

本試題是否可以使用計算機:  可使用,  不可使用 (請命題老師勾選)

1. (15%) The switch  $S_1$  in the circuit of Fig. 1 has been opened for a long time but is closed at  $t = 0$ . Please find  $V_0(t)$  for  $t \geq 0$ .

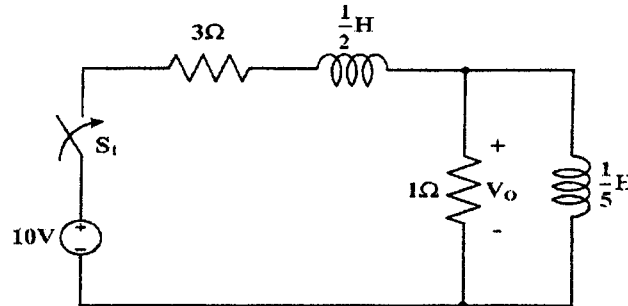


Fig. 1

2. (20%) Assume that all diodes are ideal:

- (1) Consider the circuit of Fig. 2(a). Please find the piece-wise linear equations describing the circuit's transfer characteristic  $V_0$  versus  $V_I$ . (10%)  
 (2) If the input  $V_I$  versus  $t$  is given as in Fig. 2(b), please sketch the output  $V_0$  versus  $t$ . (10%)

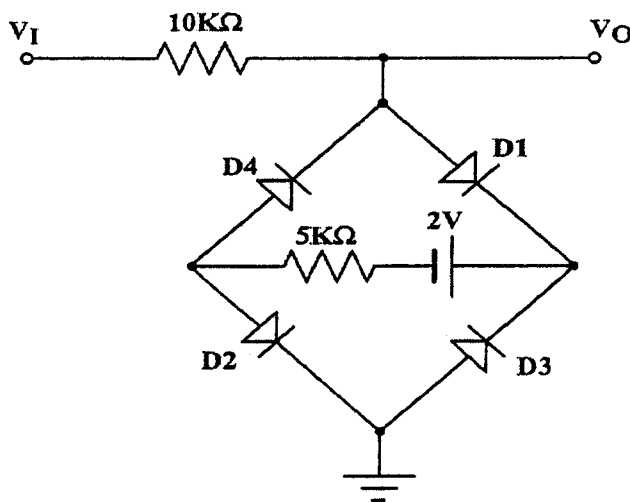


Fig. 2(a)

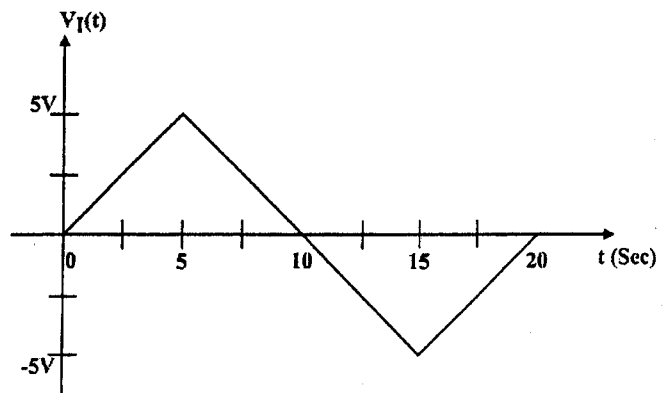


Fig. 2(b)

3. (20%) Consider the amplifier of Fig. 3. Let both transistors have  $\beta = 50$ , and assume constants  $V_{BE} = 0.7$ ,  $V_T = 25mV$  for both transistors. When the source voltage  $V_s$  has zero DC component, the output DC voltage is  $V_0 = 5V$ .
- (1) What type of feedback is employed in the circuit? (4%)  
 (2) Find the  $\frac{V_0}{V_s}$ . (8%)  
 (3) Find the  $R_{in}$ . (8%)

(背面仍有題目, 請繼續作答)

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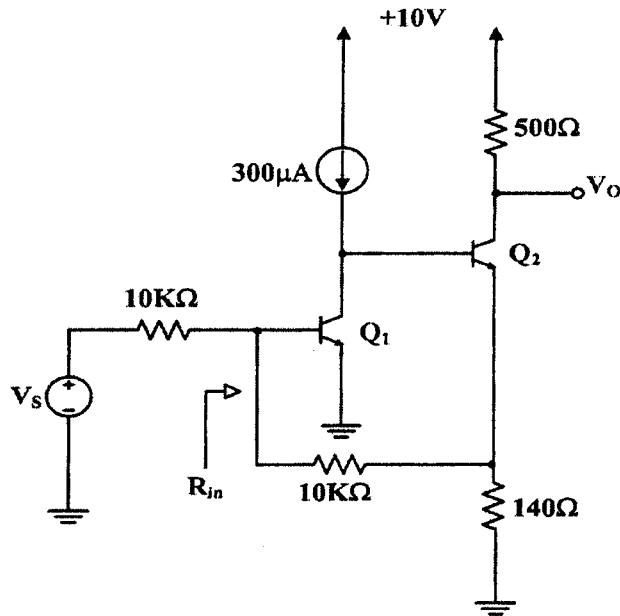


Fig. 3

4. (20%) Consider the adjustable gain difference amplifier of Fig. 4. Variable resistor  $R_V$  is to vary the gain.
- (1) Determine the output voltage  $V_o$  as a function of  $V_1$  and  $V_2$ . (10%)
  - (2) Find  $\frac{I_{out}}{(V_2 - V_1)}$  for  $R_1 = R_2 = R_V = 10\text{ K}\Omega$  and  $R_0 = 20\text{ K}\Omega$ . (10%)

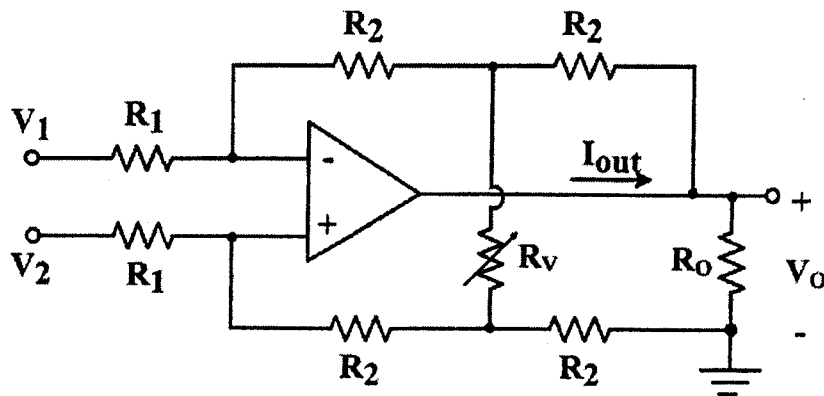


Fig. 4

5. (10%) Consider the circuit of Fig. 5. The voltage-current relationship of the nonlinear device  $N$  is given by  $I = -\frac{2}{3}V - \frac{1}{3}(|V + 1| - |V - 1|)$ . Let the  $V_{c1}$ ,  $V_{c2}$  and  $I_L$  be the state variables  $x_1$ ,  $x_2$  and  $x_3$ , respectively, please
- (1) determine the differential equation in state space. (5%)
  - (2) determine all possible steady-state solutions for the circuit. (5%)

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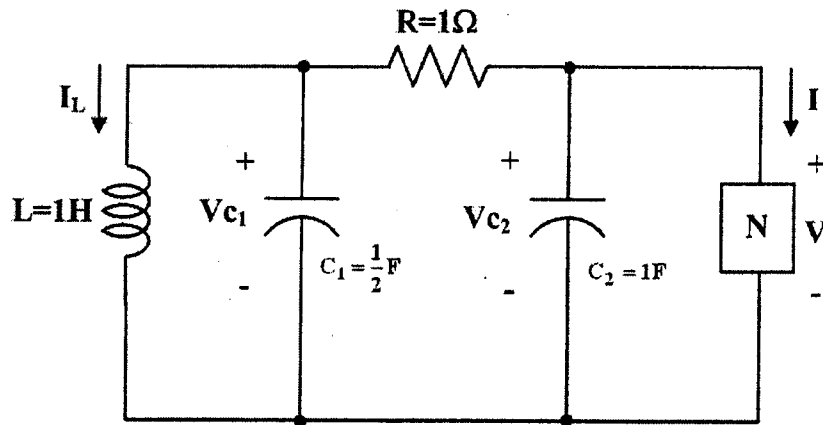


Fig. 5

6. (15%) (1) Please draw a logical circuit (gates) for the following Boolean function: (5%)

$$S_0 = A \cdot B \cdot C + \bar{A} \cdot \bar{B} \cdot C + A \cdot \bar{B} \cdot \bar{C} + \bar{A} \cdot B \cdot \bar{C}$$

- (2) Please create a truth table for the above Boolean function. (5%)

- (3) Please simplify the logical circuit from problem (b) to use the minimum number of gates. (5%)