國立臺北科技大學 100 學年度碩士班招生考試

系所組別：1111、1132 機電整合研究所甲、丙組

第二節　電子學　試題（選考）

注意事項：

1. 本試題共 4 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. The BiCMOS circuit shown in Figure P1 is equivalent to a pnp bipolar transistor with infinite input impedance. The bias current is I_Q = 0.5mA. The MOS parameters are V_{TP} = -0.5 V, k_P = 0.7 mA/V^2, and λ = 0, and the BJT parameters are β= 180, $V_{BE}(on)$ = 0.7 V, and $V_A = \infty$. (a) Sketch the small-signal equivalent circuit, and calculate the small-signal parameters for each transistor. (b) Determine the small-signal voltage gain $A_v = v_O / v_i$ for (i) R_L = 10KΩ and (ii) R_L = 100KΩ. (c) Find the small-signal output resistance R_O.　(Total 30%, each item 10%)

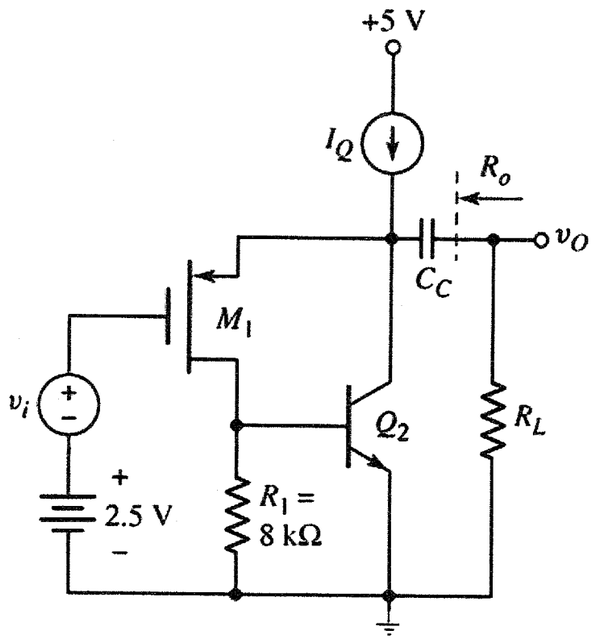

Figure of P1

2. Consider the circuit in Figure P2. Assume idea op-amps are used. (a) Derive the expression for the current i_O as a function of input voltages v_{I1} and v_{I2}. (b) Design the circuit such that i_O = 5mA for v_{I1} = 0.25 V and v_{I2} = -0.25 V. (c) using the results of part (b), determine v_{O1} and v_{O2} if R_L = 1KΩ. (d) Determine i_O, v_{O1}, and v_{O2} for R =500Ω, R_L = 3KΩ, v_{I1} = 1.25 V, and v_{I2} = 1.75 V.　(Total 20%, each item 5%)

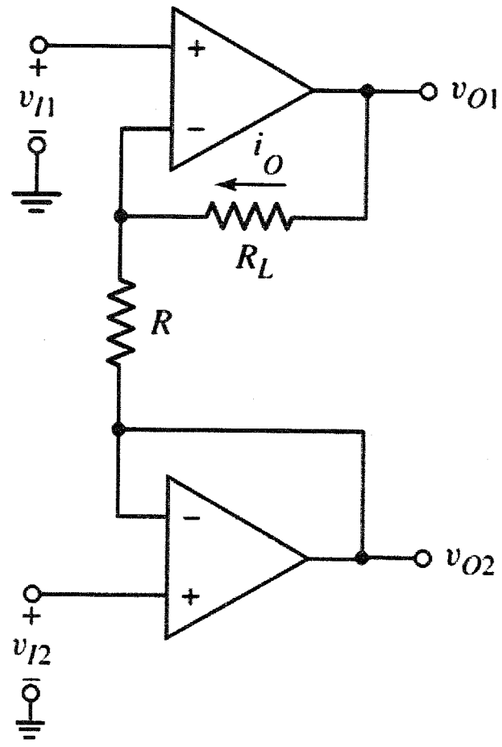

Figure of P2

3. A three-stage CMOS operational amplifier circuit is shown in Fig. P3. The transistor parameters are V_{TN} = 0.7V, V_{TP} = -0.7V, k_n' = 80μA/V^2, k_p' = 40μA/V^2, λ_n = 0.01 V^{-1}, λ_p = 0.015 V^{-1}. Assume I_{REF} = 160 μA and W/L of M_8 is 25/4. (a) The overall differential voltage gain can write as $A_v = A_{d1} A_2 A_3$, Find $A_{d1} = v_{o1}/(v_2-v_1)$. (b) Find $A_2 = v_{o2}/v_{o1}$. (c) The last stage is a class-AB output stage formed by M_6, M_7 and M_8, Find the standby current, I_{DQ}, of M_6 and M_7 ($I_{DQ} = I_{DQ6} = I_{DQ7}$).　(Total 30%, each item 10%)

4. The saturated output voltages are $\pm V_P$ for the Schmitt trigger in Figure P4. (a) Derive the expressions for the crossover voltages V_{TH} and V_{TL}. (b) If V_P = 12 V, V_{REF} = -10 V, and R_3 = 10KΩ, find R_1 and R_2 such that the switching point is V_S = -5 V and the hysteresis width is 0.2 V. (c) If V_{REF} = -6 V, sketch the voltage transfer characteristics.
[Total 20%, (a) 10%, (b) 5%, (c) 5%]

注意：背面尚有試題

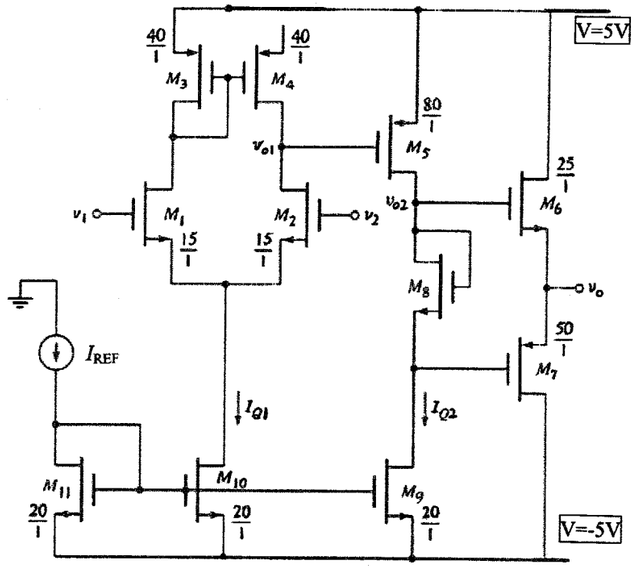

Figure of P3

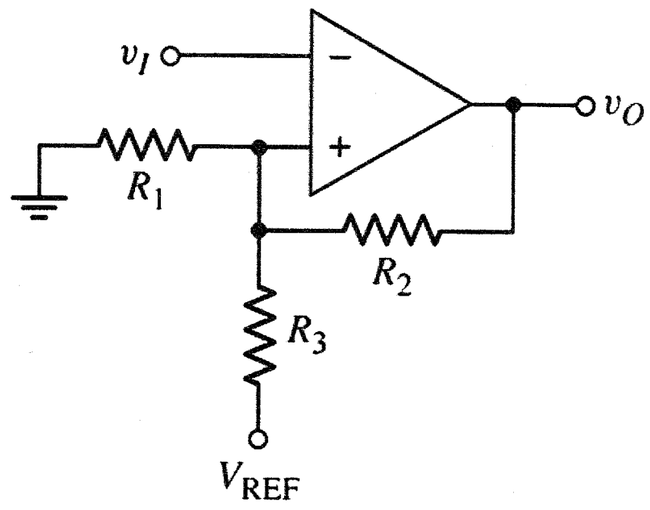

Figure of P4