HYDRAULIC ENGINEERING

V Semester: CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACEB14	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

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. The estimation of lift and drag forces for various shapes using boundary layer theory and approximate numerical solution methods.
III. The fundamentals concepts of an open channel flow, their relationships by applying fluid properties, hydrostatics, and the conservation equations.
IV. The design of open channels, energy dissipaters and hydraulic structures for uniform and gradually varied conditions.

COURSE OUTCOMES:

After successful completion of the course students are able to:

CO 1 **Recall** basic fluid properties and identify appropriate fluid systems for analysis of the flow in closed pipes.
CO 2 **Explain** the principles and governing equations of pressure and shear stress for predicting the behavior of fluid flow.
CO 3 **Summarise** the methods for analysis, design of pipe networks such as the Dead-end method, equivalent pipe method, and Hardy Cross method and using advanced softwares for the effective distribution of potable water.
CO 4 **Choose** the types of flows such as laminar, turbulent, uniform, and non-uniform flows for understanding the mechanism and the relation of various flow parameters.
CO 5 **Explain** the concept of Stoke's law to measure viscosity using Moody's chart for the determination of resistance to the flow of fluid.
CO 6 **Apply** the concept of boundary layer and viscosity theorem to avoid flow separation problems.
CO 7 **Analyse** the lift and drag forces on different shapes of the objects using various methods applicable for the separation of the boundary layer.
CO 8 **Explain** the differences between lined, unlined canals, and uniform, non – uniform flows for the designing of open channels.
CO 9 **Summarize** the geometrical properties of the open channels and establish the relationships among them for the designing of the most economical sections.
CO 10 **Outline** the ideas and importance of critical flow parameters such asspecific energy, specific force, and specific depthfor classification of surface profiles in gradually varied flows.
CO 11 **Interpret** various energy losses that occur through Hydraulic jump for designing the downstream of hydraulic structures.
CO 12 **Apply** the concept of engineering knowledge and solve real-world problems in conjunction with improved technologies for the designing of effective fluid flow systems.

MODULE–I	FLOW THROUGH PIPES
Loss of head through pipes, Darcy – Wiesbatch equation, minor losses, total energy equation, hydraulicgradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon. Analysis of pipe networks: Hardy Cross method.	
MODULE–II	**LAMINAR AND TURBULENT FLOWS IN CLOSED PIPES**
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–III	**BOUNDARY LAYER THEORY**
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–IV	**OPEN CHANNEL FLOW: UNIFORM FLOW**
Comparison between open channel flow and pipe flow, Geometrical parameters of a channel, classification of open channels, classification of 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–V	**OPEN CHANNEL FLOW: 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.	

Text Books:

1. P. M. Modi and S. M. Seth, "Hydraulics and Fluid Mechanics", Standard Book House, 22nd 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.

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. Franck N. White, ―Fluid Mechanics‖, Tata McGraw Hill Publications, 8th Edition, 2015.