ME 522 Convective Heat Transfer **(3-0-0-6)**

Transport equations and boundary conditions; Order of magnitude analysis, Reynolds analogy.
Forced Convection: Convective heat transfer in external flows: Boundary layer Approximations to momentum and energy equations, Similarity solution techniques, Momentum and energy integral methods and their applications in flow over flat plates with low and high Prandtl number approximations. Convective heat transfer in Laminar internal flow: (a) Exact solutions to N-S equations for flow through channels and circular pipe, Fully developed forced convection in pipes with different wall boundary conditions, Forced convection in the thermal entrance region of ducts and channels (Graetz solution), heat transfer in the combined entrance region, (b) Integral method for internal flows with different wall boundary conditions. Elements of turbulent heat transfer.
Natural convection: Introduction to natural convection; Boussinesq approximation and scaling analysis; Similarity solution of natural convection equations for boundary layers; Laminar and turbulent free convection;
Fundamentals of boiling and condensation; Deviations from continuum: wall slip and thermal creep, an introduction to convective transport of heat in micro-scales; Conjugate heat transfer problems.

References

1. W. M. Kays, E. M. Crawford, and B. Weigand, Convective Heat and Mass Transfer, Tata McGraw Hill, 4th Edition, 2012.
2. Louis C Burmeister, Convective Heat Transfer, John Wiley and Sons, 2nd Edition, 1993.
3. Adrian Bejan, Convective Heat Transfer, John Wiley and Sons, 4th Edition, 2013.
4. P.H. Oostuizen and D. Naylor, Introduction to Convective Heat Transfer Analysis, McGraw-Hill, 1999.
5. F P Incropera, D P Dewitt, T L Bergman, and A S Lavine, Incropera's Principles of Heat and Mass Transfer, Wiley, 2018.