

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
INSTRUCTION DIVISION
FIRST SEMESTER 2016-2017
Course Handout (Part II)

Date: 02/08/2016

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	:	DR AMIT JAIN
Co-Instructor	:	Dr Pratik N Sheth

1. Course Description

Fundamental Concepts, Fluid Statics, Integral and Differential Analysis 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 a practicing chemical engineer meets with regularly. 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 (8th Ed.)*, John Wiley & Sons Inc., 2011.
- T2 McCabe, W.L., J.C. Smith and P. Harriott, *Unit Operations of Chemical Engineering (7th Ed.)*, McGraw Hill Inc., 2005.

4. Reference Books

- R1 Bird, R.B., W.E. Stewart and E.N. Lightfoot, *Transport Phenomena (2nd Ed.)*, John Wiley and Sons Inc., 2002.
- R2 Welty, J.R., C.E. Wicks, R.E. Wilson, and G. Rorrer, *Fundamentals of Momentum, Heat and Mass Transfer (4th Ed.)*, John Wiley and Sons Inc., 2001.
- R3 Coulson, J. M. and J. F. Richardson (with J. R. Backhurst and J. H. Harker), *Coulson & Richardson's Chemical Engineering- Volume 1 (5th Ed.)*, Pergamon Press.
- R4 Nevers, N. de, *Fluid Mechanics for Chemical Engineers (3rd Ed.)*, McGraw-Hill Higher Education, 2005.
- R5 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 FLOW OPERATIONS

Lecture Number	Learning Objectives	Topics to be Covered	Reference (Text Book)
1-2	Introduction to the Fluid Mechanics	Definition of a fluid, Basic equations, Dimensions and unit, Dimensionless equations and Consistent units, Dimensional equations, Method of analysis.	TB1 & TB2: Chapter 1
3-5	Fundamental concepts [Introduction to new concepts and definitions of fluid mechanics]	Concept of fluid continuum, Velocity and stress field, Viscosity, Viscosity of gases and liquids, Surface tension, Description and classification of fluid motions.	TB1: Chapter 2
6-8	Fluid statics [Study of the principles of fluid statics and their application for various purposes]	Basic equations of fluid statics, Pressure variation in static fluids, Hydrostatic Equilibrium in a centrifugal field, Buoyancy and stability.	TB1: Chapter 3 TB2: Chapter 2
9-14	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 law of thermodynamics.	TB1: Chapter 4
15-18	Introduction to differential analysis of fluid motion	Conservation of mass and momentum equation [Navier-Stokes equations: Rectangular coordinates only], Motion of fluid elements.	TB 1: Chapter 5
19-22	Fundamentals of incompressible inviscid flow	Euler's equations, Bernoulli's equation, Relation between first law of thermodynamics and Bernoulli's equation	TB1: Chapter 6
23-25	Dimensional analysis and Similitude [Significance of non-dimensionalization technique and non dimensional numbers]	Buckingham PI theorem/ Reyleigh method, Significant dimensionless group in fluid mechanics	TB1: Chapter 7
26-33	Internal incompressible flow [Study of the mechanics of flows in side solid bodies, aspects transportation and metering of fluid]	Flow between parallel plates, Flow in pipes of various cross-sections, Energy considerations of the flow, Pumps, Flow measurement techniques (venturi and orifice meters, pitot tubes etc.)	TB1: Chapter 9-10; TB2: Chapter 8

Lecture Number	Learning Objectives	Topics to be Covered	Reference (Text Book)
34-38	External incompressible viscous flow (flow over immersed bodies) and associated effects.	Boundary layer concept, Boundary layer thickness, Pressure gradient in boundary layer, Drag & flow through beds of solids, sedimentation, fluidized beds.	TB1: Chapter 9; TB 2: Chapter 7
39-42	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	TB2: Chapter 9

EVALUATION SCHEME

Component	Duration (min)	Weightage	Date & Time	Remarks
Project (Novel Study/Experimental Demonstration)	20	10%		Poster Presentation (Open Book)
Tutorial Evaluations	15-20	25%		Closed/Open Book
Midsemester Examination	90	25%	7/10 2:00 - 3:30 PM	Closed Book
Comprehensive Examination	180	40%	12/12 FN	Closed and Open Book

- **Note: No make-up would be granted for tutorial tests.**
- **Chamber consultation hour** will be announced in the class.
- The **notices** will be displayed on the Chemical Engineering Department notice board and/or nalanda web portal only.
- **Make-up** will be granted for genuine cases only. **Prior permission of I/C is mandatory.**

Instructor-in-charge
CHE F212