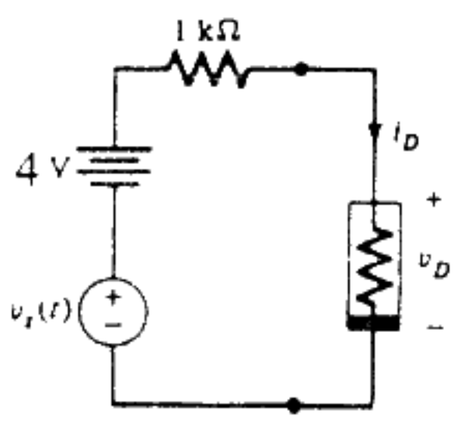
Electric Circuits Final Exam 01/21/2000

1. (a). Find all possible dc operating points of the circuit shown in Fig. 1. (10%)
   (b). For each operating point draw the small-signal equivalent circuit. (5%)

2 Find the current-controlled, hybrid 1, and transmission 1 representations of the two-port shown in Fig. 2. (The independent variables for the three representations are: current-controlled: i_1, i_2, hybrid 1: i_1, v_2 and transmission 1: v_2, i_2.) (15%)



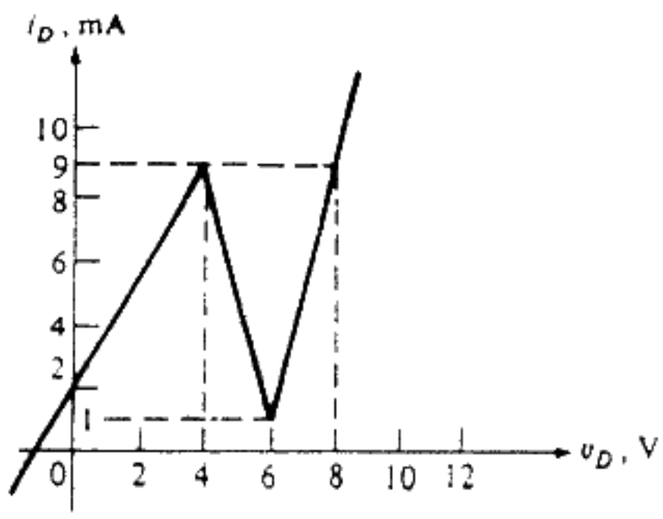


Fig. 1

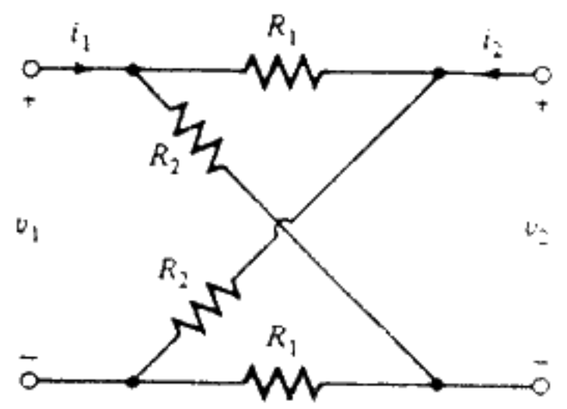


Fig. 2

3. Plot the equivalent circuits for three operating regions of the practical operational amplifiers with saturated voltages $\pm E_{sat}$. (15%)

4. Describe the four theorems in the Chapter 5. (15%)

5.(10%)

(a) What is a relaxation point of a charge-controlled capacitor $\hat{V}(q)$?

(b) Show that if a nonlinear capacitor has more than one relaxation pint, then each point will give the same stored energy $\varepsilon_c(Q)$

6.(30%)

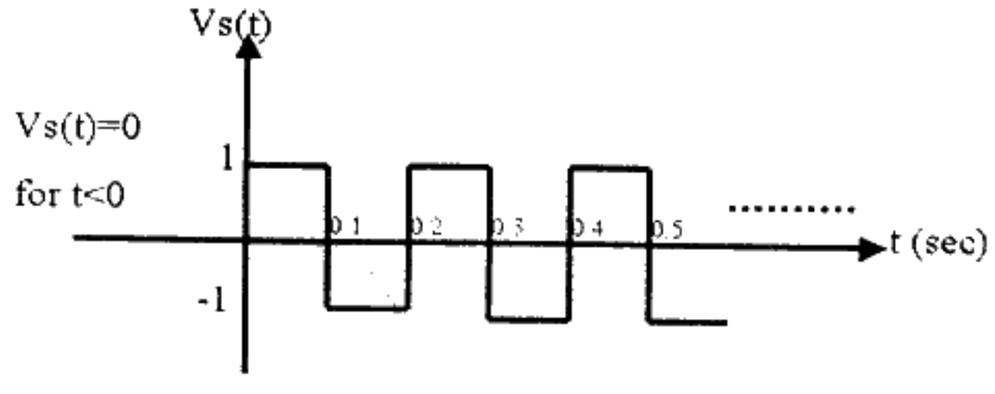
Assume an ideal op-amp model in linear region for the circuit in Fig 3. , and assume that the switch S is closed for all time for part (a),(b),(c),(d).

Let Vo(t) be the response

(a) Find the response when Vs(t) is the unit step, u(t)

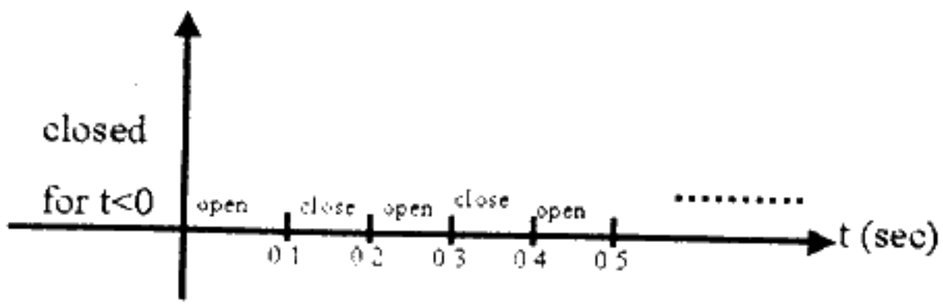
(b) Find the response when Vs(t) is the unit impulse, $\delta(t)$

(c) Find the response when Vs(t) is as follows :



(d) Find i(t) when Vs(t) is as part(c)

(e) Let Vs(t) =1 V. Find Vo(t) when the switch S is open and closed as follows:



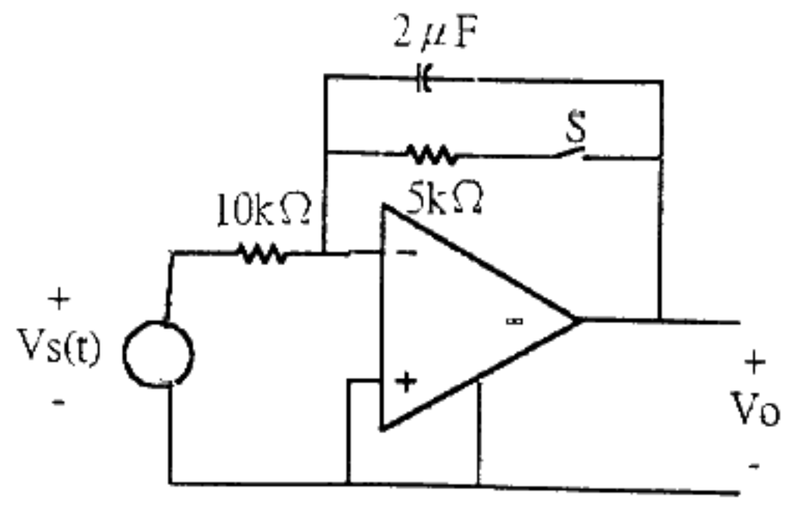


Fig. 3