國立臺灣科技大學 104 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)

1. (10%) (a) Each diode in the circuit in Figure P1 has piecewise linear parameters of $V_\gamma = 0$ and $r_f = 0$. Plot v_O versus v_I for $0 \le v_I \le 30\ V$. Indicate the breakpoints and the state of each diode in the various region of the plot.

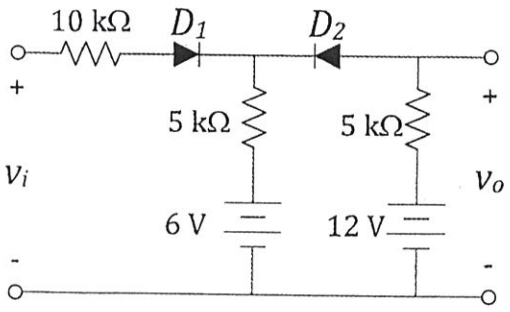

Figure P1

2. (20%) For the circuit shown in Figure P2, let $R_1 = 250\ k\Omega$, $R_2 = 100\ k\Omega$, $C_C = 0.1\ \mu F$, $R_S = 0.5\ k\Omega$, $R_C = 5\ k\Omega$, $R_E = 0.5\ k\Omega$, $\beta = 100$, $V_{BE}(on) = 0.7\ V$, and early voltage $V_A = \infty$. (a) Determine the input resistance looking into the base of the transistor (R_{ib}) (7%). (b) Determine the small-signal voltage gain $A_v = v_o/v_i$ (7%). (c) Calculate the lower corner frequency (6%).

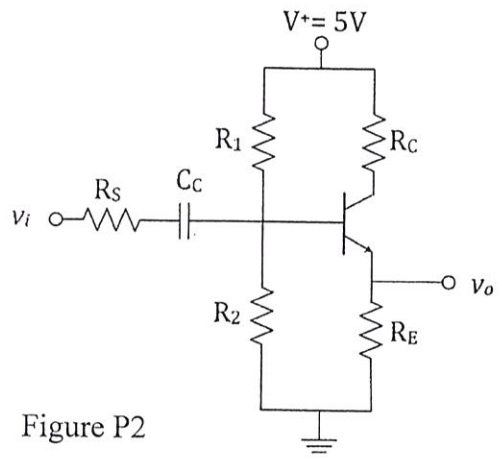

Figure P2

3. (20%)

(a) For $s = j\omega$, sketch the approximate Bode magnitude and phase plots for the transfer function

$$T(s) = \frac{2\times10^6 s}{(s+10^2)(s+10^6)} \qquad (10\%)$$

(b) Consider the common-gate circuit in Figure P3 and ignore the finite output resistance r_o. Determine the frequencies of the two poles related to C_{gs} and C_{gd} (10%).

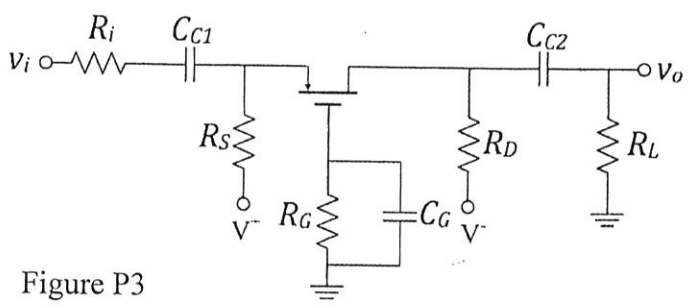

Figure P3

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4. The instrumentation amplifier circuit is shown in Figure P4. Assume that all op-amps are ideal and $R_4 = 2R_3$. Determine the range required for resistor R_1 (in terms of R_2), to realize a differential gain adjustable from 5 to 500. (10%)

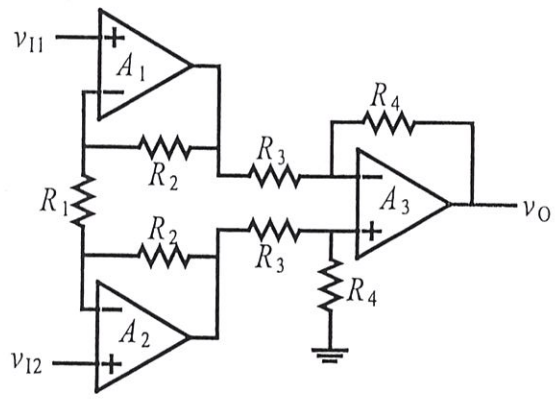

Figure P4

5. The op-amp in the circuit in Figure P5 has an open-loop differential voltage gain of $A_d = 10^2$. Neglect the current into the op-amp, and assume the output resistance looking back into the op-amp is zero. Determine: (a) the closed-loop voltage gain $A_v = V_o/V_s$, (10%) (b) the input resistance R_{if}, (5%) and (c) the output resistance R_{of}. (5%)

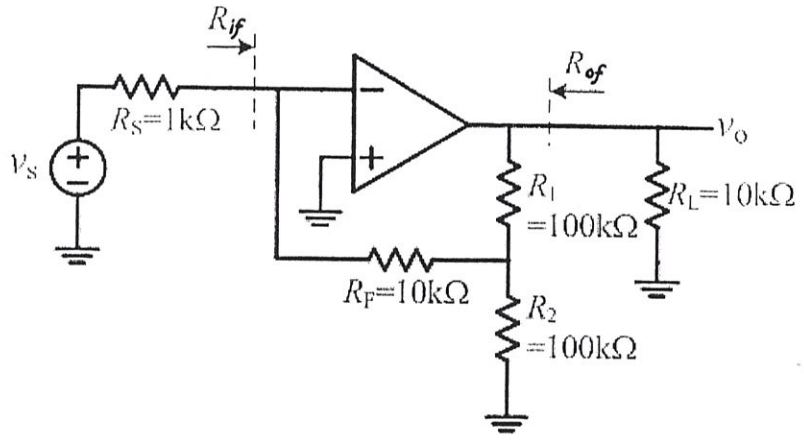

Figure P5

6. Consider a MOSFET diff-amp with the configuration in Figure P6. The transistor parameters are: $K_{n1} = K_{n2} = 0.2$ mA/V^2, $K_{n3} = K_{n4} = 0.1$ mA/V^2, $V_{TN} = 1$ V. (a) $\lambda = 0$ for all transistors, determine the differential-mode voltage gain. (10%) (b) Under quiescent condition of (a), but $\lambda = 0.01$ V^{-1} for M_4, determine the common-mode voltage gain. (5%) (c) Using (a) and (b), determine the CMRR for a MOSFET diff-amp in Figure P6. (5%)

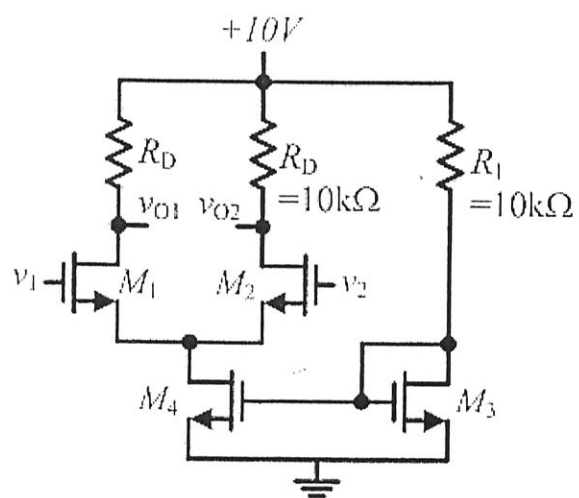

Figure P6