Course Title:	**Algorithmics of numerical analysis**
Course Code:	CSE142
Program:	Master Degree In Computer Engineering
Department:	Computer Engineering
Course coordinator:	Dr. Mohamed Fadhel SAAD
Institution:	Private Higher School of Engineers of Gafsa (ESIP)

A. Course Identification

1. Credit hours: 3 (1.5-0-1.5)

2. Course type

a. College ☐ Department ■ Others ☐

b. Fundamental ■ Transversal ☐ Optional ☐

3. Level/year at which this course is offered: 1.1/3

4. Pre-requisites for this course (if any): Mathematical Foundations (Linear Algebra,Discrete Mathematics), data structure, Basic Programming Knowledge.

1. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Self-study	Total workload
1	**Traditional classroom**	…..	33	78
2	**Blended**	45		
3	**E-learning**	.....		
4	**Distance learning**	.....		
5	**Other ()**	.....		

2. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	12.5
2	**Laboratory/Studio**	22.5
3	**Tutorial**	10
4	**Others** (specify)	-
	Total	45

B. Course Objectives and Learning Outcomes

Course Description

This course introduces numerical methods for solving mathematical problems, including interpolation, nonlinear equations, numerical integration, and differential equations. Students will learn to analyze and implement these methods using programming tools like Python or MATLAB for real-world applications in computing, engineering, and data science.

Course Main Objective

This course aims to:

- ✓ Understand fundamental numerical techniques for solving mathematical problems.
- ✓ Analyze and implement interpolation, integration, and equation-solving methods.
- ✓ Apply numerical methods in programming environments to solve real-world computational challenges.
- ✓ Evaluate the efficiency, accuracy, and stability of numerical algorithms.

1. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	✓ Explain and apply numerical methods for solving equations, interpolation, and integration.	PLO.K1
	Skills	
1.3	✓ Develop and implement numerical algorithms using Python or MATLAB for computational problem-solving.	PLO.S1
5.1	✓ Analyze the efficiency and stability of numerical techniques in real-world scenarios.	PLO.S5

C. Course Content

No	List of Topics	Contact Hours
1	**Chapter 1: Numerical Interpolation** 1. Polynomial interpolation 2. Divided differences 3. Error analysis in interpolation 4. Applications in numerical interpolation	4.5
2	**Chapter 2: Numerical Solution of Nonlinear Equations** 1. Bisection method 2. Lagrange method 3. Newton's method 4. Method comparison and convergence analysis	4.5
3	**Chapter 3: Numerical Integration** 1. Basic Newton-Cotes formulas	3

No	List of Topics	Contact Hours
	2. Composite Newton-Cotes formulas 3. Gaussian quadrature (Gauss-Legendre) 4. Applications in numerical integration	
4	**Chapter 4: Numerical Solution of Differential Equations – Single-Step Methods** 1. Euler's method 2. Runge-Kutta methods 3. Consistency, stability, and convergence 4. - Case studies in ordinary differential equations (ODEs)	3
5	**Chapter 5: Numerical Solution of Differential Equations – Multi-Step Methods** 1. Adams-Bashforth methods 2. Adams-Moulton methods 3. Comparative analysis of multi-step methods	3
	Tutorials: Tutorial 1: Interpolation and Approximation Tutorial 2: Numerical Equation Solving Tutorial 3: Numerical Integration Tutorial 4: Single-Step Methods for Differential Equations Tutorial 5: Multi-Step Methods	12
6	**Practical work:** Lab 1: Polynomial Interpolation and Error Analysis Lab 2: Root Finding Methods Lab 3: Numerical Integration Techniques Lab 4: Solving Differential Equations (Single-Step Methods) Lab 5: Multi-Step Methods for Differential Equations	15
Total		45

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding**		
K1	✓ Explain and apply numerical methods for solving equations, interpolation, and integration.	- Lectures - Class discussions	Assignments, Exams

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.0	**Skills**		
S1	Develop and implement numerical algorithms using Python or MATLAB for computational problem-solving.	- Lectures - Class discussions - Assignments - projects	Assignments, Report, Quizzes, Exams
S2	✓ Analyze the efficiency and stability of numerical techniques in real-world scenarios.	- Lectures - Class discussions - Assignments - projects	Assignments, Report, Quizzes, Exams

2. Assessment Tasks for Students

	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Practical Work (written or oral)	Weekly	15%
2	Quizzes, Homework assignments	Random	10 %
3	First mid Term	8	25%
4	Final Exam	16	50%

E. Student Academic Counselling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:
1- Office hours 2- Blackboard interface

F. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	1. Jean-Paul Chehab, Interpolation polynomiale. Universite de Picardie Jules Vernes LAMFA CNRS 6140 2. Burden, Richard L., and J. Douglas Faires. Numerical Analysis. Cengage Learning, 2016 3. Quarteroni, Alfio, and Riccardo Sacco. Numerical Mathematics. Springer, 2014,.
Essential References Materials	NA
Electronic Materials	1. MIT OpenCourseWare – Numerical Methods 2. Python for Numerical Computation (NumPy, SciPy, and Matplotlib) 3. Matlab Online Documentation & Tutorials
Other Learning Materials	NA

2. Facilities Required

Item	Resources
Accommodation	**Classroom board** **Computer lab with the necessary software** **Internet access**
Technology Resources	**Data projector**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment.	Students, course coordinator, Alumni, Employers	Direct/Indirect
Extent of achievement of course learning outcomes.	Faculty, Program Leaders, quality department	Direct
Quality of Learning resources	Faculty, Program Leaders,	Direct, Indirect
Teaching and learning quality and effectiveness.	Students, Faculty Program Leaders,	Direct, Indirect

H. Specification Approval Data

Council / Committee	Computer Engineering Council
Date	11/09/2023