Diploma, Anna Univ UG & PG Courses

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ME8093 COMPUTATIONAL FLUID DYNAMICS

DETAILED SYLLABUS

OBJECTIVES:

- To introduce Governing Equations of viscous fluid flows
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three - dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportive ness, Hybrid, Power-law, QUICK Schemes.

UNIT IV FLOW FIELD ANALYSIS

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

UNIT V TURBULENCE MODELS AND MESH GENERATION

Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

TEXT BOOKS:

1. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 2017.

2. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd. Second Edition, 2007.

REFERENCES:

1. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press, 2005.

2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002.

3. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005

4. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2014.

5. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004