1. For the circuit shown in Fig. 1, assume that the two JFETs are matched.

(a) Show that the two JFETs to operate in pinch-off (10分) the following two conditions must be satisfied.

$$I_D R_S \geq 0.5|V_p|$$

$$V_{DD} - I_D R_S \geq 1.5|V_p|$$

(b) For $V_{DD}=10V$, $|V_p|=2V$, and $I_{DSS}=4\,mA$, design (10分) R_S and R_D so that $V_{DG1}=|V_p|$ and $V_{DG2}=2|V_p|$.

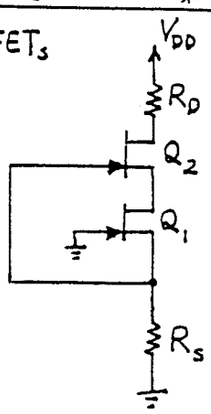

Fig. 1

2. Sketch and clearly label the transfer characteristic of the circuit in Fig. 2, for $-20V \leq v_i \leq 20V$. assume that the diodes can be represented by a piecewise-linear model with $V_{D0}=0.65V$ and $r_D=25\Omega$. Assuming that the specified zener voltage (6.2V) is measured at a current of 10mA at that $r_z=20\Omega$, represent the zener by a piecewise-linear model. (15分)

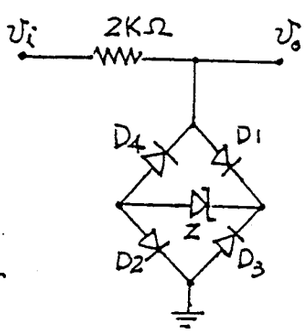

Fig. 2

3. The transistors in the circuit of Fig. 3 have $\beta_0=100$, $V_A=100V$, $C_\mu=0.2\,PF$. At a bias current of $100\mu A$, $f_T=400\,MHz$. (Note that the bias details are not shown)

Find an estimate of the upper 3-dB frequency f_H. (15分)

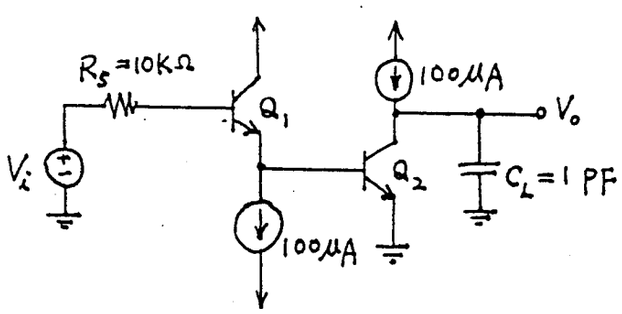

Fig. 3

4. For the circuit in Fig. 4, assume that the diodes has a constant 0.7-V drop when conducting and that the op amp saturates at ±15 V.

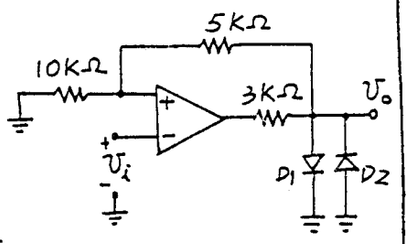

Fig. 4

(5分) (a) Sketch and label the transfer characteristic, $v_o - v_i$.

(5分) (b) What is the maximum diode current?

5. A class AB output stage using a two-diode bias network as shown in Fig. 5, utilizes diodes having the same junction area as the output transistors. Assume that $V_{cc}=10V$, $I_{bias}=0.5\,mA$, $R_L=100\Omega$, $\beta_N=50$, $|V_{CE\,sat}|=0V$.

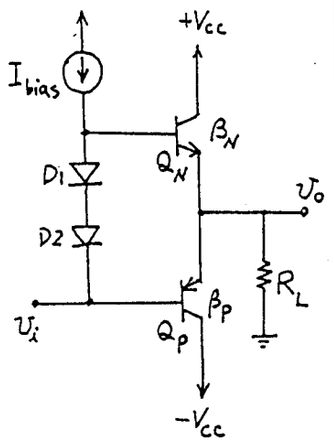

Fig. 5

(5分) (a) What is the quiescent current?

(5分) (b) What are the largest possible positive and negative output signal levels?

(5分) (c) To achieve a positive peak output level equal to the negative peak level, what value of β_N is needed if I_{bias} is not changed? and

(5分) (d) what value of I_{bias} is needed if β_N is held at 50?

6. Fig. 6 shows a circuit for a voltage-controlled current source employing series-series feedback through the resistor R_E. (The bias circuit is not shown)

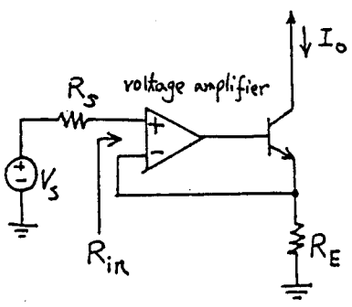

Fig. 6

(a) If the loop gain is very large, find the value of (5分) R_E to obtain a circuit transconductance (I_o/V_s) of 1 mA/V.

If the voltage amplifier has a differential resistance of 100 KΩ, a voltage gain of 100, and an output resistance of 1 KΩ, and if the transistor is biased at a current of 1 mA and has h_{fe} of 100, and r_o of 100 KΩ, $R_s=10K\Omega$.

(10分) (b) Find the actual value of transconductance (I_o/V_s) realized.

(5分) (c) Find the input resistance R_{in}.