

Identification	Subject	MATH424, Numerical Methods for Engineers, 6 ECTS
	Department	Mechanical Engineering
	Program	Undergraduate
	Term	Spring 2026
	Instructor	Dr. Mehdi Kiyasatfar
	E-mail:	mkiyasatfar@khazar.org
	Phone:	
	Classroom/hours	
	Office hours	
Prerequisites	Calculus I	
Language	English	
Compulsory/Elective	Major Elective	
Required textbooks and course materials	<ol style="list-style-type: none"> 1. Arti Kaushik, Numerical Methods for Engineers, First Edition, 2018. 2. S.C. Chapra and R. P. Canale, Numerical Methods for Engineers, McGraw Hill, Seventh Edition, 2014. 3. Richard L. Burden and J. Douglas Faires, Numerical Analysis 9th edition, 2011. 	
Course website		
Course outline	<p>This course covers fundamental numerical methods used in engineering problem solving. Topics include error analysis and Taylor series approximations; numerical solutions of nonlinear equations and systems of equations; methods for solving linear algebraic systems; curve fitting and interpolation; numerical differentiation and integration; one-dimensional optimization; and numerical techniques for solving ordinary differential equations. Emphasis is placed on algorithm development and computational implementation for engineering applications.</p>	
Course objectives	<p>This course aims to provide students with a solid foundation in numerical methods for engineering applications. It seeks to develop an understanding of approximation techniques, error analysis, and algorithmic approaches for solving mathematical problems that arise in engineering practice. The course also aims to strengthen students' ability to model engineering systems and to utilize computational tools for obtaining reliable numerical solutions.</p>	
Learning outcomes	<p>Upon successful completion of this course, students will be able to:</p> <ul style="list-style-type: none"> • Analyze numerical errors and assess the accuracy and convergence of numerical methods. • Solve nonlinear equations and systems of equations using appropriate numerical techniques. • Apply direct and iterative methods to solve systems of linear algebraic equations. • Construct numerical approximations using interpolation, curve fitting, numerical differentiation, and numerical integration methods. • Implement numerical algorithms in a computational environment to solve engineering problems. 	

	<ul style="list-style-type: none"> Solve ordinary differential equations, including initial-value and boundary-value problems, using appropriate numerical methods. 		
Teaching methods	Lecture		x
	Group discussion		x
	Experiential exercise		-
	Tutorials once a month on weekends		-
	Case analysis and assignments		x
	Course paper		-
	Others		---
Evaluation	Methods	Date/deadlines	Percentage (%)
	Midterm Exam		30
	Attendance & Activity	At each lesson	5
	Quiz (2 quizzes)	During the semester	10
	Assignment	During the semester	5
	Project	During the semester	10
	Final Exam		40
	Total		100
Policy	<ul style="list-style-type: none"> Ethics Copy of other students' work is highly discouraged. All assignments must be handled by the student himself. This is a university policy and violators will be reprimanded accordingly. Preparation for class The structure of this course demands your individual effort outside the classroom for extra practice of many problems within the textbook. After each session, every student needs to put sufficient time to practice and finish the assignments by the predetermined date. Withdrawal (pass/fail) This course strictly follows the grading policy of the School of Engineering. Thus, a student is expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year. Cheating/plagiarism Cheating or other plagiarism in handling the assignments, Mid-term and Final Examinations will lead to course failure. In this case, the student will automatically get zero (0), without any considerations. Professional behavior guidelines The students shall behave in a way to create a favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly discouraged. Attendance & Activity Attendance and in-class activity constitute 5 marks out of the total 100 marks for this course. Students who attend and actively participate in class activities will receive these marks. For each unexcused absence, 1 mark will be deducted from the attendance and activity score. 		

- **Quiz**
Quizzes constitute 10 marks out of the total 100 marks for this course. Two quizzes will be conducted during the semester. Quiz questions will primarily assess students' understanding of fundamental numerical methods, error analysis, convergence concepts, and basic analytical skills in solving engineering problems using numerical techniques. Full credit will be awarded only for clearly presented solutions, appropriate justification of the selected numerical method, and properly supported final results.
- **Assignment**
Assignments constitute 5 marks out of the total 100 marks for this course. Students are required to submit assigned homework problems by the specified deadlines. Assignments will focus on the analytical application of numerical methods, including step-by-step solution procedures and interpretation of results. Full credit will be awarded only for complete, well-structured solutions with clear explanations, correct methodology, and properly justified final answers.
- **Project**
In this course, students are required to complete computational programming projects using MATLAB or Python. The projects are designed to develop students' ability to implement numerical algorithms and apply them to engineering problems. Students must write their own codes to implement the required numerical methods. Each project will involve problem formulation, algorithm development, code implementation, testing, and analysis of results. Submitted codes must execute successfully and produce accurate and reasonable numerical results. Evaluation will be based on the correctness and functionality of the code, appropriate implementation of the numerical method, analysis of accuracy and convergence where applicable, clarity and structure of the program, and the student's ability to clearly explain the algorithm, logic, and results. Additional details regarding specific tasks, deliverables, and deadlines will be provided during the course.
- **Exam**
The midterm and final examinations will assess students' understanding of the theoretical foundations and practical applications of numerical methods covered in the course. The exams will evaluate students' ability to analyze numerical errors, select appropriate numerical techniques, perform step-by-step analytical computations, interpret numerical results, and justify methodological choices. Emphasis will be placed on conceptual understanding, algorithmic reasoning, and problem-solving skills rather than mere memorization of formulas.

Tentative Schedule

Week	Date/Day (tentative)	Topics	Textbook/Assignments
1		Syllabus- Introduction to Numerical Methods Mathematical modeling and Engineering Problem	Chapter 1, Ref1,2

		Solving	
2		Taylor Series, Approximations and Errors Roots of Equations: Bisection, False Position, and Iteration Methods	Chapter 2, Ref1,2
3		Newton-Raphson and Secant Methods, System of Non-linear Equations	Chapter 3, Ref1,2
4		System of Linear Algebraic Equations: Gauss Elimination, Matrix Inversion, Gauss-Seidel Iteration	Chapter 4, Ref1,2
5		One-dimensional Unconstrained Optimization	Chapter 5, Ref1,2
6		Curve Fitting, Least Squares Regression	Chapter 6, Ref1,2
7		Polynomial Interpolation - Spline Interpolation	Chapter 7, Ref1,2
8		Review Midterm Exam	
9		Numerical Differentiation	Chapter 8, Ref1,2
10		Numerical Integration, Newton-Cotes Formulae	Chapter 9, Ref1,2
11		Romberg's and Gauss-Quadrature Integration	Chapter 10, Ref1,2
12		Solution of Ordinary Differential Equations	Chapter 11, Ref1,2
13		Euler, Runge-Kutta, Multi-Step Methods	Chapter 12, Ref1,2
14		System of ODE's, Initial-Value Problems, Boundary-Value Problems	Chapter 12, Ref1,2
15		Applications-Case Studies	
16		Final Exam	

This syllabus is a guide for the course and any modifications to it will be announced in advance.