FACULTY OF ENGINEERING & TECHNOLOGY

First Year Master of Engineering

Semester II

Course Code: **102440201**

Course Title: **Advance Fluid Mechanics**

Type of Course: Core Course III

Course Objectives: **The course is prepared to provide the detailed understanding of laws and principles of Fluid dynamics.**

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Internal		External		Total
Lecture	Tutorial	Practical		Theory	J/V/P*	Theory	J/V/P*	
3	0	2	4	40/16	20/08	60/24	30/12	150/60

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	BASIC CONCEPTS AND FUNDAMENTALS Description of fluid motion – Types of motion of fluid elements, Internal stresses and external forces on fluid elements, Review of Concepts of Kinematics of fluid motion, vorticity, circulation, velocity potential and stream function, Concept of rotational and irrotational flows.	6
2	DYNAMICS OF IDEAL FLUID MOTION Lagrangian and Eulerian description, Reynolds transport theorem, Integral and differential forms of governing equations: mass, momentum and energy conservation equations, Integrations of Euler's Equation of Motion, Generalized form of Bernoulli Equation, Potential flows, Principle of Superposition.	8
3	GOVERNING EQUATIONS OF FLUID FLOW IN DIFFERENTIAL FORM Navier – Stokes Equation and exact solutions, Energy equation and solution of fluid flow with thermal effects.	6
4	LOW REYNOLDS NUMBER APPROXIMATION OF NAVIER – STOKES EQUATION Physical significance of the Reynolds number, Creeping flow over sphere, Stokes and Oseen approximation, Hydrodynamic Theory of Lubrication.	8
5	HIGH REYNOLDS NUMBER APPROXIMATION Prandtl's Boundary Layer Equations, Laminar Boundary Layer over a flat plat, Blausius solution, Falkner – Skan solution, Approximation method for solution of Boundary Layer Equation, Momentum Integral methods, Holstein and Bohlen method, Thermal Boundary Layer, Reynolds Analogy.	8

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6	TRANSITION TO TURBULENCE Introduction to Theory of Hydrodynamic Stability, Orr-Sommerfeld equation, Results from transition studies, factor affecting transition and its control.	**8**
7	FUNDAMENTAL OF TURBULENT FLOWS Nature of turbulent motion, Statistical description of turbulent motion, Reynolds stress tensor, Phenomenological theories of turbulence, Prandtl's Mixing Length and Eddy Viscosity concepts, Universal Velocity distribution, Laws of the Wall and the Wake, Turbulence equations	**8**
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Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks						**R**: Remembering; **U**: Understanding; **A**: Application, **N**: Analyze; **E**: Evaluate; **C**: Create
R	**U**	**A**	**N**	**E**	**C**	
10%	20%	30%	20%	15%	05%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1	Introduction to Fluid Mechanics,Fox, R.W., Pritchard P. J. and McDonald, A. T., Wiley India.
2	Fluid Mechanics,White, F., M., 4th edition, McGraw-Hill.
3	Fluid Mechanics and Fluid Machines,Som S. K., Biswas, G. and Chakraborty S., McGraw-Hill.
4	Fluid Mechanics,Yunus Cengel and John Cimbala, McGraw Hill Publication.
5	Boundary Layer Theory,H Schlichting, McGraw Hill Publication.
6	Computational Fluid Dynamics,J D Anderson, McGraw Hill Publication.
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Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Apply the fundamentals of kinematics and conservation laws of fluid flow systems.	**26**
CO-2	To provide knowledge regarding fluid-flow phenomena observed in mechanical engineering systems, such as potential flow, vortex flow, boundary-layer flows, etc.	**15**
CO-3	To enhance the understanding of fluid mechanics, including the equations of motion in differential form and turbulence.	**10**
CO-4	Understand and apply the principles of high and low Reynolds number flows to fluid flow systems.	**19**
CO-5	Understanding the concepts of boundary layer and flow in transition.	**15**
CO-6	Analyse and apply the fundamentals of turbulent flow to various fluid flow systems.	**15**
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CO-8	Click or tap here to enter text.	Click
CO-9	Click or tap here to enter text.	Click
CO-10	Click or tap here to enter text.	Click

List of Practicals / Tutorials:

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1	To study the effect of angle of attack on Lift and Drag force
2	To study the loss of energy in wake region behind various models (car, jeep, bus etc.) in the wind tunnel
3	To draw profile of NACA Aerofoils
4	To visualize and plot the pattern of flow around an object in a fluid stream using Hale-Shaw apparatus
5	Measurement of drag and pressure distribution around a circular cylinder in high Reynolds number flow
6	Experimental study of flow through compressor and turbine Cascade
7	To Investigate on Recent development and advances in rarefied gas dynamics
8	Measurements of boundary layer thickness using numerical & analytical solution.
9	A case study: Performance of real nozzle.
10	Derive the solution for flow through an elliptical duct, by solving equation $$\frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} = \frac{1}{\mu}\frac{dp}{dx} = const$$ Begin with a guessed quadratic solution, u = A + By2 + Cz2 and work your way through to the exact solution. Where 'a' is major axis radius & 'b' is minor axis radius.
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Supplementary learning Material:	
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Curriculum Revision:	
Version:	**1**
Drafted on (Month-Year):	Apr-20
Last Reviewed on (Month-Year):	Jul-20
Next Review on (Month-Year):	Apr-22

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