



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering (Part Time)**

**Subject Code: 2951902**

**Semester –5**

**Subject Name: Design of Heat Exchangers**

**Type of course:** Elective

**Prerequisite:** -

**Rationale:** The course is design to provide fundamental knowledge of different type of heat exchangers used for various thermal applications 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)		
3	0	2	4	70	30	30	20	150

### Content:

Sr. No.	Content	Total Hrs
1	<b>Different classification and basic design methodologies for heat exchanger:</b> 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	11
2	<b>Design of double pipe heat exchangers:</b> Thermal and hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop	8
3	<b>Design of Shell &amp; tube heat exchangers:</b> Basic components, basic design procedure of heat exchanger, TEMA code, J-factors, conventional design methods, Bell-Delaware method.	10
4	<b>Design of compact heat exchangers:</b> Heat transfer enhancement, plate fin heat exchanger, tube fin heat exchanger, plate heat exchanger, heat transfer and pressure drop	10
5	<b>Heat Transfer Enhancement and Performance Evaluation:</b> Enhancement of heat transfer, Performance evaluation of Heat Transfer Enhancement technique. Introduction to pinch analysis.	6

### Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	50	20	0	0

**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.



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## 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 Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	To select appropriate heat exchanger for the given application and to measure the performance degradation of heat exchangers subject to fouling.	24
CO-2	To analyse thermal and hydraulic performance of double pipe and shell and tube heat exchangers.	40
CO-3	To analyse thermal and hydraulic performance of different types of compact heat exchangers.	22
CO-4	To compare various heat transfer enhancement techniques and to apply process optimization techniques for heat exchanger design	14

## 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.

**Major Equipment:** Shell and tube heat exchanger, Plate type heat exchanger, Tube and tube heat exchanger, Compact heat exchanger

**List of Open Source Software/learning website:**<https://nptel.ac.in/course.php>