BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI HYDERABAD CAMPUS
SECOND SEMESTER 2022-2023
Course Handout - Part II

16-01-2023

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 : Dr. Iyman Abrar
Instructor **:** Dr. Afkham Mir / Dr. Iyman Abrar

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.

2. **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

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

   1. Holman, J.P., "Heat Transfer (10^{th} 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

4. **Reference books (R):**

   R1 - Yunus A. Cengel, "Heat Transfer – a practical approach", McGraw Hill 2002.

   R2 - 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.

5. **Course Plan**

Lecture No.	Learning Objectives	Topics to be covered	Chapter in the Text Book
1 – 2	Basics of Heat Transfer	Introduction to conduction, Thermal conductivity	1.1 – 1.2 (T1)
3 – 6	1-D steady state heat conduction	1-D steady state heat conduction for Cartesian, Radial and Spherical coordinate system; with and without heat source; Insulation and critical radius of insulation.	2.1 – 2.8 (T1); Ch 2 (R1)
7 – 8	Heat Transfer from extended surfaces	Fins and their function; Thermal contact resistance	2.9 – 2.11 (T1); Ch 3 (R1)
9 – 11	1 –D unsteady-state conduction	Lumped heat capacity system, Transient heat flow in a semi-infinite solid, Convective boundary conditions	4.1 – 4.4 (T1); Ch 4 (R1)
12 – 19	Principles of	Viscous flow, Inviscid flow, Laminar and	5.1 – 5.6, 5.8,

	convection	turbulent boundary layer, Heat transfer in boundary layer - Energy equation of the boundary layer and thermal boundary layer	5.10 – 5.11 (T1); Ch. 11 and 12 T2; Ch 6 (R1)
20 – 22	Forced convection heat transfer	Empirical relations for pipe and tube flow, Flow across cylinders and spheres.	6.1 – 6.3 (T1); Ch 12 T2, Ch 7 (R1)
23 – 26	Natural convection Systems	Theory and empirical relations for free convection from different geometric configurations such as plates, cylinder, sphere; Combined free and forced convection.	7.1 – 7.12 (T1); Ch 12 T2, Ch 8-9 (R1)
27 – 31	Heat exchangers	Overall HT coefficient, Types of heat exchangers, LMTD, effectiveness, Co-current and counter-current flows, Design considerations	10.1 – 10.9 (T1); Ch 15 (T2); Ch 13 (R1)
32 – 34	Radiation heat transfer	Mechanism and properties of radiation, Black body and gray body radiation, shape factor.	8.1 – 8.4 (T1); Ch 14 T2; Ch 12 (R1)
35-39	Condensation and boiling heat transfer	Condensation phenomena, Film condensation, Boiling heat transfer, The heat pipe	Ch. 9.1- 9.6 (TB); Ch 13 (T2); Ch 10 (R1)

6. **Evaluation Scheme**

Evaluation Component	Duration	Weightage (%)	Date, Time	Nature of Component
Mid Semester Test	90 min	30	17/03 2.00 - 3.30PM	CB
Surprise Test (Min 2)	-	15	-	OB
Assignment (Min 1)	-	15	-	OB
Comprehensive Examination	180 min	40	18/05 FN	CB

7. **Chamber Consultation Hour**: Will be announced in class.
8. **Notices:** Course-related notices will be uploaded on the CMS website
9. **Makeup exam Policy:** Make-up exam will be granted only for genuine cases with prior permission from the IC.
10. **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.

Dr. Iyman Abrar
Instructor–in-Charge