→ ① Chapter 7

② Quiz

③ Test

④ Next Week

⑤ Lab

⑥ Grading & Records

⑦ evaluations

T   Chapter 7

W   → Chapter 7 + Quiz

Th   → chapter 7 + Review

F   → Test chapter 7

⇒ M   → Review / self evaluation. how did you do, what should you do to get the grade you want.

W   → ~~Evaluation & Rev.~~   Makeup (Comp., Optional)

Th   Evaluation & Rev.

F   Final (all chapters everything)

⇒ all chapter 7 HW is due Fri with the Test

⇒ Make up for Test 3 is due Monday 3rd.

⇒ Make up for Test 4 is due Final.

(a) The source voltage in the circuit in Fig. P7.21 is $v_g = 96 \cos 10{,}000t$ V. Find the values of L such that i_g is in phase with v_g when the circuit is operating in the steady state.

(b) For the values of L found in (a), find the steady-state expressions for i_g.

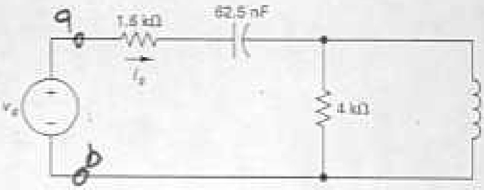


Figure P7.21

$v_g(t) = 96 \cos 10000t$ V

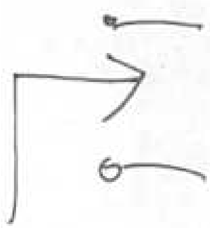
↓

$V_g = 96 \angle 0$ V $= 96$ or $96e^{j(0)}$

$V_{gm} = 96$

$\omega = 10000$ rad/s

Find L so that i_g is in phase with V_g



Z_{eq}.

$$I_g = \frac{V_g}{Z_{eq}}$$

The only way I_g will be in phase

$\theta_v = \theta_i$

with V_g ⇒ is to have

$Z_{eq} = |Z_{eq}| \angle 0$

for Z_{eq} to have 0 angle

⇓

all real! ⇒ Kill the img. part!!

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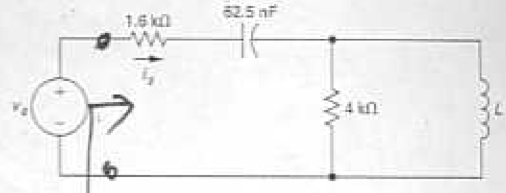

Figure P7.21

what is Z_{eq}

This can be viewed as Th. in complex. domain.

$$Z_{eq} = 1.6K + \frac{1}{j(10000)\,62.5n} + \left[\frac{1}{4K} + \frac{1}{j\omega L}\right]^{-1}$$

$$= 1.6K + \frac{1}{j\omega C} + \left[\frac{j\omega L + 4k}{(4k)(j\omega L)}\right]^{-1}$$

$$Z_{eq} = 1.6k + \frac{1}{j\omega C} + \frac{(4k)(j\omega L)}{j\omega L + 4K}$$

$$\rightarrow \frac{(4k)(j\omega L)}{j\omega L + 4k} \cdot \frac{-j\omega L + 4k}{-j\omega L + 4k}$$

$$\frac{(4k)\,\omega^2 L^2 + 16\times10^6\, j\omega L}{\omega^2 L^2 + 16\times10^6}$$

look at the imag. part

$\omega = 10\,000$

$L = ?$

$C = 62.5\times10^{-9}$

$$0 = \frac{1}{j\omega C} + \frac{16\times10^6\, j\omega L}{\omega^2 L^2 + 16\times10^6} \Rightarrow 0$$

$$L = \begin{cases} 0.8\,H \\ \text{or} \\ 0.2\,H \end{cases}$$

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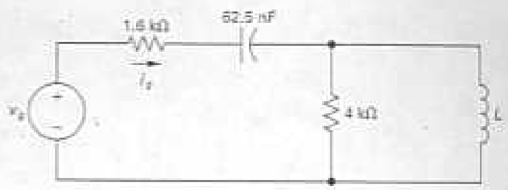


Figure P7.21

$L = 0.8\,H$

$Z_{eq} = 4800\,\Omega$

$I_g = \frac{V_o}{Z_{eq}} = \frac{96\angle 0^\circ}{4800\angle 0^\circ} = 20\angle 0^\circ$ mA

$i_g(t) = Re\{ I_g e^{j\omega t} \}$

$i_g(t) = 20\cos(10\,000t)$ mA

$L = 0.2\,H$

$Z_{eq} = 2400\,\Omega$

$I_g = 40\angle 0^\circ$ mA

$i_g(t) = 40\cos(10\,000t)$ mA

(a) For the circuit shown in Fig. P7.22, find the frequency (in radians per second) at which the impedance Z_{ab} is purely resistive.

(b) Find the value of Z_{ab} at the frequency of (a).

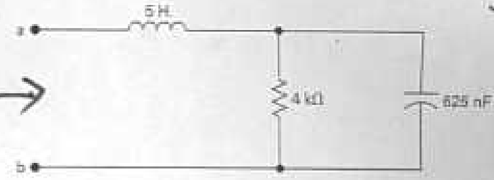


Figure P7.22

$Z_{ab} \triangleq$ purely resistive $\Rightarrow \angle 0$

$\triangleq$ purly reactive $\Rightarrow \angle \pm 90$

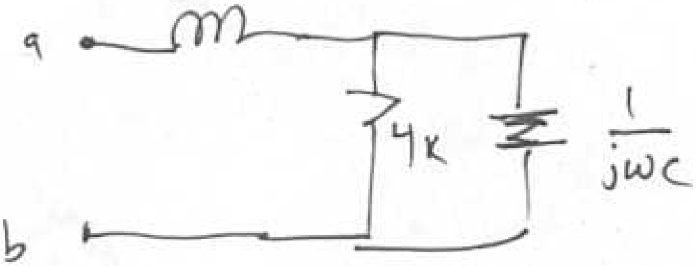
$i_g = 50 \sin(\omega t - \frac{\pi}{4})$

no phase diff

for

V_g

1st go to imped. plane.



$$Z_{ab} = j\omega L + \left[\frac{1}{4k} + j\omega c\right]^{-1}$$

$$= j\omega L + \left[\frac{1 + j\omega c(4\times10^3)}{4k}\right]^{-1}$$

$$= j\omega L + \frac{4\times10^3}{1 + j\omega c(4\times10^3)} \cdot \frac{1 - j\omega c(4\times10^3)}{1 - j\omega c(4\times10^3)}$$

$$= j\omega L + \frac{4\times10^{+3} - j\omega c(16\times10^6)}{1 + \omega^2 c^2(16\times10^6)}$$

(a) For the circuit shown in Fig. P7.22, find the frequency (in radians per second) at which the impedance Z_{ab} is purely resistive.

(b) Find the value of Z_{ab} at the frequency of (a).

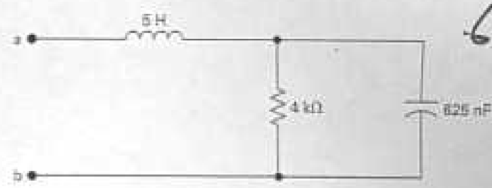


Figure P7.22

$$Z_{ab} = \frac{4\times10^3}{1+\omega^2c^2(16\times10^6)} + j\left[\omega L - \frac{\omega c\times16\times10^6}{1+\omega^2c^2(16\times10^6)}\right]$$

for purely resistive This "imag. part" should go to zero

$C = 625nF$

$L = 5H$

$\omega = ?$ $\Rightarrow$ $\omega = 400$ rad/s

$Z_{ab} = 2600\,\Omega$

$$\omega L = \frac{rad}{s} H \triangleq \Omega$$

$$\frac{1}{\omega c} = \frac{1}{\frac{rad}{s}F} \triangleq \Omega$$

$$i = C\frac{dV}{dt}$$

$$A = F\frac{V}{s} \Rightarrow \frac{V}{A} = \frac{s}{F}$$

$$V = L\frac{di}{dt}$$

$$V = H\frac{A}{s} \Rightarrow \frac{V}{A} = \frac{H}{s} = \Omega$$

$$\sqrt{\frac{L}{C}} \rightarrow \sqrt{\frac{j\omega L}{j\omega C}} = \sqrt{\frac{\Omega}{\frac{1}{\Omega}}} = \Omega$$

$$\frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{\frac{V}{A}s\,\frac{A}{V}s}} = \frac{1}{s}$$

L?

$$V = L\frac{di}{dt}$$

$$\frac{V}{A}s = H$$

$$i = C\frac{dV}{dt}$$

$$\frac{A}{V}s = F$$

dim. f & ω are the same $\frac{1}{s}$

but

f ≙ cyl. per second.

$$2\pi f = \omega = \frac{rad}{s}.$$

7.29 p379

$v_g = 150 \cos(8000\pi t + 20^\circ)$ V

a) $i_g = 30 \sin(8000\pi t + 38^\circ)$ A

$V_g = 150 \angle 20^\circ = 150 e^{j 20\left(\frac{\pi}{180}\right)}$

$I_g = -j\, 30 \angle 38^\circ = 30 e^{j 38 \frac{\pi}{180}} e^{-j\frac{\pi}{2}}$

$= 30 \angle 38^\circ - 90^\circ = 30 \angle -52^\circ = 30 e^{-j 52\left(\frac{\pi}{180}\right)}$

$Z = \frac{V_0}{I_g} = \frac{150 \angle 20^\circ}{30 \angle -52} = 5 \angle 20+52$

$= 5 \angle 72^\circ$ Ω

b) i_g lags v_g by 72°

$2\pi f = 8000\pi \Rightarrow f = 4000$

$T = 250\mu s$

$\frac{72}{360}(250) = 50\mu s$

i_g lags v_g by $50\mu s$

$\omega\left(\frac{rad}{s}\right)\left(\frac{180}{\pi}\frac{deg}{rad}\right) = \frac{\omega}{\pi} 180 \frac{deg}{s}$

7.36 p380

$\omega = 25 \text{ krad/s}$

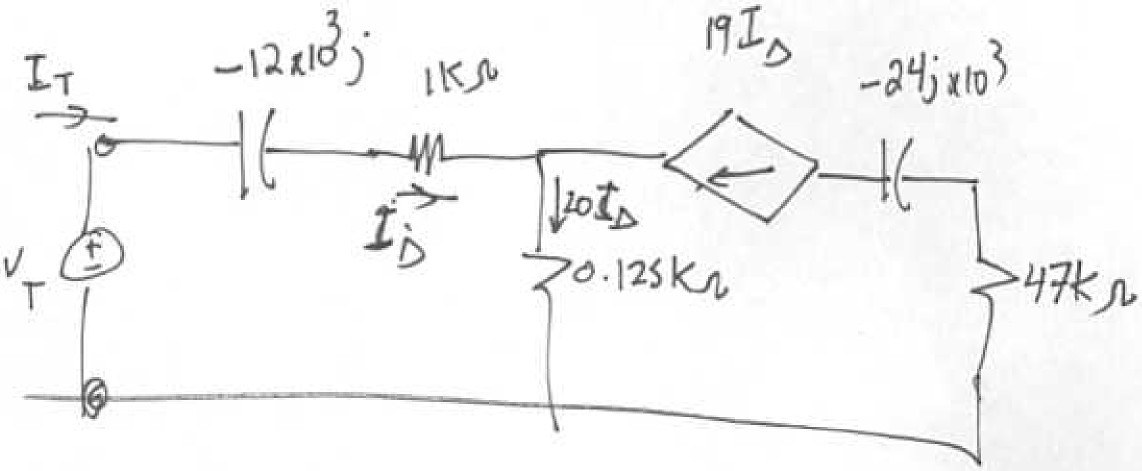
$C \rightarrow \frac{1}{j\omega C} =$

$\frac{10}{3} nF \qquad \frac{5}{3} nF \longrightarrow -j\frac{1}{\omega C} = -j\frac{1}{(25\times10^{3})(\frac{5}{3}\times10^{-9})}$

$= -j\,24 \text{ k}\Omega$

$\downarrow$

$\frac{1}{j(25\times10^{3})(\frac{10}{3}\times10^{-9})} = -j(12 \text{ k}\Omega)$



$I_\Delta \triangleq I_T$

$V_T = (1 - 12j)\times10^{3}\, I_\Delta + 20\, I_\Delta (0.125)\times10^{3}\,\Omega$

$\frac{V_T}{I_T} = 1 - 12j + 20(0.125) \quad \text{K}$

$$\boxed{Z_{eq} = 3.5 - 12j \quad \text{k}\Omega}$$