

Heat Exchanger Design

Course Code: 28172
Credits: 3
Course Type: Theoretical
Prerequisites: Heat Transfer 1
Corequisite: -
Course Length: 51 hours

Outlines:

1. Introduction

- a. Introduction to heat exchangers
- b. Design of heat exchangers
- c. Rating of heat exchangers

2. Various Types of Heat Exchangers

- a. Common types of heat exchangers
- b. Double-pipe heat exchangers
- c. Shell and tube heat exchangers
- d. Compact heat exchangers
- e. Plate heat exchangers
- f. Other heat exchangers
- g. Classification of heat exchangers
- h. Classification based on tube arrangement
- i. Classification based on number of fluids
- j. Classification based on heat transfer mechanism
- k. Classification based on temperature range
- l. Heat exchangers with periodic flow
- m. Advanced Heat Exchangers

3. Heat Transfer Mechanisms

- a. Conduction
- b. Convection
- c. Internal flow
- d. External flow
- e. Radiation
- f. Heat transfer coefficients
- g. Fins

4. Basic Theory

- a. Basic assumptions
- b. LMTD method
- c. $\varepsilon - NTU$ Method



- d. Other methods
- e. Tables and their use
- f. Heat exchangers in Series
- g. Heat Exchangers in parallel

5. Selection of Heat Exchangers

- a. Double-pipe
- b. Shell and tube
- c. Finned tube
- d. Plate

6. Design of Double-pipe Heat Exchangers

- a. Applications and limitations
- b. Heat transfer and pressure drop in smooth pipes
- c. Heat transfer and pressure drop in finned straight pipes
- d. Mutual effect of heat transfer and pressure drop
- e. Considerations in detail design

7. Design of Shell and Tube Heat Exchangers

- a. Applications and limitations
- b. Classifications
- c. Standards
- d. Important parts
- e. Calculation of heat transfer and pressure drop using Kern's method
- f. Calculation of heat transfer and pressure drop using Bell-Delaware method
- g. Calculation of heat transfer and pressure drop using network method
- h. Advanced techniques for heat transfer and pressure drop calculations
- i. Considerations in detail design

8. Design of Finned Heat Exchangers

- a. Applications and limitations
- b. Various types of fins and tubes
- c. Heat transfer on fin side
- d. Pressure drop on fin side
- e. Effect of fittings in pressure drop on both sides
- f. Mutual effect of heat transfer and pressure drop
- g. Considerations in detail design

9. Design of Plate Heat Exchangers

- a. Applications and limitations
- b. Various types of flow patterns
- c. Types of Plates
- d. Heat transfer calculations
- e. Pressure drop calculations
- f. Mutual effect of heat transfer and pressure drop
- g. Considerations in detail design

References:

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2. Kern, D. Q., “*Process Heat Transfer*”, Mc- Graw Hill International Book Company, 1965.
3. TEMA, “*Standards of The Tubular Exchanger Manufacturers Association*”, tenth edition, Tubular Exchanger Manufacturers Association (TEMA), New York, 2019.
4. Saunders, E. A. D., “*Heat Exchangers, Selection, Design and Construction*”, Longman Scientific and Technical, 1988.
5. Kakaç, S., & Liu, H., “*Heat Exchanger: Selection, Rating and Thermal Design*”, Second Edition. CRC Press, 2002.
6. Ramesh K., Shah, Dusan P. Sekulic, “*Fundamentals of Heat Exchanger Design*”, John Wiley & Sons, 2003.
7. Thulukkanam, K., “*Heat Exchanger Design Handbook*”, CRC Press, 2013.
8. Eugene Pis'menniy, Georgiy Polupan, Ignacio Carvajal-Mariscal, Florencio Sanchez-Silva, Igor Pioro, “*Handbook for Transversely Finned Tube Heat Exchanger Design*”, Academic Press, 2016.
9. Fraas, P. and Necati Ozisik, M., “*Heat Exchanger Design*”, John Wiley & Sons, Inc., New York (1965).
10. Kays, W.M. and London, A.L. (1998), “*Compact Heat Exchangers*”, 3rd Edition, McGraw-Hill, New York.
11. Taborek, J., Hewitt, G. F., Afgan, N., “*Heat Exchangers: Theory and Practice*”, Hemisphere Pub, Co. 1983.
12. Perry, R.H., Green, D., “*Perry's Chemical Engineers, Handbook*”, McGraw – Hill International Book Company, 1984.
13. Rohsenow, W. M., Hartnett, J. P., “*Handbook of Heat Transfer*”. McGraw Hill International Book Company, 1973.
14. “*Heat Exchanger Design Handbook*”, Hemisphere Pub. Co., 1985.
15. Afgan, N. Carvalho, M. G., Bar Cohen. A., Butterworth, D., Roetzel. W., “*New Developments in Heat Exchangers*”, Gordon and Breach Pub., 1996.