國 立 東 華 大 學 招 生 考 試 試 題

招生學年度	102	招生類別	碩士班
系所班別	光電電子碩士班聯合招生 (光電工程學系碩士班、電機工程學系 電子工程碩士班)		
科目	電子學		
注意事項	本考科可使用掌上型計算機		

1. (10%) A Si pn junction employs $N_A=10^{17}$ cm^{-3} and $N_D=10^{16}$ cm^{-3} (a) Estimate the minority carrier concentrations on both sides at room temperature. (b)Calculate the built-in potential. (c) To obtain a current of 1 mA with a forward bias of 0.7 V, how should the saturation current (I_S) be chosen?

2. (20%) As depicted in Fig.1, $I_{S1}=I_{S2}=5\text{x}10^{-16}$ A, $\beta_1=\beta_2=100$, and $V_A=\infty$. Assume the capacitance (C) is very large. (a) Draw the small-signal equivalent circuit. (b) Find voltage gain (v_{out}/v_{in}). (c)Determine the input impedance (R_{in})

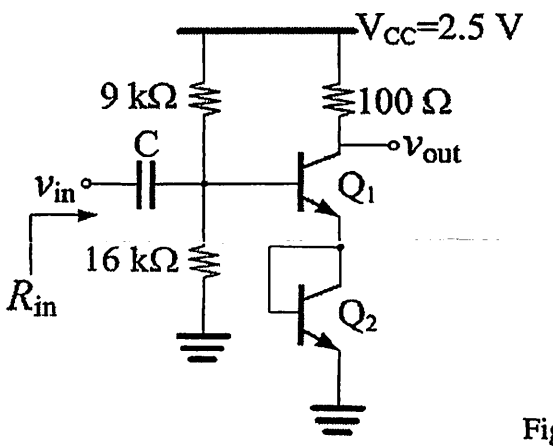

Fig.1

3. (20%) (a) Compute W/L of M_1 in Fig.2 such that the device operates at the edge of saturation. Assume $V_{DD}=1.5$ V, $V_{TH}=0.4$ V, $\lambda=0$, $\mu_nC_{ox}=200$ μA/V^2. (b) What happens if the gate oxide thickness is doubled (in triode or saturation? Why?)? Then, what is the voltage gain as a common-source (CS) amplifier?

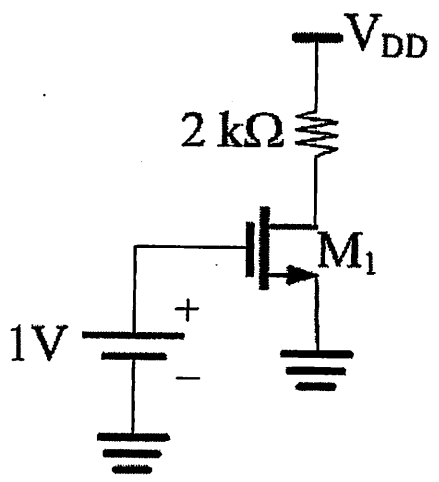

Fig.2

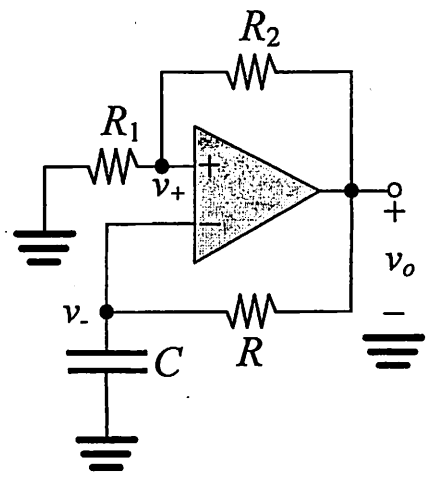

Fig. 3

4. (10%) For the circuit in Fig.3, let the op-amp saturation voltages be ±10V, $R_1=100\text{k}\Omega$, $R=R_2=1\text{M}\Omega$ and $C=0.01\mu$F. Find the frequency of oscillation.

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5. (20%) Design the KHN high-pass filter in Fig.4, with f_0=10kHz and Q=2. Choose C=1nF and $R_1=R_2=R_f$=10kΩ.

(a) What are the values of R and R_3?

(b) What is the value of high-frequency gain obtained?

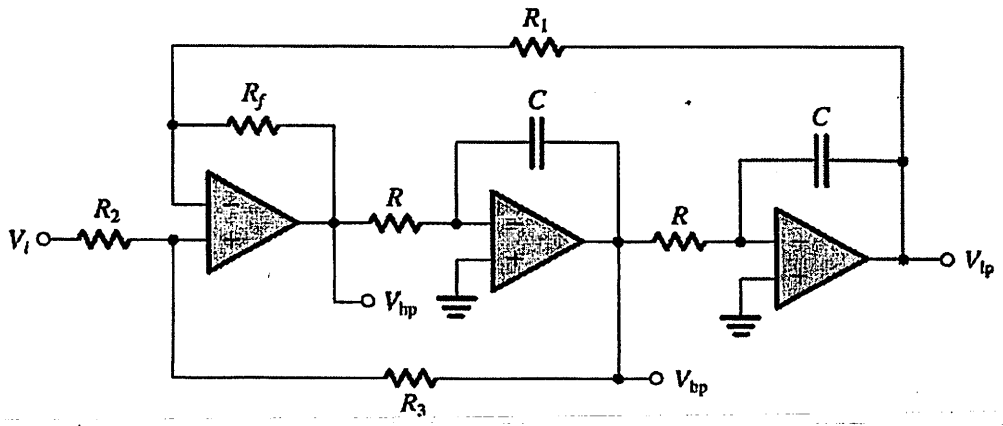

Fig.4

6. (5%) Design a CMOS logic gate circuit which performs the function of $Y = \overline{A(B+CD)}$.

7. (15%) The cascode amplifier in Fig.5 is operated at a current of 0.2mA with all devices operating at $|V_{OV}|$=0.2V. All devices have $|V_A|$=2V.

(a) Find g_{m1} and r_{o1}.

(b) Find the overall output resistance and the voltage gain realized.

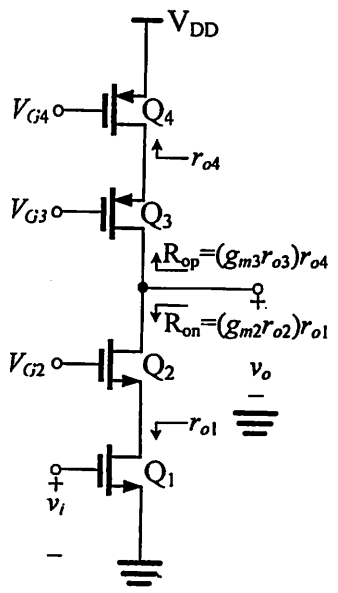

Fig.5