

Assignment 1

Instructions

- Go through the relevant content in the prescribed textbook and the learning material and write down answers to these questions in your own words in your Physics Assignment notebook.
- Submit the hard copy to me for correction on or before the due date
- Later, you need to scan the corrected assignment and upload in Moodle

Due date: 26 October 2022 (for submission of hard copy)

Maximum marks: 50 (Will be rescaled to 10)

Questions

A. Short Answer Questions

5 x 2 = 10 marks

1. What does divergence of electric field imply?
2. What is the physical meaning of $\nabla \cdot \mathbf{B} = 0$?
3. Define displacement current.
4. List the advantages of communicating over optical fibers when compared to copper wires.
5. What is the significance of the normalized frequency of an optical fiber being less than 2.405?

B. Essay Answer Questions

5 x 5 = 25 marks

1. Write Ampere-Maxwell law of Induction in complete integral form and then obtain the differential form by using Stoke's theorem.
2. Derive equation of continuity and mention its significance.
3. State and explain Maxwell's equations of electromagnetism in both the differential and integral forms.
4. Derive an expression for the acceptance angle and the numerical aperture of an optical fiber with core and cladding refractive indices being n_1 and n_2 . Assume that it has been placed in a medium with refractive index n_0 .
5. Explain single mode, multimode, step-index and graded-index fibers with relevant illustrations.

C. Problems

5 x 3 = 15 marks

1. Two equal and similar charges 3 cm apart, in air repel each other with a force equivalent to 1.5N. Calculate the magnitude of each charge.
2. Calculate the electrostatic force experienced by a positive point charge of magnitude $0.02 \mu\text{C}$ placed at a distance of 1 cm from the surface of $2 \mu\text{C}$ positively charged non-conducting sphere of radius 2 cm.
3. If a vector function $\mathbf{E} = x^2y\vec{i} - (z^3 - 3x)\vec{j} + 4y^2\vec{k}$, then compute the divergence of \mathbf{E} .
4. Calculate the numerical aperture of an optical fiber in water. Given $\mu_{\text{core}}=1.51$, $\mu_{\text{cladding}}=1.49$ and $\mu_{\text{water}}=1.33$.
5. An optical fiber has a core of refractive index 1.563 and a cladding of refractive index 1.498. Determine Acceptance angle and Numerical aperture of the fiber in water with refractive index 1.33.