MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Numerical Analysis**			**Module Delivery**	
Module Type	**C**			☒ **Theory** ☒ **Lecture** ☒ **Lab** ☒ **Tutorial** ☒ **Practical**	
Module Code	**AI2102**				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	2		**Semester of Delivery**	1	
Administering Department	AI		**College**	Computer Science and Information Technology	
Module Leader	Elaf Ali Sfooq		**e-mail**	elaf.ali@uowa.edu.iq	
Module Leader's Acad. Title	Assist lecturer		**Module Leader's Qualification**	M.Sc.	
Module Tutor	Elaf Ali Sfooq		**e-mail**	elaf.ali@uowa.edu.iq	
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Scientific Committee Approval Date	01/09/2026		**Version Number**	1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	---	**Semester**	--
Co-requisites module		**Semester**	

Department Head Approval

Dean of the College Approval

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	1. Appreciate the value of mathematical reasoning and analysis in applications 2. Realize the importance of mathematical principles and skills in solving some types of problems 3. Develop critical and analytical thinking, accuracy, neatness when using mathematics 4. Realize that a large number of problems cannot be solved by prepared "theoretical" formulas; instead, the solution is arrived at by a succession of approximations until the desired accuracy is obtained 5. Appreciate the usefulness of the computer and see how its use removed the drudgery involved in computations and how by use of programming techniques sequential processes are placed in the correct order 6. Exhibit values like: o cooperation through group study; o honesty by claiming credit only for the work he has done; o zeal and seriousness of intent to learn by participating actively in class discussion, doing his homework regularly and consulting his mentor; o patience, perseverance and diligence by solving assigned exercises completely including the difficult ones; o faith by doing what is right and giving his best in performing any assigned task; o show concern for the community through sharing of know-how and resources during group discussion; o self-reliance by being able to solve problems independently.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Knowledge and Understanding: During the lecture the student understands the nature and operations of Numerical Analysis, demonstrates familiarity with theories and concepts used in Numerical Analysis, and identifies the steps required to carry out a piece of research on a topic in Numerical Analysis. 2. Intellectual Skills: By the end of the course the student is expected to recognize and apply appropriate theories, principles and concepts relevant to Numerical Analysis, critically assess and evaluate the literature within the field of Numerical Analysis, analyze and interpret information from a variety of sources relevant to Numerical Analysis. 3. Practical Skills: By the end of the course student will have the ability to compare the computational methods for advantages and drawbacks, choose the suitable computational method among several existing methods, implement the computational methods using any of existing programming languages, testing such methods and compare between them, identify the suitable computational technique for a specific type of problems, and develop the computational method that is suitable for the underlying

	problem. 4. Transferable Skills: Within the lectures the student is able to transfer ideas and experience, work effectively as a part of a group and independently.
Indicative Contents المحتويات الإرشادية	**Introduction to Mathematical Modelling and Computational Methods –** Importance of computational modelling in engineering. Data representation and errors. Applications of commercial software packages such as MATLAB. Functions and plotting using MATLAB. **Computer Solution of Non-linear Equations -** Bracketing Methods. Bisection Method. Open Methods. Newton-Raphson Method. Secant Method. Convergence of methods. Determination of multiple roots. Engineering applications. Simultaneous Linear Equations - Solving simultaneous linear equations by Matrix Inversion. Cramer's Rule. Gauss Elimination. Gauss-Jordan Elimination. LU decomposition method. Engineering applications and choice of methods. Eigenvalues Problems. **Optimization -** Unconstrained optimization. Multi-dimensional optimization. Unconstrained optimization. Curve Fitting and Data Analysis - Interpolation using splines. Linear Least-Squares Regression. Nonlinear Regression. Introduction to Machine Learning Algorithms. **Numerical Differentiation and Integration -** Taylor's series expansion. Finite differences for the first derivative and the second derivative. High-accuracy differentiation formulas. Trapezoidal rule. Simpson's rule. High-order Newton-Cotes formulas. Applications of numerical differentiation and integration in heat transfer, solid mechanics and fluid flow problems.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Numerical analysis is the story of how functions, derivatives, integrals, and differential equations are handled as strings of numbers in the computer. At the heart of numerical analysis is an understanding of the speed of convergence of Taylor, Fourier, and other series expansions. Most scientists and engineers are sooner or later faced with computing tasks that require some knowledge of numerical analysis.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	63	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	37	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	5	10% (10)	2,3,5,8,12	LO #1, #2 and #4
	Assignments	5	10% (10)	3,4,6,9,11	LO #3, #4
	Projects / Lab.	5	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #4
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #4
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Direct methods for solving linear system of equation
Week 2	Simple Gaussian elimination method, gauss elimination method with partial pivoting,
Week 3	determinant evaluation, gauss Jordan method,
Week 4	L U decompositions Doolittle's LU decomposition, Doolittle's method with row interchange
Week 5	Finding Matrix Inverse
Week 6	Iterative methods for solving linear systems of equations
Week 7	Jacobin iteration, gauss – seidel method,
Week 8	Successive over relaxation method (sort method)
Week 9	Mid-term Exam
Week 10	Newton-Raphson Method
Week 11	Runge-kutta Method
Week 12	Interpolation and the Lagrange Polynomial, Data Approximation and Neville's Method
Week 13	Numerical Analysis Methods for Differential Equation
Week 14	Numerical Analysis Methods for Integral Equation
Week 15	Final Exam
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
eek 1	**Lab 1:** Introduction to Agilent VEE and PSPICE simulation tools
Week 2	**Lab 2:** Simulation and verification of Thévenin's, Norton's Theorems, and Kirchhoff's Laws
Week 3	**Lab 3:** First-Order Transient Responses (RC and RL circuits)
Week 4	**Lab 4:** Second-Order Transient Responses (RLC circuits)
Week 5	**Lab 5:** Frequency Response of RC Circuits
Week 6	**Lab 6:** Frequency Response of RLC Circuits
Week 7	**Lab 7:** Design and analysis of Passive Filters (Low-pass, High-pass, Band-pass)
Week 8	**Lab 8:** Resonant Circuits and Quality Factor ($Q\text{-Factor}$) analysis
Week 9	**Lab 9:** Operational Amplifiers (Op-Amps) and Active Filter Simulation
Week 10	**Lab 10:** Mid-term Practical Exam
Week 11	**Lab 11:** Numerical Solution of Systems of Linear Equations using MATLAB/PSPICE
Week 12	**Lab 12:** Numerical Integration and Differentiation of Electrical Signals
Week 13	**Lab 13:** Fourier Analysis and Harmonic Distortion in Electrical Circuits
Week 14	**Lab 14:** Simulation Project: Modelling and Analysis of Complex Dynamic Systems
Week 15	**Lab 15:** Final Practical Exam and Project Evaluation

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Richard L. Burden and etc." Numerical Analysis ", 9th edition, 2014	NO
Recommended Texts	(Numerical Methods for Engineers by Steven C. Chapra & Raymond P. Canale, 7th Edition)	NO
Websites	https://www.coursera.org/courses?query=numerical%20analysis	

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.