FET** | **Max. marks :** | **100** |

**ANSWER ANY FIVE QUESTIONS (5 x 16 = 80 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Analyze the energy band states in quantum wire structures. | CO1 | 8 |
| b. | Discuss how nanoparticles can be assembled from rare gas clusters and molecular clusters. | CO1 | 8 |
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| 2. | a. | An n+poIysilicon-gate n-channel MOS transistor is made on a p-type Si substrate with *Na*= 5 x 10l5cm-3. The SiO2 thickness is 100A in the gate region, and the effective interface charge Qt is 4 x 1010qC/cm2. Find Ci and Cmin on the *C-V* characteristics, and find Wm, VFB and VT. | CO2 | 8 |
| b. | Discuss the band diagram for the ideal MOS structure at various operating regions. | CO2 | 8 |
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| 3 | a | Discuss the narrow width effect, channel length modulation and hot carrier effects in nanoscale MOSFETs. | CO3 | 10 |
| b. | Explain the properties of high–k and low–k dielectric materials. Summarize their merits and demerits. | CO3 | 6 |
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| 4. | a. | Show the bulk and the SOI FinFET transistors and compare their device performances. | CO4 | 10 |
| b. | Illustrates the techniques used to make dynamic logic more robust against the PDSOI floating body effects. | CO4 | 6 |
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| 5. | a. | Compare the I-V charcteristics of Germanium Nano MOSFET with Silicon MOSFET. | CO5 | 8 |
| b. | Show the structure of VMOS and explain its working. | CO5 | 8 |
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| 6. | a. | Explain the optical properties, photofragmentation and Coulombic explosion of semiconducting nanoparticles. | CO1 | 10 |
| b. | Demonstrate the mobility model of nanoscale MOSFET. | CO2 | 6 |
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| 7. | a. | For an n-channel MOSFET with a gate oxide thickness of 10 nm, *VT*= 0.6 V, and *Z* = 25 µm, *L* = 1 µm. Estimate the drain current at *VG =* 5 V and *VD =* 0.1 V. Repeat for *VG* = 3 V and *VD =* 5 V. Discuss what happens for *VD =* 7 V. Assume an electron channel mobility of µn = 200 cm2/V-s. | CO2 | 8 |
| b. | Show the structure of MESFET and explain its I-V characteristics. | CO5 | 8 |
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| **COMPULSORY QUESTION (1 x 20 = 20 Marks)** | | | | |
| 8 | a. | Discuss the electrical, vibrational and mechanical properties of carbon nanotubes. | CO6 | 9 |
| b. | For a tunnel junction having C= 0.5 aF and Rt = 100 kΩ, what is the RC time constant? What does this value mean for the tunnel junction circuit? For a tunnel junction having C= 1.2 pF and Rt = 100 kΩ, what is the maximum temperature at which you would expect to find Coulomb blockade? | CO6 | 6 |
| c. | Show the circuit model of a SET inverter and explain its operation. | CO6 | 5 |