Convective Heat and Mass Transfer - Video course

COURSE OUTLINE

This course assumes that the students have undergone UG courses in Engineering Mathematics, Thermodynamics, Heat Transfer and Fluid Mechanics and are familiar with the use of experimentally derived CORRELATIONS for estimating heat/mass transfer coefficient in a variety of flow situations. The purpose of this course is to justify the basis and the form of these correlations on the basis of fundamental transport laws governing heat/mass transfer.

The treatment is highly mathematical and, through assignments, students are expected to formulate and solve problems to derive expressions for the heat/mass transfer coefficient in different situations. The course will interest students wishing to embark on a research career in heat/mass transfer.

Contents:
Definitions of Heat/Mass Transfer Coefficient, Main Flow Classifications, Transport Equations of Bulk Mass, Momentum, Energy and Sepcies transfer, Boundary Layer Theory and its approximations, Laminar and Turbulent External boundary layers with effects of Pressure Gradient, Wall thermal conditions, Viscous dissipation, Wall mass transfer. Similarity, Integral and Finite-difference solutions of boundary layer equations.

Developing Internal (ducted) flows within boundary layer approximations, Fully developed flows and heat transfer in non-circular ducts, use of superposition techniques. Turbulent Flows, laminar-turbulent transition, Universal law-of-the wall for smooth and rough surfaces, mixing-length and 2-equation models, the energy budget for boundary layer and fully-developed pipe flow.

Approximate theories of Mass Transfer , Stefan-Couette-Reynolds flow models, Applications to Inert mass transfer with and without heat transfer, Mass transfer with heterogeneous and homogeneous chemical reactions.

COURSE DETAIL

Sl. No	Topic	Hours
1.	Definitions and Flow Classifications.	2
2.	Derivation of Transport Equations – Dimensional Analysis.	4
3.	2D Laminar Velocity and Temperature Boundary Layers Solutions.	6
4.	Developing and Fully Developed Duct Flow Solutions.	4
5.	Developing and Fully Developed Duct Flow Heat Transfer Solutions.	4

NPTEL

http://nptel.iitm.ac.in

Mechanical Engineering

Pre-requisites:

Engineering Mathematics - Heat Transfer - Fluid Mechanics.

Coordinators:

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6.	Nature of Turbulent flows – Phenomenology of Near - wall Turbulence.	4
7.	2D Turbulent Velocity and Temperature Boundary Layers Solutions.	4
8.	Energy Budgets and Turbulence Modeling.	2
9.	Formulation of the Mass Transfer Problem using different Models.	6
10.	Application of Reynolds Flow Model to different problems involving simultaneous heat/mass transfer with and without chemical reaction.	4

References:

1. Kays W M and Crawford M E, "Convective Heat and Mass Transfer",McGraw Hill Int Edition, 3rd edition, 1993.
2. Spalding D B, "Introduction to Convective Mass Transfer", McGraw Hill, 1963.
3. Bird R. B., Stewart W. E. and Lightfoot E. N., " Transport Phenomena ", John Wiley and sons, Inc., 1960.
4. Schlichting H., " Boundary Layer Theory ", Sixth edition, McGraw Hill , 1968.