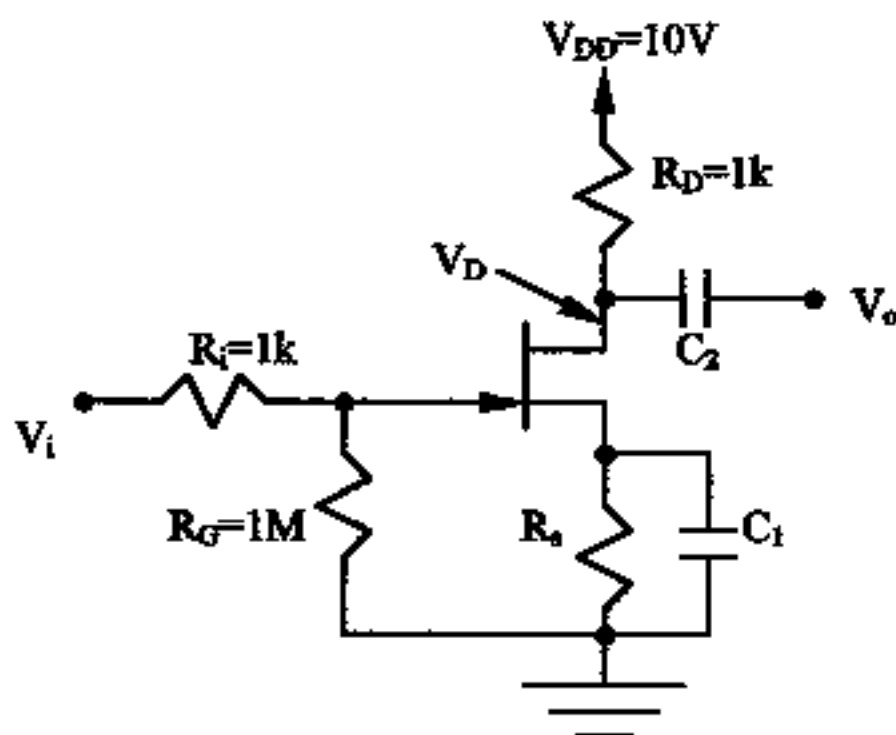


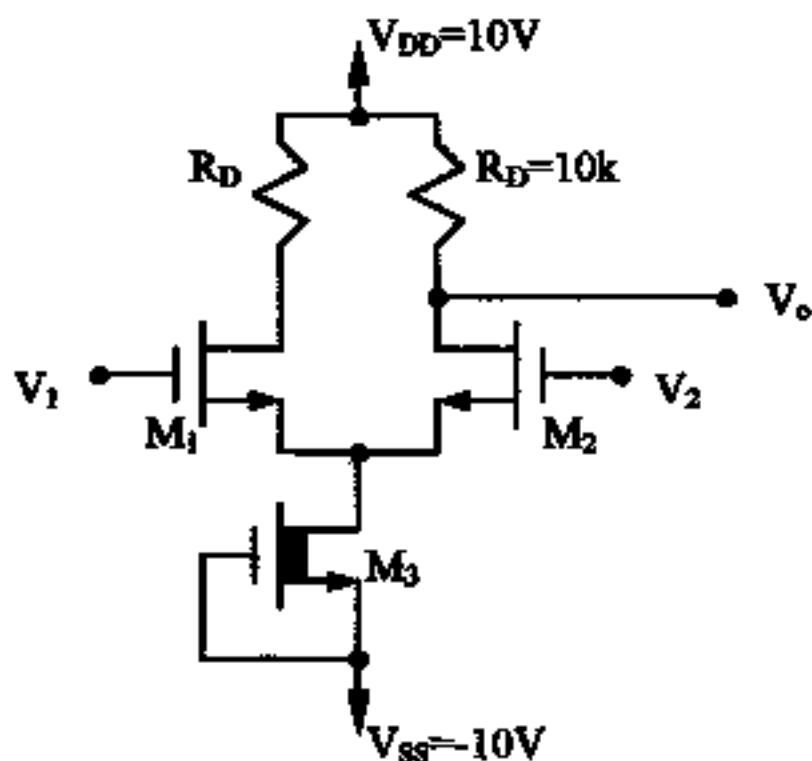
1. In the amplifier circuit as shown, JFET parameters are:  $I_{DSS}=10\text{ mA}$ ,  $V_P=-1\text{ V}$ ,  $\lambda=0$ ,  $C_{gs}=C_{gd}=0.5\text{ pF}$ . Capacitors  $C_1$  and  $C_2$  are very large. The drain voltage should be biased at  $V_D = 5.1\text{ V}$ .

- (1) Find the value of  $R_s$ . (7%)
- (2) Find the  $g_m$  value and mid-band voltage gain  $V_o/V_i$ . (7%)
- (3) Find the Miller's capacitance  $C_M$ . (3%)
- (4) Find the upper 3-dB frequency  $f_H$ . (3%)

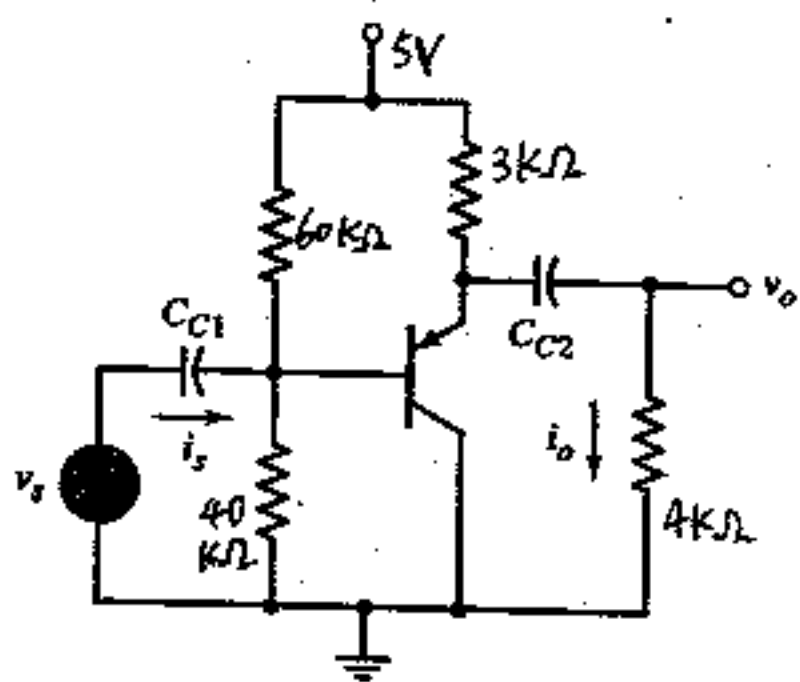


2. The MOSFET parameters in the differential amplifier circuit are:  $K_{n1}=K_{n2}=2\text{ mA/V}^2$ ,  $K_{n3}=1\text{ mA/V}^2$ ,  $V_{TN1}=V_{TN2}=2\text{ V}$ ,  $V_{TN3}=-1\text{ V}$ ,  $\lambda_1=\lambda_2=\lambda_3=0$ .

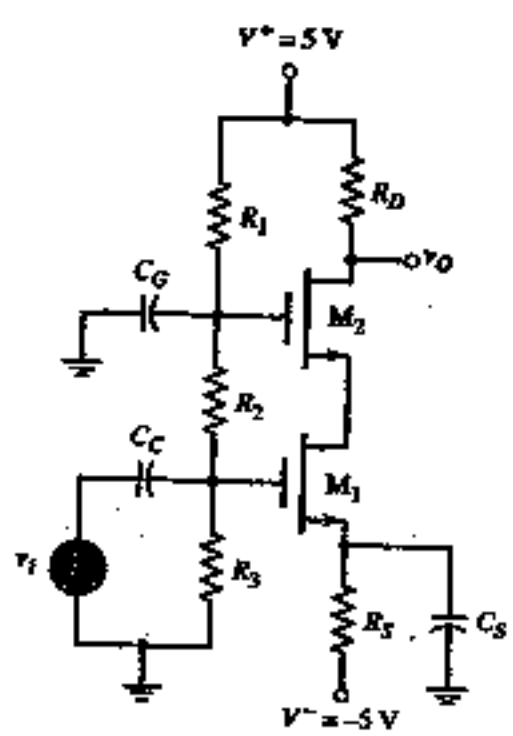
- (1) Find the differential voltage gain  $A_d=V_o/(V_1-V_2)$  and common mode rejection ratio CMRR. (8%)
- (2) Find the minimum common mode input voltage  $V_{CM,min}$ . (7%)



3. For the circuit shown below, The transistor parameters are  $\beta = 50$ ,  $V_{EB(on)} = 0.7V$ , and  $V_A = 80V$ . (a) Determine  $I_{CQ}$  and  $V_{ECQ}$ . (6%) (b) Plot the dc and ac load lines. (4%) (c) Determine  $A_v = i_o/i_s$ . (5%)



4. The transistor parameters in the following circuit are  $V_{TN1} = V_{TN2} = 1.2V$ ,  $K_{n1} = K_{n2} = W \mu_n C_{ox} / 2L = 0.8mA/V^2$ , and  $\lambda_1 = \lambda_2 = 0$ .  $R_S = 10k\Omega$ . Determine all resistance needed such that  $R_1 + R_2 + R_3 = 300 k\Omega$ ,  $I_{DQ} = 0.4mA$  and  $V_{DSQ1} = V_{DSQ2} = 2.5V$ . (15%)



5. For an amplifier with a slew rate of  $10 \text{ V}/\mu\text{s}$ , what is the full power bandwidth for outputs of  $\pm 10 \text{ V}$ ? (10%) What unity-gain bandwidth,  $\omega_u$ , would you expect if the topology was similar to that of the 741? (5%)
6. For the differentiator circuit,  $v_m = 1 \sin \omega t \text{ V}$ ,  $R = 1 \text{ k}\Omega$ ,  $C = 1 \mu\text{F}$ , the op amp power supplies are  $\pm 10 \text{ V}$ , and the slew rate is  $1 \text{ V}/\mu\text{s}$ . What is the highest signal frequency for which the output will faithfully look like the derivative of the input? (10%)
7. A noninverting op amp circuit with a feedback resistance  $R_f = 9 \text{ k}\Omega$ , and the other resistance  $R = 1 \text{ k}\Omega$  has the open-loop transfer function  $A_{OL}(j\omega) = 10^4 / [(1 + j\omega/10)(1 + j\omega/100)]$ . What is the approximate bandwidth of the circuit? (10%)