

國立中央大學 107 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 4 頁 第 1 頁

科目：電子學

本科考試禁用計算器

*請在答案卷(卡)內作答

1. 繪圖分析題(12 分) Sketch the cross section view of
 - 1-1(6 分) NMOS biased at saturation region.
 - 1-2(6 分) PMOS biased at triode region.
 You must label the nodes of source S, drain D and gate G; and show the channel length and the depletion width in the figures. (Note: the channel length and depletion width near S and D are different)

2. 計算題(12 分) Find the node voltages V_1 and V_2 in Fig. P2. All diodes in this figure are ideal ($V_D = 0$ V).

3. 計算題(12 分) For the NMOS circuit given in Fig. P3 is biased at saturation region has the threshold voltage $V_t = 1$ V, $\mu_n C_{ox} = 100 \mu\text{A}/\text{V}^2$, $L = 1 \mu\text{m}$ and $W = 20 \mu\text{m}$, neglect the body effect
 - 3-1 (6 分) Find the value of transconductance g_m
 - 3-2 (6 分) If the channel length effect voltage $V_A = 50$ V, please calculate the value of the small-signal voltage gain v_o/v_i .

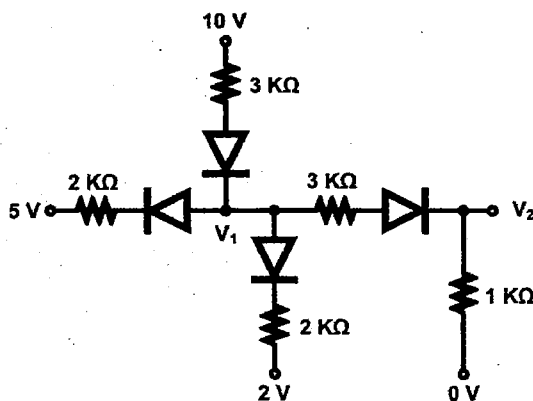


Fig. P2

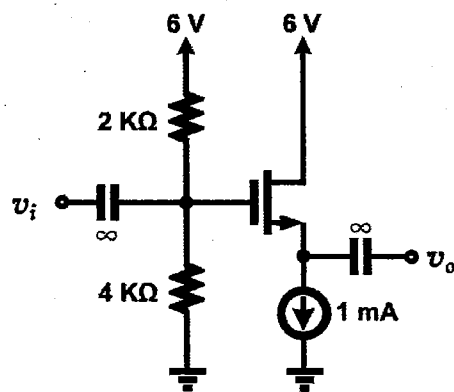


Fig. P3

注意:背面有試題

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 4 頁 第 2 頁

科目：電子學

本科考試禁用計算器

*請在答案卷(卡)內作答

4. 計算題(14 分) For the circuit shown in Fig. P4, the npn BJT is biased at forward active mode has the common emitter current gain $\beta = 100$, $V_T = kT/e = 25$ mV and Early voltage $V_A = 60$ V,
 4-1 (7 分) Find the value of R_{in} .
 4-2 (7 分) Find the value of the overall small-signal voltage gain v_o/v_i .

5. 計算題(16 分) Figures P5 (a) and (b) show the diode-connected MOSFET and BJT transistors. Assume that the dc bias current $I = 0.1$ mA. For MOSFET, let $\mu_n C_{ox} = 0.2$ mA/V² and $W/L = 25$, neglect r_o for both devices. The body effect is neglect in the MOSFET and the thermal voltage $V_T = 25$ mV in BJT.

Please find the small signal resistor R_{in} of the each transistor.

- 5-1(8 分) Diode-connected MOSFET transistor in Fig. P5(a).
 5-2(8 分) Diode-connected BJT transistor in Fig. P5(b).

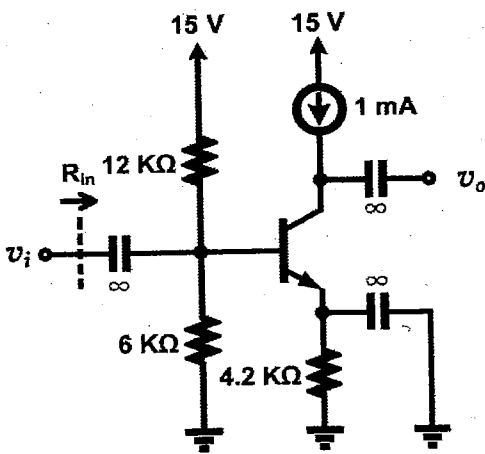


Fig. P4

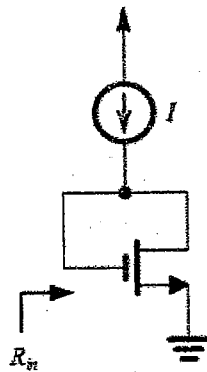


Fig. P5(a)

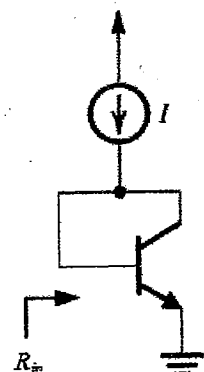


Fig. P5(b)

注意:背面有試題

入學
考
用

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)

科目：電子學

本科考試禁用計算器

*請在答案卷(卡)內作答

6. 計算題(16 分) Figure P6 shows a differential amplifier with load resistor R_D and degenerated resistor R_S . Assume the transistors are matched and with the same transconductance of g_m . Neglect the Early effect and body effect.

6-1 (8 分) Find the differential voltage gain $A_d = v_{od}/v_{id}$, in terms of g_m , R_D and R_S .

6-2 (8 分) What the voltage gain with $R_S = 0 \Omega$? What is the value of R_S (in terms of g_m) that reduces the voltage gain to the half?

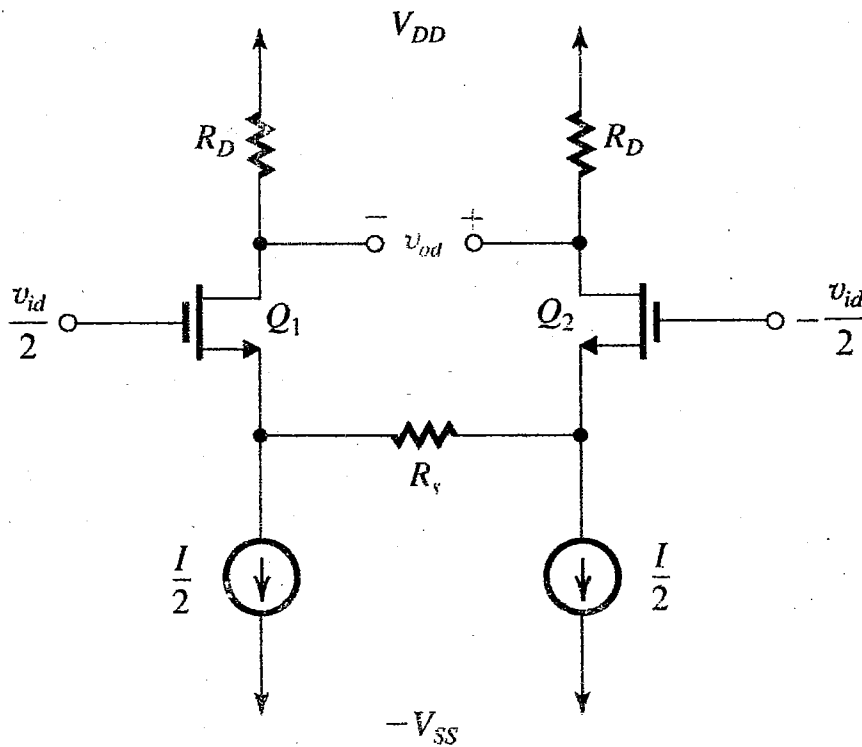


Fig. P6

注意:背面有試題

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)

科目：電子學

本科考試禁用計算器

*請在答案卷(卡)內作答

7. 計算題(18 分) Figure P7 shows a feedback current amplifier. The transconductance g_m of Q_1 and Q_2 are denoted as g_{m1} and g_{m2} , respectively. Neglect the Early effect and body effect in Q_1 and Q_2 .

7-1 (6 分) Find an expression for the open-loop gain $A = I_o/I_i$ in terms of g_m of the transistors and resistor R_D .

7-2 (6 分) Find an expression for the feedback factor $\beta = I_f/I_o$ in terms of resistors R_M and R_F .

7-3 (6 分) Find an expression for the close-loop gain $A_f = I_o/I_s$ in terms of g_m of the transistors and resistors R_D , R_M and R_F .

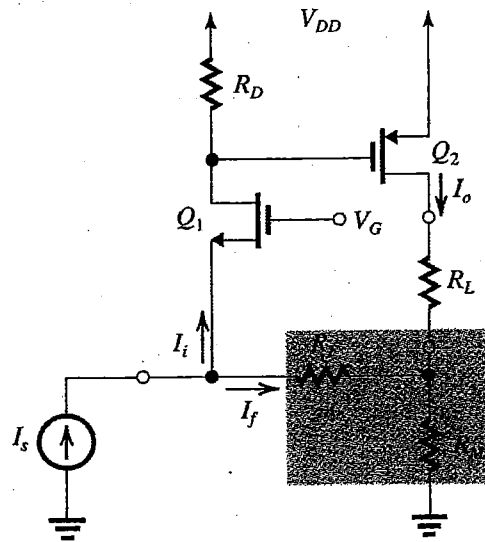


Fig. P7

注意:背面有試題