UCH832 CFD ANALYSIS IN CHEMICAL ENGINEERING

L	T	P	Cr
3	1	0	3.5

Course Objectives:
To provide brief introduction of Computational Fluid Dynamics along with chemical engineering application specifically, analysis of fluid mechanics and heat transfer related problems.

Introduction: Illustration of the CFD approach, CFD as an engineering analysis tool, Review of governing equations, Modeling in engineering, Partial differential equations- Parabolic, Hyperbolic and Elliptic equation, CFD application in Chemical Engineering, CFD software packages and tools.

Principles of Solution of the Governing Equations: Finite difference and Finite volume Methods, Convergence, Consistency, Error and Stability, Accuracy, Boundary conditions, CFD model formulation.

Mesh generation: Overview of mesh generation, Structured and Unstructured mesh, Guideline on mesh quality and design, Mesh refinement and adaptation.

Solution Algorithms: Discretization schemes for pressure, momentum and energy equations - Explicit and implicit Schemes, First order upwind scheme, second order upwind scheme, QUICK scheme, SIMPLE, SIMPLER and MAC algorithm, pressure-velocity coupling algorithms, velocity-stream function approach, solution of Navier-Stokes equations.

CFD Solution Procedure: Problem setup – creation of geometry, mesh generation, selection of physics and fluid properties, initialization, solution control and convergence monitoring, results reports and visualization.

Case Studies: Benchmarking, validation, Simulation of CFD problems by use of general CFD software, Simulation of coupled heat, mass and momentum transfer problem.

Course Learning Outcomes (CLO):

The students will be able to:

1. Solve PDE.
2. Use Finite Difference and Finite Volume methods in CFD modeling
3. Generate and optimize the numerical mesh
4. Simulate simple CFD models and analyze its results.

Text Books:

1. *P.S. Ghosdastidar, Computer Simulation of Flow and Heat Transfer, Tata McGraw-Hill (1998).*
2. *Muralidhar, K.,and Sundararajan,T. Computational Fluid Flow and Heat Transfer, Narosa Publishing. House (1995).*

Reference Books:

1. *Niyogi, P. Chakrabarty, S.K. and Laha, M.K., Introduction to computational fluid dynamics, Pearson education (2006).*
2. *LI J., G. H. Yeoh, C Liu. A Computational Fluid Dynamics, ELSEVER (2008)*

3. *Suhas V. Patankar. Numerical Heat Transfer and Fluid Flow, Taylor and Francis (1978).*
4. *S K Gupta. Numerical Methods for Engineers, New Age Publishers, 2nd Edition (1995).*
5. *Anderson J.D. Computational Fluid Dynamics, Mc-Graw Hills (1995).*
6. *Ranade, V.V., Computational flow modeling for chemical reactor engineering, Academic Press (2002).*
7. *J H Ferziger and M Peric, Computational Methods for Fluid Dynamics, Springer (2002).*

Evaluation Scheme:

S. No.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessional (May includes tutorials/ assignments/ quiz's etc)	25