※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Consider the Zener diode circuit shown in Figure 1. The Zener breakdown voltage is V_Z=5.6V at I_Z=0.1mA, and the incremental Zener resistance is r_z=10Ω. (a) Determine V_O with no load (R_L=∞). (b) Find the change in the output voltage if V_{PS} change by ±1V. (c) Find V_O if V_{PS}=10V and R_L=2kΩ.　　　　　　　　　　　　　　　　　　　　　　　　**(15%)**

2、Determine the Boolean expression for V_0 in terms of the four input voltages for the circuit in Figure 2.　　　　　　　　　　　　　　　　　　　　　　　　**(15%)**

3、Consider the voltage reference circuit in Figure 3. Using a Zener diode with a breakdown voltage of 5.6V. Design the circuit to produce an output voltage of 10V. Assume the input voltage is 12V, the R_2 current and R_4 current are 1mA and 2mA respectively, and the Zener diode current I_Z=1mA.　　　　　　　　　　　　　　　　　　　　　　　**(20%)**
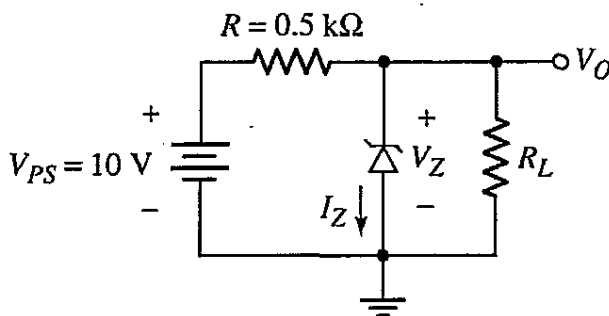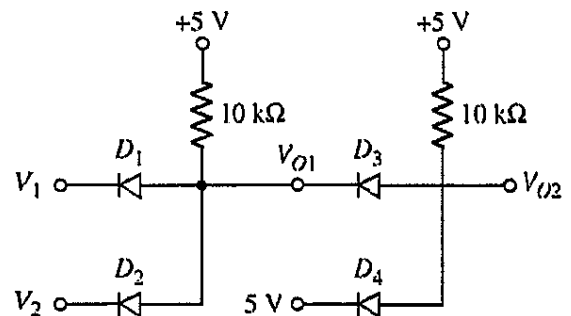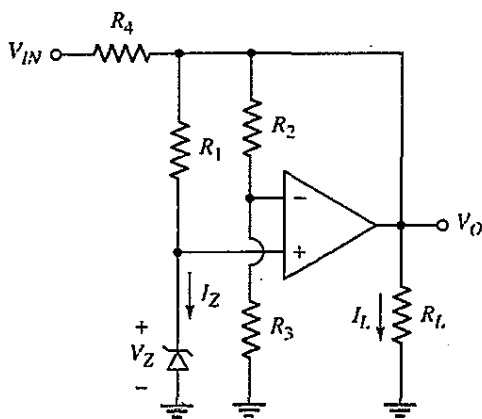

Fig.1

Fig. 2

Fig.3

4、 The transistor parameters in the circuit in Figure 4 are: K_{n1}=0.1 mA/V^2, K_{p2}=1.0 mA/V^2, V_{TN1}=+2 V, V_{TP2}=-2 V, and $\lambda_1=\lambda_2=0$. The circuit parameters are: V_{DD}=10 V, R_{S1}=4 kΩ, and R_{in}=200 kΩ. (a) Design the circuit such that I_{DQ1}= 0.4 mA, I_{DQ2}=2 mA, V_{DSQ1}= 4 V, and V_{SDQ2}=5 V. (b) Calculate the small-signal voltage gain A_v=v_o/v_i. (c) Determine the maximum symmetrical swing in the output voltage. **(20%)**

5、 Consider the current-to-voltage converter circuit shown in Figure5. The input resistance R_{if} is assumed to be small, the output resistance is R_o=0, and the op-amp gain A_z is large. **(20%)**

(a) Write the closed-loop transfer function in the form

$$A_{zf} = \frac{v_o}{i_s} = \frac{A_z}{(1+\beta_g A_z)}$$

(b) What is the expression for β_g?

(c) If $A_z = 5\times10^6\,\Omega$ and $A_{zf} = 5\times10^4\,\Omega$, what is the required β_g and R_F ?

(d) If A_z decrease by 10 percent, what is the precent change in A_{zf}?

6、 (a) Can two back-to –back connected p-n diodes be used as a transistor ? Why ? **(5%)**
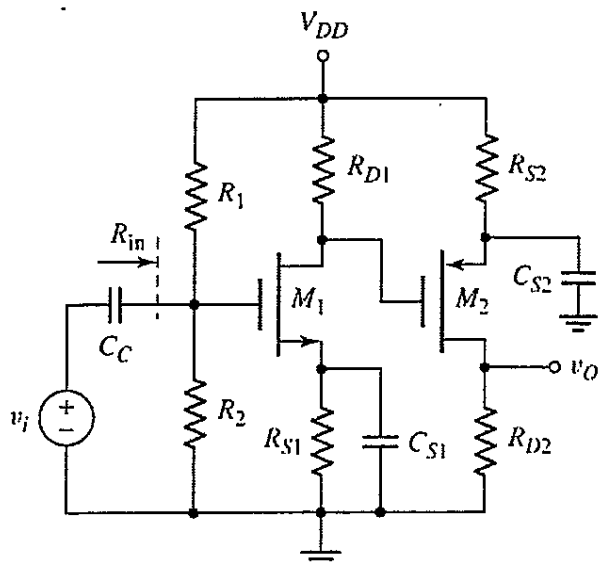
(b) Describe the ideal OP-Amp characteristics? **(5%)**

Fig.4

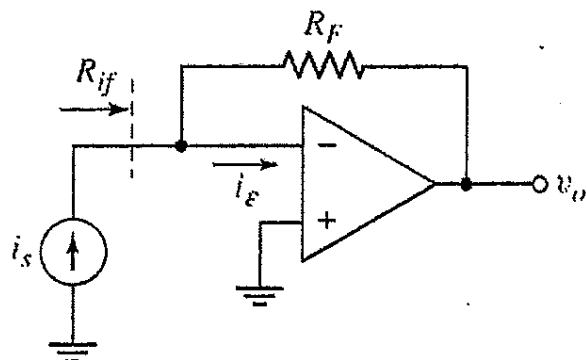Fig.5