

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (THERMAL ENGINEERING) (21)

DESIGN OF HEAT EXCHANGERS

SUBJECT CODE: 2731105

M.E. 3rd SEMESTER

Type of course: Major elective

Prerequisite: Nil

Rationale: The course is design to provide fundamental knowledge of different type of heat exchangers used for thermal application

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)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No	Content	Total Hrs	% Weightage
1	Basic design methodologies: Classification of heat exchanger, selection of heat exchanger, Thermal-Hydraulic fundamentals, Overall heat transfer coefficient, LMTD method for heat exchanger analysis for parallel, counter, multipass and cross flow heat exchanger, e-NTU method for heat exchanger analysis, Fouling, Rating and sizing problems, heat exchanger design methodology	6	14
2	Fouling of heat exchangers: Basic consideration, effect of fouling on heat transfer and pressure drop, cost of fouling, design of heat exchangers subject to fouling, fouling resistance, cleanliness factor, techniques to control fouling	4	10
3	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	6	14
4	Design of Shell & tube heat exchangers: Basic components, basic design procedure of heat exchanger, TEMA code, J-factors, conventional design methods, Bell-Delaware method.	8	20
5	Design of compact heat exchangers: Heat transfer enhancement, plate fin heat exchanger, tube fin heat exchanger, heat transfer and pressure drop	6	14
6	Condensers and evaporators Condenser: Shell and tube condenser, plate condenser, air cooled condenser, direct contact condenser, condenser for refrigeration and air-conditioning, thermal design of shell and tube condenser Evaporator: Evaporator for refrigeration and air-conditioning, thermal analysis of evaporator, standards for evaporators and condensers	6	14
7	Heat transfer enhancement and performance evaluation: Enhancement of heat transfer, Performance evaluation of Heat Transfer Enhancement technique. Introduction to pinch analysis	6	14

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:

1. Learn how to design common types of heat exchangers; namely shell-and-tube, tube and tube.
2. Learn to select appropriate Heat Exchanger for the given application.
3. 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. Design and analysis of double pipe heat exchanger with parallel and counter flow arrangement.
4. Design and analysis of shell and tube type heat exchanger.
5. Design and analysis of plate type heat exchanger.
6. Design of evaporator for refrigeration system.
7. Design of condenser for refrigeration system.

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:

- Shell and tube heat exchanger
- Plate type heat exchanger
- Tube and tube heat exchanger
- Compact heat exchanger
- Vapor Compression Refrigeration system (evaporator and condenser)

List of Open Source Software/learning website:

- nptel.ac.in
- www.learnerstv.com
- cosmolearning.org

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.