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Printed Page:-3 **Subject Code:- AMTVL0112**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)
M.Tech
SEM: I - THEORY EXAMINATION (2025 - 2026)
Subject: MOS Device Modeling

Time: 3 Hours **Max. Marks: 70**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *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 oxide layer formed in the MOSFET is (CO1,K1) 1

(a) Metal
(b) Metal oxide
(c) Silicon dioxide
(d) none

1-b. Transconductance gives the relationship between _____ (CO2,K2) 1

(a) input current and output voltage
(b) output current and input voltage
(c) input current and input voltage
(d) output current and output voltage

1-c. The amount of parasitic capacitance at the output node is determined by _____(CO3,K2) 1

(a) Concentration of the impurity doped
(b) Size of the total drain diffusion area
(c) Charges stored in the capacitor
(d) None of the mentioned

1-d. Full form of SIMOX is (CO4,K1) 1

(a) Separation by Impurity of Oxygen
(b) Separation by Implantation of Oxygen
(c) Separation by Implantation of Oxide
(d) None of the above

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1-e. FinFET is generally used to design (CO5,K2) 1

(a) Switch
(b) amplifier
(c) Processor
(d) integrator

2. Attempt all parts:-

2.a. Compare NMOS and PMOS. (CO1,K4) 2

2.b. Write the equations for the output voltage and voltage gain for CG amplifier. (CO2,K2) 2

2.c. What are short Channel Effect and Narrow Width Effect? (CO3,K2) 2

2.d. What do you understand by SOI devices? (CO4,K2) 2

2.e. What type of model is used in Level-1 ? (CO5,K1) 2

SECTION-B 20

3. Attempt all parts:-

3.a. Answer any one of the following:-

3.a.(i) Enlist and explain different MOSFET fabrication steps in short. (CO1,K2) 4

3.a.(ii) Write a short note on Subsurface punchthrough & Mobility degradation. (CO1,K2) 4

3.b. Answer any one of the following:-

3.b.(i) A MOSFET is to operate at ID = 0.1 mA and is to have gm = 1 mA/V. If kn' = 50 μA/V2, find the required W/L ratio and the overdrive voltage. (CO2,K3) 4

3.b.(ii) Explain the terms single stage MOS amplifier and MOSFET internal capacitances.(CO2,K2) 4

3.c. Answer any one of the following:-

3.c.(i) Draw and Explain high-frequency small-signal equivalent circuit model of PMOS. (CO3,K2) 4

3.c.(ii) Find the small-signal model parameters (gm, ro and gmb) for a PMOS transistor having W/L = 20 μm/2 μm and operating at ID = 100 μA and VSB = 1V. (CO3,K3) 4

3.d. Answer any one of the following:-

3.d.(i) Explain in detail the floating body effect and kink effect. (CO4,K3) 4

3.d.(ii) Write a short note on self heating effect in SOI Devices.(CO4,K2) 4

3.e. Answer any one of the following:-

3.e.(i) Show the variation of the drain current with model parameter LAMBDA for the level-1 model. (CO5,K4) 4

3.e.(ii) Show the variation of the drain current with model parameter GAMMA for the level-2 model. (CO5,K4) 4

SECTION-C 35

4. Answer any one of the following:-

4-a. What are the types of scaling? How the device characteristics are effected by scaling.(CO1,K2) 7

4-b. Why is oxide charge undesirable? How do mobile charges get introduced into the 7

oxide? How can this problem be overcome?(CO1,K3)

5. Answer any one of the following:-

5-a.	Describe the small signal equivalent circuit of the MOSFET and determine the values of small signal parameters? (CO2,K3)	7
5-b.	Explain common source amplifier with source resistor and source bypass capacitor. (CO2,K2)	7

6. Answer any one of the following:-

6-a.	Explain effect of source bias and body bias on device operation in details. (CO3, K2)	7
6-b.	For a n-channel MOSFET with gate oxide thickness of 30 nm, threshold voltage of 0.7 V, Z = 30 μm, and length of the device is 0.9 μm, calculate the drain current for V_G = 3 V and V_D = 0.2 V. Assume that the electron channel mobility is 200 cm^2/V-sec, what will be the required drain current to drive the MOS in saturation region?(CO3, K5)	7

7. Answer any one of the following:-

7-a.	Explain the construction working and characteristics of Multigate SOI MOSFET. (CO4,K2)	7
7-b.	Discuss in detail the C-∞ model. (CO4,K2)	7

8. Answer any one of the following:-

8-a.	Define sensitivity of the drain current. Using the SPICE Level 1 MOSFET Calculate the sensitivity at room temperature T=33K by using the values NA=1015 cm-3, NA (side wall) = 2.1 x 1016 cm-3, ND=1020 cm-3, Xj=0.8 μm, Tox=600 A, LD=0.5 μm. (CO5,K5)	7
8-b.	Using the SPICE LEVEL 3 MOSFET model equations, derive an expression for the sensitivity of the drain current ID with respect to temperature.(CO5,K3)	7