

國立臺北科技大學九十八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

第一頁 共二頁

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、Consider the design of a CMOS compound OR-AND-INVERT(OAI21) gate computing

$$F = \overline{(A+B)} \cdot (C+D).$$

1. Sketch a transistor-level schematic.(5%)
2. Assume that the mobility ratio of NMOS and PMOS is 2. Determine the width ratio of NMOS and PMOS to achieve the same falling and rising ability. Note that the gate length is minimal. (5%)
3. Please use the following layer pattern to layout your gate. (10%)

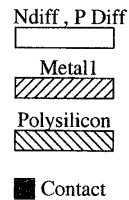


Fig.1 Layer patterns

4. Draw a side view (cross-section) of an typical inverter and annotate the corresponding layer name.(10%)

二、Suppose Supply voltage = V_{DD} and threshold voltage = V_{th} . Give an expression for the output voltage Y for the pass transistor networks shown in Fig.2(a)&(b). (10%)

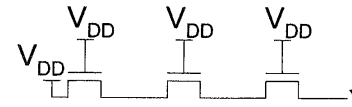


Fig.2(a)

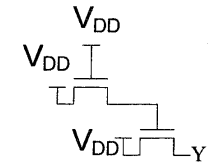


Fig.2(b)

三、Assume all MOSFETs are in saturation and the M_1 has transconductance g_{m1} and output resistance r_{o1} .

- (a) Calculate the small-signal voltage gain of each circuit in Fig.3.(5%)
- (b) Calculate the input impedance from V_{in} . (5%)
- (c) Calculate the input impedance including C_{gs1} from V_{out} . (5%)
- (d) Calculate the input impedance including C_{gs1} and C_{gd2} from V_{in} . (5%)

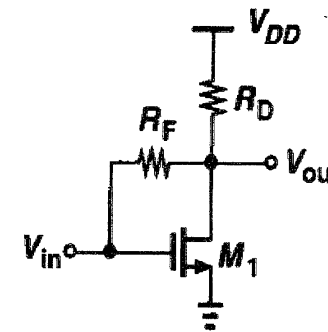


Fig.3(a)

注意：背面尚有試題

四、The circuit in Fig.4 utilizes an ideal op amp with a tunable R_L ..

1. Find V_o . (5%)
2. If V_o is not to be lower than -13V, find the maximum allowed value for R_L . (5%)
3. If R_L is varied in the range 100Ω to $1k\Omega$, what is the corresponding change in I_L and in V_o ? (5%)
4. Assume this ideal op amp has an infinite output impedance. Find the output impedance when looking into V_o . (5%)

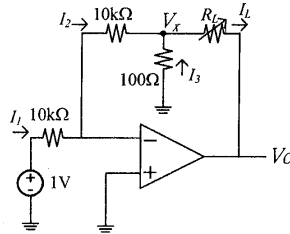


Fig.4

五、Consider an active-loaded MOS differential amplifier of the type shown in Fig.5.

Assume that for all transistors, $W/L=7.2\mu\text{m}/0.36\mu\text{m}$, $C_{gs}=20\text{fF}$, $C_{gd}=5\text{fF}$, and $C_{db}=5\text{fF}$. Also, let $\mu_n C_{ox}=387\mu\text{A}/\text{V}^2$, $\mu_p C_{ox}=86\mu\text{A}/\text{V}^2$, $V'_{An}=5\text{V}/\mu\text{m}$, $|V'_{Ap}|=5\text{V}/\mu\text{m}$. The bias current $I=0.2\text{mA}$ with output resistance $R_{SS}=25k\Omega$.

1. Calculate the low frequency value of differential gain A_d . (5%)
2. Calculate the low frequency value of common-mode gain A_{cm} . (5%)
3. Calculate the dominant pole of A_d . (10%)

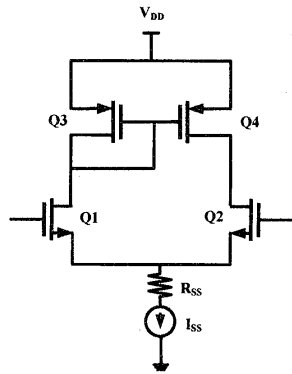


Fig.5