CSE-801 Computational Fluid Dynamics

Credit Hours: 3 **Pre-requisites:** Nil

Course Objectives:

- Equip students with the knowledge base essential for application of computational fluid dynamics to engineering flow problems,
- Will provide the graduates essential numerical background for solving the partial differential equations governing the fluid flow,Will develop students' skills of using a commercial software package.

Course Contents

- Introduction to CFD
- Mathematical review
- Governing Equations of Fluid Flow (Navier-Stokes Equations)
- Finite volume method for the diffusion problem
- Mesh generation
- Boundary conditions
- Finite volume method convection-diffusion problem
- Solution methods for discretized equations
- Solution algorithms for Pressure velocity couplings (Navier-Stokes Equations)
- Residuals in CFD and convergence criteria
- Errors and stability
- Latest trends in CFD, e.g. FSI, Multi-Physics, AI integration, etc.

Course Outcomes

- Develop a solid understanding of the fundamental principles, equations, and governing laws of fluid dynamics that form the basis for computational fluid dynamics (CFD) simulations.
- Understand the application of the finite volume method to numerically solve fluid flow problems.
- Acquire hands-on experience with industry-standard CFD software packages and develop the skills necessary to set up, solve, and analyze CFD simulations for a variety of fluid flow scenarios.
- Learn the techniques and tools required for generating appropriate computational meshes for CFD simulations.
- Gain knowledge of different types of boundary conditions commonly encountered in CFD simulations and how to apply them accurately.
- Understand convergence criteria and strategies for achieving reliable and accurate CFD solutions.

Recommended Reading (including Textbooks and Reference books)

- An Introduction to Computational Fluid Dynamics, H. K. Versteeg and W. Malalasekera, 2nd Edition, Pearson, 2007.
- The finite volume method in computational fluid dynamics, An advanced introduction with OpenFoam and Matlab, F. Moukalled, L. Mangani, M. Darwish, Springer, 2016.
- Computational Fluid Dynamics, A practical Approach, Jiyuan Tu et al., 3rd Edition, BH, 2018.
- Computational Fluid Dynamics: The Basic with Applications, J.D. Anderson, Jr., McGraw Hill, Inc., 1995.
- An Introduction to ANSYS Fluent 2022, John E. Matsson, SDC Publications, 2022
- Notes on Computational Fluid Dynamics: General Principals, Christopher J. Greenshields, Henry G. Weller, CFD Direct, 2022.