# 22ME206 MECHANICS OF FLUIDS AND HYDRAULIC MACHINES

Hours	Per \	Neek :
т	р	6

L	Т	Р	С
2	2	2	4

PREREQUISITE KNOWLEDGE: Engineering Mathematics .

## COURSE DESCRIPTION AND OBJECTIVES:

This course offers the knowledge in fluid properties, fluid statics, fluid dynamics, flow behavior in pipes and performance characteristics of hydraulic machines. The objective of this course is to enable the student to understand the fluid properties, governing equations in fluid mechanics and to evaluate the performance characteristics of hydraulic machines.

# MODULE-1

#### 6L+6T+6P=18 Hours

#### FLUID PROPERTIES, FLUID STATICS, KINEMATICS AND DYNAMICS:

**Fluid Properties:** Introduction, Properties of fluids, Capillarity and surface tension, Forces on immersed surfaces and determination of centre of Pressure; Buoyancy; Piezometer, U-tube and Differential Manometers.

Fluid statics, Statics and Dynamics: Flow characteristics, Continuity equation, Energy equation - Euler equation, Bernoulli equation and Momentum equation.

#### UNIT-2

UNIT-1

#### 10L+10T+10P=30 Hours

## FLOW THROUGH CIRCULAR CONDUITS, BOUNDARY LAYER CONCEPT:

**Major and Minor Losses:** Darcy equation on pipe roughness, Friction factor, Minor losses – flow through pipes in series and in parallel, Hydraulic and energy gradient.

**Boundary Layer:** Boundary layer concepts, Boundary layer thickness, momentum and energy. case studies, numericals, modeling and simulations.

#### PRACTICES:

- Calibration of venturimeter.
- Calibration of orifice meter.
- Determine major losses for a given pipeline.
- Determine major losses for a given pipeline.
- Verification of Bernoulli's equation.
- Problem Solving on forces determination on immersed surfaces.

#### **MODULE-2**

## UNIT-1

#### IMPACT OF JETS AND HYDRAULIC TURBINES

Impact of Jets: Flat plate, Inclined and Curved surfaces - fixed and moving.

**Hydraulic Turbines:** Classification of turbines, Impulse and Reaction turbines, Pelton wheel, Francis turbine, Kaplan turbine - working proportions; Work done, Efficiencies, Draft tube theory - efficiency.



Source: https://www.google.com/ search?q=fluid& tbm=isch&ved= 2ahUKEwiTgp3U 44H5AhWf\_ DgGHTLfDocQ2-c CegQIABAA&oq= fluid&gs\_lcp=Cg.

6L+6T+6P=18 Hours

# SKILLS:

- Estimate fluid properties and shear forces resulting from Newtonian fluids.
- Calculate the magnitude and location of hydrostatic forces on immersed surfaces.
- ✓ Analyse fluid systems using the integral form of the continuity, momentum, impulsemomentum and energy equation.
- ✓ Distinguish laminar and turbulent flows through pipes.

## UNIT-2

#### 10L+10T+10P=30 Hours

**Hydraulic Pumps:** Pumps-Classification, Working Principles, Manometric head losses and efficiencies, Specific speed, Pumps in series and parallel, discharge, slip indicator diagram, Air vessels, Cavitation, case studies and analysis.

## PRACTICES:

- Problem Solving on impact of jets.
- Performance analysis on Pelton wheel.
- Performance analysis on Kaplan turbine.
- Performance analysis on Francis turbine.
- Performance analysis on reciprocating pump.
- Performance analysis on Centrifugal pump.

# COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Compute the fluid properties and forces on bodies at fluid rest and in transit.	Apply	1, 2	1, 2, 12
2	Derive the governing equations for fluid statics and dynamics.	Apply	1, 2	1, 2, 12
3	Analyze the flow behavior of fluids inside and over the solid surfaces.	Analyze	1, 2	1, 2, 3, 5, 12
4	Determine the friction factor and minor energy losses of fluids in pipe flow.	Analyze	1	1, 2, 3, 12
5	Evaluate the performance characteristics of hydraulic turbines and pumps.	Evaluate	2	1, 2, 3, 4, 12

# TEXT BOOKS:

- 1. John. M. CimbalaYunus A. Cengel, "Fluid Mechanics: Fundamentals and Applications", McGraw-Hill, 4th Edition, 2019.
- 2. Fox and Mcdonald's, "Introduction to Fluid Mechanics ", John Wiley and Sons, 8th Edition, 2015.

#### **REFERENCE BOOKS:**

- 1. P.N.Modi and Seth, "Fluid Mechanics and Hydraulic Machines", Standard Book House, 15th Edition, 2002.
- 2. Sukumar Pati, "Fluid Mechanics and Hydraulic Machines", McGraw-Hill, New Delhi, 1st Edition, 2012.