Course Type	Course Code	Name of Course	L	T	P	Credit
DE	OMED611	Computational Fluid Dynamics	3	0	0	3

Course Objective
1. Introduce fundamental concepts and theoretical foundations of Computational Fluid Dynamics (CFD). 2. Develop proficiency in numerical methods for solving fluid flow governing equations. 3. Enable modeling and simulation of complex fluid flow phenomena using CFD software. 4. Cover turbulence modeling techniques and their industrial applications. 5. Teach mesh generation, boundary conditions, and solution convergence strategies. 6. Provide practical training in CFD analysis workflows and result interpretation. 7. Explore advanced CFD techniques including multiphase flows and heat transfer. 8. Apply CFD to real-world engineering problems in aerospace, automotive, and energy sectors.
Learning Outcomes
On successful completion of this unit students will be able to 1. Acquire a thorough understanding of fluid dynamics principles and governing equations. 2. Develop skills in using numerical methods like finite difference and finite volume for accurate CFD simulations. 3. Master advanced CFD techniques, including turbulence modeling and grid generation. 4. Apply CFD methodologies to solve practical engineering problems and validate results against experimental data.

Unit No.	Topics to be Covered	Lecture Hours	**Video time (Minutes)**	Learning Outcome
1	Introduction to Computational Fluid Dynamics, classification of partial differential equations their physical behavior	5	155	On successful completion, students will be able to understand the scope and utility of CFD in various engineering applications
2	Fundamentals of discretization	5	141	Students will be able to derive and understand the fundamental equations of fluid dynamics
3	Finite Volume approach and discretization of unsteady-state problems	5	148	Students will be able to apply these equations to formulate mathematical models for CFD simulations
4	Important consequences of discretization of time-dependent diffusion type problems	5	146	Students will be able to discretize governing equations using finite difference and finite volume techniques
5	Discretization of time-dependent diffusion type problems (contd.); finite volume discretization of 2-D unsteady state diffusion type problems	5	163	Students will analyze temporal and spatial accuracy of discretized solutions
6	Solution of systems of linear algebraic equations (Part I)	5	170	Students will be able to define and apply the concepts of consistency, stability, and convergence to numerical methods.
7	Solution of systems of linear algebraic equations (Part II)	5	143	Students will evaluate and select numerical techniques ensuring reliable simulation results.
8	Solution of systems of linear algebraic equations (Part III)	5	151	Students will evaluate and select numerical techniques ensuring reliable simulation results.

9	Solution of systems of linear algebraic equations (Part IV); A finite volume discretization of convection diffusion equations (Part I)	5	133	Students will evaluate pressure fields in incompressible flows accurately
10	A finite volume discretization of convection-diffusion equations (Part II)	5	166	Students will evaluate pressure fields in incompressible flows accurately
11	A finite volume discretization of convection-diffusion equations (Part III),Discretization of Navier-Stokes equations (Part I)	5	140	Students will evaluate pressure fields in incompressible flows accurately
12	Discretization of Navier-Stokes equations (Part II)	5	157	Students will evaluate pressure fields in incompressible flows accurately
Total		60	1813	

Text Books:

1. Numerical Computation of Internal and External Flows, Volume 1 and 2" by Charles Hirsch, John Wiley, 1990.
2. Computational Methods for Fluid Dynamics" by Joel H. Ferziger and Milovan Peric, Springer, 2002

Reference Books:

1. CFD for Engineers: From Panel Method to Computational Dynamics, Tuncer Cebeci and Jian P. Shao.
2. Verification and Validation in Computational Science and Engineering; edited by Patrick J. Roache.