國立彰化師範大學 96 學年度碩士班招生考試試題

系所：電機工程學系　　科目：電子學

☆☆請在答案紙上作答☆☆　　共 3 頁，第 1 頁

1. Sketch the voltage transfer characteristics (i.e., v_O vs. v_I) for the circuits in Figure 1. Assume all diodes to be ideal and $V_Z = 5$ V. (10%)

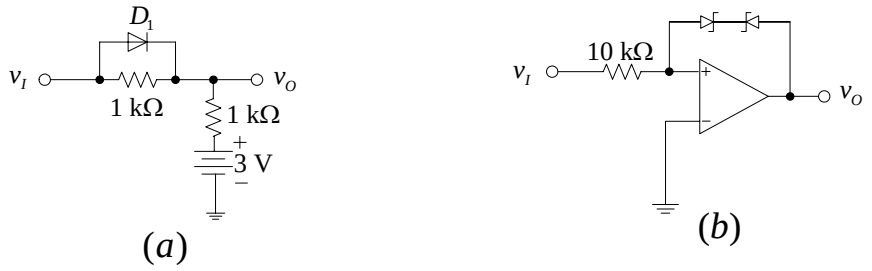

Figure 1

2. Assuming the op amps in Figure 2 (a) and (b) to be ideal, express the output voltage/current (i.e., v_O and i_O) as a function of v_1 and v_2 . (20%)

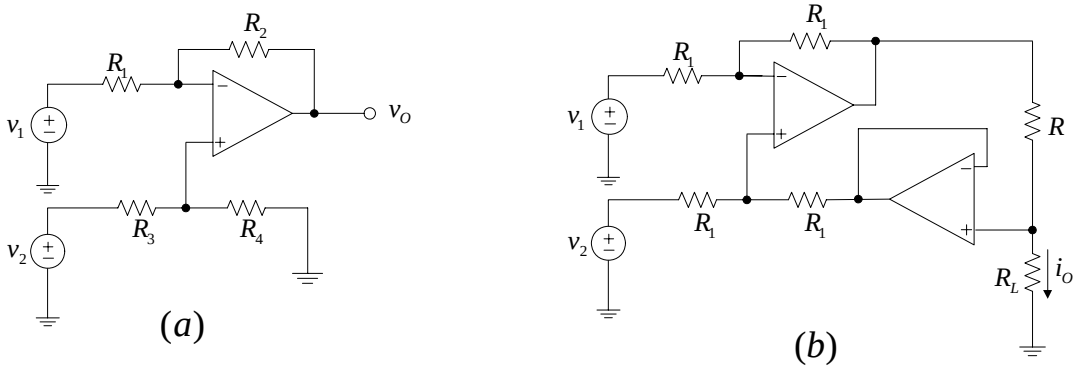

Figure 2

3. (a) Sketch the small-signal equivalent circuit for the CE amplifier in Figure 3. (5%)
   (b) Neglecting the effect of r_o, derive the expressions for the voltage gain v_o/v_s and input resistance R_{in} based on the equivalent circuit in part (a). (10%)

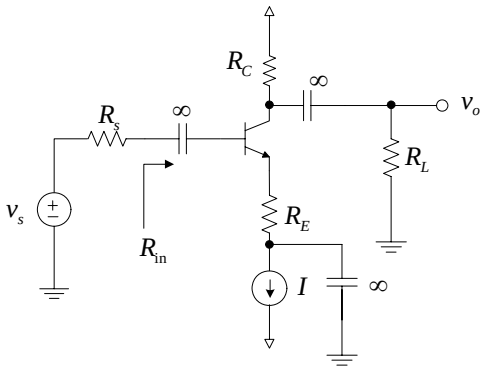

Figure 3

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4. The MOSFETs in the circuit of Figure 4 have $V_t = 1\,\text{V}$, $\mu_n C_{ox}(W/L) = 1\,\text{mA/V}^2$, and $\lambda = 0$. Find:
   (a) The current *I*, (5%)
   (b) The range of R such that Q_3 is still in saturation. (5%)

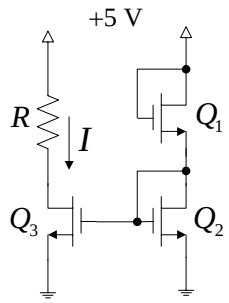

Figure 4

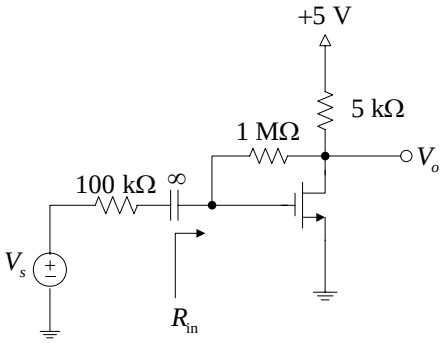

Figure 5

5. The MOS transistor in the feedback network of Figure 5 has $V_t = 1\,\text{V}$, $\mu_n C_{ox}(W/L) = 2\,\text{mA/V}^2$, $\lambda = 0$. Utilize the feedback analysis method to find:
   (a) The voltage gain V_o/V_s, (10%)
   (b) The input resistance R_{in}. (5%)

6. The amplifier in Figure 6 has the parameters: $I = 200\,\mu\text{A}$, $V_{OV} = 0.25\,\text{V}$, $R_s = 200\,\text{k}\Omega$, and $R_D = 50\,\text{k}\Omega$. Assuming $\lambda = 0$ for Q_1 and Q_2, find the low-frequency voltage gain of the amplifier. (10%)

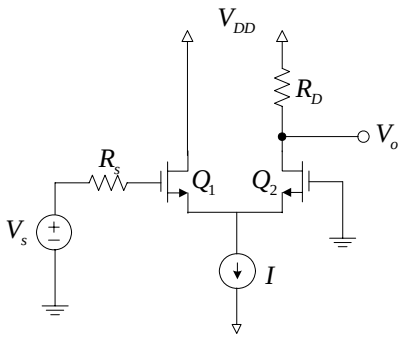

Figure 6

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7. Consider the second-order low-pass filter in Figure 7.
   (a) Derive an expression for the filter transfer function. (5%)
   (b) Find the dc gain. (5%)
   (c) Find the pole frequency ω_0. (5%)
   (d) Find the quality factor Q. (5%)

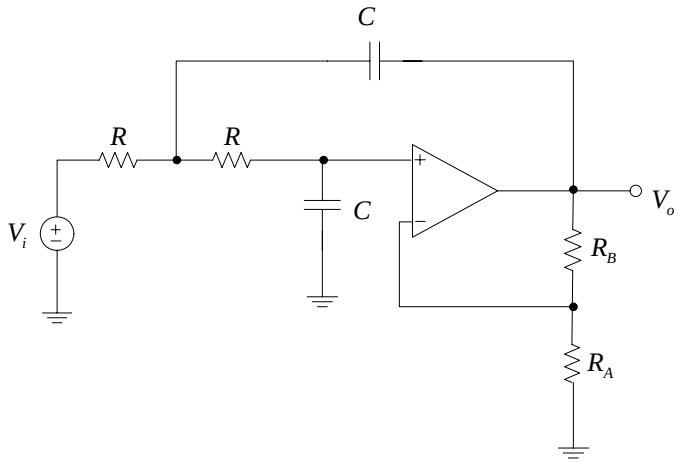

Figure 7