國立臺北科技大學 101 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. 本試題共七題，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. (10%) Answer the following questions.

(1) What is the difference between drift current and diffusion current? (2%)

(2) Please draw the distribution of space charge and electric field in the depletion region of the pn junction. (4%)

(3) Please indicate the difference between NMOS and PMOS. (2%)

(4) Please give the definition of common-mode rejection ratio (CMRR). (2%)

2. (15%) Consider the circuit shown in Fig. P2.

(1) Please derive the overall transfer function $T(s)=V_o(s)/V_S(s)$. (6%)

(2) Provide the Bode magnitude plot for $|T(j\omega)|$. (6%)

(3) What is the bandwidth between 3-dB cutoff points? (3%)

3. (15%) Fig. P3 shows the common-gate amplifier.

(1) Find the input resistance R_{in}, the output resistance R_{out}, and the voltage gain A_V. (12%).

(2) Find the 3-dB frequency using open-circuit time-constant method. (3%)

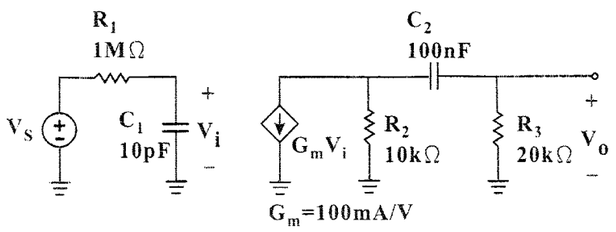

Fig. P2

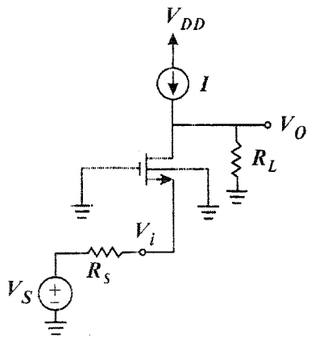

Fig. P3

4. (15%) Fig. P4 shows the logic inverter based on the differential pair. All transistors have V_{BE}=0.7V at I_C=1mA and have β=100.

(1) For v_i sufficiently low such that Q_1 is cut off, find the value of the output voltage v_o (V_{OH}). (3%)

(2) For v_i sufficiently high such that Q_1 is carrying all the current I, find the value of the output voltage v_o (V_{OL}). (3%)

(3) Determine the value of v_i that results in Q_1 conducting 1% of I (V_{IL}). (3%)

(4) Determine the value of v_i that results in Q_1 conducting 99% of I (V_{IH}). (3%)

(5) Calculate the values of the noise margins NM_H and NM_L. (3%)

5. (15%) Fig. P5 shows the CC-CB amplifier. The effects of r_x and r_o are neglected.

(1) Plot the simplified high-frequency equivalent circuit. (5%)

(2) Find the input resistance R_{in} and the overall voltage gain V_o/V_s. (5%)

(3) Derive the two poles for the CC-CB amplifier and its 3-dB frequency. (5%)

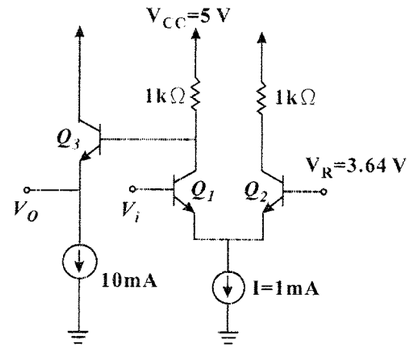

Fig. P4

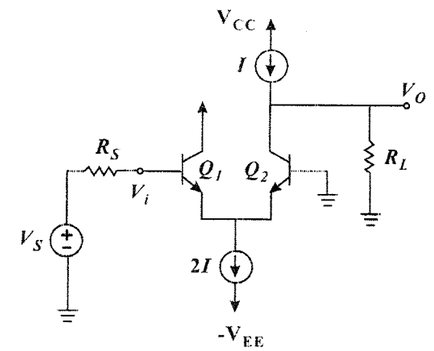

Fig. P5

6. (15%) Fig. P6 shows a feedback amplifier without details of the bias circuit.

(1) Sketch the A circuit and the circuit for determining β. (4%)

(2) Find the voltage gain, the input resistance, and the output resistance of A circuit. (8%)

(3) When Aβ is large, show the closed-loop voltage gain is $A_f \equiv V_O/V_S \cong (R_F+R_E)/R_E$. (3%)

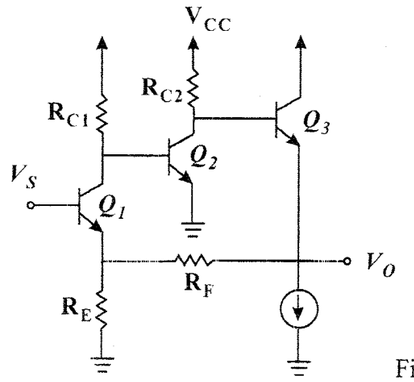

Fig. P6

注意：背面尚有試題

7. (15%) Consider the circuit in Fig. P7, find $L(s)$, $L(j\omega)$, the frequency for zero loop phase, and R_2/R_1 for oscillation.

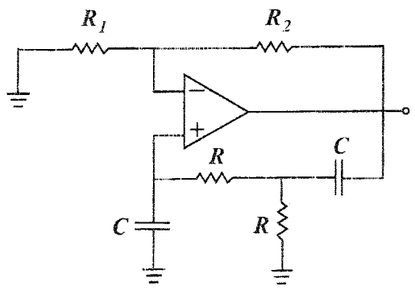

Fig. P7