1. Calculate the logic low fan-out of the DTL gate shown in Fig .1. (15%)

2. The transistors in the circuit in Fig. 2 both have parameters V_{TN}= 0.8 V and k_n' =30 μA/V^2. (a) If the width-to-length ratios of M_1 and M_2 are $(W/L)_1=(W/L)_2=40$, determine V_O and I_D. (b) Repeat part (a) if the width-to-length ratios are changed to $(W/L)_1=40$ and $(W/L)_2=15$. (18%)

3. Your answers must be as brief as possible for the following questions
   (a) Draw a block diagram of a two-stage OP-AMP, and briefly explain the function of each block. (3%)
   (b) What are the advantages of using active loads in OP-AMP IC design? (3%)
   (c) Define a (I) class A, (II) class B, and (III) class AB amplifier. (3%)
   (d) List three advantages of class B over class A. (3%)
   (e) What are the characteristics of an amplifier that can be modified by negative feedback? (3%)

4. Suppose you have an amplifier with a transfer function given by
$$a(j\omega)=\frac{10^5}{(1+j\omega/10^3)(1+j\omega/10^5)(1+j\omega/10^6)}$$
   and you apply negative feedback to the amplifier, using a feedback network that is not a function of frequency. If you desire to have a closed-loop gain of 30 dB with a 45° phase margin (PM), and you compensate the loop by moving the dominant pole frequency down, what new pole frequency should be used? (10%)

5. For the circuit in Fig. 3.
   (a) Find the loop gain L(s), and the oscillation frequency f_0. (6%)
   (b) The ratio of R_2/R_1 for oscillation. (4%)

6. For the diode circuit shown in Fig. 4, write the load line equation and draw the possible load line for the diode using (a) a constant resistor or (b) a depletion-mode n-MOSFET with $V_{GS}=0\,V$ or (c) an enhancement-mode n-MOSFET with $V_{GS}=V_{DS}$ as the load device. (15%)

7. For the circuit in Fig. 5(a) and the corresponding *i-v* characteristics in Fig. 5(b), if the dc operation point of the MOSFET is set at $(I_{DQ}, V_{GSQ})=(1.5\,mA, 3.5\,V)$, find the value of V_{DD}, R_D, R_{G2}, and voltage gain $A_v(\equiv dv_O/dv_I)$. Assume threshold voltage $V_t=1\,V$ and $R_{G1}=100\,M\Omega$. (17%)

(背面仍有題目,請繼續作答)

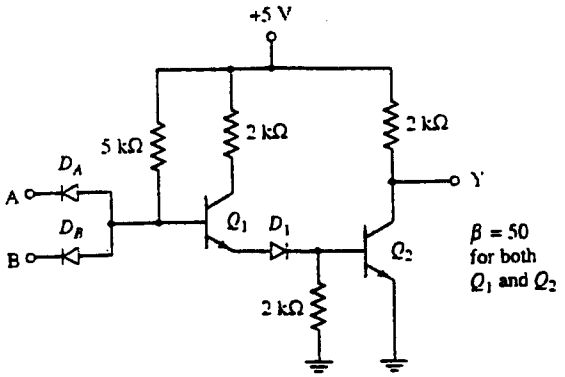

Fig. 1

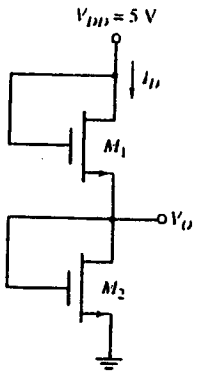

Fig. 2

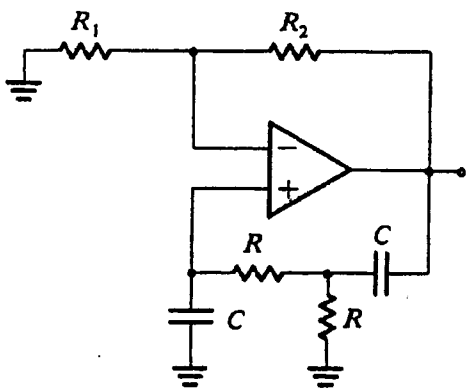

Fig. 3

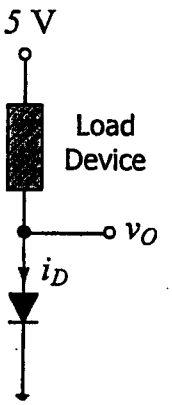

Fig. 4

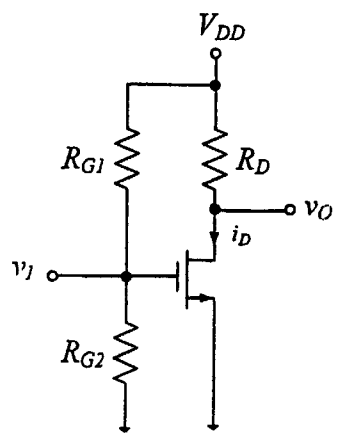

Fig. 5(a)

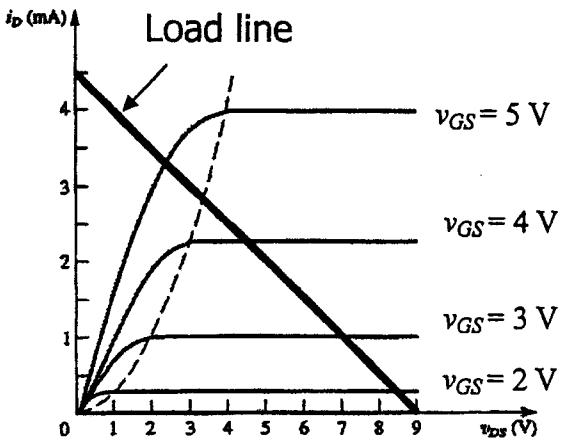

Fig. 5(b)