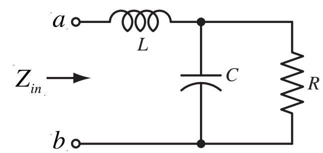
Solution of ECE 202 Test 2 S13

1. (2 pts) Find the numerical magnitude and angle (in degrees) of the input impedance between terminals *a* and *b* in the partial circuit below.

Z_{in} = ____________ $\angle$ ____________ ° Ω

$\omega = 6000\ \text{s}^{-1}$, $L = 350\ \mu\text{H}$

$C = 80\ \mu\text{F}$, $R = 5\ \Omega$



$$Z_{in} = \frac{R / j\omega C}{R + 1/ j\omega C} + j\omega L = \frac{R}{j\omega RC + 1} + j\omega L$$

$$Z_{in} = \frac{5}{j6000 \times 5 \times 80 \times 10^{-6} + 1} + j6000 \times 350 \times 10^{-6} = 0.808\angle 23.711°$$

2. (a) Find the numerical magnitudes and angles of the phasor voltages V_R, V_L and V_C in the circuit below. (Be sure to check that $V_s = V_R + V_L + V_C$.)

V_R = ____________ ∠ ____________ °V V_L = ____________ ∠ ____________ °V

V_C = ____________ ∠ ____________ °V

$$V_R = \frac{R}{R + j\omega L + 1/j\omega C} V_s = \frac{j\omega RC}{j\omega RC + 1 - \omega^2 LC} V_s$$

$$V_L = \frac{j\omega L}{R + j\omega L + 1/j\omega C} V_s = \frac{-\omega^2 LC}{j\omega RC + 1 - \omega^2 LC} V_s$$

$$V_C = \frac{1/j\omega C}{R + j\omega L + 1/j\omega C} V_s = \frac{1}{j\omega RC + 1 - \omega^2 LC} V_s$$

$$V_R = \frac{j200 \times 280 \times 20 \times 10^{-6}}{j200 \times 280 \times 20 \times 10^{-6} + 1 - (200)^2 \times 0.8 \times 20 \times 10^{-6}} 120\angle 0° = 114.24\angle 17.829°$$

$$V_L = \frac{-(200)^2 \times 0.8 \times 20 \times 10^{-6}}{j200 \times 280 \times 20 \times 10^{-6} + 1 - (200)^2 \times 0.8 \times 20 \times 10^{-6}} 120\angle 0° = 65.282\angle 107.82°$$

$$V_C = \frac{1}{j200 \times 280 \times 20 \times 10^{-6} + 1 - (200)^2 \times 0.8 \times 20 \times 10^{-6}} 120\angle 0° = 102.00\angle -72.18°$$

(b) Find a new positive radian frequency ω at which $V_R = V_s$.

New ω = ____________ s^{-1}

$$V_R = \frac{j\omega RC}{j\omega RC + 1 - \omega^2 LC} V_s \Rightarrow \text{Choose } \omega^2 LC = 1 \Rightarrow \omega = \frac{1}{\sqrt{LC}} = 250$$

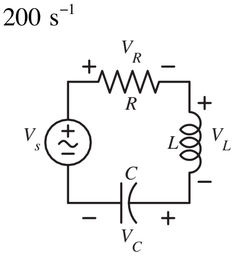
(c) At the new radian frequency found in part (b) find the new numerical magnitudes and angles of the phasor voltages across the inductor and capacitor.

$$V_L = \frac{-(250)^2 \times 0.8 \times 20 \times 10^{-6}}{j250 \times 280 \times 20 \times 10^{-6} + 1 - (250)^2 \times 0.8 \times 20 \times 10^{-6}} 120\angle 0° = 85.714\angle 90°$$

$$V_C = \frac{1}{j200 \times 280 \times 20 \times 10^{-6} + 1 - (200)^2 \times 0.8 \times 20 \times 10^{-6}} 120\angle 0° = 85.714\angle -90°$$

V_L = ____________ ∠ ____________ °V V_C = ____________ ∠ ____________ °V

$V_s = 120\angle 0°$, $R = 280\Omega$, $L = 800\text{mH}$
$C = 20\mu\text{F}$, $\omega = 200\ \text{s}^{-1}$



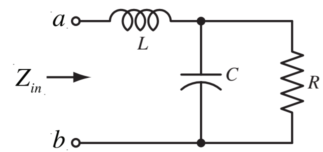
Solution of ECE 202 Test 2 S13

1. (2 pts) Find the numerical magnitude and angle (in degrees) of the input impedance between terminals *a* and *b* in the partial circuit below.

Z_{in} = ____________ $\angle$ ____________ ° Ω

$\omega = 5000\ \text{s}^{-1}$, $L = 350\ \mu\text{H}$

$C = 80\ \mu\text{F}$, $R = 5\ \Omega$



$$Z_{in} = \frac{R / j\omega C}{R + 1/ j\omega C} + j\omega L = \frac{R}{j\omega RC + 1} + j\omega L$$

$$Z_{in} = \frac{5}{j5000 \times 5 \times 80 \times 10^{-6} + 1} + j5000 \times 350 \times 10^{-6} = 1.0308\angle -14.036°$$

2. (a) Find the numerical magnitudes and angles of the phasor voltages V_R, V_L and V_C in the circuit below. (Be sure to check that $V_s = V_R + V_L + V_C$.)

V_R = ____________ ∠ ____________ °V V_L = ____________ ∠ ____________ °V

V_C = ____________ ∠ ____________ °V

$$V_R = \frac{R}{R + j\omega L + 1/j\omega C} V_s = \frac{j\omega RC}{j\omega RC + 1 - \omega^2 LC} V_s$$
$$V_L = \frac{j\omega L}{R + j\omega L + 1/j\omega C} V_s = \frac{-\omega^2 LC}{j\omega RC + 1 - \omega^2 LC} V_s$$
$$V_C = \frac{1/j\omega C}{R + j\omega L + 1/j\omega C} V_s = \frac{1}{j\omega RC + 1 - \omega^2 LC} V_s$$

$$V_R = \frac{j200 \times 280 \times 15 \times 10^{-6}}{j200 \times 280 \times 15 \times 10^{-6} + 1 - (200)^2 \times 0.8 \times 15 \times 10^{-6}} 120\angle 0° = 102.032\angle 31.76°$$

$$V_L = \frac{-(200)^2 \times 0.8 \times 15 \times 10^{-6}}{j200 \times 280 \times 15 \times 10^{-6} + 1 - (200)^2 \times 0.8 \times 15 \times 10^{-6}} 120\angle 0° = 58.304\angle 121.76°$$

$$V_C = \frac{1}{j200 \times 280 \times 15 \times 10^{-6} + 1 - (200)^2 \times 0.8 \times 15 \times 10^{-6}} 120\angle 0° = 121.4664\angle -58.241°$$

(b) Find a new positive radian frequency ω at which $V_R = V_s$.

New ω = ____________ s^{-1}

$$V_R = \frac{j\omega RC}{j\omega RC + 1 - \omega^2 LC} V_s \Rightarrow \text{Choose } \omega^2 LC = 1 \Rightarrow \omega = \frac{1}{\sqrt{LC}} = 288.68$$

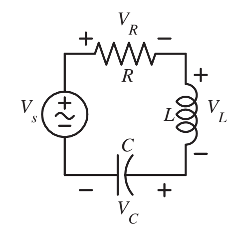
(c) At the new radian frequency found in part (b) find the new numerical magnitudes and angles of the phasor voltages across the inductor and capacitor.

$$V_L = \frac{-(288.68)^2 \times 0.8 \times 20 \times 10^{-6}}{j288.68 \times 280 \times 15 \times 10^{-6} + 1 - (288.68)^2 \times 0.8 \times 15 \times 10^{-6}} 120\angle 0° = 98.98\angle 90°$$

$$V_C = \frac{1}{j288.68 \times 280 \times 15 \times 10^{-6} + 1 - (288.68)^2 \times 0.8 \times 15 \times 10^{-6}} 120\angle 0° = 98.98\angle -90°$$

V_L = ____________ ∠ ____________ °V V_C = ____________ ∠ ____________ °V

$V_s = 120\angle 0°$, $R = 280\Omega$, $L = 800\text{mH}$
$C = 15\mu\text{F}$, $\omega = 200\ \text{s}^{-1}$



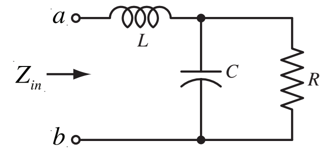
Solution of ECE 202 Test 2 S13

1. (2 pts) Find the numerical magnitude and angle (in degrees) of the input impedance between terminals *a* and *b* in the partial circuit below.

Z_{in} = ____________ $\angle$ ____________ ° Ω

$\omega = 4000\ \text{s}^{-1}$, $L = 350\ \mu\text{H}$

$C = 80\ \mu\text{F}$, $R = 5\ \Omega$



$$Z_{in} = \frac{R / j\omega C}{R + 1/ j\omega C} + j\omega L = \frac{R}{j\omega RC + 1} + j\omega L$$

$$Z_{in} = \frac{5}{j4000 \times 5 \times 80 \times 10^{-6} + 1} + j4000 \times 350 \times 10^{-6} = 1.6402\angle -31.1°$$

2. (a) Find the numerical magnitudes and angles of the phasor voltages V_R, V_L and V_C in the circuit below. (Be sure to check that $V_s = V_R + V_L + V_C$.)

V_R = ____________ ∠ ____________ °V V_L = ____________ ∠ ____________ °V

V_C = ____________ ∠ ____________ °V

$$V_R = \frac{R}{R + j\omega L + 1/j\omega C} V_s = \frac{j\omega RC}{j\omega RC + 1 - \omega^2 LC} V_s$$
$$V_L = \frac{j\omega L}{R + j\omega L + 1/j\omega C} V_s = \frac{-\omega^2 LC}{j\omega RC + 1 - \omega^2 LC} V_s$$
$$V_C = \frac{1/j\omega C}{R + j\omega L + 1/j\omega C} V_s = \frac{1}{j\omega RC + 1 - \omega^2 LC} V_s$$

$$V_R = \frac{j200 \times 280 \times 25 \times 10^{-6}}{j200 \times 280 \times 25 \times 10^{-6} + 1 - (200)^2 \times 0.8 \times 25 \times 10^{-6}} 120\angle 0° = 118.794\angle 8.13°$$

$$V_L = \frac{-(200)^2 \times 0.8 \times 25 \times 10^{-6}}{j200 \times 280 \times 25 \times 10^{-6} + 1 - (200)^2 \times 0.8 \times 25 \times 10^{-6}} 120\angle 0° = 67.882\angle 98.13°$$

$$V_C = \frac{1}{j200 \times 280 \times 25 \times 10^{-6} + 1 - (200)^2 \times 0.8 \times 25 \times 10^{-6}} 120\angle 0° = 84.853\angle -81.87°$$

(b) Find a new positive radian frequency ω at which $V_R = V_s$.

New ω = ____________ s^{-1}

$$V_R = \frac{j\omega RC}{j\omega RC + 1 - \omega^2 LC} V_s \Rightarrow \text{Choose } \omega^2 LC = 1 \Rightarrow \omega = \frac{1}{\sqrt{LC}} = 223.607$$

(c) At the new radian frequency found in part (b) find the new numerical magnitudes and angles of the phasor voltages across the inductor and capacitor.

$$V_L = \frac{-(223.607)^2 \times 0.8 \times 25 \times 10^{-6}}{j223.607 \times 280 \times 25 \times 10^{-6} + 1 - (223.607)^2 \times 0.8 \times 25 \times 10^{-6}} 120\angle 0° = 76.6653\angle 90°$$

$$V_C = \frac{1}{j223.607 \times 280 \times 25 \times 10^{-6} + 1 - (223.607)^2 \times 0.8 \times 25 \times 10^{-6}} 120\angle 0° = 76.665\angle -90°$$

V_L = ____________ ∠ ____________ °V V_C = ____________ ∠ ____________ °V

$V_s = 120\angle 0°$, $R = 280\Omega$, $L = 800\text{mH}$

$C = 25\mu\text{F}$, $\omega = 200\ \text{s}^{-1}$