FUNDAMENTALS OF CONVECTIVE HEAT TRANSFER

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TYPE OF COURSE : New | Both | UG/PG
COURSE DURATION : 12 weeks (20 Jul' 20 - 9 Oct' 20)
EXAM DATE : 18 Oct 2020

PRE-REQUISITES : Fundamental knowledge of Mathematics, Heat Conduction and Fluid Mechanics should be sufficient

INTENDED AUDIENCE : Postgraduate and undergraduate students of Mechanical Engineering and similar branches;Faculty members associated with Mechanical Engineering;Practicing engineers associated with fluid and thermal industries. **INDUSTRIES APPLICABLE TO :** BHEL, NTPC, Eaton

COURSE OUTLINE :
Convective heat transfer is one of the most important areas of engineering sciences. It is major mode of heat transfer during flowing fluid and it is the most common mode of heat transfer used in industry.

ABOUT INSTRUCTOR :
Prof. Amaresh Dalal is currently Professor in the Department of Mechanical Engineering of the Indian Institute of Technology Guwahati. He received his Ph.D. degree from Indian Institute of Technology Kanpur in 2009 and he was Post-doctoral Research Associate at Purdue University from Sep 2008 - Dec 2009.

COURSE PLAN :

Week 1: Introduction: Introduction to convective heat transfer. Basic transport equations of fluid dynamics.

Week 2: Preliminary Concept: Derivation of energy equation;Velocity and thermal boundary layers, boundary layer, displacement and momentum thickness

Week 3: Convective heat transfer in external flows - I: Steady flow over flat plate, Blasius solution. Temperature distribution over flat plate boundary layer. Approximate method for flat plate boundary layer

Week 4: Convective heat transfer in external flows - II: Viscous dissipation effects on boundary layer flow over flat plate. Boundary layer on wedge shaped bodies, Falkner-Skan Equation. Approximate method for boundary layer flows over non-zero pressure gradient surface

Week 5: Convective heat transfer in internal flows - I: Velocity profile in fully developed pipe flow. Thermal considerations during internal flows. Energy balance in pipe flows.

Week 6: Convective heat transfer in internal flows - II: Hydrodynamically and thermally fully developed flow with uniform wall heat flux (UHF). Thermally fully developed slug flow with uniform wall temperature (UWT). Hydrodynamically and thermally fully developed flow with uniform wall temperature (UWT).

Week 7: Convective heat transfer in internal flows - III: Hydrodynamically fully developed and thermally developing flow with uniform wall heat flux. Heat transfer in Couette flow

Week 8: External natural convection: Free convection over vertical flat plate: Integral Solution. Free convection over vertical flat plate: Similarity Solution.

Week 9: Internal natural convection: Internal natural convection. Mixed convection.

Week 10: Numerical solution of Navier-Stokes and energy equation: Fundamentals of numerical methods. Solution of Naiver-Stokes equations using FDM (MAC algorithm). Solution of Naiver-Stokes equations using FVM (SIMPLE algorithm).

Week 11: Turbulent flow and heat transfer: Reynolds averaged Navier-Stokes equations. Universal velocity profile on flat plate. Turbulent heat transfer in pipe.

Week 12: Fundamentals of boiling and condensation: Film condensation on a vertical surface. Introduction to boiling.