Register No.: .... Name: ....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH DEGREE EXAMINATION (Regular), DECEMBER 2023

VLSI AND EMBEDDED SYSTEMS

(2021 Scheme)

Course Code: **21VE101**

Course Name: **VLSI Technology**

Max. Marks: **60** **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Write the Wave function of an electron moving in a perfectly periodic lattice, if k is the propagation constant and explain the terms.
2. Express the intrinsic carrier concentration $n_{i,}$ as a function of energy band gap $E_{g.}$ and explain the relationship.
3. What is drift current? Write the expression for drift current due to the charge carriers in a Semiconductor.
4. What is Channel length modulation in a MOSFET?
5. Draw the small signal model of a MOSFET with channel length modulation.
6. What is ‘body-transconductance’ in a MOSFET? Explain.
7. Explain the Velocity saturation phenomenon observed in MOSFETS?
8. Explain the Gate-oxide tunneling leakage in MOSFETs.

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. Write Schrodinger wave equation. Apply the Schrodinger wave equation to find out the allowed energy levels of Hydrogen atom. (6)

OR

10. Apply the concept of E-k diagram to show that the effective mass of electron is different at different energy bands. Write necessary expressions. (6)

MODULE II

11. a) Derive the expression for the electron concentration in an extrinsic semiconductor in terms of the intrinsic carrier concentration. (4)

b) In an n-type Si sample, the Fermi level is 0.3 eV below the conduction band edge. Find the electron concentration in the conduction band for the sample at room temperature (T=300K). Given that for Si, Energy bandgap Eg is 1.1eV, $n_i = 1.5\text{x}10^{10} / \text{cm}^3$ at (2)

300K and k = 8.62 x 10^{-5} eV/K.

OR

12. Demonstrate the relation between Fermi Dirac distribution function $f_{(E)}$ in semiconductors and the energy band diagram in semiconductors, with suitable sketches for intrinsic, p-type and n-type semiconductors and explain. (6)

MODULE III

13. Derive an expression for the width of depletion layer in a p-n junction at equilibrium, in terms of doping concentrations on both sides (Na,Nd) and contact potential V_0. (6)

OR

14. Derive the diode current equation, for a p-n junction diode with an external bias voltage applied across it. (6)

MODULE IV

15. a Explain the three operating regions that can be observed in a two terminal MOS structure with applied bias voltage. Draw the energy band diagram for each case and explain. (4)

    b Calculate the maximum depletion depth achieved at the onset of surface inversion. (2)

OR

16. a) Write down the advantages of using MOSFETs as active device in VLSI design. (3)

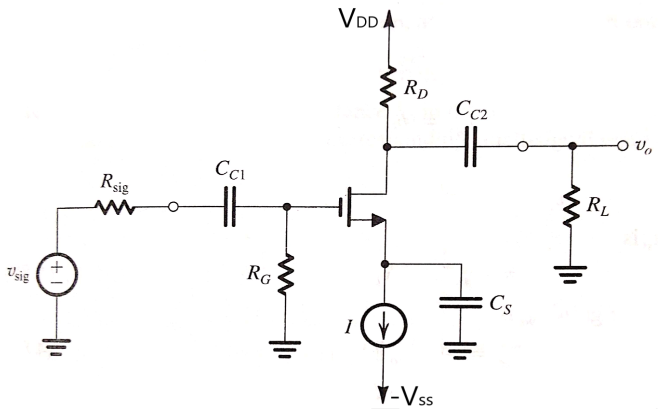
    b) Draw the output characteristics of MOS and sketch the 'Early voltage' and explain. Give expressions. (3)

MODULE V

17. Sketch the high frequency equivalent model of a MOS transistor showing all the capacitances. Explain the different internal capacitances associated with a MOSFET. Derive necessary expressions. (6)

OR

18. (6)



Draw the small signal equivalent circuit of the amplifier shown. Find out its voltage gain and output Impedance.

MODULE VI

19. What is Tunnelling in MOSFETS. Explain the different tunnelling mechanisms? How tunnelling can be reduced. (6)

OR

20. What are the different Types of Isolation techniques used in VLSI. Explain. (6)

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