National University of Engineering (UNI)
School of Computer Science
Syllabus 2024-II

1. COURSE

MA106FCCS. Numerical Methods (Mandatory)

2. GENERAL INFORMATION

2.1 Course	:	MA106FCCS. Numerical Methods
2.2 Semester	:	4^{th} Semester.
2.3 Credits	:	3
2.4 Horas	:	2 HT; 2 HP;
2.5 Duration of the period	:	16 weeks
2.6 Type of course	:	Mandatory
2.7 Learning modality	:	Face to face
2.8 Prerrequisites	:	MA103FCCS. Differential Calculus. (2^{nd} Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

Numerical methods are essential in computer science for approximating solutions to mathematical problems that cannot be solved analytically. This course provides an introduction to the most common numerical methods, including equation solving, interpolation, numerical integration, and the solution of differential equations.

5. GOALS

- Understand the importance of numerical methods in solving computational problems.
- Apply different numerical methods to approximate solutions to mathematical problems.
- Analyze the accuracy and efficiency of the numerical methods used.

6. COMPETENCES

1) Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions. (Assessment)

6) Apply computer science theory and software development fundamentals to produce computing-based solutions. (Assessment)

AG-C07) Computing Knowledge: Applies appropriate knowledge of mathematics, science, and computing. (Assessment)

AG-C12) Applies computer science theory and software development fundamentals to produce computer-based solutions. (Assessment)

7. TOPICS

Unit 1: Introduction to Numerical Methods (4 hours)	
Competences Expected: 1,6,AG-C07	
Topics	**Learning Outcomes**
• Computer representation of numbers. • Round-off and truncation errors. • Error propagation. • Analysis of stability and convergence.	• Explain how numbers are represented in a computer and the limitations of this representation. [Familiarizarse] • Differentiate between round-off and truncation errors. [Usar] • Analyze how errors propagate in numerical calculations. [Evaluar]
Readings : [CC15], [BF10]	

Unit 2: Solving Nonlinear Equations (8 hours)	
Competences Expected: 1,6,AG-C07	
Topics	**Learning Outcomes**
• Bisection method. • Newton-Raphson method. • Secant method.	• Apply the bisection method to find roots of equations. [Familiarizarse] • Use the Newton-Raphson method to approximate solutions. [Usar] • Implement the secant method to solve nonlinear equations. [Evaluar]
Readings : [CC15], [BF10]	

Unit 3: Interpolation and Polynomial Approximation (8 hours)	
Competences Expected: 1,6,AG-C07	
Topics	**Learning Outcomes**
• Lagrange polynomial interpolation. • Newton interpolation. • Splines.	• Construct Lagrange interpolating polynomials. [Familiarizarse] • Apply Newton interpolation. [Usar] • Use splines to approximate functions. [Evaluar]
Readings : [CC15], [BF10]	

Unit 4: Numerical Integration (8 hours)	
Competences Expected: 1,6,AG-C07	
Topics	**Learning Outcomes**
• Trapezoidal rule. • Simpson's rule. • Gaussian quadrature.	• Apply the trapezoidal rule to approximate integrals. [Familiarizarse] • Use Simpson's rule to calculate integrals numerically. [Usar] • Apply Gaussian quadrature for numerical integration. [Evaluar]
Readings : [CC15], [BF10]	

Unit 5: Numerical Solution of Ordinary Differential Equations (8 hours)	
Competences Expected: 1,6,AG-C07	
Topics	**Learning Outcomes**
• Euler's method. • Runge-Kutta methods.	• Apply Euler's method to approximate solutions of ODEs. [Familiarizarse] • Implement Runge-Kutta methods to solve ODEs numerically. [Usar]
Readings : [CC15], [BF10]	

Unit 6: Applications in Computing (12 hours)	
Competences Expected: 1,6,AG-C07,AG-C12	
Topics	**Learning Outcomes**
• Simulation of physical systems. • Scientific modeling. • Machine learning (e.g., model optimization).	• Use numerical methods to simulate physical systems. [Familiarizarse] • Apply numerical methods in scientific modeling. [Usar] • Implement numerical methods in machine learning algorithms. [Evaluar]
Readings : [CC15]	

8. WORKPLAN

8.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

8.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

8.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

9. EVALUATION SYSTEM

********* EVALUATION MISSING ********

10. BASIC BIBLIOGRAPHY

[BF10] Richard L. Burden and J. Douglas Faires. *Numerical Analysis*. Cengage Learning, 2010.

[CC15] Steven C. Chapra and Raymond P. Canale. *Numerical Methods for Engineers*. McGraw-Hill Education, 2015.