LOK JAGRUTI UNIVERSITY (LJU)

INSTITUTE OF ENGINEERING & TECHNOLOGY

Department of Chemical Engineering (708)

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

Course Code:	**017083302**
Course Name:	**Fluid Mechanics**
Category of Course:	Professional Core Course (PCC)
Prerequisite Course:	11^{th}-12^{th} Science Physics, Mathematics

Teaching Scheme				
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**Total Hours**
4	**0**	**2**	**5**	**40**

Syllabus

Unit No.	Topic	Prerequisite Topic	Successive Topic	Teaching Hours
01	**Introduction to Fluid Mechanics**			**4 (10%)**
	1.1 Fluid, Fluid Static and its Application		Introduction to Momentum Transport (017083501-Unit-2) Shell Momentum Balance and Velocity Distribution in Laminar Flow (017083501-Unit-3)	
	1.2 Classification of Fluid			
	1.3 Pressure Concept and Hydrostatic Equilibrium, Manometer and its types (U-tube, Inclined and Differential Manometer)		Forced balanced pressure gauge, measurement of differential pressure. (017083506-Unit-9.2)	
	1.4 Decanters Like Gravity and Centrifugal Decanter			
02	**Fluid Flow Phenomena**			**4 (10%)**
	2.1 Properties of Fluids – Viscosity		Introduction to Momentum Transport (017083501-Unit-2) Shell Momentum Balance and Velocity Distribution in Laminar Flow (017083501-Unit-3) Laminar flow in a Narrow slit (017083701-Unit-5.1)	
	2.2 Velocity Fluid, Velocity Gradient and Rate of Shear			
	2.3 Newton's Law of Viscosity			
	2.4 Rheological Behavior of Fluid			
	2.5 Reynold's Number and its Significance			
	2.6 Boundary Layer Formation,			
	2.7 Boundary Separation and Wake Formation			
03	**Basic Equation of Fluid Flow**			**5 (12.5%)**
	3.1 Potential Flow, Streamline, Stream tube			
	3.2 Continuity Equation		Equation of Continuity (017083501-Unit-4.1) The Continuity Equation (017083701-Unit-5.2)	
	3.3 Bernoulli's Equation Without Correction Factor			
	3.4 Bernoulli's Equation with Correction Factor			
	3.5 Pump Work in Bernoulli's Equation			
	3.6 Applications of the Bernoulli Equation			
04	**Flow of Incompressible Fluid**			**5 (12.5%)**
	4.1 Flow of Incompressible Fluids in Conduits and Thin Layers in Pipes			
	4.2 Relation Between Skin Friction and Wall Shear			
	4.3 Laminar Flow in Pipes			
	4.4 Hagen Poiseuille Equation			
	4.5 Flow Through Channel of Non-Circular Cross Section, Equivalent Diameter and Hydraulic Radius			
	4.6 Flow Through Sudden Enlargement & Sudden Contraction			
05	**Flow of Compressible Fluid**			**3 (7.5%)**
	5.1 Mach Number			
	5.2 Velocity of Sound			
	5.3 Isentropic Flow of Compressible Fluid Through Nozzle			
06	**Dimensional Analysis**			**3 (7.5%)**
	6.1-Dimensional Analysis and Similarity		Dimensional Analysis (017083403 – Unit-4.1)	
	6.2 Rayleigh Method			
	6.3 Buckingham π-Theorem			
07	**Transportation of Fluid**			**4 (10%)**
	7.1 Pipe and Tubing			
	7.2 Joints and Fittings, Selection of Pipe Size			
	7.3 Prevention of Leakage Around Moving Parts: Stuffing Boxes and Mechanical Seals			
	7.4 Types of Valves: Gate Valve, Globe Valve, Check			

	Valve, Ball Valve			
08	**Fluid Moving Machinery**			**5 (12.5%)**
	8.1 Pumps and its Characteristics			
	8.2 Types of Pumps: Centrifugal Pump and Positive Displacement Pump (Reciprocating pump and Rotary pump)			
	8.3 Cavitation, Priming and NPSH, Characteristic curves of Centrifugal Pump, Power required for centrifugal pump			
	8.4 Comparision of Fan, Blower and Compressor			
09	**Measurement of Flowing Fluid**			**4 (10%)**
	9.1 Types of Flow meter – Variable head meter and Variable area meter			
	9.2 Venturi meter and Orifice Meter			
	9.3 Rotameter and Pitot Tube			
10	**Flow Past Immersed Bodies**			**3 (7.5%)**
	10.1 Drag and Drag Coefficient, Buoyancy Force			
	10.2 Relation Between Drag Coefficient and Reynolds Number			

Sr No.	Practical Title	Link to Theory Syllabus
1	To determine type of flow using Reynolds Apparatus.	Unit 2
2	To Study and Verify Bernoulli's Theorem.	Unit 3
3	Determine flow rate using Orifice meter.	Unit 9
4	Determine flow rate using Venturi meter.	Unit 9
5	Determine flow rate using Pitot tube.	Unit 9
6	Pump Characteristics	Unit 8

Major Components/ Equipment	
Sr. No.	**Component/Equipment**
1	Reynolds Apparatus
2	Centrifugal Pump
3	Venturi meter
4	Orifice meter
5	Pitot tube

Proposed Theory + Practical Evaluation Scheme by Academicians (% Weightage Category Wise and it's Marks Distribution)					
L:	**4**	**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	**4**	**5**	MCQ	52%	65
Theory			Theory Descriptive	4%	5
Theory			Formulas and Derivation	12%	15
Theory			Numerical	12%	15
Expected Theory %	**80%**		**Calculated Theory %**	**80%**	**100**
Practical	**1**		Individual Project	0%	0
Practical			Group Project	10%	50
Practical			Internal Practical Evaluation (IPE)	10%	50
Practical			Viva	0%	0
Practical			Seminar	0%	0
Expected Practical%	**20%**		**Calculated Practical %**	**20%**	**100**
Overall %	**100%**			**100%**	**200**

Course Outcome	
1	To understand the fluid mechanics, including fluid behavior, flow phenomena, and practical applications in engineering.
2	To understand fundamental fluid flow equations and principles, applying them to analyze various scenarios in engineering systems effectively.
3	To analyze compressible fluid flow, employing dimensional analysis, and mastering fluid transportation principles, facilitating their proficiency in engineering applications.
4	To understand the basic idea about fluid moving machinery, flow measurement techniques, and the analysis of flow past immersed bodies, facilitating their proficiency in engineering applications.
Suggested Reference Books	
1	"Unit Operations of Chemical Engineering", McCabe W L, Smith J C, Harriott P, Mc Graw Hill Publication, 7th edition 2005.
2	"Unit Operation-I", by K A Gavhane, Nirali Prakashan.
3	"Fluid Dynamics and Heat Transfer", James G. Knudson and Donald L. Katz, Mc Graw Hill Publication
4	"Chemical Engineering" Vol. I – Fluid flow, Heat Transfer and Mass Transfer; Coulson and Richardson's, Butterworth – Heinemann Publication, 6th Edition.
5	'Fundamentals of fluid mechanics' by G. S. Sawhney, I. K. International, 2nd Edition.
6	"Introduction to Process Engineering and Design" by B. I. Bhatt and S. B. Thakore, Mc Graw Hill Education (India) Pvt. Ltd., 2nd edition, (2010).

List of Open Source Software/Learning website	
1	https://nptel.ac.in/courses/112/104/112104118/
2	https://nptel.ac.in/courses/105/103/105103192/
3	https://onlinecourses.nptel.ac.in/noc19_ce28/preview
4	https://www.edx.org/course/advanced-fluid-mechanics-1
5	https://www.edx.org/course/advanced-fluid-mechanics-2?index=product&queryID=5c90901a88c5a0014c768a98cd03f08d&position=1
6	https://www.edx.org/course/advanced-fluid-mechanics-3

Practical Project/Hands on Project		
Sr. No.	**Project List**	**Linked with Unit**
1	Explain the pressure effect at the different point of vessel.	Unit 1
2	Determine the effect of viscosity on flow of a fluid.	Unit 2
3	Discuss about the different type of flow along with their characteristics.	Unit 2
4	Demonstration of Bernoulli's theorem.	Unit 3
5	Determine the effect of friction on flow rate of a fluid.	Unit 4
6	Models of different types of valves used in industry based on their application.	Unit 7
7	Explain the characteristics of centrifugal pump based on industrial application.	Unit 8
8	Determine how to measure the flow rate of a fluid using variable head meter.	Unit 9
9	Determine how to measure the flow rate of a fluid using variable area meter.	Unit 9
10	Explain the determination of drag coefficient.	Unit 10