Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS / ME / M.TECH / SEM-2 / PGMVD-201 / 2011

2011

ANALOG VLSI CIRCUITS AND SYSTEMS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer Question No. **1** and any *five* from the rest.

1. Answer very briefly with proper reasoning with few sentences any *eight* of the following questions. Answer of this question should be in one place. $8 \times 2\frac{1}{2} = 20$

   i) Under what condition a MOS transistor acts in saturation region ?

   ii) If E be an externally applied electric field to a bar of semiconductor, then what will be current flowing per unit area of the semiconductor ?

   iii) What is the channel resistance of a MOS transistor operating in linear region, with width W and length L ?

   iv) How is the saturation drain current expression of a MOS transistor modified to incorporate the effect of channel length modulation ?

v) Specify and explain the various charge storage capacitors of a MOS transistor.

vi) What is the origin of thermal noise in a MOS transistor ?

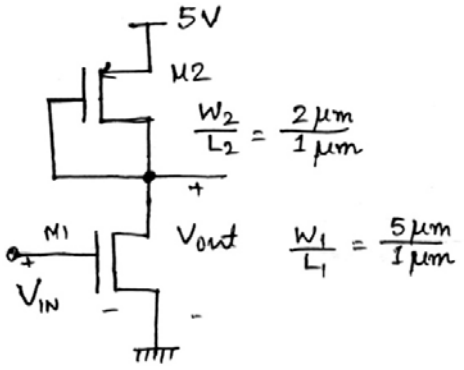
vii) Prove that a drain-gate connected MOS transistor always operate in saturation region.

viii) What are the advantages of MOSFET resistors ?

ix) What are the characteristics of a good MOS current sink ?

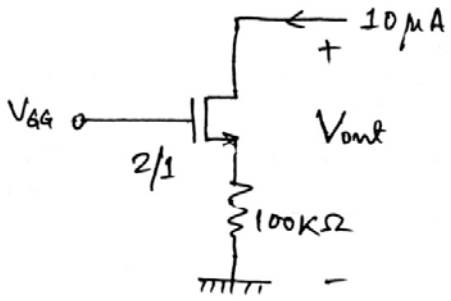
x) If Z_0 be the output impedance of any amplifier with open loop gain A and negative feedback be applied with feedback factor β, what will be the resultant output impedance considering the feedback ?

2. Consider the following circuit :



What value of V_{IN} will give a current in the circuit of 100 μA if W_1/L_1 = 5 μm /1 μm and W_2/L_2 = 2 μm/1 μm ? For this value of V_{IN} , what is small signal voltage gain and output impedance ? Assume $K_{N'}$ = 110 μA/V^2 and V_{TN} = 0·7 V. 10

3. The following figure illustrates a source-degenerated current source. Assume K' = 110 μA/V^2 and λ = 0·04 V^{-1}. Find out the output resistance at the given current bias and the minimum output voltage required to keep the dence in saturation. Neglect body effect



10

4. What do you mean by small signal ? Derive the low frequency small signal model of a MOS transistor. 10

5. a) What are the characteristics of a good current reference circuit ? 3

   b) How can you characterize the power supply independence of a voltage reference circuit ? 3

   c) Show how a voltage reference circuit can be designed using MOS transistors. 4

6. a) What is the utility of a current mirror circuit ? 2

   b) Explain how a current mirror circuit can be implemented using MOS transistor. 5

   c) Discuss the effect of channel length modulation on the performances of a current mirror circuit. 3

7. a) Derive an expression for the unity current gain frequency of an NMOS transistor. 6

   b) Comment on the significances of the above frequency parameter. 4

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