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

**HYDERABAD CAMPUS**

**SECOND SEMESTER 2019-2020**

**Course Handout - Part II**

**06-01-2020**

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 F241

**Course Title:** Heat Transfer

**Instructor-in-Charge: Prof. Ved Prakash Mishra**

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1. **Course Description**

This course covers the theoretical aspects of heat transfer involving conduction, convection and radiation. Topics such as steady and unsteady state conduction, Fourier’s law, heat transfer coefficient, heat transfer in various coordinate systems, insulation, convective heat transfer, theories of heat transfer and analogy between momentum and heat transfer and radiation will be covered. Types of heat exchangers and their design will also be introduced in this course.

1. **Scope and Objective**

The scope of this course is to study the fundamentals of heat transfer. At the end of the course, the student should have

* A sound understanding of heat transfer fundamentals
* An ability to apply fundamental heat transfer concepts to chemical engineering problems
* An understanding of the principles used to design heat transfer equipment in the chemical industry

1. **Text book (TB):**

1. Holman, J.P., “Heat Transfer (10th Ed.)”, Tata McGraw Hill, 2011.

2. McCabe, W.L., J.C. Smith, and P. Harriott, “Unit Operations of Chemical Engineering (7th Ed.)”,

McGraw Hill, 2005

1. **Reference books (RB):**

* **RB1 -**  Bird, R.B., W.E. Stewart, and E.N. Lightfoot, “Transport Phenomena”, John Wiley & Sons, 1994.
* **RB2 -**  Welty, J.R., C.E. Wicks, R.E. Wilson, and G.L. Rorrer, “Fundamentals of Momentum, Heat and Mass Transfer (4th Ed.)”, John Wiley & Sons, 2001.

1. **Course Plan**

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| **Lecture No.** | **Learning Objectives** | **Topics to be covered** | **Chapter in the Text Book** |
| 1 – 2 | Basics of Heat Transfer | Introduction to conduction, convection, radiation heat transfer, Thermal conductivity | Ch. 1(TB) |
| 3 – 8 | One dimensional steady state conduction phenomena | One dimensional steady state conduction for Cartesian, radial and spherical coordinate system, with and without heat source, Insulation and critical radius of insulation, Fins and their function, Thermal contact resistance | Ch. 2(TB) |
| 9 – 11 | One dimensional unsteady-state conduction | Lumped heat capacity system, Transient heat flow in a semi-infinite solid, Convective boundary conditions | Ch. 4(TB) |
| 12 – 19 | Principles of convection | Viscous flow, Inviscid flow, Laminar and turbulent boundary layer, Heat transfer in boundary layer - Energy equation of the boundary layer and thermal boundary layer | Ch. 5(TB); Ch 11 and 12 T2 |
| 20 – 22 | Empirical and practical relations for forced convection heat transfer | Empirical relations for pipe and tube flow, Flow across cylinders and spheres, Flow across tube banks, Liquid metal heat transfer | Ch. 6(TB); Ch 12 T2 |
| 23 – 25 | Natural convection | Theory and empirical relations for free convection from different geometric configurations such as plates, inclined surface, cylinder, sphere, Combined free and forced convection | Ch. 7(TB); Ch 12 T2 |
| 26 – 27 | Radiation heat transfer | Mechanism and properties of radiation, Black body and gray body radiation, shape factor, Radiation shield, Radiation heat transfer coefficient | Ch. 8(TB); Ch 14 T2 |
| 28 – 30 | Condensation and boiling heat transfer | Condensation phenomena, Film condensation, Boiling heat transfer, The heat pipe | Ch. 9(TB) Ch 13 (T2) |
| 31-35 | Heat exchangers | Overall HT coefficient, Types of heat exchangers, LMTD, effectiveness, Co-current and counter-current flows, Design considerations | Ch.10(TB)  Ch 15(T2) |
| 36-37 | Evaporation | Introduction, Types of evaporators, Economy and capacity, Single effect and multiple effect, methods of feeding | Ch.16(T2) |
| 38-40 | Integrated problem solving | Miscellaneous problems involving various heat transfer concepts | - |

1. **Evaluation Scheme**

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| **Evaluation Component** | **Duration** | **Weightage (%)** | **Date, Time** | **Nature of Component** |
| Mid Semester Test | 90 min | 30 | 6/3, 11.00 -12.30 PM | CB |
| Surprise Tests | 20 min | 15 |  | OB |
| Surprise Quizzes | 20min | 10 |  | CB |
| Comprehensive Examination | 3 hr | 45 | 12/05 AN | CB (25%) & OB (20%) |

1. **Chamber Consultation Hour**: Will be announced in class **(Chamber D-214)**.
2. **Notices:** Course-related notices will be uploaded on the CMS website
3. **Makeup exam Policy:** Make-up exam will be granted only for genuine cases with prior permission from the IC.
4. **Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**Instructor–in-Charge**

**CHE F241**