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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Seventh Semester, B.E. - Electronics and Communication Engineering

Semester End Examination; Jan. / Feb. - 2021

Analog CMOS VLSI Design

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Applying the principle of Electrostatic, derive an expression for the drain current equation of an NMOSFET. 8

b. Discuss any two second order effects in MOSFET. 8

c. Sketch g_m and g_{mb} of MOSFET M, in Fig. 1c as a function of the bias current - I 4

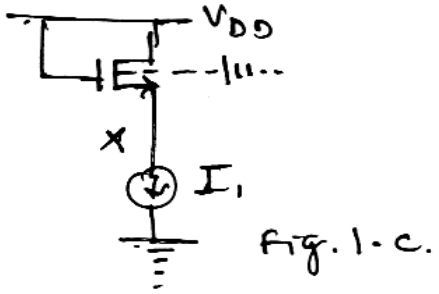

Fig. 1.c.

2 a. Draw the small signal model of a common source amplifier with diode connected load and derive an expression for its voltage gain. 8

b. Using small signal model, derive an expression for the gain of a source follower. 8

c. For the source follower in Fig. 2c, $(W/L)_1$ = 20/0.5, I_1 = 200 μA, V_{THO} = 0.5 V, $2\phi_F$ = 0.6 V, $\mu_n C_{ox}$ = 50 $\mu A/V^2$, γ = 0.33 V^2. Compute V_{out} for V_{in} = 1.4 V 4

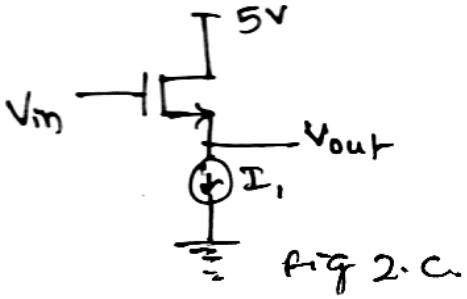

Fig 2.c.

UNIT - II

3 a. Derive an expression for the voltage gain of a differential pair. 8

b. Calculate the differential gain of the circuit in Fig. 3b. (Assuming $\lambda \neq 0$) 8

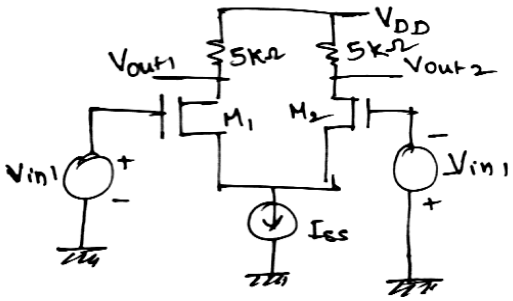

Fig. 3b

Contd…2

c. Write a note on Gilbert cell. 4

4 a. Describe the operation of a basic current mirror circuit while stating their significance in analog circuits. 8

b. Calculate the small signal voltage gain of the circuit in Fig. 4b. 8

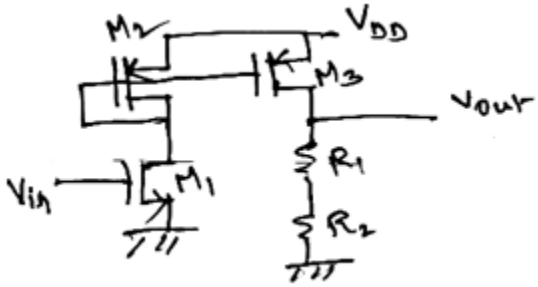

Fig. 4b

c. State the significance of a cascode current mirrors, draw the schematic of a simple cascode current source. 4

UNIT - III

5 a. Discuss the performance parameters of Op-Amp, highlighting the trade off's. 10

b. Draw the circuit diagram of two stage Op-Amp with cascoding and explain the functions of each stage. 10

6 a. With required schematics, describe the different gain boosting methods employed in Op-Amp's. 10

b. With required schematics and equations describe the noise behavior in telescopic and folded cascode Op-Amp. 10

UNIT - IV

7 a. With required schematics and graph plots explain the operation of a two pole system. 10

b. For the three stage ring oscillator show that $w_{osc} = \sqrt{3}\omega_0$ and $A_0 = 2$. 10

8 a. For Collpits oscillator, derive an expression for $\frac{V_{out}}{V_{in}}$ also show that;

$$\omega_R = \frac{1}{\sqrt{L_P \frac{C_1 C_2}{C_1 + C_2}}} \text{ and } g_m R_p = \frac{C_1}{C_2}\left(1 + \frac{C_2}{C_1}\right)^2$$ 10

b. Discuss the mathematical model of a voltage controlled oscillator, while stating the conditions of a harmonics. 10

UNIT - V

9 a. With required block diagram and waveforms, explain the operation of basic PLL. 10

b. With required block diagram and waveforms, explain the operation of a charge pump PLL. 10

10 a. Write a note on non-ideal effects in PLL. 10

b. Discuss the process of frequency synthesis and skew reduction. 10

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