國立臺北科技大學 103 學年度碩士班招生考試

系所組別：2401 光電工程系碩士班

第三節　電子學　試題（選考）

注意事項：

1. 本試題共六題，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.[15%]

For the circuit in ***Figure 1***, we wish to select appropriate values for C_{C1}, C_{C2}, and C_E, which has $R_B = 100$ kΩ, $R_C = 8$ kΩ, $R_L = 5$ kΩ, $R_{sig} = 5$ kΩ, $\beta = 100$, $g_m = 40$ mA/V, and $r_\pi = 2.5$ kΩ. It is required to have $f_L = 100$ Hz.

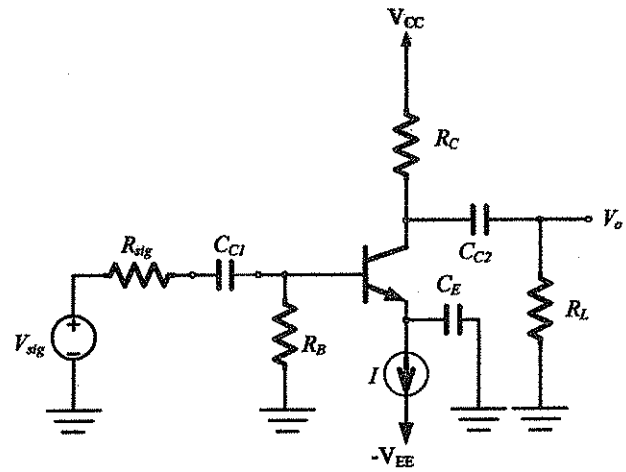

Figure 1

2.[10%]

For the circuit in ***Figure 2***, let diode cut-in voltages are $V_\gamma = 0.6$V and assume the input voltage varies over the range $0 \leqq v_I \leqq +10$V. Plot V_O versus V_I.

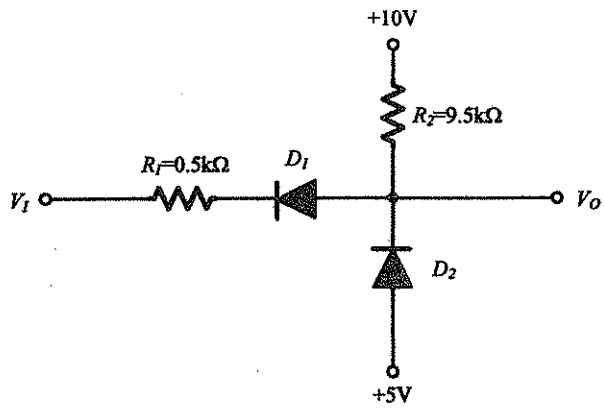

Figure 2

3.[10%]

Calculate the built-in potential and the depletion width for a silicon p-n junction diode with N_A (acceptor) = 10^{18} cm^{-3} and N_D (donor) = 10^{15} cm^{-3} at 300 K. Given silicon dielectric constant $\varepsilon_{si} = 11.7\times8.85\times10^{-14}$ F/cm, q = 1.6×10^{-19} coul, $n_i^2 = 1\times10^{20}$ cm^{-6}, kT/q = 25 mV.

4.[20%]

Transistor Q_1 in the circuit of ***Figure 4*** is operating as a CE amplifier with an active load provided by transistor Q_2, which is the output transistor in a current mirror formed by Q_2 and Q_3.

(a)Neglecting the finite base currents of Q_2 and Q_3 and assuming that their $V_{BE} \cong 0.7$ V and that Q_2 has five times the area of Q_3, find the value of *I*.

(b)If Q_1 and Q_2 are specified to have $|V_A| = 50V$, find r_{o1} and r_{o2} and hence the total resistance at the collector of Q_1.

(c)Find $r_{\pi 1}$ and g_{m1} assuming that $\beta_1 = 50$.

(d)Find R_{in}, A_v, and R_o.

注意：背面尚有試題

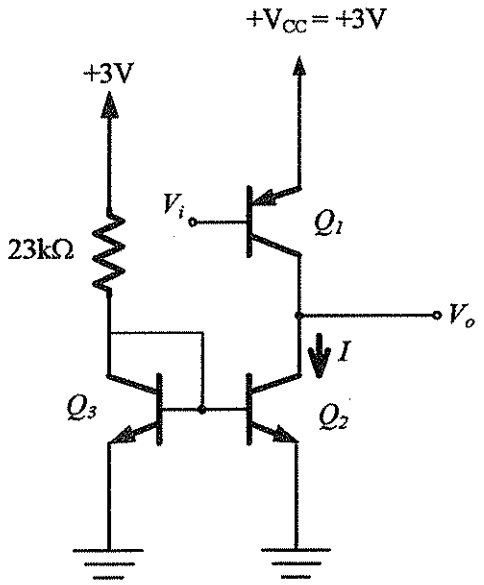

Figure 4

5.[25%]

Figure 5 shows a feedback current amplifier formed by cascading an inverting voltage amplifier μ with a MOSFET Q. The output current Io is the drain current of Q. The feedback network, consisting of resistors R_1 and R_2, senses an exactly equal current, namely, the source current of Q, and provides a feedback current signal that is mixed with Is at the input node. Note that the bias arrangement is not shown.

The amplifier μ can be implemented in a variety of ways, including by means of an op amp, a differential amplifier, or a single-ended inverting amplifier. The simplest approach is to implement μ with a CS MOSFET amplifier. However, in such a case the loop gain will be very limited. Assume that the amplifier μ has an input resistance R_{id}, an open-circuit voltage gain μ, and an output resistance r_{o1}.

If the loop gain is large, find numerical values for A_f, R_i, R_{in}, R_o, and R_{out} for the following case: $\mu = 1000$ V/V, $R_s = \infty$, $R_{id} = \infty$, $r_{o1} = 1$ kΩ, $R_1 = 10$ kΩ, $R_2 = 90$ kΩ, and for Q: $g_m = 5$ mA/V and $r_o = 20$ kΩ. (5% each)

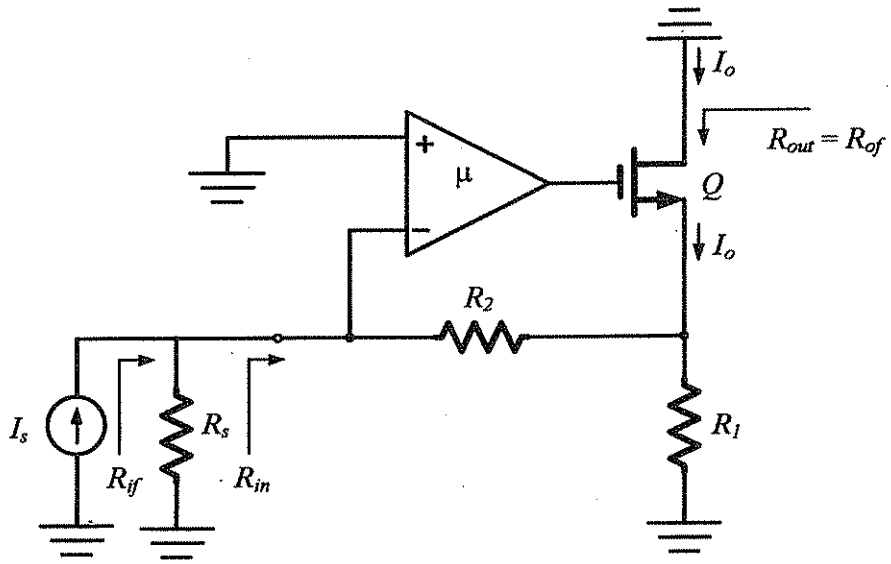

Figure 5

6.[20%]

The active biquard filter as shown contains passive elements and ideal operational amplifiers, as shown in ***Figure 6***. Please derive the transfer functions of $V_o(s)/V_i(s)$.

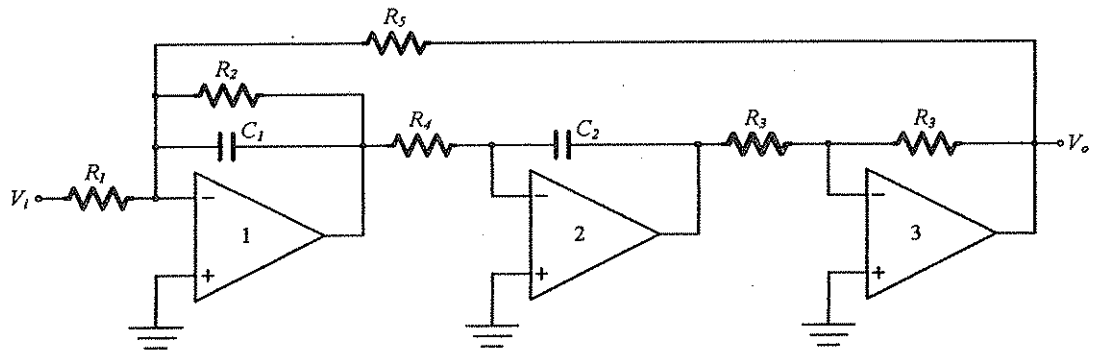

Figure 6