Introduction to Microfluidics and Nanofluidics

MECHENG 6515

Credit Hours:
3.00 - 3.00

Course Levels:
Graduate (5000-8000 level)

Course Components:
Lecture
Lab

Course Description:
Principles of incompressible fluid mechanics & electrokinetic phenomena at the micro & nanoscale; biomedical applications with a laboratory illustrating fabrication techniques & experimental methods. Undergrad students encouraged to seek permission.

Prerequisites and Co-requisites:
Prereq: 3503 or 3504 (504) or equiv, or Grad standing in Engineering, or permission of instructor.

Course Goals / Objectives:
• Be able to derive the fundamental equations of fluid flow in micro-/nanofluidic systems for pressure driven flow
• Be able to derive the fundamental equations of fluid flow in micro-/nanofluidic systems for electrokinetic flow
• Be able to explain the effects of shear forces on biomolecules and derive equations that provide amount of shear on biomolecules in flow systems
• Be able to explain the use of micro-/nanofluidic systems for biochemical analysis systems
Course Topics:
- Definition of a fluid Stress in a fluid Internal viscous flow
- Fluid slip Mass transfer fundamentals
- Electrostatics Electrolyte solutions Electric double layer
- Basics of biophysical chemistry Types of biomolecules and biomolecular structure, esp. DNA and proteins
- Diagnostics of biofluids
- Electrokinetic phenomena (electroosmosis, electromigration, electrophoresis)
- Introduction to microfabrication, advanced fabrication, and nanofabrication methods
- Experimental techniques for nanochannel flows (capillary filling, pressure filling, device packaging)
- Flow characterization in microchannels and nanochannels (I-V measurements, fluorescence)

Designation:
Elective