

國立中央大學 106 學年度碩士班考試入學試題

所別：電機工程學系 碩士班 固態組(一般生)
電機工程學系 碩士班 系統與生醫組(一般生)
電機工程學系 碩士班 電波組(一般生)

共 3 頁 第 1 頁

科目：電子學

本科考試禁用計算器

*請在答案卷 內作答

1. 計算題(10分)

Sketch the transfer characteristic v_o versus v_i for the circuit shown in Fig. P1. All diodes and Op amp shown in this figure are ideal.

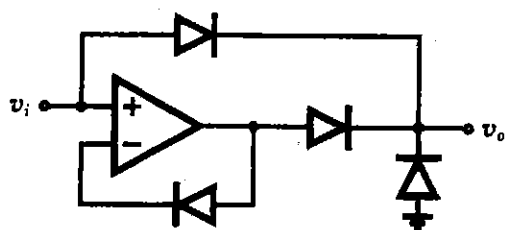
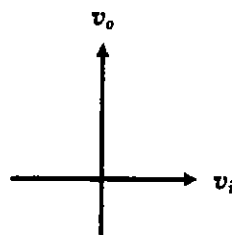


Fig. P1



參考用

2. 計算題(10分)

For the NMOS circuit given in Fig. P2 is biased at saturation mode with $g_m = 0.48 \text{ mA/V}$, $r_o = 50 \text{ k}\Omega$. Neglect the body effect please calculate the value of the small-signal input resistance R_{in}

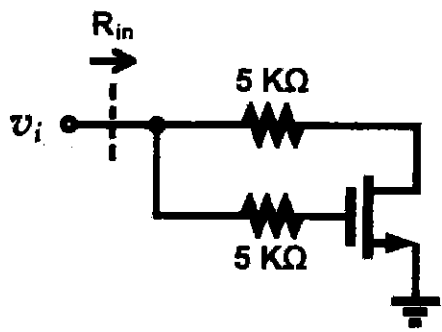


Fig. P2

3. 計算題(10分)

For the capacitor-coupled circuit shown in Fig. P3, current of the diodes are $I_d = I_s \exp(V_d/V_T)$, $V_T = 25 \text{ mV}$. For small input signals, what value of resistor R is needed for overall voltage gain $v_o/v_i = 0.2$

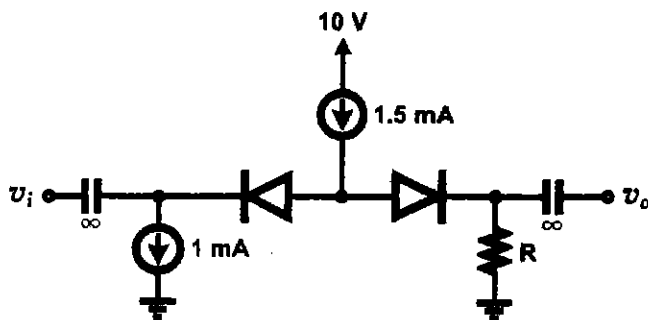


Fig. P3

注意：背面有試題

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電機工程學系 碩士班 電波組(一般生)

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4. 計算題(10 分)

An NMOS transistor biased at saturation mode has $V_{tn} = 1\text{ V}$, $\mu_n C_{ox} = 50\ \mu\text{A}/\text{V}^2$, $L = 0.5\ \mu\text{m}$, $W = 20\ \mu\text{m}$, and $V_A = 10\text{ V}$.

- (a) (5 分) Find the values of g_m and r_o when the bias voltage $V_{GS} = 1.5\text{ V}$.
 (b) (5 分) Find the values of g_m and r_o when the bias current $I_D = 1\text{ mA}$.

5. 計算題(20 分)

For the circuit shown in Fig. P5, $R_{sig} = 1\text{ M}\Omega$, $R_{G1} = R_{G2} = 8\text{ M}\Omega$, $R_D = 200\text{ k}\Omega$, $R_S = R_L = 100\text{ k}\Omega$, $V_{DD} = 16\text{ V}$, C_{C1} and C_{C2} are perfect coupling capacitors, and C_S is the bypass capacitor. The MOSFET biased at saturation mode has transconductance $g_m = 2\text{ mA/V}$, and output resistance $r_o = 200\text{ k}\Omega$. (Neglect the body effect)

- (a) (6 分) Find the value of R_{in} .
 (b) (6 分) Find the value of R_o .
 (c) (8 分) Find the value of the overall voltage gain v_o / v_{sig} .

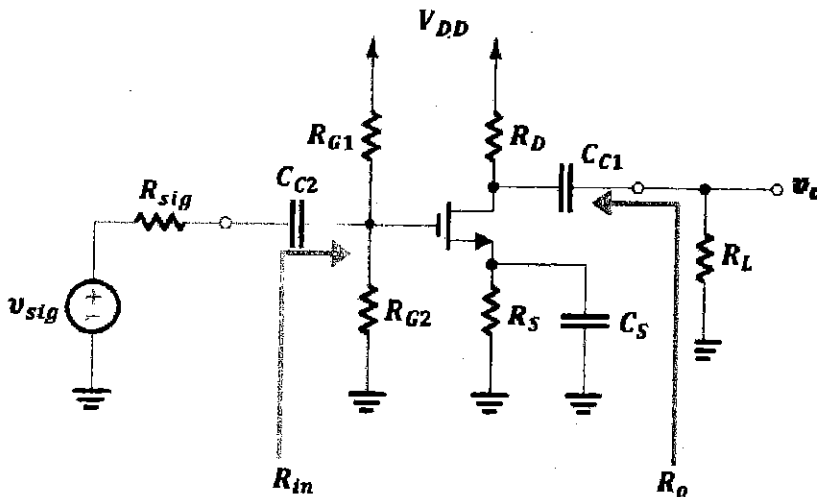


Fig. P5

注意：背面有試題

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6. 計算題(20 分)

Fig. P6 shows a common-gate amplifier at midband frequencies. The circuit is biased at saturation mode with $g_m = 0.95 \text{ mA/V}$, $r_o = 20 \text{ k}\Omega$, $R_{sig} = 8 \text{ k}\Omega$, and $R_L = 20 \text{ k}\Omega$.

6-1 (6 分) Find the value of input impedance R_{in} at low frequency.

6-2 (6 分) Find the value of overall voltage gain v_o/v_{sig} at midband frequencies.

6-3 (8 分) If the parasitic capacitors are as follow, $C_{gs} = 10 \text{ fF}$, $C_{gd} = 5 \text{ fF}$ and load capacitor $C_L = 15 \text{ fF}$. Assume that C_L includes C_{cb} . Find the value of upper 3-dB frequency f_H .

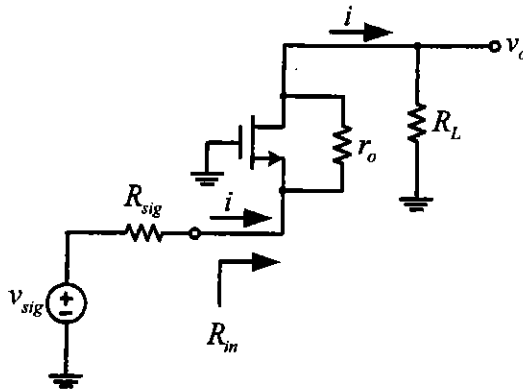


Fig. P6

7. 選擇題與計算題(20 分)

Fig. P7 shows a feedback amplifier implemented using an op amplifier with open-loop gain $\mu = 10^4$, a very large input resistance R_{id} , and a very small output resistance r_o . The output current I_o that is delivered to the load resistance $R_L = 100 \Omega$ is sensed by the feedback network composed of the three resistances $R_M = 100 \Omega$, $R_1 = 1 \text{ k}\Omega$ and $R_2 = 0.9 \text{ k}\Omega$, and a proportional voltage V_f is fed back to the negative input terminal of the op amplifier.

7-1 (4 分) Identify the feedback topology to be used. (a) shunt-series, (b) series-series, (c) shunt-shunt, (d) series-shunt.

7-2 (6 分) Find the value of feedback factor $\beta = V_f/I_o$.

7-3 (6 分) Find the value of open-loop gain $A = I_o/V_i$.

7-4 (4 分) Find the value of closed-loop gain $A_f = I_o/V_s$.

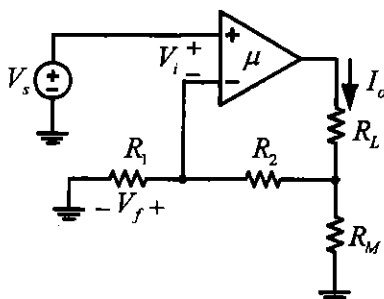


Fig. P7