

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

**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.