Program : **Diploma inMechanical Engineering/ Manufacturing Technology**	
Course Code :**4022**	Course Title: **Fluid Mechanics & Hydraulic Machinery**
Semester : **4**	Credits: **4**
Course Category: **Program Core**	
Periods per week: **4 (L:3, T:1, P:0)**	Periods per semester:**60**

Course Objectives:

- To identify the properties of fluids and various pressure measurement techniques.
- To familiarize with the science of fluid flow and its applications.
- To achieve the basic skills to find out the losses in pipe flow.
- To familiarize with the construction and working of turbines and pumps and achieve the knowledge to test their performance.

Course Pre-requisites:

Topic/Description	Course Code	Course Title	Semester
Basic knowledge in problem solving		Mathematics I&II	1 & 2
Basic knowledge in physics of fluids		Applied Physics I&II	1 & 2

Course Outcomes

On completion of the course, the student will be able to:

COn.	Description	Duration (Hours)	Cognitive level
CO1	Explain fluid properties and pressure measurement techniques.	12	Understanding
CO2	Apply conservation laws to fluid flow over notches and, through pipes and orifices.	17	Applying
CO3	Describe the construction, working and performance testing of hydraulic turbines.	17	Understanding
CO4	Describe the construction, working and performance testing of hydraulic pumps.	12	Understanding
	Series Test	2	

CO-PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3					1
CO2	3	3					1
CO3	3	3					1
CO4	3	3					1

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Explain fluid properties and pressure measurement techniques.**		
M1.01	List and Define various properties of fluids.	3	Remembering
M1.02	Solve Simple problems related to density, specific weight, specific volume, and specific gravity.	1	Applying
M1.03	Explain the terms pressure and pressure head State and explain Pascal's law. Explain Absolute, Gauge, Atmospheric and Vacuum pressures.	2	Understanding
M1.04	Solve problems related to pressure and pressure head.	1	Applying
M1.05	Illustrate the principle of working of piezometer, simple U-tube manometer, differential manometer, inverted differential manometer, bourdon's tube	2	Understanding
M1.06	Solve problems on pressure measuring instruments.	3	Applying

Contents: -Introduction to fluid mechanics Properties of fluid: Density, Specific gravity, Specific Weight, Specific Volume, Dynamic Viscosity, Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility. **Fluid Pressure & Pressure Measurement**: Fluid pressure, Pressure head, Pressure intensity, Concept of vacuum and gauge pressures, atmospheric pressure, absolute pressure, Piezometer, Simple, differential manometers and inverted U-tube manometers, Bourdon pressure gauge. Simple problems on pressure measurement.			
CO2	**Apply conservation laws to fluid flow over notches and, through pipes and orifices.**		
M2.01	Explain the types of fluid flow, Rate of Discharge, stream lines and path lines.	2	Understanding
M2.02	Explain the equation for continuity of flow without derivation. Derive & State Bernoulli's equation. State the limitations of the Bernoulli's theorem.	2	Understanding
M2.03	Solve fluid flow problems using Bernoulli's equation	2	Applying
M2.04	Explain the practical applications of Bernoulli's equation, Venturimeter, Orifice meter, Pitot Tube.	3	Understanding
M2.05	Solve problems related to the practical applications of Bernoulli's Theorem.	2	Applying
M2.06	Explain the types of notches and orifices. Discuss the equations for discharge over a notch. Mention hydraulic coefficients.	2	Understanding
M2.07	List the losses of head in pipes and identify Major losses and Minor losses.Explain Hagen-Poiseuille equation for laminar flow (no derivation). Derive Darcy's formula and Chezy's formula for loss of head in pipes and explain the terms hydraulic	2	Understanding
M2.08	Solve Numerical problems to estimate major and minor losses.	2	Applying
	Series Test I	1	

Contents:
Fluid Flow: Types of fluid flow – steady and unsteady, uniform and non-uniform, incompressible and compressible, rotational and irrotational, one dimensional and multi-dimensional flows- Path line and Stream line, Continuity equation for steady incompressible flow(no derivation), Momentum equation for steady inviscid flow, Euler equation (no derivation), Bernoulli's theorem, Applications of Bernoulli's theorem-Venturi meter, Orifice meter and Pitot tube, Derivation of discharge through venturi and orifice meter-coefficient of discharge and numerical problems**.** Types of Notches and Orifices**,** Equations for discharge over a notch (Rectangular & Triangular). Hydraulic coefficients of orifice.
Flow Through Pipes: Laminar and turbulent flows; Hagen-Poiseuille equation for laminar flow (no derivation) -Turbulent flow- Darcy's equation and Chezy's equation for frictional losses, Minor losses in pipes, Hydraulic gradient and total gradient line, Numerical problems to estimate major and minor losses.

CO3	**Describe the construction, working and performance testing of hydraulic turbines.**		
M3.01	Explain the concept of Impact of jet on fixed vertical, moving vertical flat plates, Impact of jet on curved vanes with special reference to turbines & pumps	3	Understanding
M3.02	Solve Simple numerical problems on work done and efficiency**.**	2	Applying
M3.03	Illustrate the Layout of hydroelectric power plant. Explain Features of Hydroelectric power plant Explain the Classification of hydraulic turbines.	2	Understanding
M3.04	Familiarize Selection of turbine on the basis of head and discharge available	3	Applying
M3.05	Explain the Construction and working principle of Pelton wheel, Francis and Kaplan turbines	3	Understanding
M3.06	Explain Draft tubes – types and construction, Explain the Concept of cavitation in turbines	2	Understanding
M3.07	Practice the Calculation of work done, power, efficiency of turbines, Unit quantities and simple numerical problems.	2	Applying

Contents:-**Impact of jets**: Impact of jet on fixed vertical, moving vertical flat plates, Impact of jet on curved vanes with special reference to turbines & pumps, Simple numerical problems on work done and efficiency**.**

Hydraulic Turbines: Layout of hydroelectric power plant, Features of Hydroelectric power plant, Classification of hydraulic turbines, Selection of turbine on the basis of head and discharge available, Construction and working principle of Pelton wheel, Francis and Kaplan turbines, Draft tubes – types and construction, Concept of cavitation in turbines, Calculation of work done, power, efficiency of turbines (No derivations), Unit quantities and simple numerical problems.

CO4	**Describe the construction, working and performance testing of hydraulic pumps.**		
M4.01	Explain the working, parts and types of centrifugal pumps.	2	Understanding
M4.02	Describe Priming and its methods, Cavitation.	1	Understanding
M4.03	Explain the terms Manometric head, Work done, Manometric efficiency, Overall efficiency of Centrifugal pump.	1	Understanding
M4.04	Solve numerical problems related to the performance of centrifugal pump.	1	Applying
M4.05	Explain the Construction, working principle and applications of single and double acting reciprocating pumps.	2	Understanding
M4.06	Solve numerical problems related to the performance of reciprocating pump.	1	Applying
M4.07	Describe Concept of slip, Negative slip, Cavitation and separation.	1	Understanding
M4.08	Explain hydraulic ram andspecial pumps like air lift pump, jet pump the mono block coupled submersible (open well &deep well) - propeller pumps - turbine pumps.	3	Understanding
	Series Test II	1	

Contents: -Centrifugal Pumps: Principle of working and applications, Types of casings and impellers, Concept of multistage, Priming and its methods, Cavitation, Manometric head, Work done, Manometric efficiency, Overall efficiency (No derivation, Equations only). Computation of overall efficiency and power required to drive pumps.

Reciprocating Pumps: Construction, working principle and applications of single and double acting reciprocating pumps Discharge of reciprocating pump, Concept of slip, Negative slip (No derivations), Simple Numerical problems, Cavitation and separation. Hydraulic ram, air lift pump, jet pump- propeller pumps - turbine pumps. (Working principle with schematic diagram)

Text /Reference:

T/R	BookTitle/Author
T1	Fluid mechanics and hydraulic machines – Dr. R.K. Bansal.
T2	Hydraulic, Fluid mechanics and Hydraulic machines– R.S.Khurmi
R3	Hydraulics and Fluid mechanics - Dr.P.N.Modi&Dr.S.M.Seth
R4	Hydraulics, Fluid mechanics and fluid machines – S.Ramamurtham
R5	Fluid Mechanics by Yunus A Cengel& John M Clmbala

Online resources

Sl.No	Website Link
1	https://www.elsevier.com/books/fluid-mechanics/unknown/978-0-12-405935-1
2	https://www.cambridge.org/core/books/an-introduction-to-fluid-dynamics/18AA1576B9C579CE25621E80F9266993
3	https://nptel.ac.in/courses/112105183/