

ORDRE DES INGÉNIEURS DU QUÉBEC

MAY 2016 SESSION

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

14-IF-A1 ELECTRONICS

QUESTION 1 (20 points)

For the circuit in Figure 1, $V = 5\text{ V}$, $R_1 = 10\ \Omega$, $R_2 = 50\ \Omega$, $R_3 = 80\ \Omega$ and $R_4 = 100\ \Omega$.

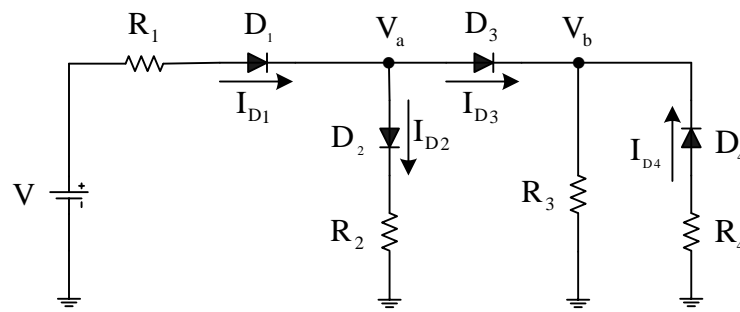


Figure 1

Find the values of I_{D1} , I_{D2} , I_{D3} and I_{D4} :

- When the diodes are ideal ($V_D = 0\text{ V}$). (10 points)
- When $V_D = 0.7\text{ V}$. (10 points)

QUESTION 2 (20 points)

For the circuit of Figure 2, $V = 5\text{V}$, $R_1 = 2\text{ k}\Omega$, $R_2 = 4\text{ k}\Omega$, $V_{D1} = V_{D2} = 0.7\text{ V}$ and

$$v_i = 12 \sin(2\pi \frac{t}{T}) \text{ V} :$$

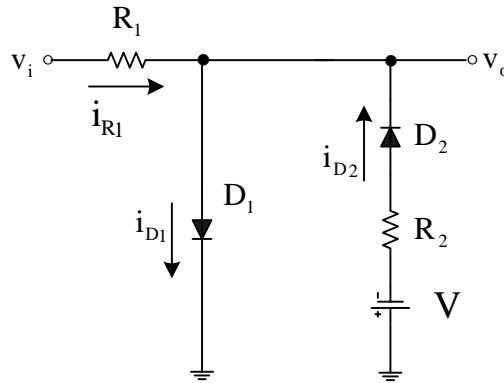


Figure 2

- Find and sketch the voltage v_o for $0 \leq t \leq T$. (10 points)
- Find and sketch the currents i_{D1} and i_{D2} for $0 \leq t \leq T$. (10 points)

QUESTION 3 (20 points)

For the circuit in Figure 3, assuming an ideal operational amplifier, $R_1 = R_5 = R_6 = R_7 = 10 \text{ k}\Omega$, $R_2 = R_4 = 20 \text{ k}\Omega$, $R_3 = 30 \text{ k}\Omega$ and $C_1 = C_2 = 0.1 \text{ }\mu\text{F}$:

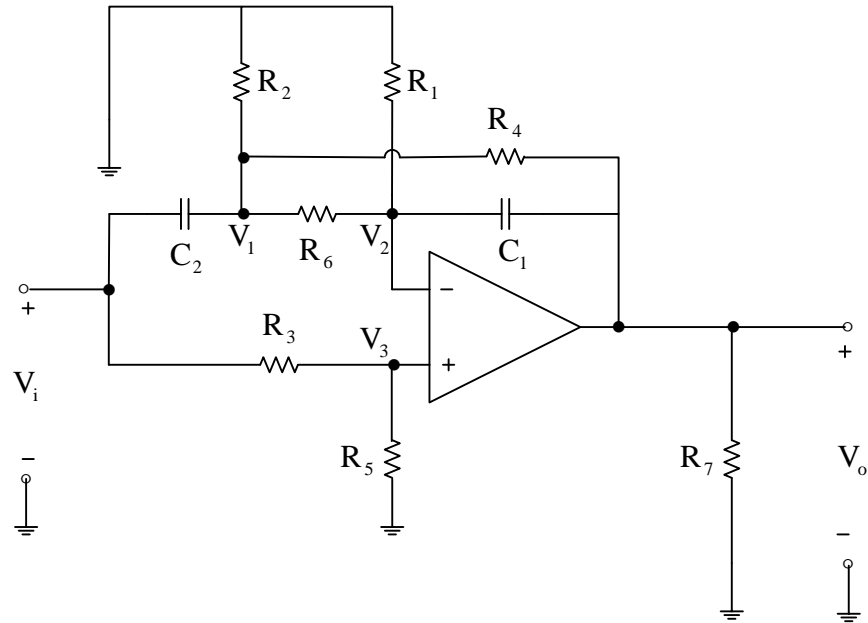


Figure 3

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

QUESTION 4 (20 points)

For the circuit in Figure 4, $R_1 = 18 \text{ k}\Omega$, $R_2 = 20 \text{ k}\Omega$, $R_E = 2 \text{ k}\Omega$, $R_C = 1 \text{ k}\Omega$, $R_L = 2 \text{ k}\Omega$, $R_S = 1 \text{ k}\Omega$, $V_{CC} = 12 \text{ V}$, $V_{EB} = 0.7 \text{ V}$, $\beta = 200$, $V_T = 26 \text{ mV}$ and $r_0 = \infty$:

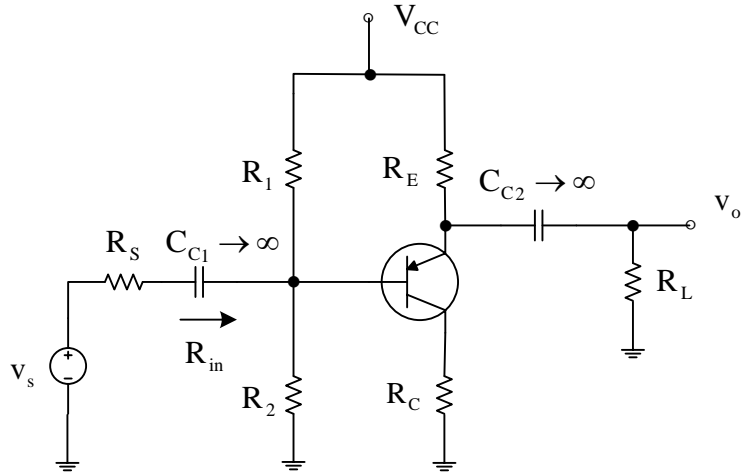


Figure 4

- Determine I_C and V_{EC} . (8 points)
- Determine R_{in} and $A_v = \frac{V_o}{V_s}$. (12 points)

QUESTION 5 (20 points)

For the circuit in Figure 5, $R_g = 100\text{k}\Omega$, $R_1 = 161\text{k}\Omega$, $R_2 = 264\text{k}\Omega$, $R_s = 1.5\text{ k}\Omega$, $R_L = 3\text{k}\Omega$, $V_p = -5\text{ V}$, $I_{DSS} = 8\text{mA}$, $r_d \sim \infty$, $I_G \sim 0$ and $V_{DD} = 12\text{ V}$:

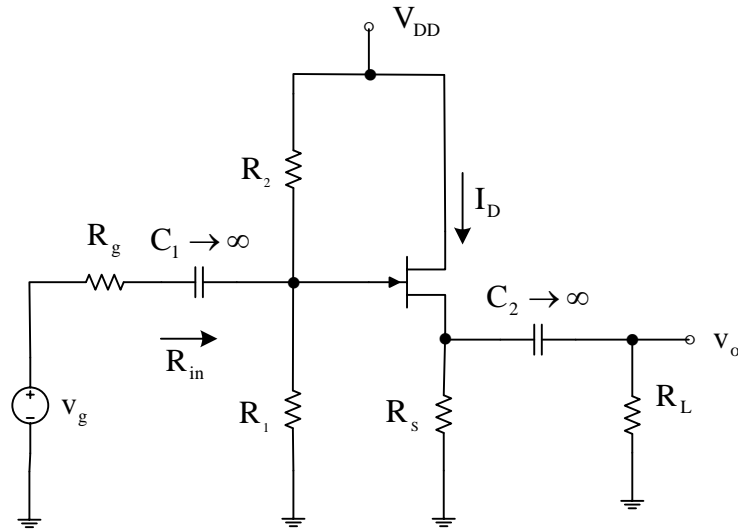


Figure 5

- Determine I_D and V_{DS} . (8 points)
- Determine the transconductance g_m . (4 points)
- Determine $A_v = \frac{v_o}{v_g}$ and R_{in} . (8 points)