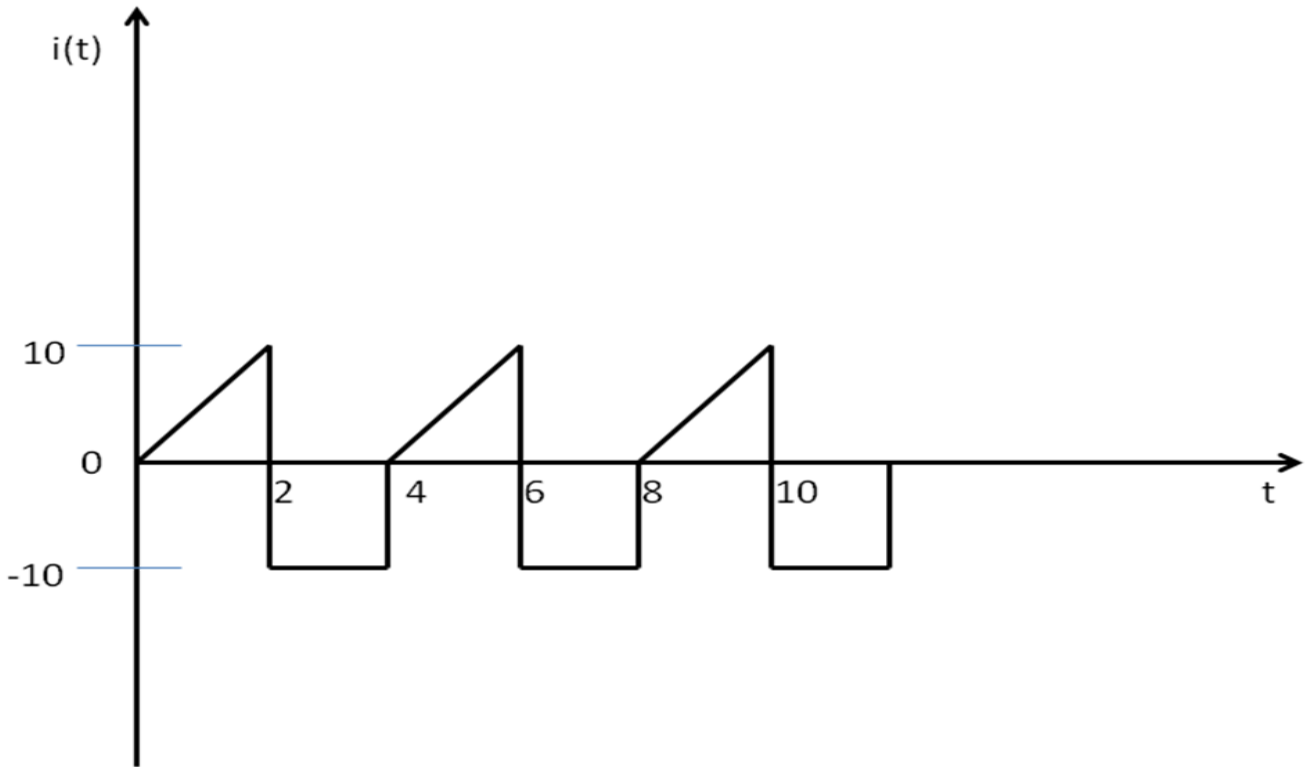
EE 1102H – Electric Circuits

AC Circuits

Practice Problems

Q1. Determine the rms value of the current waveform in the following **Figure**.



If the current is passed through a 2 Ohm resistor, find the average power absorbed by the resistor.

Solution: The period of the waveform is T=4.

Over a period, the current waveform can be written as

$$i(t)=\begin{cases}5t, & 0<t<2\\ -10, & 2<t<4\end{cases}$$

The rms value is

$$\mathrm{I}_{rms}=\sqrt{\frac{1}{T}\int_0^T i^2dt}=\sqrt{\frac{1}{4}\left[\int_0^2(5t)^2dt+\int_2^4(-10)^2dt\right]}$$

$$=\sqrt{\frac{1}{4}\left[25\frac{t^3}{3}\right]_0^2+\left[100t\right]_2^4}=8.165A$$

The power absorbed by 2 Ohm resistor is

$$\mathrm{P}=\mathrm{I}_{rms}^2R=(8.165)^2(2)=133.3W$$

Also, let *p(t)* be the instantaneous power.

Power absorbed by the resistor

= Real power

= Average power

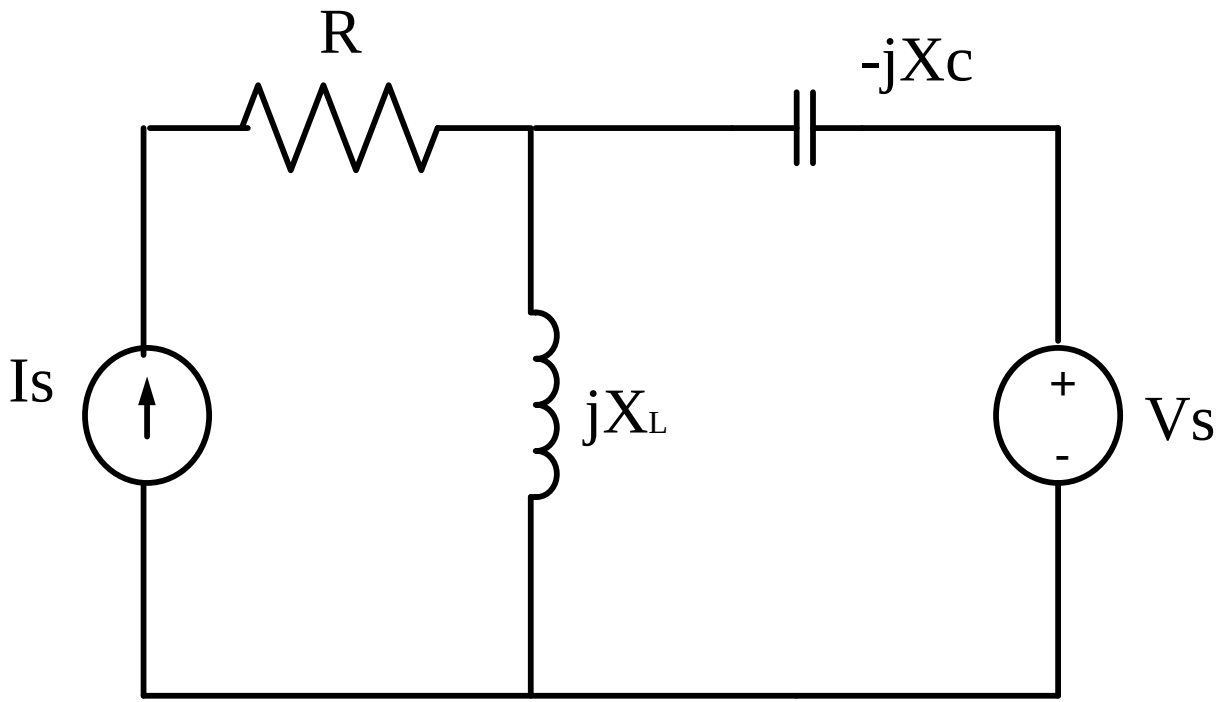
$= \frac{1}{T}\int_0^T p(t)\ dt$

$= \frac{1}{T}\int_0^T i(t)^2\ R\ dt$

*Substituting T, **i(t)** and R of the previous page in the above formula and simplifying, we get*

Average power $= \frac{400}{3} W$

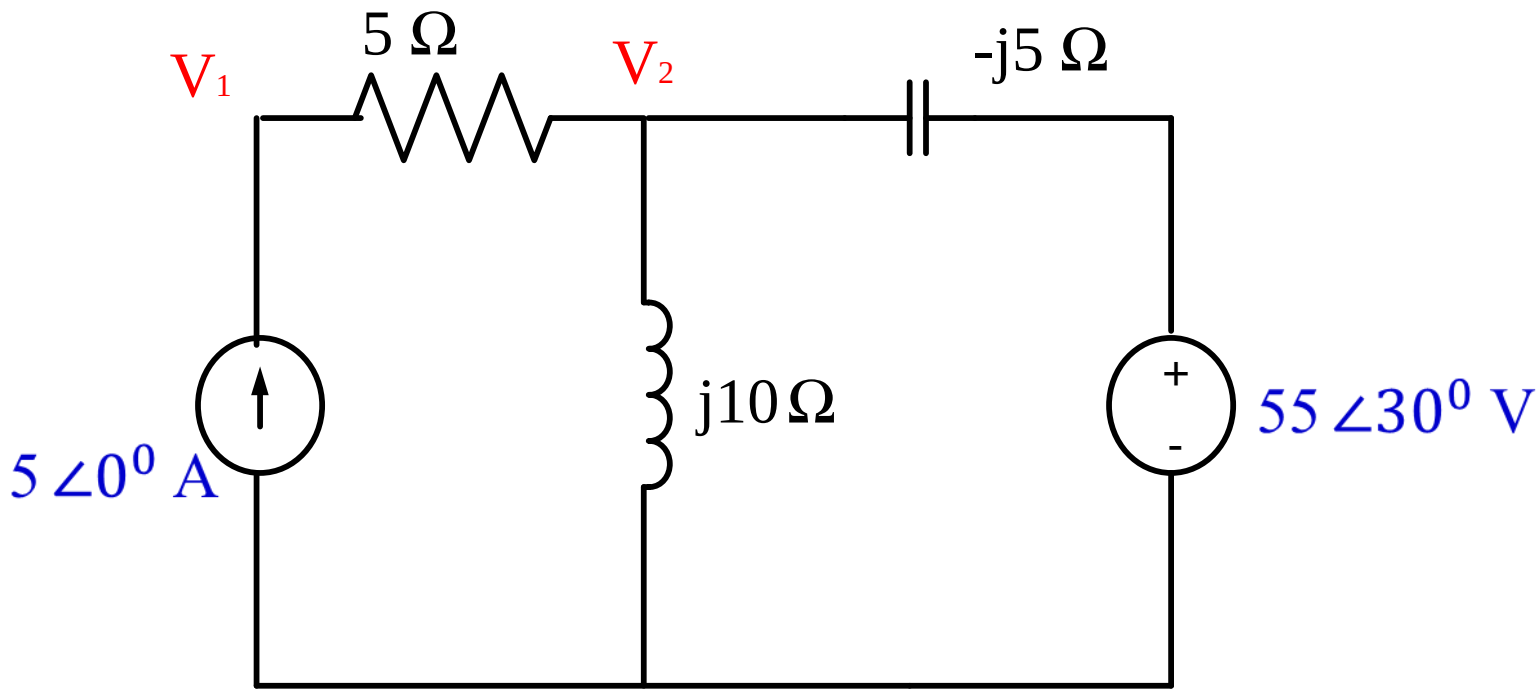
Q2. Find voltage across the current source and current through the inductor in the following circuit.



Given Is = 5 Sin wt A and Vs= 55 Sin $(wt+30^0)$ V

R = 5 Ohm X_L = 10 Ohm and X_c = 5 Ohm

Solution : Redraw the circuit using phasors



Hints : A ∠ θ = A (cos θ + j sin θ) = A e $^{j\theta}$; polar to rectangular form conversion

$$5\angle 0^0 + \frac{55\angle 30^0 - V_2}{-j5} = \frac{V_2}{j10}$$

$$\Rightarrow j50 - 2(55\angle 30^0 - V_2) = V_2$$

$$\Rightarrow V_2 = 95.263 + \text{j}5$$

$I_L = V_2/(\text{j}10) = 0.5 - \text{j}9.5263 = 9.5394 \angle -87^0$

$i_L(\text{t}) = 9.5394 \text{ Sin } (\text{wt-}87^0)$ A

Voltage across the current source:

$$V_1 = 5X5 + V_2 = 120.263 + j5$$
$$= 120.367 \angle 2.381^0$$

$$v_1(t) = 120.367 \text{ Sin } (wt + 2.381^0) \text{ V}$$

Verify your answers using some other circuit analysis techniques

END