

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information			
معلومات المادة الدراسية			
Module Title	Structural Geology		Module Delivery
Module Type	Core		☒ Theory ☒ Lecture ☒ Lab ☒ Tutorial ☐ Practical ☐ Seminar
Module Code	PE 216		
ECTS Credits	6		
SWL (hr/sem)	150		
Module Level	2	Semester of Delivery	
Administering Department	Petroleum Engineering	College	College of Engineering
Module Leader	Mohammed Mahdi Saeed	e-mail	
Module Leader's Acad. Title	Asst. Prof	Module Leader's Qualification	M.Sc
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	None	Semester	
Co-requisites module	PE226	Semester	4

Module Aims, Learning Outcomes and Indicative Contents

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Objectives أهداف المادة الدراسية	1. To understand the fundamental concepts of strike and dip and their significance in the interpretation of geological structures. 2. To develop the skills to construct and interpret geological maps, including the identification and representation of structural features. 3. To comprehend the forces and stresses acting on rocks and their role in deformation processes. 4. To apply the principles of Mohr circles and stress analysis in determining stress states and their implications for rock behavior. 5. To recognize and differentiate between various types of brittle deformation structures, such as joints and veins. 6. To gain knowledge of fault types, their classification, and their significance in the Earth's crust. 7. To understand the processes of faulting and the factors influencing fault development and displacement. 8. To interpret focal mechanisms and understand their use in determining fault orientations and earthquake mechanisms. 9. To examine the concepts and techniques of hydraulic fracturing, focusing on its application to the Marcellus Shale. 10. To analyze and interpret strain in rocks, including the measurement and characterization of deformation. 11. To comprehend the processes and characteristics of ductile deformation in rocks. 12. To identify, classify, and interpret different types of folds and understand their implications in structural geology. 13. To analyze and interpret deformation fabrics, including lineations and foliations, and their significance in rock deformation. 14. To gain knowledge of the tectonic history and processes related to the formation of the Appalachian Mountains. 15. To critically evaluate the Müller & Chapin article and understand its relevance to the broader concepts of structural geology
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	By the end of the module, students will be able to: 1. Understand and apply the concepts of strike and dip in the interpretation of geological structures. 2. Interpret and construct geological maps to represent structural features and their spatial relationships. 3. Demonstrate knowledge of forces and stresses acting on rocks and their role in deformation processes. 4. Analyze and interpret Mohr circles to determine stress states and their implications for rock behavior. 5. Identify and describe various types of brittle deformation structures, including joints and veins.

	6. Explain the formation, classification, and characteristics of faults and their role in the Earth's crust. 7. Understand the principles of faulting and the processes involved in fault development and displacement. 8. Interpret focal mechanisms to determine the orientation and nature of faulting in earthquake studies. 9. Evaluate the concepts and techniques of hydraulic fracturing, particularly in the context of the Marcellus Shale. 10. Analyze and interpret strain in rocks, including the measurement and characterization of deformation. 11. Understand the processes and characteristics of ductile deformation in rocks. 12. Identify, classify, and interpret different types of folds and their significance in structural geology. 13. Describe and interpret deformation fabrics in rocks, including lineations and foliations. 14. Analyze and understand the tectonic history and processes related to the Appalachian Mountains. 15. Critically review and discuss the Müller & Chapin article, relating it to the broader concepts of structural geology.
Indicative Contents المحتويات الإرشادية	Introduction to Structural Geology (5 hours) • Basic concepts and terminology in structural geology • Importance and applications of structural geology Strike and Dip (10 hours) • Definition and measurement of strike and dip • Stereonets and their use in representing orientation data • Interpretation of strike and dip in geological structures Geological Maps and Cross-Sections (15 hours) • Interpretation and construction of geological maps • Techniques for creating cross-sections and their interpretation • Integration of maps and cross-sections for structural analysis Forces and Stress (15 hours) • Types of forces acting on rocks • Stress tensors and their components • Stress analysis and determination of principal stresses Mohr Circles and Rock Mechanics (10 hours) • Construction and interpretation of Mohr circles • Applications of Mohr circles in rock mechanics • Strength properties of rocks and failure criteria Brittle Deformation: Joints and Veins (15 hours) • Formation and classification of joints

	• Vein formation and types of veins • Analysis and interpretation of joint and vein patterns Faults and Faulting (20 hours) • Types of faults and fault classification • Fault geometry, kinematics, and displacement • Structural analysis of fault zones Focal Mechanisms and Earthquakes (10 hours) • Focal mechanism solutions and their interpretation • Relationship between focal mechanisms and faulting • Applications of focal mechanisms in earthquake studies Hydraulic Fracturing and Marcellus Shale (10 hours) • Introduction to hydraulic fracturing techniques • Application of hydraulic fracturing in the extraction of Marcellus Shale gas • Environmental considerations and challenges Strain and Ductile Deformation (20 hours) • Types of strain and measurement techniques • Rheology of rocks and ductile deformation processes • Analysis and interpretation of ductile structures Folds and Fold Analysis (20 hours) • Types of folds and fold classification • Fold geometry, anatomy, and terminology • Techniques for fold analysis and interpretation Deformation Fabrics and Tectonic Fabrics (15 hours) • Lineations and foliations in deformed rocks • Fabric analysis techniques and interpretation • Tectonic fabrics and their significance Appalachian Tectonics (10 hours) • Overview of the tectonic history of the Appalachian Mountains • Structural features and geological evolution of the Appalachian region Müller & Chapin Article (10 hours) • Reading and critical analysis of the selected article • Discussion of the article's contribution to structural geology Review and Integration (10 hours) • Recapitulation of key concepts and topics covered in the module • Integration of knowledge and skills through practical exercises and case studies Preparation for assessments and final evaluation
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Learning and Teaching Strategies

استراتيجيات التعلم والتعليم

Strategies	Lectures: Provide interactive lectures to introduce and explain key concepts, theories, and principles of structural geology. Use visual aids, diagrams, and real-life examples to enhance understanding. Practical Exercises: Include hands-on activities, such as measuring strike and dip, analyzing geological maps, and interpreting cross-sections. Encourage students to apply their knowledge and skills to solve practical problems. Laboratory Work: Conduct lab sessions where students can analyze rock samples, study structural features, and interpret deformation fabrics. Promote teamwork, data analysis, and critical thinking skills. Field Trips: Organize field trips to examine geological structures in real-world settings. Allow students to observe and analyze different rock formations, faults, folds, and other structural features. Group Discussions: Foster group discussions and debates on topics like hydraulic fracturing, tectonic events, and geological interpretations. Encourage students to share their perspectives and engage in critical thinking. Research Projects: Assign research projects that require students to investigate specific topics within structural geology. Encourage them to gather data, analyze information, and present their findings to the class. Assessment Methods: Use a variety of assessment methods, including quizzes, exams, practical assignments, research papers, and presentations. This allows students to demonstrate their understanding of both theoretical and practical aspects of structural geology. Online Resources: Provide access to online resources, such as interactive tutorials, video lectures, and virtual field trips, to support independent learning and provide additional study materials. Office Hours: Offer regular office hours where students can seek clarification, discuss questions, and receive individualized guidance on their studies.
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Student Workload (SWL)

الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا

Structured SWL (h/sem) الحمل الدراسي المنتظم للطلاب خلال الفصل	78	Structured SWL (h/w) الحمل الدراسي المنتظم للطلاب أسبوعيا	5
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطلاب خلال الفصل	72	Unstructured SWL (h/w) الحمل الدراسي غير المنتظم للطلاب أسبوعيا	5
Total SWL (h/sem) الحمل الدراسي الكلي للطلاب خلال الفصل	150		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	2	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	1	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	Midterm Exam	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Introduction to Structural Geology
Week 2	Forces and Stress
Week 3	- Mohr Circles and Rock Mechanics - Brittle Deformation: Joints & Veins
Week 4	- Faults and Faulting - Focal Mechanisms and Earthquakes
Week 5	- Hydraulic Fracturing and Marcellus Shale - Strain and Ductile Deformation
Week 6	- Folds and Fold Analysis - Deformation Fabrics and Tectonic Fabrics
Week 7	- Appalachian Tectonics - Müller & Chapin Article Discussion
Week 8	Review and Integration

Week 9	Case Studies in Structural Geology
Week 10	Field Trip or Virtual Field Experience
Week 11	Guest Speaker Session on Current Research in Structural Geology
Week 12	Practical Exercises and Data Analysis
Week 13	Student Presentations on Research Projects
Week 14	Exam Preparation and Revision
Week 15	Final Exam or Assessment

Delivery Plan (Weekly Lab. Syllabus) المناهج الاسبوعي للمختبر	
	Material Covered
Week 1,2	- Introduction to Lab Equipment and Safety - Measurement of Strike and Dip
Week 3,4	- Geological Mapping Techniques - Interpretation of Geological Maps
Week 5,6	- Mohr Circle Construction and Analysis - Measurement of Stress Components
Week 7,8	- Analysis of Joints and Veins in Rocks - Identification of Faults in Rock Samples
Week 9,10	- Measurement and Analysis of Strain - Interpretation of Ductile Deformation Structures
Week 11,12	Focal Mechanism Analysis using Data
Week 13-15	- Analysis of Folds in Rock Samples - Identification and Interpretation of Deformation Fabrics

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	Available in the Library?
Required Texts	Structural Geology (Haakon Fossen, 2nd Edition, 2016)	No
Recommended Texts	Structural Geology (Marland P. Billings, 3rd Edition), 1976	No
Websites		

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.				