Fluid Mechanics-II

Course Code	Credit Hours
CE-252	2-1

Course Description

This course is designed to give the advance 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. 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-I

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 Assesment/ Viva	20%

Teaching Plan

Week No	Topics/Learning Outcomes

1	Incompressible, steady, uniform laminar flow b/w parallel plates; derivation of governing equ & special cases. Problems.
2	Incompressible, steady, uniform laminar flow in circular pipes; derivation of Hagen-Poiseuille equ. & problems.
3	Incompressible, steady, uniform turbulent flow in conduits; derivation of governing equ. & problems.
4-5	Incompressible, steady, uniform turbulent flow in circular pipes. Derivation of governing equ., Moody chart, Colebrook-White equation, Problems.
6	Development of boundary layer along a flat plate, development length in pipes at entry, laminar sublayer, turbulent shear stresses. Prandtl mixing length theory, universal velocity distribution. Problems.
7	Mid semester Exam
8	Boundary layer thickness, laminar boundary layer along a flat plate, skin friction coefficient, three regimes of flow & expressions for *f*. Separation/minor losses in pipe flow.
9	Losses in pipe fittings, bends and at entry and exit. Equivalent pipe length for pipe fitting loss calculations. Effect of pressure gradient on boundary layer
10	Forces on a body submerged in external flow. Drag & Lift, profile drag, pressure drag, skin friction drag. Wake, free stream velocity, stagnation pressure. Bluff body & streamlined body. Drag & lift coeffs. Stokes law. Problems
11	Steady, incompressible flow in pipelines. Flow through pipes in series & parallel. The three reservoir problem. Problems.
12	Steady, uniform flow in free surface flow. Continuity, momentum and energy equ. Flow resistance equ. for free surface flow. Chezy formula, Kutter formula, Manning Equ. Optimum channel shape in free surface flow. Problems.
13	Hydraulic machinery: Classification: turbine, pump, fan & compressor, positive development machines, rotodynamic machines, centrifugal, axial, mixed flow machines. 1D theory of flow through a hydraulic machine. Euler turbine equation.
14	Losses & efficiency of hydraulic machines. Impellor loss, Volumetric loss, casing loss, mechanical loss. Overall efficiency of a machine. Different performance characteristics of a machine. Dimensionless coefficients & similarity laws. Problems

15	Scale effects, type number/specific speed. Centrifugal pumps. Velocity diagrams for centrifugal pumps, different types of centrifugal pumps based on blade outlet angle. Impulse and reaction turbines. Pelton wheel and Francis turbine. Efficiency of a Pelton wheel turbine, energy equation. Problems
16	Machine-network interaction: Operating point of a pump. Duty required of a pump. Pump matching. Problems
17-18	End Semester Exam

Practical:.

Experiment No	Description
1	To observe laminar, transitional, and turbulent flow in pipes.
2	To determine the characteristics of open channel flow over a V-notch.
3	To investigate the head loss due to friction in the flow of water through a pipe and to determine the associated friction factor.
4	To determine the loss factors for flow through a range of pipe fittings including bends, contraction, enlargement, and a gate valve.
5	OEL: Discharge measurement in laboratory flume
6	To determine the operating characteristics of a Pelton Turbine.
7	To demonstrate the phenomenon of cavitation in a hydraulics system.
8	To determine the operating characteristics of a centrifugal pump.
9	To find the operating characteristics of two pumps in series and parallel.
10	Flow visualization.
11	Demonstration of transient flow using water hammer apparatus.