

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information				
معلومات المادة الدراسية				
Module Title	Nodal Analysis		Module Delivery	
Module Type	Core		☒ Theory ☒ Lecture ☐ Lab ☒ Tutorial ☐ Practical ☐ Seminar	
Module Code	PE322			
ECTS Credits	4			
SWL (hr/sem)				
Module Level	3	Semester of Delivery		5
Administering Department	Petroleum Engineering	College	College of Engineering	
Module Leader	Raed H. Allawi		e-mail	raed.Allawi@alayen.edu.iq
Module Leader's Acad. Title		Module Leader's Qualification	Ph.D.	
Module Tutor	Raed H. Allawi		e-mail	raed.Allawi@alayen.edu.iq
Peer Reviewer Name		e-mail		
Scientific Committee Approval Date		Version Number	1.0	

Relation with other Modules			
العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	PE225	Semester	
Co-requisites module	None	Semester	



Module Aims, Learning Outcomes and Indicative Contents

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Objectives أهداف المادة الدراسية	This course aims to provide students with a comprehensive understanding of nodal system analysis as a method for optimizing petroleum production systems. It will equip students with the technical skills required to evaluate well performance by determining IPR and VLP, diagnose production constraints, and design efficient reservoir-to-surface flow systems.		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	Knowledge	A2	A2. Explain the principles of nodal analysis and its significance in petroleum production. A2.2 Describe reservoir inflow performance and its relationship to wellbore dynamics. A2.3 Identify factors influencing pressure losses and flow constraints in production systems
		B1	B1.1 . Understand the role of multiphase flow correlations in nodal analysis. B1.2 Recognize key elements of artificial lift and production system optimization. Intellectual Skills
	Skills	B2	B2.1 . Analyze production system behavior using nodal analysis techniques B2.2 Evaluate and select appropriate multiphase flow models for different field conditions.
		C2	C2.1 Using nodal analysis software to model and optimize petroleum production systems. C2.2 Applying troubleshooting techniques to identify and resolve production issues
Indicative Contents المحتويات الإرشادية	• Introduction to Nodal Analysis. • Reservoir inflow performance. • Fundamentals of fluid flow – Single-phase and multiphase flow in pipes. • Wellbore dynamics – Tubing performance and vertical flow considerations. • Pressure distribution in production systems – Identifying pressure losses. • Multiphase flow correlations – Choosing appropriate models for various conditions. • Gradient curves. • Production optimization using nodal system analysis. • Production system integration – Coupling reservoir, wellbore, and surface facilities. • Sensitivity analysis and decision-making		

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Learning and Teaching Strategies

استراتيجيات التعلم والتعليم

Strategies	Teaching and Learning Strategies:
	1. Lectures with Visual Aids
	- Short, focused lectures using slides, diagrams, and videos
	- Emphasis on real-world engineering relevance to maintain student engagement.
	2. Interactive Discussions
	- Encourage student participation through Q&A, discussions on petroleum engineering problems related to well testing
	3. Case Study-Based Learning
	- Presentation of real-world engineering projects (e.g., well testing design and computer assisted well test analysis)
	- Group analysis and discussion of success or failure factors.
	4. Formative Assessment Activities
	• - Quick in-class quizzes

Student Workload (SWL)

الحمل الدراسي للطلاب محسوب لـ ١٥ اسبوعا

Structured SWL (h/sem) الحمل الدراسي المنتظم للطلاب خلال الفصل	48	Structured SWL (h/w) الحمل الدراسي المنتظم للطلاب أسبوعيا	3
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطلاب خلال الفصل	52	Unstructured SWL (h/w) الحمل الدراسي غير المنتظم للطلاب أسبوعيا	3.5
Total SWL (h/sem) الحمل الدراسي الكلي للطلاب خلال الفصل	100		

Module Evaluation

تقييم المادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	10% (10)	5 and 10	A2
	Assignments	2	10% (10)	2 and 12	A2
	Projects	1	10% (10)	Continuous	B2
	Report	1	10% (10)	13	A2
Summative	Midterm Exam	1hr	10% (10)	7	A2

assessment	Final Exam	3hr	50% (50)	16	all
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المناهج الاسبوعي النظري		
	Material Covered	LOs
Week 1	Introduction to nodal analysis - Definition and significance in petroleum production - Overview of production system components	A2, B1, B2, C2
Week 2&3	Reservoir Performance: - Drive mechanism - Well performance equations: Darcy's Law, Productivity Index, Factors Affecting IPR - IPR behavior of gas wells	A2, B1, B2, C2
Week 4&5	Reservoir Performance: - Prediction IPR for oil wells: Vogle, standing, Fetkovich, ... methods - Predicting Future IPR for Oil wells: standing, Fetkovich, combining standing and Fetkovich methods - Predicting IPR for gas wells: Back pressure equation, Blount and Glaze Method. - Predicting Future IPR for Gas wells	A2, B1, B2, C2
Week 6&7	Fluid Flow in Tubing: - Single phase flow - Multiphase flow fundamentals and behavior	A2, B1, B2, C2
Week 8&9	Pressure Losses and Flow Restrictions in Production System: - Sources of pressure losses (friction, elevation, etc.) - Methods for estimating pressure drops	A2, B1, B2, C2
Week 10&11	Multiphase Flow Correlations and Applications: - Selection of appropriate multiphase flow models - Flow pattern identification and impact on performance	A2, B1, B2, C2
Week 12	Fluid flow in chokes and restrictions	A2, B1, B2, C2
Week 13	Calculating Pressure Using Gradient Curves	A2, B1, B2, C2
Week 14	Well Optimization Using Nodal Analysis: - Methods for improving well productivity	A2, B1, B2, C2
Week 15	Production System Integration: - Coupling reservoir, wellbore, and surface facilities - Holistic approach to production optimization Sensitivity analysis and decision-making: - Evaluating the impact of changing operational conditions Optimizing system performance through parameter adjustments	A2, B1, B2, C2

Delivery Plan (Weekly Lab. Syllabus)	
المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	
Week 2	

Learning and Teaching Resources		
مصادر التعلم والتدريس		
	Text	Available in the Library?
Required Texts	Production Optimization Using Nodal Analysis (2nd Edition)" by H Dale Beggs -- 2nd ed, Tulsa, Okla,	No
Recommended Texts	"Nodal Analysis of Oil and Gas Production Systems" Textbook -- Jan Dirk Jansen -- 2020 -- Society of Petroleum Engineers -	No
Websites	https://onepetro.org/books/search-results?page=1&q=&fl_SiteID=5&allBooks=1	

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.				