國立臺北科技大學九十九學年度碩士班招生考試

系所組別：2240 電腦與通訊研究所丁組

第二節　電子學　試題

注意事項：

1. 本試題共五題，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。

一、(20%) Consider the single op-amp difference amplifier in Fig. 1.

1. Please derive the expression for v_O as a function of v_{I1} and v_{I2}. (5%)
2. Please derive the common-mode gain A_{cm}. (10%)
3. Please give the condition using R_1, R_2, R_3, and R_4 to satisfy CMRR=∞. (5%)

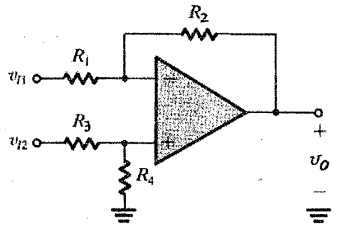

Fig. 1

二、(20%) Consider a common-source amplifier in Fig. 2. Assume the transistor has V_t=1.5V, $k'_n(W/L)$=0.25mA/V^2, and V_A=50V. The channel-length modulation is neglected.

1. Determine the output resistance r_o. (5%)
2. Determine the small-signal voltage gain A_v. (5%)
3. Determine the input resistance R_{in}. (5%)
4. Determine the maximum allowable input signal peak. (5%)

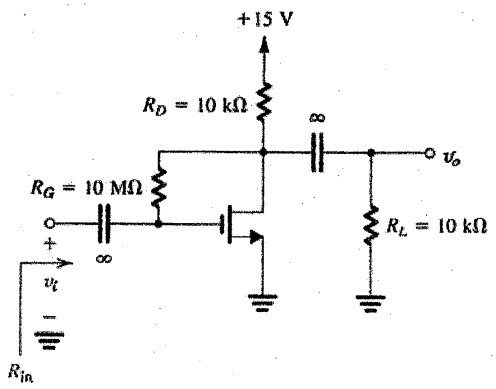

Fig. 2

三、(20%) Consider a current-steering circuit in Fig. 3. Assume the V_{DD}=V_{SS}=1.5V, V_{tn}=0.6V, V_{tp}= −0.6V, all channel lengths=1μm, k'_n=200μA/V^2, k'_p=80μA/V^2, and λ=0. The I_{REF}=10μA, I_2=60μA, I_3=20μA, and I_5=80μA. It is further required that the voltage at the drain of Q_2 be allowed to go down to within 0.2V of the negative supply and that the voltage at the drain of Q_5 be allowed to go up to within 0.2V of the positive supply. Please find the widths of all transistors W_1, W_2, W_3, W_4, and W_5.

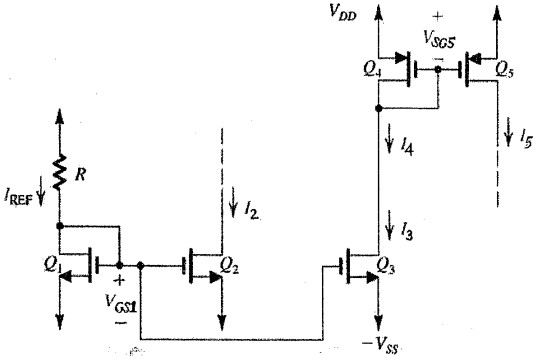

Fig. 3

注意：背面尚有試題

四、(20%) Fig.4 shows an ideal voltage amplifier having a gain if −100 V/V with an impedance Z connected between the output and input terminals.

1. Find the Miller equivalent circuit when Z is 1-MΩ resistance, and determine V_o/V_{sig} (10%)
2. Find the Miller equivalent circuit when Z is 1-pF capacitance, and determine V_o/V_{sig} (10%)

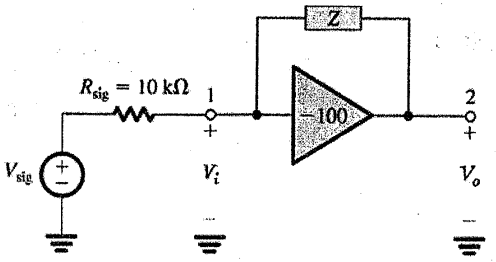

Fig. 4

五、(20%) Fig.5 shows an active-load bipolar differential pair.

1. Assume the input signals $v_{B1}=+v_{id}/2$ and $v_{B2}=-v_{id}/2$. Please plot the small-signal equivalent circuit and to determine the overall short-circuit transconductance $G_m \equiv i_o/v_{id}$. (10%)
2. Please plot the equivalent circuit and to determine the output resistance R_o. (10%)

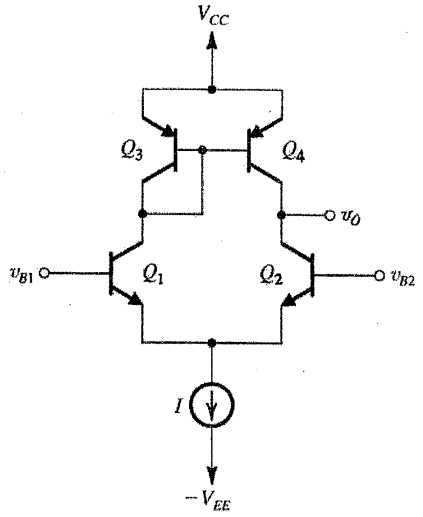

Fig. 5