Physics of Waves

PH11003

Tutorial 6

ElectroMagneticWaves

31 December 2022

[6.1] A plane harmonic em wave with plane polarization propagates in vacuum. The electric component of the wave has a strength amplitude $E_m = 50\ mV/m$, the frequency is $\nu = 100\ MHz$, Find (a) the rms value of the displacement current density, (b) the mean energy flow averaged over an oscillation period.

[6.2] Find the mean radiation power of an electron performing harmonic oscillations with amplitude $a = 0.10\ nm$ and frequency $\omega = 6.5 \times 10^{14}\ s^{-1}$.

[6.3] An em wave emitted by an elementary dipole propagates in vacuum so that in the far field zone the mean value of the energy flow density is equal is equal to S_0 at the point removed from the dipole by a distance r along the perpendicular drawn to the dipole's axis. Find the mean radiation power of the dipole.

[6.4] The mean power radiated by an elementary dipole is equal to P_0. Find the mean space density of energy of the em field in vacuum in the far field zone at the point removed from the dipole by a distance r along the perpendicular drawn to the dipole's axis.

[6.5] A system consists of two coherent point sources 1 and 2 located in a certain plane so that their dipole moments are oriented at right angles to that plane. The sources are separated by a distance d, the radiation wavelength is λ. Taking into account that the oscillations of source 2 lag in phase behind the oscillations of source 1 by ϕ ($\phi < \pi$), Find (a) the angles θ at which the radiation intensity is maximum. (b) the conditions under which the radiation in the direction $\theta = \pi$ is maximum and in the opposite direction, minimum.

Answer Keys