Subject Code: KOE095

PAPER ID-410080

Roll No: | | | | | | | | | | | | | |

**BTECH**
**(SEM VIII) THEORY EXAMINATION 2023-24**
**MODELING OF FIELD-EFFECT NANO DEVICES**

**TIME: 3 HRS** **M.MARKS: 100**

**Note: 1.** Attempt all Sections. If require any missing data; then choose suitably.

## SECTION A

**1. Attempt *all* questions in brief.** **2 x 10 = 20**

| Q no. | Question | Marks | CO |
|---|---|---|---|
| a. | Discuss about quantum effects in MOSFET. | 02 | 1 |
| b. | Why high-k dielectrics are used in MOSFETs? | 02 | 1 |
| c. | What is CMOS technology, and what are its ultimate limits? | 02 | 2 |
| d. | How does a double gate MOS system behave under different conditions? | 02 | 2 |
| e. | Describe silicon nanowire MOSFETs. | 02 | 3 |
| f. | Discuss the concept of molecular transistors. | 02 | 3 |
| g. | What are multi VT devices? | 02 | 4 |
| h. | Discuss the key factors in analog circuit design. | 02 | 4 |
| i. | Describe the structure of SOI MOSFETs. | 02 | 5 |
| j. | Discuss the purpose of a bandgap voltage reference circuit. | 02 | 5 |

## SECTION B

**2. Attempt any *three* of the following:** **3 x 10 = 30**

| | | | |
|---|---|---|---|
| a. | Describe the concept of MOSFET scaling and its impact on device performance. | 10 | 1 |
| b. | Describe the current-voltage characteristics of MOSFETs. How does CMOS technology utilize these characteristics in circuit design? | 10 | 2 |
| c. | Discuss the I-V characteristics of nanowire MOSFETs under nondegenerate and degenerate carrier statistics. | 10 | 3 |
| d. | Explain the radiation effects in SOI MOSFETs, focusing on total ionizing dose effects. | 10 | 4 |
| e. | Explain the design considerations for SRAM (Static Random-Access Memory). | 10 | 5 |

## SECTION C

**3. Attempt any *one* part of the following:** **1 x 10 = 10**

| | | | |
|---|---|---|---|
| a. | Explain the concept of SOI (Silicon-on-Insulator) MOSFETs. | 10 | 1 |
| b. | Describe multigate transistors, including single gate, double gate, and triple gate configurations. | 10 | 1 |

**4. Attempt any *one* part of the following:** **1 x 10 = 10**

| | | | |
|---|---|---|---|
| a. | Describe electron tunnel current and its significance in MOSFETs. | 10 | 2 |
| b. | Explain scattering and its impact on mobility in MOSFETs. How do different scattering mechanisms affect device performance? | 10 | 2 |

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**5. Attempt any *one* part of the following: 1 x 10 = 10**

| | | | |
|---|---|---|---|
| a. | Discuss the concept of Schottky barrier carbon nanotube FETs. | 10 | 3 |
| b. | Explain electronic conduction in molecules. How are molecular transistors used in nano electronics? | 10 | 3 |

**6. Attempt any *one* part of the following: 1 x 10 = 10**

| | | | |
|---|---|---|---|
| a. | Explain scaling effects in SOI MOSFETs. How does scaling impact device performance and reliability? | 10 | 4 |
| b. | Describe the effects of radiation on single-gate SOI and multi-gate devices. | 10 | 4 |

**7. Attempt any *one* part of the following: 1 x 10 = 10**

| | | | |
|---|---|---|---|
| a. | Explain the design principles of operational amplifiers. How are operational amplifiers used in various applications? | 10 | 5 |
| b. | Discuss the design of comparators in analog circuits. What are the key considerations in comparator design? | 10 | 5 |