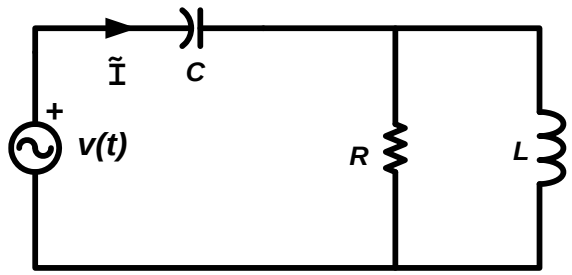
**ECET 3000 Electrical Principles _____ Homework # 3 – Due: 26 March 2019**

**Instructions – You must submit a complete set of solutions to the problems that show all steps required to achieve the correct answer. Your solutions should appear in the numerical order of the assigned homework problems, and should be written single-sided on blank paper. Draw a box around all of the final answers for each problem.**

**Problem #1)** Given the following circuit:




$v(t) = 36 \cdot \sin(\omega \cdot t + 20°)$ volts $\quad f = 400$ Hz

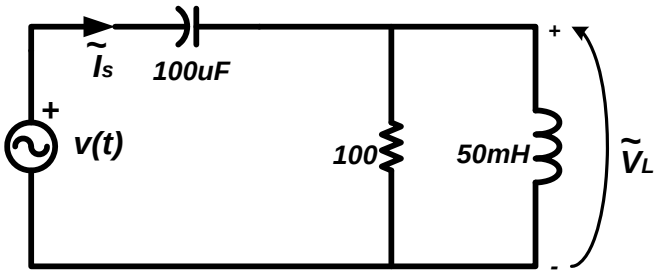
$R = 30\,\Omega \quad L = 20$ mH $\quad C = 22\,\mu$F

**a)** Specify the ***source voltage v(t)*** in (RMS) **phasor form** $\tilde{V}$,

**b)** Express the ***load elements*** (R,L, and C) **as impedances** ($Z_R$, $Z_L$, and $Z_C$) , and

**c)** Determine the ***source current*** $\tilde{I}$ in **phasor form**.

**Problem #2)** Given the following (steady-state) AC circuit:




$v(t) = \sqrt{2} \cdot 24 \cdot \sin(\omega t + 30°)$

$\omega = 2\pi \cdot f$

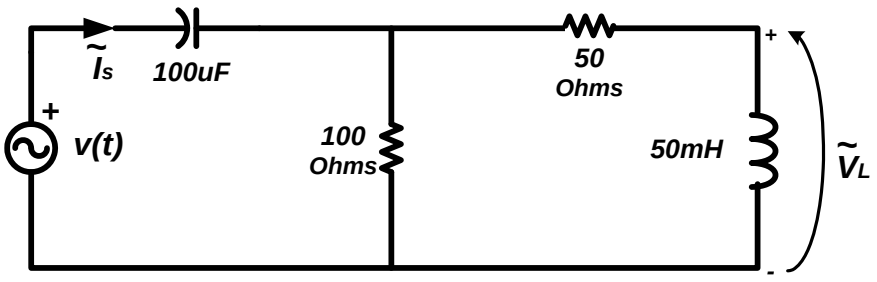
$f = 60\ Hz$

**a)** Express the ***source voltage*** in (RMS) **phasor form** and the R,L,C ***load values*** **as impedances**.

**b)** Determine the ***source current*** $\tilde{I}_S$ and the ***inductor voltage*** $\tilde{V}_L$, both in **phasor form**.

**c)** Express the ***source current $i_S(t)$*** and ***inductor voltage $v_L(t)$*** as sinusoidal **time functions**.

**Problem #3)** Given the following (steady-state) AC circuit:



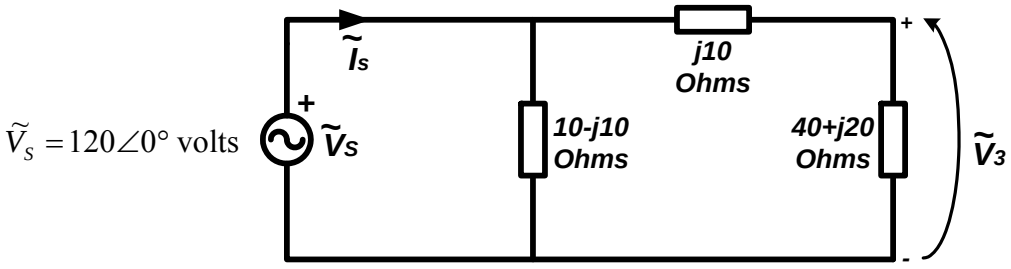

$v(t) = \sqrt{2} \cdot 60 \cdot \sin(\omega t - 45°)$

$\omega = 2\pi \cdot f = 1000\ {}^{rad}/_{sec}$

**a)** Determine the ***source current*** $\tilde{I}_S$ and the ***inductor voltage*** $\tilde{V}_L$, both in **phasor form**.

**b)** Determine the ***total complex power***, ***S***, supplied by the source to the circuit.

**Problem #4)** Given the following (steady-state) AC circuit:

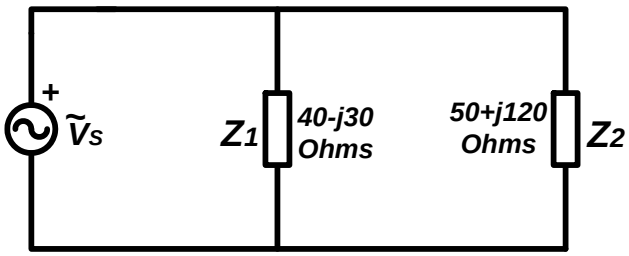



**a)** Determine the ***source current*** $\tilde{I}_S$ and the ***load voltage*** $\tilde{V}_3$, both in phasor form.

**b)** Determine the ***total complex power*** produced by the source and the ***power factor*** of the source.

**c)** Determine the ***reactive power*** consumed only by the 40+j20Ω load.

**Problem #5)** Given the following (steady-state) AC circuit:

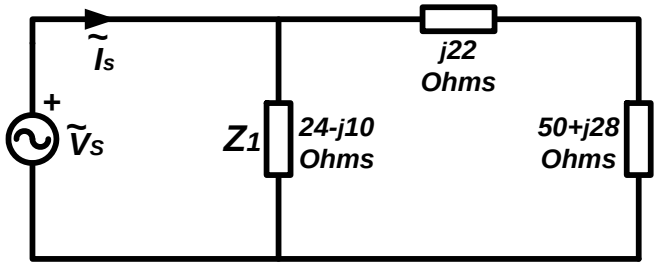



$\tilde{V}_S = 240\angle 180°$ volts

Determine the ***complex power*** consumed by EACH of the load impedances, $S_1$ and $S_2$, as well as the total ***complex power*** produced by the source, $S_{source}$.

**Problem #6)** Repeat problem #5, but use the new source voltage: $\tilde{V}_S = 240\angle -90°$ volts

**Problem #7)** Given the following (steady-state) AC circuit:




$\tilde{V}_S = 48\angle -30°$ volts

Determine the **real power** $P_1$ that is consumed ***only by the impedance labeled $Z_1$*** in the circuit.

**Problem T/F)** Specify whether each of the statements are **TRUE** or **FALSE**.

_____ Given an AC (sinusoidal) voltage source, the ***RMS voltage magnitude*** of the source provides an effective voltage of the source compared to a DC source supplying power to a resistive load.

_____ The ***impedance of an inductor*** is linearly proportional to frequency.

_____ The ***impedance of a capacitor*** is linearly proportional to frequency.

_____ The ***impedance of a resistor*** is linearly proportional to frequency.

_____ When expressed in ***phasor form***, a sinusoidal voltage's magnitude and phase angle are shown but the frequency of the voltage is not.

_____ When connected to an AC voltage source, the ***power*** (rate of energy transfer) to a resistor fluctuates at a rate (frequency) that is ½ the rate (frequency) of the applied voltage.

**Answers:**

**1)** $\widetilde{V} = 25.456\angle 20° \quad R = 30\Omega \quad Z_L = j50.27 \quad Z_C = -j18.09 \quad \widetilde{I} = 1.124\angle 32.45°$

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$\widetilde{V} = 24\angle 30°, \quad Z_R = 100\Omega, \quad Z_L = j18.9\Omega, \quad Z_C = -j26.5\Omega$

**2)** $\widetilde{I}_S = 2.68\angle 97.3°$ *amps* $\qquad \widetilde{V}_L = 49.8\angle 176.6°$ *volts*

$i_S(t) = \sqrt{2} \cdot 2.68 \cdot \sin(\omega t + 97.3°) \qquad v_L(t) = \sqrt{2} \cdot 49.8 \cdot \sin(\omega t + 176.6°)$

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**3)** $\widetilde{I}_S = 1.455\angle -59.04°$ amps, $\widetilde{V}_L = 46.02\angle 12.53°$ volts, $\mathrm{S}_{\text{source}} = 84.7 + j21.1$

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$\widetilde{I}_S = 9.14\angle 29.93°$ amps, $\widetilde{V}_3 = 107.33\angle -10.30°$ volts

**4)** $S_S = 950.4 - j547.2, \quad p.f. = \cos\theta = \cos(0° - 29.93°) = 0.866$

$Q_{40+j20} = 115.2$ vars

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**5)** $S_1 = 170.4 + j409 \qquad S_2 = 921.6 - j691.2 \qquad S_S = 1092 - j282.2$

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**6)** **No change – same complex powers as # 5**

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**7)** $P_1 = 81.8$ watts

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**True/False)** **True, True, False, False, True, False**