Course Title:	**Engineering mathematics**
Course Code:	CSE111
Program:	Master Degree In Computer Engineering
Department:	Computer Engineering
Course coordinator:	Adel DALLALI
Institution:	Private Higher School of Engineers of Gafsa (ESIP)

A. Course identification

1. Credit hours: 3 (2-1-0)

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): Undergraduate analysis, Basic Mathematics, Preparatory Cycle, Fundamental concepts of signal processing

1. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Self-study	Total workload
1	**Traditional classroom**	…..	35	80
2	**Blended**	45		
3	**E-learning**	.....		
4	**Distance learning**	.....		
5	**Other ()**	.....		

2. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	30
2	**Laboratory/Studio**	-
3	**Tutorial**	15
4	**Others** (specify)	-
	Total	45

B. Course Objectives and Learning Outcomes

Course Description

This course provides computer engineering students with the mathematical foundation needed for signal processing and systems analysis. It covers key concepts such as signals, systems, Fourier transforms, distributions, and linear time-invariant (LTI) systems. Students will also learn about sampling, quantization, encoding, and how signals are processed in digital systems.
The course introduces practical applications in audio, video, and communication systems, with a focus on filter design and frequency analysis. Students will apply these concepts in CSE113, where they will use MATLAB to model and analyze signals, gaining hands-on experience in digital signal processing, spectral analysis, and data compression.

Course Main Objectives

- ✓ Build a mathematical foundation for understanding signals and systems in both continuous and discrete forms.
- ✓ Introduce Fourier Transform and distributions to analyze signals in the frequency domain and their applications in engineering and communication systems.
- ✓ Explain linear time-invariant (LTI) systems and filters, focusing on signal processing in audio, video, and communication.
- ✓ Teach signal sampling, quantization, and encoding, including PCM, Delta modulation, and digital signal reconstruction.
- ✓ Introduce Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) for digital signal processing, image, and audio analysis.
- ✓ Ensure hands-on practice in MATLAB (CSE113) to apply these mathematical concepts in real-world signal processing.

1. Course Learning Outcomes

CLOs		Aligned PLOs
	Knowledge and understanding	
1.1	✓ Demonstrate an understanding of engineering mathematics, including signals, systems, transformations, and filters, and apply this knowledge to solve complex problems in signal processing and system analysis.	PLO.K1
	Skills	
2.1	✓ Effectively communicate mathematical and engineering concepts, present analytical results in a clear and organized manner, and collaborate with others for problem solving and technical discussions.	PLO.S2
7.1	✓ Analyze, design, and develop computational solutions to signal processing problems, using software tools such as MATLAB (in	PLO.S7

CLOs		Aligned PLOs
	CSE113) for simulation, signal transformation, and digital system analysis.	

C. Course Content

No	List of Topics	Contact Hours
1	**Chapter 1: General Concepts** 1. Introduction to fundamental concepts of signals and systems. 2. Types of signals (discrete, continuous) and their characteristics. 3. Definitions of linear and time-invariant systems. 4. Basic concepts of transformations and filters.	5
2	**Chapter 2: Fourier Transform of Functions (Frequency Representation of Signals)** 1. introduction 2. Definition and properties of the Fourier Transform. 3. Frequency domain interpretation of signals and their spectrum. 4. Applications in signal analysis: filtering, modulation, data compression. 5. Examples of Fourier Transform for continuous-time signals.	5
3	**Chapter 3: Distributions**: 1. introduction to distributions in applied mathematics. 2. Generalized functions: Dirac Delta, Heaviside distribution. 3. Applications of distributions in physical system modeling and signal processing. 4. Use of distributions in differential and integral equations.	5
4	**Chapter 4: Linear Continuous Invariant Systems (Filters):** 1. introduction 2. Theory of linear and time-invariant systems (LTI). 3. System response to sinusoidal input. 4. Design and analysis of continuous filters: low-pass, high-pass, band-pass filters. 5. Applications of filters in audio, video, and communication signal processing.	5
5	**Chapter 5: Sampling, Quantization, Encoding, and Signal** 1. Introduction 2. Reconstruction (From Continuous to Digital Signal)	5

No	List of Topics	Contact Hours
	3. Sampling theory: Nyquist-Shannon theorem. 4. Signal quantization and encoding: Pulse Code Modulation (PCM), Delta modulation. 5. Reconstruction of sampled signals. 6. Effects of sampling and quantization on the quality of digital signals.	
6	**Chapter 6: Discrete Signals and Discrete Fourier Transform (DFT):** 1. Introduction 2. Discrete-Time Fourier Transform (DTFT). 3. Introduction and properties of the Discrete Fourier Transform (DFT). 4. Fast Fourier Transform (FFT) algorithm. 5. Applications of DFT in digital signal processing: spectral analysis, image and audio compression. 6. Comparison between DTFT and DFT, practical use cases.	5
10	**Tutorials:** ✓ Fundamentals of Signals, Systems, and Transformations ✓ Fourier Transform and Frequency Domain Analysis ✓ Sampling, Quantization, and Signal Reconstruction ✓ Linear Time-Invariant Systems and Filters ✓ Discrete Fourier Transform (DFT)	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**		
PLO.K1	✓ Demonstrate a strong understanding of engineering mathematics, including signals, systems, transformations, and filters, and apply this knowledge to solve complex problems in signal processing and system analysis.	- Lecturing - Class discussions	- Assignments - Quizzes - Exams
2.0	**Skills**		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
PLO.S2	✓ Effectively communicate mathematical and engineering concepts, present analytical results in a clear and organized manner, and collaborate with others in problem solving and technical discussions.	- Lecturing - Class discussions - projects	- Assignments, - Quizzes - Exams
PLO.S7	✓ Analyze, design, and develop computational solutions to signal processing problems, using software tools such as MATLAB (in CSE113) for simulation, signal transformation, and digital system analysis.	- Lecturing - Class discussions - projects	- Assignments - Quizzes - Exams

2. Assessment Tasks for Students

	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Practical Work (written or oral)	Weekly	00 %
2	Quizzes, Homework assignments	Random	10%
3	First mid Term	8	25%
4	Final Exam	16	65%

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. Alan V. Oppenheim & Ronald W. Schafer – *Digital Signal Processing, Pearson, 2010.* 2. Simon Haykin & Barry Van Veen – *Signals and Systems, Wiley, 2014.* 3. Benoit B. Mandelbrot – *Fractals and Scaling in Finance, Springer, 1997.*
Essential References Materials	NA
Electronic Materials	▪ MATLAB & Simulink Documentation (MathWorks). ▪ Online lecture notes on digital signal processing (MIT OpenCourseWare).

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, Faculty, Program Leaders, Peer Reviewer	Direct/Indirect
Extent of achievement of course learning outcomes.	Faculty, Program Leaders, Peer Reviewer	Direct, Indirect
Quality of Learning resources	Faculty, Program Leaders, Peer Reviewer	Direct, Indirect
Teaching and learning quality and effectiveness.	Students, Faculty Program Leaders, Peer Reviewer	Direct, Indirect

H. Specification Approval Data

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