

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.

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** - 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.

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, 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-	Lumped heat capacity system, Transient heat flow in a	Ch. 4(TB)

	state conduction	semi-infinite solid, Convective boundary conditions	
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	-

6. Evaluation Scheme

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%)

7. **Chamber Consultation Hour:** Will be announced in class (**Chamber D-214**).

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.

Instructor-in-Charge

CHE F241