BIRLA INSTITUTE OF TECHNOLOGY &SCIENCE-PILANI, HYDERABAD CAMPUS

FIRSTSEMESTER 2020-2021

COURSE HANDOUT: PART - II

Date: 14.08. 2020

In addition to Part - I (a general handout for all courses appended to the time-table), this handout provides the specific details of this course.

Course No. : ME G536
Course Title : THERMAL EQUIPMENT DESIGN
Instructor-in-charge : SANTANU PRASAD DATTA

1. Course Description

To impart knowledge on theory and constructional details of various types of thermal equipment and their design aspects, this course will be helpful for the students.

2. Scope and Objectives

- Understand the basic concept and design methodology of heat exchangers.
- Select appropriate fin geometry, configuration and density for optimum performance analysis.
- Estimate the overall heat transfer coefficient and the effectiveness of aheat exchanger.
- Consider economic factors and perform cost-effective analysis.
- Acquire knowledge on modern heat transfer equipment like thermoelectric, thermoacoustic, heat pipes, etc.
- Conduct experiment and develop computer programs to perform parametric analysis and optimization of thermal equipment design.

3. Prerequisites

Fundamentals of Thermodynamics,Heat Transferand Fluid Mechanics

4. Text Book (TB)

a) HoSung Lee, Thermal Design, Wiley, 2015
b) S. Kakac, Heat Exchangers: Selection, Rating, and Thermal Design, 2nd, CRC Press, 2002

5. Reference Books (RB)

a) R. K. Shah and D. P. Sekulić, Fundamentals of Heat Exchanger Design, Wiley, 2003
b) G. F. HeWitt, G. L. Shires, and T. R. Bott, Process Heat Transfer, CRS Press, USA, 1994
c) Wilbert Stoecker, Design of Thermal Systems, 3rd Edition, Tata McGraw Hill, New Delhi, 2011.
d) YogeshJaluria, Design and Optimization of Thermal Systems, 2nd Edition, CRC Press, 2007.

6. Course Plan

Lecture No.	Learning Objectives	Topics to be covered	TB/ RB
1-3	Introduction	Basic Concept; Classification of Heat Exchangers-Parallel Flow, Counter Flow and Cross Flow;Shell and Tube and Plate Type; Single-pass and Multi-pass;Selection of Heat Exchangers; Sizing and Rating of Different types of Heat Exchangers	TB- b; RB- a
4-12	Design Methodology	General Design Requirements;Heat Transfer Correlations; Overall Heat Transfer Coefficient;Heat Exchanger Variables and Thermal Circuit; Temperature Distribution and its Implications; LMTD Method; ε-NTU Method; Fin Performance and Selection;Correction factors	TB- a, b; RB- b
13-15	Shell and Tube Heat Exchanger	Tube Layouts, BafflesSpacing, Classification of Shell and Tube Exchangers; Design Calculation of Shell and Tube Heat Exchangers; Controlling Parameters; Heat Transfer and Pressure Drop Evaluations; Performance and Design Calculations; TEMA Standard	TB- b; RB- b

16-20	Boiling and Condensation in Heat Exchanger	Film Condensation on a Single Horizontal Tube, Film Condensation in Tube Bundles, Condensation inside Tubes, Flow Boiling	TB- b
21-22	Fouling and Corrosion	Fouling Growth Models and its Impact on Heat Exchanger Performance and life-cycle Analysis; Testing and Inspection	TB- b
23-25	Pinch Analysis	Heat Exchanger Networking	RB- b
26-29	Heat Sinks	Longitudinal Fin of Rectangular Profile, Heat Transfer from Fin, Fin Effectiveness, Fin Efficiency, Corrected Profile Length, Optimization, Multiple Fin Array	TB- a
30-33	Micro-Mini Channel Heat Exchanger	Introduction to Microchannel and Minichannel, Single Phase Liquid and Gas Flow through Channels, Correlations	TB- b
34-38	Heat Pipe	Types and Applications,Operating Principles, Working Fluids, Wick Structures, Loop Heat Pipe, Micro Heat Pipe, Design Example	TB- a
39-40	Thermoelectric	Thermoelectric Effect, Thermocouple Thermoelectric Generator, Thermoelectric Coolers	TB- a
41-42	Thermoacoustic	Thermoacoustic Systems, Different Configurations, Application for Cooling and Waste Heat Utilization	Journals
Laboratory	Experiment and Simulation*	Steady State and Dynamic Analysis; Data Processing; Error Analysis; Regression Analysis and Curve Fitting;Different Correlations; Use of Software or Coding in Heat Exchanger Design	-

7. Evaluation Scheme

Evaluation Component	Duration (min.)	Weightage (%)	Date & Time	Nature of Component
Test 1	-	12%	To be announced	Open Book
Test 2	-	12%	To be announced	Open Book
Test 3	-	12%	To be announced	Open Book
Term-project/Assignment	-	15%	Continuous	Open Book
Simulation	-	15%	Continuous	Open Book
Comprehensive Exam	120	34%	04/12 AN	Open Book

8. Chamber Consultancy Hour: To be announced in the class.

9. Notices

Students are advised to visit regularly *CMS*(institute's web based **C**ourse **M**anagement **S**ystem) for all notices and updates.

10. Make-up Policy

Make-up request for tests shall be granted only for the genuine cases with sufficient evidence. Request letter duly signed by the student should reach the under signed well in advance.

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 (I/C)
(ME G536)