

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**  
**HYDERABAD CAMPUS**  
**FIRST SEMESTER 2022-2023**  
**Course Handout**

Date: 29<sup>th</sup> Aug. 2022

In addition to part – I (General Handout for all courses appended to the timetable), this portion gives further specific details regarding the course.

**Course No.** : **CHE F212**  
**Course title** : **Fluid Mechanics**  
**Instructor-in-charge** : **Ramesh Adusumalli**

**1. Course Description**

Fundamental Concepts, Fluid Statics, Integral and Differential Analyses for Fluid Motion, Dimensional Analysis, Internal and External Fluid Flow, Fluid Machinery, Flow through Packed Bed, Agitation, Introduction to Compressible Flow.

**2. Scope and Objective**

This course is an introduction to the field of fluid mechanics. It mainly covers the basic principles of fluid mechanics and introduces the student to the fundamental and practical aspects of basic fluid flow operations, which are commonly experienced by a chemical engineer during pilot plant studies or in production. The physical concepts of fluid mechanics and analysis methods, beginning from basic principles shall be dealt with in this course.

**3. Text Books**

- T1 Fox, R.W. and A.T. McDonalds, *Introduction to Fluid Mechanics (7<sup>th</sup> Ed.)*, John Wiley & Sons Inc., 2001. [ISBN: 9971-51-355-2]  
T2 McCabe, W.L., J.C. Smith and P. Harriott, *Unit Operations of Chemical Engineering (7<sup>th</sup> Ed.)*, McGraw Hill Inc., 2005. [ISBN 007-124710-6]

**4. Reference Books**

- R1 Cengel, Y. A. and Cimbala J M (Adapted by: S Bhattacharyya), *Fluid Mechanics: Fundamentals and Applications (In SI Units)*, Tata McGraw-Hill Publishing Co. Ltd., Second Reprint 2007.

**PTO**

## COURSE PLAN: FLUID MECHANICS

Lecture Number	Learning Objectives	Topics to be Covered	Chapter in the Text Book
1-2 (Module1 = M1)	Introduction to the Fluid Mechanics	Definition of a fluid, Basic Equations, Methods of Analysis; Units and Dimensions and Dimensional Analysis,.	T1: 1.2 – 1.6 T2: Page 15
3-6 (M2)	Fundamental Concepts [Introduction to new concepts and definitions of Fluid Mechanics]	Fluid as a Continuum, Velocity and Stress fields, Viscosity and Surface Tension, Description and Classification of Fluid Motions.	T1: 2.1 – 2.6
7-10 (M3)	Fluid statics [Study of the principles of Fluid Statics and their applications for various purposes]	Basic Equations of Fluid Statics, Pressure variation in Static Fluids, Hydrostatic Equilibrium in a Centrifugal Field,	T1: 3.1, 3.3, T2: Pages 33-34
11-15 (M4)	Basic Equations in Integral form for a Control Volume [General Mathematical Formulations for a Control Volume using Basic laws of Mechanics, Physics and Thermodynamics]	Basic Laws for a System, Conservation of Mass and Momentum Equations for Integral Control Volumes, Angular Momentum Principle [Fixed Control Volume Analysis only], First and Second Laws of Thermodynamics.	T1: 4.1, 4.3, 4.4, 4.7.1, 4.8-4.9
16 – 20 (M5)	Introduction to Differential Analysis of Fluid Motion	Conservation of Mass and Momentum Equations [Navier-Stokes equations: Rectangular coordinates only], Motion of fluid Elements.	T1: 5-1.1, 5-1.2, 5-3 – 5.4 T2: Pages 68-82
21 – 25 (M6)	Fundamentals of Incompressible Inviscid flows	Euler's Equations, Bernoulli's Equation, Bernoulli's Equation as an Energy Equation	T1: 6.1 – 6.4, T2: Pages 86-94
26 – 28 (M7)	Dimensional Analysis and Similitude [Significance of Non-Dimensionalization Technique and Non Dimensional numbers]	Buckingham PI theorem/ Rayleigh's Method, Significant Dimensionless Groups in Fluid Mechanics	T1: 7.1 – 7.4 T2: Page 16-20
29-33 (M8)	Internal Incompressible flow [Study of the Mechanics of flows inside Solid bodies, Aspects of Transportation and Metering of fluids]	Flow between parallel plates, Flow in pipes and ducts, Energy considerations in Pipe flow, Pumps, Flow Measurement Techniques (Venturi and Orifice meters, Pitot tubes etc.)	T1: 8.1 – 8.11 T2: Pages 98-108, 202-214

Lecture Number	Learning Objectives	Topics to be Covered	Chapter in the Text Book
34-37 (M9)	External Incompressible Viscous flow (Flow over Flat Plates and Flow past Immersed bodies) and Associated effects.	Boundary layer concept, Boundary Layer thickness, Boundary layer formation and Separation, Drag & Streamlining, Flow through beds of solids	T1: 9.1 – 9-2, 9-7.1-9-7.3 T2: Pages 60-65, 155-167
38-40 (M10)	Agitation and Mixing of Liquids [Agitation and Mixing of Homogeneous Liquids, Liquid-Liquid, Gas-Liquid and Solid-Liquid Dispersions]	Agitated Vessels and Accessories, Flow patterns in Vessels, Velocity patterns and Gradients, Power Consumption, Blending & Mixing, Static Mixers	T2: Chap. 9 Pages 244-271

## EVALUATION SCHEME

Component	Duration	Weightage	Date & Time	Nature of Component
Mid-Sem Exam	90 min	30%	02/11 11.00 - 12.30PM	CB
Surprise tests*	20 min	20%		OB
Seminars*		10%		OB
Comprehensive Examination	3 hours	40%	22/12 AN	CB

CB - Close book      OB - Open book

\*Total three surprise tests will be conducted. Best two will be taken for 20 % weightage.

- **Chamber consultation hour: Monday 2-5 PM**
- The **notices** will be displayed in CMS.
- **Make-up** will be granted for genuine cases only. Certificate from authenticated doctor must accompany make-up application (*only prescription or vouchers for medicines will not be sufficient*). Prior permission of IC is compulsory.
- **Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**Instructor-in-charge**  
CHE F212