Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. in Thermal Engg.	Computational Fluid Dynamics	MET 508	SM+MT+ET 25+25+50
Semester	**Credits**	**L-T-P**	**Exam.**
II	3	3-0-0	3 **Hours**

Unit – I

Introduction: Governing equations of fluid flow and heat transfer; Partial differential equations - Physical and mathematical classification - Parabolic; Elliptical and Hyperbolic equations. **(05 Hours)**

Unit – II

Finite Difference Method: Discretization –Converting derivatives to discrete Algebraic Expressions; Taylor's series approach; Polynomial fitting approach; Discretization error; Heat conduction –Steady one and two dimensional in Cartesian and cylindrical co-ordinates; Handling of boundary conditions.

(09 Hours)

Unit – III

Finite Volume Method: Discretization of governing equations; Steady one-dimensional conduction equation; Uunder-relaxation and over relaxation; Solution of simultaneous equations – direct and iterative methods; Tridiagonal Matrix algorithm

(06 Hours)

Unit – IV

Two Dimensional Steady State Conduction Problems in Cartesian: Point by point and line by line method of solution: Dealing of Dirichlet; Neumann and Robbins type boundary conditions -Formation of discretized equations for regular boundaries; irregular boundaries and interfaces. **(09 Hours)**

Unit – V

Transient Heat Conduction Problems in Cartesian and Cylindrical Co-ordinates: Explicit; Implicit; Crank Nicholson and ADI methods- stability of each system- Conservation -Consistency; stability and convergence for marching problems-Discrete perturbation stability analysis- Fourier or Von Neumann stability analysis. **(09 Hours)**

Unit – VI

Discretization Equation for Two-Dimensions: Calculation for the flow-field-stream function- vorticity approach; SIMPLE; SIMPLER and SIMPLEC Algorithm; Numerical Marching Techniques; Two dimensional parabolic flows with heat.

(07 Hours)

Recommended Books:

1. Computational Methods for Fluid Dynamics; J. H. Ferziger and M Peric; Springer; 3rd Edition; 2002.
2. Computational Fluid Dynamics; J. D. Anderson; Jr.; McGraw Hill; 2008.
3. An Introduction to CFD: The Finite Volume Method; H. K. Versteeg and W. Malalasekera; Longman Scientific and Technical; 2007.
4. Numerical Heat Transfer and Fluid Flow; S. V. Patankar; Tayler and Francis; 1980.
5. Computational Fluid Dynamics: An Introduction; J. F. Wendt; Springer; 3rd Edition; 2008.