GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Mechanical Engineering (Thermal Engineering)

Course / Subject Code : ME01000451

Course / Subject Name : Design of Heat Exchangers

w. e. f. Academic Year:	2024-25
Semester:	1st Semester
Category of the Course:	PEC

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

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Choose proper design methodology for a given heat exchanger problem	Apply
2	Examine the effect of fouling on performance of heat exchangers	Analyze
3	Design double pipe and shell and tube heat exchangers for given conditions	Create
4	Design condensers, evaporators and compact heat exchangers for different applications	Create
5	Analyze different heat transfer enhancement techniques for various heat exchangers	Analyze

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Basic design methodologies:** Classification and selection of heat exchanger, Thermal-Hydraulic fundamentals, Overall heat transfer	6	13

	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, Rating and sizing problems, heat exchanger design methodology		
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	9
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 and tube heat exchangers:** Basic components, basic design procedure of heat exchanger, TEMA code, J-factors, conventional design methods, Bell-Delaware method.	9	20
5.	**Design of compact heat exchangers**: Heat transfer enhancement, plate fin heat exchanger, tube fin heat exchanger, heat transfer and pressure drop	7	15
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	7	15
7.	**Heat transfer enhancement and performance evaluation:** Enhancement of heat transfer, Performance evaluation of Heat Transfer Enhancement technique. Introduction to pinch analysis	6	14
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
-	-	15	25	30	30

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) 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 Schlunder E.U., Hemisphere Pub.

(b) Open-source software and website:

1. https://onlinecourses.nptel.ac.in/noc19_me62

Suggested Course Practical List:

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.

List of Laboratory/Learning Resources Required: Shell and tube heat exchanger, Plate type heat exchanger, Tube and tube heat exchanger, Compact heat exchanger, Evaporator and condenser

Suggested Project List:

Suggested Activities for Students: Students are required to download 3-5 research papers from reputed international journals on the recent advancement in the areas of heat exchangers. They need to go through the same and prepare a review for the research papers. The review should have three parts: Summary, Critical Evaluation and Creative synthesize

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