NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

M.Tech.

SEM: II - THEORY EXAMINATION (2021 - 2022)

Subject: Nanoscale Devices: Modeling &Simulation

Time: 3 Hours   Max. Marks: 70

General Instructions:

1. The question paper comprises three sections, A, B, and C. You are expected to answer them as directed.

2. Section A - Question No- 1 is 1 marker & Question No- 2 carries 2 marks each.

3. Section B - Question No-3 is based on external choice carrying 4 marks each.

4. Section C - Questions No. 4-8 are within unit choice questions carrying 7 marks each.

5. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION A   15

1. Attempt all parts:-

1-a.   The short-channel effects are attributed to a physical phenomenon (CO1)   1

            (a) the limitation imposed on electron drift characteristics in the channel only

            (b) the modification of the threshold voltage due to the shortening channel length only

            (c) Both a & b

            (d) None of these

1-b.   The Poisson-Boltzmann equation is a...... (CO2)   1

            (a) nonlinear differential equation

            (b) linear differential equation

            (c) linear equation

            (d) None of these

1-c.   In how many methods the CNT can be prepared? (CO3)   1

            (a) 1

            (b) 2

            (c) 3

            (d) 4

1-d.   FinFET was developed to overcome the....(CO4)   1

        (a) short-channel effect

        (b) large-channel effect

        (c) mid-channel effect

        (d) no channel effect

1-e.   A transconductance amplifier is also called _____. (CO5)   1

        (a) current to voltage convertor

        (b) voltage to current convertor

        (c) resistor

        (d) inductor

2. Attempt all parts:-

2.a.   What is Quantum effects? (CO1)   2

2.b.   What is the threshold voltage? Write formula for the drain current and thresold voltage. (CO2)   2

2.c.   What do you understand by quantum mechanical tunnelling effect? (CO3)   2

2.d.   What is the difference between FinFET and CMOS? (CO4)   2

2.e.   Give any two advantages of SAR type ADC. (CO5)   2

<div align="center">SECTION B   20</div>

3. Answer any <u>five</u> of the following:-

3-a.   Write a short note on quantum effect and volume inversion. (CO1)   4

3-b.   Briefly discuss the velocity saturation due to short channel effect using the suitable diagram. (CO1)   4

3-c.   Explain the oxide thickness effect in detail with suitable diagram.(CO2)   4

3-d.   What is the channel length modulation ? Drive the equation for effective channel length.(CO2)   4

3.e.   Explain mechanical and thermal properties of CNT? (CO3)   4

3.f.   How to protect the MOS devices from radiation? (CO4)   4

3.g.   What is a sample and hold circuit? Where it is used? (CO5)   4

<div align="center">SECTION C   35</div>

4. Answer any <u>one</u> of the following:-

4-a.   What do you mean by drain punch through condition? Explain it with suitable   7

diagram.(CO1)

4-b.   What is the significance of interconnects in MOS devices and also enlist its types.(CO1)   7

5. Answer any <u>one</u> of the following:-

5-a.   Discuss an asymmetrical operation of DGSOI FETs with suitable diagram.(CO2)   7

5-b.   Write the short note on followings. (CO2)   7

        i) Miller overlap capacitance

        ii) Transition capacitance

        iii) Depletion Capacitance

6. Answer any <u>one</u> of the following:-

6-a.   Explain top-down and bottom-up approaches for synthesis of CNTs.(CO3)   7

6-b.   Discuss MOSFETs with 1D and 2D channel and draw the graph of it density of states.(CO3)   7

7. Answer any <u>one</u> of the following:-

7-a.   How total ionizing dose effects works in multi-gate devices? Explain in detail with suitable   7
        diagram?(CO4)

7-b.   Discuss radiation effects in SOI MOSFETs in detail with suitable diagram.(CO4)   7

8. Answer any <u>one</u> of the following:-

8-a.   What is multi-VT devices? Explain in detail? (CO5)   7

8-b.   Discuss the operation of VCO and LNA and also write the designing step for LNA.(CO5)   7