

ORDRE DES INGÉNIEURS DU QUÉBEC

NOVEMBER 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, $V_1 = 10\text{ V}$, $V_2 = 5\text{ V}$, $V_3 = 5\text{ V}$, $R_1 = 2\text{ k}\Omega$, $R_2 = 6\text{ k}\Omega$ and $R_3 = 2\text{ k}\Omega$.

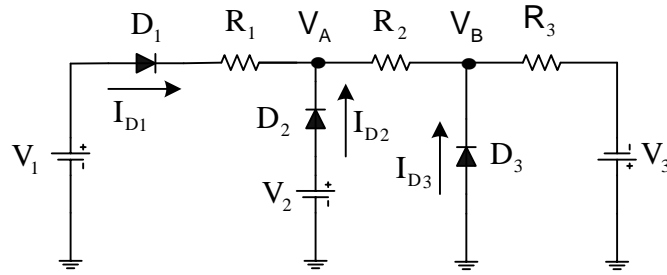


Figure 1

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

- 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, $V = 4\text{V}$, $R_1 = 5\text{ k}\Omega$, $R_2 = 5\text{ k}\Omega$, $R_3 = 5\text{ k}\Omega$, $V_{D1} = V_{D2} = 0.7\text{V}$

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

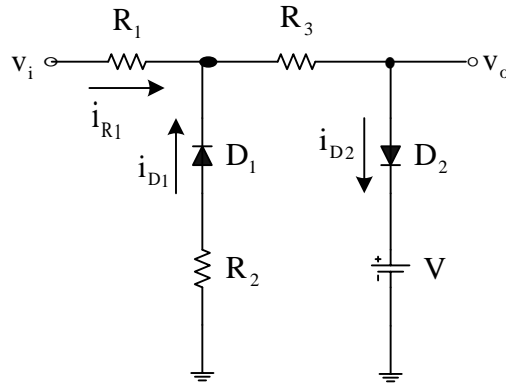


Figure 2

- 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, $R_1 = 10 \text{ k}\Omega$, $R_2 = 10 \text{ k}\Omega$, $R_3 = 10 \text{ k}\Omega$, $R_4 = 10 \text{ k}\Omega$, $R_5 = 10 \text{ k}\Omega$, $R_6 = 10 \text{ k}\Omega$, $C_1 = 0.1 \text{ }\mu\text{F}$, $C_2 = 0.1 \text{ }\mu\text{F}$, $C_3 = 0.1 \text{ }\mu\text{F}$ and assuming ideal operational amplifier :

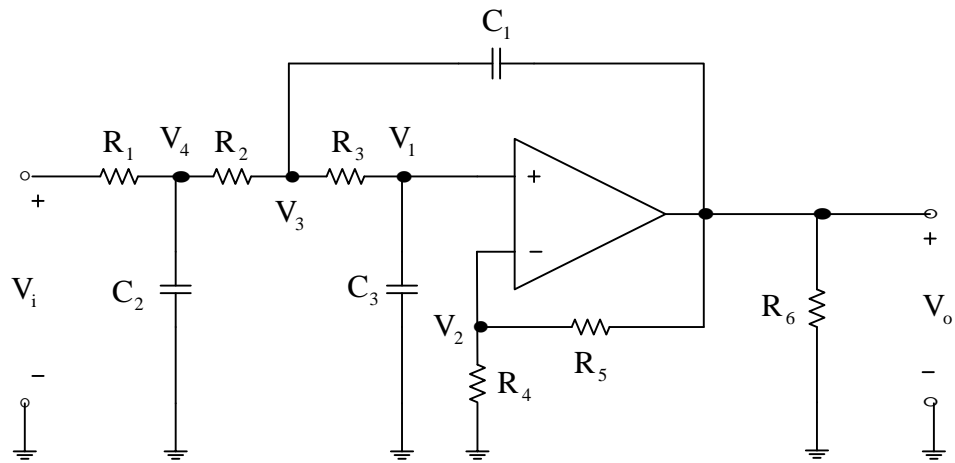


Figure 3

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

QUESTION 4 (20 points)

For the circuit in Figure 4, $R_B = 220\text{ k}\Omega$, $R_E = 1.5\text{ k}\Omega$, $R_L = 1.5\text{ k}\Omega$, $R_S = 50\text{ k}\Omega$, $V_{CC} = 12\text{ V}$, $V_{BE} = 0.7\text{ V}$, $\beta = 100$, $V_T = 26\text{ mV}$ and $r_0 = \infty$:

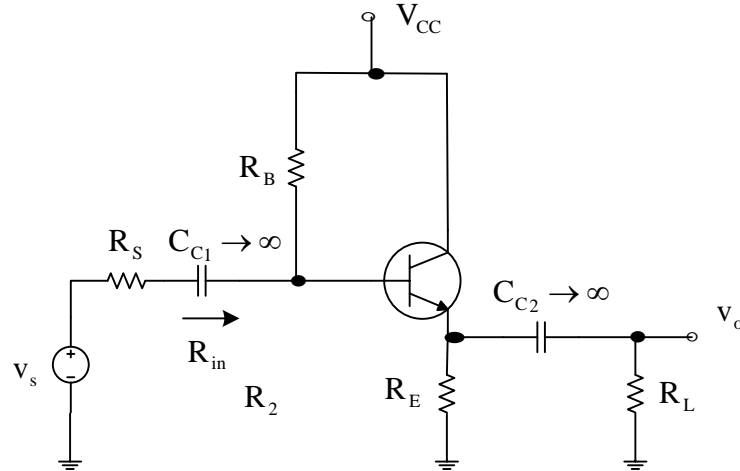


Figure 4

- Determine I_C and V_{CE} . (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, $R_{\text{gen}} = 220\text{ k}\Omega$, $R_1 = 820\text{ k}\Omega$, $R_s = 1.8\text{ k}\Omega$, $R_L = 2.2\text{ k}\Omega$, $I_{\text{DSS}} = 15\text{ mA}$, $V_p = -4\text{ V}$, $r_d \sim \infty$, $I_G \sim 0$ and $V_{\text{DD}} = 12\text{ V}$:

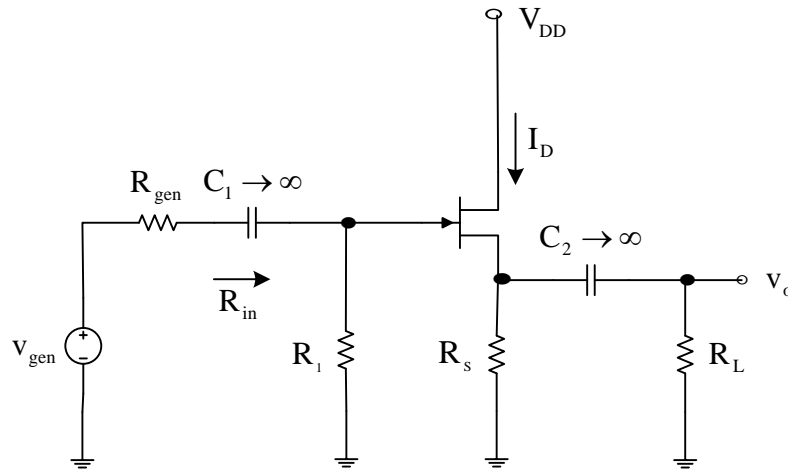


Figure 5

- Determine I_D and V_{GS} . (8 points)
- Determine $A_v = \frac{v_o}{v_{\text{gen}}}$ and R_{in} . (12 points)