Course Description Form

1. Course Name
Numerical Analysis I
2. Course Code:
MATH314
3. Semester / Year
First / 2023/2024
4. Description Preparation Date
1ST September 2023
5. Available Attendance Forms
Full time attendance
6. Number of Credit Hours (Total) / Number of Units (Total)
75/4
7. Course administrator's name (mention all, if more than one name)
Course leader name: **Dr. Omar Al-Tameemi** Email: omar.ismael@nahrainuniv.edu.iq Tutorial Assistant name: Ass. Lec. **Abbas Ibrahim Khleaf** Lab staff names: **1- Lec. Raneen zaid** **2- Ass. Lec. Haneen Abdulkareem** **3- Ass. Lec. Nabaa Husain** 4- **Ass. Lec. Batol Imkhelf**
8. Course Objectives

Course Objectives	• Derive appropriate numerical methods to solve algebraic and transcendental equations. • Develop appropriate numerical methods to approximate a function. • Derive appropriate numerical methods to evaluate a derivative at a value. • Perform an error analysis for various numerical methods • Prove results for various numerical root finding methods. • Derive appropriate numerical methods to calculate a definite integral. • Code various numerical methods in a modern computer language.

9. Teaching and Learning Strategies

Strategy	Subject content will be presented in a combination of online materials and in the lectures. Lectures will take the form of an interactive session (3 hours per week) where the material is covered in depth. Students are expected to revise the online material before each lecture. Computer labs (2 hours per week) will focus on the practical implementation of numerical methods. Direct feedback will be provided during the computer labs. Further feedback on progress will be provided using the check-in Assignments which are spaced throughout the semester. Students will be encouraged to develop code-sharing practices in the computer labs, and to tackle problems collaboratively, as well as being able to work on solving problems individually. A central aim of this is to prepare students for real-world coding environments, which consist of a mix of collaboration with intense periods of individual work. Real world problems examples will enable the students to tackle an authentic and challenging problem in science or mathematics that can be approached using the methods given in this subject.

10. Course Structure (Theory)

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	3 hrs of lecture +1 hr tutorial	Preliminaries of Computing	Numerical Solution, type of errors; relative error, absolute error, percentage error, truncation	Lectures notes, In class presentations, Examples of Practical	Quizzes , Weekly homework, Team and homework problems , Open questions that have a definite answer , (Oral questions)

			error, round off error. Floating	Applications, Tutorial	
2	3 hrs of lecture +1 hr tutorial	Numerical solution of Nonlinear Equations	Bisection method, fixed-point iteration, Newton's method.		
3	3 hrs of lecture +1 hr tutorial		Error analysis for Iterative Methods		
4	3 hrs of lecture +1 hr tutorial		Computing roots of polynomials.		
5	3 hrs of lecture +1 hr tutorial	Interpolation and Polynomial Approximation	Lagrange Polynomial		
6	3 hrs of exam +1 hr tutorial	Midterm exam			
7	3 hrs of lecture +1 hr tutorial	Interpolation and Polynomial Approximation	Divided Differences	Lectures notes, In class presentations, Examples of Practical Applications, Tutorial	Quizzes , Weekly homework, Team and homework problems , Open questions that have a definite answer , (Oral questions)
8	3 hrs of lecture +1 hr tutorial		Hermite Interpolation, Extrapolation Methods		
9	3 hrs of lecture +1 hr tutorial	Numerical Differentiation	Forward, backward and central difference approximation of the derivatives.		
10	3 hrs of exam +1 hr tutorial	Midterm exam			

11	3 hrs of lecture +1 hr tutorial	Numerical Differentiation	Higher Order Derivatives.	Lectures notes, In class presentations, Examples of Practical Applications, Tutorial	Quizzes , Weekly homework, Team and homework problems , Open questions that have a definite answer , (Oral questions)
12	3 hrs of lecture +1 hr tutorial	Numerical Integration	Trapezoidal Method, Simpson's Method		
13	3 hrs of lecture +1 hr tutorial		Quadrature Integration Methods, Including Gauss-Quadrature Methods, NewtonCots Open and Closed Methods		
14	3 hrs of lecture +1 hr tutorial		Romberg integration		
15	4hrs	Review			

Course Structure (Lab)

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	2 hours of Lab.	Preliminaries of Computing	Fundamentals of MATLAB Programming, relative error, absolute error, percentage error, round off error. Floating	Lab Lectures, Practical Applications, Tutorial	Exams , Weekly homework, Lab quizzes
2	2 hours of Lab.	Numerical solution of Nonlinear Equations	Bisection method, fixed-point iteration, Newton's method.		
3	2 hours of Lab.		Error analysis for Iterative Methods		

4	2 hours of Lab.	Interpolation and Polynomial Approximation	Computing roots of polynomials.		
5	2 hours of Lab.		Lagrange Polynomial		
6	2 hours of Lab.	Midterm exam			
7	2 hours of Lab.	Interpolation and Polynomial Approximation	Divided Differences	Lab Lectures, Practical Applications, Tutorial	Exams , Weekly homework, Lab quizzes
8	2 hours of Lab.		Hermite Interpolation, Extrapolation Methods		
9	2 hours of Lab.	Numerical Differentiation	Forward, backward and central difference approximation of the derivatives.		
10	2 hours of Lab.	Midterm exam			
11	2 hours of Lab.	Numerical Differentiation	Higher Order Derivatives.	Lab Lectures, Practical Applications, Tutorial	Exams , Weekly homework, Lab quizzes
12	2 hours of Lab.	Numerical Integration	Trapezoidal Method, Simpson's Method		
13	2 hours of Lab.		Quadrature Integration Methods, Including Gauss-Quadrature Methods, Newton Cots Open and Closed Methods		
14	2 hours of Lab.		Romberg integration		
15	2hrs	Review			
11. Course Evaluation					

Formative assessment 40%: Theory (15% Midterm exams + 10% homework) + 15% lab assessment. Summative assessment 60%: Theoretical final exam 50% + Lab final exam 10%)

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Burden, R. L., Faires, J. D., & Burden, A. M. (2015). Numerical analysis. Cengage learning.
Main references (sources)	J. Stoer and R. Bulirsch, Introduction to Numerical Analysis, Springer-Verlag, ISBN 0-387- 90420-4
Recommended books and references (scientific journals, reports…)	C.T. Kelley, Iterative methods for linear and nonlinear equations, Society of Industrial and Applied Mathematics
Electronic References, Websites	