

Branch Name:	CIVIL ENGINEERING
Program Code:	ET106
Course Title:	Advanced Fluid Mechanics
Course Code:	2ET1060603T
Pre-requisite Course:	Basic Knowledge of fluid mechanics, Mathematics and Applied Physics.

Course Objectives:

- CO-1: To take up important concepts of fluid flows to the civil engineers managing and designing systems of various fluid flows.
- CO-2: To develop a student's skills in analyzing fluid flows through the proper use of modeling and the application of the basic fluid-flow principles.
- CO-3: Relate fluid mechanics to real-world and research applications, including a general introduction to experimental fluid mechanics and computational fluid dynamics.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	3	-	-	3	24	60	16	40	-	-	-	-	100

Course Contents:

Unit No	Topic	Total Hours	Weightage (%)
01	<u>Behavior of Real Fluids:</u> Introduction-Forces acting on fluid in motion-Euler's equation of motion for 3D flow-Navier-Stokes equation of motion- Initial conditions and boundary conditions.	02	05
02	<u>Flow Through Pipes:</u> Introduction-Major and minor energy losses-hydraulic gradient line and total energy line-pipes in series and parallel-equivalent pipe- water hammer in pipes.	05	15
03	<u>Steady Viscous and Turbulent Flow:</u> Reynold's Experiment-Couette flow-Hagen-Poiseuille equation-flow between two parallel plates Prandtl's mixing length theory- shear stress and velocity distribution in turbulent flow through pipes-hydro dynamically Smooth and rough boundaries.	05	15
04	<u>Boundary Layer:</u> Boundary layer concept-Laminar and turbulent boundary layer growth over a flat plate-Von-Karman momentum integral equation-Separation of boundary layer.	04	10

05	<u>Flow Through Open Channel:</u> Basic concept, classification and characteristics of open channel flow-Chezy's formula for Steady Uniform flow-Most Economical or Hydraulically Efficient rectangular, trapezoidal, triangular, circular etc. Channel Section-specific energy-specific energy diagram-Application of specific energy and discharge diagrams. Gradually varied flow equation-direct Step method-rapidly varied flow-hydraulic jump & its location-Water surface profiles.	10	20
06	<u>Hydraulic Turbines and Centrifugal Pumps:</u> Classification of hydraulic turbine and pumpss-construction and working of Pelton, Francis and Kaplan turbines-draft tube-significance of specific speed-unit quantities-priming in pumps-cavitation in turbines and pumps-performance characteristics curves for water turbines and pumps.	06	15
07	<u>Dimensional Analysis and Similitude:</u> Fundamental dimensions-physical quantity and its dimensions-dimensional homogeneity-methods of dimensional analysis-Dimensionless numbers i.e. Reynolds, Froude's, Euler's, Weber's, Mach's and its uses in experimental investigation-Geometric similarity, kinematic similarity and dynamic similarity-Model similitude, model laws, undistorted and distorted models.	10	20

Reference Books:

1. Fluid Mechanics and Hydraulic Machines by Dr. R.K.Bansal, Laxmi Publications Pvt. Ltd., New Delhi
2. Fluid Mechanics and Hydraulic Machines by R.K.Rajput, S.Chand and Company Ltd., New Delhi
3. Fluid Mechanics by A.K. Jain, Khanna Publishers, New Delhi
4. Hydraulics and Fluid Mechanics by P.N. Modi and S.M. Seth, Standard Book House, New Delhi
5. Theory and Applications of Fluid Mechanics by K Subramanya, McGraw Hill Publication
6. Fluid Mechanics by Victor L. Streeter, E. B. Wylie by, McGraw Hill Publication
7. Hydraulic Fluid Mechanics and Fluid Machines by Ramamrutham S., Dhanpat Rai Publication.

Course Learning Outcomes (CLO):

After successful completion of the course the students shall be able to:

1. Analyze fluid flow through pipes in series, parallel and also pipe networks under laminar and turbulent flow conditions
2. Analyze and design streamlined objects considering boundary layer effects.
3. Analyze open channel flow and design optimal sections; calculate forces on sluice gates considering specific energy principle.
4. Understand, analyze and study the performance characteristics of hydraulic machines like pumps, turbines etc...
5. Carry out model studies for fluid flow problems

Web Material Links:

<https://nptel.ac.in/courses/105101082>

<https://nptel.ac.in/courses/105103095>

https://onlinecourses.nptel.ac.in/noc22_me102/preview

<https://nptel.ac.in/courses/112105218>

Course Learning Outcomes (CLO):

After successful completion of the course the students shall be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Analyze fluid flow through pipes in series, parallel and also pipe networks under laminar and turbulent flow conditions	
CLO2	Analyze and design streamlined objects considering boundary layer effects.	
CLO3	Analyze open channel flow and design optimal sections; calculate forces on sluice gates considering specific energy principle.	
CLO4	Understand, analyze and study the performance characteristics of hydraulic machines like pumps, turbines etc...	
CLO5	Carry out model studies for fluid flow problems	

L1- Remember, L2- Understand, L3- Apply, L4- Analyze, L5- Evaluate, L6- Create

Mapping of CLOs with POs & PSOs

	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
Course Learning Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO1															
CLO2															
CLO3															
CLO4															
CLO5															

H: High, M: Medium, L: Low