DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
INDRAPRASTHA INSTITUTE OF INFORMATION TECHNOLOGY DELHI

MONSOON Semester | ECE 315/ ECE515: Analog CMOS Circuit Design | 2023 – 2024

Time: 40 minutes. **Quiz -1** **M.M.: 20**

Instructions: For the multiple choice type questions, answer with the **correct option only on the provided space in question paper**. **Overwritten/multiple answers** for a question **will not be checked**. There is no negative marking.

Name: _____ **Enr. No.:_____**

Part-1 **5×1=5**

1. For a MOSFET in the pinch off region, as the drain voltage is increased, the drain current
(A) becomes zero (B) abruptly decreases (C) abruptly increases (D) remains constant

2. Given the operating point values I_{DQ}= 1.8 mA and V_{DSQ} = 3.1 V for common-source amplifier circuit operating in edge of saturation region, value of the small signal parameter g_m will be (V_T = 1.6 V, $\lambda = 0$)
(A) 1.16×10^{-3} S (B) 0.005 S (C) 0.625×10^{-3} (D) cannot be determined

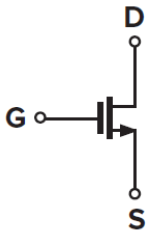

Fig. 1

3. For the MOS transistor in Fig. 1, if $V_{GS}>V_T$ and $V_{DS}<V_{GS}-V_T$, the channel voltage _____ along the length of the transistor, and the charge density _____ as we go from the source to the drain.
(A) remains constant, falls (B) varies, remains unchanged
(C) remains constant, increases (D) varies, falls

Fig. 2

4. R_{DS}(ON) of the MOSFET in Fig. 2 _____ with increasing V_{GS}.
(A) decreases (B) increases
(C) remains constant (D) first increases then decreases

5. In the CS-stage with source degeneration, if the source resistance R_S is bypassed by a capacitor C_S, then ac voltage gain of the amplifier
(A) remains the same (B) increases (C) decreases (D) gain is not affected

Answer:

1	2	3	4	5

Part-2 **5×3=15**

6. For the amplifier stage in Fig. 3, the following transistor parameters are given: k = 0.4 mA/V^2, V_T = 1 V, λ = 0, γ = 0. **(2+1+1+1)**

(a) Find the bias value V_1 which gives a bias value of 0 V for V_O.

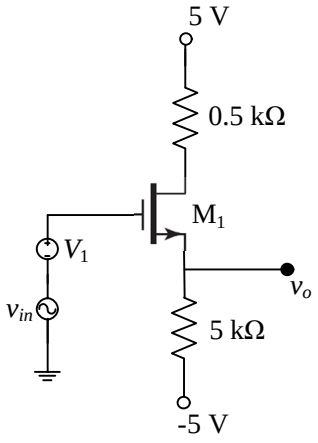

Fig. 3

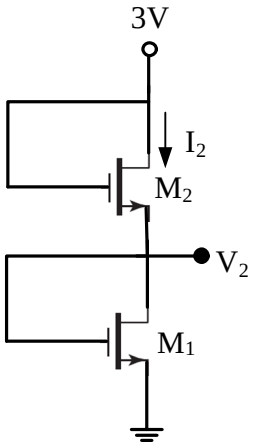

Fig. 4

(b) Draw the small-signal equivalent model for the amplifier stage.

(c) Find the small-signal open-circuit voltage gain $A_v = v_o/v_{in}$.

(d) Find the small signal input and output impedances.

7. (a) For the circuit shown in Fig. 4, both transistors are characterized by the following parameters $\mu_n C_{ox} = 20\ \mu A/V^2$, V_T = 1 V, L= 10 μm, W = 30 μm and λ = 0. Find the labeled current and voltage. **(3+2)**

(b) Is there channel-length modulation in the triode region? Justify your answer in 2-3 sentences.

8. Assuming all the MOSFETs in Fig. 5 are in saturation and λ ≠ 0, γ = 0,

(a) draw the small-signal equivalent model of the circuit in Fig. 5. **(2+3)**

(b) calculate the small-signal voltage gain of the circuit.

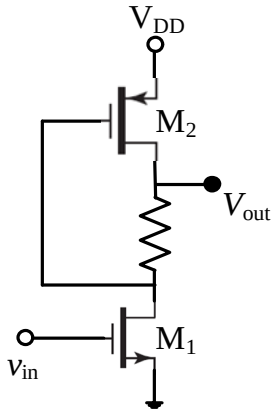

Fig. 5