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: Nil	Practical Classes: Nil				Total Classes: 45		

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. OBJECTIVES:

The course should enable the students to:

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 foruniform and gradually varied conditions.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Recall** basic fluid properties and identify appropriate fluid systems for analysis of the flow in closed pipes.	Remember
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'sdiagram	Apply
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.	Understand
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.	Analyze
CO 5	**Summarize** the geometrical properties of the open channels and establish the relationships among them for the designing of the mosteconomical sections.	Apply
CO 6	**Outline** the ideas and importance of critical flow parameters such as specific energy, specific force, and specific depth, Hydraulic jump forclassification of surface profiles in gradually varied flows.	Understand

IV. SYLLABUS:

MODULE – I	FLOW THROUGH PIPES	Classes: 10

Loss of head through pipes, DarcyWies batch equation, minor losses, total energy equation, hydraulic gradient 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	Classes: 08

Laminar flow through circular pipes, annulus and parallel plates. Stake's law, Measurement of viscosity .Reynolds 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	Classes: 08
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**	**Classes: 09**
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**	**Classes: 10**
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. Subramanya K. "Open Channel Flow", Tata McGraw Hill Publications, 3rd Edition, 2009.
3. 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. Rajput R.K., "A text book of Fluid Mechanics, S.Chand Publications, 1998.
4. Franck N. White, ―Fluid Mechanics‖, Tata McGraw Hill Publications, 8thEdition, 2015.

Web References:

1. http://nptel.ac.in/courses/112104117/
2. http://nptel.ac.in/courses/105103096/
3. http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/machine/ui/TOC.htm

E-Text Books:

1. https://drive.google.com/file/d/0B9_2yANiGJ12aWJrSGJZVjlxbHM/view
2. https://books.google.co.in/books?id=mLpf6YjHM5AC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false