Course No.	**CE 205004**
Course Title	**Computational Hydraulics**
Credits	**L T P C** **3 0 2 4**
Prerequisites	**Fluid Mechanics**

Course contents:

Introduction
Understanding the turbulence characteristics of flow structure, Modelling theory, Mathematical classification of flows, Conceptualisation of building model, development and application of models.

Modelling water related flow
Governing Equations for 1-D and 2-D flow, Mathematical classification of flow equations, Dimensionless form of Equations, Solution of Ordinary differential equations and partial differential equations, Navier-Stokes equations, Saint-Venant equations, Characteristics forms of Saint-Venant equations.

Discretisation of fluid flow domain
Discrete solutions of equations, space discretisation – structure grids, unstructured grids, grid generation, physical aspects of space discretisation, Time discretisation.

Numerical Methods
Method of characteristics, Initial and Boundary conditions, Characteristics grid method, Method of specified intervals.

Finite Difference Methods
General concept, approximations of the first order derivation and higher order derivatives, Explicit finite difference schemes, Implicit finite difference schemes.

Finite Volume Methods: An overview
General concept, Approximation of surface integrals and volume integrals, Variables arrangement on the grids: collocated and staggered, discretisation of convective and diffusive fluxes, evaluation of the time derivative, boundary conditions.

Properties of Numerical Methods
Consistency, Stability, Convergence, Conservation, Boundedness, Realizability, Accuracy, Lax theorem of equivalence.

Introduction to Turbulence Modelling
Direct Numerical Simulation (DNS), Large Eddy Simulation (LES), Reynolds Averaged Navier Stokes Models.

References Books

1. Popescu, I. Computational Hydraulics: Numerical Methods and Modelling, IWA publishing.
2. Chaudhary M. H., Open-channel flow, Springer Publications.
3. Ferziger J. H., and Peric M., Computational Methods for Fluid Dynamics, Springer.

4. Nezu I., and Nakagawa H. Turbulence in Open Channel Flows. IAHR Monograph.