ChE 410  ADVANCED TRANSPORT PHENOMENA  
Term: Fall 2018    Instructor: Vivek Sharma  

Course Outline  
(A few topics will be added or altered based on the class participation and performance)  

Lectures 1-5: All is flux. Everything flows.  
Review of conservation equations, constitutive relationships and material properties underlying momentum, heat and mass transport. Governing equations and boundary conditions. Non-dimensionalization, scaling and dimensionless groups. Solving unsteady & steady state problems with linear PDEs & ODEs. (Expected from students: a rapid-fire review of topics covered in CHE 311/312 or standard undergraduate chemical engineering transport course).  
Self-similar solutions and similarity transformations. Introduction to regular perturbation theory.  
Deen: Chapters 1-4, Appendix A-B; Leal: Chapter 1-3 (Select sections)  
BSL: Chapters 1-3 & 4.1, Chapters 9-11 & 12.1-12.2, Chapters 17-19 & 20.1, Appendix A-C  
Leal: Chapter 2 A, B, D, G, etc. Probstlein: Chapters 1-3.  

Lectures 6-9: Fundamentals of fluid mechanics  
Deen: Chapter 6; BSL: Chapters 1-4. Appendix A-C  

Lectures 10-13: Nearly unidirectional transport: skipping stones & measuring viscosity  
Deen: Chapter 6-7; Supplemented by sections from Leal and Middleman.  
Leal: Selected topics from Chapter 5-6.  

Lectures 14-16: Microhydrodynamics, swimming with bacterium, colloidal hydrodynamics  
Deen: Chapter 8.  
Selections from BSL, Leal (Chapter 7 &10), GHPM and Middleman  

Lectures 17-20: Charge Transfer & Charge Transport  
Deen: Chapter 4 & 15, Appendix A-B; Supplemented with sections from Newman, Cussler & Probstein.  

Lectures 21-24: Viscous Flows and Convection; Convective Transport  
Application of scaling and asymptotic methods to transport problems and fluid dynamics. Weak convection effects. High Re flows and convective transport. Boundary layers.  
Selected topics from Leal and Middleman  

Lectures 25-26: Special topics: Inkjet printing, coating flows and pattern formation.  
Selections from Leal (Chapter 12), Middleman and GHPM, plus Deen (Chapter 12 & 15)  

Lectures 27-28  
Student projects/presentations OR additional special topics.