Quiz 1, ECED 3300

Instructor: Sergey A. Ponomarenko.

Place, Date and Time: B308; Friday October 5, 2018, 3:05 to 4:05 pm.

Closed Books: Formula sheets are provided; no calculators are allowed.

Hint: *Make sure to justify all your answers to get full credit.*

Problem 1

Given a vector field

$$\mathbf{A} = \frac{\mathbf{a}_\phi \sin\theta}{r^2},$$

determine

a) the curl of $\mathbf{A}$,

b) the circulation of $\nabla \times \mathbf{A}$ along a circle of unit radius in the xy-plane, centered at the origin.

Problem 2

a) Determine the flux of a vector field $\mathbf{M} = \mathbf{r}$, where $\mathbf{r}$ is a position vector, through a unit sphere centered at the origin.

b) What is a **vector** projection of $\mathbf{r}$ **orthogonal** to the direction specified by the unit vector $\mathbf{a}_z$?

Problem 3

The temperature in a room is distributed according to

$$T(\mathbf{r}) = \exp(-\rho^2/2 - z^2).$$

A mosquito, entering the room at the point $(1, 1, 1)$, flies in the direction of the fastest temperature increase. What direction does the mosquito fly in?

Hint: Make sure to apply your vector algebra/calculus knowledge to justify all your answers to get full credit!