

CH 203 Transport Phenomena August-December 2015

Date	Topic	Reading/Assignment
04/08/15	Introduction to transport processes.	
06/08/15	Unit operations using dimensional analysis. Limitations of this approach.	Chapter 1, FTP1 Lec 1-4
	Assignment Due 13/08/15	FTP 1.2,1.3
11/08/15	Transport by convection and diffusion. Diffusion due to random motion. Estimates of diffusion coefficient from kinetic theory and for turbulent flow.	Chapter 2. BSL 1, 8, 16; Cussler 5; FTP1 Lec 5-7
12/08/15	Tutorial — Diffusion.	FTP 2.3,2.4.
13/08/15	Steady and unsteady diffusion in one dimension. Solution for heat conduction from a plate in one dimension, fluid flow for an impulsively started plate. Separation of variables solution for impulsively started flow in a channel.	Chapter 2 BSL 4.1, 4.4, Leal 3 A-D; FTP1 9-10
	Assignment due 18/08/15	FTP 2.1,2.5,2.6.
18/08/15	Orthogonality relations for impulsively started flow. Oscillatory flow in a pipe — solutions using complex variables.	Chapter 3. BSL 2.2,2.3, Leal 3 A-D, FTP1 Lec 20.
19/08/15	Tutorial 3.	FTP 3.1
20/08/15	Oscillatory flow in a pipe in the limit of low and high Re. Boundary layer solutions in the limit of high Re. Balance laws for stationary control volumes for mass and energy in Cartesian coordinate.	FTP1 Lec 21-22
	Assignment due 25/08/15	FTP 3.4
25/08/15	Balance laws in Cartesian coordinate. Balance laws in spherical coordinate.	Chapter 4. BSL 3.4
26/08/15	Tutorial 4	FTP 3.5.
27/08/15	Diffusion dominated transport. Temperature due to a spherically symmetric source. Separation of variables for temperature field in spherical coordinates.	Chapter 5. Leal 3C, 4D-E. FTP1 Lec 29-30.
	Assignment due 01/09/15	FTP 4.2, 4.3.

Date	Topic	Reading
01/09/15	Temperature field for conduction around spherical inclusion and conductivity of a composite. Multipole expansions.	Chapter 5. Leal 3C, 4D-E. FTP1 Lec 31,32.
02/09/15	Tutorial	FTP 5.1
03/09/15	Multipole expansions. Equivalence to spherical harmonics.	Chapter 5. Leal 3C, 4D-E. FTP1 Lec 33,34.
	Assignment due 08/09/15	FTP 5.2.
08/09/15	Exam	
09/09/15	Exam	
10/09/15	Exam	
15/09/15	Effect of convection at low Reynolds number and high Peclet number. Flow past a flat plate, flow around a sphere.	Chapter 6. Leal 9 A-B. FTP1 Lec 36, 37.
16/09/15	Tutorial	FTP 5.4.
17/09/15	Holiday	
	Assignment due 22/09/15	FTP 6.1.
22/09/15	Convection at low Reynolds number and high Peclet number. Boundary layer solution for streaming flow past an object of arbitrary shape.	Chapter 6. Leal 9 C-E. FTP 1 Lec 38.
23/09/15	Tutorial	FTP 6.2
24/09/15	Introduction to vectors and tensors. Vector notations.	Chapter 7. Griffiths 1.1, Aris 2. FTP2 Lec 3-6
	Assignment due 29/09/15	FTP 7.1,7.2
29/09/15	Vector calculus. Substantial derivatives. Kinematics.	Chapter 7. Griffiths 1.2-1.3, Aris 3. FTP2 Lec 7-8.
30/09/15	Tutorial	FTP 7.3.
01/10/15	Derivation of Navier-Stokes equations.	Chapter 8. Batchelor Appendix 2. FTP2 Lec 9-14.
	Assignment due 06/10/15	FTP 7.6.
06/10	Viscous flows. Linearity and superposition. Spherical harmonics solutions. Flow around a sphere.	Chapter 9. Batchelor 3.1,3.2 FTP2 Lec 15-17.
07/10/15	Tutorial	FTP 9.1,9.4.
08/10/15	Viscous flows. Relation between spherical harmonics and monopoles, dipoles, etc. Streaming flow around a sphere.	Chapter 9. Batchelor 3.3, Aris 5. FTP2 Lec 18.

Date	Topic	Reading
	Assignment due 13/10/15	FTP 9.2,9.6.
13/10/15	Viscous flows. Sphere in a shear flow. Viscosity of a suspension.	Chapter 9. Batchelor 1.9, Leal 4A-C. FTP2 Lec 19-20.
14/10/15	Tutorial	FTP 9.5
15/10/15	Lubrication flow. Oseen correction to drag at low Reynolds number.	Chapter 9. FTP2 Lec 21-23.
	Assignment due 20/10/15	FTP 9.8
20/10/15	Exam	
21/10/15	Exam	
22/10/15	Holiday	
27/10/15	Potential flows at high Reynolds number. Derivation of the potential flow and pressure equation. Potential flow around a sphere using spherical harmonics.	Chapter 10. Batchelor 6.1, 6.2, 6.4, Leal 10A. FTP2 Lec 25-26.
28/10/15	Tutorial	FTP 10.1,10.4
29/10/15	Potential flows in two dimensions. Complex variables.	Chapter 10. FTP2 Lec 27-28.
	Assignment due 03/11/15	FTP 10.3.
03/11/15	Potential flows in two dimensions. Conformal mappings, Zhukowski theorem.	Chapter 10. FTP2 Lec 29-30.
04/11/15	Tutorial	FTP 10.6.
05/11/15	Boundary layer theory for the flow past a flat plate.	Chapter 11. Leal 10B, 10C. FTP2 Lec 31-32.
	Assignment due 17/11/15	FTP 11.1.
17/11/15	Falkner-Skan boundary layer solutions	Chapter 11. FTP2 Lec 33-35.
18/11/15	Tutorial	FTP 11.2
19/11/15	Introduction to turbulence	FTP2 Lec 39.
	Assignment due 24/11/15	FTP 11.3.
24/11/15	Turbulent flow in a channel	FTP2 Lec 40.

Text books:

1. Notes at <http://chemeng.iisc.ernet.in/kumaran/transport.html>
 2. Bird, Stewart and Lightfoot (BSL), Transport Phenomena, Wiley International, 1960.
 3. L. G. Leal, Laminar Flow and Convective Transport Processes, Butterworth-Heinemann, 1992.
 4. G. K. Batchelor, An Introduction to Fluid Dynamics, Cambridge University Press, 1967.
 5. D. J. Griffiths, An Introduction to Electrodynamics, Prentice Hall International, 1994.
 6. R. Aris, Vectors, Tensors and the Basic Equations of Fluid Mechanics, Dover, 1989.
 7. E. L. Cussler, Diffusion: Mass transfer in fluid systems, Cambridge University Press, 1984.
 8. H. Tennekes and J. L. Lumley, A first course in turbulence, The MIT Press, 1972.
 9. Lecture notes: <http://chemeng.iisc.ernet.in/kumaran/transport.html>
 10. FTP1 — Fundamentals of Transport Processes 1 at
<http://chemeng.iisc.ernet.in/kumaran/transport.html>
 11. FTP2 — Fundamentals of Transport Processes 2 at
<http://chemeng.iisc.ernet.in/kumaran/transport.html>
 12. FTP — Chapter-wise notes at
<http://chemeng.iisc.ernet.in/kumaran/transport.html>
- Lectures, notes and exercises: <http://chemeng.iisc.ernet.in/kumaran/transport.html>