ADVANCED MECHANICS OF FLUIDS

CourseCode		Year		Semester	
Course Category	HONORS	Branch	ME	Course Type	Theory
Credits	3	L – T – P	3 – 0 – 0	Prerequisites	Fluid Mechanics
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes: Upon successful completion of the course, the student will be able to

	Statement	Skill	BTL	Units
CO1	Understand the fundamentals of inviscid Incompressible and viscid compressible flow fluid flow systems.	Understand	L2	1,2,3,4,5
CO2	Apply the fundamentals of transition and turbulent flow to various fluid flow systems and Review the concepts of boundary layer	Apply	L3	1,3,4
CO3	Analyze the principles of normal and oblique shock formation through compressible fluid flow and its effects.	Analyze	L4	1,2,4,5

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2		3		3		1	2			3	1
CO2	3	3			3		2		1	2			3	1
CO3	3	3			3		2		1	2			3	1

Syllabus

UNIT	Contents	Mapped COs
I	**Inviscid Flow of Incompressible Fluids:** Eulerain Descriptions of fluid motion- Path lines, Stream lines, Streak lines, stream tubes – velocity of a fluid particle, types of flows – Stream and Velocity potential functions. Basic Laws of fluid Flow: Potential flow, Condition for irrotationality, circulation & vorticity Accelerations in Carte systems normal and tangential accelerations, Euler's, Bernouli equations Dimensional Analysis & Similarity	CO1, CO2, CO3
II	**Viscous Flow:** Equation of Fluid flow-Continuity & Momentum equation. Derivation of Navier-Stoke's Equations for viscous compressible flow – Exact solutions to certain simple cases: Plain Poisoulle flow – Coutte flow with and without pressure gradient – Hagen Poisoulle flow.	CO1, CO3
III	**Boundary Layer Concepts:** External Flow-Prandtl's contribution to real fluid flows –Blasius solution-Prandtl's boundary layer theory – Boundary layer thickness for flow over a flat plate – Approximate solutions – Creeping motion (Stokes) – Oseen's approximation – Von-Karman momentum integral equation for laminar	CO1, CO2

	boundary layer	
IV	**Turbulent Flow:** Introduction to Turbulent Flow: Fundamental concept of turbulence – Time Averaged Equations – Boundary Layer Equations – Prandtl Mixing Length Model – Universal Velocity Distribution Law: Van Driest Model – Approximate solutions for drag coefficients – More Refined Turbulence Models – k-epsilon model.	**CO1, CO2, CO3**
V	**Compressible Fluid Flow:** Thermodynamic basics – Sonic Velocity – Mach Number – Generalized and simple 1D compressible flows – Development of Equations – Acoustic Velocity Derivation of Equation for Mach Number – Area – Pressure Velocity Relationship, Nozzles, Diffusers – Isothermal Flow in Long Ducts – Fanno and Raleigh Lines, Property Relations — Normal Compressible Shock, Oblique Shock: Expansion and Compressible Shocks	**CO1, CO3**

Learning Resources
Text books
1.Fox and McDonald – 'Fluid Mechanics' – John Wiley – 2011 – 8th Edition 2.White F. M. – 'Fluid Mechanics' – Mc Graw Hill International Edition – 2010 – 7th Edition 3.C. S. Jog, Fluid Mechanics: Volume 2: Foundations and Applications of Mechanics (Cambridge-IISC), June 2015.
Reference books
1. Munson, Young and Okiishi's Fundamentals of Fluid Mechanics, 8th Edition, Wiley Publications 2. Hermann Schlichting, Klaus Gersten, Boundary Layer Theory, Springer Publications 3. Fluid Mechanics and Machinery/ D. Rama Durgaiah/New Age Publications 4. Fluid Dynamics/ William F. Hughes & John A. Brighton/TMH
E- Resources & other digital material
1.https://nptel.ac.in/courses/112105287 2.https://nptel.ac.in/courses/112105045
Data Books
1.Gas Tables by Ethirajan Rathakrishnan 3rd Edition.