



CONVECTIVE HEAT TRANSFER

PROF. ARUP KUMAR DAS

Department of Mechanical and Industrial Engineering
IIT Roorkee

PRE-REQUISITES : Fluid Mechanics and Thermodynamics

INTENDED AUDIENCE : It is an elective course for Bachelor students in Mechanical/Chemical/Aerospace Engineering, Middle level managers from related industry.

INDUSTRIES SUPPORT: Intel, General Electric, General Motors, ABB, Nuclear Industries, etc.

COURSE OUTLINE :

Convection is a major mode of heat transfer when fluid is attached with the source. Processes of convection are fundamental and linked up with fluid mechanics laws and derivations of thermodynamics. Convective heat transfer has its wide horizon spreading from flow over a flat plate under constant heat flux or constant temperature boundary conditions to thermally developing or developed flow inside a duct. Moreover convection theories will widely vary depending on medium flow field which differentiates forced flow and natural gravity driven heat transfer modes. Convective heat transfer takes a major role in phase change heat transfer as well as mass transfer analogies in chemical processes. Present course targets fundamental understanding of all these facets with derivations and mathematical examples.

ABOUT INSTRUCTOR :

Prof. Arup Kumar Das is Assistant Professor in Department of Mechanical and Industrial Engineering at IIT Roorkee and actively involved in teaching and research in the direction of convective heat transfer for last ten years. His research interests are in the fundamental understanding of interfacial transport in macro and micro-scale confinements with applications in energy, environment, and bio-systems. He has authored and co-authored more than 35 peer-reviewed journal papers, which includes publications in Springer, Royal Society of Chemistry, American Chemical Society and Elsevier journals. He is also active in writing book chapter with reputed international publication house. For his contributions in engineering and sciences, he has been awarded by Indian National Science Academy (INSA), Indian National Academy of Engineers (INAE).

COURSE PLAN :

- Week 1:** Different Convective Modes, Balance of Total Energy, Derivation of Thermal Energy Equation, Thermal Boundary Layer, Forced Convection: Low Prandtl Number over a Flat Plate
- Week 2:** Forced Convection: High Prandtl Number over a Flat Plate, Forced Convection over a Flat Plate: Uniform Heat Flux, Natural Convection: Uniform Wall Temperature, Natural Convection: Uniform Heat Flux, Tutorials on Convection over flat plate
- Week 3:** Forced Convection in Ducts, Thermally Developed Slug Flow in a Duct, Thermally and Hydrodynamically Developed Flow: Uniform Heat Flux, Thermally and Hydrodynamically Developed Flow: Uniform Wall Temperature, Thermal Entrance Region
- Week 4:** Tutorials on Convection inside duct, Rayleigh Benard Convection, Heat Transfer with Phase Change, Mass Transfer, Tutorials on Phase change and mass transfer