國立中央大學九十七學年度電機系碩士在職專班招生試題

筆試科目：基礎電子學　　考試時間：100 分鐘　　共 1 頁，第 1 頁

1. 問答題 (p-n diode: 12 分)

1-1 Zener diode has the function of rectification. Why its rectification-voltage (~7V) is much larger than that of a typical p-n diode (0.7V)? (6 分)

1-2 In addition, for the applications of diode or Zener diode to voltage regulation; what's the key parameter of these two diodes to minimize the voltage fluctuation? Why? (6 分)

2. 問答題 (Diode, MOSFET and BJT: 25 分)

Please explain the following nouns

1. Built-in potential of p-n diode (5 分)
2. Diffusion capacitance (5 分)
3. Early effect in BJT (5 分)
4. Inversion layer (5 分)
5. Body Effects in MOSFET (5 分)

3. 問答題(Frequency response of amplifier: 13 分)

Figure 1 shows the high-frequency small-signal model of BJT

3-1 For the capacitance of C_π and C_μ, which one is larger when the BJT is operated under forward active mode? Why? (4 分)

3-2 In order to achieve an ideal **unilateral** amplifier, the value of which circuit element in Fig. 2 should be minimized. Why? (4 分)

3-3 Will the unilateral amplifier have a superior high-frequency bandwidth to the **non-unilateral** amplifier? Why? (5 分)

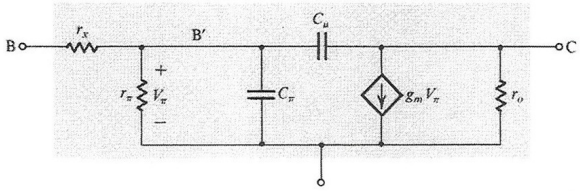

Fig. 1

4. 計算題(op amplifier high-pass filter design: 20 分)

Figure 2 shows a circuit that performs the high-pass single-time-constant function. The circuit uses an ideal op amplifier, R_1 = 10 kΩ, R_2 = 1 MΩ, and C = 15.9 nF.

4-1 Derive the transfer function $V_o(s)/V_i(s)$ in terms of s, R_1, R_2, and C. (5 分)

4-2 High-frequency gain (in dB). (5 分)

4-3 3-dB frequency. (5 分)

4-4 At what frequency does the magnitude of the transfer function reduce to unity. (5 分)

5. 計算題(CS amplifier with active load: 15 分)

Figure 3 shows a common source CMOS amplifier with a current mirror active load. The dc bias current I_{REF} is 100 μA. The circuit has W/L = 7.2 μm/0.36 μm for all transistors, $\mu_n C_{ox}$ = 387 μA/V^2, $\mu_p C_{ox}$ = 86 μA/V^2, $|V'_{An}|$ = 5 V/μm, and $|V'_{Ap}|$ = 6 V/μm. For Q_1, C_{gs} = 0.2 fF, C_{gd} = 5 fF, and signal source resistance R_{sig} = 10 kΩ.

5-1 Find the transconductance of Q_1, g_{m1}. (5 分)

5-2 Find the dc voltage gain A_M. (5 分)

5-3 Assume the dominated-pole frequency f_H is dominated by the input port. Find f_H using the Miller equivalent approach. (5 分)

6. 選擇與計算題(Feedback amplifier: 15 分)

Figure 4 shows a feedback amplifier. The transistor has current gain β = 100, and set V_{BE}=0.7 V.

6-1 Identify the feedback topology (a) series-shunt, (b) shunt-shunt, (c) shunt-series, (d) series-series. (3 分)

6-2 Find the dc bias point, I_C and V_{CE}. (4 分)

6-3 Determine the small-signal voltage gain Vo/Vs. (4 分)

6-4 Find the input resistance R_{in}. (4 分)

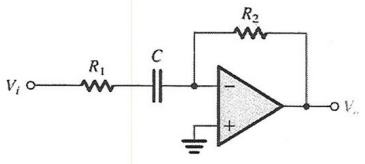

Fig. 2

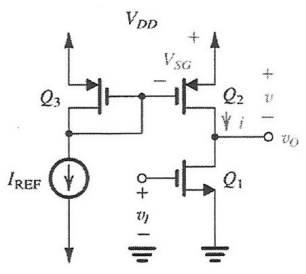

Fig. 3

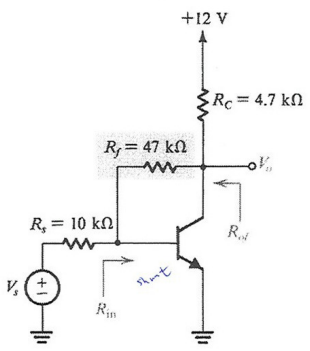

Fig. 4