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

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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

M.Tech

SEM: I - THEORY EXAMINATION (2022 - 2023)

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 majority carriers of p-type semiconductor are (CO1) 1

(a) Holes

(b) Positive ions

(c) Electrons

(d) Negative ions

1-b. Gate capacitance per unit area is scaled by (CO2) 1

(a) α

(b) 1

(c) 1/β

(d) β

1-c. The junction parasitic capacitance are produced due to _____ (CO3) 1

(a) Source diffusion regions

(b) Gate diffusion regions

(c) Drain diffusion region

(d) All of the mentioned

1-d. Types of SOI Devices are (CO4) 1

(a) PASOI and FASOI

(b) PESOI and FESOI

(c) PDSOI and FDSOI

(d) None of the above

1-e. Hot carrier degradation phenomena occur in (CO5) 1

(a) advanced BJTs

(b) Diodes

(c) simple BJTs

(d) CMOS

2. Attempt all parts:-

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

2.b. Draw the transfer characteristic for n-channel depletion type MOSFET? (CO2) 2

2.c. Draw the small signal equivalent model of a MOSFET, What does gm V_{GS} stand for? (CO3) 2

2.d. Explain the term Fin in FinFET. (CO4) 2

2.e. What is the advantage of SPICE modeling of MOS Transistor ? (CO5) 2

SECTION B **20**

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

3-a. Explain the operation of MOS under bias condition. (CO1) 4

3-b. List out characteristics of Non ideal MOSFET. (CO1) 4

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

3-d. Explain the terms single stage MOS amplifier and MOSFET internal capacitances.(CO2) 4

3.e. Draw low-frequency small-signal equivalent circuit model of NMOS. (CO3) 4

3.f. Compare kink effect in FDSOI and PDSOI devices.(CO4) 4

3.g. What are the variation of mobility with electric field is observed in level-2 model? (CO5) 4

SECTION C **35**

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

4-a.	Sketch the energy band diagrams of an MOS capacitor with N-type silicon substrate and N+ poly-Si gate at flatband, in accumulation, in depletion, at threshold, and in inversion. (CO1)	7
4-b.	What are the types of oxide charges? Explain in detail.(CO1)	7

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

5-a.	Discuss the frequency response of MOSFET CS amplifier.(CO2)	7
5-b.	Describe the channel length modulation effect and define the parameter λ. Describe the body effect and define the gama parameter. (CO2)	7

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

6-a.	Explain and draw high-frequency small-signal equivalent circuit model of PMOS. (CO3)	7
6-b.	What is sub threshold swing? Explain the effect of interface states on sub threshold swing in details. (CO3)	7

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

7-a.	Explain the advantages and disadvantages of FinFET over the planer MOSFET. (CO4)	7
7-b.	Explain the construction, working and characteristics of FinFET devices. (CO4)	7

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

8-a.	What are the small geometry corrections in level-2 ? (CO5)	7
8-b.	What is BSIM? Explain in detail. (CO5)	7