MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	Fluid Mechanics			**Module Delivery**	
Module Type	**Core**			☒ **Theory** ☐ **Lecture** ☐ **Tutorial** ☒ **Lab** ☒ **Practical** ☐ **Seminar**	
Module Code	**PE225**				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	2		**Semester of Delivery**	4th	
Administering Department	PE		**College**	CE	
Module Leader			**e-mail**		
Module Leader's Acad. Title			**Module Leader's Qualification**		
Module Tutor			**e-mail**		
Peer Reviewer Name			**e-mail**		
Scientific Committee Approval Date			**Version Number**	1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module		**Semester**	
Co-requisites module		**Semester**	

Module Aims, Learning Outcomes and Indicative Contents اهداف المادة الدراسية ونتائج التعلم و المحتويات الارشادية	
Module Objectives اهداف المادة الدراسية	1- Provide students with a comprehensive understanding of the fundamental principles of fluid mechanics, including fluid properties, fluid statics, and fluid dynamics, as applied in engineering systems. 2- Equip students with the skills to analyze and solve problems involving internal and external fluid flows, including pipe flow, head losses, and flow networks, using mathematical and physical principles. 3- Develop students' ability to apply conservation laws (mass, momentum, and energy) to practical engineering problems, such as the design of piping systems, flow measurement, and hydraulic equipment. 4- Introduce students to flow measurement techniques and their application in real-world systems, ensuring they can evaluate and optimize system performance effectively. 5- Familiarize students with the operating principles of turbomachinery, including pumps and turbines, and their role in engineering systems like water supply and power generation. 6- Strengthen students' experimental and analytical skills through laboratory work, enabling them to link theoretical concepts with real-world observations and validate engineering solutions. 7- Prepare students for advanced engineering applications by fostering problem-solving, critical thinking, and teamwork in the context of fluid mechanics. 8- Highlight the importance of fluid mechanics in diverse engineering fields.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Identify and explain the fundamental properties of fluids, such as density, viscosity, compressibility, and surface tension, and their relevance in engineering applications. 2. Apply the principles of fluid statics to determine pressure distributions, hydrostatic forces, and buoyancy in engineering systems, including tanks, dams, and floating structures. 3. Derive and use the continuity, momentum, and energy equations (e.g., Bernoulli's equation) to analyze fluid flow in various engineering system. 4. Solve practical fluid flow problems. 5. Understand flow measurement techniques and their applications in petroleum engineering. 6. Explain the principles of boundary layer behavior, drag, and lift, and apply these concepts to the design of objects in external flows, such as vehicles or structures. 7. Demonstrate the ability to use and analyze data from flow measurement devices, such as Venturi meters, orifice plates, and Pitot tubes, in practical engineering applications. 8. Explain the operating principles of pumps and turbines, analyze their performance, and select appropriate equipment for engineering systems. 9. Solve practical and theoretical problems in fluid mechanics using analytical methods and mathematical modeling. 10. Conduct experiments to measure fluid properties, evaluate flow behavior, and validate theoretical principles through hands-on laboratory work. 11. Present technical findings from lab work and problem-solving exercises in a clear and professional manner, through written reports and oral presentations. 12. Recognize and evaluate the role of fluid mechanics in real-world engineering systems, such as oil distribution networks.

Indicative Contents المحتويات الارشادية	**Indicative Contents for Fluid Mechanics** 1. **Introduction to Fluid Mechanics** o Importance of fluid mechanics in engineering applications. o Fundamental concepts: fluid as a continuum, dimensions, and units. 2. **Fluid Properties** o Physical properties: density, viscosity, surface tension, compressibility, and vapor pressure. o Specific weight and specific gravity. o Temperature and pressure effects on fluid properties. 3. **Fluid Statics** o Pressure distribution in a static fluid. o Hydrostatic forces on submerged and curved surfaces. o Center of pressure and its applications in engineering structures. o Principles of buoyancy and stability of floating and submerged objects. 4. **Fluid Kinematics** o Description of fluid motion: streamlines, pathlines, and streaklines. o Classification of flows: steady vs. unsteady, uniform vs. non-uniform, laminar vs. turbulent. o Visualization of flow fields and patterns. 5. **Fundamentals of Fluid Dynamics** o Conservation principles: mass, momentum, and energy. o Continuity equation for steady and unsteady flows. o Bernoulli's equation: derivation, assumptions, and applications in engineering. o Energy grade line and hydraulic grade line. 6. **Internal Flows** o Laminar and turbulent flow in pipes. o Darcy-Weisbach equation and its use in determining head losses. o Friction factors and the Moody diagram. o Minor losses in pipes: effects of bends, fittings, and valves. 7. **External Flows** o Introduction to boundary layer theory and its significance. o Drag and lift forces on objects (e.g., cylinders, airfoils). o Reynolds number and its role in external flow characterization. o Applications in engineering design, such as vehicle aerodynamics and wind turbines. 8. **Dimensional Analysis and Similitude** o Buckingham Pi Theorem and its applications. o Key dimensionless numbers: Reynolds, Froude, Weber, and Mach. o Principles of similitude and model testing in engineering. 9. **Flow Measurement Techniques** o Devices: Venturi meters, orifice plates, Pitot tubes, rotameters. o Calibration and application of flow measurement tools in industrial and structural systems. 10. **Flow Networks** • Analysis of fluid flow in interconnected systems, such as piping networks. • Conservation of mass and energy in flow networks. • Hardy Cross method for pipe network analysis. • Design and optimization of flow systems for industrial and municipal applications. • Applications in water supply systems, gas pipelines, and process industries. 11. **Turbomachinery** • Introduction to pumps and turbines. • Centrifugal and axial pumps: operating principles and performance.

	• Energy transfer in turbomachinery. • Applications in water supply, power generation, and industrial processes. 12. **Laboratory Experiments** • Measuring pressure, velocity, and flow rates. • Visualization of flow patterns (e.g., streamlines, vortices). • Experimental study of pipe friction and minor losses. • Calibration of flow meters. • Pump and turbine performance analysis.

Learning and Teaching Strategies استراتيجيات التعلم و التعليم	
Strategies	1- Lectures (Interactive and Traditional) : Deliver core theoretical knowledge of fluid mechanics principles. 2- Problem-Based Learning (PBL): Develop problem-solving skills by applying theoretical knowledge to practical scenarios. 3- Laboratory Sessions: Provide hands-on experience to reinforce theoretical concepts. 4- Structured Assignments: Reinforce learning and encourage independent study.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem)	63	**Structured SWL (h/w)**	4
Unstructured SWL (h/sem)	37	**Unstructured SWL (h/w)**	2
Total SWL (h/sem)	**100**		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizz.1**	1	5% (5)	4	LO #1, #2 and #4
	Quizz.2	1	5% (5)	11	LO #5, #6 and #8
	Assignments	2	5% (5)	2 and 12	LO #1, #2 , #3, #4, #5, #6 and #9
	Projects / Lab.	2	15% (15)	7 and 12	LO #1, #2 , #4, #5, #7 and #10
	Report	2	10% (10)	Optional out of 5 dates	LO #7, #10 and #11
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 to #5
	Final Exam	3hr	50% (70)	15	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	**Introduction to Fluid Mechanics** • Overview of fluid mechanics in engineering. • Fundamental concepts: fluid as a continuum, units, and dimensions.
Week 2	**Week 2: Fluid Properties** • Density, viscosity, surface tension, and compressibility. • Specific weight and specific gravity.
Week 3	**Week 3: Fluid Statics** • Pressure distribution in static fluids. • Hydrostatic forces on submerged and curved surfaces. • Center of pressure and buoyancy.

Week 4	**Week 4: Fluid Kinematics** • Streamlines, pathlines, and streaklines. • Classification of flows: steady vs. unsteady, laminar vs. turbulent.
Week 5	**Fundamentals of Fluid Dynamics** • Conservation laws: mass, momentum, and energy.
Week 6	**Fundamentals of Fluid Dynamics** • Bernoulli's equation and its applications. • Energy grade line and hydraulic grade line.
Week 7	**Midterm Exam and Review**
Week 8	**Internal Flows** • Laminar and turbulent flow in pipes.
Week 9	**Internal Flows** • Darcy-Weisbach equation and friction factor. • Head losses in pipe systems, including minor losses.

Week 10	**Flow Networks** • Analysis of interconnected flow systems (pipe networks). • Conservation of mass and energy in flow networks. • Hardy Cross method for solving pipe networks.
Week 11	**External Flows** • Boundary layer theory. • Drag and lift forces in external flow.
Week 12	**External Flows** • Reynolds number and its engineering applications.
Week 13	**Flow Measurement Techniques** • Devices: Venturi meters, orifice plates, Pitot tubes, and rotameters. • Calibration and practical applications.
Week 14	**Pumps and Turbomachinery** • Centrifugal and axial pumps: working principles. • Pump performance curves and selection. • Applications in industrial and municipal systems.
Week 15	**Course Review and Final Exam Preparation**

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبرات

	Text	Available in the Library?
Required Texts	Curriculum and Textbook	Yes
Recommended Texts	Munson, Bruce Roy, Donald F. Young, and Theodore Hisao Okiishi. "F**undamentals of fluid mechanics**" *Oceanographic Literature Review* 10.42 (2009): 831.	
Websites	None	

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Additional Guide

The **reports** should focus on practical, experimental, and analytical topics that align with the learning outcomes and provide students with an opportunity to connect theory to practice.

Suggested Report Topics

1. **Measurement of Fluid Properties**
   - Determination of fluid density, viscosity, and surface tension.
   - Analysis of experimental results compared to theoretical predictions.
2. **Hydrostatic Pressure and Buoyancy**
   - Experimental verification of hydrostatic pressure distribution.
   - Application of buoyancy principles to analyze submerged and floating objects.
3. **Flow Measurement Techniques**
   - Use of Venturi meters, orifice plates, and Pitot tubes to measure flow rates.
   - Calibration of flow measurement devices and analysis of measurement errors.
4. **Pipe Flow and Head Losses**
   - Experimental determination of friction factor in laminar and turbulent flows.
   - Analysis of major and minor head losses in pipelines.
5. **Energy Conservation in Fluid Systems**
   - Verification of Bernoulli's equation through experiments.
   - Application to real-world scenarios like nozzles or open-channel flows.
6. **Flow Network Analysis**
   - Experimental modeling of simple flow networks.
   - Validation of mass and energy conservation principles.
7. **Pump Performance Analysis**
   - Testing of pump efficiency and performance curves.
   - Comparison between theoretical and experimental results.
8. **Boundary Layer and External Flows**
   - Analysis of drag and lift forces on objects.
   - Study of flow patterns around submerged or streamlined bodies.

Purpose of These Reports

- Enhance understanding of key fluid mechanics concepts through hands-on activities.
- Develop technical writing skills and the ability to analyze and interpret experimental data.
- Provide a platform for critical thinking and connecting theory to real-world applications.

Report Submission Schedule

1. **Report 1:**
   Topic: Measurement of Fluid Properties
   Delivery Week: Week 3
   (Covers early content: density, viscosity, and surface tension)
2. **Report 2:**
   Topic: Hydrostatic Pressure and Buoyancy
   Delivery Week: Week 5
   (Aligns with fluid statics content taught in Weeks 2–4)
3. **Report 3:**
   Topic: Pipe Flow and Head Losses
   Delivery Week: Week 9
   (Matches internal flow topics taught in Weeks 8–9)
4. **Report 4:**
   Topic: Flow Measurement Techniques
   Delivery Week: Week 10
   (Coincides with flow measurement experiments in Week 10)
5. **Report 5:**
   Topic: Pump Performance Analysis
   Delivery Week: Week 14
   (Focuses on turbomachinery, which is taught in Week 14)