Introduction to Computational Fluid Dynamics

Introduction: Basic tools of CFD, Numerical Vs experimental tools; Mathematical Behavior of PDEs: Parabolic, Hyperbolic and Elliptic PDEs; Methodology of CFDHT: Discrete representation of flow and heat transfer domain: Grid generation, Governing equations and boundary conditions based on FVM/FDM, Solution of resulting set of linear algebraic equations, Graphical representation and analysis of qualitative results, Error analysis in discretization using FVM/FDM; Solution of 1-D/2-D steady/unsteady: Diffusion problems, Convection problems, Convection-diffusion problems, source term linearization; Explicit and Implicit Approach: Explicit and implicit formulation of unsteady problems, Stability analysis; Solution of Navier-Stokes Equations for Incompressible Flows: Staggered and collocated grid system, SIMPLE and SIMPLER algorithms; Special Topics in CFDHT: Numerical Methodology for Complex Geometry, Multi-block structured grid system, Solution of phase change Problems.

Essential Reading:

S.V. Patankar, Numerical Heat Transfer and Fluid Flow, Taylor and Francis, ISBN-10: 0891165223.

Supplementary Reading:

1. H. K. Versteeg and W. Malalasekra, Introduction to Computational Fluid Dynamics: The Finite Volume Method, Prentice Hall (2nd Edition), ISBN-10: 0131274988.
2. Jr. D. A. Anderson, Computational Fluid Mechanics and Heat Transfer by McGraw-Hill Education
3. M. N. Ozisik, Finite Difference Method, CRC (1st Edition).