LOK JAGRUTI UNIVERSITY (LJU)

INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Mechanical Engineering

Bachelor of Engineering (B.E.) – Semester – IV

Course Code:	**017103491**
Course Name:	**Fluid Mechanics**
Category of Course:	Professional Core Course (PCC)
Prerequisite Course:	Mathematics 1 (017101191), Physics (017101192), Engineering Graphics 1 (017102191), Mathematics 2 (017101291), Engineering Mechanics (017102291), Strength of Materials (017103391), Mathematics 3 (017101391)

Teaching Scheme

Lecture (L)	Tutorial (T)	Practical (P)	Credit	Total Hours
5	**0**	**2**	**6**	**50**

Syllabus

Unit No.	Topic	Prerequisite Topic	Successive Topic	Teaching Hours
01	**Fluids and Their Properties**			**4 (8%)**
	1.1 Introduction of fluid and fluid classifications	---	---	
	1.2 Hypothesis of continuum	---	---	
	1.3 Shear stress in a moving fluid and molecular structure of material	Shear stresses and its application (017103391-Unit-6.1)	---	
	1.4 Fluid Properties (Fluid density, viscosity, causes of viscosity in gases and liquids, surface tension, capillary effect, vapor pressure, cavitation, compressibility and the bulk modulus) with basic numerical	Types of elasticity (017101192-Unit-2.3)	---	
02	**Pressures and Head**			**4 (8%)**
	2.1 Types of pressure	Manometer (017101192-Unit-7.2)	---	
	2.2 Derive Pascal's law for pressure at a point and apply for vertical, Horizontal and inclined element	---	Hydraulic Machines (017103501-Unit-10)	
	2.3 Pressure and head (Pressure variation in a fluid at rest)			
	2.4 Hydrostatic paradox	---	---	
	2.5 Pressure measurements devices (Diaphragm Pressure Gauge, Simple U-tube manometer, Single Column manometer, Inverted U-tube differential manometer, U-tube differential manometer) with numerical	Pressure gauges and bourdon tube (017101192-Unit-7.3)	---	
03	**Motion of Fluid Particles and Streams**			**4 (8%)**
	3.1 Different types of flow	---	---	
	3.2 Fluid flow, motion of a fluid particle, acceleration of a fluid particle Discharge and mean velocity	Directional derivatives (017101291-Unit-7.6)	---	
	3.3 Continuity of flow, continuity equations for 2-D and 3-D flow in Cartesian coordinates of system.	First order ordinary differential equations (017101391-Unit-06)	---	
04	**Static Forces on Surface**			**7 (14%)**
	4.1 Fluid static and action of fluid pressure on surface	Basic integration by formulae (017101191-Unit-3.4), Angles (017101191-Unit-2.1)	---	
	4.2 Resultant force and center of pressure on a plane surface immersed in a liquid and submerged in air with numerical	---	---	
	4.3 Pressure diagrams	Scale (017102191-Unit-3.1)	---	
	4.4 Forces on a curved surface due to hydrostatic pressure with numerical	Basic integration by formulae (017101191-Unit-3.4), Angles (017101191-Unit-2.1)	---	
05	**Buoyancy and Metacentric Height**			**6 (12%)**
	5.1 Buoyancy, Metacenter and Metacentric Height	Laws of motion (017101192-Unit-1.3)	---	
	5.2 Equilibrium and stability of floating bodies	---	---	
	5.3 Stability of a submerged body	---	---	
	5.4 Determination of the metacentric height by analytical and practical method with numerical	Moment (017102291-Unit-4.1), Basic integration by formulae (017101191-Unit-3.4), Angles (017101191-Unit-2.1)	---	
06	**The Energy Equation**			**5 (10%)**
	6.1 Momentum and fluid flow	Laws of motion (017101192-Unit-1.3)	---	
	6.2 Euler's equation of motion along a stream line	---	---	
	6.3 Mechanical energy of a flowing fluid –Bernoulli's theorem	---	Minimum starting speed to deliver the discharge (017103501-Unit-4.6)	
07	**Applications of Energy Equation**			**7 (14%)**
	7.1 Determination of flow rate through Pitot tube with numerical	Pressure measurements devices (017103491-Unit-2.5)	---	

	7.2 Determination of flow rate through Venturimeter with numerical	---	---	
	7.3 Determination of flow rate through Orificemeter and Mouth pieces with numerical	---	---	
	7.4 Determination of flow rate through Notches (Rectangle and Triangular) with numerical	---	---	
08	**Dimensional Analysis**			**4 (8%)**
	8.1 Dimension reasoning and dimensional homogeneity	Units and dimensions (017101192-Unit-1.1)	---	
	8.2 Dimensional analysis using Rayleigh's method with numerical	Surds (017101191-Unit-1.2)	---	
	8.3 Buckingham π-theorem with numerical	---	Dimensional analysis applied to free convection (017103591-Unit-9.1), Dimensional analysis applied to forced convection (017103591-Unit-10.1)	
09	**Model Similarities**			**4 (8%)**
	9.1 Significance and use of dimensionless number with numerical	Units and dimensions (017101192-Unit-1.1)	Reynolds number (017103591-Unit-10.2)	
	9.2 Geometric similarity, dynamic similarity, Kinematic similarity	Plain scale (017102191-Unit-3.2)	---	
	9.3 Model testing-Model laws with numerical, Undistorted and Distorted models	Dimensionless number (017103491-Unit-8.1)	---	
10	**Viscous and Turbulent Flow**			**5 (10%)**
	10.1 Reynolds number and Reynold's experiment	Dimensionless number (017103491-Unit-8.1)	---	
	10.2 Flow of viscous fluid through circular pipe- Hagen Poiseuille formula with numerical	First order ordinary differential equations (017101391-Unit-06), Basic differentiation by formulae (017101191-Unit-3.1)	---	
	10.3 Expression for coefficient of friction Darcy-Weisbach Equation with numerical	Basic differentiation by formulae (017101191-Unit-3.1)	---	

Major Components/ Equipment

Sr. No.	Component/Equipment
1	Metacentric height apparatus
2	Bernoulli's theorem apparatus
3	Orificemeter
4	Venturimeter
5	Notch apparatus
6	Mouthpiece apparatus
7	Reynolds' apparatus

Sr No.	Practical Title	Link to Theory Syllabus
1	To determine metacentric height by metacentric height apparatus.	Unit-5
2	Verification of Bernoulli's theorem	Unit-6
3	To measure the velocity of flow using Orifice meter.	Unit-7
4	To measure the velocity of flow using Venturimeter.	Unit-7
5	To determine the coefficient of discharge through open channel flow over a notch.	Unit-7
6	To determine coefficient of discharge, coefficient of velocity and coefficient of contraction using flow through mouthpiece.	Unit-7
7	To determine the different types of flow patterns by Reynolds' experiment.	Unit-10

Proposed Theory + Practical Evaluation Scheme by Academicians
(% Weightage Category Wise and it's Marks Distribution)

L :	5	T:	0	P:	2

Note : In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject.
Each Test will be of 25 Marks.
Each Test Syllabus Weightage: Range should be 20% - 30%

Group (Theory or Practical)	Group (Theory or Practical) Credit	Total Subject Credit	Category	% Weightage	Marks Weightage
Theory	5	6	MCQ	19%	23
Theory			Theory Descriptive	0%	0
Theory			Formulas and Derivation	27%	32
Theory			Numerical	38%	45
Expected Theory %	**84%**		**Calculated Theory %**	**84%**	**100**
Practical	1		Individual Project	0%	0
Practical			Group Project	6%	40
Practical			Internal Practical Evaluation (IPE)	10%	60
Practical			Viva	0%	0
Practical			Seminar	0%	0
Expected Practical %	**16%**		**Calculated Practical %**	**16%**	**100**
Overall %	**100%**			**100%**	**200**

Course Outcome	
	Upon completion of the course students will be able to
1	Analyze various Properties of fluids & to estimate fluid pressure, fluid kinematics.
2	To explore & characterize fluid statics.
3	To articulate & apply energy equation on various fluid flow systems.
4	To develop Non dimensional equation & model laws for various fluid flow application and analyze fully developed laminar and turbulent pipe flows.

Suggested Reference Books	
1	Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K.Kataria and Sons
2	Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Laxmi Publications
3	Fluid Mechanics and Hydraulic Machines by R.K. Rajput, S.Chand and Co.
4	Fluid Mechanics by Frank .M. White, McGraw Hill Publishing Company Ltd.
5	Fundamentals of Fluid Mechanics by Munson, Wiley India Pvt. Ltd
6	Fluid Mechanics by A. K. Mohanty, PHI Learning Pvt. Ltd.
7	Laboratory Manual Hydraulics and Hydraulic Machines by R V Raikar

List of Open Source Software/Learning website	
1	http://nptel.ac.in
2	www.learnerstv.com
3	http://www.mne.psu.edu
4	http://www.efluids.com

Practical Project/Hands on Project

Sr. No.	Project List	Linked with Unit
1	Prepare a working model of any type of U-tube Manometer	Unit 02
2	Prepare a working model of hydraulic press	Unit 02
3	Considering required data, prepare a model for maximum water level in the dam/canal/ tunnel such that it will automatically open the gate/door to discharge water (You can also find angle at which the gate will open) take reference of Sardar Sarovar Dam, Dharoi Dam…	Unit 04
4	Prepare a working model of ship by deciding Metacentric height.	Unit 05
5	Prepare a model to measure flow of water through a channel.	Unit 06, 07
6	Prepare a working model on application of Bernoulli application.	Unit 06, 07
7	Using python programming prepare a model to solve Bernoulli equation	Unit 06, 07
8	Using python programming prepare a model to solve any Dimensional less number	Unit 08, 09
9	Using python programming prepare a model to solve Hagen Poiseuille equation.	Unit 10