

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information			
معلومات المادة الدراسية			
Module Title	Mathematical Modeling Systems		Module Delivery
Module Type	Basic		☒ Theory ☐ Lecture ☐ Lab ☒ Tutorial ☐ Practical ☐ Seminar
Module Code	ATU11304		
ECTS Credits	5		
SWL (hr/sem)	125		
Module Level	UGII	Semester of Delivery	1
Administering Department		College	NETC
Module Leader	Asaad. S. Daghal	e-mail	ad466kent@atu.edu.iq
Module Leader's Acad. Title	Assist. Prof.	Module Leader's Qualification	Ph.D.
Module Tutor	Name (if available)	e-mail	E-mail
Peer Reviewer Name	Nasir Hussein Selman	e-mail	Coj.nas@atu.edu.iq
Scientific Committee Approval Date	01/10/2024	Version Number	1.0

Relation with other Modules			
العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	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	1- To understand functions of multiple variables, limits, continuity, and partial derivatives. 2- To apply the chain rule, directional derivatives, and gradients. 3- To determine tangent planes, normal vectors, and extrema of functions in two variables. 4- To work with polar, cylindrical, and spherical coordinates. 5- To understand vectors in 3D space, including dot and cross products. 6- To evaluate double and triple integrals over various regions. 7- To apply convergence tests to infinite series. 8- To approximate functions with Maclaurin and Taylor polynomials. 9- To explore power series and their applications.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1- Understanding functions of multiple variables 2- Computing partial derivatives 3- Applying the chain rule in multivariable calculus 4- Calculating directional derivatives and gradients of functions 5- Determining tangent planes and normal vectors to surfaces 6- Finding maxima and minima of functions of two variables 7- Working with polar coordinates and graphing polar equations 8- Calculating areas and lengths in polar coordinates 9- Understanding conic sections and their representation in polar coordinates 10- Working in three-dimensional space 11- Understanding vectors, dot product, cross product, and their applications 12- Describing lines and planes using parametric equations 13- Understanding quadric surfaces and working with cylindrical and spherical coordinates 14- Evaluating double integrals over various regions 15- Calculating surface area and working with parametric surfaces 16- Computing triple integrals in different coordinate systems 17- Applying change of variables and understanding Jacobians in multiple integrals 18- Understanding sequences and series 19- Applying convergence tests and analyzing convergence properties 20- Approximating functions using Maclaurin and Taylor polynomials 21- Understanding power series and their convergence properties 22- Modeling with the Taylor series for various applications
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. 1- Multivariable Calculus: (25 h) • Functions of Two or More Variables • Limits and Continuity • Partial Derivatives • Directional Derivatives and Gradients • Tangent Planes and Normal Vectors 2- Optimization and Extrema: (9 h) • Maxima and Minima of Functions of Two Variables • Lagrange Multipliers 3- Coordinate Systems and Vectors: (25 h) • Polar Coordinates • Cylindrical and Spherical Coordinates • Matrices and Determinants • Vectors in Three-Dimensional Space • Dot Product and Cross Product 4- Multiple Integrals: (25 h) • Double Integrals • Triple Integrals

	• Change of Variables in Multiple Integrals • Surface Area and Volume Calculations 5- Infinite Series and Sequences: (25 h) • Convergence and Divergence • Taylor and Maclaurin Series • Power Series • Applications of Taylor Series
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Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Use the following Learning, Teaching, and Assessment strategies Learning Strategies: • Encourage students to actively engage with the material through problem-solving, discussions, and group activities. • Use visual aids like graphs, diagrams, and interactive simulations to help students grasp complex concepts in multivariable calculus and vector calculus. • Connect calculus concepts to real-world scenarios to demonstrate their practical relevance and enhance understanding. • Conduct engaging lectures that involve student participation, discussions, and demonstrations to keep students actively involved. • Incorporate hands-on activities, such as working with software tools for graphing or numerical calculations, to reinforce learning. • Assign challenging problems that require critical thinking and problem-solving skills, promoting a deeper understanding of the material. • Use formative assessments like quizzes, homework assignments, and in-class exercises to provide feedback and monitor student progress. • Present case studies or application problems that require students to apply calculus concepts to analyze and solve real-world problems. • Incorporate peer evaluation in group activities or projects to promote collaboration and peer learning. By incorporating these strategies into the learning and teaching process, students can develop a solid understanding of advanced calculus topics and enhance their problem-solving skills in multivariable calculus, vector calculus, and series expansions.

Student Workload (SWL) الحمل الدراسي للطلاب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطلاب خلال الفصل	63	Structured SWL (h/w) الحمل الدراسي المنتظم للطلاب أسبوعيا	4.2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطلاب خلال الفصل	62	Unstructured SWL (h/w) الحمل الدراسي غير المنتظم للطلاب أسبوعيا	4.1
Total SWL (h/sem) الحمل الدراسي الكلي للطلاب خلال الفصل	125		

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
	Homework	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	Functions of Two or More Variables, Limits and Continuity, Partial Derivatives
Week 2	The Chain Rule, Directional Derivatives and Gradients.
Week 3	Tangent Planes and Normal Vectors, Maxima and Minima of Functions of Two Variables, Lagrange Multipliers.
Week 4	Polar Coordinates, Graphing Polar Coordinate Equations, Areas and Lengths in Polar Coordinates
Week 5	Conic Sections, Conics in Polar Coordinates
Week 6	THREE-DIMENSIONAL SPACE; VECTORS: Rectangular Coordinates in 3-Space
Week 7	Spheres; Cylindrical Surfaces, Vectors, The Dot Product, The Cross Product
Week 8	Parametric Equations of Lines, Planes in 3-Space, Quadric Surfaces, Cylindrical and Spherical Coordinates
Week 9	MULTIPLE INTEGRALS: Double Integrals, Double Integrals over Nonrectangular Regions,
Week 10	Double Integrals in Polar Coordinates, Surface Area; Parametric Surfaces
Week 11	Triple Integrals, Triple Integrals in Cylindrical and Spherical Coordinates, Change of Variables in Multiple Integrals; Jacobians
Week 12	INFINITE SERIES: Sequences, Monotone Sequences, Infinite Series, Convergence Tests
Week 13	The Comparison, Ratio, and Root Tests, Alternating Series; Absolute and Conditional Convergence
Week 14	Maclaurin and Taylor Polynomials, Maclaurin and Taylor Series; Power Series
Week 15	Convergence of Taylor Series, Differentiating and Integrating Power Series; Modeling with Taylor Series
Week 16	Final Exam

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	Available in the Library?
Required Texts	Thomas' Calculus 14 th edition	Yes
Recommended Texts	Calculus 10 th edition by Anton , Bivens , and Davis	Yes
Websites	https://www.lboro.ac.uk/departments/mlsc/student-resources/helm-workbooks/	

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.				