23CE22T4 HYDRAULICS AND HYDRAULIC MACHINARY

Course Category	Professional Core	Credits	3
Course Type	Theory	Lecture – Tutorial –Practical	2-1-0
Prerequisite	Fluid Mechanics	Sessional Evaluation	30
		Semester End Exam. Evaluation	70
		Total Marks	100

Course Objectives	1. To Introduce concepts of laminar and turbulent flows 2. To teach principles of uniform flows through open channel. 3. To teach principles of non-uniform flows through open channel. 4. To impart knowledge on design of turbines. 5. To impart knowledge on design of pumps		
Course Outcomes	COs	Statements	Blooms Level
	CO1	Understand the characteristics of laminar and turbulent flows.	L2
	CO2	Apply the knowledge of fluid mechanics to address the uniform flow problems in open channels.	L3
	CO3	Solve non-uniform flow problems and hydraulic jump phenomenon in open channel flows.	L3
	CO4	Evaluate the performance of impact of jets on plates and design Pelton wheel, Francis and Kaplan turbine	L5
	CO5	Understand the principles, losses and its efficiencies of centrifugal pumps	L2
Course Content	**UNIT I** **Laminar & Turbulent flow in pipes:** Laminar Flow- Laminar flow through circular pipes, annulus and parallel plates; Stoke's law; Measurement of viscosity; Reynolds experiment; Transition from laminar to turbulent flow; Resistance to flow of fluid in smooth and rough pipes; Moody's diagram; Introduction to boundary layer theory. **UNIT II** **Uniform flow in Open Channels:** Open Channel 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; Hydraulically efficient channel sections- Rectangular, trapezoidal and triangular channels; Energy and Momentum correction factors.		

UNIT III

Non-Uniform flow in Open Channels: Specific energy; critical flow; discharge curve; Specific force; Specific depth; and Critical depth; Measurement of Discharge and Velocity; Gradually Varied Flow - Dynamic Equation of Gradually Varied Flow; Classification of channel bottom slopes and surface profiles; Characteristics of surface profiles; Hydraulic Jump and classification; Elements and characteristics; Energy dissipation.

UNIT IV

Impact of Jets: Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes; Velocity triangles at inlet and outlet; Work done and efficiency Hydraulic Turbines- Classification of turbines; pelton wheel and its design; Francis turbine and its design, efficiency; Draft tube – theory; characteristic curves of hydraulic turbines; Cavitation - causes and effects.

UNIT V

Pumps: Working principles of a centrifugal pump; work done by impeller; heads, losses and efficiencies; minimum starting speed; Priming; specific speed; limitation of suction lift, net positive suction head (NPSH); Performance and characteristic curves of centrifugal pumps ; Cavitation effects; Multistage centrifugal pumps; troubles and remedies.

Textbooks and Reference books	**TEXTBOOKS:** 1. Dr. P.N. Modi, Dr. S.M. Seth, *"Hydraulics and Fluid Mechanics Including Hydraulics Machine"*, Standard Book House, 22nd edition, 2019. 2. K Subramanya, *"Flow in Open Channels"*, Tata McGraw-Hill Educational Private Ltd., 5th edition, 2019. 3. R.K. Bansal, *"A Textbook of Fluid Mechanics and Hydraulic Machines"*, Laxmi Publications, 11th edition, 2024. **REFERENCE BOOKS**: 1. Frank M. White, Henry Xue, *"Fluid Mechanics"*, Tata McGraw Hill, 9th edition, 2022. 2. C. S. P. Ojha, R. Berndtsson and P. N. Chadramouli, *"Fluid Mechanics and Machinery"*, Oxford University Press, 2010. 3. S K Som, Gautam Biswas, S Chakraborty, *"Introduction to Fluid Mechanics and Fluid Machines"*. Tata McGraw Hill, 3rd edition 2017.

	4. Madan Mohan Das, *"Open Channel Flow"*, PHI Publications, 3rd edition, 2009. 5. Ven Te Chow, "*Open-Channel Hydraulics*", The Blackburn Press, 7th edition, 2009.
E-resources	1. https://nptel.ac.in/courses/105105203 2. https://archive.nptel.ac.in/courses/112/103/112103249/ 3. https://archive.nptel.ac.in/courses/105/103/105103096/

CO-PO Mapping: 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	1	2	2	1	-	1	-	-	-	2	3			
CO 2	3	3	3	3	-	-	1	-	1	-	3	2	-	2	1
CO 3	3	2	1	2	1	-	-	-	1	-	2	2	-	1	-
CO 4	3	3	3	3	2	1	-	-	2	-	2	2	-	1	-
CO 5	3	2	3	3	1	2	-	-	2	-	3	2	-	1	1