University of Nicosia, Cyprus

Course Code	**Course Title**	**ECTS Credits**
MATH-341	Numerical Analysis I	8
Department	**Semester**	**Prerequisites**
Mathematics	Fall	MATH-191,MATH-280, MATH-140
Type of Course	**Field**	**Language of Instruction**
Elective	Mathematics	English
Level of Course	**Year of Study**	**Lecturer(s)**
1st Cycle	3rd	Dr Nectarios Papanicolaou Dr. Marios Christou
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	None

Objectives of the Course:

The main objectives of the course are to:

- Introduce students to the concepts of computational error, floating point arithmetic and asymptotic order.
- Cover in depth the theory and applications of numerical methods for solving nonlinear algebraic equations.
- Discuss direct methods for the solution of systems of linear equations in detail.
- Develop polynomial interpolation and numerical differentiation techniques.
- Introduce students to Numerical Quadrature.
- Discuss the implementation of numerical techniques using high-level programming languages

Learning Outcomes:

After completion of the course students are expected to be able to:

- Use error and asymptotic order of convergence to assess numerical methods
- Implement approximation methods (Bisection, Newton, Secant etc) for finding the solution of nonlinear algebraic equations.
- Apply direct methods to solve linear systems of algebraic equations.
- Use Lagrange and Newton interpolation to approximate functions.
- Utilize finite differences to approximate derivatives of functions.
- Apply fundamental numerical integration methods (Trapezoidal rule, Simpson's and midpoint rules).
- Design numerical algorithms and implement them using high-level programming languages.

Course Contents:

1. Review of Calculus and Introductory Concepts
    a. Taylor's Theorem, the Mean Value and Extreme Value Theorems
    b. Error and Asymptotic Order
    c. Elementary Computer Arithmetic
2. Root Finding
    a. The Bisection Method
    b. Newton's Method
    c. The Secant Method
    d. Fixed Point Iterations
3. Numerical Solution of Linear Systems
    a. Review of Linear Algebra
    b. Gaussian Elimination and Pivoting
    c. Operation Counts
    d. LU Decomposition and the Thomas Algorithm.
4. Approximation of Functions
    a. Lagrange Interpolation
    b. Newton Divided Differences
    c. Hermite Interpolation
    d. Errors in Polynomial Interpolation
5. Numerical Differentiation
    a. Finite Difference Approximations to Derivatives
    b. Truncation Error
6. Numerical Integration
    a. Review of the Riemann Integral
    b. The Trapezoidal Rule
    c. Simpson's Rule
    d. The Midpoint Rule

Learning Activities and Teaching Methods:

Lectures, Homework and Programming Assignments

Assessment Methods:

Homework, Mid-Term Exam, Programming Assignments, Final Exam

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
J. F. Epperson	An Introduction to Numerical Methods and Analysis (Revised Edition)	Wiley	2007	0470922486

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
R. L. Burden, J. D. Faires	Numerical Analysis (9^{th} edition)	Brooks-Cole	2010	0538733519
K.Atkinson, W. Han	Elementary Numerical Anaysis (3^{rd} edition)	Wiley	2004	0471433373