

Register No.: Name:

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH DEGREE EXAMINATION (Regular), FEBRUARY 2022*(VLSI & 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 Schrodinger wave equation and explain the terms. Give its significance.
2. Define Fermi level. Give the significance of Fermi level in semiconductor.
3. Give the Einstein relation connecting diffusion coefficient and mobility of charge carriers and explain.
4. Explain the effect of channel length modulation on drain current for a MOS at saturation.
5. Draw the small signal model of a MOSFET including the effect of both Channel length modulation and Body effect.
6. Derive an expression for transconductance (g_m) of a MOSFET.
7. Explain Velocity saturation in MOSFETS.
8. What is scaling? List the advantages of scaling.

PART B*(Answer one full question from each module, each question carries 6 marks)***MODULE I**

9. Explain the concept of band splitting in silicon crystal with help of neat diagrams. (6)

OR

10. What is E-k diagram. Show analytically that the effective mass of electron is different at different energy bands. (6)

MODULE II

11. Sketch the relation between $f_{(E)}$ and energy band diagram by applying the Fermi Dirac distribution function $f_{(E)}$ to semiconductors for intrinsic, p-type and n-type semiconductors and explain. (6)

OR

12. a) Derive an expression for the electron concentration in the conduction band of a semiconductor at thermal equilibrium. (4)
- b) Given an n-type Si sample in which 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 E_g is 1.1eV, $n_i = 1.5 \times 10^{10}$ per cm^3 at 300K and $k = 8.62 \times 10^{-5}$ eV/K (2)

MODULE III

13. Derive the current equation for a P-N junction diode with an external bias voltage applied across it. (6)

OR

14. a) Define transition capacitance and diffusion capacitance in a P-N junction diode. (2)
 b) Derive an expression for the transition capacitance of a P-N junction diode with an external voltage V applied across it. (4)

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. (4.5)
 b) Calculate the maximum depletion depth achieved at the onset of surface inversion. (1.5)

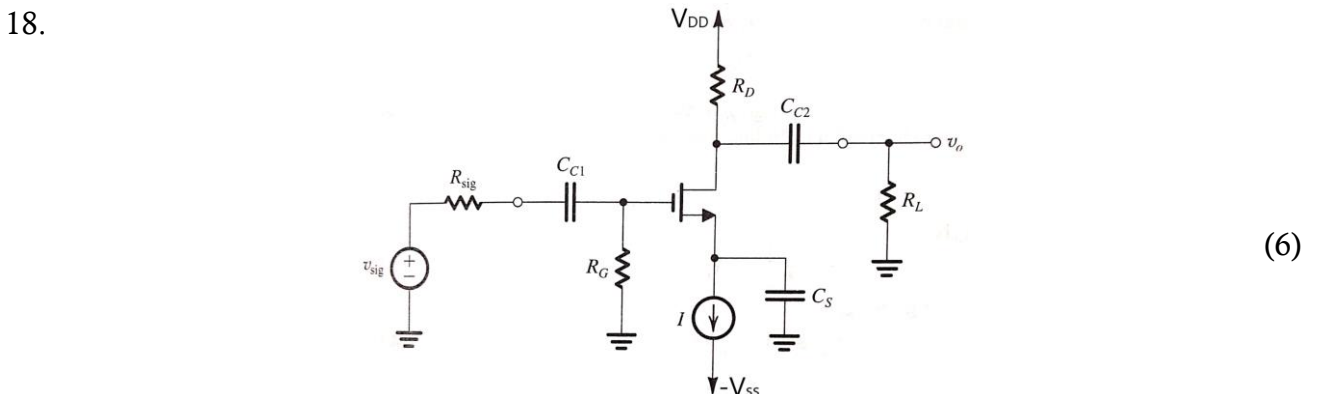
OR

16. Derive an expression for drain current in a MOS for both the triode and saturation regions of operation. (6)

MODULE V

17. What are the different internal capacitances associated with a MOSFET. Write the necessary expressions. Draw the high frequency equivalent model showing all these capacitances. (6)

OR



Draw the equivalent circuit of the above amplifier by applying the small signal model of a MOSFET and find out its voltage gain and output impedance.

MODULE VI

19. Explain the different types of isolation techniques used in VLSI. (6)

OR

20. What is tunneling in MOSFETS? Explain the different tunneling mechanisms. How tunneling can be reduced? (6)
