Dr. Subhash Chand 24/11/2023 (12.1)

Department of Physics and Photonics Science, NIT Hamirpur
B.Tech. Engineering Physics
End Semester Examination November, 2023

Electromagnetic Theory (PH-213) **Total Marks = 50** **Time: 3.00 hrs**

Note: ***Attempt all the questions.***

Q. No.	Question statement	Marks
1	Starting with the Maxwell's equations derive continuity equation.	(5)
2	Solve Maxwell's equations in a conducting medium and discuss attenuation behavior of electromagnetic fields. Obtain an expression for skin depth in terms of medium and wave properties.	(5)
3	How far away from a light bulb that emits 60 watt of radiant energy uniformly in all directions, the E filed amplitude will be 20 V/m.	(5)
4	If $\frac{1}{2}(\vec{E}.\vec{D} + \vec{H}.\vec{B})$ represent the total energy density associated with an electromagnetic fields, then show that the wave energy is equally shared between electric and magnetic fields.	(5)
5 (a)	Write define of uniqueness theorem.	(2)
(b)	The magnetic vector potential in the region is given as $\overrightarrow{A} = (y^2\hat{i} + x^2\hat{j})$. Estimate the magnetic induction B and current density J associated with this potential.	(3)
6	An e.m. wave with its electric field vector E parallel to the plane of incidence travels from one medium to another and ratio of reflected and incidence amplitudes of the electric field are given as $\frac{E_r}{E_i} = \frac{\tan(\theta_i - \theta_t)}{\tan(\theta_i + \theta_t)}$. Using this discuss the nature of reflected wave. Graphically show this ratio for incident angle 0 to 90°. Also discuss concept of Brewster angle, and estimate it value for wave incidence from air (refractive index 1) to glass (refractive index 1.5).	(5)
7	What is magnetic vector potential. Starting with Biot-Savart's law obtain an expression for magnetic vector potential.	(5)
8	Show that a conducting loop carrying current I, is equivalent to a magnetic dipole. Estimate the magnetic moment of this dipole.	(5)
9	Describe the situation in which the magnetic flux density may be expressed in terms of magnetic scalar potential. Show that the magnetic scalar potential satisfies the Laplace's equation.	(5)
10	What is an electrical image. Estimate electrical field strength at any point (x,y,z,) near a point charge q and a grounded infinite conducting plane.	(5)

Constants: The $\varepsilon_o = 8.85\times10^{-12}$ F/m, $\mu_o = 4\pi\times10^{-7}$ Wb/amp-m.

***Good Luck ***