

## CHBE481 - ENCH648W, Fall 2019

### Transport Phenomena in Small and Biological Systems

#### Instructor:

Dr. Panos Dimitrakopoulos

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Office hours: Monday and Wednesday: 3:00-4:00pm

Course web: ELMS Enterprise Learning Management System

Class: Monday and Wednesday: 5:00pm-6:15pm (CHE 2136)

#### Course Description:

Interdisciplinary course primarily for senior undergraduate and graduate students from engineering or science departments. The course's main goal is to make the students familiar with the fundamental physics and modeling of transport phenomena in small and biological systems, and their current scientific and engineering utilization in microfluidics, nanofluidics and biological systems.

The course gives emphasis on small-scale complex systems such as transport physics at the micro- and nano-scale, hydrodynamics, diffusion, mixing and electrostatics of small-scale systems. In addition, the course focuses on physiological transport phenomena including fluid flow in circulation and tissues, mass transport in biological systems, blood flow, hemodynamics and hemopathology, cell adhesion and transport in organs.

#### For the Fall 2019 semester, the course contains the following chapters:

- (a) Transport Phenomena: Governing Equations and BCs - review
- (b) Lubrication Theory
- (c) Droplet dynamics in micro-channels
  - Non-lubrication and lubrication relevant theories
- (d) Membrane description and moduli
  - Capsule dynamics in basic flows
  - Asymptotic theories for capsules: small and large deformations
- (e) Erythrocyte description and physiological role
  - Erythrocyte dynamics in basic flows
  - Multi-body effects of erythrocytes in vascular vessels
- (f) Leukocyte description and physiological role
  - Theories on adherent leukocytes and other cells
- (g) Vascular endothelium
- (h) Further chapters may include oxygen delivery in tissues, flow in porous media, etc, if time permits.

#### Recommended Textbooks:

Any undergraduate or graduate book on Transport Phenomena

*Introduction to Microfluidics*, by Patrick Tabeling, Oxford University Press (2005).

Please note that the course relies on class notes and review papers.