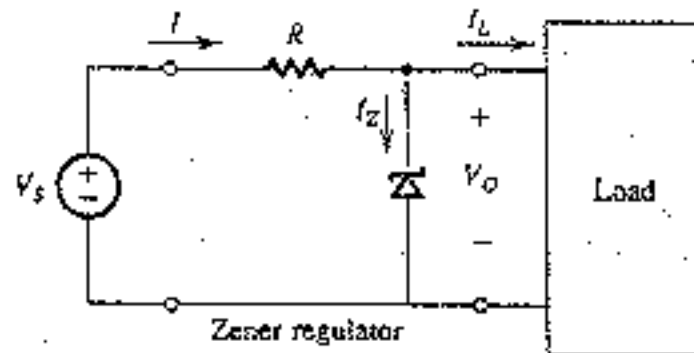


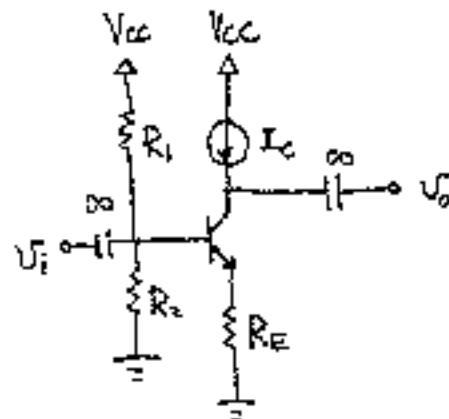
八十四學年度 電機 所 丙 組碩士班研究生入學考試

科目 電子學 科號 2402 共 四 頁第一 頁 \*請在試卷【答案卷】內作答

1. It is required to design a zener shunt regulator to provide an output voltage of about 10 V. The raw supply available varies between 15 and 25 V and the load current varies over the range 0 to 20 mA. The available 10-V zener of type 1N4740 is specified to have a 10-V drop at a test current of 25 mA. At this current its  $r_z$  is  $7\Omega$ . Design for a minimum zener current of 5 mA.
- Find  $V_{z0}$ . (2%)
  - Calculate the required value of  $R$ . (3%)
  - Find the line regulation. What is the change in  $V_o$  expressed as a percentage, corresponding to the  $\pm 25\%$  change in  $V_s$ ? (5%)
  - Find the load regulation. By what percentage does  $V_o$  change from the no-load to the full-load condition? (5%)



2. For the circuit shown, derive the expression of its output resistance. What is the use of the emitter resistance? (15%)



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3. The circuit of a basic CMOS amplifier is shown in Fig. (a). The dc characteristics of NMOSFET and the PMOSFET as a load is shown in Fig. (b). The transfer characteristics of this amplifier between  $V_i$  and  $V_o$  is shown in Fig. (c). (15%)
- Show the corresponding location of points A and B in Fig. (b) on Fig. (c).
  - Express  $V_A$  in Fig. (c) in terms of  $V_{DD}$ ,  $V_{SG}$ , and  $V_{tp}$ .
  - Suggest which regions (off, active, or triode)  $Q_1$  and  $Q_2$  operate as in the region I, II, III, and IV shown in Fig. (c), respectively.

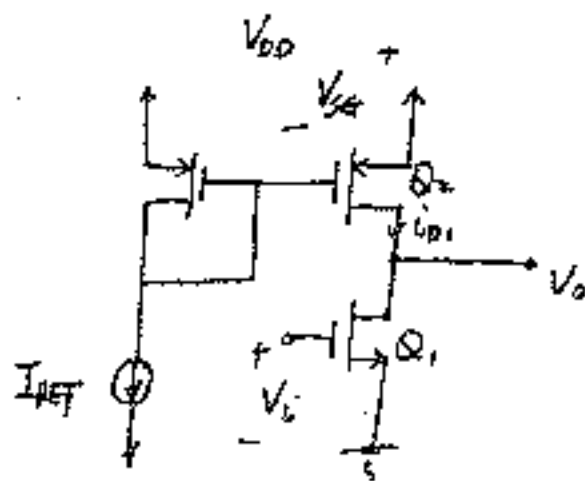


Fig. (a)

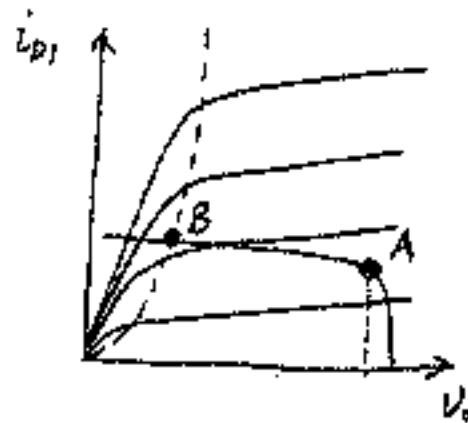


Fig. (b)

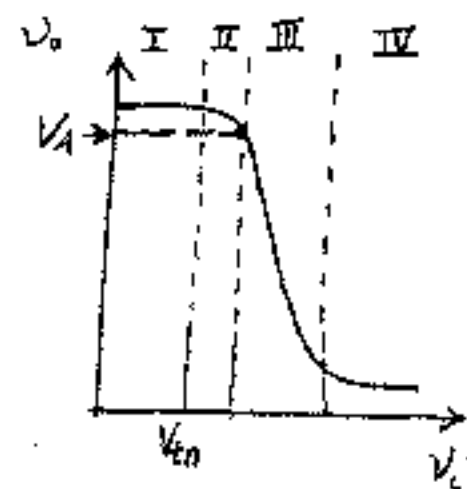


Fig. (c)

4. Find the s-domain transfer function of a first-order circuit, which has a gain of 10 at dc, a gain of 2 at infinite frequency, and a pole at  $\omega = 1\text{M rad}$ . (15%)

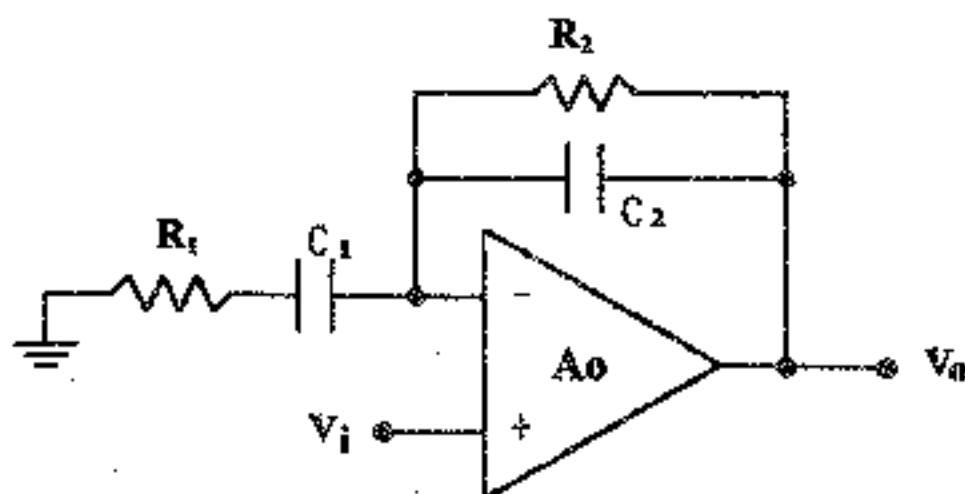
八十四學年度 電機 所 丙 組碩士班研究生入學考試

科目 電子學 科號 2402 共 四 頁 第 三 頁 \*請在試卷【答案卷】內作答

5 An ideal operational amplifier with open-loop gain  $A_o$  is connected with the feedback circuit as shown. (10%)

(1) Derive the expression for the loop gain.

(2) Find the characteristic equation and Q factor of the circuit.



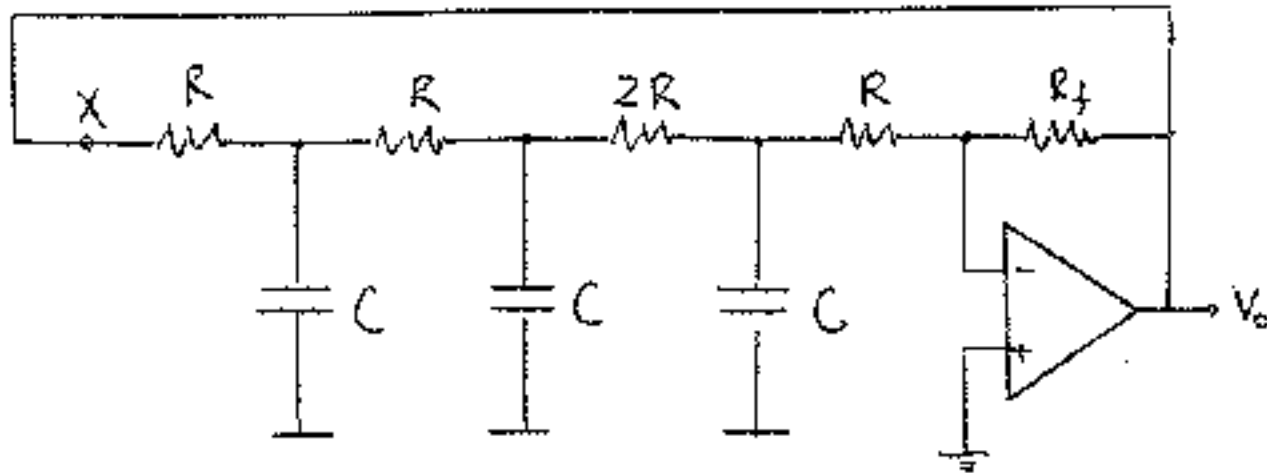
6. A power device has junction-to-ambient and junction-to-case thermal resistances of  $0.2$  and  $0.01^\circ\text{C}/\text{mW}$ , respectively. The maximum junction temperature is rated to  $150^\circ\text{C}$ .

If it is designed to dissipate  $1\text{W}$  under ambient temperature of  $90^\circ\text{C}$ , a heat sink is needed for safe operation. Find the required thermal property of the heat sink. (5%)

八十四學年度 電機 所 丙 組碩士班研究生入學考試

科目 電子學 科號 2402 共 四 頁第 四 頁 \*請在試卷【答案卷】內作答

7. The following circuit shows a phase shift oscillator. Break the loop at node X and find the loop gain and  $R_f$  and C (in terms of R) to obtain sinusoidal oscillation at 10 kHz. (15%)



8. (10%) For a two-input RTL gate as shown below, when driving N identical gates, answer the following questions.

- (a) Find the logic function of this RTL gate, i.e.,  $Y = ?$ .

- (b) Let  $V_{BE} = 0.7\text{ V}$ ,  $V_{CC} = 5\text{ V}$ , find  $V_{OH}$  in terms of N,  $R_C$ , and  $R_B$ .

