電子學期中考

89.11.27. (三面, 共五題)

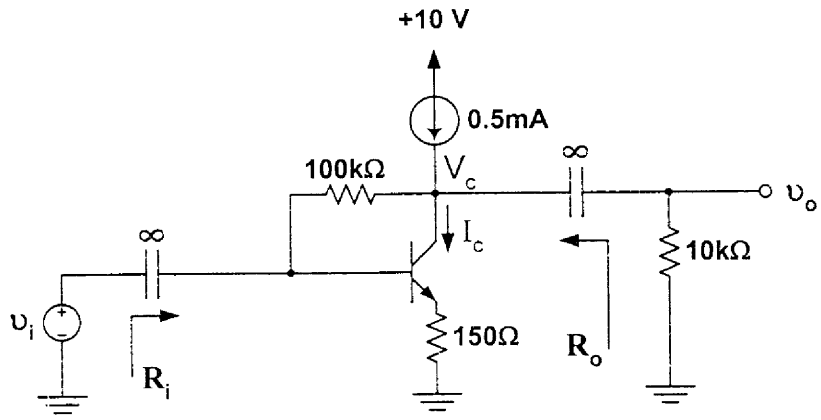
1. **Bipolar transistor application**. (see below)

Assuming that $\beta \rightarrow \infty$, $V_{BE,active} = 0.7V$, and $V_t = 25mV$.

(1) Determine DC current I_c and DC voltage V_c of the transistor. (6%)

(2) Draw the small signal circuit. (6%)

(3) Find the value of small signal voltage gain v_o/v_i and input resistance R_i. (8%)



2. **Bipolar transistor small signal model**.

Considering parasitic resistors r_μ and r_o .

(1) Draw the hybrid-π small signal model of BJT. (6%)

(2) As the common base structure, assuming the input small signal current $i_e = 0$, caculate the output resistance. (8%)

$$R_o = \frac{v_{cb}}{i_c}\bigg|_{i_e=0}$$

(3) As the common emitter structure, assuming the input small signal current $i_b = 0$, caculate the ouput resistance. (8%)

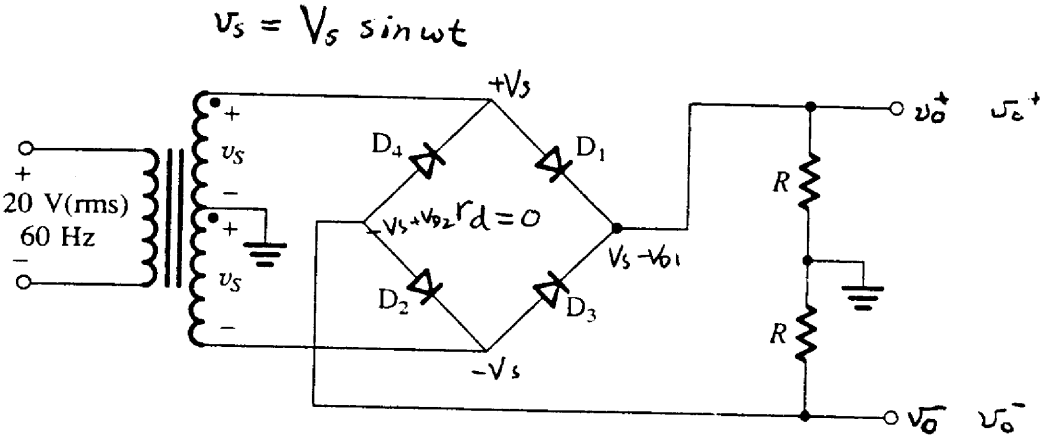
$$R_o = \frac{v_{ce}}{i_c}\bigg|_{i_b=0}$$

3. **Rectifier circuits** (see bellow) The turn-on voltages of these four diodes are slightly different, and are labeled as V_{D1}, V_{D2}, V_{D3}, and V_{D4}. Note r_d =0.

(a) Is it a full-wave or half-wave rectifier? (1%)

(b) Please draw the waveforms of output v_o^+ and v_o^- in a period. Label the peak voltage using V_s, V_{D1}, V_{D2}, V_{D3}, and V_{D4}. (8%)

(c) Find the PIV of each diode. (6%)

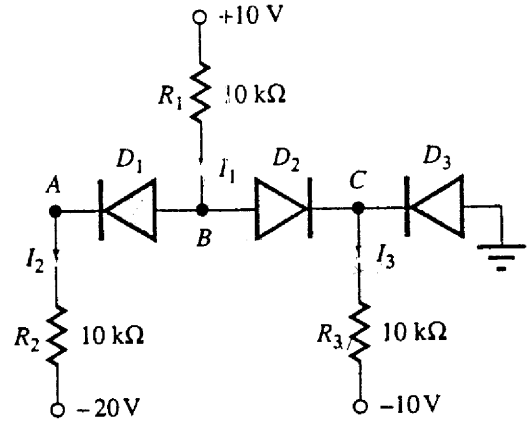


4. **Diode circuit** (see bellow)

(a) How many possible combinations of diode states in this circuit? (3%)

(b) You assume that all diodes are on as initial guess. Is it correct? Why? (4%)

(c) Find the current through each diode. (8%)



5. **Intrumentation Amlifier** (see below)

Analyze the circuit to determine v_o as a function of v_1 and v_2 , and determine the differential gain. Suggest a way for making the gain variable. Also find the input resistance. Design the circuit to provide a gain that can be varied over the range 2 to 1000 utilitzing a 100-kΩ variable resistance (a potentiometer, or "pot" for short). (28%)