## CHE-242: Heat Transfer

**Credit Hours:** 3-1

**Pre-requisites:** None

### Course Objectives

To develop understanding of the concepts and laws of heat transfer for design of heat transfer equipment.

### Course Contents

i. Conduction in Steady state and unsteady state cases for one dimension
ii. Heat transfer by convection (Natural & Forced Convection)
iii. Application of dimensional analysis to convection
iv. Heat transfer by Radiation
v. Radiation from black and real surfaces, radiation between black surfaces, radiation between grey surfaces, radiation from gases
vi. Concept of film and overall heat transfer coefficients
vii. Unsteady state heat transfer
viii. Heat transfer equipments, their types and selection criteria
ix. Heat Exchangers and their design
x. Heat transfer with phase change; Condensation and boiling heat transfer and designing of single component condensers
xi. Evaporation: Heat transfer in evaporators, Single effect evaporators, Multiple-effect evaporators, the calculation of multiple-effect systems
xii. Comparison of forward and backward feeds, vapor compression evaporators, the heat pump cycle, Evaporator operation, Equipment for evaporation.

### Course Outcomes

After taking this course, students should have understanding of the concepts and laws of heat transfer for design of heat transfer equipment.

### List of Practicals

i. To calculate the efficiency of a double pipe heat exchanger for parallel flow at different flow rates.
ii. To calculate the efficiency of a double pipe heat exchanger for counter flow at different flow rates.
iii. To determine the relationship between flow rate and overall heat transfer co-efficient in double pipe heat exchanger for parallel flow.

iv. To determine the relationship between flow rate and overall heat transfer co-efficient in double pipe heat exchanger for counter flow.
v. To calculate the efficiency of Shell & Tube heat exchanger for parallel flow at different flow rates.
vi. To calculate the efficiency of Shell & Tube heat exchanger for counter flow at different flow rates.
vii. To determine the relationship between flow rate and overall heat transfer co-efficient in shell and tube heat exchanger for parallel flow.
viii. To determine the relationship between flow rate and overall heat transfer co-efficient in shell and tube heat exchanger for counter flow.
ix. To show that the intensity of radiation on surface is inversely proportional to the square of the distance of the surface from radiation source (inverse square law).
x. To determine emissivity of radiation surfaces with different finishings namely polished, grey and black.
xi. To show that intensity of radiation varies as fourth power of the source temperature (Stefan Boltzmann Law).
xii. Film wise heat flux & surface heat transfer coefficient determination at constant pressure
xiii. Drop wise heat flux & surface heat transfer coefficient determination at constant pressure.
xiv. Effect of air inside the chamber of film and drop wise condensation unit.
xv. To demonstrate the various stages in flow boiling within the tube of Flow Boiling Unit including:
    a. Convective heat transfer to sub cooled liquid
    b. Nucleation in sub cooled and saturated liquid
    c. Slugging
    d. Annular Flow
    e. Droplet Entrainment
    f. Complete dry out to superheated vapor
xvi. To demonstrate the circulation prompted by natural convection.

***Recommended Books***


- Kern, Donald Q. (1997). Process Heat Transfer. McGraw Hill Book Company.

- Cengel, Yunus A. (1988). Heat Transfer: A Practical Approach. McGraw Hill Book Company.
- Incropera, Frank P. and De Witt, David P. (2002). Fundamentals of Heat and Mass Transfer. 5th Ed. John Wiley and Sons.
- Coulson, J.M. and Richardson, J.F. (2002). Chemical Engineering, Vol-II. 5th Ed. The English Book Society and Pergamon Press.
- Hewitt, G.F. and Bott, T.R. (2012). Process Heat Transfer. CRC Press.
- Holman, J.P. (2002). Heat Transfer. McGraw Hill Book Company.