MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Advanced Mathematics I**			**Module Delivery**	
Module Type	**Basic Learning Activities**			☒ **Theory** ☐**Lecture** ☐ **Lab** ☒ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**ADMA313**				
ECTS Credits	5				
SWL (hr/sem)	**125**				
Module Level	2		**Semester of Delivery**	1	
Administering Department	Type Dept. Code		**College**	Type College Code	
Module Leader	**Dr. Omar Janeh**		**e-mail**	120049@uotechnology.edu.iq	
Module Leader's Acad. Title	**Lecturer**		**Module Leader's Qualification**	Ph.D.	
Module Tutor	**None**		**e-mail**	**None**	
Peer Reviewer Name	1. Dr. Riadh Jabar 2. Azhar Malik		**e-mail**	Dhari.a.mahmood@uotechnology.edu.iq 120016@uotechnology.edu.iq	
Scientific Committee Approval Date	**1 / 4 /2026**		**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.** Develop a strong foundation in advanced algebraic structures and their applications. **2.** Explore calculus techniques for solving real-world and theoretical problems. **3.** Introduce concepts of linear algebra, including vector spaces and matrices. **4.** Analyze complex numbers and their role in mathematical modeling. **5.** Foster critical thinking and problem-solving skills in abstract mathematics.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1.** Understand and apply set theory and logical reasoning to develop rigorous mathematical proofs and problem-solving frameworks. **2.** Analyze and classify functions, including polynomial, trigonometric, exponential, and hyperbolic functions, for their properties and applications. **3.** Evaluate infinite sequences and series, determining convergence using advanced mathematical tests such as ratio, root, and integral tests. **4.** Master concepts of limits and continuity, enabling precise analysis of function behavior and application in calculus. **5.** Solve differentiation problems, including higher-order and partial derivatives, with applications in optimization and engineering systems. **6.** Apply techniques of multivariable calculus, such as gradient, divergence, and curl, to solve problems in vector fields. **7.** Formulate and solve optimization problems using methods like Lagrange multipliers and constrained optimization techniques. **8.** Compute integrals using advanced techniques, including substitution, integration by parts, and special functions. **9.** Evaluate multiple integrals, including double and triple integrals, for solving problems related to volume, mass, and center of gravity. **10.** Understand the structure of vector spaces and apply concepts of linear transformations and orthogonality in various domains. **11.** Solve systems of linear equations using matrix operations, Gaussian elimination, and LU decomposition. **12.** Analyze eigenvalues and eigenvectors to study linear transformations and stability in dynamical systems. **13.** Apply complex number theory, including polar forms, Euler's formula, and complex functions, to solve engineering and physics problems. **14.** Derive and solve ordinary differential equations (ODEs) using methods such as separation of variables, variation of parameters, and Laplace transforms. **15.** Solve partial differential equations (PDEs) using separation of variables, Fourier series, and boundary value problem techniques to address real-world applications.
Indicative Contents المحتويات الإرشادية	**Module 1: Foundations of Advanced Mathematics (20 hours)** **1.** Set theory, logic, and mathematical proofs. **2.** Functions: types, properties, and transformations. **3.** Sequences and series: convergence, divergence, and tests.

	Module 2: Calculus of Single and Multivariable Functions (25 hours) **1.** Limits and continuity of functions. **2.** Differentiation techniques: chain rule, implicit, and higher-order derivatives. **3.** Applications of differentiation: optimization and curve sketching. **4.** Introduction to partial derivatives and their applications. **Module 3: Integral Calculus and Applications (20 hours)** **1.** Definite and indefinite integrals: methods of integration. **2.** Applications of integrals: areas, volumes, and physical applications. **3.** Multiple integrals: double and triple integrals in Cartesian coordinates. **Module 4: Linear Algebra and Matrix Theory (20 hours)** **1.** Vectors and vector spaces: linear independence, bases, and dimension. **2.** Matrix operations: addition, multiplication, and inverses. **3.** Solving systems of linear equations: Gaussian elimination and LU decomposition. **4.** Eigenvalues and eigenvectors: diagonalization and applications. **Module 5: Differential Equations (20 hours)** **1.** First-order differential equations: separable, exact, and linear forms. **2.** Higher-order ODEs: homogeneous and non-homogeneous equations. **3.** Applications of ODEs in modeling physical systems. **Module 6: Complex Numbers and Fourier Series (20 hours)** **1.** Complex numbers: algebra, polar form, and Euler's formula. **2.** Complex functions and residues. **3.** Fourier series and applications in solving boundary value problems. **Self-Study and Revision (20 hours)** **1.** Problem-solving sessions, assignments, and self-paced learning. **2.** Preparation for assessments and project-based tasks.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Lectures**: Instructors will deliver in-class lectures to introduce and explain key networking concepts, architectures, and protocols. These presentations will cover theoretical foundations and practical applications. **2. Interactive Discussions**: Students will be encouraged to participate in

	discussions that foster critical thinking and problem-solving skills. These discussions will revolve around case studies, hypothetical scenarios, and current events in networking. 3. **Hands-on Laboratory Work**: Practical lab sessions will allow students to apply theoretical knowledge by working with networking hardware and simulation software. This includes setting up networks, configuring routers and switches, and analyzing network traffic with tools like Wireshark and Cisco Packet tracer. 4. **Group Projects**: Students will collaborate on projects that involve designing and implementing network solutions for simulated environments. This promotes teamwork and the practical application of learned concepts, including network planning, security measures, and troubleshooting. 5. **Simulations and Virtual Labs**: Utilizing advanced simulation tools and virtual lab environments to provide students with hands-on experience, especially when physical resources or access to actual networking equipment is limited. 6. **Use of Visuals and Multimedia**: Integration of visual aids such as diagrams, flowcharts, and multimedia content to enhance understanding of complex network structures and data flow mechanisms. 7. **Assessment and Feedback**: Regular assessments through quizzes, tests, and exams to gauge students' understanding and mastery of course content. Feedback will be provided systematically to guide students' learning processes and adjustments. 8. **Practice and Revision Sessions**: Dedicated sessions for practice and revision will be available to reinforce learning, address students' questions, and prepare them adequately for assessments.

Student Workload (SWL)

الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	**48**	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	**3**
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	**77**	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	**3**
Total SWL (h/sem) الحمل الدراسي الكلي للطالب 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- #5 and #6 - #11
	Assignments	2	10% (10)	3 and 12	LO #2 and #5, #7, #11
	Projects / Lab.	1	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5 - #12
Summative assessment	Midterm Exam	2hr	10% (10)	8	LO #1 - #10
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered
Week 1	**Introduction to Laplace Transformation** 1. Properties of Laplace Transform: Linearity, time shifting, frequency shifting. 2. Applications: Initial exploration of solving differential equations in engineering.
Week 2	**Laplace Transform of Derivatives and Integrals** 1. Laplace transforms for derivatives and integrals. 2. Applications: Solving mechanical system equations.
Week 3	**Special Theories in Laplace Transformation** 1. Shifting, convolution, scaling, and periodic functions in Laplace Transform. 2. Applications: Signal processing, control systems.
Week 4	**Inverse Laplace Transform Using Residue Theorem** 1. Residue theorem and solving inverse Laplace transforms.

	2. Applications: Analysis of dynamic systems in electrical engineering.
Week 5	**Initial Value Problem (IVP) Solving of Differential Equations** 1. Solving ODEs using Laplace Transform for IVP. 2. Applications: Modeling electrical circuits and mechanical vibrations.
Week 6	**Electrical Circuit Analysis by Laplace Transform** 1. Applying Laplace Transform to analyze RLC circuits. 2. Applications: Understanding transient and steady-state responses.
Week 7	**Introduction to Vector Analysis** 1. Basic vector operations: Addition, subtraction, scalar multiplication. 2. Applications: Physics simulations and motion analysis.
Week 8	**2D and 3D Vector Analysis** 1. Vector representations in 2D and 3D spaces. 2. Applications: Computer-aided design (CAD), 3D modeling.
Week 9	**Dot and Cross Product** 1. Geometrical and physical significance of dot and cross products. 2. Applications: Calculating forces in engineering systems.
Week 10	**Unit and Normal Vectors, Lines, and Planes** 1. Representation of lines, planes, and unit vectors in space. 2. Applications: Navigation, graphics rendering.
Week 11	**Gradient, Divergence, and Curl** 1. Physical interpretation and applications in fluid dynamics and electromagnetism. 2. Applications: Field visualization, computational fluid dynamics.
Week 12	**Line Integral and Conservative Fields** 1. Understanding line integrals and conservative fields. 2. Applications: Electromagnetic theory, energy calculations.
Week 13	**Green's Theorem** 1. Green's theorem and its applications in line and area integrals. 2. Applications: Fluid flow analysis, network simulations.

Week 14	**Gamma and Beta Functions** 1. Definitions and applications of Gamma and Beta functions. 2. Applications: Probability distributions, statistical mechanics.
Week 15	**Introduction to Bessel and Legendre Functions** 1. Basic properties and applications of Bessel and Legendre functions. 2. Applications: Signal processing, wave propagation in media.

Delivery Plan (Weekly Tutorials Syllabus)

المنهاج الاسبوعي للدروس التعليمية

	Material Covered
Week 1	Tutorial 1: Solve Laplace transforms of basic functions. Apply to simple electrical circuits.
Week 2	Tutorial 2: Practical problems involving motion and control systems using derivatives.
Week 3	Tutorial 3: Apply convolution and periodic functions to analyze periodic signals.
Week 4	Tutorial 4: Solve problems with real-world signals using inverse Laplace methods.
Week 5	Tutorial 5: Solve IVPs for mechanical systems and electrical networks.
Week 6	Tutorial 6: Hands-on circuit analysis with transient and steady-state responses.
Week 7	Tutorial 7: Solve physical simulation problems using vector algebra.
Week 8	Tutorial 8: Practical examples: navigation and robotics (path calculations).
Week 9	Tutorial 9: Solve problems in force calculations and torque in engineering.
Week 10	Tutorial 10: Applications in graphics rendering and 3D transformations.
Week 11	Tutorial 11: Solve problems in electric and magnetic fields.
Week 12	Tutorial 12: Calculate work done by forces in engineering systems.
Week 13	Tutorial 13: Solve fluid flow problems and analyze circulation in vector fields.
Week 14	Tutorial 14: Solve probability-related problems and integrate real-world cases.
Week 15	Tutorial 15: Apply to problems in signal processing and wave equations.

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**1.** Erwin Kreyszig - Advanced Engineering Mathematics, 10th Edition **2.** C. Ray Wylie & Louis C. Barrett - Advanced Engineering Mathematics **3.** Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, & Keying E. Ye - Probability and Statistics for Engineers and Scientists, 9th Edition	Yes
Recommended Texts	1. Gilbert Strang - Introduction to Linear Algebra, 5th Edition 2. Steven C. Chapra & Raymond P. Canale - Numerical Methods for Engineers, 7th Edition 3. John H. Mathews & Kurtis D. Fink - Numerical Methods Using MATLAB, 4th Edition 4. Michael D. Greenberg - Advanced Engineering Mathematics 5. Thomas L. Harman, James Dabney, & Norman Richert - Advanced Engineering Mathematics with MATLAB 6. Andrew Gelman et al. - Bayesian Data Analysis, 3rd Edition	Yes
Websites	1. MIT OpenCourseWare: Courses such as Mathematics for Computer Science and Advanced Calculus. 2. Khan Academy: Tutorials on Laplace transforms, vector calculus, and numerical methods. 3. YouTube Channels: 3Blue1Brown: Visual explanations of calculus, linear algebra, and differential equations. 4. MIT OpenCourseWare: Lecture videos on advanced mathematics and numerical methods. 5. Wolfram MathWorld: A comprehensive online resource for mathematical concepts and applications. 6. MATLAB Documentation: Official MATLAB tutorials and examples for numerical analysis and engineering simulations.	

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.