
CL 202

Fluid Mechanics

Instructors: Prof. V V Goud and Dr. Raghvendra Gupta
Department of Chemical Engineering
Indian Institute of Technology Guwahati

General Information

- Timing:
 - Tuesday: 7:55-8:50 AM (Can we change it)
 - Wednesday: 11-11:55 AM
 - Thursday: 11-11:55 AM (Generally it would be a Tutorial/Quiz)
- Platform:
 - MS Teams
- Instructors:
 - Prof. Vaibhav V Goud : vvgoud@iitg.ac.in
 - Dr. Raghvendra Gupta : guptar@iitg.ac.in
- Branch Representatives:
 - CL: Please give 2 names
 - CST: Please give 2 names

CLASSWISE TIME-TABLE July-Nov 2021										
II Year B.Tech										
Day	07:55-08:50 (Tutorial)	9-9:55	10-10:55	11-11:55	12-12:55	1-1:55	2-2:55	3-3:55	4-4:55	5-5:55
Monday		2		CL 203(AKDM)	CL 204(DB)					
Tuesday	CL 202(RG)	1	CL 201(VSM, TKM)	CL 203(AKDM)	CL 204(DB)					
Wednesday			CL 201(VSM, TKM)	CL 202(RG)						
Thursday	CL 203(AKDM)		CL 201(VSM, TKM)	CL 202(RG)						
Friday			CL 203(AKDM)	CL 204(DB)	3					

Syllabus

Properties and classification of fluids, fluid statics: pressure, gravity and surface tension, Newton's law of viscosity; Integral and differential analyses for fluid motion: Reynolds Transport theorem, Navier-Stokes equation; Potential flow, stream functions; Euler and Bernoulli equations; Flow measuring techniques; Dimensional analysis and similitude, Buckingham Pi theorem; Internal and external fluid flows: friction factor, energy losses in fittings and valves, boundary layer theory; concepts of drag and lift; Fluid machinery: pumps, blowers, fans and compressors; Introduction to turbulent flows, flow through porous media, non-Newtonian fluids and compressible flows.

Available at <http://iitg.ac.in/acad/CourseStructure/Btech2018/CL/CL202.htm>

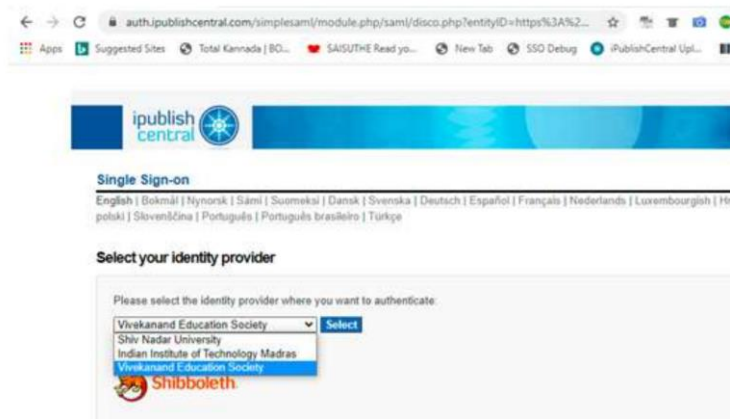
Books

Textbook: R. W. Fox, A. T. McDonald, P. J. Pitchard and J. W. Mitchell, Introduction to Fluid Mechanics, Wiley India Edition, John Wiley & Sons, 2015.

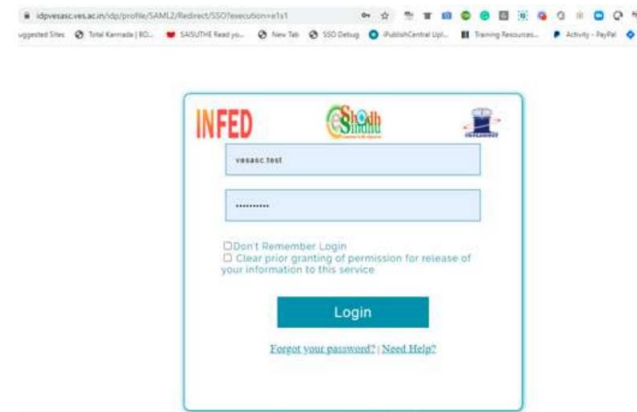
<https://ebooks.wileyindia.com/pdfreader/fluid-mechanics50156779>

Steps to access the book

1. Go to ebooks.wileyindia.com, click login, and click single sign on.



2. Select the Institution from the Dropdown (See the image)



3. It takes to the Institution page login with the valid credentials and click login

Books

Reference Books:

1. F. M. White, Fluid Mechanics, 8th Ed., McGraw Hill Publications, 2017.
2. Y. Cengel and J. Kimbala, Fluid Mechanics: Fundamentals and Applications, McGraw Hill Publication, 3rd Ed., 2014
3. W. M. Deen, Introduction to Chemical Engineering Fluid Mechanics, Cambridge University Press, New York, 2016.
4. W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th Ed., McGraw - Hill, International Edition, 2014.
5. G. K. Batchelor, An Introduction to Fluid Dynamics, Cambridge University Press, 1967.
6. L. D. Landau and E. M. Lifshitz, Fluid Mechanics, Course of Theoretical Physics, Vol. 6, 2nd Edition, 1987.

Syllabus

Chapter 2: Properties and classification of fluids,

Chapter 7: Dimensional analysis and similitude, Buckingham Pi theorem;

Chapter 3: Fluid statics: pressure, gravity and surface tension, Newton's law of viscosity;

Chapter 4: Integral and differential analyses for fluid motion: Reynolds Transport theorem, Navier-Stokes equation;

Chapter 6: Potential flow, stream functions; Euler and Bernoulli equations;

Chapter 8: Internal and external fluid flows: friction factor, energy losses in fittings and valves, Flow measuring techniques;

Chapter 9: Boundary layer theory; concepts of drag and lift

Chapter 10: Fluid machinery: pumps, blowers, fans and compressors

Special Topics: Introduction to turbulent flows, flow through porous media, non-Newtonian fluids and compressible flows.

*Chapter numbers of the text book

Other Resources

MOOCs Lectures:

NPTEL course by

Prof. V Shankar (Chemical Engineering, IIT Kanpur): Fluid Mechanics

Prof. Suman Chakrabarty (Mechanical Engineering, IIT Kharagpur): Introduction to Fluid Mechanics and Fluids Engineering

Dr. Raghvendra Gupta: Fluid Mechanics for Chemical and Biomedical Engineers

Some Useful Fluid Mechanics Videos: Illustrated Experiments in Fluid Mechanics

<http://web.mit.edu/hml/ncfmf.html>

Gallery of fluid motion: <https://gfm.aps.org/>

Can we create a Fluid Mechanics Gallery of our own?

Evaluation plan (**Tentative**)

Midsem Examination	20
Endsem Examination	20
Tutorials (6 best out of 8)	30
Quizzes (2)	30
Total	100

- Tutorials, quizzes and exams will be conducted using Moodle (tentative).

Moodle

Website:

<https://www.iitg.ac.in/moodle/login/index.php>

Login using IITG Email credentials (login, password)

Coursename:

CL202-2021

Or

CL202 Fluid Mechanics 2021

Enroll yourself

Enrollment Key:

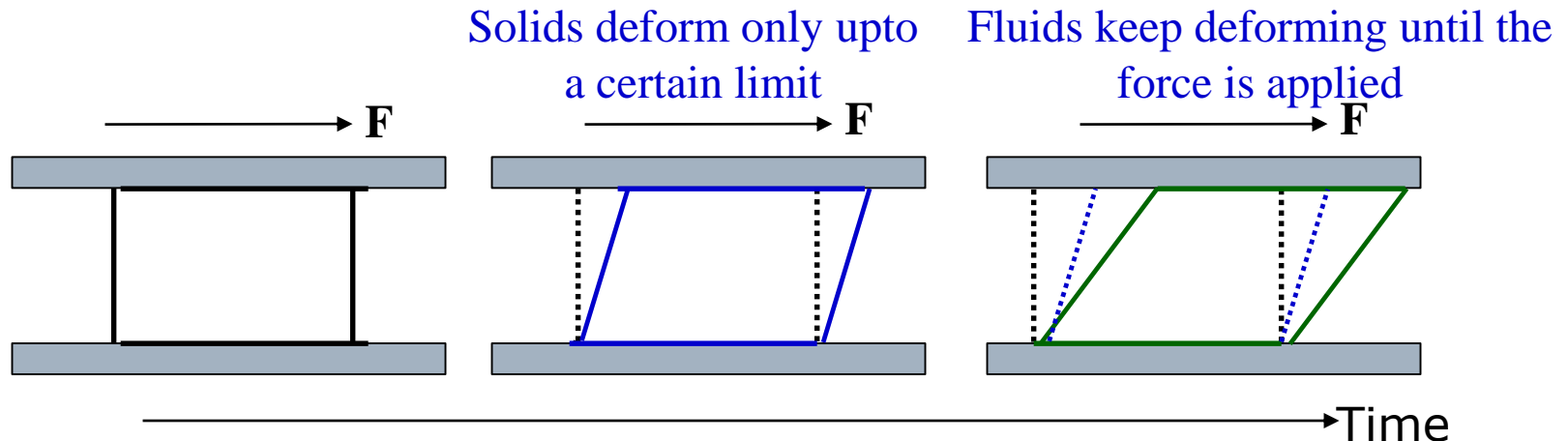
RoddamN

What do we already know about Fluid Mechanics?

- Reynolds number
- Continuity
- Bernoulli's principle
- Viscosity
- Surface tension and capillary action
- Stokes' law- terminal velocity
- Buoyancy- Archimedes' Principle

Fluid Mechanics

- What is a fluid?
 - Substances/ materials that flow
 - Can be liquid and gas
 - Substances that deform continuously when a tangential (or shear) stress is applied over them



Fluid Mechanics

- Solid: Stress is related to **strain**
 - For an elastic solid: Stress is proportional to **strain**
(proportionality constant elasticity)
- Fluid: Stress is related to **rate of strain**
 - For a Newtonian fluid: Stress is proportional to **rate of strain**
(proportionality constant viscosity)
- Some materials show both fluid and solid like properties
 - Known as viscoelastic fluids

Fluid Mechanics

- Mechanics – Analysis of action of forces on objects/materials
 - Statics
 - When a shear stress is present- fluid deforms continuously i.e. flows
 - Only normal stress is present for a static fluid
 - Fluid statics- Also called hydrostatics
 - $P = \rho gh$
 - Archimedes' Principle
 - Dynamics: Concerned with flow of fluids
 - Aerodynamics: air and other gases
 - Hydrodynamics: liquids

Role of Fluid Mechanics in Chemical Engineering

- Role of Chemical Engineer
 - Conventionally, production of chemicals/materials at the industrial scale
 - Develop, design and engineer the complete process and the equipment required to convert the raw materials into desired products efficiently, safely and economically
- Operations performed in the **continuous mode** (and not batch)
- Most of the materials are fluids (in liquid and gaseous form)
 - Flow of solid materials- Granular flow