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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH DEGREE EXAMINATION (Regular), DECEMBER 2022

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. What do you mean by effective mass (m*) of electrons. Why is it different at different energy bands?
2. Draw the Fermi – Dirac Distribution function (f(E)) Versus Energy (E) in Semiconductors, for different temperatures and explain how (f(E)) varies with temperature.
3. Give the relation between diffusion coefficient and mobility of charge carriers and explain how mobility varies with diffusion coefficient.
4. What is Body effect in a MOSFET?
5. What is transconductance in a MOSFET? Obtain an expression for it.
6. Sketch the high frequency equivalent model of a MOS transistor showing all the capacitances and list out all the capacitances associated.
7. Explain the effects of gate-oxide tunneling leakage associated with MOSFETs.
8. What is scaling in VLSI? Give its advantages.

PART B

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

MODULE I

9. Differentiate between Direct and Indirect Semiconductors. Explain the recombination mechanisms with the help of E-k diagram. (6)

OR

10. With the help of neat diagrams explain how energy bands are formed in Silicon, when isolated Si atoms combine to form its crystal. (6)

MODULE II

11. Derive expressions for the electron concentration in the conduction band and hole concentration in valance band of a semiconductor at thermal equilibrium. (6)

OR

12. a) Derive expressions for the position of fermi level in both n-type and p-type semiconductors. (4)

b) The intrinsic carrier concentration n_i of Silicon at 300K is $1.5x10^{10}$ / cm^3. Find out n_i at 400 K. (Given k = 8.62 x 10^{-5} eV/K and energy band gap of Si is 1.12eV). (2)

MODULE III

13. Explain the two types of capacitances associated with a p-n junction diode? Derive an expression for the depletion capacitance of a p-n junction diode. (6)

OR

14. For a p-n junction with forward bias voltage applied, derive an expression for the steady-state density variation of injected holes in the n-type material as a function of distance. (6)

MODULE IV

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

OR

16. Derive an expression for threshold voltage (V_T) for the ideal Metal Oxide Semiconductor structure. (6)

MODULE V

17. Draw the small signal model of a MOSFET with following three given conditions. (a.) Neglect the effect of Channel length modulation, (b.) Include the effect of Channel length modulation and (c.) Including the effect of both Channel length modulation and Body effect. Deduce necessary expressions. (6)

OR

18. Draw the circuit of a common source amplifier and find out its voltage gain and output impedance by applying the small signal model of MOSFET. (6)

MODULE VI

19. Explain the techniques of Junction isolation and Dielectric isolation used in VLSI technology. (6)

OR

20. Explain the different techniques used to control the threshold voltage (V_T) of MOSFET. (6)

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