- The y-parameter that we want to determine are Y_{11}, Y_{12}, Y_{21}, Y_{22}. The values of the parameters can be evaluate by setting:

  i) $V_1 = 0$ (input port short – circuited).

  ii) $V_2 = 0$ (output port short – circuited).

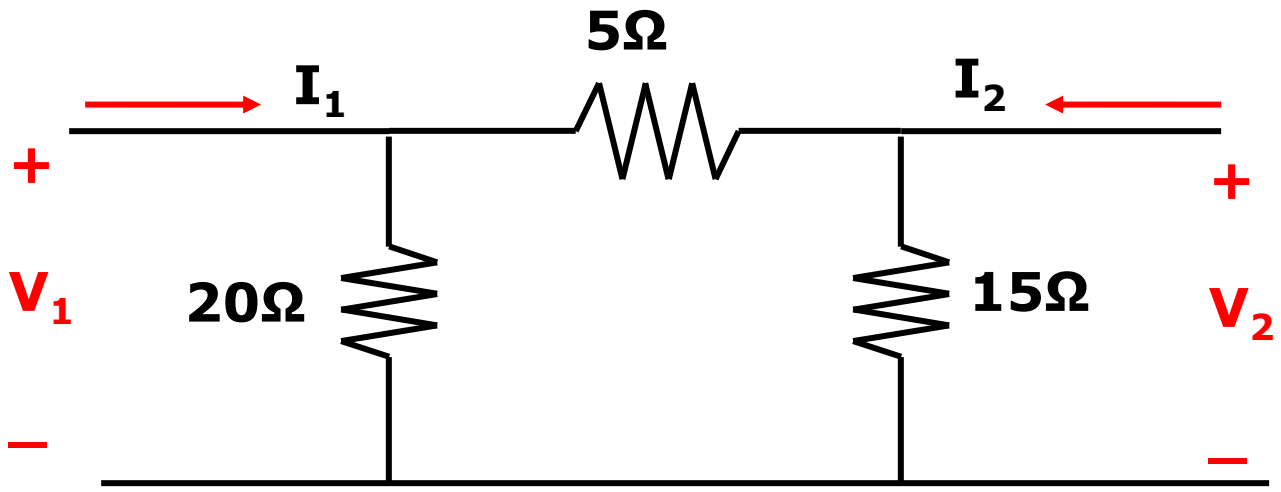
- Thus;

$$Y_{11} = \left.\frac{I_1}{V_1}\right|_{V_2=0} \qquad Y_{12} = \left.\frac{I_1}{V_2}\right|_{V_1=0}$$

$$Y_{21} = \left.\frac{I_2}{V_1}\right|_{V_2=0} \qquad Y_{22} = \left.\frac{I_2}{V_2}\right|_{V_1=0}$$

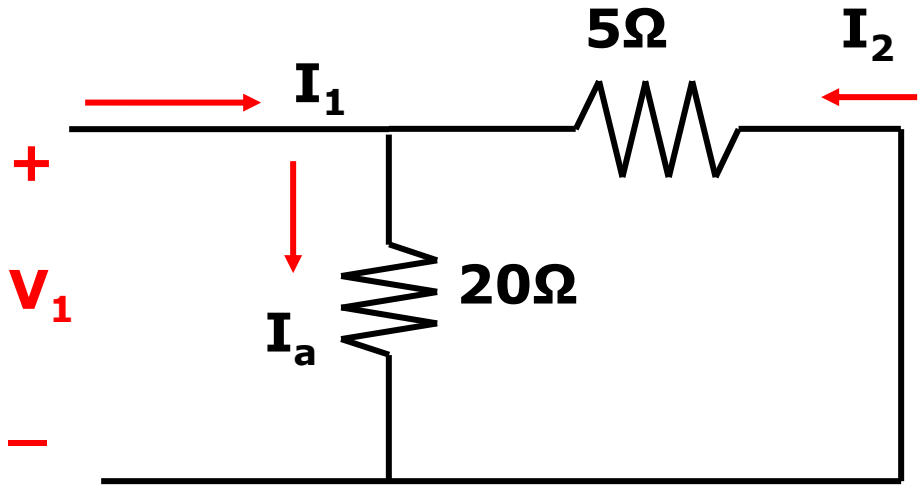
Example 1

Find the Y – parameter of the circuit shown below.



Solution

i) $V_2 = 0$



$$V_1 = 20I_a \ldots\ldots(1)$$

$$I_a = \frac{5}{25} I_1 \ldots\ldots(2)$$

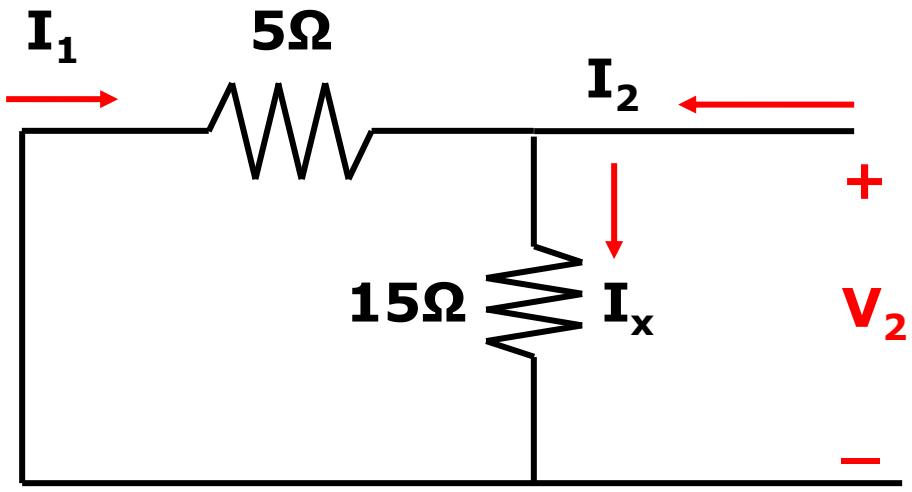
$$\text{sub } (1) \rightarrow (2)$$

$$\therefore Y_{11} = \frac{I_1}{V_1} = \frac{1}{4} S$$

$$V_1 = -5I_2$$

$$\therefore Y_{21} = \frac{I_2}{V_1} = -\frac{1}{5} S$$

ii) $V_1 = 0$



$$V_2 = 15I_x \ldots\ldots(3)$$

$$I_x = \frac{5}{25} I_2 \ldots\ldots(4)$$

sub (3) $\rightarrow$ (4)

$$\therefore Y_{22} = \frac{I_2}{V_2} = \frac{4}{15} S$$

In matrix form;

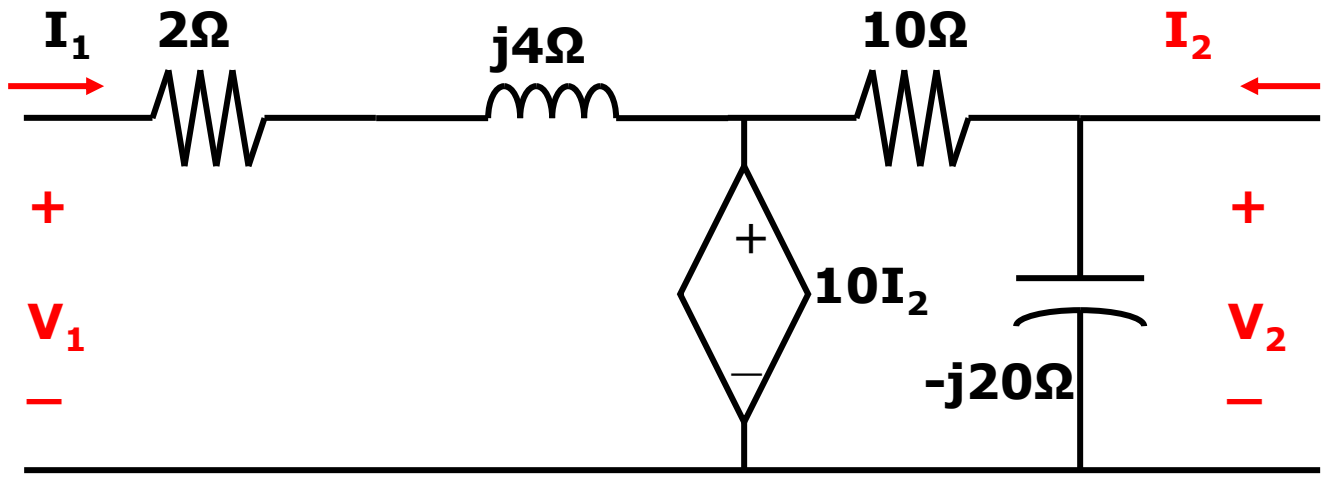
$$[Y] = \begin{bmatrix} \frac{1}{4} & -\frac{1}{5} \\ -\frac{1}{5} & \frac{4}{15} \end{bmatrix} S$$

$$V_2 = -5I_1$$

$$\therefore Y_{12} = \frac{I_1}{V_2} = -\frac{1}{5} S$$

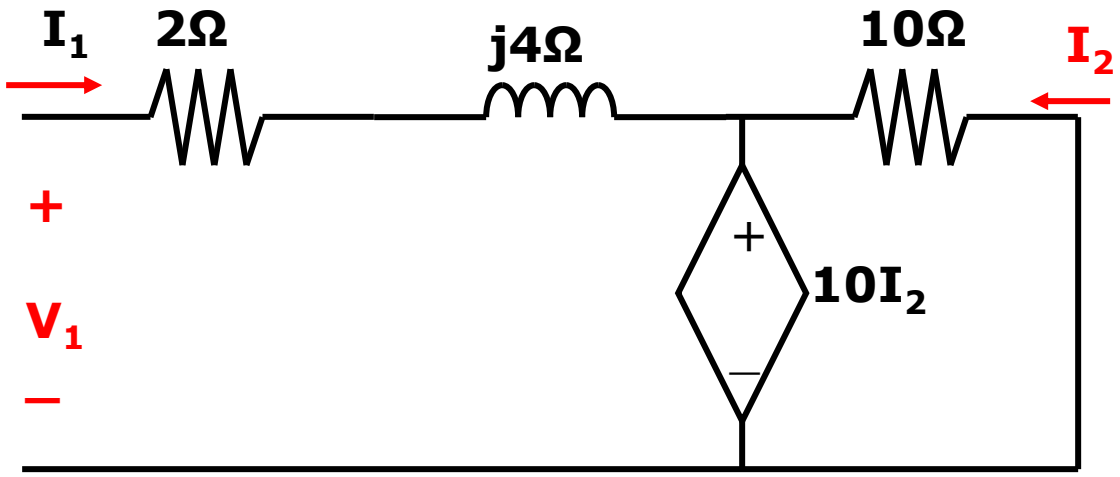
Example 2 (circuit with dependent source)

Find the Y – parameters of the circuit shown.



Solution

i) $V_2 = 0$ (short – circuit port 2). Redraw the circuit.



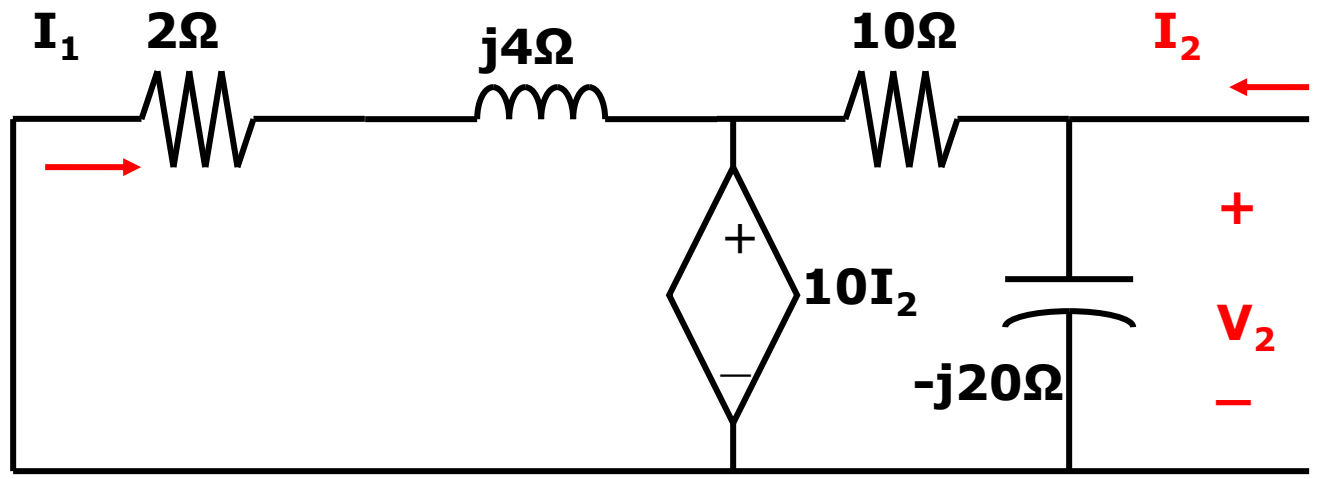
$$I = 0$$

$$V_1 = (2 + j4)I_1$$

$$\therefore Y_{11} = \frac{I_1}{V_1} = \frac{1}{2 + j4} = (0.1 - j0.2)\ S$$

$$\therefore Y_{21} = \frac{I_2}{V_1} = 0\ S$$

ii) $V_1 = 0$ (short – circuit port 1). Redraw the circuit.



$$I_1 = \frac{-10I_2}{2 + j4} \text{.....(1)}$$

$$I_2 = \frac{V_2}{-j20} + \frac{V_2 - 10I_2}{10}$$

$$2I_2 = V_2\left(\frac{1}{10} + \frac{1}{-j20}\right) \text{.....(2)}$$

$$\therefore Y_{22} = \frac{I_2}{V_2} = (0.05 + j0.025)\ S$$

sub (2) → (1)

$$Y_{12} = \frac{I_1}{V_2} = (-0.1 + j0.075)\ S$$

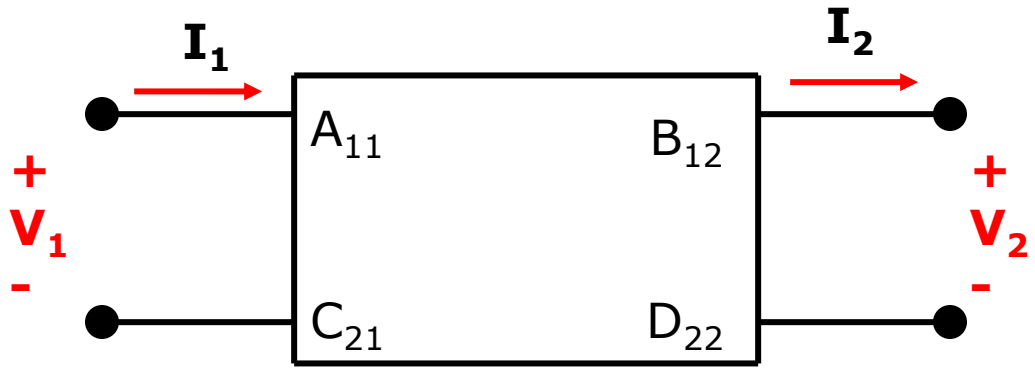
In matrix form;

$$\therefore [Y] = \begin{bmatrix} 0.1 + j0.2 & -0.1 + j0.075 \\ 0 & 0.05 + j0.025 \end{bmatrix} S$$

T (ABCD) PARAMETER

- T – parameter or ABCD – parameter is a another set of parameters relates the variables at the input port to those at the output port.
- T – parameter also called *transmission parameters* because this parameter are useful in the analysis of transmission lines because they express sending – end variables (V_1 and I_1) in terms of the receiving – end variables (V_2 and $-I_2$).

- The “black box” that we want to replace with T – parameter is as shown below.



- The equation is:

$$V_1 = AV_2 - BI_2 \ldots\ldots (1)$$

$$I_1 = CV_2 - DI_2 \ldots\ldots (2)$$

- In matrix form is:

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_2 \\ -I_2 \end{bmatrix}$$

- The T – parameter that we want determine are A, B, C and D where A and D are dimensionless, B is in ohm (Ω) and C is in siemens (S).
- The values can be evaluated by setting

  i) $I_2 = 0$ (input port open – circuit)

  ii) $V_2 = 0$ (output port short circuit)