COURSE TITLE	**FLUID MECHANICS**
COURSE CODE	**01CH2301**
COURSE CREDITS	**4**

Objective:

1 To provide fundamental knowledge of fluid properties, fluid statics, and fluid flow behavior, and their application in chemical engineering processes and equipment.

Course Outcomes: After completion of this course, student will be able to:

1 Identify and evaluate fluid properties and hydrostatic pressure relationships using appropriate pressure measuring devices.

2 Apply fundamental fluid flow equations to analyze fluid motion and flow measurement systems.

3 Analyze laminar and turbulent flow in pipes and estimate frictional and minor energy losses in pipelines.

4 Evaluate flow behaviour in packed beds, fluidized systems, and around immersed bodies.

5 Analyze the working and performance characteristics of pumps and compressors and apply dimensional analysis for fluid flow systems.

Pre-requisite of course: Basic Knowledge in physical sciences and base level maths

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Fluid Properties and Fluid Statics** Definition of fluid and continuum hypothesis, , Fluid properties: density, specific gravity, viscosity, compressibility, surface tension, vapour pressure, , Newtonian and non-Newtonian fluids, Pressure Concept, Pascal's Law, Hydrostatic law of equilibrium,, Pressure Measurement devices like Piezometer, U-tube Manometers, and Differential Manometer	8
2	**Fundamentals of Fluid Flow and Flow Measurement** Kinematics of fluid flow: Streamlines, pathlines and streamlines, , Types of fluid flow, volumetric flow rate and mass flow rate, Continuity equation, , Dynamics of fluid flow: Equation of motion, Euler's equation of motion, Bernoulli's equation, , Practical application of Bernoulli's equation- Venturi meter, Orifice meter, Pitot tube, Rotameter	8

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Contents : Unit	Topics	Contact Hours
3	**Flow through Pipes and Energy Losses** Laminar and turbulent flow, Reynolds number and flow regimes, Hagen–Poiseuille equation for laminar flow in pipes, Friction losses in pipe flow,, Darcy–Weisbach equation, Friction factor and Moody chart, Major and minor losses in pipelines, Equivalent length method, Energy losses in pipe fittings and valves, Flow through pipe networks.	8
4	**Flow Through Packed Beds, Fluidization and Immersed Bodies** Flow past immersed bodies such as spheres and cylinders, Drag and lift forces. , Drag coefficient, Terminal settling velocity of particles. Flow through packed beds and pressure drop, , Ergun equation. Introduction to fluidization, Minimum fluidization velocity, , Types of fluidization, Industrial applications of fluidized beds, Basics of multiphase flow and microfluidics.	8
5	**Pumps, Compressors and Dimensional Analysis** Pumps– Positive Displacement Pumps, Centrifugal Pumps, Pump performance characteristics, , Pump characteristic curves, Net Positive Suction Head (NPSH) and cavitation, Pump selection and operation., Compressors- Classification of compressors, Working principles of reciprocating and centrifugal compressors, performance parameters, compression ratio, multistage compression, basic applications in process industries., Dimensional Analysis: Different methods of dimensional analysis applied to fluid flow problems, Dimensionless numbers. , Introduction to Computational Fluid Dynamics (CFD).	10
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment 1** To study the flow behaviour using Reynolds's apparatus	2
2	**Experiment 2** To study various pressure measurement devices	2
3	**Experiment 3** To determine the viscosity of a fluid using a viscometer	2
4	**Experiment 4** To study and verify Bernoulli's Theorem	2
5	**Experiment 5** To determine the coefficient of discharge through venturi meter	2
6	**Experiment 6** To determine the coefficient of discharge through orifice meter	2
7	**Experiment 7** To study Rotameters and determine its coefficient of discharge	2
8	**Experiment 8** To measure the velocity of flow using Pitot tube	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
9	**Experiment 9** To determine the friction factor in pipes.	2
10	**Experiment 10** To determine the minor losses in pipe fittings	2
11	**Experiment 11** To study of characteristic curves of centrifugal pump.	2
12	**Experiment 12** Study of flow through packed bed and pressure drop measurement	2
Total Hours		**24**

Textbook :

1 A Textbook of Fluid Mechanics, , R. K. Bansal, , Laxmi Publications Pvt. Limited, 2005

2 Chemical Engineering Vol. I: Coulson & Richardson's Chemical Engineering Series, Raj Chhabra and V. Shankar, Butterworth-Heinemann Publication, 1999

References:

1 Unit Operations of Chemical Engineering, Unit Operations of Chemical Engineering, McCabe W L, Smith J C, Harriott P,, McGraw Hill Publication, 2005

2 Fluid Mechanics for Chemical Engineers, Fluid Mechanics for Chemical Engineers, Noel de Nevers,, McGraw Hill Publication, , 1991

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
0.00	0.00	35.00	35.00	30.00	0.00

Instructional Method:

1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room

3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

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Supplementary Resources:

1 https://nptel.ac.in/courses/112104118
2 https://nptel.ac.in/courses/105103192

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