Department of Mechanical Engineering
Indian Institute of Technology New Delhi
II Semester -- 2025 – 2027

MEL7405/MCL814: CONVECTIVE HEAT TRANSFER

(3-0-0)

Syllabus

Introduction: Application of convective heat transfer, Foundations of heat transfer
Governing Equations: Derivation of energy equation, Derivation of boundary layer equation, Derivation of boundary layer energy equation.
Convection in Laminar Boundary: Blasius solution: similarity method, Pohlhausen solution: similarity method, Pohlhausen solution: heat transfer parameters, Falkner-Skan equation: Boundary layer flow over a wedge.
Laminar BL flow over flat plate: Uniform surface temperature, Laminar BL flow over flat plate: Uniform surface heat flux, Solution of example problems.
Convection in Internal Flows : Hydrodynamic and thermal regions: Energy balance in channel flow, Determination of heat transfer coefficient, Velocity profile in fully-developed channel flows, Thermally fully developed laminar slug flow with uniform wall heat flux condition, Hydrodynamically and thermally fully developed flow with uniform wall heat flux condition, Fully developed flow through parallel plate channel with uniform wall temperature, Fully developed flow through circular pipe with uniform wall temperature, Thermally developing flow through circular pipe with uniform wall heat flux, Thermally developing flow through circular pipe with uniform wall temperature.
Heat transfer in plane Couette flow: Solutions of example problems 438 WEEK 8 26 Lec 26: Introduction and scale analysis.
Natural convection over a vertical plate: Similarity solution of energy equation, Integral solution, Natural convection over inclined plate and mixed convection.
Natural convection inside enclosures, Solution of example problems.
Convection in Turbulent Flows: Derivation of Reynolds Averaged Navier-Stokes Equations, External Turbulent Flow, Integral solution for turbulent boundary layer flow over a flat plate.
Convection in turbulent pipe flows.
Pool Boiling and Flow Boiling: Boiling regimes and boiling curve.
Laminar film condensation on a vertical plate, Laminar film condensation on horizontal tubes.

Textbooks and References:

Convective Heat and Mass Transfer, by W M Kays.
Convective Heat Transfer: https://ahtt.mit.edu/wp-content/uploads/2020/08/AHTTv510.pdf