UNIVERSITY OF ENGINEERING AND TECHNOLOGY TAXILA
CIVIL ENGINEERING DEPARTMENT
OUTCOME BASED EDUCATION
CE-308: FLUID MECHANICS II

Course Contents:

Fluid flow in pipes

Reynold's number and its significance. Instability of viscous flow. Viscous flow through circular pipes.

Turbulence flow through circular pipes. Semi-empirical theories of turbulence. Velocity profile in turbulent flow. Pipe roughness. Nikurades's experiments. Moody's diagrams, Introduction to pipe networks.

Dimensional Analysis

Rayleigh and Buckingham's Pi-theorem and their applications.

Elementary Hydro-dynamics

Ideal and real fluid. Differential equation of continuity. Rotational and irrotational flow. Stream function and velocity potential function. Circulation and vorticity. Orthogonality of streamlines and equipotential lines. Brief description of flow fields. Flow net and its limitations. Different methods of drawing a flow net.

Forces on Immersed Bodies

Theoretical concept of boundary layers. Development of boundary layer on immersed bodies. Separation of boundary layer.

Forces on Vanes and Turbo machinery.

Impulse momentum equation.

Forces on moving flat and curved vanes. Definition, similarity laws and factors for turbomachines.

Types of Turbines

Impulse turbine: Construction, features and operations, specific speed.

Reaction Turbine, Types, construction, features and operation, specific speed. Cavitation. Draft tube.

Governing of turbines.

Centrifugal Pumps: Classification. Construction features and operations, Specific speed, Cavitations.

Reciprocating Pumps. Single acting and double acting pumps. Acceleration head. Maximum suction lift. Use of air vessels.

Course Learning Objectives

The course will help the students to understand the basic principles and applications of fluid flow phenomenon and to solve relevant problems.

Course Learning Outcomes

At the end of the course the student will be able to

CLO:1 Understand the fundamental concept of dimensional analysis and its significance in research
CLO:2 Analyze the problems associated with pipe flow and pipe networks and work out their solutions
CLO:3 Have knowledge of components, working and performance of turbomachinery
CLO:4 Have understanding of hydrodynamics and forces on immersed bodies

Mapping of objectives and outcomes and mapping of contents and outcomes

CLO's / PLO's	CLO 1	CLO 2	CLO 3	CLO 4
PLO 1 (Engineering Knowledge)	✓	✓	✓	✓
PLO 2 (Problem Analysis)	✓	✓		
PLO 3 (Design/Development of Solutions)	✓	✓		
PLO 4 (Investigation)			✓	
PLO 5 (Modern Tool Usage)		✓		
PLO 6 (The Engineer and Society)				
PLO 7 (Environment and Sustainability)				
PLO 8 (Ethics)				
PLO 9 (Individual and Team work)				
PLO 10 (Communication)				
PLO 11 (Project Management)				
PLO 12 (Lifelong Learning)				

Weekly Lesson Plan

Week	Course Covered
1	**Dimensional Analysis** Rayleigh and Buckingham's Pi-theorem and their applications.
2	**Dimensional Analysis** Rayleigh and Buckingham's Pi-theorem and their applications.
3	**Fluid flow in pipes** Reynold's number and its significance. Instability of viscous flow. Viscous flow through circular pipes.
4	**Fluid flow in pipes** Reynold's number and its significance. Instability of viscous flow. Viscous flow through circular pipes.
5	**Turbulence flow** through circular pipes. Semi-empirical theories of turbulence. Velocity profile in turbulent flow. Pipe roughness. Nikurades's experiments. Moody's diagrams, Introduction to pipe networks.
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9	**Elementary Hydrodynamics** Ideal and real fluid. Differential equation of continuity. Rotational and irrotational flow. Stream function and velocity potential function. Circulation and vorticity. Orthogonality of streamlines and equipotential lines. Brief description of flow fields. Flow net and its limitations. Different methods of drawing a flow net.
10	**Elementary Hydrodynamics** Ideal and real fluid. Differential equation of continuity. Rotational and irrotational flow. Stream function and velocity potential function. Circulation and vorticity. Orthogonality of streamlines and equipotential lines. Brief description of flow fields. Flow net and its limitations. Different methods of drawing a flow net.
11	**Forces on Immersed Bodies** Theoretical concept of boundary layers. Development of boundary layer on immersed bodies. Separation of boundary layer.
12	**Forces on Vanes and Turbo machinery.** Impulse momentum equation. Forces on moving flat and curved vanes. Definition, similarity laws and factors for turbomachines
13	**Impulse turbine:** Construction, features and operations, specific speed. Reaction Turbine, Types, construction, features and operation, specific speed. Cavitation. Draft tube. Governing of turbines.

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List of Reference Books/material

- ✓ Fluid Mechanics with Engineering Applications by E. John Finnemore and Joseph B. Franzini
- ✓ Fluid Mechanics Including Hydraulic Machines by Dr. A. K. Jain
- ✓ Hydraulics Machinery by S. S. Rattan
- ✓ Hydraulic Engineering by Henderson

Practicals:

1. Study of components, working and performance of Francis Reaction Turbine
2. Investigation of parts, operation and characteristic curves of Pelton Wheel Turbine
3. Proof of Bernoulli's Equation in Water Hammer Apparatus
4. Study of computer software for pipe network design
5. Application of computer software for water supply design
6. Study of parts and working of centrifugal pumps
7. Study of components and operation of reciprocating pumps

Mapping of CLOs to Lab Practical of Fluid Mechanics-II Engineering		
Lab Practical	**CLOs**	
	CLO-1 (Fluid Flows)	**CLO-2** (Software Application)
Study of components, working and performance of Francis Reaction Turbine	✓	
Investigation of parts, operation and characteristic curves of Pelton Wheel	✓	
Proof of Bernoulli's Equation in Water Hammer Apparatus	✓	
Study of computer software for pipe network design		✓
Application of computer software for water supply design		✓
Study of parts and working of centrifugal pumps	✓	
Study of components and operation of reciprocating pumps	✓	