Subject Descriptions

Subject Code	MATH 332
Subject Name	Computational Fluid Dynamics I
Credit Hours	3
Level of Study	3
Pre-Requisites	MATH 331
Faculty	Science

Subject Description

Fluid Dynamic Definition: Types of Fluid and its Properties, Viscosity and Viscoelasticity Fluid, Newtonian and Non-Newtonian Fluid, Compressible and In-compressible Fluid, Advection Equation in one Dimension: General Form, Physical Meaning, Discretization of variables and of Solution Space, Finite Difference Method for the Advection Equation in 1D: The 1D (Upwind, FTFS, FTBS, FTCS, Lax-Friedrichs, Leapfrog, Lax-Wendroff, Iterative Crank-Nicolson) Scheme, The Wave Equation in 1D: General Form, Physical Meaning, Finite Difference Method for the Wave Equation in 1D: The (FTCS, Lax-Friedrichs, Leapfrog, Lax-Wendroff) Scheme, Local Truncation Error (LTE), Consistency and Convergence, Convergence and Stability, CFL Condition, Fourier Analysis, Von Neumman Analysis, Monotonicity Preserving Scheme, Godunov's Theorem.

Subject Aims

1. To know a brief introduction on the origin of fluid dynamics.
2. Understanding of the hyperbolic partial differential equations in one space dimension.
3. Know the entire analysis of finding the analytical solutions of the transport, wave, and heat equations.
4. Comprehension of the underlying analytical solution of PDEs will be stressed as well as appropriate programming skills.
5. Comparison between the numerical and analytical solutions of the previous PDEs.

Intended Learning Outcomes

1. Know theoretically and practically of fluid dynamics
2. To understand mathematical characteristics of partial differential equations.
3. To understand basic properties of computational methods – accuracy, stability, consistency.
4. To learn computational solution techniques for time integration of ordinary differential Equations.
5. To learn computational solution techniques for various types of partial differential equations
6. To acquire basic programming and graphic skills to conduct the flow field calculations and data analysis.

Teaching Details

Lectures, supported by lecture notes with problem sets and model solutions, problems classes and small group tutorials.

Assessment Details

	Percentage Formal assessment
First Exam	25%
Second Exam	25%
Final Exam	40%
In-course Assessment	10%
Total Percentage	100%

Teaching Schedule and Support for Students

	Hours
Lecture	39
Tutorial	13
Practical	0
Office hours	6 hr/week
Academic Advising	5 hr/week

Textbook Information

Author	Date	Title	Edition	Publisher
Randall J. LeVeque	2007	Finite Difference Methods for Ordinary and Partial Differential Equations		SIAM