Name of Institute: INDUS INSTITUTE OF TECHNOLOGY AND ENGINEERING
Name of Faculty: Dr. Umang J Patdiwala

Course code: ME 0314
Course name: FLUID MECHANICS
Pre-requisites: Basic Mathematics
Credit points:

L	T	P	C
2	0	2	3

Offered Semester: III

Course Coordinator

Full Name: Dr. Umang J Patdiwala
- Department with seating location: 1st Floor, FM LAB, Bhanwar Building, IITE - IU
- Telephone: 3102
- Email: umangpatdiwala.me@indusuni.ac.in
- Consultation times: 9.00 am to 5.00 pm on regular working days

Course Lecturer
Full Name: Dr. Umang Patdiwala
- Department with seating location: 1st Floor, FM LAB, Bhanwar Building, IITE - IU
- Telephone: 3102
- Email: umangpatdiwala.me@indusuni.ac.in
- Consultation times: 9.00 am to 5.00 pm on regular working days

Students will be contacted throughout the session via e-mail with important information relating to this course. They will be also communicated through Google class room for subject materials.

Course Objectives
By participating in and understanding all facets of this course a student should be able to

1. Provide fundamental knowledge of fluid.

2. Develop basic understanding of Fluid properties.

3. Give the knowledge of behavior of fluid under various conditions

Course Outcomes (CO)

1. Understand the fundamentals of Fluid Mechanics and related applications.

2. Know basics of fluid kinematics and dynamics and their applications.

3. Formulate basic equations for Fluid Engineering problems.

4. Calibrate various fluid flow measuring devices.

5. Understand the necessity and concept of dimensional analysis, boundary layer and compressible fluid flow

Course Outline

(Key topics to be dealt)

1. Fluid Statics
2. Fluid dynamics
3. Detailed understanding of various types flow
4. Dimensional and model analysis

Method of delivery

(Chalk Board -Face to Face Lecture, PPT & Video, Interaction)

Study time

02+02 = 04 Hrs Classroom and Laboratory Teaching each.

CO-PO Mapping (PO: Program Outcomes)

The objectives of the Mechanical Engineering undergraduate program are to produce graduates who have:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Blooms Taxonomy and Knowledge retention(For reference)

(Blooms taxonomy has been given for reference)

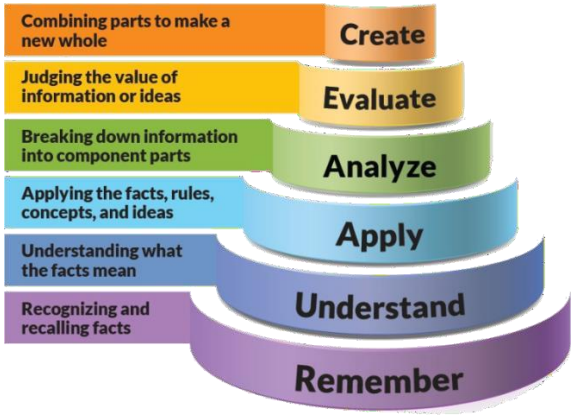

Figure 1: Blooms Taxonomy

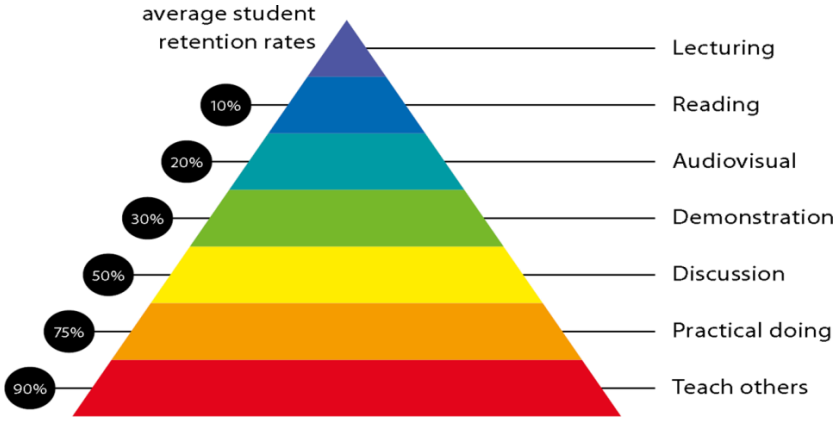

Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of_____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**

Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and Professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

1. Performance to determine Metacentric height using Buoyancy force.
2. Experimental verification of Bernoulli's theorem.
3. To determine type of flow using Reynold's experiment.
4. To evaluate friction factor of pipe flow experimentally.
5. Experimental determination of coefficient of discharge of rectangular and V notch in open channel flow.
6. Experimental calibration of Venturi meter.
7. Experimental calibration of Orifice meter.
8. Experimental calibration of Rotameter.
9. Dimensional Analysis, Model Similitude and various Dimensionless numbers- their study, application and case study
10. Pressure measurement using Pitot tube in wind tunnel.
11. Additional Practical (Practical beyond curriculum based on wind tunnel)

Lecture/tutorial & Practical times

Lecture	**Wednesday** **Thursday**	**10.50 to 11.45** **9:55 to 10:50**	**Room LH 8** **Room DH I**
Practical	**Tuesday**	**10.50 to 12.40**	**Fluid Mechanics Laboratory**

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

Details of referencing system to be used in written work

Text books

1. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar– Kataria & Sons – New Delhi
2. A text of Fluid Mechanics – R. K. Rajput – S. Chand & Company Ltd., Delhi

Reference Books

1. Fluid Mechanics & Hydraulics Machines-R.K.Bansal-Laxmi Publications.Delhi
2. Engineering Fluid Mechanics –K.L. Kumar, Eurasia Publication House, Delhi
3. Mechanics of Fluid – B.S. Massey – English Language Book Society (U.K.)
4. Fluid Mechanics- Yunush A. Cengel, John M. Cimbala- MH, Delhi
5. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas- MH, Delhi
6. Hydraulics and Fluid Mechanics Including Hydraulic Machine- PN Modi, & SM Seth-
7. Theory and Application of Fluid Mechanics- K.Subramanya-TMH Delhi
8. A text of Fluid Mechanics – R. K. Rajput – S. Chand & Company Ltd., Delhi

Additional Materials

List of PPTs, NPTEL materials etc. (available in soft copy)

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

CIE Theory: 60 %
ESE Theory: 40 %
CIE Practical: 60 %
ESE Practical: 40 %

Evaluation Pattern	CIE-Theory (60 Marks)	Evaluation Pattern	CIE-Practical (60 Marks)
Mid Sem Exam (MSE)	**40 Marks**	**Laboratory file Work**	**40 Marks**
Attendance	**05 Marks**	**Attendance**	**05 Marks**
Assignments	**10 Marks**	**Practical Performance**	**10 Marks**
Class Participation	**05 Marks**	**Lab Participation**	**05 Marks**

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment).

Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc. as well in the table under the TeachingLearning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	**Fluid Properties and Fluid Statics** Fluid, ideal and real fluid, properties of fluid: mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapor pressure, compressibility and bulk modulus.	To Develop basic understanding of Fluid properties.	Assignment
	Weeks 2	Newtonian and Non-Newtonian fluids. Pressure, Pascal's law, Hydro static law, Manometer, and Hydrostatic forces on submerged planes and curved surfaces, Buoyancy and Flotation.	To Develop basic understanding of Fluid static	Assignment
	Week 3	**Fluid Kinematics** Streamline, stream tube. Continuity equation ,acceleration of a fluid particle, motion of fluid particle along curved path, Normal and tangential acceleration	To understand fundamental of Fluid Kinematics	Assignment
	Week 4	Description of fluid motion, Lagrangian and Eulerian approach, Type of fluid flow, Type of flow lines-path line, streak line, acceleration	To understand fundamental of Fluid Kinematics	Assignment
	Week 5	Rotational flow, Rotation and Vorticity circulation, stream and potential function	To understand fundamental of Fluid Dynamics	Assignment
	Week 6	**Fluid Dynamics** Euler's Equation, Bernoulli's equation and its practical application, Venturimeter, Orifice meter,	To gain the fundamental knowledge of Fluid Dynamics	Assignment
	Week 7	Nozzle, Pitot tube, Impulse momentum equation, Momentum of Momentum equation, Kinetic energy and Momentum correction factor	To gain the fundamental knowledge of Fluid Dynamics	Assignment
	Week 8	**Viscous Flow** Flow of viscous fluids in circular pipe, shear stress and pressure gradient relationship, Velocity distribution, Hagen Poiseuille Equation,	To understand various types of flow	Assignment
	Week 9	flow of viscous fluids between two parallel plates (Couette flow), shear stress and pressure gradient relationship, Velocity distribution	To understand various types of flow	Assignment

	Week 10	**Turbulent Flow** Reynolds's experiment, Effect of turbulence, Expression for loss of head due to friction in pipes (Darcy-Weisbach equation)	To understand various types of flow	Assignment
	Week 11	Expression for co-efficient of friction in terms of shear stress.	To understand various types of flow	Assignment
	Week 12	**Compressible Fluid Flow** Basic Thermodynamic relations, Basic equations for one dimensional compressible flow, stagnation properties,	To understand various types of flow	Assignment
	Week 13	pressure wave propagation and sound velocity, Flow through nozzles	To understand various types of flow	Assignment
	Week 14	Dimensional Analysis and Model Analysis Methods of dimensional analysis, Rayleigh's method, Buckingham's theorem, Limitations.	To Understand the necessity and concept of dimensional analysis.	Assignment
	Week 15	Dimensionless number and their significance, model laws, Reynolds model law, Fraude's model law, Euler's model law, Weber's model law, Mach's model law,	To Understand the necessity and concept of dimensional analysis	Assignment
	Week 16	Type of models, scale effect in model, limitation of hydraulic similitude.	To Understand the necessity and concept of dimensional analysis	Assignment

B.TECH MECHANICAL ENGINEERING