ORDRE DES INGÉNIEURS DU QUÉBEC

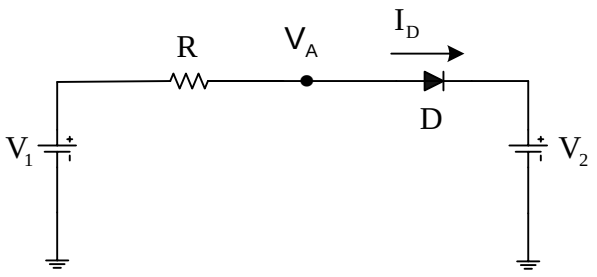
MAY 2017 SESSION

Open-book examination
Calculators: only authorized models
Duration: 3 hours

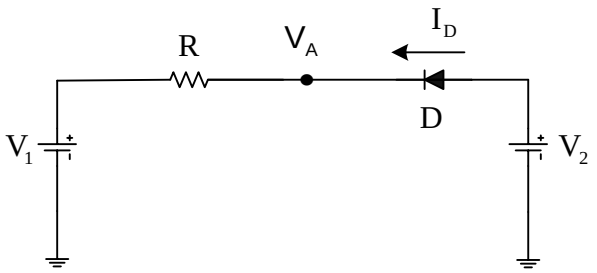
14-IF-A1 ELECTRONICS

QUESTION 1 (20 points)

For the circuits shown in Figure 1, $V_1 = 3\ V$, $V_2 = -3\ V$ and $R = 10\ k\Omega$.



a)



b)

Figure 1

Find the values of I_D and V_A:

a. When the diode is ideal ($V_D = 0\ V$). (10 points)

b. When $V_D = 0.7\ V$. (10 points)

QUESTION 2 (20 points)

For the circuit of Figure 2, $R_1 = 5\ k\Omega$, $R_2 = 500\ k\Omega$, $R_3 = 10\ k\Omega$, $V_D = 0.7\,V$ and $v_i = 50\sin(2\pi\frac{t}{T})\ V$:

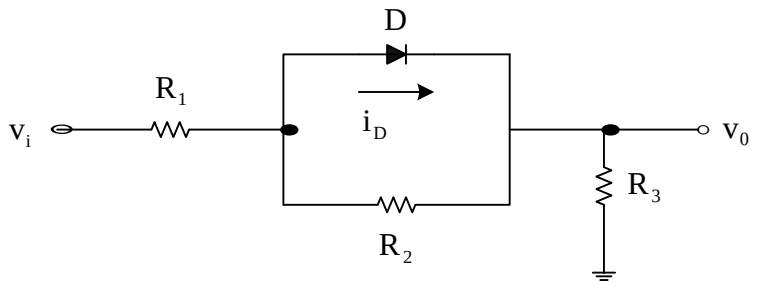


Figure 2

a. Find and sketch the voltage v_o for $0 \le t \le T$. (10 points)

b. Find and sketch the current i_D for $0 \le t \le T$. (10 points)

QUESTION 3 (20 points)

For the circuit in Figure 3, assuming an ideal operational amplifier, $R_1 = R_2 = R_3 = R_b = 10\ k\Omega$, $R_a = 5\ k\Omega$ and $C_1 = C_2 = C_3 = 0.1\ \mu F$:

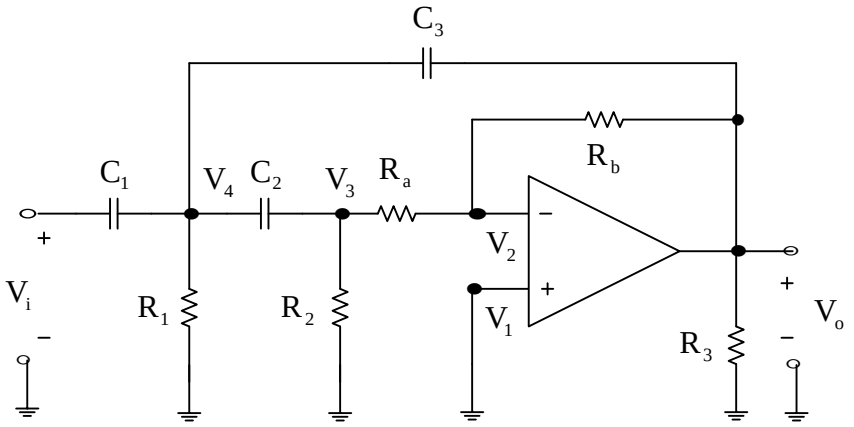


Figure 3

Find the gain $\frac{V_o}{V_i}$. (20 points)

QUESTION 4 (20 points)

For the circuit in Figure 4, $R_B = 82\ k\Omega$, $R_E = 3.9\,k\Omega$, $R_C = 100\ \Omega$, $R_L = 3.9\ k\Omega$, $R_S = 10\ k\Omega$, $V_{CC} = 12\ V$, $V_{EB} = 0.7\ V$, $\beta = 100$, $V_T = 26\ mV$ and $r_0 = \infty$:

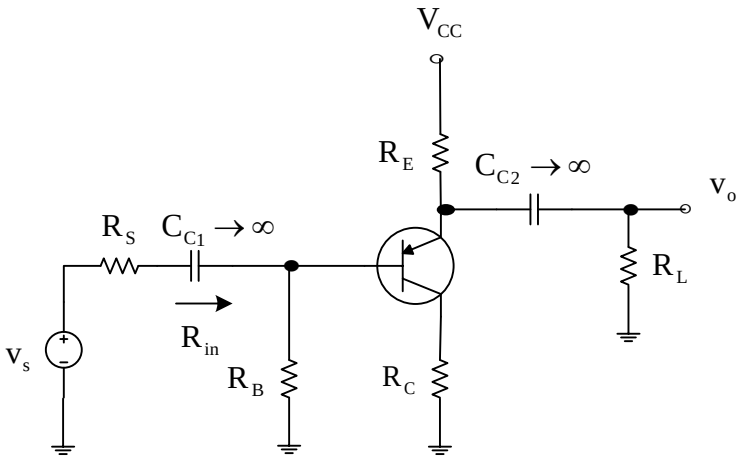


Figure 4

a. Determine I_C and V_{EC}. (8 points)

b. Determine R_{in} and $A_v = \frac{v_o}{v_s}$. (12 points)

QUESTION 5 (20 points)

For the circuit in Figure 5, $R_g = 100\,k\Omega$, $R_G = 1M\Omega$, $R_{S1} = 1.5\ k\Omega$, $R_{S2} = 100\ \Omega$, $R_L = 1.5k\Omega$, $V_p = -5\,V$, $I_{DSS} = 8\,mA$, $r_d \sim \infty$, $I_G \sim 0$ and $V_{DD} = 12\,V$:

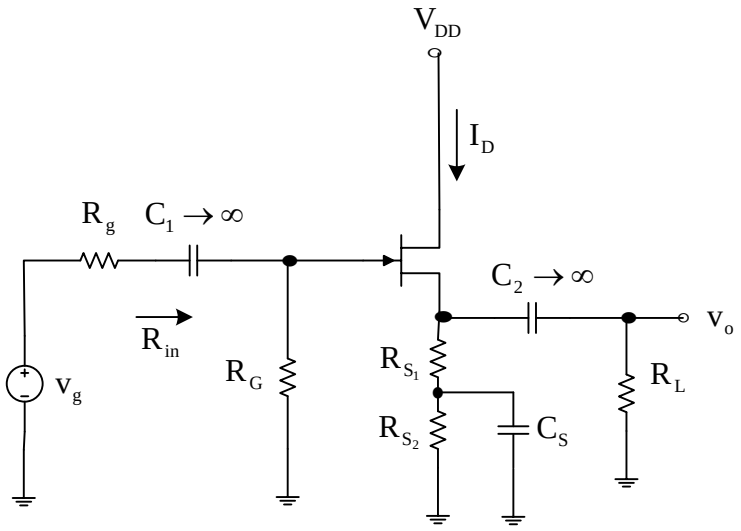


Figure 5

a. Determine I_D and V_{DS}. (8 points)

b. Determine the transconductance g_m. (4 points)

c. Determine $A_v = \frac{v_o}{v_g}$ and R_{in}. (8 points)