Engineering Assignment:

Flux

Student learning outcomes:

2.7.4	Convert from rectangular to spherical coordinates
2.3.1	Calculate the dot product of two given vectors
2.4.1	Calculate the cross product of two given vectors
2.4.2	Use determinants to calculate a cross product
6.2.4	Describe the flux and circulation of a vector field
6.4.3	Calculate circulation and flux on more general regions
6.7.3	Use Stokes' theorem to calculate a surface integral

Assignment Overview

Recall Flux=$\int\int_S \vec{F}\cdot\vec{n}\,dS$ gives the flux of a vector field F with unit normal vector n

through a surface S.

Exercise 1: Find the flux where vector field $\vec{F}=<x^2,y^2,z>$ and S is the surface given by the paraboloid $z=1-x^2-y^2$ and $z\geq 0$.

Gauss's Law for electric field states that the flux through a closed surface is

$$\Phi_E=\oint_S \vec{E}\cdot\vec{n}dA=\frac{Q}{\epsilon_0},$$

for any closed surface S containing charge Q, where E is the electric field, and ϵ_0 is a constant representing the permittivity of free space in C/Vm.

Exercise 2: Find the electric flux through the surface of a charged sphere with radius 2 meter,

when the charge Q is $2 \times 10^{-10} C/m^2$. Use 2 methods with each part of Gauss's Law.