

Department of Physics, IIT Kanpur

Semester-1, 2016-17

PHY103 Problem Set # 12 Date: October 26, 2016 [RCB/Krishnacharya]

1. Consider that a parallel plate capacitor is being charged. The capacitor has circular plates of radius a separated by a distance d . Calculate the pointing vector. How does the energy enter the capacitor? Show that the rate of energy entering into the space between the plates is the same as the rate of change in the electrical energy.
2. A very long solenoid of radius a , with n turns per unit length, carries a current I_s . Coaxial with the solenoid, at radius $b \gg a$, is a circular ring of wire, with resistance R . When the current in the solenoid is gradually decreased, a current I_r is induced in the ring.
 - (a) Calculate I_r in terms of dI_s/dt .
 - (b) The power ($I_r^2 R$) delivered in the ring must have come from the solenoid. Confirm this by calculating the Poynting vector just outside the solenoid. Integrate over the entire surface of the solenoid, and check that you recover the correct total power.
3. Show that the standing wave $f(z,t) = A \sin(kz) \cos(kvt)$ satisfy the wave equation, and express it as the sum of wave traveling to the left and a wave traveling to the right. If the frequency of the wave $\nu = 65$ Hz, and velocity $v = 343$ m/s, find the angular frequency ω , wave number k and the wavelength λ .
4. Write down the electric and magnetic fields for a monochromatic plane wave of amplitude E_0 , frequency ω , and phase angle zero that is (a) traveling in the negative x direction and polarized in the z direction; (b) Traveling in the direction from the origin to the point $(1,1,1)$, with polarization parallel to the xz plane. In each case sketch the wave and the explicit Cartesian components of \mathbf{k} and $\hat{\mathbf{n}}$.
5. The intensity of sunlight hitting the earth is about 1300 W/m^2 . If the sunlight strikes a perfect absorber, what pressure does it exert? How about the perfect reflector? What fraction of atmospheric pressure does it amount to?