Birla Institute of Technology and Science Pilani

Pilani Campus, Rajasthan
FIRST SEMESTER 2015-2016
Course Handout Part II

Date: 03/08/2015

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No.	:	**CHE F414**
Course Title	:	**Transport Phenomena**
Instructor-in-charge	:	**Pratik N Sheth**

1. **Course Description**:
   Analogy for momentum, heat and mass transport; shell balance approach for analysis of individual and simultaneous momentum, heat and mass transport; hydrodynamic and thermal boundary layers; velocity, temperature and concentration distributions in turbulent flow; interphase transport for isothermal and non-isothermal systems.

2. **Scope and Objective of the Course**:
   Transport phenomena is a subject of importance both in science and engineering. All the three transport mechanisms i.e. momentum, heat and mass transfer frequently occur in chemical processes either individually or simultaneously. The aim of this course is to feel the physics of the process and then use the knowledge of the transport phenomena to represent the process behavior. Finally the aim is to analyze a few real life problems to understand the complexity of the chemical processes in view of three transport mechanisms.

3. **Books:**

   Text Book

   1. Bird, Stewart and Lightfoot, 'Transport Phenomena', John Wiley & Sons, 2002, 2nd edition

   Reference Books

   1. Fox and McDonald, 'Introduction to fluid dynamics,' John Wiley & Sons, 2008, 7th edition
   2. Holman, J.P., 'Heat transfer', McGraw Hill, 1997, 8th edition

4. **Course Plan:**

Lecture No.	Learning Objectives	Topics to be covered	Text Book Chap./Sec
1	Introduction	Scope and objectives of course, methodology	Ch. 0
2 – 4	Molecular momentum transport, Convective momentum transport	Newton's law of Viscosity, Convective momentum transport	1.1-1.2, 1.7
5	Momentum balances	Shell momentum balances, boundary conditions	2.1

6 – 8	Velocity distributions in laminar flow	Examples	2.2-2.5
9	Equations of change for isothermal systems	Equations of continuity, motion and mechanical energy	3.1-3.3
10 – 12	Applications of equations of change	Examples	3.5-3.6
13	Applications of equations of change	Dimensional analysis	3.7
14	Velocity distributions with more than one independent variables	Time-dependent flow of Newtonian fluids	4.1
15 – 17	Stream functions and velocity potential	Solving flow problems using stream functions and velocity potential	4.2-4.3
18	Flow near solid surfaces	Boundary layer theory	4.4
19	Turbulent flow	Time-smoothed equations of change and velocity profiles	5.1-5.3
20 – 21	Velocity distributions in turbulent flow	Empirical expressions for turbulent momentum flux; turbulent flow in ducts etc.	5.4-5.5
22 - 23	Molecular energy transport, Convective energy transport	Fourier's law of heat conduction, Convective transport of energy, work associated with molecular motions	9.1, 9.7-9.8
24 – 25	Energy balances	Shell energy balances, examples	10.1-10.7
26	Convection	Forced and free convection	10.8-10.9
27	Equations of change for non isothermal systems	Various forms of energy equations	11.1-11.3
28 – 29	Applications of equations of change	Examples	11.4
30	Applications of equations of change	Dimensional analysis	11.5
31 – 33	Molecular mass transport, Convective mass transport	Fick's law of binary diffusion, Mass and molar transport by convection, summary of mass and molar fluxes	17.1, 17.7-17.8
34	Mass balances	Shell mass balance, boundary conditions	18.1
35 - 37	Concentration distributions in solids and laminar flow	Examples	18.2-18.7
38	Equations of change for multicomponent systems	Equations of continuity, summary of multicomponent equations of change	19.1-19.3
39	Applications of equations of change for multicomponent systems	Examples/Dimensional Analysis	19.4

40 - 41	Temperature distributions in turbulent flow	Time-smoothed equations of change and temperature profiles for turbulent flow in tubes	13.1-13.4

4. **Evaluation Scheme**:

EC No.	Evaluation Component	Duration	Weightage	Date & Time	Remarks
1	Mid Semester Test	1½ hrs	120	8/10 8:00 - 9:30 AM	CB + OB
2	Assignments / Projects (CFD – FLUENT/ANSYS)		60	Throughout Semester	Take home type/ During Regular Class hours
3	Comprehensive Exam	3 hrs	120	8/12 FN	OB+CB

Notices: Notice will be displayed on Chemical Engineering Department Notice Board.

Make-up:
Make-up will be granted for genuine cases only. Prior permission of IC is required.

Chamber Consultation Hour: It will be announced in the class.

Instructor-in-charge
(CHE F414)