

國立臺灣科技大學101學年度碩士班招生試題

系所組別： 電子工程系碩士班乙二組

科 目： 電子學

(總分為100分)

- (a) The transistors in Figure P1a have same common emitter current gain β , and the small signal parameters include $g_{m1} \sim g_{m4}$, $r_{\pi 1} \sim r_{\pi 4}$, and $r_{o1} \sim r_{o4}$. Determine the output resistance R_{O1} . (10%)

(b) The transistors in Figure P1b have small signal parameters include $g_{m1} \sim g_{m4}$ and $r_{o1} \sim r_{o4}$. Determine the output resistance R_{O2} . (10%)

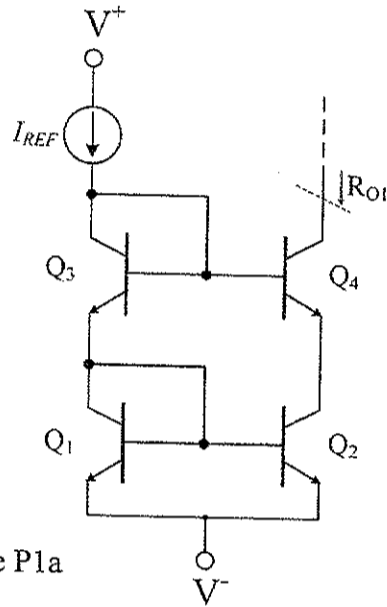


Figure P1a

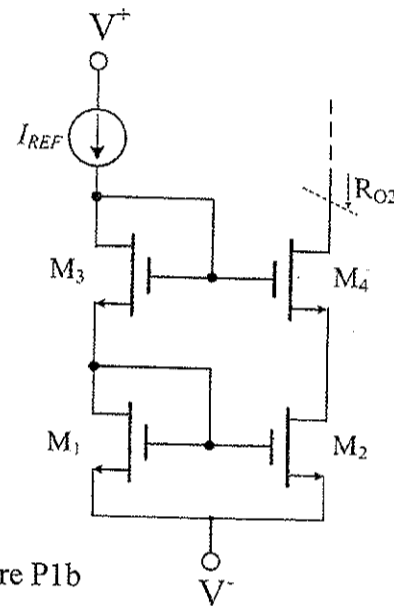


Figure P1b

- The parameters of the transistors in the circuit in Figure P2 are $V_{TND} = V_{TNL} = 0.6 \text{ V}$, $K_{nD} = 0.5 \text{ mA/V}^2$, $K_{nL} = 2 \text{ mA/V}^2$, and $\lambda_D = \lambda_L = 0$. Plot the relationship of V_o versus V_i over the range $0 \leq V_i \leq 5 \text{ V}$. (10%)
- For the circuit shown in Figure P3, the small signal parameters include g_m and r_{π} , derive the expression of the 3dB frequency associated with coupling capacitor C_{C1} and C_{C2} respectively. (20%)

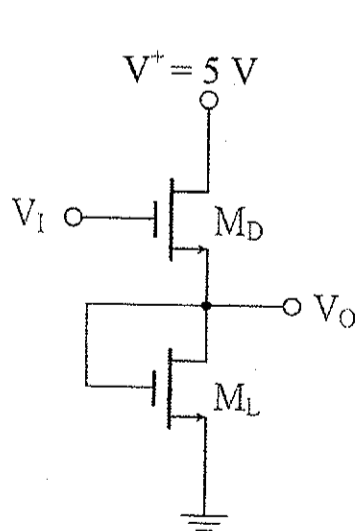


Figure P2

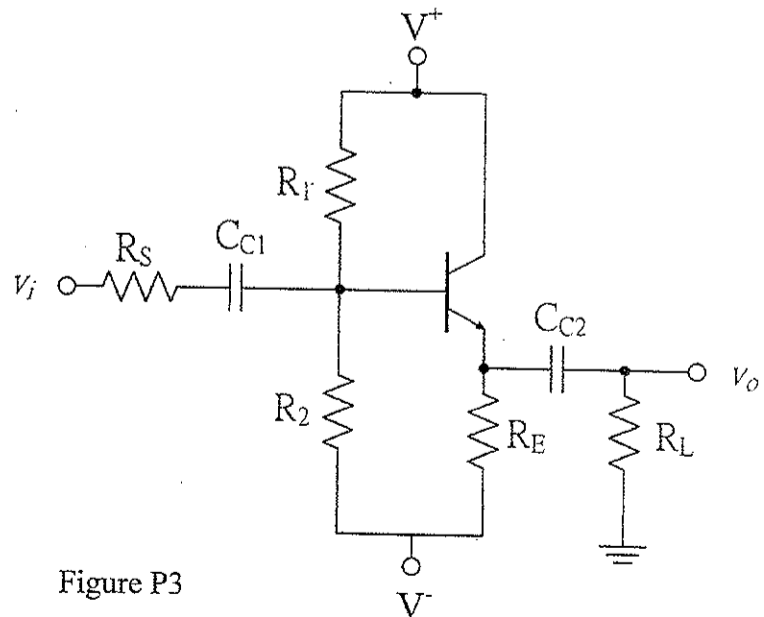


Figure P3



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4. For the circuit in Figure P4, derive the expressions for the voltage transfer function $T(s) = V_o(s)/V_i(s)$ and the cutoff frequency f_{3dB} . (20%)

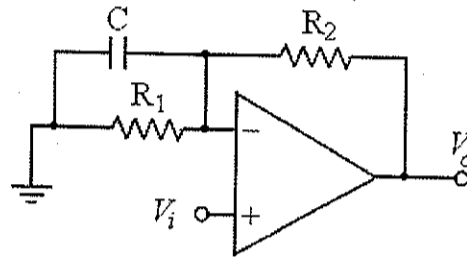


Figure P4

5. Consider the oscillator circuit in Figure P5, find the loop gain function, the frequency of oscillation, and the R_2/R_1 required for oscillation. (20%)

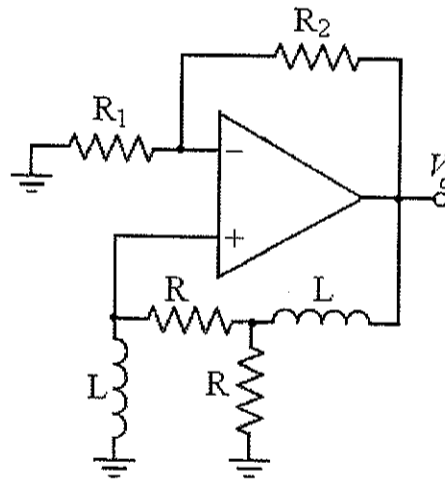


Figure P5

6. Consider a power MOSFET for which the thermal resistance parameters are: $\theta_{dev-case} = 2^\circ\text{C/W}$, $\theta_{case-snk} = 1^\circ\text{C/W}$, and $\theta_{snk-amb} = 4^\circ\text{C/W}$. The ambient temperature is $T_{amb} = 25^\circ\text{C}$, and the maximum junction or device temperature is $T_{j,max} = T_{dev} = 150^\circ\text{C}$. Determine the maximum power dissipation in a transistor and determine the temperature of the transistor case and heat sink. (10%)

