بسمه تعالی

تمرین سری ۷ | **تئوری مدار های الکتریکی** | **تحویل: ٤ اردیبهشت ٩٥**

2. Draw an oriented graph whose node-to-branch incidence matrix $\mathbf{A}_a$ is given by

$$\mathbf{A}_a = \begin{bmatrix} 1 & 1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 1 & 0 & 0 & 0 & -1 \\ 0 & -1 & 0 & -1 & 0 & 1 & 0 & -1 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & -1 & 1 \end{bmatrix}$$

3. Consider the oriented graph shown in Fig. P9.3

a. Write the node-to-branch incidence matrix.

b. Specify which of the following sets of branches are cut sets and justify your answer: {1,9,5,8}, {1,9,4}, {6,8}, {1,9,4,7,6}, or {3,4,5,6}.

4. Consider the oriented graph shown in Fig. P9.4.

a. Write equations corresponding to the cut sets indicated.

b. Are these cut-set equations linearly independent?

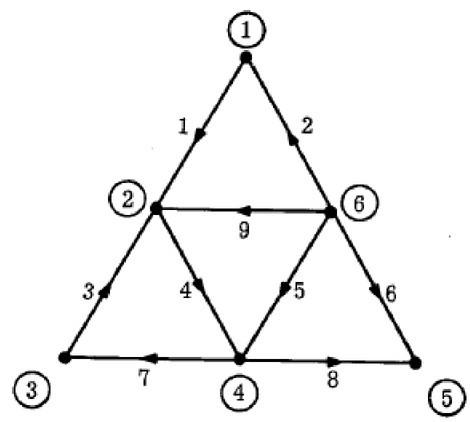


Fig. P9.3

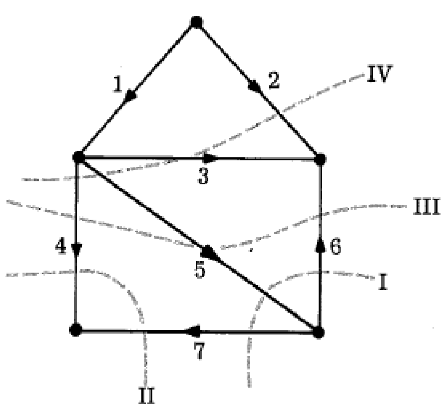


Fig. P9.4

5. Consider the graph shown in Fig. P9.5. Are the loop equations corresponding to loops *abc*, *bdf*, *cde*, *aef*, *cehj*, and *bcgi* linearly independent? Justify your answer.

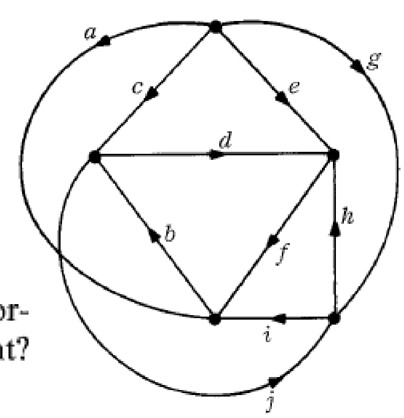
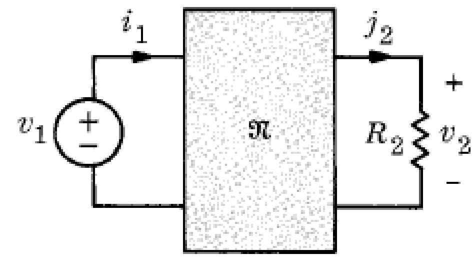


Fig. P9.5

Tellegen's theorem

7. The network $\mathfrak{N}$ shown in Fig. P9.7 is made of $n-2$ linear time-invariant resistors. Voltage and current measurements were taken for two values of R_2 and the input. The measurements are tabulated in the figure. Determine the value $\hat{v}_2$.



With $R_2 = 1\ \Omega$	With $\hat{R}_2 = 2\ \Omega$
$v_1 = 4$ volts	$\hat{v}_1 = 6$ volts
$i_1 = 1$ amp	$\hat{i}_1 = 1.2$ amp
$v_2 = 1$ volt	$\hat{v}_2 = ?$

Fig. P9.7

Tellegen's theorem

9. Consider the sinusoidal steady-state measurements performed on a linear time-invariant RLC network, shown in Fig. P9.9. In both instances the same voltage source is used (same frequency and same phasor). Show that $\hat{J}_1 = J_2$. (Hint: Show that $V_2\hat{J}_2 + V_1\hat{J}_1 = \hat{V}_2J_2 + \hat{V}_1J_1$.)

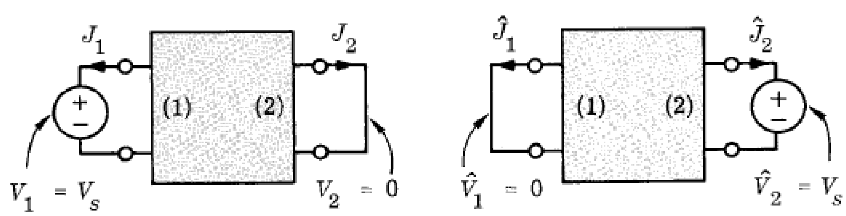


Fig. P9.9

10. Your technician measures the driving-point impedance (or admittance) at a fixed frequency ω_0 of a number of linear time-invariant networks made of passive elements. In each case, state whether or not you have any reasons to believe his results (in ohms or in mhos).

a. RC network: $Z = 5 + j2$

b. RL network: $Z = 5 - j7$

c. RLC network: $Y = 2 - j3$

d. LC network: $Z = 2 + j3$

e. RLC network: $Z = -5 - j19$

f. RLC network: $Z = -j7$

Whenever you accept a measurement as plausible, assume $\omega_0 = 1$ rad/sec, and give a linear time-invariant passive network which has the specified network function.