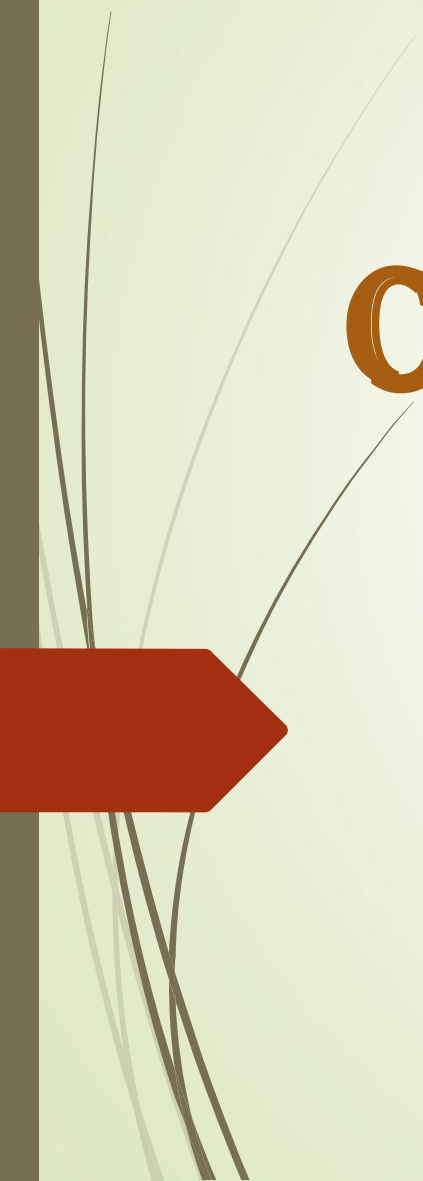




BEEE203L

CIRCUIT THEORY

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MODULE – VII

TWO PORT NETWORKS

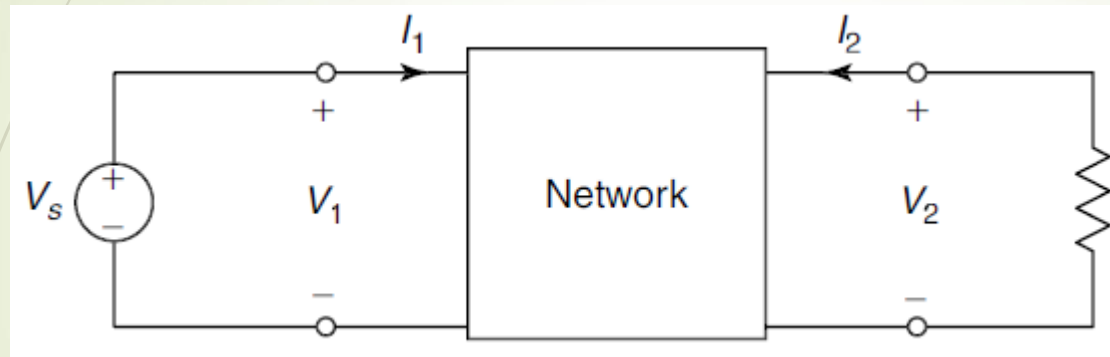
Contents

- Open circuit impedance parameters
- Short circuit admittance parameters
- Transmission parameters
- Hybrid parameters
- Relationship between parameter sets
- Interconnection of two port networks

Application problems

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The Z-parameters of a two-port network shown in Fig. are $Z_{11} = Z_{22} = 10 \Omega$, $Z_{21} = Z_{12} = 4 \Omega$. If the source voltage is 20 V, and load resistance is 20Ω determine I_1, I_2, V_2 and input impedance.



$$V_1 = 10I_1 + 4I_2$$

$$V_2 = 4I_1 + 10I_2$$

$$V_1 = V_s = 20 \text{ V}$$

$$V_2 = -20I_2$$

$$-20I_2 = 4I_1 + 10I_2$$

$$4I_1 = -30I_2$$

$$I_1 = -7.5I_2$$

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Substituting in the previous equation,

$$V_1 = 10(-7.5I_2) + 4I_2 = -71I_2$$

$$20 = -71I_2$$

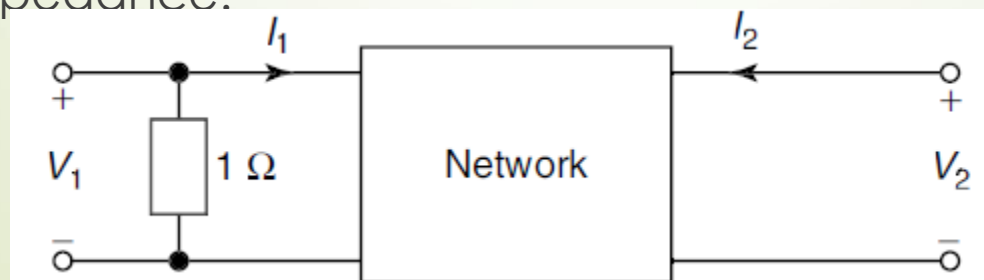
$$I_2 = -0.28 \text{ A}$$

$$I_1 = -7.5(-0.28) = 2.1 \text{ A}$$

$$V_2 = -20(-0.28) = 56 \text{ V}$$

$$Z_i = \frac{V_1}{I_1} = \frac{20}{2.1} = 9.52 \Omega$$

The y-parameters for a two-port network shown in Fig. are given as, $Y_{11} = 4 \text{ S}$, $Y_{22} = 5 \text{ S}$, $Y_{12} = Y_{21} \text{ S} = 4$. If a resistor of 1Ω is connected across port-1 of the network then find the output impedance.



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- The two-port network can be represented in terms of Y-parameters.

$$I_1 = 4V_1 + 4V_2$$

$$I_2 = 4V_1 + 5V_2$$

- When the $1\text{-}\Omega$ resistor is connected across port-1 of the network

$$V_1 = -1I_1 = -I_1$$

$$I_1 = -V_1$$

- Substituting value of I_1 in Eq (i),

$$-V_1 = 4V_1 + 4V_2$$

$$-5V_1 = 4V_2$$

$$V_1 = -\frac{4}{5}V_2$$

- Substituting value of V_1 in Eq (ii),

$$I_2 = 4\left(-\frac{4}{5}V_2\right) + 5V_2 = \frac{9}{5}V_2$$

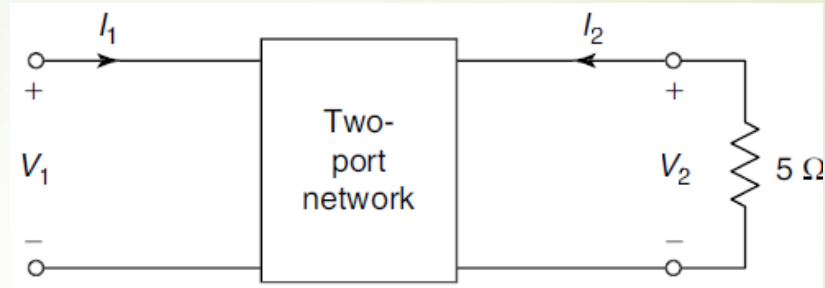
- Output impedance

$$Z_0 = \frac{V_2}{I_2} = \frac{5}{9} \Omega$$

The following equation gives the voltage and current at the input port of a two port network shown in Fig.

$$V_1 = 5V_2 - 3I_2$$

$$I_1 = 6V_2 - 2I_2$$



- A load resistance of 5 ohms is connected across the output port. Calculate the input impedance.

$$V_2 = -5I_2$$

- Substituting the value of V2 in the given equations,

$$V_1 = 5(-5I_2) - 3I_2 = -28I_2$$

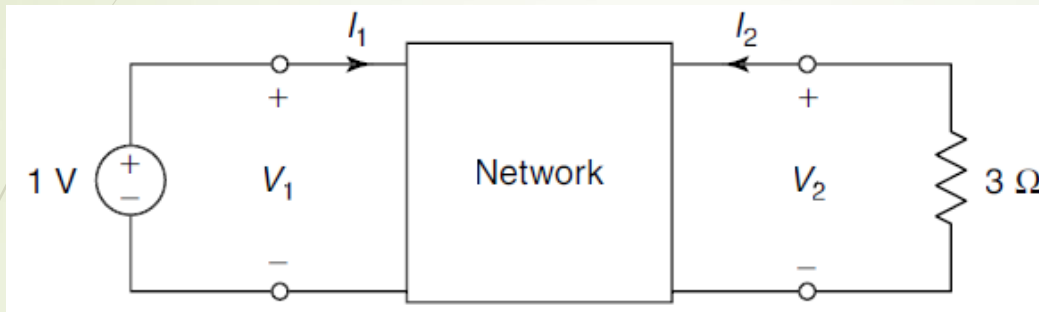
$$I_1 = 6(-5I_2) - 2I_2 = -32I_2$$

- Input impedance

$$Z_i = \frac{V_1}{I_1} = \frac{-28I_2}{-32I_2} = \frac{7}{8} \Omega$$

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The h-parameters of a two-port network shown in Fig. are $h_{11} = 4\Omega$, $h_{12} = 1$, $h_{21} = 1$, $h_{22} = 0.5 \text{ } \Omega$. Calculate the output voltage V_2 when the output port is terminated in a 3Ω resistance and a 1 V is applied at the input port.



$$V_1 = 1\text{ V}$$

$$V_2 = -3I_2$$

The two-port network can be represented in terms of h parameters.

$$V_1 = 4I_1 + V_2$$

$$I_2 = I_1 + 0.5V_2$$

$$I_2 = I_1 + 0.5(-3I_2)$$

$$2.5I_2 = I_1$$

$$1 = 4(2.5I_2) - 3I_2$$

$$1 = 7I_2$$

$$I_2 = \frac{1}{7}\text{ A}$$

$$V_2 = -3\left(\frac{1}{7}\right) = -\frac{3}{7}\text{ V}$$

► Substituting the value of V_1 and I_1 in Eq (i),

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The h-parameters of a two-port network shown in Fig. are $h_{11} = 2 \Omega$, $h_{12} = 4$, $h_{21} = -5$, $h_{22} = 2 \text{ } \Omega$. Determine the supply voltage V_s if the power dissipated in the load resistor of 4Ω is 25 W and $R_s = 2 \Omega$.

