GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

Mechanical Engineering (Cryogenic Engineering)

Subject Name COMPUTATIONAL FLUID DYNAMICS

Sr.No	Course content
1.	Introduction & Basic concepts: Introduction of CFD, Types of fluids and basic equations of flow, Conservation of mass, Newton's Second law of Motion, Governing equations of fluid flow, Navier-Stokes equations, Boundary layer equations, Expanded form of N-S equations, Conservation of energy principle, Special form of N-S equations, Classification of second order partial differential equations, Initial and boundary conditions, Governing equations in generalized coordinates. Review of essentials of fluid dynamics.
2.	Differential Equations & Discretization: Elementary Finite Difference Equations, Basic aspects of Finite Difference Equations, Errors and Stability Analysis, Discretization , Application to heat conduction and convection, Problems on 1-D and 2-D steady state and unsteady state conduction, Problem on Advection phenomenon, Incorporation of Advection scheme.
3.	Introduction to Finite Element Philosophy: Basics of finite element method, stiffness matrix, isoperimetric elements, formulation of finite elements for flow & hear transfer problems.
4.	Introduction to Finite Volume Philosophy: Integral approach, discretization & higher order schemes, Application to Complex Geometry.
5.	Introduction to solutions of viscous incompressible flows using MAC and

	simple algorithm.
6.	Solutions of viscous incompressible flows by stream function, vorticity formulation. Two dimensional incompressible viscous flow, estimation of discretization error, applications to curvilinear geometries, derivation of surface pressure & drag.

Experiment list:

1. Exercise on pin-fin analysis
2. Exercise on 1-D steady state heat conduction
3. Exercise on 1-D unsteady state heat conduction
4. Exercise on 2-D steady state heat conduction
5. Exercise on 2-D unsteady state heat conduction
6. Exercise on heat transfer by convection
7. Exercise on fluid flow
8. Exercise on irregular geometry

Reference Books:

1. Anderson D.A., Tannehil j.c.Pletcher R.H." Computational fluid mechanics & heat transfer" Hemisphere publishing corporation,. Newyork, U.S.A2004.
2. Anker S.V., "Numerical heat transfer & flow" Hemisphere corporation,2001
3. H.K.verstag & W.Malalsekra," An introduction to computational fluid dynamics" Longman-2000
4. Carnahan B, "Applied numerical method" John Wiley & Sons-2001.
5. Patankar, " Numerical heat transfer & Fluid Flow", Mc.GrawHill.,2002
6. Murlidhar K., Sunderrajan T., "Computational Fluid Mechanics and Heat Transfer", Narosa Publishing House.
7. Date A. W., "Introduction to Computational Fluid Dynamics", Cambrige Uni. Press, 2005.
8. Ferziger J. H., Peric M., "Computational Methods for Fluid Dynamics", Springer, 2002.