MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Advanced calculus**			**Module Delivery**	
Module Type	**Core**			☒**Theory** ☒**Lecture** ☒**Lab** ☐**Tutorial** ☐**Practical** ☐**Seminar**	
Module Code	**MATH201**				
ECTS Credits	٤				
SWL (hr/sem)	٦٠				
Module Level			**Semester of Delivery**	1	
Administering Department	Type Dept. Code		**College**	Type College Code	
Module Leader	*Akil Jassim Harfash*		**e-mail**	E-mail akil.harfash@uobasrah.edu.iq	
Module Leader's Acad. Title	Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	*Akil Jassim Harfash*		**e-mail**	E-mail akil.harfash@uobasrah.edu.iq	
Peer Reviewer Name	Name		**e-mail**	E-mail	
Scientific Committee Approval Date	17/06/2023		**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 develop advanced calculus problem-solving skills. 2. To understand the derivation of multivariate states. 3. This course deals with the basic concepts of multiple integrals. 4. Includes a thorough understanding of vectors and their applications. 5. It includes studies of surface and linear integrals. 6. It also includes the study of basic integration theories.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	Here are some common learning outcomes that are typically covered in an Advanced Calculus course: 1. Understanding of Mathematical Rigor: Develop a solid foundation in mathematical proof techniques, including logical reasoning, theorem formulation, and proof writing skills. 2. Limits and Continuity: Gain a deeper understanding of the concept of limits and continuity, including the ability to evaluate limits using various techniques, such as L'Hôpital's rule. 3. Differentiation: Extend knowledge of differentiation to more advanced topics, such as partial derivatives, implicit differentiation, and higher-order derivatives. Apply differentiation techniques to solve problems involving optimization, related rates, and curve sketching. 4. Integration: Explore advanced techniques of integration, such as integration by parts, trigonometric substitutions, partial fraction decomposition, and improper integrals. Apply integration methods to compute areas, volumes, and arc lengths. 5. Sequences and Series: Study the convergence and divergence of sequences and series, including the use of tests, such as the comparison test, ratio test, and integral test. Understand power series and Taylor series expansions. 6. Vector Calculus: Introduce the concepts of vector-valued functions, including differentiation and integration of vectors. Study vector fields, line integrals, surface integrals, and the theorems of Green, Gauss, and Stokes. 7. Multivariable Calculus: Extend the ideas of differentiation and integration to functions of multiple variables. Explore topics such as partial derivatives, directional derivatives, multiple integrals, and applications to areas, volumes, and centroids. 8. Differential Equations: Introduce ordinary differential equations (ODEs) and their solutions. Cover topics such as first-order ODEs, linear second-order ODEs with constant coefficients, and basic techniques for solving ODEs. 9. Applications: Apply calculus concepts to real-world problems in physics, engineering, economics, and other fields. Develop the ability to model and solve practical problems using calculus techniques. 10. Mathematical Communication: Enhance mathematical communication skills, including the ability to explain concepts, write clear mathematical proofs, and present solutions to complex problems. It's important to note that these learning outcomes provide a general overview, and the actual content and depth of an Advanced Calculus course can vary. It's always advisable to refer to the specific course syllabus and learning objectives provided by your institution or instructor for a comprehensive understanding of the module.

Indicative Contents
المحتويات الإرشادية
	The indicative contents of an Advanced Calculus module may include the following topics:
	
	1. Partial Derivatives:
	  o Definition and interpretation of partial derivatives
	  o Computing partial derivatives using the limit definition and rules of differentiation
	  o Higher-order partial derivatives
	  o Chain rule for functions of several variables
	  o Implicit differentiation
	2. Gradient and Directional Derivatives:
	  o Gradient vector and its properties
	  o Directional derivative and its interpretation
	  o Finding the direction of maximum and minimum rates of change
	3. Multiple Integrals:
	  o Double integrals over rectangular and non-rectangular regions
	  o Iterated integrals and Fubini's theorem
	  o Change of variables in double integrals
	  o Triple integrals over various coordinate systems (cartesian, cylindrical, and spherical)
	  o Applications of multiple integrals, such as computing volumes, areas, and center of mass
	4. Vector Fields:
	  o Definition and properties of vector fields
	  o Gradient, divergence, and curl of vector fields
	  o Conservative vector fields and potential functions
	  o Irrotational and solenoidal vector fields
	5. Line Integrals:
	  o Definition and interpretation of line integrals
	  o Computing line integrals of scalar and vector fields
	  o Path independence and conservative vector fields
	  o Green's theorem for line integrals
	6. Surface Integrals:
	  o Definition and interpretation of surface integrals
	  o Parametric representation of surfaces
	  o Computing surface integrals of scalar and vector fields
	  o Flux and surface area
	7. Integral Theorems:
	  o Green's theorem for plane regions
	  o Gauss's theorem (divergence theorem) for volume integrals
	  o Stokes' theorem for surface integrals
	  o Applications of integral theorems in physics and engineering

Learning and Teaching Strategies استراتيجيات التعلم والتعليم

Strategies	1. Lectures: Traditional lectures are a common teaching strategy in Advanced Calculus. Instructors present key concepts, definitions, theorems, and examples to students. Lectures provide a structured framework for delivering the course content and help students understand the fundamental concepts. 2. Problem-Solving Sessions: Dedicated problem-solving sessions allow students to apply the concepts learned in lectures to solve mathematical problems. Instructors can present challenging problems and guide students through the problem-solving process, providing explanations and strategies along the way. These sessions encourage active participation and deepen students' understanding of the material. 3. Interactive Discussions: Engaging students in interactive discussions fosters critical thinking and deeper understanding of concepts. Instructors can encourage students to ask questions, share their insights, and engage in discussions about the theory and applications of Advanced Calculus. This strategy promotes active learning and can help clarify any misconceptions. 4. Collaborative Learning: Encouraging students to work in small groups or pairs can enhance their learning experience. Instructors can assign group projects or problem sets that require collaborative problem-solving. This approach promotes teamwork, communication, and the exchange of ideas among students. 5. Real-World Applications: Connecting Advanced Calculus concepts to real-world applications helps students see the practical relevance of the material. Instructors can provide examples from fields such as physics, engineering, economics, or computer science to demonstrate how calculus is used to model and solve problems in various domains. 6. Technology Integration: Utilizing mathematical software, graphing calculators, or online resources can enhance the learning experience. Instructors can demonstrate the use of technology to visualize mathematical concepts, solve complex problems, or conduct simulations. This strategy helps students connect theory with practice and promotes technological literacy. 7. Practice Exercises: Assigning practice exercises, both in-class and as homework, is essential for reinforcing the learned material and developing problem-solving skills. Instructors can provide a variety of exercises that range in difficulty to cater to different learning levels. Feedback on the solutions can be provided to help students understand their mistakes and improve their approach. 8. Assessments: Regular assessments, such as quizzes, exams, or projects, are important for evaluating students' understanding and progress. Assessments can include a mix of theoretical questions, problem-solving tasks, and application-based scenarios to assess different aspects of students' knowledge and skills in Advanced Calculus. 9. Office Hours and Individual Support: Providing opportunities for individual support, such as office hours or one-on-one consultations, allows students to seek clarification, ask questions, and receive personalized guidance. This strategy promotes a supportive learning environment and helps address individual learning needs. 10. Reflection and Feedback: Encouraging students to reflect on their learning and providing constructive feedback can enhance their understanding and metacognitive skills. Instructors can incorporate reflective activities, self-

	assessment tasks, or peer feedback to promote self-awareness and continuous improvement.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**200**		

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	functions, limits, and continuity
Week 2	partial derivatives, higher order partial derivatives, differentiation of composite functions
Week 3	implicit functions, jacobians, partial derivatives using jacobians
Week 4	transformations
Week 5	double integrals,

Week 6	triple integrals
Week 7	transformations of multiple integrals
Week 8	the differential element of area in polar coordinates, differential elements of area in cylindral and spherical coordinates
Week 9	vectors, geometric properties, algebraic properties of vectors, components of a vector
Week 10	dot or scalar product, cross or vector product
Week 11	line equation, plane equation
Week 12	vector functions
Week 13	line integrals, evaluation of line integrals for plane curves
Week 14	green's theorem in the plane, surface integrals
Week 15	divergence (or gauss) theorem, stokes' theorem

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Thomas, G. B., Finney, R. L., Weir, M. D., & Giordano, F. R. *Thomas' calculus*. Reading: Addison-Wesley, 2003.	Yes
Recommended Texts	Wrede, Robert, and Murray R. Spiegel. *Theory and problems of advanced calculus*. McGraw-Hill, 2002.	Yes
Websites	https://www.calc2.org/	

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.