

八十六學年度 動機 系(所) 乙 組碩士班研究生入學考試

科目 電工學 科號 2702 共 5 頁第 1 頁 請在試卷【答案卷】內作答

- Assume ideal diodes for each diode and ideal OP amplifier in the circuit shown in Fig. 1
  - Plot  $V_o$  versus  $V_i$  for  $-20 \leq V_i \leq 20$  volt. (5%)
  - Plot  $V_o$  versus  $V_i$  with calculation procedures. (5%)
  - What will the plot of  $V_o$  versus  $V_i$  be affected by the power supply to the OP amplifier if  $\pm 15$  volts is used? (5%)

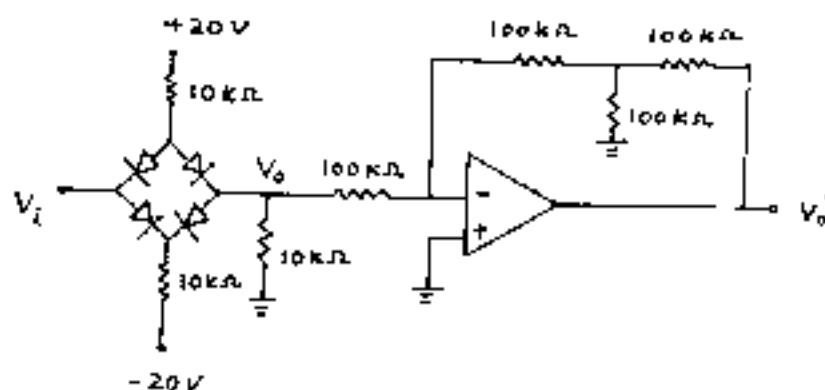


Fig 1

- The DC load line and Q-point of the circuit shown in Fig 2(a) are shown in Fig 2(b). For the transistor with  $\beta = 100$ ,
  - Find the  $R_C$ ,  $R_1$ , and  $R_2$  such that the circuit is bias-stable. (3%)
  - If  $\beta$  is changed to 150, what are the  $I_{CQ}$  and  $V_{CEQ}$ ? (2%)

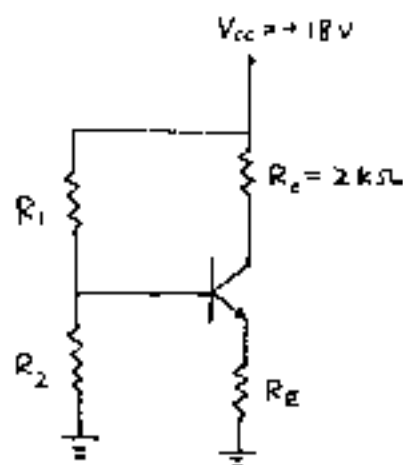


Fig 2(a)

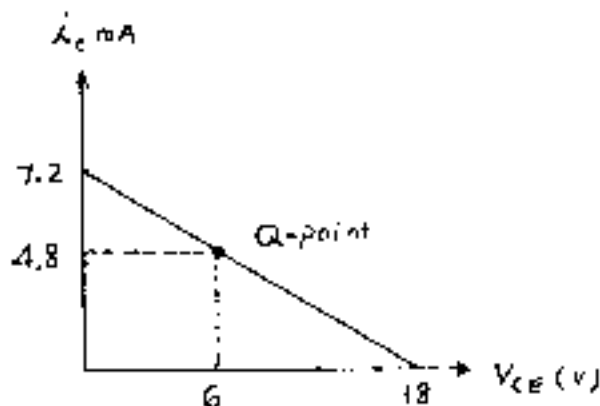


Fig 2(b)

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3. The common source amplifier in Fig. 3 has the MOSFET transistor parameters  $k = 2 \text{ mA/V}^2$ ,  $V_{th} = -2 \text{ V}$ , and  $r_o = \infty \Omega$ .
- (1) Determine  $I_{DQ}$  and  $V_{DSQ}$ . (5%)
  - (2) Calculate small signal voltage gain  $A_v$ . (5%)

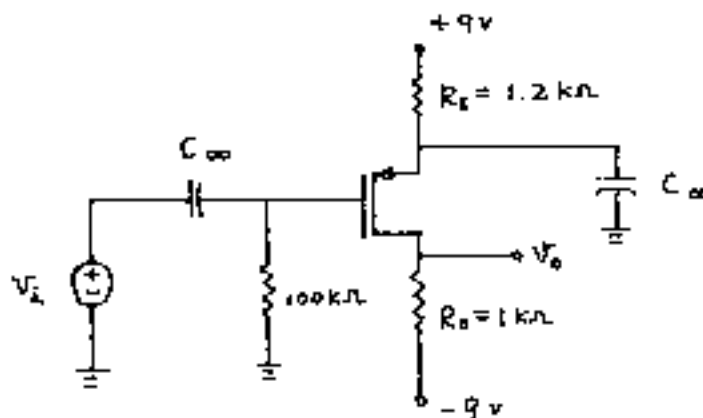


Fig. 3

4. For the amplifying circuit as shown in Fig. 4, please explain the effects of capacitor  $C_A$ ,  $C_B$ ,  $C_C$ , and  $C_D$  on the input-output frequency response. (5%)

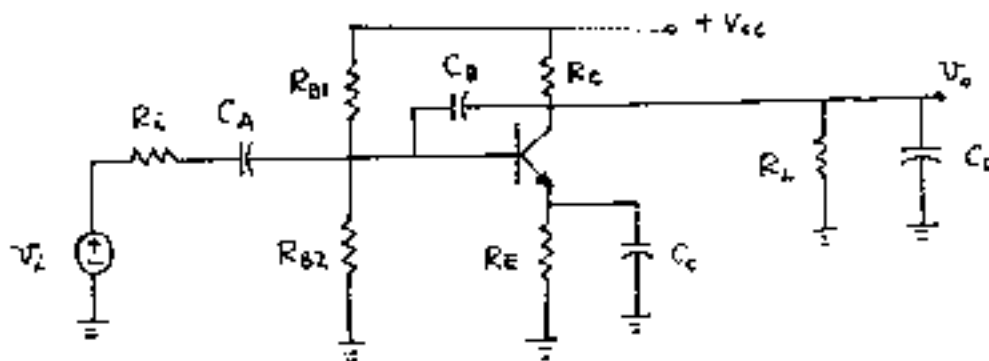


Fig. 4

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5. Please explain the following terminology

(1) J-K Flip-Flop. (2) PAL circuits (3) Maxterm (4) TTL circuits (5) Race condition. (10%)

6. A 7-segment display is required to display the alphabet characters in Fig. 5, please design the 2-to-7 decoding circuits with minimized gate number by using AND/OR/NOT implementation, the 0, 1, 2, 3 are the inputs of the decoder and a-g are the outputs.(5%)



Fig. 5

7. Assume that in Fig. 6 the switch is connected at the point A for a long time and then switched to point B at  $t=0$ .

(a) Find  $v_c(0^-)$ ,  $i_{L1}(0^-)$ ,  $i_{L2}(0^-)$ . (5%)

(b) Find  $v_c(\infty)$ ,  $i_{L1}(\infty)$ ,  $i_{L2}(\infty)$ . (5%)

(c) Find  $v_c(t)$ ,  $i_{L1}(t)$ ,  $i_{L2}(t)$  for  $t > 0$ . (10%)

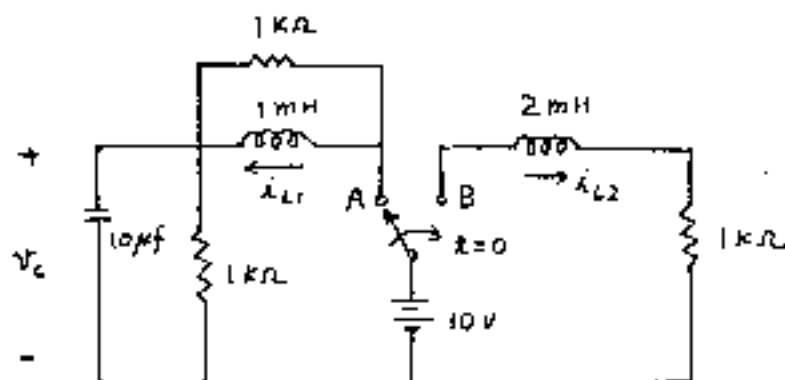


Fig. 6

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8. A network shown in Fig. 7(a) is simplified to the network shown in Fig. 7(b). Find  $Z_1$ ,  $Z_2$ ,  $V_1$  and  $V_2$ . (20%)

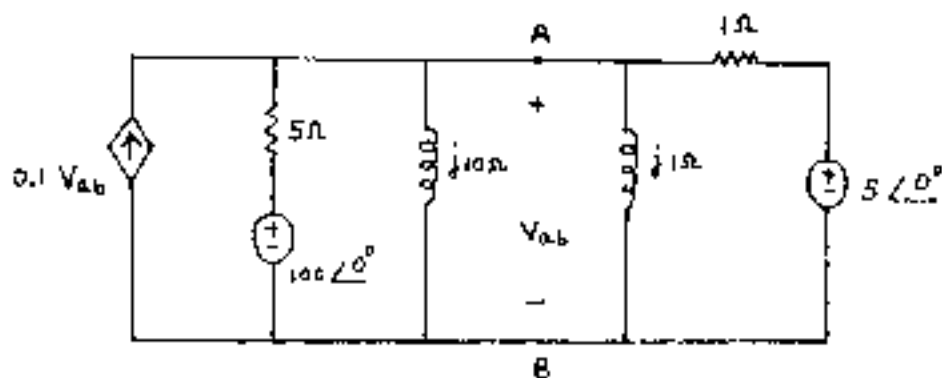


Fig 7 (a)

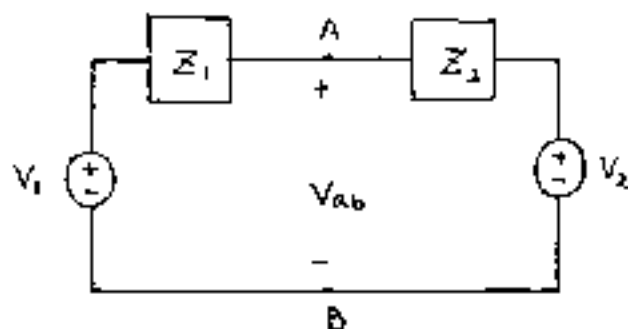


Fig 7(b)

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9. A linear transformer circuit is shown in Fig. 8. If a sinusoidal input with phasor  $V_s$  and frequency  $\omega$  is applied,

(a) give the dot markings on the transformer circuit. (5%)

(b) find  $3 \times 3$  matrix  $A$  and  $3 \times 1$  vector  $B$  for the following relationship among  $I_1, I_2, I_3$  and  $V_s$  (5%)

$$[A] \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = B V_s$$

Where  $L_1, L_2$ , and  $L_3$  are self-inductance,  
 $M_{12}, M_{23}$ , and  $M_{31}$  are mutual inductance,  
 $I_1, I_2, I_3$  and  $V_s$  are phasors, and  
 $Z_2$  and  $Z_3$  are impedance.

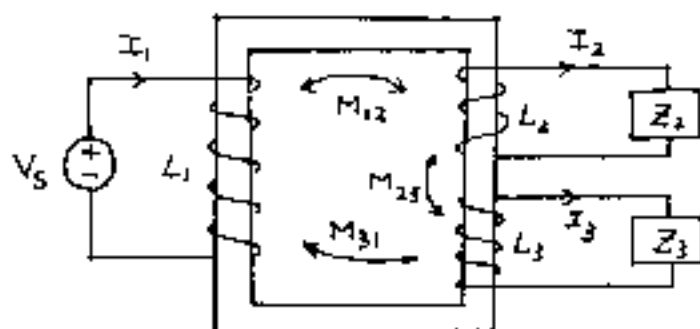


Fig. 8