# MA608 Computational Fluid Dynamics

Credit: 3-0-0-3 Approval: Approved in 2nd Senate

Prerequisites: Basic knowledge in Fluid Mechanics

Students intended for: MS/ Ph.D. and UG

Elective or Core: Elective Semester: Even

**Course Objective:**

This course will emphasize on the development of basic as well as advance Finite Difference approaches to provide numerical solutions of Partial Differential Equations, frequently arise in the field of Fluid Mechanics. This course is a theoretical course along with two small projects. First project will be done before Quiz 2 and second project will be completed before End-semester examination. Both of the projects will be related to the application of finite difference method to solve fluid flow problems. Finally, the main objective of this course is to provide basic concepts of Computational Fluid Dynamics, in terms of comprehensive theoretical study and some of its computational aspects.

**Course Outline:**

**UNIT-I:** Introduction: Historical Perspective, Comparisons of experimental, Theoretical and Numerical approaches. Different numerical Approaches.

[4 lectures]

**UNIT-II:** Governing Equations: Classification of Partial Differential Equations, Physical Classification, Mathematical Classification, Well-posed problems, Navier-Stokes System of equations. [6 lectures]

**UNIT-III :** Finite Difference Methods: Derivation of Finite Difference Equations, Simple Methods, General Methods, Multidimensional Formulas, Accuracy of Finite Difference solutions. [6 lectures]

**UNIT-IV** : Solution Methods of Finite Difference Equations: Elliptic Equations, Parabolic Equations, Hyperbolic Equation, Example Problems, Stability, Convergence and Consistency of the Solution methods. [14 lectures]

**UNIT-V**: Application of Finite Difference Methods to the Equations of Fluid Mechanics: Numerical Methods for Inviscid Flow Equations, Numerical Methods for Boundary-Layer Type Equations.

[9 lectures]

**UNIT-VI :** Introduction to Finite Volume Methods: Basic Formulations, SIMPLE algorithm.

[4 lectures]

**Text & Reference Books:**


1. D. A. Anderson, J. C. Tannehill, and R. H. Pletcher, *Computational Fluid Mechanics and Heat Transfer*, 2nd ed, Taylor & Francis, 1997.
2. J. D. Anderson Jr, *Computational Fluid Dynamics*, McGraw-Hill International Edition, 1995.
3. S. V. Patankar, *Numerical Heat Transfer and Fluid Flow*, Hemisphere, 2000.
4. T. J. Chung, *Computational Fluid Dynamics*, 2nd ed. Cambridge University Press, 2010.
5. P. Niyogi, S. K. Chakrabartty, M. K. Laha, *Introduction to Computational Fluid Dynamics*, Pearson Publications, 2011.