

EE2104 Introduction to Electromagnetics
Assignment 1

Deadline (for uploading): 11:59 pm, 16 Sep 2021
Please put down your name and university ID.

- Given the vectors $\mathbf{M} = 100\hat{x} + 24\hat{y}$ and $\mathbf{N} = 38\hat{x} + 37\hat{y}$. Draw the two vectors and then find:
 - the unit vector pointing from $\mathbf{M}$ to $\mathbf{N}$;
 - $\mathbf{M} \cdot \mathbf{N}$;
 - the angle between $\mathbf{M}$ and $\mathbf{N}$;
 - $\mathbf{M} \times \mathbf{N}$; and
 - an unit vector perpendicular to both $\mathbf{M}$ and $\mathbf{N}$.

- A field is given as

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

Find:

- the unit vector in the direction of $\mathbf{G}$ at $P(3, 3)$ and
 - the angle between $\mathbf{G}(x, y)$ and $\hat{x}$ at P .
- For two vector fields
$$\mathbf{A}(\rho, \phi) = \rho^{\frac{3}{2}} \cos\phi \hat{\rho} + \rho^{\frac{3}{2}} \sin\phi \hat{\phi},$$
$$\mathbf{B}(\rho, \phi) = \rho^{\frac{1}{2}} \cos\phi \hat{\rho} + \rho^{\frac{1}{2}} \sin\phi \hat{\phi},$$
is there any point in space with $\mathbf{A}$ and $\mathbf{B}$ being perpendicular? Please provide clear reasoning using mathematics.
 - Consider a line at $y = L$ to $5L$. It contains electric charge of density $\rho_L = \rho_{L0}(y/L)^{-20}$ for some constant ρ_{L0} in C/m. Find the total charge of this line.
 - In the cylindrical coordinate system, the six surfaces: $\rho = 3, \rho = 5, \phi = 0^\circ, \phi = 30^\circ, z = 0$, and $z = 5$ define a closed surface.
 - Sketch the volume enclosed by the six surfaces as a 3D picture.
 - Calculate the enclosed volume.