



**National Institute of Technology Meghalaya**  
An Institute of National Importance

**CURRICULUM**

Programme	<b>Master of Technology in Mechanical Engineering</b>	Year of Regulation	<b>2018</b>
Department	<b>Mechanical Engineering</b>	Semester	<b>I</b>

Course Code	Course Name	Credit Structure				Marks Distribution				
		L	T	P	C	INT	MID	END	Total	
<b>ME501</b>	<b>Advanced Fluid Mechanics</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>50</b>	<b>50</b>	<b>100</b>	<b>200</b>	
Course Objectives	To introduce different properties of fluid with governing equations for fluid flows – mass, momentum and energy, and knowledge of exact solutions of NS equations	Course Outcomes	CO1	Able to classify governing equations and examine the role of Reynolds Transport Theorem (Understanding)						
	To introduce to the concept of potential flows and boundary layer flows and control of boundary layer separation		CO2	Able to solve exact solutions for various approximations of Navier Stokes equations (Analyzing).						
	To introduce to concept of compressible flows, Mach number, and shock waves		CO3	Able to explain irrotational flows and solve different potential flows with building blocks for potential flow analysis like source, sink, doublet (Analysing)						
			CO4	Able to solve boundary layer flows and differentiate between laminar and turbulent boundary layer and explain boundary layer separation (Applying and Analysing).						
			CO5	Able to classify shock waves and associated curves waves (Applying).						

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Basic concept and Governing Equations of Fluid Motion:</b> Definition and Properties of Fluids, Langragian and Eulerian description, Velocity and stress field, Fluid statics, Fluid Kinematics, Reynolds transport theorem, Integral and differential forms of governing equations: mass, momentum and energy conservation equations, Navier-Stokes equations, Euler's equation, Bernoulli's Equation	<b>08</b>	<b>CO1</b>
II	<b>Exact solutions of Navier-Stokes Equations:</b> Couette flows, Poiseuille flows, Fully developed flows in non-circular cross-sections, Unsteady flows, Creeping flows.	<b>05</b>	<b>CO1</b>
III	<b>Potential Flows:</b> Stream and Velocity potential function, Circulation, Irrotational vortex, Source and Sink, Vortex flow, Doublet, Flow past a circular cylinder, Magnus effect; Kutta-Joukowski lift theorem; Concept of lift and drag	<b>06</b>	<b>CO2</b>
IV	<b>Laminar Boundary Layers:</b> Boundary layer equations, Boundary layer parameters, Boundary layer on a flat plate, Integral form of boundary layer equations, Approximate Methods, Flow separation and control	<b>08</b>	<b>CO2</b>
V	<b>Compressible Flows:</b> Speed of sound and Mach number, Basic equations for one dimensional flows, Isentropic relations, Normal-shock wave, Rankine-Hugoniot relations, Fanno and Rayleigh curve, Mach waves, Oblique shock wave, Prandtl-Meyer expansion waves, Quasi-one dimensional flows, Compressible viscous flows, Compressible boundary layers.	<b>09</b>	<b>CO3</b>
<b>Total Hours</b>		<b>36</b>	

**Essential Readings**

1. K. Muralidhar and G. Biswas, "Advanced Engineering Fluid Mechanics", Narosa, 2016
2. F. M. White, "Fluid Mechanics", Tata McGraw-Hill, 2015
3. G. K. Batchelor, "An Introduction to Fluid Dynamics", Cambridge University Press, 2000
4. P. K. Kundu and I. M. Cohen, "Fluid Mechanics", Academic Press (ELSEVIER), 2014

**Supplementary Readings**

1. F. M. White, "Viscous Fluid Flow", McGraw-Hill Series of Mechanical Engineering, 2017
2. H. Schlichting, "Boundary Layer Theory", Springer Verlag, 2003
3. J.D. Anderson Jr., "Modern Compressible Flow with Historical Perspective", McGraw-Hill, 2017