REG.NO.: 24BVD0194

VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF ELECTRONICS ENGINEERING
CONTINUOUS ASSESSMENT TEST - 1
WINTER SEMESTER 2025-2026

SLOT: B2

Programme Name & Branch: B.Tech Electronics Engineering (VLSI Design and Technology)
Course Code and Course Name : BEVD206L - Semiconductor Device Modelling
Faculty Name(s) : Dr. Sandeep Moparthi
Class Number(s) : VL2025260500893
Date of Examination : 28.01.2026
Exam Duration : 90 minutes **Maximum Marks: 50**

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Bloom's Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes:
  CO1. Understand the semiconductor physics and carrier transport mechanism in semiconductors and model the P-N Junction Diode.
  CO2. Understand the physics of MOSFETs and equivalent circuit models for MOSFETS.
  CO3. Understand Technology Computer-Aided Design (TCAD) tools and simulate the electrical characteristics of various semiconductor devices using these tools.

Q. No	Question	M	CO	BL
1.	A Silicon sample is doped with 10^{16} phosphorus atoms per cm^3 and $1.8x10^{16}$ boron atoms per cm^3. Find out the resistivity of the sample at 300 K, assuming all impurities are ionized. If this sample is now uniformly illuminated with light that generates 10^{16} excess electron-hole pairs (EHP) per cm^3 per second, calculate the change in resistivity of the sample caused by the light in the steady state. Assume $\tau_n = \tau_p = 10^{-6}$ s.	10	1	3
2.	Calculate the minority carrier concentrations at the edge of the space charge regions in a forward-biased pn junction. Consider a Silicon pn junction at T = 300 K. Assume the doping concentration in the n region is $N_d = 10^{16}$ cm^{-3} and the doping concentration in the p region is $N_a = 6 \times 10^{15}$ cm^{-3}, and assume that a forward bias of 0.60 V is applied to the pn junction.	10	1	3
3.	An ideal MOSFET is fabricated on a p-type silicon substrate having a doping concentration of $N_a = 1x10^{16}$ per cm^3. What is the work function of the silicon substrate at room temperature?, (For Silicon, E_g =1.12 eV, $n_i = 1.5 \times 10^{10}$ cm^{-3}, Electron affinity = 4.05 V). Draw the energy band diagram of the same under no bias.	10	2	2
4.	Calculate the threshold voltages at V_{SB} = -1.8 V and -2.5 V, for a polysilicon gate n-channel Silicon MOS transistor, with the following parameters: substrate doping density $N_A = 10^{16}$ cm^{-3}, gate oxide thickness t_{ox} = 500 Å. Assume the workfunction difference between the gate and substrate as 0.3 eV and there are no internal trap charges.	10	2	3
5.	Assume that an N-MOSFET is simulated with the Sentaurus TCAD simulator. Explain the Physics and Math section of the SDEVICE file. How to mention the biasing in the solve section to plot the DC transfer characteristics of MOSFET for the V_{GS} range from 0 to 1 V at V_{DS} of 0.5 V.	10	3	2