GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Civil (Water Resource Engineering)

Course / Subject Code: ME01033018

Course / Subject Name: Advanced Hydraulics

w. e. f. Academic Year:	2024-2025
Semester:	1st Semester
Category of the Course:	PCC

Prerequisite:	Fundamental knowledge of properties of fluid, Fundamental knowledge of engineering mathematics, Knowledge of equations of motion, energy and momentum and free surface flow.
Rationale:	Students will be able to understand Navier-Stokes equation solutions, design of open channel, various flow profiles in open channel, hydraulic jump, finite difference method, finite element method, drag, lift and compressible flow.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Understand advanced topics of fluid mechanics and open channel flow	**R,U**
02	Analyze different types of pipe flow	**U,A,N**
03	Calculate dynamics in open channel flow at different flow conditions	**U,N,E**
04	Create streamlined bodies in the flow passing through immersed bodies	**R,U,N,E,C**
05	Apply the fundamentals in the turbo-machineries like pumps and turbines	**R,U**

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Flow in pipes Equation of fluid motion, Momentum and Energy equations, Navier-Stokes equation exact and approximate solutions, laminar flow in pipes, flow between parallel plates, Couette flow Turbulent Flows: Reynolds equations of motion, semi-empirical theories of turbulence, velocity profiles for inner, outer and overlap layers, Boundary Layers: Similarity solutions of boundary layer equations, Falkner-Skan Wedge flows, Karman's momentum integral equations, Karman-Puhlhausen approximate solution, separation in boundary layer under adverse pressure gradient, turbulent boundary layer, skin drag,	**15**	**34**
2.	Flow in channels: Steady non-uniform flow, water surface profiles and its computation, Elements of hydraulic jump, hydraulic jump in variety of situations including contracting and expanding geometries and rise in floor levels, Design of channel transitions, Unsteady Flows: St. Venant's equations and their solution using method of characteristics and finite difference schemes; dam break problem, surges in channel resulting from gate operation, propagation of positive and negative waves, application of Method of Characteristics, Finite Difference and Finite element methods to transient flow in open channels Spatially Varied Flows: Flows past side weirs, De Marchi equations, design of side weirs, flow past bottom racks, trench weirs and waste water gutters.	**16**	**38**

3.	Flow Past Immersed Bodies Drag and lift, Types of drag, drag on sphere, cylinder, flat plate and Airfoil, Karman vortex street, Effect of drag, Development of lift, Magnus effect, Circulation and lift characteristics of airfoils.	**7**	**14**
4.	Pumps and Turbines Water Turbines: Impulse turbine, Reaction turbine, Specific speed, Unit quantities, Performance characteristics for water turbines Centrifugal pumps: Pumps in series and parallel, Specific speed, Unit quantities, and characteristics curves, Cavitation in turbines and pumps.	**7**	**14**
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**20**	**20**	**20**	**20**	**10**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Theory and Applications of Fluid Mechanics by K Subramanya, McGraw Hill Publication
2. Fluid Mechanics by A.K. Jain, Khanna Publishers, New Delhi
3. Hydraulics and Fluid Mechanics by P.N. Modi and S.M. Seth, Standard Book House, New Delhi
4. Fluid Mechanics by Victor L. Streeter, E. B. Wylie by, McGraw Hill Publication
5. Fluid Mechanics by Frank M White , McGraw Hill Publication
6. Engineering Hydraulics - Hunter Rouse
7. Engineering Fluid Mechanics - Narasimhan.
8. Open channel Hydraulics - V.T.Chow
9. Open channel flow - Henderson

10. Open channel hydraulics - Richard H. French
11. Flow through open channel – K. Subramanya
12. Flow through an open channel – K. G. Ranga Raju
13. Open Channel Flow – M. Hanif Chaudhry
14. Fluid Mechanics – Granger
15. Fluid mechanics – Streeter and Wiley

(b) Open source software and website:

1. https://archive.nptel.ac.in/courses/112/105/112105218/

Suggested Course Practical List: If any

List of Laboratory/Learning Resources Required:

1. To study the velocity distribution in an open channel and to estimate the energy and momentum correction factors.
2. Water surface profile in open channel flow
3. To study the characteristics of a hydraulic jump.
4. Laminar and turbulent flow in pipes
5. To study the boundary layer velocity profile
6. Surges in channel resulting from gate operation

PO1	An ability to independently carry out research /investigation and development work to solve practical problems.
PO2	An ability to write and present a substantial technical report/document.
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program .

PO4	An ability to apply advanced knowledge and skills appropriate to civil engineering.
PO5	An ability to think critically and apply appropriate logic, analysis, judgment and decision making and to function as an effective member or leader of engineering teams to achieve common goals.
PO6	An ability to use appropriate techniques, skills, and modern engineering tools necessary for engineering practice and commit to professional ethics and responsibilities.

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