	Ministry of Higher Education and Scientific Research - Iraq University of Warith Al-Anbiya College of Engineering Aircraft Engineering Department	

MODULE DESCRIPTOR FORM

Module Information

Module Title	Engineering and Numerical Analysis		**Module Delivery**	
Module Type	CORE		**Theory** **Lab**	
Module Code	AIE241			
ECTS Credits	6			
SWL (hr/sem)	150			
Module Level	2	**Semester of Delivery**	4	
Administering Department	Aircraft Engineering	**College**	Engineering	
Module Leader	Muhammad Abdel-Daem	**e-mail**		
Module Leader's Acad. Title	Lec.	**Module Leader's Qualification**	Ms.c.	
Module Tutor	None	**e-mail**	None	
Peer Reviewer Name		**e-mail**		
Review Committee Approval	2025/9/26	**Version Number**	2025	

Relation With Other Modules

Prerequisite module	AIE231	**Semester**	3
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents

Module Aims	1. To provide a course of high academic quality in Engineering and Numerical Analysis in a challenging and supportive learning environment that encourages students to reach their full potential, personally and academically. 2. To provide a course that is suitable both for students aiming to pursue research and for students going into other careers. 3. To provide an integrated system of teaching which can be tailored to the needs of individual students. 4. To develop in students the capacity for learning and clear logical thinking. 5. To continue to attract and select students of outstanding quality. 6. To provide an intellectually stimulating environment in which students have the opportunity to develop their skills and enthusiasm to their full potential.
Module Learning Outcomes	Knowledge and Understanding: This Course will develop learners' ability to: 1. Understand and use the relationships to define the principle of Engineering and Numerical analysis 2. Select and apply operational skills in algebra, geometry, and trigonometry within mathematical contexts 3. Select and apply skills in solving the non-linear and linear equations. 4. Use numerical models 5. Use engineering analysis reasoning skills to interpret information, select a strategy to solve a problem, and communicate solutions. 6. To apply the numerical analysis on the data tables, which are obtained from experimental work. Subject-specific skills: It is expected that learners will develop the following: 7. Broad, generic skills through this Course. 8. Skills for Learning, and drawn from the main skills areas listed below. 9. Skills for Life 10. and Skills for Work These must be built into the Course where there are appropriate opportunities.
Indicative Contents	Indicative content includes the following. **Engineering Analysis** **Laplace Transformations:**

	Introduction. Definition of L.T., Definition of I.L.T. Examples. [8hrs] **Solution of differential equations using L.T:** Method of solution. Using L.T. for solving practical problems. [5hrs] **Solution of 2nd order D.E. using power series method:** Solution near the ordinary point. Solution near the singular point. [5hrs] **Solution of partial D.E:** Definition. Solution methods of P.D.E. Examples. [5hrs] **Using of separation method:** Definition of separation method. Examples. [5hrs] **Applications of the solution of P.D.E:** Solution of unsteady one-dimensional heat equation. Solution of vibrating string. [5hrs] **Numerical Analysis** **Solution of non-linear equations:** Simple iteration method, Examples. Newton –Raphson method, Derivation, Square Roots, Reciprocal of any number. [5hrs] **Solution of simultaneously linear equations:** Definition and Methods of Solution. Direct methods: Gauss- Elimination, Gauss -Jordan Elimination. Indirect methods: Jacob's method. Gauss- Seidle method. [5hrs] **Numerical interpolation:** Linear interpolation. Quadratic interpolation. [5hrs] **Newton and Lagrange forms:** Using this method for equal segment and unequal segments. [5hrs] **Numerical differentiation** First derivative. Second derivative. [5hrs] **Numerical Integration** trapezoidal rule, Simpson Rule (1/3). Simpson Rule (3/8). [5hrs] **Curve fitting** linear Regression. Applications of linear regression. Polynomial curve fitting. [4hrs] **Solution of ordinary differential equations O.D.E.** Taylor series method. Simple Euler method. Runge-kutta method. [5hrs]
Learning and Teaching Strategies	
Strategies	All lectures reflect the higher values, purposes and principles. They offer flexibility, provide more time for learning, focus on skills and applying to learn, and scope for personalization and choice. In this Course, and its component Units, there will be an emphasis on skills development and the application of those skills. Assessment approaches will be proportionate, fit for purpose and will promote best practices, enabling learners to achieve the highest standards they can. This course provides learners with opportunities to continue to acquire and develop the attributes and capabilities of the four capacities, as well as skills for learning, skills for life and skills for work.

Student Workload (SWL)			
Structured SWL (h/sem)	78	**Structured SWL (h/w)**	5
Unstructured SWL (h/sem)	72	**Unstructured SWL (h/w)**	4.8
Total SWL (h/sem)	150		

Module Evaluation					
		Time/ Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	4	20% (20)	3,5, 7,10	LO #1, 2, 3,4,5 and 10
	Assignments	2	10% (10)	6, 11	LO # 3, 4, 7 and 9
	Projects / Lab.	Lab. 5	10% (10)	Continuous	All
	Report	-	-	-	-
Summative assessment	**Midterm Exam**	2 hrs.	10% (10)	9	LO # 1-7
	Final Exam	3 hrs.	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)	
Week	**Material Covered**
Week 1	**Laplace Transformations (L.T):** Introduction. Definition of L.T. Examples.
Week 2	**Inverse Laplace Transformations (I.L.T.):** Introduction. Definition of I.L.T. Examples.
Week 3	**Solution of differential equations using L.T:** Method of solution. Using L.T. for solving practical problems Examples.
Week 4	**Solution of 2nd order D.E. using power series method:** Introduction. Solution near the ordinary point. Solution near the singular point.
Week 5	**Solution of partial D.E:** Definition. Solution methods of P.D.E.

	Examples.
Week 6	**Using of separation method:** Definition of separation method. Examples.
Week 7	**Applications of the solution of P.D.E:** Solution of unsteady one-dimensional heat equation. Solution of vibrating string.
Week 8	**Solution of non- linear equations:** Introduction Simple iteration method, Examples. Newton –Raphson method, Derivation, Square Roots, Reciprocal of any number. Applications.
Week 9	**Solution of simultaneously linear equations:** Definition and Methods of solution. Direct methods: Gauss- Elimination, Gauss -Jordan Elimination. Indirect methods: Jacob's method. Gauss- Seidle method.
Week 10	**Numerical interpolation:** Linear interpolation. Quadratic interpolation.
Week 11	**Newton and Lagrange forms:** Using this method for equal segment and unequal segments
Week 12	**Numerical differentiation** First derivative Second derivative
Week 13	**Numerical Integration** Trapezoidal rule Simpson Rule (1/3) Simpson Rule(3/8)
Week 14	**Curve fitting** Linear Regression Applications of linear regression Polynomial curve fitting
Week 15	**Solution of ordinary differential equations O.D.E.** Taylor series method Simple Euler method Runge-kutta method
Week 16	**Final Exam**

Delivery Plan (Weekly Lab. Syllabus)	
	Material Covered
Week 1	Exp. 1: Solution of non-linear equations by using MATLAB program (Simple iteration method and Newton –Raphson method)

Week 2	Exp. 2: Solution of linear equations by using MATLAB program (Gauss- Elimination and Gauss- Seidle method)
Week 3	Exp. 3: Newton forwards interpolation method for equal segment by using MATLAB program
Week 4	Exp. 4: Solution of Numerical Integration (Simpson Rule (1/3)) by using MATLAB program.
Week 5	Exp. 5: Solution of ordinary differential equations O.D.E. by using MATLAB program (Runge-kutta method).

Learning and Teaching Resources		
	Text	**Available in the Library?**
Required Texts	1. Chapra C. S., "Numerical Methods for Engineers",Mc Graw-Hill, Inc., 2006.	Yes
Recommended Texts	2. د.حسن مجيد الدلفي ود. محمود عطاء الله مشكور, " التحليل الهندسي والعددي التطبيقي" دار انشر الوطنية , الطبعة الثانية 2016. 3. Erwin Kreyszig, "Engineering mathematics",McGRAW-HILL, 9th edition, 2006.	Yes
Websites		

APPENDIX:

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	مقبول بقرار	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note:

NB 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.