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**Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018  
Microelectronics Circuits**

Time: 3 hrs.

Max. Marks:100

**Note: Answer FIVE full questions, selecting at least TWO questions from each part.**

**PART – A**

- 1 a. What is channel length modulation? Derive the expression for finite output resistance of an NMOS transistor in saturation region. (08 Marks)
- b. Calculate the value of  $r_{DS}$  obtained for a device having  $K'_a = 100 \mu A/V^2$  and  $W/L = 10$  when operated with an overdrive voltage of 0.5V. Assume transistor is opening in triode region.
- c. Explain any three Biasing circuits in MOS amplifier. (04 Marks)  
(08 Marks)

- 2 a. From the small signal operation of an amplifier, derive the expression for i) DC bias point ii) Signal current in the drain terminal iii) transconductance and iv) Voltage gain. (08 Marks)
- b. A transistor amplifier is fed with a signal source having an open circuit voltage  $V_{sig}$  of 10mV and an internal resistance  $R_{sig}$  of 100k $\Omega$ .  $V_i$  and  $V_o$  are measured both without and with a load resistance  $R_L = 10k\Omega$  connected to the amplifier output. The measured result are as follows :

	$V_i$ (mv)	$V_o$ (mv)
With $R_L$	8	70
Without $R_L$	9	90

- Find: i)  $A_v$  ii)  $A_{v0}$  iii)  $G_v$  and iv)  $G_{v0}$ . (04 Marks)
- c. With a neat circuit diagram and small signal model of common drain amplifier prove that  $A_{v0} = 1$  and  $G_v = 1$ . (08 Marks)
  - 3 a. For the high frequency equivalent circuit of a common source MOSFET amplifier shown in Fig. Q3(a) having  $R_{sig} = 100K\Omega$ ,  $R_{in} = 420K\Omega$ ,  $C_{gs} = C_{gd} = 1pF$ ,  $g_m = 4 MA/V$  and  $R'_L = 3.33K\Omega$ . Find the midband voltage gain  $A_m = \frac{V_o}{V_{sig}}$  and upper 3dB frequency.

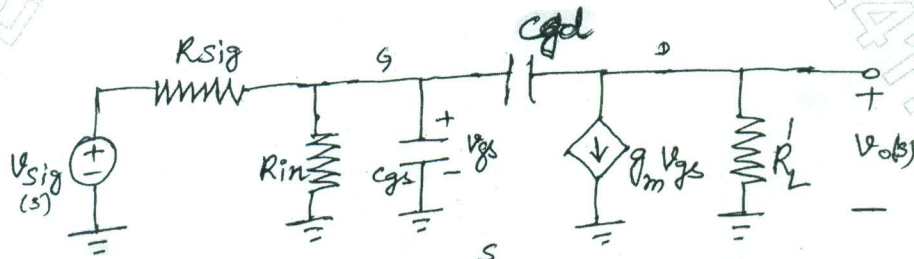


Fig Q3(a)

(08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.



- b. What is scaling of MOSFET? Explain two types of scaling with examples. (04 Marks)
- c. With a neat circuit diagram, explain the basic MOSFET current source and MOSFET current steering circuit. (08 Marks)
- 4 a. Derive the expression for  $R_{in}$ ,  $G_{vo}$ ,  $A_v$  and  $G_v$  of common gate amplifier with active load. (10 Marks)
- b. Consider a CC-CE amplifier such that in Fig Q4(b) with the following specifications.  $I_1 = I_2 = 1\text{mA}$ , and identical transistors with  $\beta = 100$ ,  $f_T = 400\text{MHz}$  and  $C_\mu = 2\text{pF}$ . Let the amplifier be fed with a source  $V_{sig}$  having a resistance  $R_{sig} = 4\text{K}\Omega$  and  $r_e = 25\text{m}\Omega$ . Assume a load resistance of  $4\text{K}\Omega$ ,  $g_m = 40\text{mA/V}$ . Find the voltage gain  $A_m$ . (10 Marks)

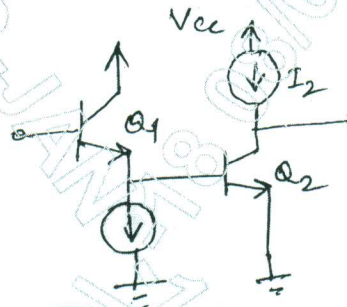


Fig Q 4(b)

**PART - B**

- 5 a. Derive the expression for common mode gain common mode rejection ratio of the MOS Differential amplifier. (10 Marks)
- b. With a neat circuit diagrams explain the working of active loaded MOS Differential pair. (10 Marks)
- 6 a. With a neat block diagram, explain the General structure of feedback. (08 Marks)
- b. Explain the effect of phase margin on closed loop response and hence prove that  $|A_f(j\omega_1)| = \frac{1.3}{\beta}$ . (04 Marks)
- c. Explain the properties of Negative feedback. (08 Marks)
- 7 a. With neat circuit diagram, explain the working of instrumentation amplifier. (08 Marks)
- b. Consider the inverting configuration with  $R_1 = 1\text{K}\Omega$  and  $R_2 = 100\text{K}\Omega$ . Find the closed loop gain for the cases  $A = 10^3$  and  $10^4$ . In each case determine the percentage error in the magnitude of  $G$  relative to the ideal value of  $R_2/R_1$  (contain with  $A = \infty$ ) Also determine the voltage  $V_1$  that appears at the inverting terminal when  $V_i = 0.1\text{V}$ . (06 Marks)
- c. With a neat circuit diagram explain the working of antilogarithmic amplifier. (06 Marks)
- 8 a. Explain Digital IC technology and logic circuit families. (08 Marks)
- b. From the VTC curve, explain the static operation of CMOS invertors. (06 Marks)
- c. With example explain the working of CMOS logic gate circuit. (06 Marks)

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