

GRADES

PHYS 223 University Physics III Exam 5

November 19, 2014

Name

J. C. DALY

104
102
100
93
88

1. Find the phasor representation ($R e^{j\theta}$) for the following signals;

a. $15 \sin(\omega t)$ $15 \angle -90^\circ$

b. $5 \cos(\omega t + 10^\circ)$ $5 \angle 10^\circ$

Find the sinusoidal time function represented by the following phasors;

a. $10 + j10$ $10\sqrt{2} \cos(\omega t + 45^\circ) = 14.14 \cos(\omega t + 45^\circ)$

b. $4 e^{-j\pi/2}$ $4 \sin(\omega t)$

PHYS 223 University Physics III

Exam 5

November 19, 2014

2. The voltage source shown in Figure 2 has a frequency of 10.0 kHz and an RMS amplitude of 8.0 volts.

- What is the magnitude of the current, I ?
- What is the power dissipated in the resistor?

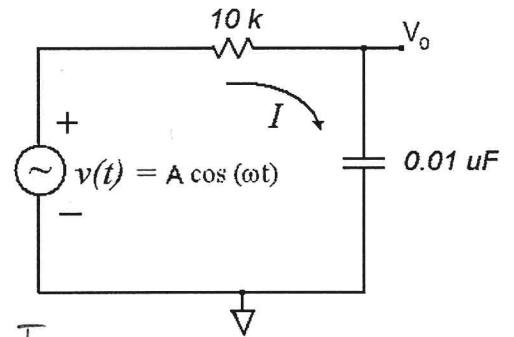


Figure 2

$$V = IR + \frac{I}{j\omega C} = (R - j\frac{1}{\omega C})I = ZI$$

$$Z = R - j/\omega C$$

$$\omega C = 2\pi \times 10^4 \times 10^{-8} = 2\pi \times 10^{-4}$$

$$\frac{1}{\omega C} = 1.59 \times 10^3$$

$$Z = (10 - j1.59) \times 10^3$$

$$I = \frac{V}{Z} = \frac{8 \times 10^{-3}}{10 - j1.59} =$$

$$a) \quad |I| = \frac{8 \times 10^{-3}}{\sqrt{10^2 + 1.59^2}} = 0.79\text{ mA}$$

$$b) \quad P = I^2 R = (0.79 \times 10^{-3})^2 \times 10 \times 10^3$$

$$P = 6.24 \times 10^{-3} = 6.24\text{ mW}$$

PHYS 223 University Physics III

Exam 5

November 19, 2014

3. Consider the circuit shown in Figure 3. The inductive reactance is 20 ohms. The capacitive reactance is 10 ohms.

- What is the magnitude and phase of the current, I ?
- What is the input impedance V/I ?

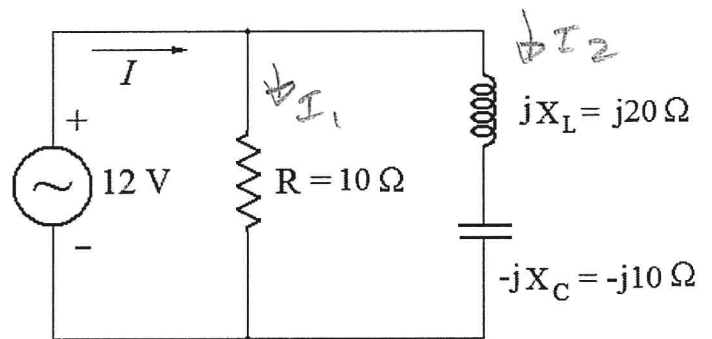


Figure 3

$$I = I_1 + I_2$$

$$I_1 = \frac{V}{R} = \frac{V}{10}$$

$$I_2 = \frac{V}{Z} \quad Z = jX_L - jX_C = j10$$

$$I_2 = \frac{V}{j10}$$

$$I = \frac{V}{10} - j\frac{V}{10} = V \left[\frac{1}{10} - \frac{j}{10} \right] = 12 \left[\frac{1}{10} - \frac{j}{10} \right]$$

$$I = 1.2 - j1.2 = \sqrt{2} * 1.2 \angle -45^\circ$$

$$I = 1.697 \angle -45^\circ$$

$$Z = \frac{V}{I} = \frac{12}{1.697} \angle 45^\circ = 7.07 \angle 45^\circ$$

PHYS 223 University Physics III

Exam 5

November 19, 2014

Extra Credit

4. Write Maxwell's Equations;

a. In Integral Form

b. In Differential Form

GAUSS' LAW

$$\oint \vec{E} \cdot d\vec{s} = \frac{1}{\epsilon_0} \int \rho \, dV$$

$$\oint \vec{B} \cdot d\vec{s} = 0$$

$$\oint \vec{E} \cdot d\vec{l} = - \frac{d}{dt} \int \vec{B} \cdot d\vec{s}$$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 \int (\vec{J} + \epsilon_0 \frac{\partial \vec{E}}{\partial t}) \cdot d\vec{s}$$

$$\vec{\nabla} \cdot \vec{E} = \rho / \epsilon_0$$

$$\vec{\nabla} \cdot \vec{B} = 0$$

$$\vec{\nabla} \times \vec{E} = - \frac{\partial \vec{B}}{\partial t}$$

$$\vec{\nabla} \times \vec{B} = \mu_0 \vec{J} + \mu_0 \epsilon_0 \frac{\partial \vec{E}}{\partial t}$$

c. In Words

1. Gauss' Law

The net electric flux through any closed surface is equal to the net electric charge enclosed within that surface divided by the permittivity of free space.

2. The net magnetic flux through any closed surface is equal to zero

3. Faraday's Law

The induced electromagnetic force in any closed circuit is equal to the negative of the time rate of change of the magnetic flux through the circuit.

4. Ampere's Law

The integral of the magnetic field around a closed circuit is equal to the conduction current and the displacement current through the circuit multiplied by the permeability of free space.