GAU, Faculty of Engineering

Course Unit Title	Numerical Analysis
Course Unit Code	MT308
Type of Course Unit	Compulsory for CEN, EEN, ESE, CVEN, IE
Level of Course Unit	3rd year BSc
National Credits	3
Number of ECTS Credits Allocated	5
Theoretical (hour/week)	3
Practice (hour/week)	0
Laboratory (hour/week)	0
Year of Study	3
Semester when the course unit is delivered	6
Mode of Delivery	Face to face, E-learning
Language of Instruction	English
Prerequisites	MT112
Corequisites	
Recommended Optional Programme Components	Linear Algebra, Introduction to programming (ENG102)

Objectives of the Course:

- to provide a solid foundation in numerical methods for solving engineering and scientific problems.
- to develop the ability to analyse errors, stability, and convergence of numerical algorithms.
- to teach the formulation and solution of nonlinear equations, systems of equations, interpolation, numerical differentiation, and integration.
- to gain practical experience implementing numerical algorithms using modern engineering tools such as MATLAB or equivalent programming languages.
- to strengthen analytical thinking and problem-solving skills required for advanced engineering applications.

Learning Outcomes

When this course has been completed the student should be able to		Assess.
1	Apply mathematical foundations to formulate and solve engineering problems using appropriate numerical methods	1,3,6
2	Analyze and evaluate errors, stability, and convergence of numerical algorithms to ensure accuracy and reliability of computational results	1
3	Develop and implement numerical algorithms for solving nonlinear equations, systems of equations, interpolation, differentiation, and integration problems using modern computational tools	1,3,6
4	Select and justify appropriate numerical techniques for a given engineering problem considering efficiency, computational cost, and robustness	1
5	Interpret and communicate computational results effectively, demonstrating critical thinking and the ability to use modern engineering software	1,3

Assessment Methods: 1. Written Exam, 2. Assignment, 3. Project/Report, 4. Presentation, 5. Lab Work

Course's Contribution to Program

		CL
1	Ability to understand and apply knowledge of mathematics, science, and engineering	3
2	Ability to design and conduct experiments as well as to analyze and interpret	3
3	Ability to work in multidisciplinary teams while exhibiting professional responsibility and ethical conduct	1
4	Ability to apply systems thinking in problem solving	3
5	Knowledge of contemporary issues while continuing to engage in lifelong learning	3
6	Ability to use the techniques, skills and modern engineering tools necessary for engineering practice	3
7	Ability to express their ideas and findings, in written and oral form	1
8	Ability to design and integrate systems, components or processes to meet desired needs within realistic constraints	1
9	Ability to approach engineering problems and effects of their possible solutions within a well structured, ethically responsible and professional manner	2

CL: Contribution Level (1: Very Low, 2: Low, 3: Moderate, 4: High, 5: Very High)

Course Contents

Week	Chapter	Subject	Exams
1		Introduction to Numerical Analysis	
2		Error Analysis, introduction to iterative methods	
3		Nonlinear Equations: Bisection Method and False Position Methods	
4		Nonlinear Equations: Newton-Raphson and Secant Methods	
5		Solution of Linear Systems: Direct Methods	
6		Solution of Linear Systems: Iterative methods	
7		Polynomial Approximations, Taylor Series	
8			Midterm
9		Interpolation, Lagrange Interpolation	
10		Curve fitting: Least squares line	
11		Curve fitting: Spline functions	
12		Numerical Differentiation	Quiz
13		Numerical Integration	
14		Numerical Optimization	
15			Final

Recommended Sources

- Mathews, J. H., & Fink, K. D. (2008). Numerical methods using MATLAB (3rd ed.). Pearson.
- Sauer, T. (2012). Numerical analysis (2nd ed.). Pearson.
- Burden, R. L., & Faires, J. D. (2010). Numerical analysis (9th ed.). Brooks/Cole.
- Scott, L. R. (2011). Numerical analysis. Princeton University Press.

Assessment

Midterm	25 %
Final exam	45 %
Assignments	10 %
Quiz	15 %
Attendance	5 %

ECTS Allocated Based on the Student Workload

Activities	Number	Duration (hour)	Total Workload (hour)
In-class lecture	13	3	39
Midterm exam	1	2	2
Midterm exam preparation	1	20	20
Final exam	1	2	2
Quiz	1	1.5	1.5
Exam Preparation	3	8	24
Assignment	10	0.5	5
Project/presentation/report writing	0	0	0
Lab and tutorial	12	0.5	6
Self-study	15	3	45
Total Workload			144.50
Total Workload / 30 (h)			4.82
ECTS Credit of the Course			5