

EE2104 Introduction to Electromagnetics
Assignment 1

Deadline (for uploading): 7:00 pm, 19 Sep 2020
Please put down your name and university ID.

1. Given the vectors $\mathbf{M} = -10\hat{x} + 4\hat{y} - 8\hat{z}$ and $\mathbf{N} = 8\hat{x} + 7\hat{y} - 2\hat{z}$. Find:
- (a) the unit vector pointing from $\mathbf{M}$ to $\mathbf{N}$;
 - (b) $\mathbf{M} \cdot \mathbf{N}$;
 - (c) the angle between $\mathbf{M}$ and $\mathbf{N}$;
 - (d) $\mathbf{M} \times \mathbf{N}$; and
 - (e) an unit vector perpendicular to both $\mathbf{M}$ and $\mathbf{N}$.

2. A field is given as

$$\mathbf{G}(x, y) = 7 \frac{x\hat{x} + y\hat{y}}{x^2 + y^2}$$

Find:

- (a) the unit vector in the direction of $\mathbf{G}$ at $P(4, -2)$ and
- (b) the angle between $\mathbf{G}(x, y)$ and $\hat{x}$ at P .

3. Show that the two vector fields

$$\begin{aligned}\mathbf{A}(\rho, \phi, z) &= \rho^{\frac{3}{2}} \cos\phi \hat{\rho} + \rho^{\frac{3}{2}} \sin\phi \hat{\phi} + \rho \hat{z} \\ \mathbf{B}(\rho, \phi, z) &= \rho^{\frac{1}{2}} \cos\phi \hat{\rho} + \rho^{\frac{1}{2}} \sin\phi \hat{\phi} - \rho \hat{z}\end{aligned}$$

are everywhere perpendicular to each other.

4. Consider a line at $y = L$ to $2L$. It contains electric charge of density $\rho_L = \rho_{L0}(y/L)^{-2}$ for some constant ρ_{L0} in C/m. Find the total charge of this line.
5. In the cylindrical coordinate systems, the six surfaces: $\rho = 3, \rho = 5, \phi = 100^\circ, \phi = 170^\circ, z = 3$, and $z = 5$ define a closed surface. Find:
- (a) the enclosed volume;
 - (b) the total area of the enclosing surface; and
 - (c) the total length of the twelve edges of the surfaces.