Subject Code: 01ME0832

Subject Name: Computational Fluid Dynamics

B.Tech. IV Year – (Sem-8) Mechanical Engineering

Type of course: Programme core

Prerequisite: -.Higher Engineering Mathematics, heat transfer and Fluid Mechanics at UG level

Rationale: This course aims to introduce numerical modeling and its role in automotive field; it will enable the students to understand the various discretisation methods and solving methodologies and to create confidence to solve complex problems in the automotive field with the knowledge of Heat transfer and fluid dynamics. Further students can able to develop finite difference and finite volume discretized forms of the CFD equations and to formulate explicit & implicit algorithms for solving the Euler Eqns &Navier Stokes Eqns.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
4	2	0	5	70	30	30	0	20	0	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1.	Unit 1: Introduction & Basic concepts: Introduction of CFD, Types of fluids and basic equations of flow, Mass Conservation, Newton's Second law of Motion, Fluid flow Governing equations, 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.	15	30
2.	Unit 2: Differential Equations & Discretisation: Elementary Finite Difference Equations, Basic aspects of Finite Difference Equations, Errors and Stability Analysis, Discretisation , Application to heat conduction and convection, Problems on one dimension and two dimension steady state and unsteady state conduction,	12	25
3.	Unit 3: Introduction to Finite Element Philosophy: Basics of finite element Method, Stiffness Matrix, Isoperimetric elements, Formulation of finite elements for flow & hear transfer problems.	9	20
4	Unit 4: Introduction to Finite Volume Philosophy: Integral approach, discretization & higher order schemes, Application to Complex Geometry.	7	15
5	Unit 5: Introduction to solutions of viscous incompressible flows using MAC and simple algorithm	5	10

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", CambrigeUni. Press, 2005.
8. Ferziger J. H., Peric M., "Computational Methods for Fluid Dynamics", Springer, 2002.

Course Outcome:

1. Know the basics of CFD
2. Apply differential equation to Fluid Dynamic Problem
3. Gain the elementary knowledge of finite elements method for flow & hear transfer problems.
4. Solve problem of viscous incompressible flows using MAC and simple algorithm
5. Solve the problem of viscous incompressible flows by stream function