



本試題共六題，每題得分如各題中所示，共計 100 分，請依題號作答並將答案寫在答案卷上，違者不予計分。

1. Calculate the currents of the circuits of Fig.P1(a) and (b) respectively.

(a) (5 分) find the current I_1 shown in Fig.P1(a) (assume $V_{D1,on} = 800\text{mV}$).

(b) (10 分) find the current I_2 shown in Fig.P1(b) (assume $V_{D1,on} = V_{D2,on} = 800\text{mV}$).

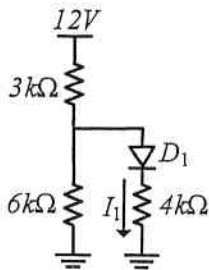


Fig.P1(a)

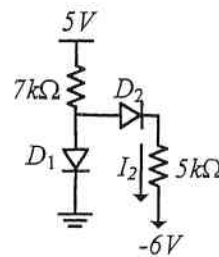


Fig.P1(b)

2. Determine the input or output resistances of the stages shown in Fig.P2 (a), (b), (c).

(a) (5 分) find the input resistance in Fig.P2(a), R_{in} .

(b) (10 分) find the output resistance in Fig.P2(b) (assume $V_A < \infty$).

(c) (10 分) find the output resistance in Fig.P2(c) (assume $V_A = \infty$)

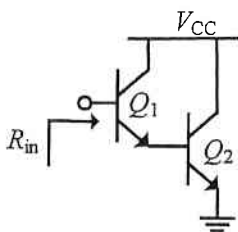


Fig.P2(a)

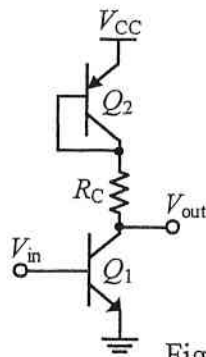


Fig.P2(b)

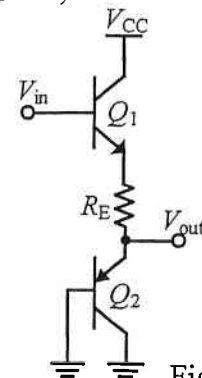


Fig.P2(c)

3. (10 分) The source follower of Fig.P3 is to be designed with a maximum bias gate voltage of 1.8V. Compute the current I_{DS} for a voltage gain of 0.85 if $\lambda = 0$. (assume $V_{TH,N} = 0.4\text{V}$).

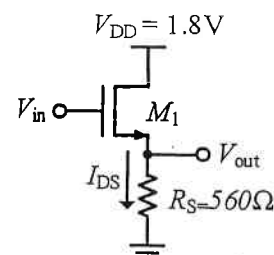


Fig.P3



4. The current mirror circuit shown in Fig. P4 has transistor M_1 with channel width $W_1 = 0.9 \mu\text{m}$ and channel length $L_1 = 0.18 \mu\text{m}$. Given a reference current $I_{\text{REF}} = 0.5 \text{ mA}$:

- (a) (10 分) If I_2 is set to 0.2 mA with $L_2 = 0.18 \mu\text{m}$, determine the required channel width W_2 .
- (b) (10 分) If I_3 is set to 0.8 mA with $L_3 = 0.18 \mu\text{m}$, determine the required channel width W_3 .

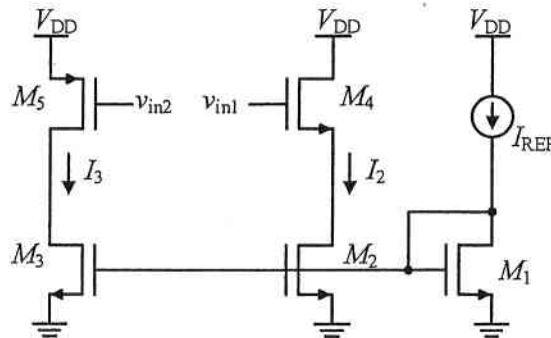


Fig. P4

5. Fig. P5 shows a fully symmetrical differential amplifier, properly biased in the linear region, with channel-length modulation neglected. Derive the differential voltage gain $A_v = v_{od}/v_{id}$. (Show the derivation process.) (10 分)

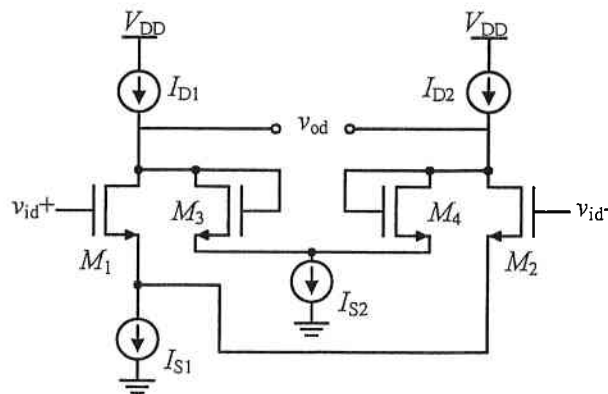


Fig. P5

6. Fig. P6 shows the small-signal model of a specific circuit. Apply *Miller's theorem* to:

- (a) (10 分) Derive an expression for the equivalent capacitance C_x .
- (b) (10 分) Derive an expression for the equivalent output capacitance C_o .

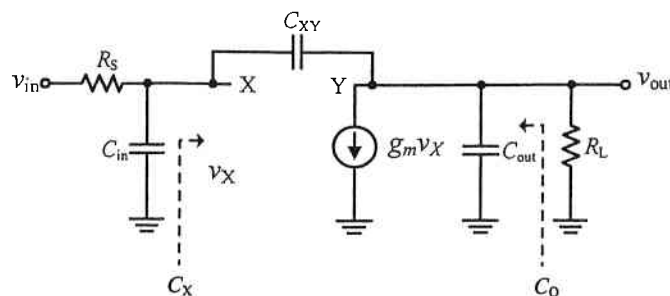


Fig. P6