MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Strength of Materials**			**Module Delivery**	
Module Type	**Core**			☒ **Theory** ☐ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**PE 224**				
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	Name (if available)		**e-mail**	E-mail	
Peer Reviewer Name	Name		**e-mail**	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	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسة ونتائج التعلم والمحتويات الإرشاد ة	
Module Objectives أهداف المادة الدراسة	1. Understand the fundamental concepts of mechanics of materials and their applications in petroleum engineering. • Define stress, strain, and deformation in materials. • Explain the relationship between stress and strain using Hooke's Law. • Understand the significance of material properties in engineering design and analysis. 2. Analyze and calculate the internal forces and stresses in structural members. • Apply equilibrium principles to determine internal forces in simple structural systems. • Calculate normal, shear, and bending stresses in beams and columns. • Determine stress distributions in statically determinate structures. 3. Determine the mechanical behavior of materials under different loading conditions. • Explain the concepts of elastic, plastic, and elastic-plastic deformation. • Analyze the stress-strain behavior of materials using stress-strain curves. • Understand the concepts of yield strength, ultimate strength, and fracture toughness. 4. Understand the behavior of materials under different temperature and environmental conditions. • Analyze the effects of temperature on material properties and behavior. • Evaluate the impact of environmental factors, such as corrosion and fatigue, on material performance. • Consider material selection criteria for specific petroleum engineering applications. 5. Develop problem-solving and critical thinking skills through practical examples and case studies. • Solve engineering problems related to the strength and stability of materials. • Apply theoretical concepts to real-world scenarios in petroleum engineering. • Analyze and interpret experimental data to validate theoretical predictions.

Module Learning Outcomes مخرجات التعلم للمادة الدراسة	By the end of the module, students will be able to: 1. Demonstrate a solid understanding of the fundamental concepts of mechanics of materials and their applications in petroleum engineering. 2. Analyze and calculate internal forces and stresses in structural members, including beams and columns, under various loading conditions. 3. Evaluate the mechanical behavior of materials, including elastic, plastic, and elastic-plastic deformation, using stress-strain relationships. 4. Apply the principles of mechanics of materials to practical engineering applications, including the analysis and design of simple structural components and systems. 5. Understand the behavior of materials under different temperature and environmental conditions, including the effects of temperature, corrosion, and fatigue. 6. Develop problem-solving and critical thinking skills through practical examples and case studies related to the strength and stability of materials. 7. Apply appropriate safety factors and design codes in engineering design and structural analysis. 8. Demonstrate effective communication of technical concepts related to the strength of materials, both in written and oral forms. 9. Work collaboratively in groups to solve engineering problems and present findings. 10. Apply theoretical knowledge to interpret and analyze experimental data related to the strength and stability of materials. 11. Recognize the importance of ethical considerations in engineering design and analysis, including considerations of safety and environmental impact.

Indicative Contents المحتويات الإرشادية	This indicative content provides a framework for the Strength of Materials module, allowing students to develop a strong foundation in the principles and applications of mechanics of materials. It enables them to analyze and design structural members, consider temperature and environmental effects, and apply their knowledge to real-world engineering scenarios. The module incorporates case studies and practical applications to enhance problem-solving skills and facilitate a deeper understanding of the subject matter. The following indicative contents outline the major topics covered throughout the 15-week duration in addition to the available lab tests: **Week 1: Introduction to Basic Concepts** ▪ Introduction to Strength of Materials ▪ Importance in Engineering Design **Week 2: Introduction Basic Concepts** ▪ Basic Definitions (Stress, Strain, Load, etc.) ▪ Types of Materials and Material Properties **Week 3: Stress and Strain** • Explain the concepts of stress and strain and their relationship. **Week 4: Stress and Strain** • Numerical Problems: Assign problem-solving exercises related to stress and strain calculations. **Week 5: Mechanical Properties of Materials** • Classification of materials based on mechanical properties • Stress-strain relationships and material behavior • Elasticity, plasticity, and viscoelasticity **Week 6: Axial Loading and Stress Analysis** • Introduction to Simple Stresses • Normal stress and strain in axial loaded members **Week 7: Axial Loading and Stress Analysis** • Stress distribution and deformation in tension and compression • Shear stress and strain in shear-loaded members **Week 8: Torsion and Torsional Deformation** • Torsional loading and shear stress distribution • Torsional deformation and stress-strain relationships • Power transmission and design considerations

	Week 9: Bending and Flexural Analysis • Introduction to bending moments and flexural stress • Bending stress distribution in beams • Moment-curvature relationships and flexural deformation **Week 10: Shear Forces and Shear Stresses in Beams** • Shear force distribution in beams • Shear stress distribution and shear flow **Week 11: Shear Forces and Shear Stresses in Beams** • Shear stress in beams of different cross-sections **Week 12: Thermal Stresses** • Thermal stresses and strains in materials • Thermal expansion and contracting in structural design **Week 13: Thermal Stresses** • Corrosion and fatigue considerations in material selection • Temperature effects in petroleum engineering structures **Week 14: Pressure vessels** • Introduction to pressure vessels • Explain the types of stresses in pressure vessels • Mode of failure in pressure vessels **Week 15: Combined Stresses and Mohr's Circle** • Principle of superposition and combined stress analysis • Mohr's circle for plane stress analysis • Analysis of complex stress states
Lab	1. **Introduction to the Strength of Materials Tests and Lab Safety** 2. **Tensile Testing** 3. **Bending and Flexural Testing** 4. **Torsion Testing**

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies الاستراتيجيات	Learning and Teaching Strategies for Strength of Materials Module (15 weeks): 1. Lectures: Conduct interactive lectures to introduce and explain key concepts, theories, and principles of strength of materials. Use visual aids, examples, and real-life applications to enhance understanding. 2. Problem-solving Sessions: Organize regular problem-solving sessions where students can apply the learned concepts to solve numerical and analytical problems related to strength of materials. Encourage group discussions and collaboration to promote critical thinking and problem-solving skills. 3. Laboratory Sessions: Conduct laboratory sessions to provide hands-on experience with material testing and analysis. Allow students to perform experiments to measure material properties, such as stress-strain behavior and mechanical properties. Emphasize proper laboratory techniques and data interpretation. 4. Workshops: Arrange workshops to address specific topics or challenging concepts in strength of materials. Provide additional guidance and support to students who may require extra assistance. Encourage active participation and discussions during these sessions. 5. Case Studies and Real-world Examples: Integrate case studies and real-world examples from the petroleum engineering industry to illustrate the practical applications of strength of materials. Discuss how materials are selected, tested, and used in various engineering scenarios. 6. Assignments and Assessments: Assign regular homework and assessments, including problem-solving exercises, case studies, and theoretical questions. Provide timely feedback to students to monitor their progress and address any misconceptions. 7. Online Resources and Learning Platforms: Utilize online resources, educational platforms, and multimedia tools to supplement classroom learning. Provide access to relevant textbooks, articles, videos, and interactive simulations for self-study and review. 8. Class Discussions and Debates: Encourage class discussions, debates, and presentations to promote active engagement and foster a deeper understanding of strength of materials. Encourage students to express their opinions, ask questions, and challenge concepts for a comprehensive learning experience.

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

Module Evaluation تقيم المادة الدراسية					
		Time/Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	4	20%	4, 7, 12 and 15	All
	Assignments	4	10%	3, 6, 11 and 14	All
	Lab Reports	3	10%	9, 10, 11, and 12	LO #1, #2, #3, #4, #5, #6, #7, #8, and #9
	Midterm Exam	2hr	10%	8	LO #1 - #7
Summative Assessment	**Final Exam**	3hr	50%		All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظر ي	
	Material Covered
Week 1	Introduction to Strength of Materials • Lecture: Provide an overview of the module and its importance in petroleum engineering. • Discussion: Engage students in a discussion on the relevance of strength of materials in the petroleum industry. • Case Study: Present a case study highlighting the role of material strength in a real-world petroleum engineering project.

Week 2	Introduction to Strength of Materials • Provide an overview of the strength of materials basic including the definition of stress, strain, load, etc.
Week 3	Stress and Strain • Explain the concepts of stress and strain and their relationship.
Week 4	Stress and Strain • Numerical Problems: Assign problem-solving exercises related to stress and strain calculations.
Week 5	Mechanical Properties of Materials • Lecture: Discuss mechanical properties such as elasticity, plasticity, and viscoelasticity. • Group Activities: Divide students into groups and assign each group a specific mechanical property to research and present to the class.
Week 6	Axial Loading and Stress Analysis • Lecture: Teach the concept of axial loading and its effect on stress distribution, as well as present an introduction to the simple stresses.
Week 7	Axial Loading and Stress Analysis • Lecture: Teach the stress distribution and deformation in tension and compression, the shear stress and strain in shear-loaded members. • Tutorial: Guide students through calculations of stress in axially loaded members.
Week 8	Torsion and Torsional Deformation • Lecture: Explain torsion and its effect on shear stress and deformation. • Problem-solving Session: Assign numerical problems related to torsion and torsional deformation. • Hands-on Activity: Provide physical models for students to manipulate and observe torsional deformation.
Week 9	Bending and Flexural Analysis • Lecture: Introduce the concept of bending moments and flexural stress, the bending stress distribution in beams, and moment-curvature relationships. • Class Discussion: Discuss the importance of flexural analysis in designing structures for the petroleum industry. • Design Project: Assign a design project where students analyze and design a beam subjected to bending loads.
Week 10	Shear Forces and Shear Stresses in Beams • Lecture: Explain the shear force distribution in beams and its relation to shear stress. • Group Activity: Divide students into groups and assign each group a specific beam configuration to analyze and calculate shear stresses.
Week 11	Shear Forces and Shear Stresses in Beams • Lecture: Explain the shear stress in beams of different cross-sections. • Case Study: Present a case study involving shear forces and stresses in a petroleum engineering structure.

Week 12	Thermal Stresses • Lecture: Discuss the effects of temperature on material behavior and structural design, as well as presents the thermal expansion and contraction in structural design.
Week 13	Thermal Stresses • Lecture: Discuss the corrosion and fatigue considerations in material selection. • Case Studies: Present case studies involving temperature effects in petroleum engineering structures.
Week 14	Pressure vessels • Lecture: Present an Introduction about the pressure vessels, explain the types of stresses in pressure vessels, and understand the failure mode in pressure vessels
Week 15	Combined Stresses and Mohr's Circle • Lecture: Teach the concept of combined stresses and introduce Mohr's circle. • Problem-solving Session: Assign problems involving the use of Mohr's circle to analyze combined stresses. • Interactive App: Utilize an interactive app or software to allow students to explore and construct Mohr's circles.

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 9	1. Introduction to Strength of Materials and Lab Safety • Lab Safety Briefing: Discuss safety protocols, equipment handling, and laboratory etiquette. • Introduction to Lab Equipment: Familiarize students with the materials testing equipment, including universal testing machines, strain gauges, and extensometers. • Demonstration: Perform a demonstration of a tensile test to showcase the equipment and measurement techniques.

Week 10	2. Tensile Testing • Pre-lab Discussion: Review the principles of tensile testing, stress-strain curves, and mechanical properties. • Lab Experiment: Conduct a tensile test on different materials, such as steel, aluminum, or polymers, to determine their mechanical properties. • Data Analysis: Guide students in analyzing the test results, calculating stress and strain, and constructing stress-strain curves.
Week 11	3. Bending and Flexural Testing • Pre-lab Discussion: Explain the principles of bending and flexural testing, moment curvature relationships, and beam behavior. • Lab Experiment: Perform bending and flexural tests on beam specimens of various materials to determine their flexural strength and stiffness. • Data Analysis: Assist students in analyzing the test data, calculating bending moments, and determining the modulus of elasticity for different materials.
Week 12	4. Torsion Testing • Pre-lab Discussion: Discuss the concepts of torsion, shear stress, shear strain, and torsional deformation. • Lab Experiment: Conduct torsion tests on cylindrical or solid specimens to measure torsional strength and shear modulus. • Data Analysis: Guide students in analyzing the test data, calculating torsional stresses and strains, and determining material properties.

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	1. A.Pytel, F.L. Singer 'Strength of Materials", 4th Edition, Harper Collins, India, 1998	No
Recommended Texts		
Websites		

Grading Scheme مخطط الدراجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتاز	90 - 100	Outstanding Performance
	B - Very Good	جد جدا	80 - 89	Above average with some errors
	C - Good	ج د	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 (قد 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.