國立中央大學 109 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)　　　　　　　共３頁　第１頁
　　　　電機工程學系 碩士班 系統與生醫組(一般生)
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科目： 電子學

本科考試禁用計算器　　　　　　　　　　　　　　＊請在答案卷(卡)內作答

＊計算題需計算過程，無計算過程者不予計分

1. 計算題(10 分)

   Assuming ideal op amplifier as shown in Fig. P1. If R_1 = 1 kΩ, R_2 = 10 kΩ, R_3 = 1 kΩ, R_4 = 10 kΩ, and V_i = 2 V,

   1-1 (5 分) Find the value of output voltage V_o.

   1-2 (5 分) Find the value of input resistance (R_{in}) of the circuit.
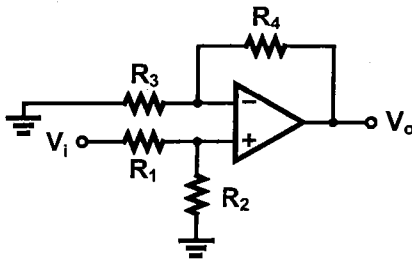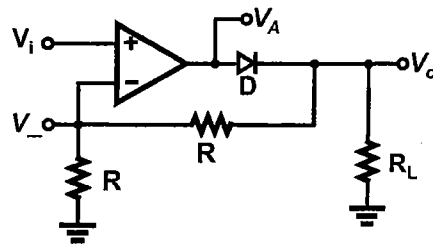

Fig. P1　　　　　　　　　　　　　　　Fig. P2

2. 計算題(10 分)

   The op amp in the circuit of Fig. P2 is ideal with output saturation levels of ±13V. The diode exhibits a constant 0.7 V drop when conducting.

   2-1 (5 分) Find the values of V_-, V_o, and V_A for V_i = +3V.

   2-2 (5 分) Find the values of V_-, V_o, and V_A for V_i = -1V.

3. 計算題(10 分)

   For the circuit shown in Fig. P3:

   3-1 (5 分) Find the values of voltage source (V_s) and source resistance (R_s) for the Thévenin equivalent circuit between node 4 and ground.

   3-2 (5 分) Find the current that flows through a load resistance (R_L) of 10 kΩ connected between node 4 and ground.
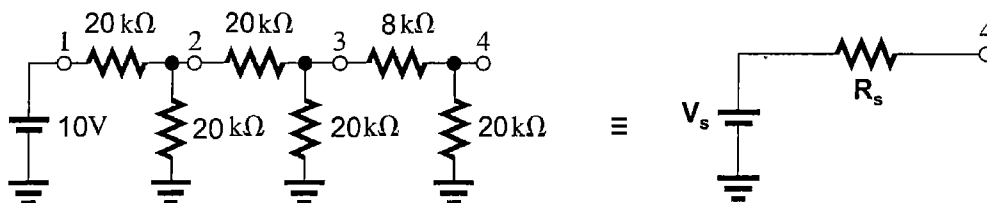

Fig. P3

注意：背面有試題

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4. 計算題(15 分)

Figure P4 shows a CMOS amplifier. Both p-channel MOSFET M_1 and M_2 operate in saturation and with identical bias current. The device parameters are $\lambda_n = \lambda_p = 0.01$ V^{-1}, $K_n = 0.5 \cdot \mu_n C_{ox}(W/L)_n = 0.1$ mA/V^2. Current source I_Q is 0.05 mA, please find the following values,

4-1 (5 分) Find output resistance R_o.

4-2 (5 分) Find transconductance g_m of M_3 ?
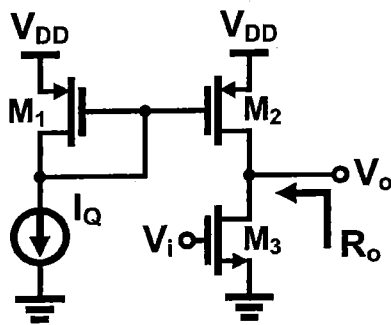
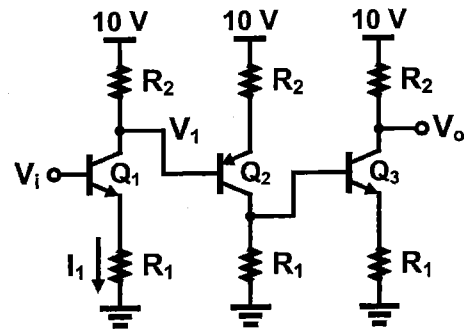4-3 (5 分) Find small-signal gain V_o/V_i ?

Fig. P4

Fig. P5

5. 計算題(20 分)

Figure P5 shows an npn/pnp transistor amplifier. The threshold voltage $|V_{BE}|$ is 0.7 V and current gain β is 100 when operates in active region; otherwise, $V_{CE} = 0.2$ V when operates in saturation region. Assume $I_B = 0$ and $I_C = \alpha \cdot I_E$, please find the following values when the input voltage $V_i = 5$ V.

5-1 (5分) Find bias current I_1 when $R_1 = R_2 = 10$ kΩ.

5-2 (5分) Find V_1 when $R_1 = R_2 = 10$ kΩ.

5-3 (5分) Find operation region of transistor Q_3 when $R_1 = R_2 = 10$ kΩ.

5-4 (5分) Find V_1 when $R_1 = 5$ kΩ and $R_2 = 10$ kΩ.

注意：背面有試題

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6. 計算題(15 分)

Figure P6 shows a common source amplifier with a source resistance R_s which has g_m = 2 mA/V, R_{sig} = R_L = r_O = 20 kΩ, R_s= 1 kΩ, C_{gs} = 10 fF, C_{gd} = 5 fF, and C_L= 15 fF. Please find the following values,

6-1 (5 分) The overall transconductance G_m.

6-2 (5 分) The mid-frequency band voltage gain A_M.

6-3 (5 分) If R_s= 0 kΩ, use the method of open-circuit time constants to find 3-dB frequency f_H.
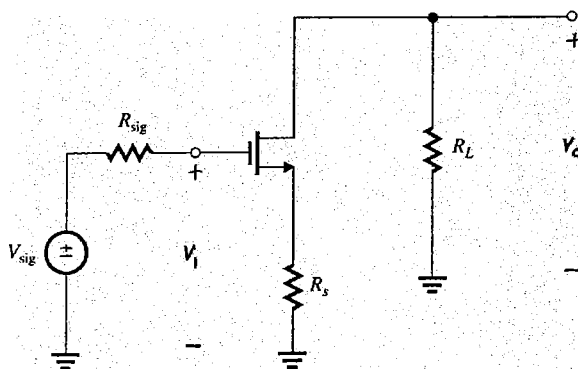

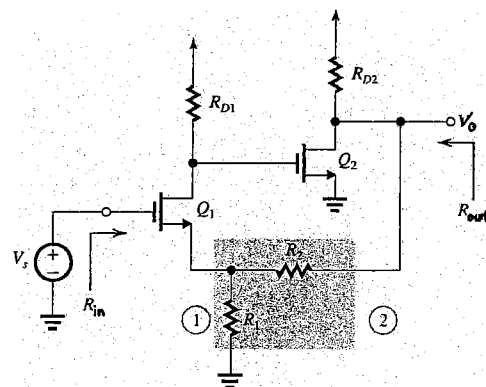Fig. P6   Fig. P7

7. 計算題(20 分)

Figure P7 shows a series-shunt feedback amplifier. For the case of g_{m1} = 2 mA/V, g_{m2} = 2.5 mA/V, R_{D1} = R_{D2} = 10 kΩ, R_1 = 1 kΩ, and R_2 = 9 kΩ. For simplicity, neglect r_{O1} and r_{O2}.

7-1 (5 分) Find the value of feedback factor β.

7-2 (5 分) Find the value of open-loop gain A.

7-3 (5 分) Find the value of close-loop gain A_f = V_O/V_S.

7-4 (5 分) Find the value of output resistance R_{out}.

參考用