

Devi Ahilya University, Indore, India Institute of Engineering & Technology				BE IV Year (Mechanical Engineering)					
Subject Code & Name	Instruction Hours per Week			Marks					
4ME109 COMPUTATIONAL FLUID DYNAMICS	L	T	P		TH	CW	SW	PR	Total
	4	-	-	Max	100	50	-	-	150
				Min	35	25	-	-	60
Duration of Theory Paper: 3 Hours									

**Objective and Pre requisites:** The objective of the subject to introduce the students about the new and advanced methods in fluid dynamics using computer systems. Pre requisites are Engineering Mathematics, Fluid Mechanics & Thermodynamics.

## COURSE CONTENT

### UNIT 1

#### Introduction to Fluid Dynamics

Review of conservation equations, Continuum concept, control volume equations, Ideal fluid flow and hydraulic singularities, Navier-stokes equations, and their use. Concept of compressible flow, one dimensional isentropic flow, normal shock, flow with-friction, heat transfer, boundary-Layer theory and applications

### UNIT 2

#### Boundary Layer Theory

Basic concepts, Boundary Layer Parameters, Boundary Layer on flat plate, Hiemenz flow, flow near rotating disc. Von-Karman Momentum Equation. General Properties of Boundary Layer equations, Theory of stability. Theory of similarity in heat transfer and exact solutions. Turbulence, correlation coefficient.

### UNIT 3

#### Numerical Methods

Fluid Dynamics Equations in Eulerian systems, the characteristic method, finite element methods and application in fluid dynamics, solution of physical flow problems. Scaling and nondimensionalisation Order of Magnitude method.

### UNIT 4

#### Computational Methods

Algebraic equations, ordinary differential equations, Numerical solutions of non-linear equation. Problems leading to system of linear equations. Techniques for solving system of linear equations (direct and iterative). Linear and non linear regression techniques to correlate experimental data. Numerical Integration, application to flow processes. Solution to partial differential equations, Difference forms, implicit and explicit methods for steady state and transient problems.

### UNIT 5

#### Optimisation Methods

Classical optimization methods, unconstrained minimization. Univariate, conjugate direction, gradient and variable metric methods, constrained minimization, feasible direction and projections. Integer and Geometric programming, genetic algorithms.

### BOOKS RECOMMENDED:

- [1] Douglas, J. F., *Fluid Mechanics*, Pearson Education, 2005.
- [2] Streeter, V. L and Wylie, E. B., *Fluid Mechanics*, McGraw-Hill Co, 2003.
- [3] Streeter, V. L and Wylie, E. B., *Fluid Dynamics*, McGraw-Hill Co, 2003.
- [4] White F., *Fundamentals of Fluid mechanics*, McGraw-Hill Co, 2003.
- [5] Wirz H.J. and Smolderen J.J., *Numerical Methods in Fluid Dynamics*, McGraw-Hill, 1978.