Answer on Question#60918 – Physics – Electric Circuits

A series RLC circuit with $L = 300H$, $C = 15\mu F$, and $R = 50\Omega$, is connected to an AC voltage source with amplitude 12.8V and frequency 50Hz. Find: a) the current amplitude, b) the phase difference between the voltage and the current, c) sketch the phasor diagram of the circuit

Solution. a) Find impedance of the series RLC circuit using formula

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

where$X_L = 2\pi\nu L$ inductive reactance, $X_C = \frac{1}{2\pi\nu C}$ – capacitive reactance, ν – frequency.

Hence $X_L = 2\pi \cdot 50 \cdot 300 \approx 94248\Omega$

$X_C = \frac{1}{2\pi \cdot 50 \cdot 15 \cdot 10^{-6}} = 212.2\Omega$

Therefore $Z = \sqrt{50^2 + (94248 - 212.2)^2} = 94036\Omega$

Using Ohm's law for circuit $I = \frac{U}{Z}$. Get $I = \frac{12.8}{94036} \approx 1.36 \cdot 10^{-4}A$.

b) the phase angle θ between the source voltage U and current I is the same as for the angle between Z and R in the impedance triangle. This phase angle may be positive or negative in value depending on whether the source voltage leads or lags the circuit current and can be calculated mathematically from the ohmic values of the impedance triangle as:

$$\cos\theta = \frac{R}{Z} \text{ or } \sin\theta = \frac{X_L - X_C}{Z}$$

As result using a) $\sin\theta = \frac{94248 - 212.2}{94036} \approx 89.9^0$

c) Sketch the phasor diagram of the circuit. Find voltage on all resistance

$U_R = IR = 1.36 \cdot 10^{-4} \cdot 50 = 0.0068V$

$U_C = IX_C = 1.36 \cdot 10^{-4} \cdot 212.2 = 0.02886V$

$U_L = IX_L = 1.36 \cdot 10^{-4} \cdot 94248 = 12.818V$

Hence