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Unified Engineering
Fall 2004

Problem Set #5

Due Date: Tuesday, October 12, 2004 at 5pm

	Time Spent (minutes)
S4	
S5	
S6	
CP11	
CP12	
CP13	
Study Time	

Name: _____

Problem S4 (Signals and Systems)

For the circuit of Problem S3, find the branch voltages and branch currents using the loop method. Of course, your answer should agree with that of Problem S3.

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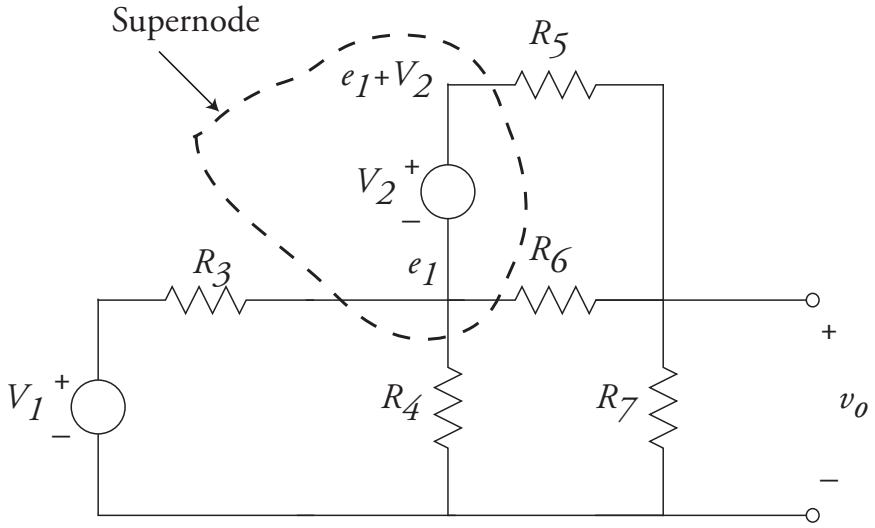
Problem S5 (Signals and Systems)

Consider the circuit below:



where

$$R_3 = 2\ \Omega, \quad R_4 = 2\ \Omega, \quad R_5 = 8\ \Omega, \quad R_6 = 8\ \Omega, \quad R_7 = 3\ \Omega$$

$$V_1 = 10\ V, \quad V_2 = 5\ V$$

Find the output voltage, v_o, using the node method. Note that because the two voltage sources do not have a common terminal, it is not possible to choose a ground node that is the negative terminal of both. As a result, one of the voltage sources will be "floating," that is, it will not have a terminal at ground potential. Therefore, the node voltages will be unknown, not known. This is a problem, because application of KCL at a node of a voltage source will include the current through the voltage source. However, the constitutive law of the source gives no information about the current.

To eliminate this problem, you can use the "supernode" method. In this case, the supernode includes both nodes connected to V_2. Label the negative terminal as, say, e_1. Then the positive node should be labeled as $e_1 + V_2$. KCL applied at each of these nodes will contain the unknown current i_2. By adding the equations together, this unknown current is automatically eliminated. In essence, we treat the two nodes as a single node (a "supernode"), and sum all the current flowing out of the super node.

Note: Feel free to use the loop method to *check* your answer, but use the node method for your final answer.

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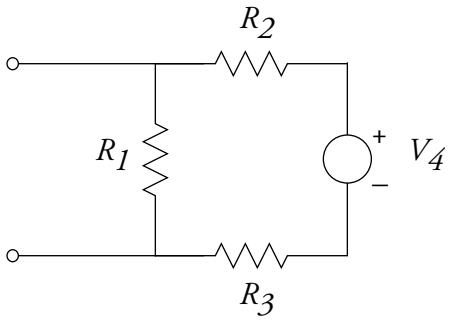
Problem S6 (Signals and Systems)

Find the Thevinin and Norton equivalent circuits for the circuits below. Hint: Add a test current to the terminals, and then determine the voltage at the terminals as a function of the test current. You should find that the terminal voltage can be expressed as

$$v = V_T + R_T I_{\text{test}}$$

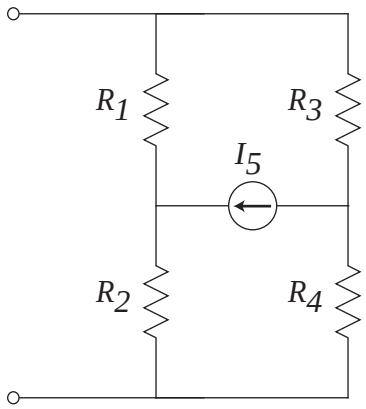
1.



where

$$R_1 = 2\ \Omega, \quad R_2 = 4\ \Omega, \quad R_3 = 3\ \Omega, \quad V_4 = 12\ V$$

2.



where

$$R_1 = 1\ \Omega, \quad R_2 = 3\ \Omega, \quad R_3 = 3\ \Omega, \quad R_4 = 1\ \Omega, \quad I_5 = 8\ \text{A}$$

Problem Set 5

CP 11) Define an Ada95 record with four fields: **[5 points]**

a. Aircraft_ID of type integer

b. Airline of enumeration type with possible values {United, Delta, SouthWest, JetBlue, American}

c. Direction of type character

d. Aircraft_Type of type integer

CP 12) **[35 points]**

Write an Ada95 program to:

i. Define four arrays with 5 elements each of types Aircraft_ID, Airline, Direction and Aircraft_Type

ii. Accept user input for 5 aircraft as shown in Figure 1 below.

iii. Sort the elements based on Aircraft_ID array as shown in Figure 2.

iv. Display the sorted arrays to the user

Aircraft_ID	**Airline**	**Direction**	**Aircraft_Type**
10	Delta	N	777
4	American	S	737
6	JetBlue	E	767
3	SouthWest	W	737
1	United	N	747

Figure 1: Four User Input Arrays

Aircraft_ID	**Airline**	**Direction**	**Aircraft_Type**
1	United	N	747
3	SouthWest	W	737
4	American	S	737
6	JetBlue	E	767
10	Delta	N	777

Figure 2: Sorted Arrays Displayed to the User

Turn in a **hard copy** of your **code listing** and an **electronic copy** of your **code**.

CP 13) **[60 points]**

a. Define your own package, with the type definition of an array with ten aircraft records (as defined in question 1 above), and four functions/procedures to:

   i. Sort the array in ascending order based on Aircraft_ID.

   ii. Display the contents of records in the array

   iii. Read in aircraft information into the array based on user input.

   iv. Read in aircraft information into the array from an input file called aircraft_record_input.txt

b. Write a test program that uses your package to:

   i. Create an array with 5 records input by the user, and 5 records read in from the file called aircraft_record_input.txt

   ii. Sort the records based on the Aircraft_Id

   iii. Display each record of the array as shown in Figure 3.

```
Aircraft_ID:  1
     Airline:  United
   Direction:  N
Aircraft_Type:  747
           …
           …
Aircraft_ID:  10
     Airline:  Delta
   Direction:  N
Aircraft_Type:  777
```

Figure 3. Sorted Records Displayed to User

iv. Store the contents of a sorted array into a file called sorted_aircraft_records.txt

Turn in a **hard copy** of your **code listing** and an **electronic copy** of your **code**.