Chapter 4
Flux of a Vector Field

In this chapter we concentrate on aspects of vector calculus. A common physical application of this theory is the fluid flow problem of calculating the amount of fluid passing through a permeable surface. The abstract generalization of this leads us to the flux of a vector field through a regular 2-surface in $\mathbb{R}^3$. More precisely, let the vector field $F$ in $\mathbb{R}^3$ represent the velocity vector field of a fluid. We immerse a permeable surface $S$ in that fluid, and we are interested in the amount of fluid flow across the surface $S$ per unit time. This is the flux integral of the vector field $F$ across the surface $S$. 