INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

HYDRAULIC ENGINEERING								
IV Semester: CE								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACED08	**Core**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Fluid Mechanics								

I. COURSE OVERVIEW:

Hydraulic Engineering is concerned with the flow and conveyance of fluids in both closed pipes and open channels. The course deals with the principles of fluid mechanics and application of collection, control, transport, measurement, and use of water. First part of the course deals with analysis and design of hydraulic parameters for closed pipes. Latter part emphasis open channel flow, which is governed by the interdependent interaction between the water and the channel, hydraulic structures for various types of the flows to overcome the head losses.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The principles of Fluid Mechanics for design and analysis of different geometrical configurations in both laminar and turbulent flows.
II. Methods of estimation of lift and drag forces for various shapes using boundary layer theory and approximate numerical solution methods.
III. Fundamentals concepts of an open channel flow, their relationships by applying fluid properties, hydrostatics, and the conservation equations.
IV. Design of open channels, energy dissipaters and hydraulic structures for uniform and gradually varied conditions.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Explain basic fluid properties and identify appropriate fluid systems for analysis of the flow in closed pipes.
CO 2 Choose the types of flows such as laminar, turbulent using Reynolds's experiment to reduce the losses in smooth and rough pipes by Moody's diagram
CO 3 Apply the concept of boundary layer and viscosity theorem, the lift and drag forces on different shapes of the objects using various methods applicable to avoid the flow separation problems
CO 4 Analyze the lift and drag forces on different shapes of the objects using various methods applicable for the separation of the boundary layer
CO 5 Summarize the geometrical properties of the open channels and establish the relationships among them for the designing of the most economical sections.
CO 6 Outline the ideas and importance of critical flow parameters such as specific energy, specific force, and specific depth, hydraulic jump for classification of surface profiles in gradually varied flows

IV. COURSE CONTENT:

MODULE - I: LAMINAR AND TURBULENT FLOWS IN CLOSED PIPES (10)

Laminar flow through circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity. Reynold's experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.

MODULE - II: BOUNDARY LAYER THEORY (09)
Assumption and concept of boundary layer theory, Boundary layer thickness, displacement, momentum and energy thickness – problems. Laminar and Turbulent boundary layers on a flat plate. Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Boundary layer separation and control.

MODULE - III: OPEN CHANNEL FLOW – UNIFORM FLOW (10)
Uniform Flow: Comparison between open channel flow and pipe flow, Geometrical parameters of a channel, classification of open channels, classification open channel flow, Velocity distribution of channel section.

Uniform Flow - Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient. Most economical section of channel. Computation of Uniform flow, normal depth.

MODULE - IV: OPEN CHANNEL FLOW – NON - UNIFORM FLOW (10)
Non - Uniform Flow: Non – Uniform Flow: Specific energy, specific energy curve, critical flow, discharge curve specific force, specific depth, and critical depth. Gradually Varied Flow –Dynamic Equation of Gradually Varied Flow, Classification of channel bottoms lopes, Classification of surface profile, Computation of water surface profile by Direct Step method. Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump.

MODULE - V: TURBINES AND PUMPS (09)
Heads and Efficiencies of Turbines, Classifications of Turbines, Pelton wheel – velocity triangles, Radial flow Reaction Turbine, Francis Turbine, Axia Flow Reaction Turbine, Draft tube, Pumps and working principle, classifications of pumps, Centrifugal Pumps-Stages of Centrifugal pumps, Reciprocating Pumps.

V. TEXT BOOKS:

1. P. M. Modi and S. M. Seth, *Hydraulics and Fluid Mechanics*, Standard Book House, 2nd edition, 2019.
2. Rajput R.K., *A text book of Fluid Mechanics*, S. Chand Publications, 1998.
3. Subramanya K. *Open Channel Flow*, Tata McGraw Hill Publications, 3rd edition, 2009.
4. Narayana and C. R. Ramakrishnan Pillai, *Principles of Fluid Mechanics and Fluid Machines*, Sangam Books Ltd, 1st edition, 2003.

VI. REFERENCE BOOKS:

1. Ojha CSP, Chandramouli P. N., Berndtsson R., *Fluid Mechanics and Machinery*, Oxford University Press, 2010.
2. Chow V.T., *Open Channel Hydraulics*, Blackburn Press, 2009.
3. Jann Kiusalaas, *Numerical Methods in Engineering with Python*, Cambridge University Press, 2nd Edition, 2010.

VII. ELECTRONICS RESOURCES:

1. https://nptel.ac.in/courses/112105171/1
2. https://textofvideo.nptel.iitm.ac.in/112105171/lec1.pdf
3. https://www.fkm.utm.my/ syahruls/3-teaching/2-fluid-II/fluid-II-enote/32-pump-2.pdf
4. https://www.scribd.com/doc/16605891/Fluid-Mechanics.html

VIII. MATERIAL ONLINE:

1. Course template
2. Tech-talk topics
3. Assignments
4. Definition and terminology
5. Tutorial question bank
6. Model question paper – I
7. Model question paper – II
8. Lecture notes
9. Early lecture readiness videos (ELRV)
10. Power point presentations