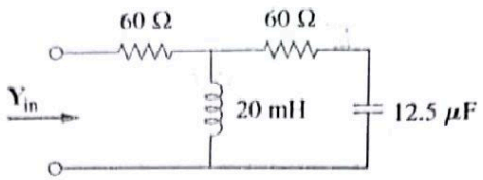
VE215 2022Fall Assignment 5

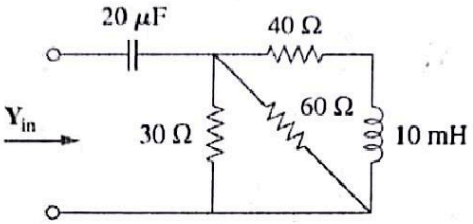
JOINT INSTITUTE 交大密西根学院

Due Date: 23:59, Nov.27 ,2022

Exercise 5.1 (20%)
Find the equivalent admittance of the circuits at $\omega = 50\,rad/s$.



(a)



(b)

(a) $Z_L = j\omega L = j\times 50\times 20\times 10^{-3} = j\Omega$ (错-2')

$Z_C = \frac{1}{j\omega C} = \frac{1}{j\times 50\times 12.5\times 10^{-6}} = -1600j\Omega$ (错-2')

$\therefore Z = 60 + (j)\,//\,(60-1600j) = (60+j)\Omega$ (只算了Z最对-4')

$\therefore Y_{in} = \frac{1}{Z} = (+0.0167 - 2.779\times 10^{-4}j) = 0.0167\angle -0.955^\circ$ (10')

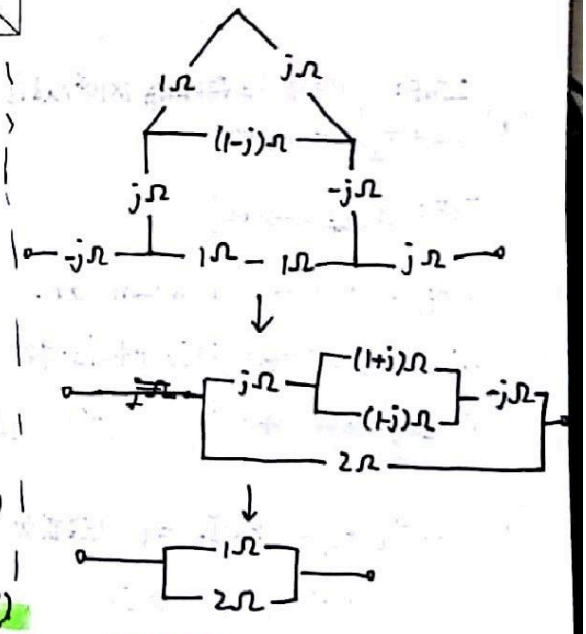
(b) $Z_L = j\omega L = 0.5j$ (错-2')

$Z_C = \frac{1}{j\omega C} = \frac{1}{j\times 50\times 20\times 10^{-6}} = -1000j$ (错-2')

(只算了Z且对-4')

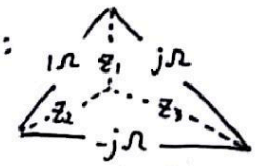
$\therefore Z = -1000j + 30\,//\,60\,//\,(40+0.5j) = 13.334 - 999.944j$

$\therefore Y_{in} = \frac{1}{Z} = 1.333\times 10^{-3} + 9.999\times 10^{-4}j = 1\times 10^{-4}\angle 89.236^\circ$ (10')

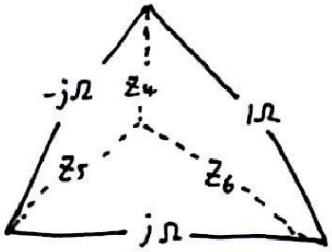


$\therefore Z_{ab} = \frac{2}{3}\Omega$ (10')

(c) Δ-Y:



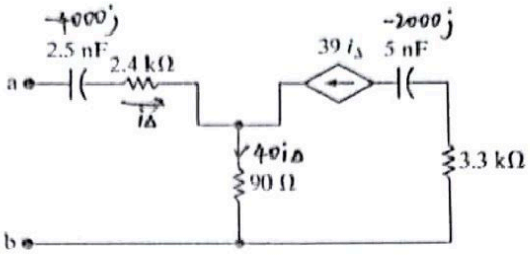
$\therefore Z_1 = \frac{\pm j}{1+j-j} = \pm j\Omega$, $Z_2 = -j\Omega$, $Z_3 = 1\Omega$ (错-3')



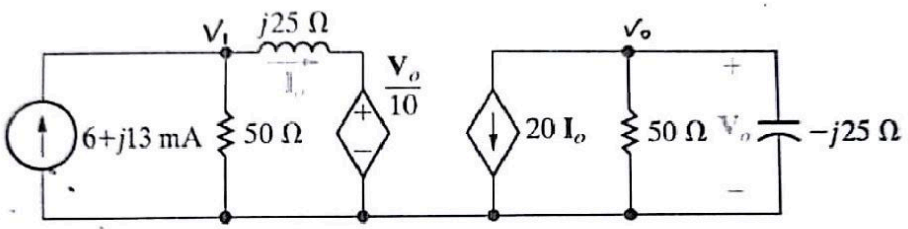
$\therefore Z_4 = -j\Omega$, $Z_5 = 1\Omega$, $Z_6 = j\Omega$ (错-3')

Exercise 5.2 (20%)

(a) (15%) Calculate the Thevenin impedance between terminal a and b if the frequency of operation is $(50/\pi)$ kHz.



(b) (15%) Find V_0 and I_0 shown in the figure below.



2.5nF: $\omega = 2\pi f = 1\times10^5$ rad/s

(a) $Z_C = \frac{1}{j\omega C} = -4000j$

5nF: $Z_{C_{5nF}} = -2000j$

∴ Apply $V_S = 1\angle 0°$ between ab.

∴ $V_S = (2400-4000j)i_\Delta + 40i_\Delta \cdot 90 = (6000-4000j)i_\Delta = 1\angle 0°$ (公式分 2')

∴ $Z_{eq} = (6000-4000j)\,\Omega$ (15') (如果错了看公式吧，算了 Z_{25nF}, Z_{5nF} 一个2分)

(b) ∴ $\frac{V_o}{50} + \frac{V_o}{-25j} + 20I_o = 0$ (公式分 2')

$(2+4j)V_o = -2000I_o$

$V_o = (-200+400j)I_o$

$I_o = \frac{V_1 - V_o}{25j}$ ∴ $V_1 = (-20+65j)I_o$

∴ $0.006 + 0.013j = \frac{V_1}{50} + I_o = (-0.4+1.3j)I_o + I_o = (0.6+1.3j)I_o$ (公式分 2')

∴ $I_o = \frac{0.6+1.3j \times 10\times10^{-3}}{0.6+1.3j} = 10\angle 0°\ mA$ (I_o 7'算)

∴ $V_o = (-200+400j)I_o = -2+4j = 4.47\angle 116.57°\ V$ 总共 (15')

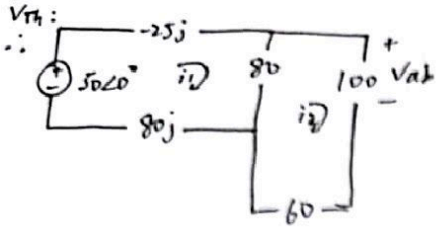
(8')

↓

V_o

(a) 1° $\omega = 2000\,rad/s$ $\therefore Z_C = -25j\,\Omega, Z_L = 80j\,\Omega$ (2')

V_{Th}:



$$\therefore \begin{cases} (80+55j)i_1 - 80i_2 = 50\angle 0^\circ \\ 240i_2 - 80i_1 = 0 \end{cases}$$

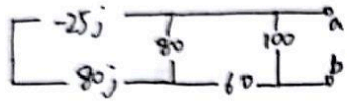
$$\therefore i_2 = \frac{320}{2113} - \frac{330}{2113}j = 0.1514 - 0.1562j = 0.2175\angle -45.88^\circ$$

$\therefore V_{ab} = 21.755\angle -45.88^\circ V = (15.194 - 15.618j)V = V_{Th}$ (10')

($V_{Th} = 21.755\cos(2000t - 45.88^\circ)\,V$ 也给)

OK

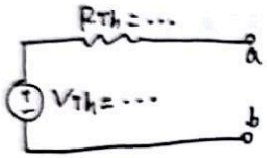
R_{Th}:



$\therefore R_{Th} = 100 // (60 + 80 // 55j) = (48.237 + 10.411j)\,\Omega$ (3')

~~49.346 + 20.18~~

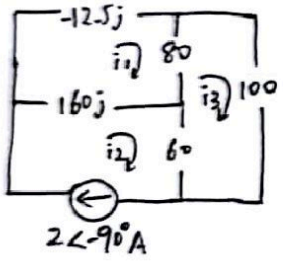
$\therefore$



(图 2')

2° $\omega = 4000\,rad/s$ $\therefore Z_C = -12.5j\,\Omega, Z_L = 160j\,\Omega$. (2')

V_{Th}:



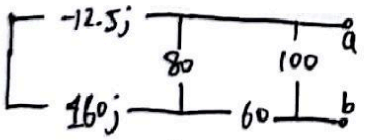
$$\therefore \begin{cases} (80+147.5j)i_1 - 160j\,i_2 - 80i_3 = 0 \\ i_2 = 2\angle -90^\circ \\ 240i_3 - 80i_1 - 60i_2 = 0 \end{cases}$$

$\therefore i_3 = 1.178\angle -82.62^\circ\,A = (0.1513 - 1.1685j)A$

$V_{Th} = V_{ab} = 100 i_3 = 117.821\angle -82.62^\circ V = (15.13 - 116.85j)V$ (10')

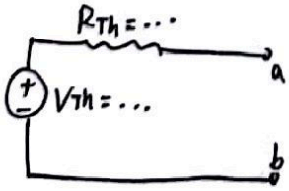
($V_{Th} = 117.821\cos(4000t - 82.62^\circ)\,V$ 也行)

$\therefore R_{Th}$:

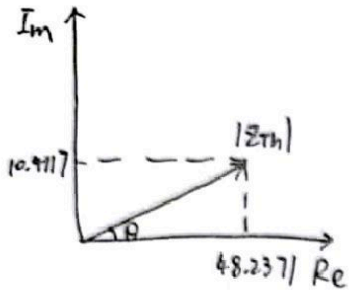


$\therefore R_{Th} = 100 // (60 + 80 // 147.5j) = (55.924 + 6.662j)\,\Omega$ (3')

$\therefore$



(图 2')



∴1' $\omega = 2000 rad/s$

∴ $R_{Th} = (48.2371 + 10.4117j)\Omega (= 49.348 \angle 12.18°)$

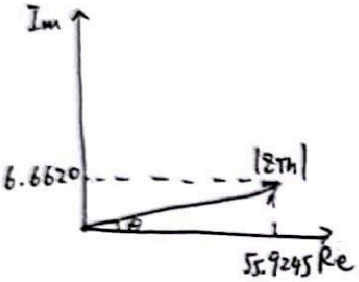
∴ $|Z_{Th}| = 49.348\Omega$, $\theta = 12.18°$

(图上 Re, Im 坐标 2×1')

$|Z_{Th}|$ 值 1'

θ 值 1'

图上有 $|Z_{Th}|$ 和 θ 标准 1'



2' $\omega = 4000 rad/s$

∴ $R_{Th} = (55.9245 + 6.6620j)\Omega (= 56.3199 \angle 6.79°)$

∴ $|Z_{Th}| = 56.3199\Omega$, $\theta = 6.79°$

(同上)