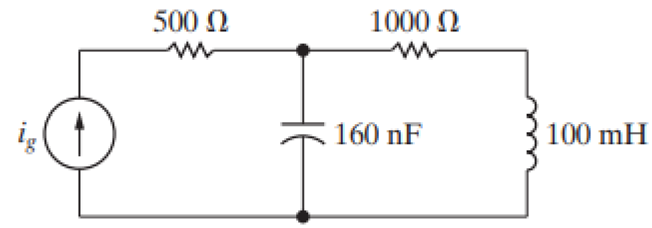
Homework-02 ENGR 117 Due date 02/21/2022

5 Questions 20 points each

Q-1 Find the average power delivered by the ideal current source in the circuit

$i_g = 8 \cos 5000t$ A

Here 8 is the max value



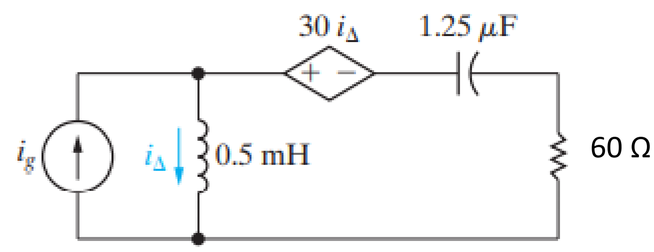
w	5000	rad/s
L	100	mH
C	160	nF

ig	=	8	+ j	0.0000000	=	8.0000	∠	0		A
R1	=	500	+ j	0.0000000	=	500.0000	∠	0	Deg	Ω
R2	=	1000	+ j	0.0000000	=	1000.0000	∠	0	Deg	Ω
ZL	=	0	+ j	500.0000000	=	500.0000	∠	90	Deg	Ω
ZC	=	0	+ j	-1250.0000000	=	1250.0000	∠	-90	Deg	Ω
ZL + R2	=	1000		500.0000000	=	1118.0340	∠	26.56505	Deg	Ω
1/(ZL+R2)	=	0.0008	+ j	-0.0004000	=	0.0009	∠	-26.5651		Ω
1/ZC	=	4.90059E-20	+ j	0.0008000	=	0.0008	∠	90	Deg	mho
I/Zx	=	0.0008	+ j	0.0004000	=	0.0009	∠	26.56505	Deg	mho
Zx	=	1000	+ j	-500.0000000	=	1118.0340	∠	-26.5651	Deg	Ω
Zeq	=	1500	+ j	-500.00	=	1581.1388	∠	-18.4349	Deg	Ω

Pavg	48000	Watt

Q-2 Find the average power dissipated in the resistor in the circuit $i_g = 6 \cos 20{,}000t$ A. 60 Ω

Here 6 is the max value

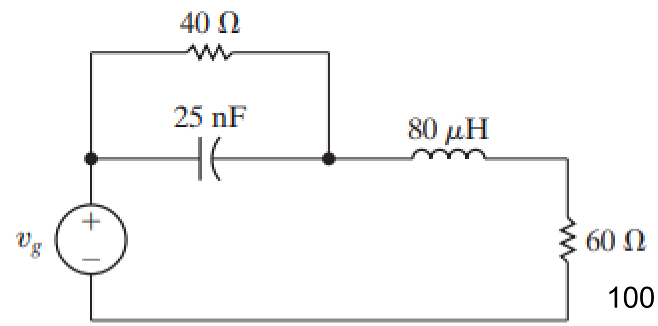


w	20000	rad/s
L	0.5	mH
C	1250	nF

ig	=	6 + j 0.0000000	=	6.0000	L	0	A
R	=	60 + j 0.0000000	=	60.0000	L	0 Deg	Ω
			=				Ω
ZL	=	0 + j 10.0000000	=	10.0000	L	90 Deg	Ω
ZC	=	0 + j -40.0000000	=	40.0000	L	-90 Deg	Ω
ZC + R	=	60 + j -40.0000000	=	72.1110	L	-33.6901 Deg	Ω
ZL(ZC+R)	=	400 + j 600.0000000	=	721.1103	L	56.30993	Ω
1/ZL	=	6.12574E-18 + j -0.1000000	=	0.1000	L	-90 Deg	mho
I/(ZC+R)	=	0.011538462 + j 0.0076923	=	0.0139	L	33.69007 Deg	mho
1/(ZL)(ZC+R) = XXX	=	0.000769231 + j -0.0011538	=	0.0014	L	-56.3099 Deg	
30(XXX)	=	0.023076923 + j -0.0346154	=	0.0416	L	-56.3099 Deg	
cccc	=	-0.011538462 + j -0.057692308	=	0.0588	L	258.6901 Deg	
V				101.9804		-258.69	
V		-20 + j 100.0000000		101.9804	L	101.3099 Deg	
Idelta		10 + j 2.0000000		10.1980	L	11.30993 Deg	
I 60 = Ig-Idelta		-4 + j -2		4.4721	L	206.5651 Deg	
P 60-ohm	=	600 Watt					

Q-3 Find the average power, the reactive power, and the apparent power supplied by the voltage source in the circuit $v_g = 40 \cos 10^6 t$ V.

Here 40 is the max value



100 Ω

w	1000000	rad/s
L	0.08	mH
C	25	nF

Vg	=	40 + j 0.0000000	=	40.0000	∠	0	A
R1	=	40 + j 0.0000000	=	40.0000	∠	0 Deg	Ω
R2	=	100 + j 0.0000000	=	100.0000	∠	0 Deg	Ω
ZL	=	0 + j 80.0000000	=	80.0000	∠	90 Deg	Ω
ZC	=	0 + j -40.0000000	=	40.0000	∠	-90 Deg	Ω
ZL + R2	=	100 + j 80	=	128.0625	∠	38.65981 Deg	Ω
1/ZC	=	1.53144E-18 + j 0.0250000	=	0.0250	∠	90 Deg	Ω
1/R1	=	0.025 + j 0.0000000	=	0.0250	∠	0 Deg	mho
1/X = (1/R1)+(1/ZC)	=	0.025 + j 0.025	=	0.0354	∠	45 Deg	mho
X	=	20 + j -20.0000000	=	28.2843	∠	-45 Deg	
Zeq	=	120 + j 60	=	134.1641	∠	26.56505 Deg	
Ig = Vg/Zeq	=	0.2667 + j -0.1333	=	0.2981	∠	-26.5651 Deg	
Ig (Conj)	=	0.2667 + j 0.1333	=	0.2981	∠	26.56505 Deg	
Sg = 1/2 (Vg * Ig(conj))	=	5.3333 + j 2.6667	=	5.9628	∠	26.56505 Deg	
P(avg)	=	**5.3333** **Watts**					
Q(reactive)	=	**2.6667** **VAR**					
|S| (Apparent)	=	**5.9628** **VA**					

Q- 4 A single-phase source is applied to a two-terminal, passive circuit with equivalent impedance $Z = 2.0\underline{/-45^\circ}\ \Omega$ measured from the terminals. The source current is $i(t) = 4\sqrt{2}\cos(\omega t)$ kA. Determine the (a) instantaneous power, (b) real power, and (c) reactive power delivered by the source. (d) Also determine the source power factor.

Here current is max value representation

$Z = 2\angle -45\ \Omega$

$i(t) = 4\sqrt{2}\cos\omega t\ KA \Rightarrow \boxed{I_{rms} = 4\ KA}$

$V(t) = (4\sqrt{2}\cos\omega t)(2\angle -45) = (4\sqrt{2}\angle 0)(2\angle -45)$

$V(t) = 8\sqrt{2}\angle -45\ KV \Rightarrow \boxed{V_{rms} = 8\ KV}$

$\theta_v = -45^\circ \quad \theta_i = 0^\circ \Rightarrow \theta_v - \theta_i = \phi = -45^\circ$

a) $p(t) = \boxed{22.63 + 32\cos(2\omega t - 45)}$ MW

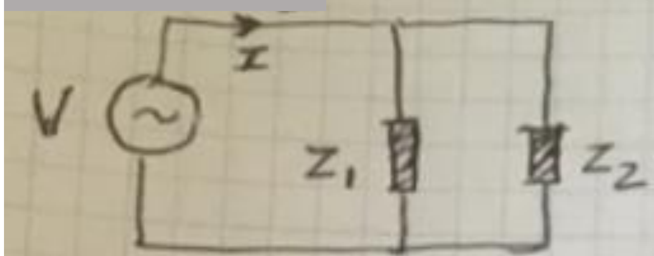
b) $P = V_{rms} I_{rms} \cos\phi = 8 \times 4 \cos(-45) = \boxed{22.62\ MWatt}$

c) $Q = V_{rms} I_{rms} \sin\phi = 8 \times 4 \sin(-45) = \boxed{-22.62\ MVAR}$

d) $P.F = \cos\phi = \cos(-45) = \boxed{0.707}$ leading

Q-5 The real power delivered by a source to two impedances, $Z_1 = 3 + j4\ \Omega$ and $Z_2 = 10\ \Omega$, connected in parallel, is 1100 W. Determine (a) the real power absorbed by each of the impedances and (b) the source current.

Here V is RMS value representation



$$P = 1100\ W$$

$$Z_1 = 3 + j4 = 5\angle 53.13\ \Omega$$

$$Z_2 = 10 + j0 = 10\angle 0\ \Omega.$$

$$Z_T = \frac{Z_1 \times Z_2}{Z_1 + Z_2} = 3.676\angle 36.03^\circ$$

$$I = \frac{V}{3.676\angle +36.03} \Rightarrow I^* = \frac{V^*}{3.676\angle 36.03}$$

$$\bar{S} = VI^* = \frac{V \times V^*}{3.676\angle 36.03} = V^2(0.272\angle +36^\circ)$$

$$\bar{S} = V^2(0.22 - j0.1598) = \underbrace{0.22V^2}_{P} - j0.1598V^2$$

$$0.22V^2 = 1100 \Rightarrow \boxed{V = 70.71\ V}$$

$$I_1 = \frac{V}{Z_1} \Rightarrow$$

a)

$$\boxed{I_1 = \frac{V}{5\angle 53.13}} \Rightarrow \boxed{I_1^* = \frac{V^*}{5\angle -53.13}}$$

$$\bar{S}_1 = V I_1^* = V \times \frac{V^*}{5\angle -53.13} = V^2 (0.2\angle 53.13)$$

$$\bar{S}_1 = V^2 (0.12 + 0.16)$$

$$\boxed{P_1} = 0.12\, V^2 = 0.12 \times (70.71)^2 = \boxed{600 \text{ Watt}}$$

$$I_2 = \frac{V}{Z_2} = \frac{V}{10\angle 0} = 0.1 V\angle 0 \Rightarrow \boxed{I_2^* = 0.1 V^* \angle 0}$$

$$\bar{S}_2 = V I_2^* = V \cdot V^* (0.1\angle 0) = V^2 (0.1 + 0j).$$

$$\boxed{P_2} = 0.1\, V^2 = 0.1 \times (70.71)^2 = \boxed{500 \text{ Watt}}$$

b) $I = \frac{V}{Z_T}$

I = 19.23 ***L*** -36.03 A