Analog & Digital VLSI Design

EEE/INSTR F313

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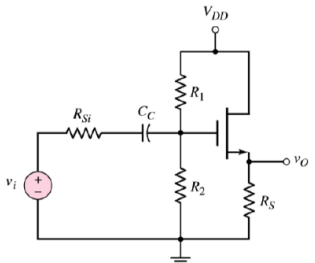
Tutorial 13

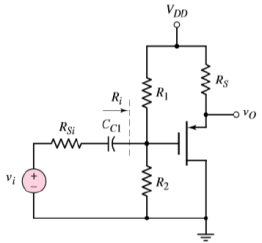
Problem 1

Calculate the small signal voltage gain A_v and output resistance R_{out} of circuit. Given: $V_{DD} = 12$ V, $R_1 = 162$ kΩ, $R_2 = 463$ kΩ, $R_S = 0.75$ kΩ, $R_{sig} = 4$ kΩ, $V_t = 1.5$ V, $\beta = 1$ mA/V^2, $\lambda = 0.01$ /V.



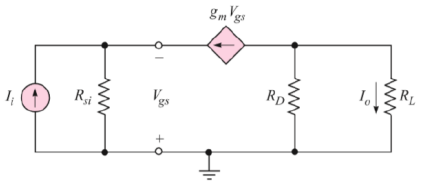
Problem 2

Given: $V_{DD} = 20$ V, $V_t = -2$ V, $\mu_p C_{ox} = 40$ μA/V^2, $\lambda = 0$, $R_{sig} = 4$ kΩ. Design a circuit such that $V_{SDQ} = 10$ V, $I_{SQ} = 2.5$ mA, $R_{in} = 50$ kΩ, and the transistor (W/L) ratio is such that the small signal voltage gain is $A_v = 0.9$ V/V.



Problem 3

Determine the output voltage gain for a given input current. Given: $I_Q = 1$ mA, $V_+ = 5$ V, $V_- = -5$ V, $R_G = 100$ kΩ, $R_D = 4$ kΩ, $R_{si} = 50$ kΩ and $R_L = 10$ kΩ, $V_t = 1$ V, $\beta = 2$ mA/V^2, $\lambda = 0$, and the input current is $100 \sin(\omega t)$ μA.



Problem 4

For the following differential amplifier, determine the DC voltages at nodes A and B. Also calculate the small signal differential gain for the amplifier. Assume no channel length modulation, no body effect, all transistors are operating in saturation region, $\mu_n C_{ox} = 200\ \mu A/V^2$, $V_t = 1$ V.