

Course Number: 28043

Course Name: Convection Heat Transfer

Course Type: Theory
Prerequisite: Heat Transfer I
Level: Graduate
Group: Energy Conversion

Type & Max Unit: Constant 3
Corequisite: -
First Presentation: 2016-2
Last Edition: 2016-2.

Objectives:

The main goal of this course is to present the basic principles of analysis and solution procedures of convection heat transfer. Analysis of the free and force convection on the surfaces and conduits both at laminar and turbulent flows, mass transfer and convection heat transfer in porous media. Solution procedures such as scale analysis, similarity solution and integral solution will be explained.

Topics:

- **Introduction:** review of fundamental laws, continuity, momentum, first and second laws of thermodynamics, scale analysis, heat and flow lines
- **Laminar Boundary Layer Flow:** Concept of boundary layer, thickness of velocity and thermal boundary layers, Navier Stokes and energy equations applied to velocity and thermal boundary layer regions, different boundary conditions, integral and similarity solutions of boundary layer equations
- **Laminar Boundary Layer Flow in Conduits:** Hydrodynamic entrance length, heat transfer and pressure in fully developed flow
- **Laminar Natural Convection:** The concept of natural and forced convection, Boussinesq approximation, Buoyancy driven or combined natural and force convection
- **Wall Turbulence:** Time averaging of equations, turbulent boundary layer equations, turbulent models, mixing length model, other turbulent models
- **Free Layer Turbulence:** Free shear layer, jets, plumes, thermal wake behind different centralized sources, point source, line source, cylindrical and spherical sources
- **Mass Transfer:** Mass transfer in convection, Natural and force convection
- **Convection in Porous Media:** Darcy Law, different assumptions in porous media, variables of porous media, different solution methods of energy equation

References:

- 1- A. Bejan, "Convection Heat Transfer" John Wiley ,Fourth Ed., 2013
- 2- S. Kakac, Y. Yener, A. Pramuanjaroenkij - Convective Heat Transfer, third Edition, CRC Press Taylor and Francis, 2013
- 3- V. S. Arpachi and P. S. Larsen, "Convection Heat Transfer" Prentice Hall, 1984
- 4- W. M. Kays and M. E. Crawford, B. Weigand "Convective Heat and Mass Transfer" McGraw – Third Ed. 1994