

MODULE DESCRIPTION

وصف المادة الدراسية

Module Information					
معلومات المادة الدراسية					
Module Title	Data Analytics and Artificial Intelligence		Module Delivery		
Module Type	Core		☒ Theory ☒ Lecture ☐ Lab ☒ Tutorial ☒ Practical ☒ Seminar		
Module Code	PE321				
ECTS Credits	3				
SWL (hr/sem)	75				
Module Level		3	Semester of Delivery		2
Administering Department		Petroleum Engineering		Type College Code	
Module Leader	Husham Hadi Nghamish		e-mail	Hisham.Hadi@alayen.edu.iq	
Module Leader's Acad. Title		Msc	Module Leader's Qualification		Msc
Module Tutor	Husham Hadi Nghamish		e-mail	Hisham.Hadi@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	PE223	Semester	
Co-requisites module	None	Semester	



Module Aims, Learning Outcomes and Indicative Contents				
Module Objective s	- Introduce fundamental concepts of data analytics and AI in engineering applications. - Develop skills in data processing, visualization, and predictive modeling. - Apply machine learning techniques to engineering problem-solving. Familiarize students with Python programming for data-driven engineering analysis.			
	Module Learning Outcome s	Knowledge	A1	A1-1 define fundamental concepts of data analytics, machine learning, and AI applications in engineering, including data types, preprocessing techniques, and basic Python tools. A1-2 choose the appropriate tool and machine learning methods to analyze engineering data and develop predictive models for engineering applications. A1-3 analyze data visualization methods, statistical analysis techniques, and the principles of supervised and unsupervised learning in engineering contexts. A1-4 design a program using python for different case study related to engineering applications.
			A2	A2-1 Recall fundamental concepts of data analytics, machine learning, and AI applications in engineering, including data types, preprocessing techniques, and basic Python tools. A2-2 classify data visualization methods, statistical analysis techniques, and the principles of supervised and unsupervised learning in engineering contexts. A2-3 Apply Python-based tools and machine learning methods to analyze engineering data and develop predictive models for engineering applications.
		Skills	B1	B1.1 Function efficiently as an individual Perform anatomical dissections and identify structures efficiently as an individual. B1.2 Function as a member of a team during laboratory sessions and clinical seminars.
			B2	B2.1 Communicate effectively – graphically with a range of audiences using contemporary tools. B2.2 Communicate verbally and in writing with a range of audiences using contemporary tools.
		Ethics	C2	C1-1: Commit to quality standards. C1-2: Adhere to deadlines. C1-3: Strive for continuous improvement.

Indicative Contents	➤ Fundamentals of Data Analytics • Introduction to data-driven decision-making in engineering. • Types of engineering data: sensor data, experimental data, and simulation outputs. • Data preprocessing: cleaning, filtering, and handling missing values. • Introduction to Python for data analytics. ➤ Data Visualization and Statistical Analysis • Exploratory data analysis using Matplotlib, Seaborn, and Pandas. • Descriptive statistics: mean, variance, correlation, and regression. • Inferential statistics: hypothesis testing and confidence intervals. • Case studies on engineering data analysis. ➤ Machine Learning Fundamentals for Engineers Overview of supervised and unsupervised learning. • Regression models for predictive maintenance and system optimization. • Clustering techniques for pattern recognition in engineering data. • Decision trees and neural networks for automated decision-making. ➤ AI Applications In Engineering • AI-driven fault detection and anomaly prediction. • Machine learning for process optimization and automation. • AI-based control systems and robotics. • Case studies on successful AI applications in engineering. ➤ Python Programming for AI in Engineering • Introduction to NumPy, Pandas, and Scikit-learn. • Building predictive models for engineering systems. • Automating workflows for data-driven engineering analysis. Hands-on projects using real engineering datasets.
	• Regression models for predictive maintenance and system optimization. • Clustering techniques for pattern recognition in engineering data. • Decision trees and neural networks for automated decision-making. ➤ AI Applications in Engineering • AI-driven fault detection and anomaly prediction. • Machine learning for process optimization and automation. • AI-based control systems and robotics. • Case studies on successful AI applications in engineering. ➤ Python Programming for AI In Engineering • Introduction to NumPy, Pandas, and Scikit-learn. • Building predictive models for engineering systems. • Automating workflows for data-driven engineering analysis. • Hands-on projects using real engineering datasets.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Assessment is based on hand-in assignments, written exam, Case study, Quizzes, seminars, Practical testing and Online testing.

Student Workload (SWL) الحمل الدرايس للطلاب محسوب ل ٥١ أسبوعا			
Structured SWL (h/sem) الحمل الدرايس المنتظم للطلاب خلال الفصل	48	Structured SWL (h/w) الحمل الدرايس المنتظم للطلاب أسبوعيا	1.56
Unstructured SWL (h/sem) الحمل الدرايس غير المنتظم للطلاب خلال الفصل	27	Unstructured SWL (h/w) الحمل الدرايس غير المنتظم للطلاب أسبوعيا	2.77
Total SWL (h/sem) الحمل الدرايس الكلي للطلاب خلال الفصل	75		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	10% (10)	5 and 10	A1,A2
	Assignments	2	10% (10)	2 and 12	A1.A2.B1.B2.C2
	Projects	1	10% (10)	Continuous	A1.A2.B1.B2.C2
	Report	1	10% (10)	13	A1.A2.B1.B2.C2
Summative assessment	Midterm Exam	2hr	10% (10)	7	A1.A2.
	Final Exam	3hr	50% (50)	16	A1.A2
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)		
	Material Covered	LOs
Week 1-3	➤ Fundamentals of Data Analytics • Introduction; Types of engineering data; Data preprocessing; Introduction to Python for data analytics.	A1.1-A1.2-A1.3 B1.1
Week 4-6	➤ Data Visualization and Statistical Analysis • Exploratory data analysis using Matplotlib, Seaborn, and Pandas; Descriptive statistics; Inferential statistics; Case studies on petroleum engineering data analysis.	A2.1-A2.1-A2.3 B1.1-B1.2

Week 7-9	➤ Machine Learning Fundamentals for Engineers	A1.1-A1.2-A1.3 B1.1- B1.1-B1.2
	Overview of supervised and unsupervised learning; Regression models for predictive maintenance and system optimization; Clustering techniques for pattern recognition in engineering data; Decision trees and neural networks for automated decision-making.	A1.1-A1.2-A1.3 B1.1- B1.1-B1.2
Week 10-12	➤ AI Applications in Engineering AI-driven fault detection and anomaly prediction; Machine learning for process optimization and automation; AI-based control systems and robotics; Case studies on successful AI applications in engineering.	A1.1-A1.2-A1.3-A1.4 B1.1- B1.2-C1.1-C1.2-C1.3
Week 13-15	➤ Python Programming for AI in Engineering (Weeks 13-15) Introduction to NumPy, Pandas, and Scikit-learn; Building predictive models for engineering systems; Automating workflows for data-driven engineering analysis; Hands-on projects using real engineering datasets.	A1.1-A1.2-A1.3-A1.4 B1.1- B1.2-C1.1-C1.2-C1.3

Learning and Teaching Resources		
مصادر التعلم والتدريس		
	Text	Available in the Library?
Required Texts	Fundamentals of Machine Learning for Predictive Data Analytics, John D. Kelleher, Brian Mac Namee and Aoife D'Arcy; The MIT Press, July 24, 2015	Yes
Recommended Texts	Data Mining and Machine Learning: Fundamental Concepts and Algorithms, Mohammed J. Zaki, Wagner Meira Jr, Cambridge University Press, 2020	Yes
Websites	https://eng.alayen.edu.iq/colleges/e/42	

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 (فيد 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.