

USN

14EVE421

Fourth Semester M.Tech. Degree Examination, Dec.2018/Jan.2019

Advances in VLSI Design

Time: 3 hrs

Max. Marks:100

Note: Answer any FIVE full questions.

- 1 a. What are MOS devices? Explain saturation, linear and cut-off regions using drain current equations for MOS devices. (12 Marks)
- b. Explain with suitable circuit diagram the implementations of a simple BICMOS inverter. Also explain the two main issues with this simple BICMOS inverter implementation. (08 Marks)
- 2 a. With a neat sketch describe the structure of a MODFET and explain the band diagrams associated with this structure. (11 Marks)
- b. Consider an n-channel MOSFET with the following information $N_a = 5 \times 10^{16} \text{ cm}^{-3}$, $\mu_n^1 = 500 \text{ cm}^2/\text{V-S}$, $\phi = 5 \times 10^{10} \text{ a/cm}^2$, $z = 50 \text{ }\mu\text{m}$, $d = 30 \text{ nm}$, $L = 5 \text{ }\mu\text{m}$, $n_i = 10^{10} \text{ cm}^{-3}$, $K_o = 3.9$, $E_g = 1.12 \text{ eV}$, $K = 11.9$.
 - i) Determine the drain current at a gate voltage $V_G = 2\text{V}$ and drain voltage $V_D = 1\text{V}$.
 - ii) Consider the case when the gate voltage is 3V and drain voltage is 4V. (09 Marks)
- 3 a. Calculate the cut-off frequency of n-channel MOSFET with channel length = 1 μ , with ρ -type substrate $\mu_n^1 = 1200 \text{ cm}^2/\text{VS}$, threshold voltage $V_T = 1.1 \text{ V}$ and $V_G = 5\text{V}$ and $z = 10$. (04 Marks)
- b. With the help of neat sketches and mathematical expressions, explain the short channel effects in MOSFET. (06 Marks)
- c. Explain MIS system in equilibrium. (10 Marks)
- 4 a. Show that in constant electric field scaling the threshold voltage and drain current scale linearly with dimensions and voltage. (12 Marks)
- b. What are super buffers? Explain operations of NMOS super buffer circuit with neat figure and stick diagram. (08 Marks)
- 5 a. For a NMOS PTL based 2 input NAND gate, give the modified truth table, the resulting K-MAP and one implementation of the function. (12 Marks)
- b. Explain carbon nanotubes. (08 Marks)
- 6 a. With a neat diagram, explain the difference between LUMO states and Homo states in molecular diode under forward and reverse bias conditions. (09 Marks)
- b. Realize NAND implementations of NMOS 4:1 MUX using depletion mode transistor and a dynamic CMOS 4:1 MUX using a clocked precharge pull-up. (11 Marks)
- 7 a. With a suitable example, explain the following:
 - i) Hierarchy
 - ii) Regularity
 - iii) Modularity
 - iv) Locality
 (12 Marks)
- b. Realize 4-bit tree network using tally circuit and draw its stick diagram. (08 Marks)
- 8 Explain the following:
 - a. Programmable structure
 - b. Barrel shifter
 - c. Standard cell design
 - d. Full custom design
 (20 Marks)

* * * * *