Bachelor of Technology in Mechanical Engineering

Short Syllabus

BMEE204L Fluid Mechanics and Machines (3-0-0-3)

Introduction to Fluid Statics and Buoyancy, Fluid properties - Fluid Kinematics, Lagrangian and Eulerian approach - Fluid Dynamics, Euler and Bernoulli equations - Viscous Flow in pipes, Hagen Poiseuille equation - Dimensional Analysis - Boundary layer flow - Hydraulic Machines, Pumps and Turbines.

BMEE204L	Fluid Mechanics and Machines	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To apply hydrostatic law, principle of mass and momentum in fluid flows, concepts in Euler's and Bernoulli equations.
2. To provide fundamental knowledge of fluids, its properties and behaviour under various conditions of internal and external flows.
3. To determine the losses in a flow system, flow through pipes, boundary layer concepts.
4. To familiarize the student with the various pumps and turbines.

Course Outcomes

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

1. Demonstrate the significance of fluid properties and laws of fluid statics to engineering systems.
2. Describe the flow fields using Lagrangian and Eulerian approaches.
3. Formulate suitable governing equations to solve fluid flow problems.
4. Analyse the viscous flow through pipes and determine various losses.
5. Perform dimensional analysis of various flow problems.
6. Apply the boundary layer concept and predict the flow separation.
7. Analyse the performance of hydraulic pumps and turbines.

Module:1	**Fluid Statics and Buoyancy**	**8 hours**

Definition of fluid, Concept of continuum, Fluid properties, Rheological classification, Pascal's Law and Hydrostatic pressure and its measurement -Manometry.
Hydrostatic forces on Plane, Inclined and Curved surfaces, Buoyancy, Condition of Equilibrium for Submerged and Floating Bodies, Centre of Buoyancy.

Module:2	**Fluid Kinematics**	**5 hours**

Description of fluid motion – Lagrangian and Eulerian approach, Types of flows, Control volume, Material derivative and acceleration, Streamlines, Pathlines and Streaklines, Stream function and velocity potential function, The Reynolds transport theorem.

Module:3	**Fluid Dynamics**	**5 hours**

The continuity equation, The Euler and Bernoulli equations – venturimeter, orificemeter, Pitot tube, Momentum equation and its application – forces on pipe bends, moment of momentum, The Navier–Stokes Equations.

Module:4	**Viscous Flow in pipes**	**6 hours**

General Characteristics of pipe flow, Fully-developed laminar flow, Hagen Poiseuille equation, Turbulent flow, Darcy–Weisbach equation, Moody chart, major and minor losses, Multiple pipe systems.

Module:5	**Dimensional Analysis**	**5 hours**

Dimensional homogeneity, Rayleigh's method, Buckingham π theorem, Non-dimensional numbers, Model laws and distorted models, Modelling and similitude.

Module:6	**Boundary layer flow**	**5 hours**

Boundary layers, Laminar flow and turbulent flow, Boundary layer thickness, Momentum integral equation, Drag and lift, Separation of boundary layer, Methods of preventing the boundary layer separation.

Module:7	**Hydraulic Machines**	**9 hours**

Introduction - Centrifugal pumps – Work done - Head developed - Pump output and Efficiencies - priming - minimum starting speed - performance of multistage pumps - Cavitation - methods of prevention - Pump characteristics – Classification of hydraulic turbines - Pelton wheel - Francis turbine - Kaplan and Propeller turbines - - Specific speed - Theory of draft tube - Governing - Performance characteristics - Selection of turbines.

Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Books			
1.	Som S K, Gautam Biswas, Chakraborty S, Introduction to Fluid Mechanics and Fluid Machines, 2017, McGraw Hill.		
2.	Fox and McDonald, Introduction to Fluid Mechanics, 2020, 10th Edition, Wiley.		
Reference Books			
1.	Yunus A. Cengel and John. M. Cimbala, Fluid Mechanics: Fundamentals and Applications, 2019, 4th Edition, McGraw Hill.		
Mode of Evaluation: CAT, Written assignment, Quiz, FAT			
Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022