

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL ENGINEERING DESIGN OF HEAT EXCHANGER SUBJECT CODE:2181924 B.E. 8TH SEMESTER

Type of course: Elective

Prerequisite: Engineering Thermodynamics, Fluid Mechanics, Heat Transfer

Rationale: The course is design to provide fundamental knowledge of different type of heat exchangers used for thermal application and to learn the sizing of heat exchangers, thermal analysis for various heat exchange applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	No. of Hrs.	% Weightage
1	Different classification and basic design methodologies for heat exchanger: Classification of heat exchanger, selection of heat exchanger, overall heat transfer coefficient, LMTD method for heat exchanger analysis for parallel, counter, multi-pass and cross flow heat exchanger, e-NTU method for heat exchanger analysis, fouling, cleanliness factor, percent over surface, techniques to control fouling, additives, rating and sizing problems, heat exchanger design methodology	10	24
2	Design of double pipe heat exchangers: Thermal and hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop	8	19
3	Design of Shell & tube heat exchangers: Basic components, basic design procedure of heat exchanger, TEMA code, J-factors, conventional design methods, Bell-Delaware method.	10	24
4	Design of compact heat exchangers: Heat transfer enhancement, plate fin heat exchanger, tube fin heat exchanger, heat transfer and pressure drop	8	19
5	Heat Transfer Enhancement and Performance Evaluation: Enhancement of heat transfer, Performance evaluation of Heat Transfer Enhancement technique. Introduction to pinch analysis.	6	14

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	10	15	20	10	5

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Heat Exchanger Selection, Rating and Thermal Design by Sadik, Kakac, CRC Press
2. Fundamentals of Heat Exchanger Design by Ramesh K Shah, Wiley Publication
3. Compact Heat Exchangers by Kays, V.A. and London, A.L., McGraw Hill
4. Heat Exchanger Design Handbook by Kuppan, T, Macel Dekker, CRC Press
5. Heat Exchanger Design Hand Book by Schunder E.U., Hemisphere Pub.
6. Process Heat transfer by Donald Q Kern, McGraw Hill

Course Outcome:

After learning the course, the students should be able to:

- Learn how to design common types of heat exchangers; namely shell-and-tube, tube and tube.
- Demonstrate a basic understanding of several types of heat exchangers that will include shell-and-tube, double pipe, finned tube, and plate-fin heat exchangers and learn to select appropriate heat exchanger for the given application
- Measure the performance degradation of heat exchangers subject to fouling.
- Become aware of single and multiphase heat transfer and friction coefficient correlations, and they will know how to select the appropriate ones for the case in hand

List of Experiments:

1. Design of heat exchange equipment by using LMTD method.
2. Design of heat exchange equipment by using effectiveness– NTU method.
3. Measure the effectiveness of shell and tube heat exchanger.
4. Design and analysis of Parallel flow and Counter flow heat exchanger.
5. Design and analysis of Shell and tube type heat exchanger.
6. Design and analysis of Plate type heat exchanger.

Design based Problems (DP)/Open Ended Problem:

1. Calculate the effectiveness of car radiator
2. Observe the effect of ambient temperature over the performance of air conditioner

Major Equipment:

1. Shell and tube heat exchanger
2. Plate type heat exchanger
3. Tube and tube heat exchanger
4. Compact heat exchanger

List of Open Source Software/learning website:

1. nptel.ac.in
2. www.learnerstv.com
3. cosmolearning.org

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.