1. 計算題 (14 分)

　　For the circuits shown in Fig. P1(a) and (b),

　　1-1 (6 分) Using the ideal op amp model ,please find the values of current i_o in Fig. P1(a)
　　　　if R_1 = 1 kΩ, R_2 = 4 Ωk and R_3 = 8 kΩ .

　　1-2 (8 分) Using the ideal diode model ,please find the values of current for the diodes in
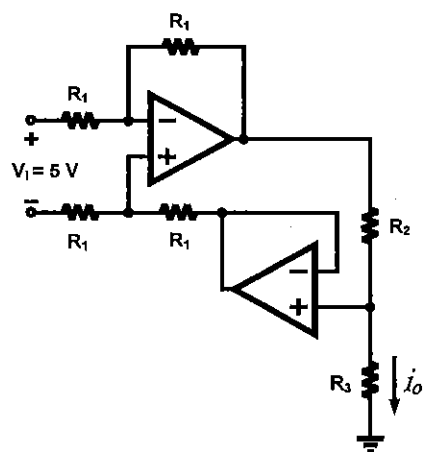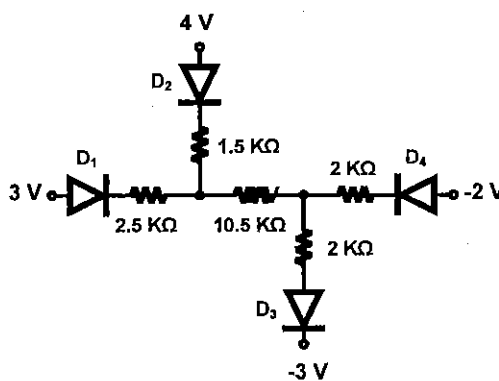　　　　Fig. P1 (b)

Fig. P1(a)　　　　　　　　　　Fig. P1(b)

2. 計算題 (16 分)

　　In the circuit shown in Fig. P2, NMOS transistor is characterized by V_t = 1 V, k'W/L = 2
　　mA/V^2, and λ = 0.

　　2-1 (4 分)Find the labeled bias voltage V_1

　　2-2 (4 分)Find the value of g_m at the bias point.

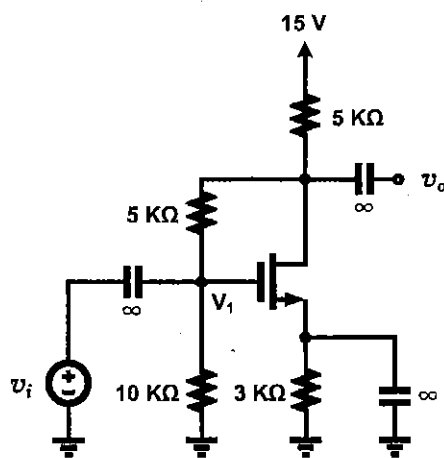　　2-3 (8 分)Find the voltage gain from signal source to output node v_o / v_i

Fig. P2

注意：背面有試題

參考用

3. 計算題 (20 分)

The transistor in the circuit shown in Fig. P3 is biased to operate in the active mode.
Assuming that $V_{BE} = 0.7V$, $V_T = 25$ mV, $\beta = 50$ and $r_o = $ infinity,

3-1 (4 分)Find the dc collector current I_c

3-2 (4 分)Find the value of g_m.

3-3(4 分)Find the small-signal model parameter r_e.

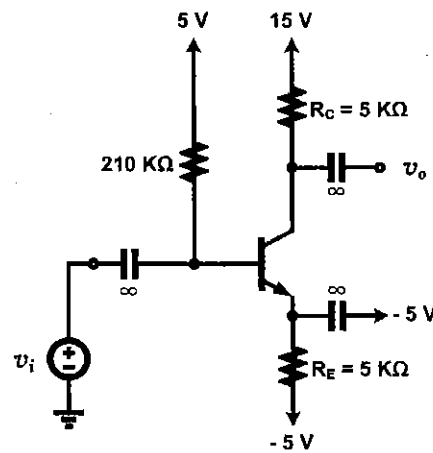3-4(8 分)Find the voltage gain from signal source to output node v_o / v_i

Fig. P3

4. 計算題(16 分)

Figures P4 (a) and (b) show the common source and common gate amplifiers with shunt-shunt feedback (note that bias circuits are not shown.). Assume the MOSFETs in the circuits are matched; each transistor has the same transcondcutance of g_m with infinite r_O. The body effect is neglect in the common-gate amplifier. In terms of g_m and R_f, please find the expression of the voltage gain v_{out}/v_{in} for the following,

4-1　(8 分) Common-source amplifier in Fig.P4(a).

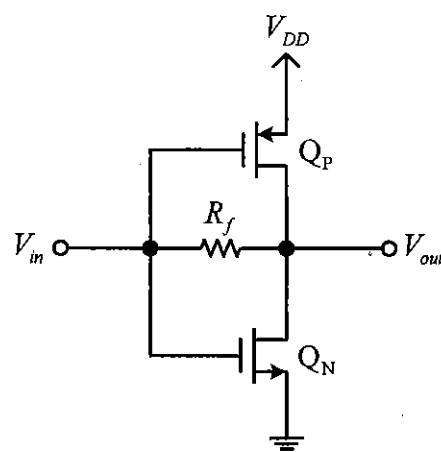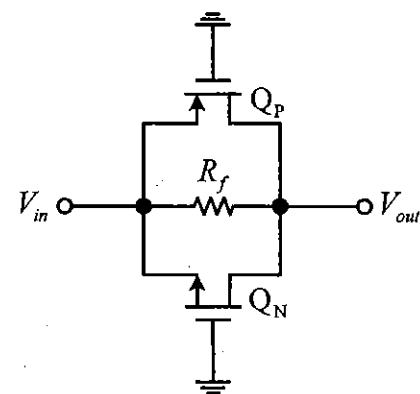4-2　(8 分) Common-gate amplifier in Fig.P4(b).

Fig. P4(a)　　　　　　　　Fig. P4(b)

注
意：背面有試題

5. 計算題(16 分)

Figure P5 shows an amplifier by cascading an NMOS and a PMOS common-source stages. Each of Q_1 and Q_2 is operated at an overdrive voltage of 0.2 V, and $|V_A|$ = 10 V. The transistor capacitances are as follows: C_{gs} = 20 fF, C_{gd} = 5 fF and C_{db} = 5 fF. R_{sig} = 10 kΩ.

5-1 (8 分) Find the dc voltage gain.

5-2 (8 分) The dominant pole is determined at the inter-stage capacitance. Please use the Miller approximation to find the input capacitance of Q_2 and hence determine the total capacitance at the drain of Q_1. Then calculate the frequency of the dominant pole.
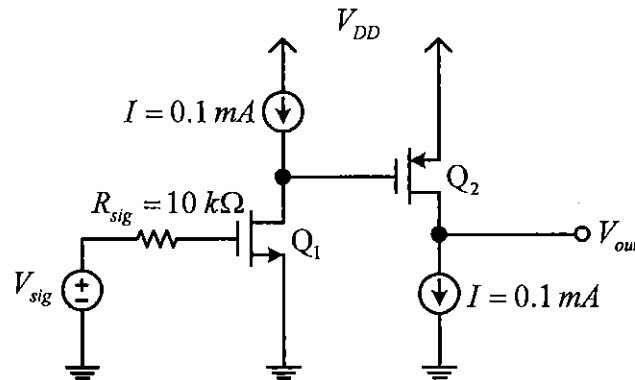

Fig. P5

6. 計算題(18 分)

Fig. P6(a) shows a traditional CMOS cascode amplifier, where V_B is a dc bias voltage. All transistors have the same transconductance of g_m, and output resistance of r_O. The amplifier improves the achievable gain by employing an auxiliary amplifier with a voltage gain μ as shown in Fig. P6(b). This modified amplifier is called a super common gate or regulated cascode amplifier.

6-1 (6 分) Find an expression for the overall transconductance G_m of the regulated cascode amplifier in terms of g_m, r_O and μ.

6-2 (6 分) Find an expression for the output resistance R_{out} of the regulated cascode amplifier in terms of g_m, r_O and μ.

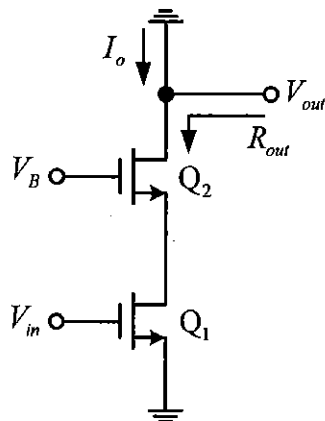6-3 (6 分) Find an expression for the voltage gain v_{out}/v_{in} of the regulated cascode amplifier.
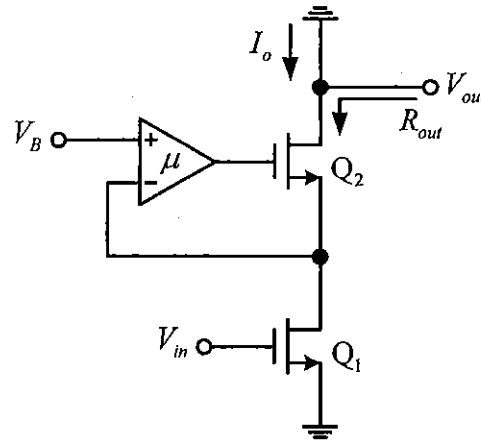

Fig. P6(a)　　　　　　　　　　　　　　　　　Fig. P6(b)