113 CC04

國立臺北科技大學 113 學年度碩士班招生考試

系所組別：2240 電子工程系碩士班丁組

第一節　電子學　試題

注意事項：

1. 本試題共四題，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。
4. 每題需詳列解題過程，僅寫答案不予計分。

一、(30%) Fig. 1 shows an ideal voltage amplifier having a gain of -200V/V with an impedance Z connect between its output and input terminals. The frequency of V_{sig} is 1 MHz, and PI=3.1415. (註：各小題答案需四捨五入到小數第一位)

1. Consider the Miller equivalent circuit for Fig. 1 when Z is a 500-kΩ resister. Find the corresponding impedance (Z_1) at port 1, corresponding impedance (Z_2) at port 2, and gain V_o/V_{sig}. (15%)

2. Consider the Miller equivalent circuit of Fig. 1 when Z is a 5-pF capacitor. Find the corresponding impedance (Z_1) at port 1, corresponding impedance (Z_2) at port 2, and gain V_o/V_{sig}. (15%)
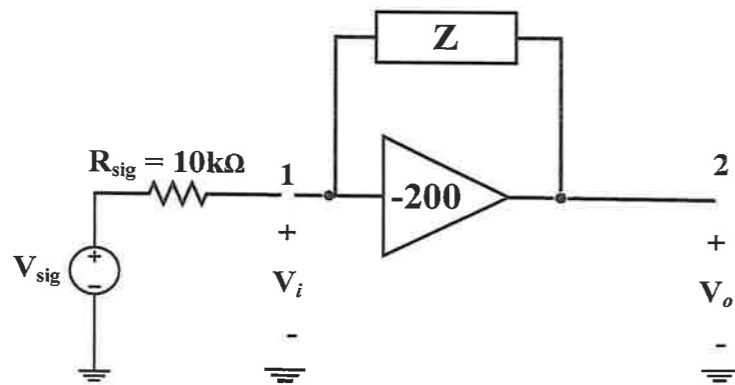

Fig. 1

二、(30%) Fig. 2 shows a common-source amplifier, and all the transistors are in saturation regions. W/L = 1.8 μm/90 nm for all transistors, k_n' = 35 μA/V^2, k_p' = 20 μA/V^2, I_{REF} = 10 μA, V'_{An} = 5 V/μm, and V'_{Ap} = 8 V/μm. (註：各小題答案需四捨五入到小數第一位)

1. Find the overdrive voltage of transistor Q_1. (5%)
2. Find the g_m of transistor Q_1. (5%)
3. Find the r_{o1} of transistor Q_1. (5%)
4. Find the r_{o2} of transistor Q_2. (5%)
5. Find the output resistance of the amplifier. (5%)
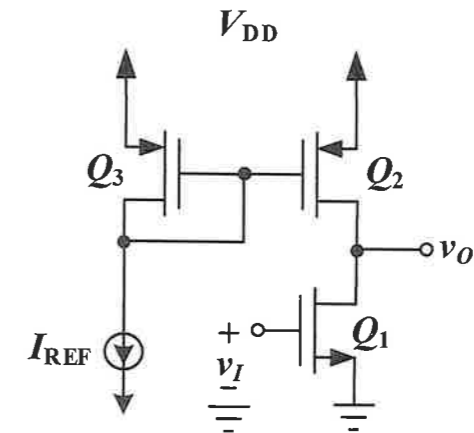6. Find the voltage gain (v_O/v_I) of the amplifier. (5%)

Fig. 2

三、(30%) Follow the above questions and analyze the amplifier in Fig. 2. For Q_1, C_{gs}=30fF, C_{gd}=10fF, C_L=20fF, and R_{sig} = 10kΩ, Assume the C_L includes all the capacitance introduced by Q_2 at the output node. (註：各小題答案需四捨五入到小數第一位)

1. Find the overall input capacitance C_{in} by using Miller theorem. (5%)
2. Find the 3-dB frequency f_H of the amplifier by using Miller's theorem. (5%)
3. Find the time constant τ_{gs}. (5%)
4. Find the time constant τ_{gd}. (5%)
5. Find the time constant τ_{C_L}. (5%)
6. Find the 3-dB frequency f_H of the amplifier by the using open-circuit time constants method. (5%)

四、(10%) For a junction diode, the relationship of diode current i and diode voltage v is given in equation (1).

$$i = I_S e^{v/V_T} \qquad (1)$$

where V_T=25.3 mV, I_s =6.9 x 10^{-13} A. For a decade change in current, find the voltage change. (註：答案需四捨五入到小數第一位)