ChBE 6260: Mass Transfer *(core course)*
Credit: 3

Suggested Prerequisites:
Transport I (fluid mechanics, heat transfer), transport II (heat transfer, mass transfer)

Catalog Description:
Mathematical description of mass transport processes, including analytical solutions for steady state, transient, and multi-dimensional diffusion.

Textbook:
Analysis of Transport Phenomena, William M. Deen, Oxford University Press (2012), 2nd edition.

Course Objectives:
This course explores a wide range of mass transfer behavior for binary and multicomponent systems that are encountered in chemical engineering. Special attention will be given to developing mathematical solutions to common steady and transient mass transfer problems, with an emphasis on understanding the physical implications of such systems. Fick's law, flux definitions, constitutive equations, and conservation equations will be developed. Steady and transient mass transfer by diffusion will be analyzed in detail along with convective mass transfer, mass transport in flowing media, and free convection. Models will also be developed for mass transfer with simultaneous homogeneous or heterogeneous reaction and simultaneous heat and mass transfer. Attention is also given to the development of boundary layer theory and correlations for mass transfer by forced convection. Special topics may include: membrane separation processes, drug delivery and controlled release, and adsorption separations.

Learning Outcomes:
By the end of this course, a student should be able to:
1. Develop conservation laws, constitutive equations, modes of transport, and diffusive fluxes and materials properties for a mass transfer problem.
2. Identify boundary conditions and reduce dimensionality of a problem.
3. Identify appropriate mathematical methods for determining concentration profiles.
4. Justify the selection of a given solution approach for a given problem.
5. Perform dimensional analysis and scaling.
6. Identify/develop correlations for mass transfer when analytical solutions cannot be obtained.
7. Apply these techniques to problems encountered in chemical engineering research settings.

Representative Topical Outline:
1. Diffusive fluxes and material properties
2. Conservation equations
3. Diffusion/reaction systems and nondimensionalization
4. Perturbation methods for mass transfer
5. Transient, one-dimensional diffusion in semi-infinite media
6. Forced convection
7. Multicomponent mass transfer and simultaneous heat and mass transfer.