國立臺北科技大學

九十四學年度光電工程系碩士班入學考試

電子學試題

填准考證號碼

注意事項：

1. 本試題共【7】題，配分共100分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. [10%]

For the p-n junction breakdown, the two possible breakdown mechanisms are the zener effect (5%) and the avalanche effect (5%). Please briefly describe them.

2. [15%]

A silicon (energy gap = 1.12eV) abrupt p-n junction in thermal equilibrium at T = 300K is doped such that $E_C - E_F = 0.21$eV in the n region and $E_F - E_V = 0.18$eV in the p region (see the Fig. 1). ($n_i = 1.5 \times 10^{10}$ cm^{-3}, $E_i \cong E_{midgap}$, $\varepsilon_s = 11.9 \times 8.854 \times 10^{-14}$ F/cm)

(a) Determine the impurity doping concentrations in each region. (5%)

(b) Determine the built-in voltage V_{bi}. (5%)

(c) Determine the depletion width. (5%)

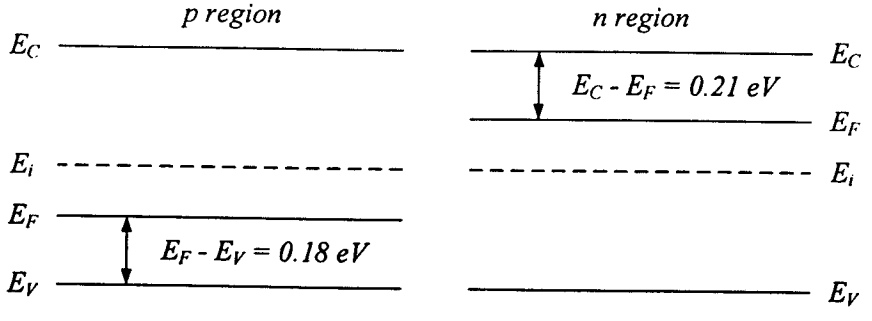


Fig. 1

3. [15%]

In the circuit shown in the Fig. 2, v_s is a small sine-wave signal with zero average value. Assume β=50,

(a) Find R_{in}. (5%)

(b) Find v_o/v_s. (5%)

(c) If the amplitude of the signal v_{be} is limited to 5mV, what is the largest signal at the input? (5%)

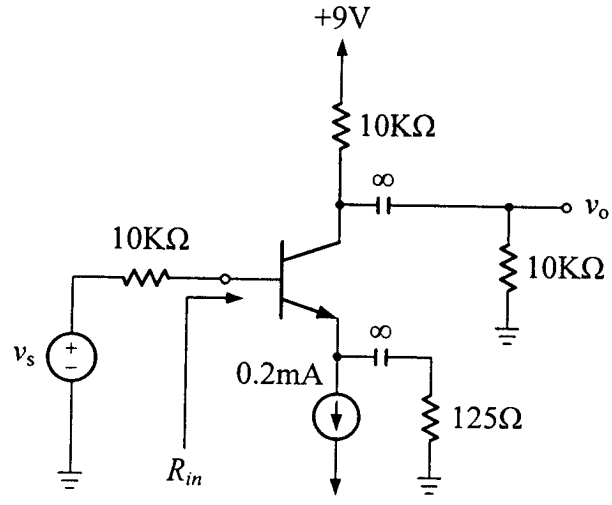


Fig. 2

4. [15%]

Consider the circuit shown in the Fig. 3. Assume C_{gd} = 1pF, C_{gs} = 4pF, g_m = 5mA/V (both FETs have the same bias current), R_s = 2KΩ and R_L = 3KΩ.

(a) Find the midband voltage gain v_X/v_Y. (5%)

(b) Find the over-all midband voltage gain v_O/v_S. (5%)

(c) Please estimate the bandwidth of this circuit. (5%)

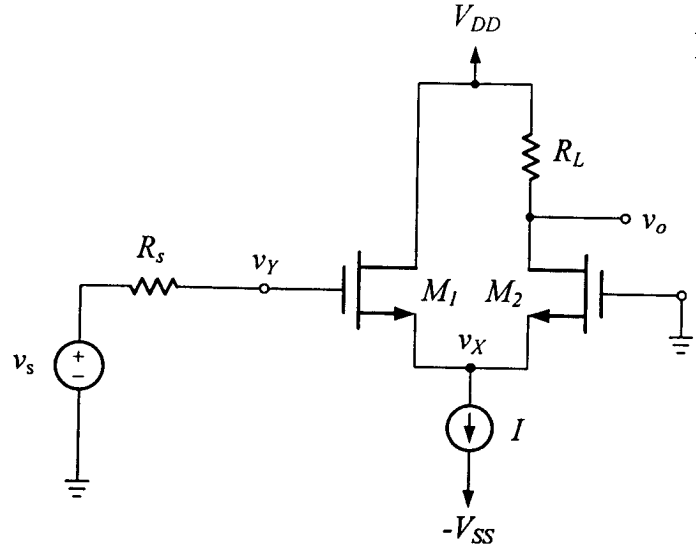


Fig. 3

注意：背面尚有試題

5. [20%]

As shown in the Fig. 4, the circuit is composed of three gain stages with feedback provided by the network composed of R_{E1}, R_F, and R_{E2}. Assume that the bias circuit causes I_{C1} = 2.5mA, I_{C2} = 2.5mA, and I_{C3} = 0.5mA. Using these values and assuming h_{fe} = 100 and ro = ∞, find:

(a) the open-loop gain A, (4%)

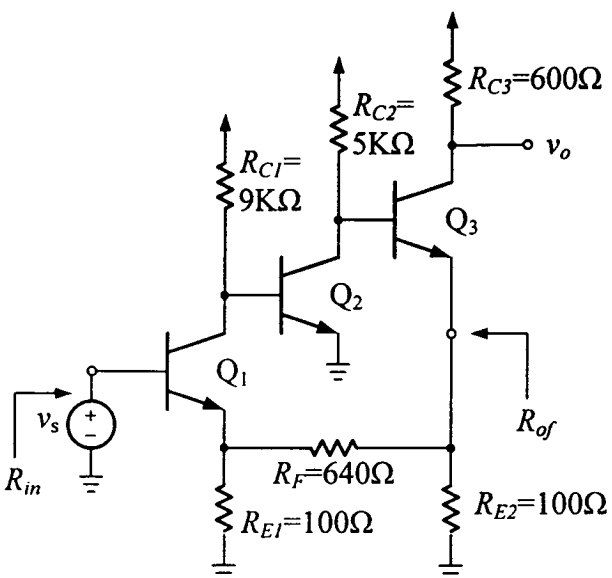
(b) the feedback factor β, (4%)

(c) the voltage gain V_o/V_s, (4%)

(d) the input resistance R_{in}, (4%)and

(e) the output resistance R_{of}. (4%)

Fig. 4



6. [10%]

Consider the circuit in the Fig. 5, in which $R_1 = R_2 = R_3 = R_4 = R_5 = R_6$ = 10KΩ, V_{DD} = 5V, and V_I = 3V.

(a) Assume the op amp have infinite gain. What are the values of current I_1 and I_2? (5%)

(b) Find the current I_1 and I_2 again using op amps with a finite gain (A =10) for the same circuit. (5%)

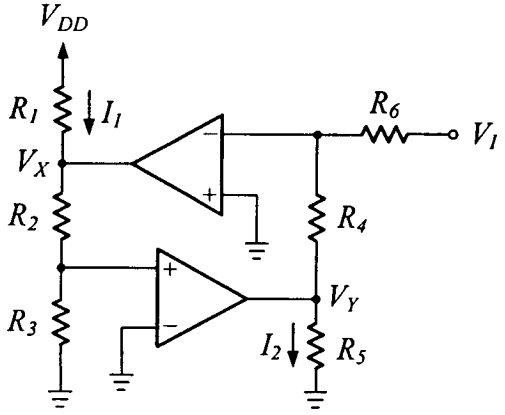


Fig. 5

7. [15%]

A pass-transistor logic circuit is shown in the Fig. 6. Determine the truth table for this circuit. (10%) What logic function does it implement? (5%)

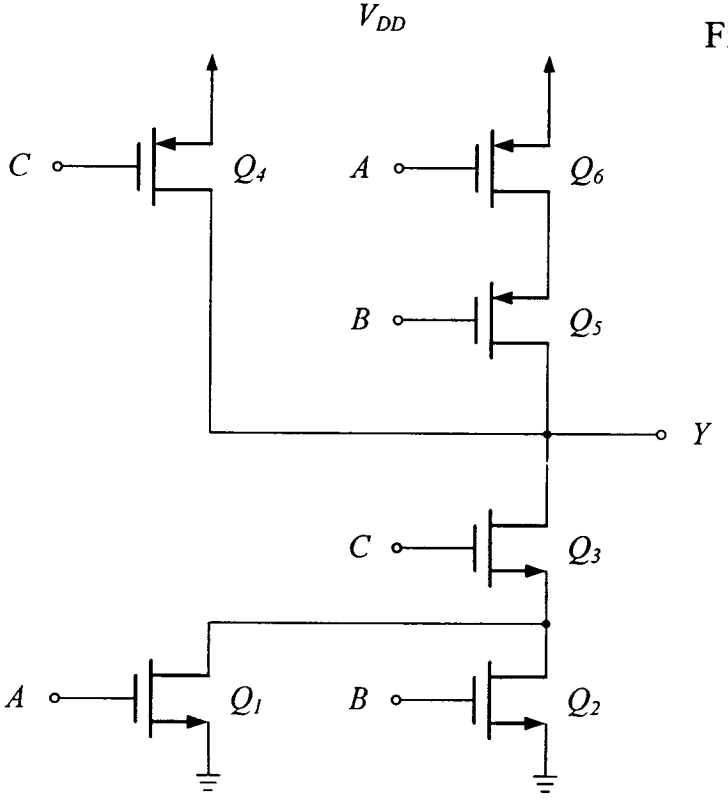


Fig. 6