Convective Heat Transfer - Video course

COURSE OUTLINE

Governing Equations: Continuity, Momentum and Energy Equations and their derivations in different coordinate systems, Boundary layer Approximations to momentum and energy.
Laminar External flow and heat transfer: (a) Similarity solutions for flat plate (Blasius solution), flows with pressure gradient (Falkner-Skan and Eckert solutions), and flow with transpiration, (b) Integral method solutions for flow over an isothermal flat plate, flat plate with constant heat flux and with varying surface temperature (Duhamel's method), flows with pressure gradient (von Karman-Pohlhausen method).
Laminar internal flow and heat transfer: (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.
Natural Convection heat transfer: Governing equations for natural convection, Boussinesq approximation, Dimensional Analysis, Similarity solutions for Laminar flow past a vertical plate with constant wall temperature and heat flux conditions, Integral method for natural convection flow past vertical plate, effects of inclination, Natural convection in enclosures, mixed convection heat transfer past vertical plate and in enclosures.
Turbulent convection: Governing equations for averaged turbulent flow field (RANS), Analogies between heat and Mass transfer (Reynolds, Prandtl-Taylor and von Karman Analogies), Turbulence Models (Zero, one and two equation models), Turbulent flow and heat transfer across flat plate and circular tube, Turbulent natural convection heat transfer, Empirical correlations for different configurations.

References:

Textbooks:

1. Convective Heat and Mass Transfer, 4th Edition by W. Kays, M. Crawford and B. Weigand, McGraw Hill International, 2005.

NP-TEL

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http://nptel.iitm.ac.in

Mechanical Engineering

Pre-requisites:

Heat Transfer, Fluid Mechanics, Differential Equations

Coordinators:

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2. Convective Heat Transfer, 2nd Edition by S. Kakac and Y. Yener, CRC Press, 1995.
3. Convection Heat Transfer, 3rd Edition by A. Bejan, John Wiley, 2004

References:

1. Fundamentals of Heat and Mass Transfer, 7th Edition by F.P. Incropera and D. Dewitt, John Wiley, 2011.
2. Boundary Layer Theory, 8th Edition by H. Schlichting and K. Gersten, Springer-Verlag, 2000.