ABV-INDIAN INSTITUTE OF INFORMATION TECHNOLOGY & MANAGEMENT GWALIOR

विश्वजीवनामृत ज्ञानम्

Major Theory Exam (2024-2025) 2023BEE012

Duration: 3:00 Hours
Max. Marks: 50

BEE-III
Faculty: Dr. Alok Kumar Kamal

Date: 02/12/2024
Time: 02:00 PM - 05:00 PM

Important Instructions:

- **This is a closed book, closed notes examination.**
- **All sections are compulsory.**
- **Calculators are allowed.**

Section A

1) Draw the current flow mechanism involved P^+N diode? **[2]**

2) Explain accumulation, depletion and inversion modes of N-MOSCAP with the help of appropriate diagram and conditions. **[2]**

3) Define short channel effects and discuss Drain Induced Barrier Lowering (DIBL). **[2]**

4) What is the type of parasitic charges that exist within the oxide as well as at oxide/silicon interface. **[2]**

5) Why C-V characteristics for ideal MOSCAP behave differently for low and high frequency. Give detailed explanation. **[2]**

6) Consider the MOS structure for an oxide thickness of t_{ox} = 200 ^{0}A and an equivalent density of oxide charge (Q'_o = 8e10 /cm^2), calculate the flat-band voltage. **[2]** $\phi_{ms} = -1.13$

7) Why we cannot use square law equation of drain current beyond $V_{DS} = V_{DSsat}$. **[2]**

8) How is gradual channel approximation different from Depletion approximation. **[2]**

9) What is channel length modulation and how it is modelled in the drain current equation of MOSFET. **[2]**

10) What is pinch-off in MOSFET. **[2]**

Section B

1)Explain why threshold voltage changes when source to bulk junction is reversed biased. Also, derive the expression for change in threshold voltage with impact of body effect. **[5]**

2) Define threshold voltage of a practical MOSFET and derive the expression. **[5]**

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3) Consider a p-type silicon substrate at T= 300 ^{0}K doped with Na=3e16 /cm^3. Assume density of oxide charge $Q'_o = 10^{11}$ /cm^2. Determine the threshold voltage such that the oxide thickness is t_{ox}=504 ^{0}A. The work function difference is ϕ_{ms} = -1.13 V **[5]**

3) Discuss N^+P junction under thermal equilibrium, and illustrate concentration, space charge, electric field and potential profile plot, with proper explanation. **[5]**

4)Derive the drain current equation for normally off NMOS transistor with clear schematic and explanation. **[10]**