國立雲林科技大學 112 學年度 系所：電子系
碩士班招生考試試題 科目：電子學

本試題共 5 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. Assuming that diodes D_1 and D_2 are ideal, find the following V_{out} of the circuit shown in Fig. P1 for different V_{in} ranges.

(a) (4 分) for -1 V ≤ V_{in} ≤ 1 V
(b) (3 分) for V_{in} ≤ -1 V
(c) (3 分) for V_{in} ≥ 1 V

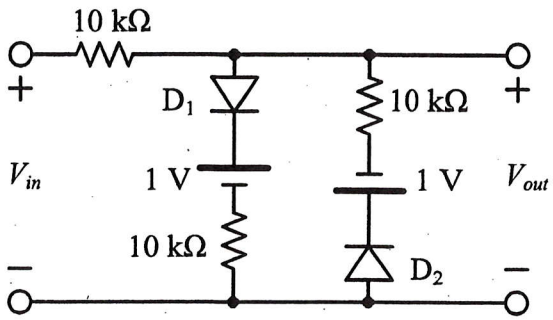

Fig. P1

2. The circuit in Fig. P2(a)(b) utilizes an ideal operational amplifier A. Derive the following corresponding voltage gain A_V formulas.

(a) (10 分) for Fig. P2(a).
(b) (10 分) for Fig. P2(b).

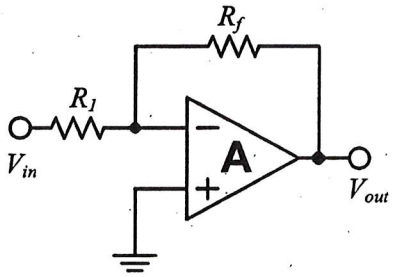

Fig. P2(a)

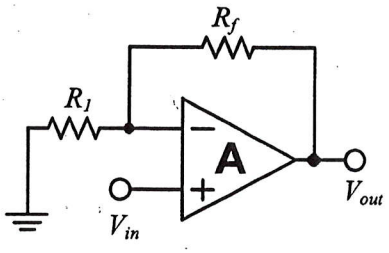

Fig. P2(b)

3. The NMOS transistors in the circuit of Fig. P3 have V_t = 1 V, $\mu_n C_{ox}$ = 100 μA/V², λ = 0, and channel length $L_1 = L_2 = L_3$ = 1 μm.

(a) (10 分) Find the required values of channel width for each of M_1, M_2, and M_3 to obtain the voltage and current values indicated in Fig. P3.
(b) (10 分) Shows which regions the transistors M_1, M_2, and M_3 work in, respectively.

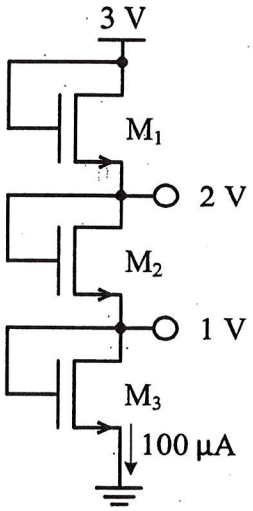

Fig. P3

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4. (40 分) The transistors operate in the saturation region. Calculate (a) g_{M1}, (b) R_{op}, (c) the low-frequency small-signal voltage gain, and (d) the output resistance of the amplifier. Some related parameters are: $\mu_n C_{ox} = 100 \times 10^{-6}\ {}^{A}/_{V^2}$, $(\frac{W}{L})_{M1,M2} = 40$, $\lambda_n = 0.1\ V^{-1}$, $\mu_p C_{ox} = 50 \times 10^{-6}\ {}^{A}/_{V^2}$, $(\frac{W}{L})_{M3,M4} = 50$, $\lambda_p = 0.14\ V^{-1}$, and $I_{D1,2,3,4} = 0.6\ mA$. Neglect the Body effect of MOS transistors.

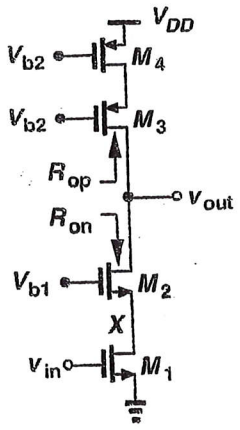

Fig. P4

5. (10 分) These MOS transistors operate in the saturation region. Neglect the Body effect of MOS transistors. Calculate R_{out}. Some related parameter values are: $g_{M1,3} = 1.0 \times 10^{-3}$ A/V, $g_{M2} = \sqrt{2} \times 10^{-3}\ A/V$, $r_{o1,3} = 20\ k\Omega$, $r_{o2} = 10\ k\Omega$, and the aspect ratio of all transistors is 10.

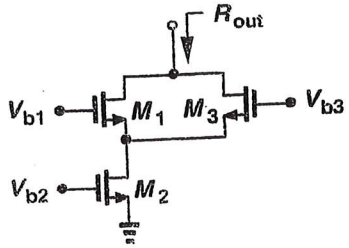

Fig. P5