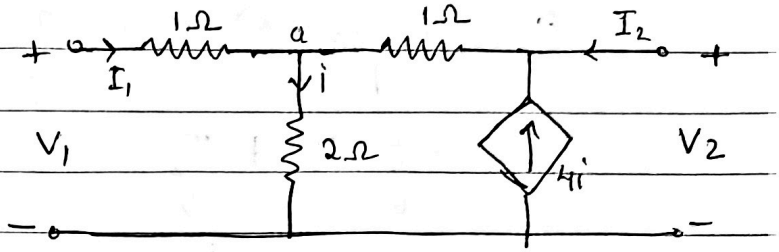
6/11/22

NAS - AIHIP Assignment - Unit 4

1. For the given 2 port network, find the following:

a. Z parameters
b. y parameters
c. h parameters
d. t parameters



t - parameters

$V_1 = AV_2 - BI_2$

$I_1 = CV_2 - DI_2$

$I_2 = 0$

$$I_1 = \frac{V_a}{2} + \frac{V_a - V_2}{1} \quad \text{---①}$$

$$\frac{V_a - V_1}{1} + \frac{V_a}{2} + \frac{V_a - V_2}{1} = 0$$

$$i = \frac{V_a}{2}$$

$$\frac{V_2 - V_a}{1} = 4\left(\frac{V_a}{2}\right) + I_2 \Rightarrow 0 = V_2 - 3V_a \Rightarrow V_a = V_2/3 \quad \text{---②}$$

$$I_1 = \frac{V_2}{6} - \frac{2}{3}V_2 \longrightarrow \boxed{C = \frac{I_1}{V_2} = -\frac{1}{2}\,S}$$

$$I_1 = \frac{V_1 - V_a}{1} = V_1 - \frac{V_2}{3} = -\frac{1}{2}V_2$$

$$\boxed{A = -\frac{1}{6}}$$

$V_2 = 0$

$$\frac{V_a - V_1}{1} + \frac{V_a}{2} + \frac{V_a - 0}{1} = 0 \Rightarrow V_1 = \frac{5}{2}V_a \quad \text{---③}$$

$$I_2 + 2V_a = \frac{0 - V_a}{1} \Rightarrow I_2 = -3V_a \Rightarrow V_a = -\frac{I_2}{3}$$

$$I_2 = -3 \times \frac{2}{5} V_1 \quad \Rightarrow \quad 5 I_2 = -6 V_1$$

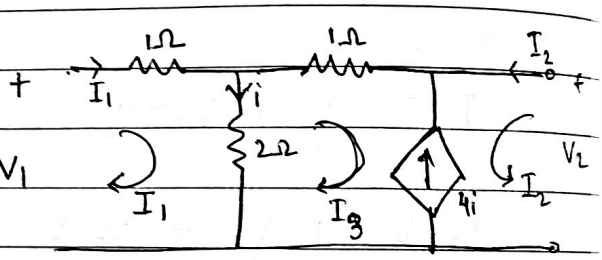
$$B = \frac{-V_1}{I_2} = \frac{-5}{6}\,\Omega \rightarrow \boxed{B = \frac{5}{6}}$$

$$I_1 = \frac{V_1 - V_a}{1} \; ; \quad V_a = -\frac{I_2}{3}$$

$$I_1 = -\frac{5}{6} I_2 + \frac{I_2}{3}$$

$$\boxed{\frac{-I_1}{I_2} = D = \frac{1}{2}}$$

Z parameters



$$V_1 = Z_{11} I_1 + Z_{12} I_2$$
$$V_2 = Z_{21} I_1 + Z_{22} I_2$$

$$I_3 = -4i$$

KCL

$$I_1 - I_3 + i = 0 \Rightarrow I_1 = -3i$$

$$V_1 = 2 I_1 - 2 I_3 \quad \text{---} \quad (1)$$

$$\boxed{Z_{11} = \frac{V_1}{I_1} = \frac{-i}{-3i} = \frac{1}{3}\,\Omega}$$

$$V_2 = -3 I_3 + 2 I_1 = 6i$$

$$\boxed{Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2=0} = \frac{6i}{-3i} = -2\,\Omega}$$

$I_1 = 0$

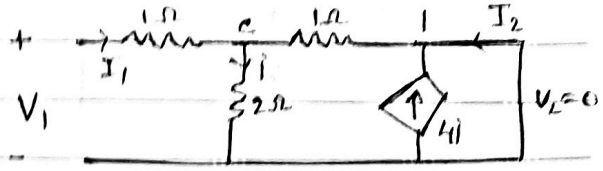
$I_3 = -i + 4i = +3i$ ~~$i - 4i = -3i$~~

$V_1 = 2i$

$$\boxed{Z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1=0} = \frac{2i}{-3i} = -\frac{2}{3}\,\Omega}$$

$$Z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0} = \frac{3i}{-4.3i} = -1\Omega$$

Y parameters



short $V_2 = 0$

$$\frac{V_c}{1} - V_1 + \frac{V_c}{2} + \frac{V_c - 0}{1} = 0$$

$$V_1 = \frac{5}{2} V_c \quad \text{---(1)}$$

$$I_2 + 2V_c + \frac{0 - V_c}{1} = 0$$

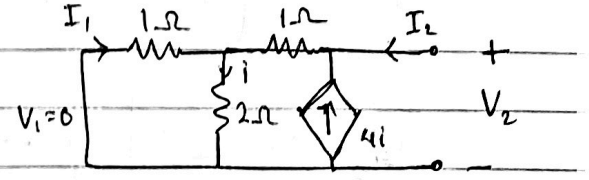
$$I_2 = -3V_c \quad \text{---(2)}$$

$$V_1 = \frac{5}{2} \times -\frac{1}{3} I_2 = \frac{-5}{6} I_2 \Rightarrow \boxed{y_{21} = \left.\frac{I_2}{V_1}\right|_{V_2=0} = \frac{-6}{5} = -1.2S}$$

$$I_1 = \frac{V_1 - V_c}{1} \Rightarrow I_1 = V_1 - \frac{2}{5} V_1$$

$$\boxed{y_{11} = \left.\frac{I_1}{V_1}\right|_{V_2=0} = \frac{3}{5} = 0.6S}$$

short $V_1 = 0$



$$\frac{V_c - 0}{1} + \frac{V_c}{2} + \frac{V_c - V_2}{1} = 0$$

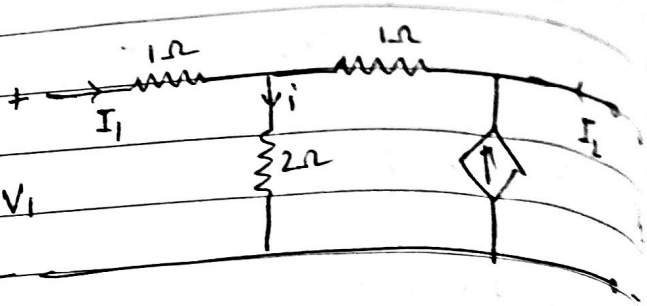
$$\Rightarrow \quad 5V_c = 2V_2 \quad \text{---(3)}$$

$$\frac{V_2 - V_c}{1} - 4\left(\frac{V_c}{2}\right) = I_2 = 0 \Rightarrow V_2 - 3V_c = I_2$$

$$\rightarrow \quad V_2 - 3\left(\frac{2}{5}V_2\right) = I_2 \Rightarrow \boxed{y_{22} = \left.\frac{I_2}{V_2}\right|_{V_1=0} = -0.2S}$$

$$5(-I_1) = 2V_2 \Rightarrow \boxed{y_{12} = \left.\frac{I_1}{V_2}\right|_{V_1=0} = -0.4S}$$

h-parameters



$I_1 = 0$

$\frac{V_1 - V_2}{1} + \frac{V_1}{2} = 0$

$$h_{12} = \frac{V_1}{V_2} = \frac{2}{3}$$

$-4i + i - I_2 = 0 \Rightarrow I_2 = -3i$

$V_2 = (1+2) \times i = 3i$

$$h_{22} = \frac{I_2}{V_2}\Big|_{I_1=0}$$

$$h_{22} = \frac{-3i}{3i} = -1S$$

→ $V_2 = 0$

$\frac{V_x - V_1}{1} + \frac{V_x}{2} + \frac{V_x - 0}{1} = 0$

$V_1 = \frac{5}{2}V_x$ ~~$\Rightarrow i = 5$~~ ; $i = \frac{V_x}{2}$

KCL

$I_1 = -3i$

$$h_{11} = \left(\frac{5}{2} \times 2i\right) \div 3i = \frac{5}{3}\Omega$$

$$h_{21} = -2S \quad \left(\because I_2 = -3V_x = 6i\right)$$