



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code: BE04000161

Subject Name: Fluid Mechanics

w.e.f. Academic Year:	2024-25
Semester:	4
Category of the Course:	Professional Core Course

Prerequisite:	<input type="checkbox"/> Basic knowledge of Engineering Physics (mechanics, pressure, forces). <input type="checkbox"/> Fundamental concepts from Engineering Mathematics (differentiation, integration, differential equations). <input type="checkbox"/> Elementary exposure to Engineering Graphics (visualization of fluid domains) and Engineering Mechanics (statics & dynamics).
Rationale:	<p>Fluid Mechanics is a core subject for Mechanical and Automobile Engineering that provides the foundation for understanding the behavior of fluids at rest and in motion. It forms the basis for advanced courses such as Thermal Engineering, Heat Transfer, Turbo-machinery, Computational Fluid Dynamics (CFD), and Vehicle Aerodynamics.</p> <p>This course enables students to:</p> <ul style="list-style-type: none">• Understand properties and governing principles of fluid motion.• Apply mathematical models to real-world fluid flow situations in pipes, channels, and automotive systems.• Develop analytical and problem-solving skills essential for designing cooling systems, lubrication systems, hydraulic devices, and aerodynamic components in vehicles. <p>Thus, the course bridges theory with engineering applications, preparing students for both academic progression and industry practices.</p>

Course Outcomes: At the end of the course, students will be able to:

Sr. No.	COstatement	Marks% weightage
CO-1	Explain properties of fluids and principles of fluid statics.	22%
CO-2	Apply continuity, momentum, and energy equations to solve engineering problems.	29%
CO-3	Analyze laminar and turbulent flows in pipes and channels.	27%
CO-4	Apply dimensional analysis and similitude to engineering and automotive model studies.	11%
CO-5	Demonstrate fundamentals of compressible flow and conduct fluid mechanics experiments relevant branch of engineering.	11%



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code: BE04000161

Subject Name: Fluid Mechanics

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	Total no of hours per semester		Theory		Tutorial / Practical			
						ESE (E)	PA / CA (M)	PA/CA (I)	PBL (I)	ESE (V)	
45	0	30	45	120	4	70	30	20	30	50	200

- **Problem Based Learning (PBL)** aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.

Content:

Sr.No.	Content	Total Hrs
1	Unit 1: Properties of Fluids : Concept of fluids and continuum, Properties: density, specific gravity, specific weight, Viscosity: dynamic, kinematic – significance in lubricants, Surface tension and capillarity – applications in fuel injectors, brake fluids. Compressibility, bulk modulus, vapor pressure – cavitation in pumps and cooling systems, Real-world applications: lubricants, coolants, brake fluids	5
2	Unit 2: Fluid Statics: Pressure concepts and measurement, Pascal’s law – applications in hydraulics (brakes, lifts) , Manometers and pressure gauges (U-tube, inclined, differential), Hydrostatic forces on plane and curved submerged surfaces, Buoyancy, stability of floating and submerged bodies – automotive fuel tanks, float gauges, Applications in hydraulics, brake systems, and cooling systems	5
3	Unit 3: Fluid Kinematics: Types of flow: steady/unsteady, laminar/turbulent, compressible/incompressible, Streamline, path line, streak line – visualization methods, Velocity and acceleration in fluid flow, Continuity equation in 2D and 3D flows, Applications: intake ducts, exhaust manifolds, carburetor air flow.	5
4	Unit 4: Fluid Dynamics : Euler’s equation of motion and assumptions, Bernoulli’s theorem – derivation, limitations, and assumptions, Practical applications: Venturimeter, orifice meter, pitot tube, Notches and weirs – flow measurement in test rigs, Momentum equation	7



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code: BE04000161

Subject Name: Fluid Mechanics

	and its applications – force on bends, nozzles, jet impingement, Automotive applications: carburetor venturi effect, aerodynamic pressure measurement	
5	<p>Unit 5: Dimensional Analysis & Similitude :</p> <p>Dimensional homogeneity – importance in fluid mechanics, Rayleigh’s method – basic problems, Buckingham π-theorem – systematic approach to model studies, Dimensionless numbers: Re, Fr, We, Eu, Ma – physical significance, Model laws and similarity criteria, Applications: automotive wind tunnel testing, scale modeling in aerodynamics</p>	5
6	<p>Unit 6: Laminar & Turbulent Flow :</p> <p>Reynolds’s experiment – critical Reynolds number, Hagen–Poiseuille equation for laminar flow, Velocity distribution and shear stress in laminar flow, Darcy–Weisbach equation, friction factor – flow resistance, Moody diagram – significance in design of pipes and ducts, Applications: radiator tubes, lubrication circuits, exhaust gas flow</p>	6
7	<p>Unit 7: Flow in Pipes & Channels :</p> <p>Energy losses in pipes (major and minor) – sudden expansion, contraction, bends, fittings, Hydraulic Grade Line (HGL) and Total Energy Line (TEL), Pipes in series and parallel – equivalent pipe concept, Basics of water hammer – mitigation in pipelines, Applications: coolant flow in IC engines, oil lubrication systems, HVAC ducts in vehicles</p>	6
8	<p>Unit 8: Introduction to Compressible Flow :</p> <p>Compressibility and Mach number – classification of flows, Speed of sound in fluids – dependence on medium, Stagnation properties: pressure, temperature, density, 1D isentropic flow relations – nozzle and diffuser analysis, Applications: IC engine intake/exhaust, turbochargers, supersonic aerodynamics</p>	6
TOTAL		45

Suggested Specification table with Marks(Theory):(For B.E. only)

Distribution of Theory Marks					
RLevel	ULevel	ALevel	NLevel	ELevel	CLevel
15	25	30	20	10	

R: Remembrance; U: Understanding; A: Application; N: Analyze; E: Evaluate; C: Create and above Levels (Revised Bloom’s Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code: BE04000161

Subject Name: Fluid Mechanics

Reference Books:

1. R.K. Bansal – A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications.
2. P.N. Modi & S.M. Seth – Hydraulics and Fluid Mechanics, Standard Book House.
3. White, F.M. – Fluid Mechanics, McGraw-Hill.
4. Munson, Young & Okiishi – Fundamentals of Fluid Mechanics, Wiley.
5. Som & Biswas – Introduction to Fluid Mechanics and Fluid Machines, McGraw-Hill.

List of Experiments:

1. Verification of Pascal's law and hydrostatic pressure.
2. Determination of metacentric height of a floating body.
3. Verification of Bernoulli's theorem.
4. Flow measurement using venturimeter.
5. Flow measurement using orificemeter.
6. Flow measurement using notches (V-notch/rectangular).
7. Coefficient of discharge of an orifice.
8. Reynolds's experiment for laminar and turbulent flow.
9. Determination of friction factor in pipes.
10. Measurement of head losses in fittings.
11. Velocity measurement using pitot tube.
12. Demonstration of model studies (wind tunnel / CFD if available).

Major Equipment:

- Manometers, U-tube differential manometer.
- Flow measuring devices (venturimeter, orificemeter, notches, pitot tube).
- Reynolds apparatus.
- Pipe friction apparatus with fittings.
- Metacentric height apparatus.
- Bernoulli's apparatus.
- Small-scale wind tunnel (if available).

List of Open Source Software / learning website:

1. NPTEL – Fluid Mechanics (IIT Kharagpur, IIT Madras, IIT Kanpur), <https://nptel.ac.in>
2. MIT OpenCourseWare – Fluid Mechanics, <https://ocw.mit.edu>
3. IIT Bombay Virtual Labs (Fluid Mechanics & Hydraulics), <https://vlab.co.in>
4. CFD Online (Community & Tutorials for Computational Fluid Dynamics), <https://www.cfd-online.com>
5. Engineering Toolbox – Fluid Properties & Charts , <https://www.engineeringtoolbox.com>
6. OpenFOAM (Open Source CFD Software), <https://www.openfoam.com>
7. ANSYS Student (Free version for simulations including fluid flow), <https://www.ansys.com/academic/students>



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code: BE04000161

Subject Name: Fluid Mechanics

8. Coursera / edX Courses on Fluid Mechanics & CFD, <https://www.coursera.org>. <https://www.edx.org>

9. YouTube Channels

- LearnChemE (University of Colorado Boulder)
- Mechanical Engineering NPTEL Official Channel
- Khan Academy (Basics of Fluids)

10. ResearchGate / Google Scholar – for free access to academic papers in fluid mechanics and automotive applications.

• **List of suggested activities for Problem Based Learning:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5hrs., Report preparation = 5hrs. Total = 10hrs.	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numericals based assignment is preferable.	5 assignments of 4hrs. each. Total = 20hrs.	Based on the correctness of submitted assignment.
4.	Problem solving/Coding using C, C++, MATLAB, Python, SCILAB, modeling and Analysis software or any other software	5 small coding-based assignment of 2hrs. each. Total = 10hrs.	Based on the coding solution submitted.
5.	Self-learning online course	Minimum duration of the course should be 10hrs.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Identification and solution of Complex problem	Maximum 2 problems. Study of the problem and solution finding, Total = 10hrs.	Based on the depth of the solution submitted.
7.	Videos on Industrial safety/Disaster Management aspects based on subject	Duration of video = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Based on quiz/report submitted
8.	Technical paper reading and summarization of research papers based on relevant subject	5 research papers = 20 hrs.	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 hrs.	Based on poster/chart preparation and presentation



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code: BE04000161

Subject Name: Fluid Mechanics

			skills
10	Working/non-working model on technical topics	Working = 12 hrs. Non- working = 8 hrs.	Based on inter department/external evaluation
11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/sustainability/any other issue	Duration = 15 hrs. for industrial exposure Problem identification and tentative solution = 10 hrs. Total = 20 hrs.	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging/trending technical topics based on subject	Duration = Min. 1 hr.per subject. Max. 3 hrs. per subject	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration = 10 hrs.	Depending on the complexity of the Application/Software
15.	Research paper publication	Duration = 10 hrs.	Based on submission of proof of publication
16.	Upgradation/Reverse engineering studies of existing equipment of the laboratory	Duration 10 hrs.	Based on the performance of the equipment
17.	Expert lecture/session	Duration 3 hrs. For attending the lecture/session– 2 hrs. and for report writing 1 hr.	Based on the proof of attendance and report submitted
18.	Annotated Video Explanation of Concept/Problem	10h (Preparation + Recording + Submission)	Based on accuracy of explanation, clarity, and presentation style.
19.	Patent Search and Innovation Gap Identification	10h (Search + Report)	Based on number of relevant patents analyzed and identification of innovation scope.

Note:

- All the suggested activity should be related to the subject.
- The number of hours are suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.
- Subject teacher can add the relevant activities other than those listed above, with the consent of head of the department and DQAC.
