FLUID MECHANICS

Course Code: 13CE1107

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Course Educational Objectives:

- To introduce the concepts of fluid mechanics (along with application) and fluid flow measurements.
- To familiarize the students with fluid statics and fluid dynamics.

Course Outcomes:

- Students will demonstrate the ability to apply the boundary layer theory in aircraft structures.
- Students will be capable of understanding the behaviour in their static and dynamic conditions of a fluid along with simple applications.

UNIT-I (10 Lectures)

INTRODUCTION :

Dimensions and units – Physical properties of fluids, density, specific weight, specific volume, specific gravity, viscosity, surface tension, vapour pressure and their influences on fluid motion- fluid continuum- pressure at a point, Pascal's law, Hydrostatic law - atmospheric, gauge and vaccum pressure- measurement of pressure, Pressure gauges, Manometers: Differential and Micro Manometers.

HYDROSTATIC FORCES:

Hydrostatic forces on submerged plane (Horizontal, Vertical, inclined) and curved surfaces – Center of pressure, Derivations and problems.

UNIT-II (14 Lectures)

FLUID KINEMATICS:

Description of fluid flow, velocity, acceleration – convective, local and total, Stream line, path line and streak lines and stream tube. Classification of flows: Steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational and irrotational flows – Equation of continuity- one, two, three

dimensional flows – stream and velocity potential functions, flownet analysis.

UNIT-III (15 Lectures)

FLUID DYNAMICS:

Surface and body forces, Lagrangean and Eularian approaches – Concepts of fluid system and control volume – control volume approach for fluid flow problems – Euler's and Bernoulli's equations for flow for 2-D flow, Momentum equation and its application – forces on pipe bend.

MEASUREMENT OF FLOW:

Pitot tube, Venturi meter and Orifice meter – classification of orifices and mouth pieces–flow over rectangular, triangular and trapezoidal notches– Broad crested weirs.

UNIT-IV (15 Lectures)

VISCOUS FLOW:

Reynolds experiment – Classification of Laminar & Turbulent flows. Flow between two parallel plates, Flow through long pipes.

CLOSED CONDUIT FLOW:

Laws of Fluid friction – Darcy-Weisbach equation, Minor losses – pipes in series – pipes in parallel – Total energy line and hydraulic gradient line, variation of friction factor with Reynolds number – Moody's Chart.

UNIT-V (10 Lectures)

BOUNDARY LAYER (BL) THEORY:

Concepts, Prandtl's contribution, Characteristics of boundary layer along a thin flat plate, laminar and turbulent Boundary layers (no derivations), BL in transition, separation of BL, control of BL separation, flow around submerged objects-Drag and Lift- Magnus effect.

TEXT BOOKS:

1. V.L.Streeter, E. Benjamin Wiley and W. Bedford, *"Fluid Mechanics"*, 9th Edition, McGraw-Hill Companies, 1997.
2. P.N Modi and S.M. Seth, *"Hydraulics and Fluid Mechanics Including Hydraulic Machines"*, 14th Edition, Standard Book House, 2002.

3. K.L. Kumar, *"Fluid Mechanics"*, 6th Edition, Eurasia Publishing House, 1995.

REFERENCES:

1. Frank.M. White, *"Fluid Mechanics"*, 14th Edition, Tata McGraw hill Pvt. Ltd, 2002.
2. A.K. Mohanty, *"Fluid Mechanics"*, 14th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
3. J.F. Douglas, J.M. Gasirock and J.A. Swaffield, *"Fluid Mechanics"*, 14th Edition, Pearson Education Publishers, 2002.
4. A.K.Jain, *"Fluid Mechanics Including Hydraulic Machines"*, 8th Edition, Khanna Publishers, New Delhi, 2003.