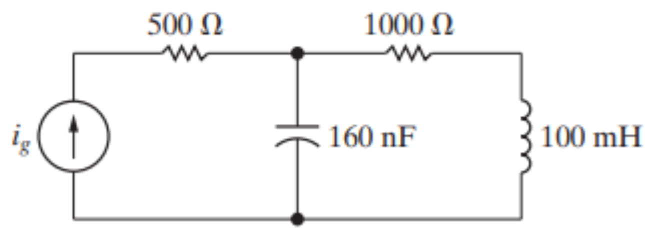
Homework-02 ENGR 117 Due date 02/21/2022

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

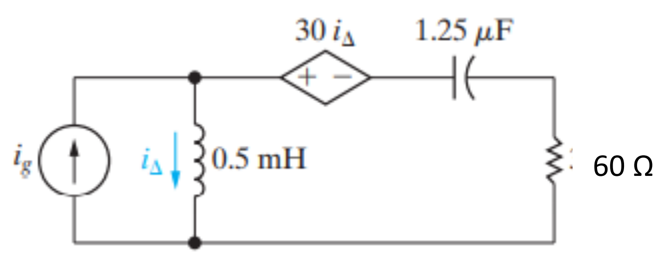
Here 8 is max value



Q-2 Find the average power dissipated in the 60 Ω resistor in the circuit

$i_g = 6\cos 20{,}000t$ A.

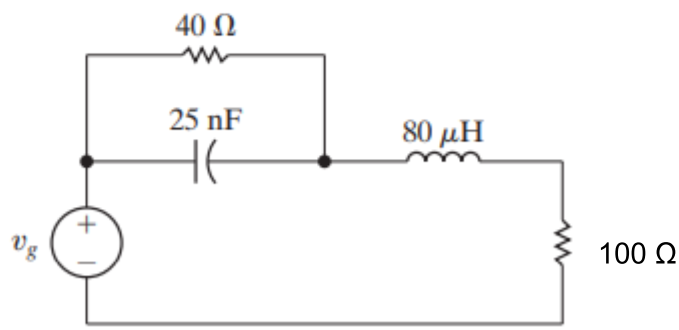
Here 6 is max value



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 max value



Q- 4 A single-phase source is applied to a two-terminal, passive circuit with equivalent impedance $Z = 2.0\angle{-45^\circ}\ \Omega$ 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.

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

Q1.

$Z_L = j\omega L = j(5000)(100 \times 10^{-3}) = j500\ \Omega$

$Z_C = \dfrac{-j}{\omega C} = \dfrac{-j}{(5000)(160 \times 10^{-9})} = -j1250\ \Omega$

$R_{eq1} = 1000 + j500$

$\dfrac{1}{R_{eq2}} = \dfrac{1}{1000 + j500} + \dfrac{1}{-j1250}$

$R_{eq2} = 1000 - j500$

$Z = 500 + R_{eq2}$

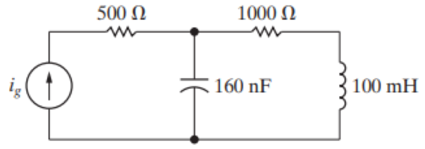
$= 500 + (1000 - j500)$

$= 1500 - j500$

$= 1581.13 \angle -18.43^\circ$

$i_g = 8 \cos 5000t$ A

Here 8 is max value



$V = IZ = (8 \angle 0^\circ)(1581.13 \angle -18.43^\circ)$

$= 12649.04 \angle -18.43^\circ$

$6324.52 \angle -18.43^\circ$

$P_{avg} = \dfrac{V_m I_m}{2} \cos(\theta_v - \theta_i) = \dfrac{(12\,649.04)(8)}{2} \cos(-18.43 - 0) = 48\,001.11\ \text{W} \approx 48\ \text{kW}$

Q2

$Z_L = j\omega L = j(20\,000)(0.5 \times 10^{-3}) = j10\ \Omega$

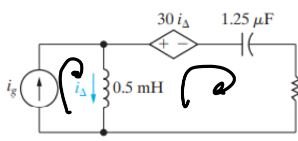
$i_g = 6 \angle 0^\circ \approx 6$ A

$Z_c = \dfrac{-j}{\omega C} = \dfrac{-j}{(20\,000)(1.25 \times 10^{-6})} = -j40\Omega$

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

Here 6 is max value

$R_{eq1} = -j40\Omega + 60\Omega = 60 - j40\Omega$



$0.5(i_g - i_\Delta) = 0$

KCL: $j10(I - i_g) + 30 i_\Delta - j40 I + 60 I = 0$

$I(j10 - j40 + 60) = j10(6) - 30 i_\Delta$

$I(60 - j30) = j60 - 30(6 - I)$

$I(60 - j30 - 30) = j60 - 180$

$I = \dfrac{-180 + j60}{30 - j30} = -4 - j2$

$= 2\sqrt{5} \angle -153.43^\circ$

$i_g \rightarrow I \rightarrow$, $i_\Delta \downarrow$

$6 = i_\Delta + I$

$i_\Delta = 6 - I$

$P_{60} =$

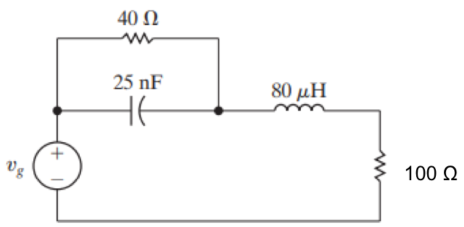
$V = (I \angle \theta_i)(R \angle \theta_r)$

$\dfrac{VI}{2} \cos(\theta_v - \theta_i)$

$\dfrac{I^2 R(\theta_i + \theta_r)}{2} \cos(\theta_v - \theta_i)$

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 max value



Q3. $Z_L = j\omega L = j(10^6)(80\times10^{-6}) = j80\Omega$

$Z_C = \dfrac{-j}{\omega C} = \dfrac{-j}{(10^6)(25\times10^{-9})} = -j40\Omega$

$Z_{eq1} : 40\Omega \,//\, 25nF = \dfrac{1}{\frac{1}{40}+\frac{1}{-j40}} = 20-j20$

$Z_{eq} = R_{eq1} + j80\Omega + 100\Omega = (20-j20)+j80+100$

$= 120+j60\,\Omega \approx 60\sqrt{5}\angle 26.57°$

$V = IZ \rightarrow I = \dfrac{V}{Z} = \dfrac{40\angle0°}{60\sqrt5\angle26.57°} = 0.298\angle-26.57°$

$P_{ave} = \dfrac{(40)(0.298)}{2}\cos(0+26.57°) = 5.33\text{ W}$

$Q = \dfrac{(40)(0.298)}{2}\sin(0+26.57°) = 2.67\text{ W}$

$|S| = \sqrt{P^2+Q^2}$

$= \sqrt{(5.33)^2+(2.67)^2} = 5.96$

$\theta = \tan^{-1}(Q/P)$

$= \tan^{-1}(2.67/5.33) = 26.61°$

Apparent Power: $|S| = 5.96$ W

Q4

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

$P = VI\cos\theta_i$

$P_1 = V(V/Z_1)\cos\theta_{i1}$

$= \dfrac{V^2}{5}\cos(-53.13°)$

$= 0.12V^2$

$P_2 = V(V/Z_2)\cos\theta_{i2}$

$= \dfrac{V^2}{10}\cos 0°$

$= 0.1V^2$

$V = IZ$

$I_1 = \dfrac{V}{Z_1} = \dfrac{V}{5\angle-53.13°} = \dfrac{V}{5}\angle-53.13°$

$I_2 = \dfrac{V}{Z_2} = \dfrac{V}{10\angle0} = \dfrac{V}{10}\angle0°$

$P = P_1 + P_2$

$1100 = 0.12V^2 + 0.1V^2$

$V^2 = 5000$

$V = 50\sqrt2$

$P_1 = 0.12V^2$

$= 0.12(5000)$

$= 600$ W

$P_2 = 0.1V^2$

$= 0.1(5000)$

$= 500$ W

$I_1 = \dfrac{50\sqrt2}{5}\angle-53.13°$

$= 10\sqrt2\angle-53.13°$

$I_2 = \dfrac{50\sqrt2}{10}\angle0° = 5\sqrt2\angle0°$