



Vidyavardhini's College of Engineering and Technology, Vasai (West)

First Year Engineering

Academic Year: 2024-2025

Assignment No.: 3 (Electrodynamics)

Subject: BSC102/AP

Date: 15/11/2024

Total Marks: 30

Submission Deadline: 22-11-2024

Note: All Questions are Compulsory

Q1. Gradient, Divergence and Curl

- (a) What are scalar and vector fields? How is a del operator expressed? (3 Marks)
- (b) If $\phi(x, y, z) = 3x^2y - y^3z^2$, find $\nabla\phi$ at the point $(-1, -2, 1)$. (2 Marks)
- (c) What is the divergence of a vector field? Find the divergence of a field $\mathbf{F} = xz\hat{i} + y^2z^3\hat{j} - xyz\hat{k}$ at a point $(3, -1, 2)$. Interpret the result you obtain. (5 Marks)
- (d) Explain the term 'curl of a vector' and state its significance. Show that the divergence of the curl of a vector is zero. (5 Marks)

Q2. Maxwell's Equations

- (a) Explain Gauss's laws for static electric and static magnetic fields in differential and integral forms. (5 Marks)
- (b) State and derive Maxwell's equation in differential form which describes how the electric field circulates around the time-varying magnetic field. (5 Marks)
- (c) Obtain Ampere's circuital law for a static magnetic field in differential and integral forms. (5 Marks)

These equations unified the concepts of electricity and magnetism, establishing that they are interrelated phenomena of a single entity: electromagnetism.

NB: *James Clerk Maxwell, in the 1860s, mathematically demonstrated that electric and magnetic fields can propagate through space as waves, traveling at a finite speed. When he calculated this speed, it matched the measured speed of light. This groundbreaking discovery led to the realization that light is an electromagnetic wave—a combination of oscillating electric and magnetic fields moving through space. It not only explained the nature of light but also paved the way for understanding the entire electromagnetic spectrum, from radio waves to gamma rays.*

Maxwell's work revolutionized physics and formed the foundation for modern technologies like wireless communication, optics, and quantum mechanics.