**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**

**K. K. BIRLA GOA CAMPUS**

**FIRST SEMESTER 2020-2021**

**Course Handout**

**Date: 19/08/2020**

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| Course No. | : | **CHE F414** |
| Course Title | : | **TRANSPORT PHENOMENA** |
| Instructor-in-charge | : | **Dr. Asima Shaukat** |

1. **Course Description**:
   Analogy among momentum, heat and mass transport phenomena; Shell balance approach for all three transport phenomena, Boundary layer concepts, velocity, temperature and concentration distribution in laminar flow; Velocity distributions in turbulent flow.

2. **Scope and Objective of the Course**:
   Transport phenomena is a subject of importance in the field of engineering. All the three transport mechanisms namely momentum, heat and mass transfer frequently occur in chemical processes either individually or simultaneously. The aim of this course is to understand the analogy between the transport mechanisms and how the same methods of solution can be applied to the problems involving different transport processes.

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 | Ch. 0 |
| 2 | Molecular momentum transport | Newton's law of viscosity | 1.1-1.2 |
| 3 | Convective momentum transport | Convective momentum transport | 1.7 |
| 4 | Momentum balances | Shell momentum balances, boundary conditions | 2.1 |
| 5 - 7 | Velocity distributions in | Examples | 2.2-2.5 |

| | | | |
|---|---|---|---|
| | laminar flow | | |
| 8 | Problems | Problems for Ch. 2 | |
| 9 | Equations of change for isothermal systems | Equations of continuity, motion and mechanical energy | 3.1-3.3 |
| 10 | Equations of change in terms of substantial derivative | Partial, total and substantial derivative | 3.5 |
| 11 - 12 | Applications of equations of change | Examples | 3.6 |
| 13 | Problems | Problems for Ch. 3 | |
| 14 | Molecular energy transport | Fourier's law of heat conduction | 9.1 |
| 15 | Convective energy transport | Convective transport of energy, work associated with molecular motions | 9.7-9.8 |
| 16-18 | Energy balances | Shell energy balances, examples | 10.1-10.7 |
| 19-20 | Convection | Forced and free convection | 10.8-10.9 |
| 21 | Problems | Problems for Ch. 10 | |
| 22 | Equations of change for non-isothermal systems | Various forms of energy equations | 11.1-11.3 |
| 23-24 | Applications of equations of change | Examples | 11.4 |
| 25 | Problems | Problems for Ch. 11 | |
| 26 | Molecular mass transport | Fick's law of binary diffusion | 17.1 |
| 27 | Convective mass transport | Mass and molar transport by convection, summary of mass and molar fluxes | 17.7-17.8 |
| 28 | Mass balances | Shell mass balance, boundary conditions | 18.1 |
| 29 - 30 | Concentration distributions in solids and laminar flow | Examples | 18.2-18.7 |
| 31 | Problems | Problems for Ch. 18 | |
| 32-33 | Equations of change for multicomponent systems | Equations of continuity, summary of multicomponent equations of change | 19.1-19.4 |
| 34 | Problems | Problems for Ch. 19 | |
| 35 | Velocity distributions with more than one independent variables | Time-dependent flow of Newtonian fluids | 4.1 |
| 36-37 | Stream function and velocity potential | Solving flow problems using stream functions and velocity potential | 4.2-4.3 |
| 38 | Flow near solid surfaces | Boundary layer theory | 4.4 |
| 39 | Problems | Problems for Ch. 4 | |
| 40-41 | Temperature distributions with more than one independent variable | Unsteady state heat conduction in solids, Steady potential flow | 12.1-12.3 (R2 - 3.5, 4.6) |
| 42 | Turbulent flow | Time-smoothed equations of change and velocity profiles | 5.1-5.3 |

4. **Evaluation Scheme**:

| EC No. | Evaluation Component | Weightage (%) | Date & Time | Duration |
|---|---|---|---|---|
| 1 | Test 1 | 15 | September 14 (During scheduled class hour) | 30 min |
| 2 | Test 2 | 15 | October 16 (During scheduled class hour) | 30 min |
| 3 | Test 3 | 15 | November 16 (During scheduled class hour) | 30 min |
| 4 | Quizzes/assignments | 20 | To be announced | - |
| 5 | Comprehensive | 35 | 05/12/20 (AN) | 120 min |

**Notices:**
Notices, if any, concerning the course will be uploaded on the Moodle

**Make-up**:
Make-up will be granted for genuine cases only. Prior permission of IC is compulsory. No make-up for Quizzes will be given.

**Consultation Hour:** Monday, 5:00 to 6:00 pm.

**Instructor-in-charge**
**(CHE F414)**