Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NMED544	Finite Volume Method in Fluid Flow and Heat Transfer	3	0	0	3

Course Objective

1. To study the fundamentals of Finite volume method and its application for solving the fluid flow and heat transfer problems
2. To differentiate between FDM and FVM
3. To study the suitability of FVM over FDM and FEM

Learning Outcomes

Upon successful completion of this course, students will be able:

1. To understand the fundamentals of Finite Volume
2. To understand different discretization techniques
3. To understand the application of FVM in simulation of flow and heat transfer problems
4. To understand the application of unstructured grid in FVM

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Need of Finite Volume Method, Introduction to different discretization methods, Finite difference method, finite volume method and finite element method	3	To know about the need of finite volume method
2	The finite volume principles for general conservation laws, Time discretization, Space discretization, Comparison with other discretization techniques	3	To know about the preliminaries of discretization
3	A one-dimensional elliptic problem on heat transfer, A finite volume method for the Dirichlet problem, Formulation of a finite volume scheme, Comparison with a finite difference scheme, Convergence and error analysis for the Dirichlet problem, An error estimate using a finite difference technique	6	To know about the finite volume discretization and how this method differs from other discretization methods
4	Elliptic problems in two or three dimensions in flow and heat transfer, Dirichlet boundary conditions, N-S Equations, SIMPLE Algorithm, Structured meshes, Unstructured meshes, General meshes, Convergence,	10	To know about the finite volume discretization of 2-D and 3-D heat transfer problems
5	Neumann boundary conditions, Meshes and schemes, Error estimate, Convergence	5	To know about the mesh generation

6	Parabolic equations in heat transfer, Meshes and schemes, Error estimate for the linear case ,	4	To know about the solution of parabolic equation in heat transfer
7	Multidimensional nonlinear hyperbolic equations, Explicit schemes, Implicit schemes, Stability results for the explicit scheme	5	To know about the solution of multi-dimensional hyperbolic equations in fluid flow
8	Incompressible viscous flow simulation, Stream function / vorticity formulation, Energy equation, Discretization by finite volume method	6	Formulation of vorticity stream function and its solution by special finite volume approach given by Gosman
	Total	42	

Text Books:

1. Muralidhar K and Sundarrajan, T(1995) Computational Fluid Flow and Hear Transfer: IIT Kanpur Series of Advanced Text, Narosa Publishing House

2. Versteeg, H and Malalasekra, W(2nd Edition), An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson Publication.

Reference Books:

1. Patankar, S. V (1980), Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation, Taylor and Francis Group. New York

2. Gosman, A, D, Pun, W.M, Runchal, A.K, Spalding, and Wolfshtein, M (1969), Heat and Mass Transfer in Recirculating Flows, Academic Press, New York

3. Roache, P.J(1982), Computational Fluid Dynamics, Hermosa, New Mexico, USA.