

DESIGN OF THERMAL EQUIPMENT

Course Code: 15ME2313

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Course Outcomes: At the end of the course, the student will be able to

CO1: Classify and design heat exchangers

CO2: Estimate convective heat transfer in ducts, concentric annuli, circular pipes.

CO3: Determine pressure drop and effect of fouling in heat exchangers.

CO4: Design double pipe heat exchangers and compact heat exchangers by considering fin effects.

CO5: Design condensers and evaporators for application in refrigeration and air-conditioning.

UNIT-I

(10-Lectures)

Classification of heat exchangers: Tubular heat exchangers, plate heat exchangers, extended surface heat exchangers – flow arrangements – applications.

Basic design methods of heat exchangers: Overall heat transfer coefficient – multi pass and cross flow heat exchangers - log mean temperature difference method – effectiveness-NTU method for heat exchanger analysis–heat exchanger design calculation–heat exchanger design methodology.

UNIT-II

(10-Lectures)

Correlations for forced convection heat transfer coefficients: Laminar forced convection in ducts and concentric annuli – turbulent forced convection in circular pipes – heat transfer in helical coils and spirals – heat transfer in bends.

UNIT-III

(10-Lectures)

Heat exchanger pressure drop and pumping power: Tube side pressure drop in laminar and turbulent flows – pressure drop in helical and spiral

coils – pressure drop in bends and fittings.

Fouling of heat exchangers: Basic considerations – effect of fouling and heat transfer and pressure drop – aspects of fouling – design of heat exchangers subject to fouling.

UNIT-IV (10-Lectures)

Double pipe heat exchangers: Pressure drop – hydraulic diameter – hairpin heat exchanger – parallel and series arrangements of hairpins – total pressure drop.

Compact heat exchangers: Plate-fin heat exchangers – tube-fin heat exchangers – pressure drop for finned-tube heat exchangers – pressure drop for plate-fin heat exchangers.

UNIT-V (10-Lectures)

Condensers and evaporators: Horizontal shell-and-tube condensers – horizontal in-tube condensers – plate condensers – air-cooled condensers, thermal design of shell-and-tube condensers – design and operational considerations.

TEXT BOOK:

Sadik Kakac and Hongtan Liu, “Heat Exchangers – Selection, Rating and Thermal Design”, CRC Press, New York, USA, 2000.

REFERENCES:

1. Donald Q. Kern, “Process Heat Transfer”, Tata McGraw-Hill, 2001.
2. S. Kakac, A.E. Bergles and F. Mayinger, “Heat Exchangers: Thermal-Hydraulic Fundamentals and Design”, Hemisphere Pub., 1981.
3. “Standards of the Tubular Exchanger Manuf. Assoc(TEMA)”, Inc., 7th Edition, New York, 1988.