國立臺北科技大學 104 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 6 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. For a pn junction of which the doping concentrations in the p side and n side are $N_A = 10^{17}$ /cm^3 and $N_D = 10^{16}$ /cm^3, respectively, please find at temperature T = 300 K, (a) the built-in voltage, (b) the width of the depletion region, and (c) the distance it extends in the p side and in the n side of the junction. Use the intrinsic carrier density $n_i = 1.5 \times 10^{10}$ /cm^3. (每個 5 %，共 15%)

2. The op amp in the circuit of Fig.1 is ideal with output saturation levels of ±12 V. The diodes exhibit a constant 0.7-V drop when conducting. Find V_-, V_A, and V_O for (a) V_I = +2 V (b) V_I = −2 V. (每個 9 %，共 18%)
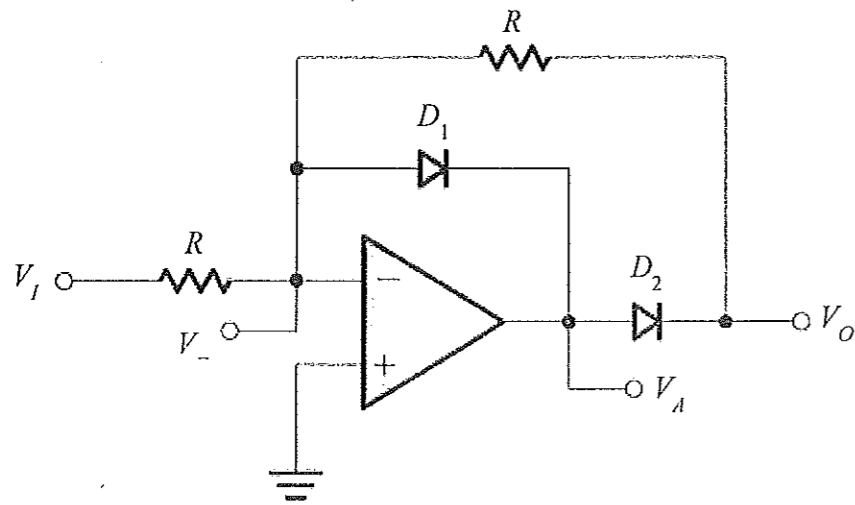

Fig. 1

3. Consider the low-frequency response of the CS amplifier of Fig. 2. Let $R_{sig} = 0.5$ MΩ, R_G = 2 MΩ, $g_m = 3$ mA/V, $R_D = 20$ kΩ, and $R_L = 10$ kΩ. (a) Find midband gain $A_M \equiv V_o/V_{sig}$. (b) Also, design the bypass capacitor C_S and the coupling capacitors C_{C2} and C_{C1} to locate the three low-frequency poles at 50 Hz, 10 Hz, and 3 Hz, respectively. (c) Use a minimum total capacitance, with capacitors specified only to a single significant digit. What value of the lower 3-dB frequency f_L results ? (5%，9%，5%，共 19%)
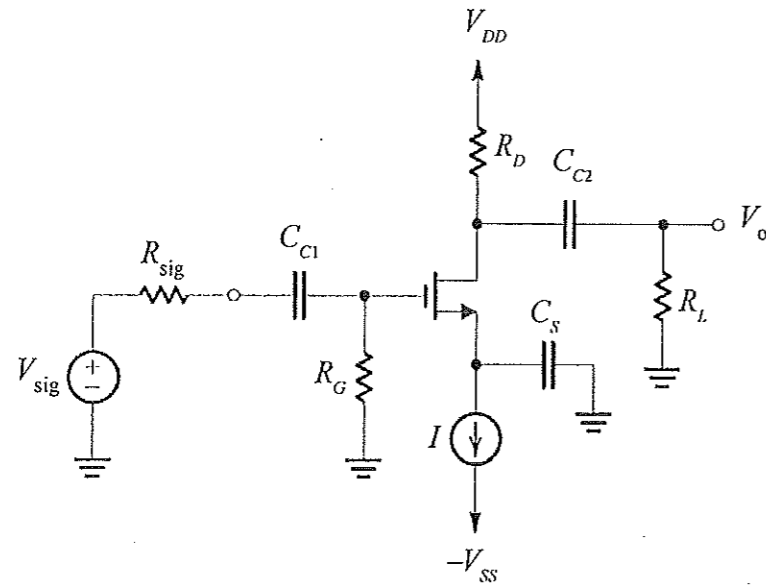

Fig. 2

4. Consider the common-emitter amplifier of Fig. 3 under the following conditions: $R_{sig} = 5$ kΩ, $R_1 = 33$ kΩ, $R_2 = 22$ kΩ, $R_E = 3.9$ kΩ, $R_C = 4.7$ kΩ, $R_L = 5.6$ kΩ, $V_{CC} = 5$ V. The dc emitter current can be shown to be $I_E \cong 0.3$ mA, at which $\beta_0 = 120$, $r_o = 300$ kΩ, and $r_x = 50$ Ω. Find (a) the input resistance R_{in} and (b) the midband gain A_M. If the transistor is specified to have $f_T = 700$ MHz and $C_\mu = 1$ pF, fine (c) the upper 3-dB frequency f_H. (5 %，5 %，8 %，共 18%)
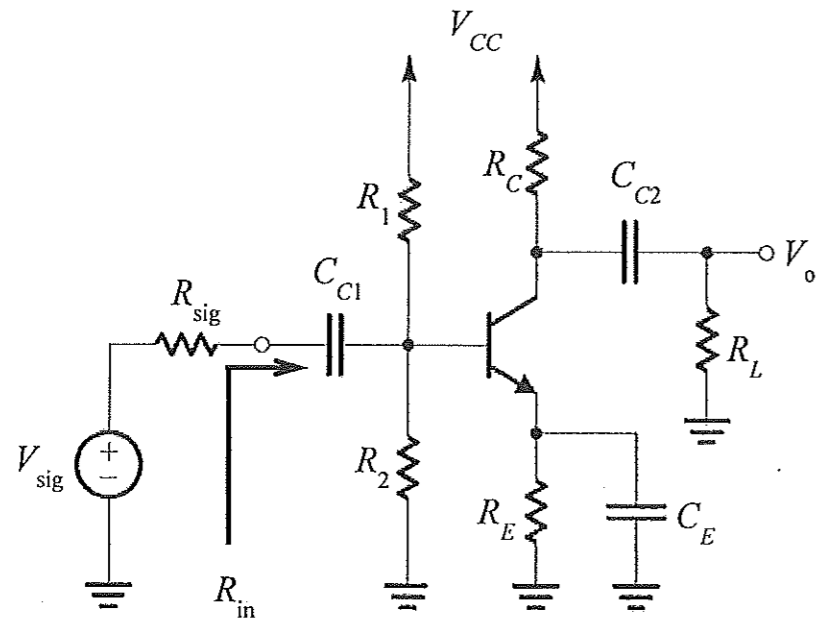
Fig. 3

5. For the series-series feedback amplifier in Fig. 4, the op amp is characterized by an open-loop voltage gain μ, an very large input resistance R_{id}, and an output resistance r_o. The amplifier supplies a current i_o to a load resistance R_L. The feedback network is composed of resistors r, R_2, and R_1. Please find (a) an expression for the gain-with-feedback $A_f \equiv i_o/V_s$ and (b) an expression for A_f if $\mu = \infty$. (10 %，5 %，共 15%)
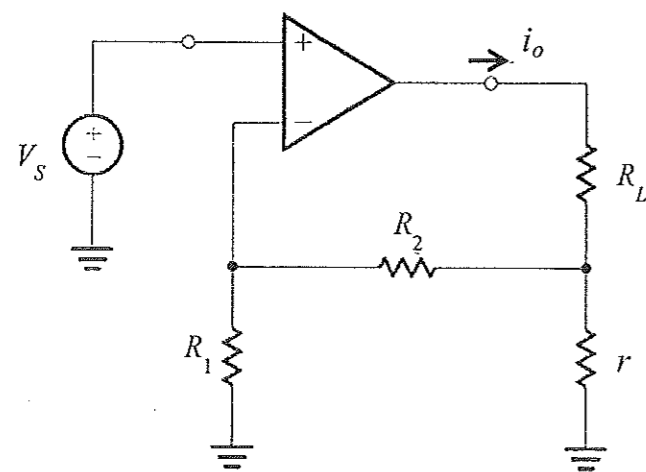

Fig. 4

6. For the circuit in Fig. 5 find (a) the loop gain $L(s)$, (b) the frequency for zero loop phase, and (c) the condition of R_2/R_1 for oscillation. (每個 5 %，共 15%)
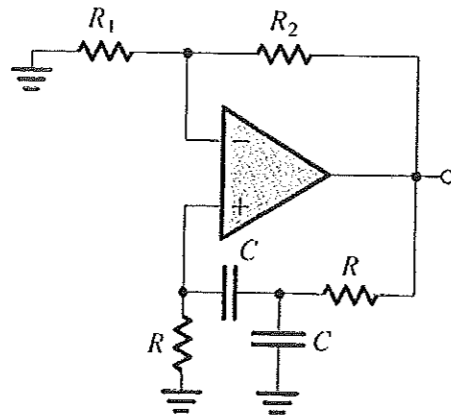

Fig. 5