ME 619 Fundamentals of Micofluidics_(3 - 0 - 0 - 6)

Fundamentals of kinetic theory-molecular models, Micro and macroscopic properties, Concept of miniaturization, scaling laws for micro-domains, Fundamentals of microscale flow physics, Deviations from the continuum hypothesis. Introductory concept on gas flows: Transitional and free molecular regimes, Maxwell first order slip model and accommodation coefficients, Effects of compressibility, Analysis of thermo-fluidic transport in microscale gas flows and its applications.**:** Low Reynolds number hydrodynamics, different scales, Effect of apparent slip: Navier slip effects, Physics of near-wall microscale liquid flows, Unsteady microflows and different time scales, Oscillatory flow problem through microfluidic confinements, Effect of confinements, Implication of low Reynolds number hydrodynamics on energy equation and species conservation equation, Surface tension driven flows and microcapillary transport, Young Laplace equation and concept of contact angle, Dynamics of Capillary rise, Capillary filling dynamics.**:** From Basics to applications, thermodynamic background, electroosmotic flows-EDL phenomena, electrosmosis, electrophoresis, dielctrophoresis, analysis of hydro-dynamically and thermally fully developed electro-osmotic flows, ac electro-osmosis, electroosmotic flow of non-Newtonian fluids, introduction to bio-microfluidics, An introduction to modeling of electrically actuated microscale two phase flows.

Text/References:

(1) Henrik Bruus, Theoretical Microfluidics, Volume 18 of Oxford master series in condensed matter physics, 2007.
(2) John Happel, Howard Brenner, Low Reynolds number hydrodynamics, Springer, 1983.
(3) L. Gary Leal, Advanced Transport Phenomena Fluid Mechanics and Convective Transport Processes, First Edition, Cambridge Series in Chemical Engineering, 2007
(4) Suman Chakraborty, Microfluidics and Microfabrication, First Edition, Springer, 2010.
(5) Patrik Tabeling: Introduction to Microfluidics, Oxford University Press, 2011 (Reprint).