A

23. A beam of light is incident normally on a diffraction grating of width 2 cm. It is found that at 30°, the n^{th} order diffraction maximum for $\lambda_1 = 5000$ Å is super-imposed on the $(n+1)^{th}$ order for $\lambda_2 = 4000$ Å. How many lines per cm does the grating have? Find out whether the first order spectrum from such a grating can be used to resolve the wavelengths $\lambda_3 = 5800$ Å and $\lambda_4 = 5802$ Å?

A

24. Consider two electromagnetic plane waves propagating in vacuum with their electric field vectors $\vec{E}_1 = E_0 \cos(k z - \omega t)\hat{i}$ and $\vec{E}_2 = E_0 \cos(k z + \omega t)\hat{i}$.

(a) Evaluate the magnetic field vector corresponding to the superposition of these two waves.

(b) Calculate the time-averaged energy density as well as the time-averaged Poynting vector for the resultant wave. (The time average is carried over one period of oscillation).

25. A 150 Ω resistor, a 10 μF capacitor and a 0.1 H inductor are connected in series to an a.c. source operating at an angular frequency ω.

(a) Find the value of ω for which the combination acts as a pure resistive load.

(b) The a.c. source is operated at a peak voltage of $300\sqrt{2}$ V and a frequency equal to half the resonance frequency of the circuit. Find the peak value of the current in the circuit and the phase difference between the current and voltage. Also, find the peak voltage across the inductor.