

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
HYDERABAD CAMPUS
SECOND SEMESTER 2023-2024
Course Handout - Part II

09-01-2024

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. Afkham Mir

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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.

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 (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

4. Reference books (RB):

- **RB1** - Yunus A. Cengel, "Heat Transfer – a practical approach", McGraw Hill 2002.
- **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.

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 – 1.4 (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 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	5.1 – 5.2 ,5.5 – 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 – 29	Radiation heat transfer	Mechanism and properties of radiation, Black body and gray body radiation, shape factor, Radiation shield, Radiation heat transfer coefficient	8.1 – 8.5, 8.8, 8.17 (T1); Ch 14 T2; Ch 12 (R1)
30 – 34	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)
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)
40-41	Course revision	Course revision	-

6. Evaluation Scheme

Evaluation Component	Duration	Weightage (%)	Date, Time	Nature of Component
Mid Semester Test	90 min	20	15/03 - 9.30 - 11.00AM	Closed book
Surprise Test (Min 5)	15 mins each	25	Continuous Evaluation	OB
Assignment (1)	-	15	TBA	OB
Comprehensive Examination	180 min	40	16/05 FN	OB

7. **Chamber Consultation Hour: (Chamber D-318).** Tuesday 9 am to 10 am

8. **Notices:** Course-related notices will be uploaded on the CMS website

9. **Makeup exam Policy:** Make-up requests for the Midsem and Comprehensive exam may be granted only for genuine cases with sufficient evidence and with prior approval. No make-up will be allowed for tests and viva.

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. Afkham Mir
Instructor-in-Charge
CHE F241