EE2029 Introduction to Electrical Energy Systems

(Tutorial on AC Fundamentals)

1. Perform the following addition using phasors, and express the result in time domain.
   (a) $v_1(t) = 40sin628t + 60\cos(628t - 45^0) + 30cos628t$
   (b) $v_2(t) = 20sin314t + 10\cos(314t + 60^0) - 5\sin(314t - 20^0)$

   Ans: $(a)109.72\cos(628t - 48.69o)\ volts; (b)9.44\cos(314t - 44.71)\ volts$

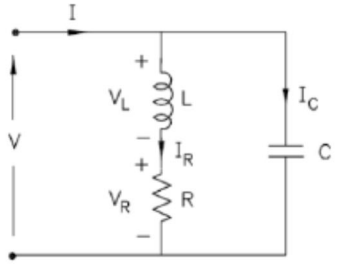
2. A source delivers a current of $i(t) = I_m\cos(314.16t + \beta)$ to a circuit consisting of a resistor of 40Ω and a capacitor of 137.83μF connected in parallel. If the source voltage is $v(t) = 282.84\cos(314.16t + 10^0)$, determine the currents $i_1(t)$ and $i_2(t)$ that flow through the resistor and the capacitor respectively. Express the source current in $i(t)$ in time domain.

   Ans: $i(t) = 14.14\ cos(314.16\ t + 70)$

3. A current $i(t) = 2\sqrt{2}\cos(5000t + 30^0)mA$ flows in a series circuit of R=2309Ω and L=0.8H.
   (a) Determine the impedance Z of the series combination.
   (b) Determine the voltage v(t) across the series combination.
   (c) Show the voltage and current phasors on a phasor diagram.

   Ans: $V=9.24\sqrt{2}cos(5000t + 90^o)V$

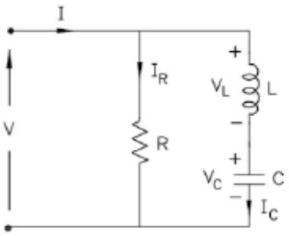
4. In the following figure, inductance L = 2H, resistance R = 3Ω, capacitor C = 0.2F and $v_R = 6\sqrt{2}cos2t$ volts. Determine the phasors I_R, V_L and I show them on a phasor diagram.



   Ans: V = 10 ∠53.13° V; I = 2.68∠116.57° amps

5. In the following circuit, R = 2Ω, L = 3.25mH and C = 100μF. The steady state voltage across C is $v_C = 100\sqrt{2}\cos(2000t - 90^0)$ volts.
   (a) Determine V_C, I_C and V_L
   (b) Determine I_R and I
   (c) Draw a phasor diagram showing all the phasors

(d) Determine *i(t)*.



Ans: V_L=j130 V, I = 25∠36.9° amps;

(d) $i(t) = 25\sqrt{2}\cos(2000t + 36.9°)$ A

6. A coil of resistance 5Ω and inductance 0.6H is connected in series with a capacitance of 10μF. If a variable frequency source of 200V is applied to this circuit, determine the frequency for which the current flow in the circuit will be maximum.

   Under this condition, determine the voltage across the inductance and capacitance, and compare them with that of the source.

Ans: 48.99

7. A purely resistive lamp is rated at 200V (rms), 120 W (i.e., it dissipates 120 W power when connected to a 200 V (rms) AC source).

(a) What is the RMS value of current drawn from the power supply?

(b) Calculate the resistance of the lamp.

(c) We want to connect this lamp across a supply voltage of 240 V (rms), 50 Hz. In order to keep the voltage across the lamp to the rated value of 200 V, a capacitor is connected in series with the lamp. What is the value of the capacitor to be used?

Ans: 0.6A; 333.33 ohms; 14.4μF