Course Type	Course Code	Name of the Course	L	T	P	Credits
DC	NMCC527	Computational Fluid Dynamics	3	1	0	4

Course Objective

- This course would enable the students to learn fluid flow problems of realistic systems such as flow through channels, heat engines, piston rings, heat transfer analysis using numerical techniques such as finite difference and finite volume methods.

Learning Outcomes

- Computational Fluid Dynamics is an indispensable subject in many areas of real systems such as food processing, oil recovery, heat engines, and structural mechanics and so on. After attending this course the students would be able to find numerical solutions of linear and nonlinear equations arising in fluid flow problems. Also, the students will be able to learn varieties of numerical methods and stability of numerical schemes along with convergence criterion.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Introduction to Numerical Methods: Finite approximations, Discretization approaches, Finite difference methods, Finite volume methods. Solution of linear systems, Solution of IVP & BVP, Shooting Method, Tridiagonal Systems, LU Decomposition, Multigrid Methods, Coupled Equations and their solutions.	8L+2T	Numerical scheme suitability and solution methodologies for coupled and non-coupled ordinary or partial differential equations.
2	Basic concepts of Fluid Flow: Conservation principles, Mass conservation, Momentum conservation, Dimensional forms of equations, Mathematical classification of flows: Hyperbolic, parabolic, Elliptic and Mixed type.	9L+3T	The students would be able to learn fluid interactions and real-life applications of fluid problems in mathematical representation.
3	Methods for unsteady problems: Two level methods, P-C and multipoint methods, Application to the transport equation.	8L+3T	The students will be able to simulate complex fluid flow problems.
4	Finite volume methods: Approximation of surface and volume integrals, boundary conditions, upwind interpolation, Quick scheme.	9L+3T	The students will be able to simulate more complex and geometric simulation with finite volume method.
5	Complex geometries, efficient, accuracy and convergency, stability criterion of numerical schemes.	8L+3T	The student will be able to assess the performance of numerical schemes.
Total		**42L+14T**	

Text Books

1. J.H. Ferziger & M. Peric, Computational Methods for Fluid Dynamics, Springer (South Asian reprint) 2003.
2. H. Versteeg & W. Malalasekera, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson Education Ltd., 2009.

Reference Books

1. P. Niyogi, S.K. Chakrabarty, M.K. Laha, Introduction to Computational Fluid Dynamics, Pearson

2. John D. Anderson Jr., Computational Fluid Dynamics, CRC Press, 2019 (Reprint).