

MODULE DESCRIPTION FORM

Module Information			
Module Title	Mathematics IV		Module Delivery
Module Type	Core		☒ Theory ☒ Lecture ☐ Lab ☒ Tutorial ☐ Practical ☐ Seminar
Module Code	PE223		
ECTS Credits	5		
SWL (hr/sem)	125 H/Sem.		
Module Level	2	Semester of Delivery	4
Administering Department	Petroleum Engineering	College	College of Engineering
Module Leader	Hussam Wheed Maktooff	e-mail	h564127@gmail.com
Module Leader's Acad. Title	Assistant lecture	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			
Prerequisite module	Mathematics III (PE213)	Semester	3
Co-requisites module	Engineering Analytics (PE313)	Semester	5

Module Aims, Learning Outcomes and Indicative Contents	
Module Objectives	1. This module is an important module that should be taken by students in mathematics, engineering, and natural science. It represents the Infinite Series, which give students precise ways to express many numbers and functions as arithmetic sums with infinitely many terms. Partial derivatives and multiple integrals are then covered in this module. An introduction to the order and degree of ordinary differential equations, and types and solutions of 1st order differential equations are also presented. 2. Enable the student to know many types of infinite sequences and infinite series and which of them are converged or diverged. 3. Understand the representation of functions as power series and study their

	radius and interval of convergence. 4. Learn how infinite series are used in approximation of functions, solving differential equations, and in numerical methods (e.g., Taylor series expansion). 5. Learn how to deal with functions of more than one variable and understand how changes in each variable affect the function. 6. Learn how to interpret the meaning of partial derivatives in real-world contexts, such as in physics (rate of change of temperature, pressure, etc.). Learn the definition of a double integral and understand how it extends the concept of a single integral to two dimensions. 7. Understand how to set up and evaluate double integrals over rectangular and more general regions (non-rectangular regions) in the xy-plane. 8. Introduce the order and degree of differential equations and solving 1st order DE using different methods.		
Module Learning Outcomes	Knowledge	A2	A2.1 Define the basic concepts of sequences, infinite series, and convergence and divergence properties. A2.2 Classify of types of ordinary first-order differential equations. A2.3 Apply Power, Taylor, and Maclaurin series to solve equations. A2.3 Solve various types of first-order ordinary differential equations.
	Skills	B1	B1.1 Communicate effectively B1.2 Students will have developed problem solving and reasoning abilities that will serve them well in many important petroleum engineering aspects as well as their lives.
		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	C2.1 Recognize professional and ethical responsibility. C2.2 Adhere and respect diversity.

Indicative Contents	Indicative content includes the following.		
	Unit 1: Infinite Sequences and Series, Sequences, Infinite Series, The Integral Test, Comparison Tests, Absolute Convergence, The Ratio and Root Tests, Alternating, Series and Conditional Convergence, Power Series, Taylor and Maclaurin Series		
	Convergence of Taylor Series, The Binomial Series and Applications of Taylor Series [8 hours].		
	Unit 2: Functions of Several Variables, Limits and Continuity in Higher Dimensions, The Chain Rule, Directional Derivatives and Gradient Vectors, Tangent Planes and Differentials, Extreme Values and Saddle Points, Lagrange Multipliers, Taylor’s Formula for Two Variables, Partial Derivatives with Constrained Variables [8 hours].		
	Unit 3: Double Integral, Double and Iterated Integrals over Rectangles, Double Integrals over General Regions, Area by Double Integration, Double Integrals in Polar Form [6 hours].		
Strategies	Unit 4: First-Order Differential Equations, Introduction to Ordinary and, Partial Differential Equations (order and degree), Types and Solutions of 1st Order LDE [6 hours].		
	Learning and Teaching Strategies		
	• Presentation • Interactive learning • Discussions • Brainstorming • Group Solving Problems • Problem-Based Learning • Self-learning		
	Student Workload (SWL) for 15 weeks		
	Structured SWL (h/sem)	77	Structured SWL (h/w)
Unstructured SWL (h/sem)	48	Unstructured SWL (h/w)	3.2
Total SWL (h/sem)	125		

Module Evaluation

تقييم المادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	10% (10)	5 and 10	A2
	Interaction within the class	All	10% (10)	All	A2
	Assignments	2	10% (10)	4 and 10	A2,B1,B2
	Projects / Lab.				
	Report	1	10% (10)	13	A2
Summative assessment	Midterm Exam	1hr	10% (10)	14	A2,B1
	Final Exam	3hr	50% (50)	15	A2
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered	LOs
Week 1	Infinite Sequences and Series - Sequences - Infinite Series	A2, B1, B2, C1
Week 2	Infinite Sequences and Series - The Integral Test - Comparison Tests	A2, B1, B2, C2
Week 3	Infinite Sequences and Series - Absolute Convergence; The Ratio and Root Tests - Alternating Series and Conditional Convergence	A2, B1, B2, C1
Week 4	Infinite Sequences and Series - Power Series - Taylor and Maclaurin Series	A2, B1, B2, C1
Week 5	Infinite Sequences and Series - Convergence of Taylor Series - The Binomial Series and Applications of Taylor Series	A2, B1, B2, C1
Week 6	Partial Derivatives - Functions of Several Variables - Limits and Continuity in Higher Dimensions	A2, B1, B2, C1
Week 7	Partial Derivatives - The Chain Rule - Directional Derivatives and Gradient Vectors	A2, B1, B2, C1
Week 8	Partial Derivatives Tangent Planes and Differentials	A2, B1, B2, C1

	• Extreme Values and Saddle Points	
Week 9	Partial Derivatives • Lagrange Multipliers • Taylor's Formula for Two Variables • Partial Derivatives with Constrained Variables	A2, B1, B2, C1
Week 10	Multiple Integrals • Double Integral • Double and Iterated Integrals over Rectangles	A2, B1, B2, C1
Week 11	Multiple Integrals • Double Integrals over General Regions	A2, B1, B2, C1
Week 12	Multiple Integrals • Area by Double Integration	A2, B1, B2, C1
Week 13	Multiple Integrals • Double Integrals in Polar Form	A2, B1, B2, C1
Week 14	First-Order Differential Equations • Introduction to Ordinary and Partial Differential Equations • Order and Degree of Ordinary Differential Equations	A2, B1, B2, C1
Week 15	First-Order Differential Equations • Types and Solutions of 1st Order LDE	A2, B1, B2, C1

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	1. "Thomas Calculus" G. Thomas, M. Weir, et al., 13th edition, 2024.	Yes
Recommended Texts	Non	No
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 (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.