Special Assignment

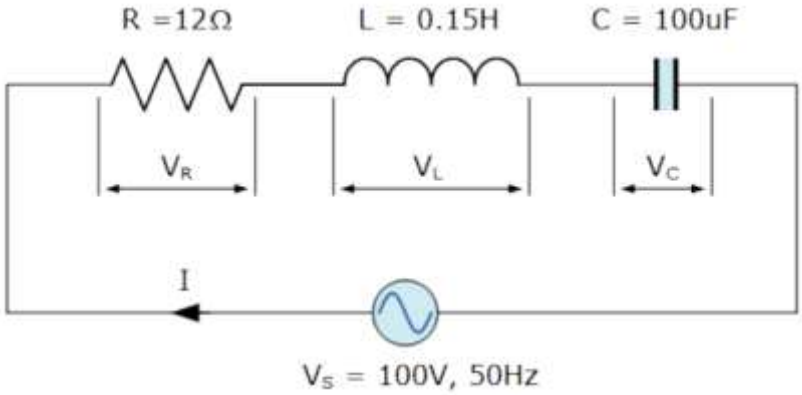
1. The 12-gauge Copper wire in a typical residential building has a cross – sectional area of 3.31 x 10^{-6} m^2. If it carries current of 10A, what is the drift speed of the electrons? Assume that each copper atom contributes one free electron to the current. The density of copper is 8.95 g / cm^3

   Molar mass of copper = 63.5 g/mol

   Avogadro number = 6.02 x 10^{23}

   Charge of an electron = 1.6 x 10^{-19} C

2. A series RLC circuit containing a resistance of 12Ω, an inductance of 0.15H and a capacitor of 100uF are connected in series across a 100V, 50Hz supply. Calculate the total circuit impedance, the circuits current, draw the voltage phasor diagram.



3. The phase velocity v of transverse waves in a crystal of atomic separation a is given by

$$v = c\left(\frac{\sin(ka/2)}{(ka/2)}\right)$$

where k is the wave number and c is constant. Show that the value of the group velocity is

$$c\cos\frac{ka}{2}$$

What is the limiting value of the group velocity for long wavelengths?

4. An AC generator consists of eight turns of wire, each having area A = 0.0900 m2, with a total resistance of 12.0 Ω . The coil rotates in a magnetic field of 0.500 T at a constant frequency of 60.0 Hz, with axis of rotation perpendicular to the direction of the magnetic field. (a) Find the maximum induced emf. (b) What is the maximum induced current? (c) Determine the induced emf and current as functions of time. (d) What maximum torque must be applied to keep the coil turning?

5. Find the matrix P which transform the following matrix A to the diagonal form. Hence calculate A^4.

$$A = \begin{pmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{pmatrix}$$