Advanced Fluid Mechanics

Course Code	Credit Hours
CE-215	2-1

Course Description

This course is designed to give advanced knowledge of fluid statics and fluid dynamics. The aim is to give the perception of the governing principles of pipe flow problems and pipe network design salient features. Further, fluid flow in hydraulic machines, especially roto-dynamic machines is treated in this course. Open Channel flow is also studied in this course. The ideas and concepts are further utilized to be implemented on designing different hydraulic structures and hydraulic machinery.

Text Book:

1. J. F. Douglas, J. A. Swaffield “Fluid Mechanics” Fourth Edition.
2. “A Textbook of Hydraulics, Fluid Mechanics and Hydraulic Machines” by R.S. Khurmi.
3. “Fundamentals of Fluid Mechanics” by Munson, B.R, Young, D.F, and Okiishi, T.H, John Wiley & Sons Inc.
4. E. John Finnemore and Joseph B. Franzini “Fluid Mechanics with Engineering Applications” 10 th Edition.

Reference Book:

1. Streeter, Wylie, Bedford “Fluid Mechanics” Ninth Edition
2. Dr Andrew Sleigh “An Introduction to Fluid Mechanics” May 2001 (School of Civil Engineering, University of Leeds)
3. R E. Featherstone “Civil Engineering Hydraulics” Third Edition

Prerequisites :

CE-251 Fluid Mechanics**.**

ASSESSMENT SYSTEM FOR THEORY

	Without Project (%)	With Project/Complex Engineering Problems (%)
Quizzes	15	10-15
Assignments	10	5-10
Mid Terms	25	25
Project	-	5-10

End Semester Exam	50	45-50

ASSESSMENT SYSTEM FOR LAB

Lab Work/ Psychomotor Assessment/ Lab Reports	70%
Lab Project/ Open Ended Lab Report/ Assignment/ Quiz	10%
Final Assessment/ Viva	20%

Teaching Plan

Week No	Topics/Learning Outcomes
1-2	**Hydrodynamics Review** • Ideal and real fluids • Differential equation of continuity • Rotational and irrotational flow • Stream function and velocity potential function • Brief description of flow fields • Orthogonality of streamlines and equipotential lines • Flow net and its limitations. Different methods of drawing flow net
3-6	**Steady Flow through Pipes** • Type of flows • Laminar and turbulent flow in circular pipes, semi empirical theories of turbulence • Type of losses in pipes • General equation for friction • Velocity profile in circular pipes, pipe roughness • Nukuradse's experiments • Darcy-Weisbach equation • Friction factor, Colebrook & Haaland equations and Moody's diagrams • Minor losses • Pipe flow problems. • Darcy's friction versus fanning friction factor Branching pipes
7-8	**Flow around immersed bodies** • Lift and drag force.

	• Boundary layer along smooth flat plate • Thickness of boundary layer, shear stresses and velocity distributions • Types of boundary layers (laminar, transitioning, and turbulent) Friction drag coefficient
9	**Mid Semester Exam**
10	**Impact of Jets** • Impulse momentum principle • Force of jet on stationary flat and curved plates • Force of jet on moving flat and curved plates Forces on plumbing fittings
11-12	**Water Turbines** • Types of turbines • Impulse and reaction turbines • Momentum equation applied to turbines. • Specific speed • Turbine characteristic curves cavitation and operation
13	**Centrifugal Pumps** • Types • Classifications • Construction features, operation, and efficiencies • Maximum suction lift Specific speed and characteristic curve
14	**Reciprocating Pumps** • Types • Construction features • Single acting and Double acting Reciprocating pumps • Coefficient of discharge and slip of the pump. Sum of heads in single acting reciprocating pumps
15-16	**Introduction to related software** TURBNPRO software application
17-18	End Semester Exam

Practical

Experiment No	Description
1	To measure the head loss (h_L) in a pipe of uniform diameter (d) and to investigate the critical Reynolds Number, relationship between hydraulic gradient and velocity of flow and relationship between friction factor and Reynolds Number.
2	To verify the 'Impulse Momentum Principle' for a jet of water striking on 90°, 120° & 180°deflectors and to investigate the effect of velocity of flow on impulse force of the jet for various deflectors.
3	To make the study of the 'Pelton Wheel' and 'Turgo Impulse Turbine.
4	To perform experiment on Pelton Wheel and hence to plot its characteristic curves.
5	To make the study of Francis Reaction Turbine.
6	To make the study of Double Stage Centrifugal Pump
7	To perform experiment on "Double Stage Centrifugal Pump" and hence to plot its Characteristic Curves.
8	To perform experiment on the "Double Acting Reciprocal Pump" and to determine co-efficient of discharge and Slip of the Pump.