National University of Sciences and Technology

Course Description

Course Title	Course Code	Credit Hours
Computational fluid mechanics	**ME 831**	3 – 0

Textbook:

- Tu, J., Yeoh, G. H., and Liu, C., Computational Fluid Dynamics, A Practical Approach, Butterworth & Heiemann.

Reference Books:

- Patankar. S. V. Numerical heat transfer and fluid flow, Hemisphere.
- Malalasekra, W. and Versteeg, H., An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Prentice Hall.
- Anderson, J., Computational Fluid Dynamics, McGraw Hill Book Co

Course Objective:

- Develop students' proficiency in numerical methods and computational tools for simulating and solving complex fluid dynamics problems across various engineering applications.

Course Outline:

- Governing Differential Equations: continuity, momentum, turbulence and energy balance equations; The generic form of governing equations.; Basic steps for numerical solution: geometry definition, grid, boundary conditions, solutions, post-processing; Finite Difference Method in CFD: Forward, Backward, Central Difference and Upwind Schemes for advection-diffusion and wave equations, discussion of round- off and numerical errors and stability of various schemes; Finite Volume Method in CFD:
- General guidelines and various interpolation schemes, derivation of discretization equations for diffusion, advection-diffusion and full Navier-Stokes Equations; pressure-velocity coupling algorithms, SIMPLE, SIMPLER, SIMPLEC etc, Implementation of boundary conditions, discussion of methods of solution, convergence and tools for accelerating convergence.
- Introduction to Finite Element Method for CFD: element shapes and shape functions, derivation of finite element equations for potential flow using weighted residual approach.

An introduction to modern commercial and open-source CFD codes and practical case studies using these codes 98.

ASSESSMENTS

Description	Percentage Weightage (%)
Assignments	05-10%
Quizzes	10-15%
Mid Semester Exams	30-40%
End Semester Exam	40-50%