ECE-390 Homework 2

25 pt in total, Due date: 10/12 online

Problem 1 (8 pt)

3.5 Given vectors $\mathbf{A} = \hat{\mathbf{x}} + \hat{\mathbf{y}}2 - \hat{\mathbf{z}}3$, $\mathbf{B} = \hat{\mathbf{x}}2 - \hat{\mathbf{y}}4$, and $\mathbf{C} = \hat{\mathbf{y}}2 - \hat{\mathbf{z}}4$, find

(a) A and $\hat{\mathbf{a}}$,

(b) the component of $\mathbf{B}$ along $\mathbf{C}$,

(c) θ_{AC},

(d) $\mathbf{A} \times \mathbf{C}$,

(e) $\mathbf{A} \cdot (\mathbf{B} \times \mathbf{C})$,

(f) $\mathbf{A} \times (\mathbf{B} \times \mathbf{C})$,

(g) $\hat{\mathbf{x}} \times \mathbf{B}$, and

(h) $(\mathbf{A} \times \hat{\mathbf{y}}) \cdot \hat{\mathbf{z}}$.

Problem2 **(a) and (d)** only (4 pt)

3.35 Transform the following vectors into spherical coordinates and then evaluate them at the indicated points:

(a) $\mathbf{A} = \hat{\mathbf{x}}y^2 + \hat{\mathbf{y}}xz + \hat{\mathbf{z}}4$ at $P_1 = (1, -1, 2)$

(b) $\mathbf{B} = \hat{\mathbf{y}}(x^2 + y^2 + z^2) - \hat{\mathbf{z}}(x^2 + y^2)$ at $P_2 = (-1, 0, 2)$

*(c) $\mathbf{C} = \hat{\mathbf{r}}\cos\phi - \hat{\boldsymbol{\phi}}\sin\phi + \hat{\mathbf{z}}\cos\phi\sin\phi$ at $P_3 = (2, \pi/4, 2)$

(d) $\mathbf{D} = \hat{\mathbf{x}}y^2/(x^2 + y^2) - \hat{\mathbf{y}}x^2/(x^2 + y^2) + \hat{\mathbf{z}}4$ at $P_4 = (1, -1, 2)$

Problem 2 (4pt): Question 3.49

3.49 For the vector field $\mathbf{D} = \hat{\mathbf{R}}3R^2$, evaluate both sides of the divergence theorem for the region enclosed between the spherical shells defined by $R = 1$ and $R = 2$.

Problem 3 (6pt): Prove that 1) $\nabla \cdot (\nabla \times \vec{A}) = 0$; and 2) $\nabla \times (\nabla V) = 0$

Problem 4 (3pt): find a, b and d

4.5 Find the total charge on a circular disk defined by $r \leq a$ and $z = 0$ if:

(a) $\rho_s = \rho_{s0} \cos\phi$ (C/m^2)

(b) $\rho_s = \rho_{s0} \sin^2\phi$ (C/m^2)

(c) $\rho_s = \rho_{s0} e^{-r}$ (C/m^2)

(d) $\rho_s = \rho_{s0} e^{-r} \sin^2\phi$ (C/m^2)

where ρ_{s0} is a constant.