Birla Institute of Technology & Science, Pilani
Hyderabad Campus

SECOND SEMESTER 2024 - 2025
COURSE HANDOUT (PART II)

Date: 06-01-2025

In addition to Part I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course No	**: EEE / ECE / INSTR F243**
Course Title	: **Signals & Systems**
Instructor-in-charge	**: Prof. Nitish Kumar Gupta**
Instructors	**: Prof. Nitish Kumar Gupta, Prof. BVVSN Prabhakar Rao, Prof. Venkateswaran Rajagopalan, Prof. Subhendu Kumar Sahoo**

1. 1: Scope and Objective:

This course introduces the fundamental principles of signals and system analysis. These concepts form the building blocks of digital signal processing, communication, and control systems. Hence, a sound understanding of these principles is necessary for all students of Electronics and Communication Engineering (ECE), Electrical and Electronics Engineering (EEE), and Instrumentation Engineering (INSTR). The students must review the following mathematical topics: Calculus, Complex variables, Statistics, Fourier Series, and Fourier & Laplace Transforms.

1.2: Learning outcomes:

On completion of this course, students should be able to:

1. **Represent** both continuous-time and discrete-time signals as a Fourier series.
2. **Use** the Fourier transform and the Laplace transform to analyze continuous-time signals and systems.
3. **Explain** the importance of superposition and convolution in the analysis of linear time invariantsystems.
4. **Demonstrate** an understanding of the relationship between the stability and causality of systems and the region of convergence of their Laplace transforms
5. **Use** the discrete-time Fourier transform and the z-transform to analyze discrete-time signals and systems
6. **Use** the FFT algorithm.

2. Text Book:

T1: Lathi B P, Principles of *Signal Processing & Linear Systems* Oxford University Press, 2009.

3. Reference Books:

R1: A V Oppenheim, A S Willsky, Nawab S N, *"Signals & Systems"*, PHI, Second Edition, 2006

R2: Nagrath I J, Sharan S N, Ranjan Rakesh & Kumar S, S*ignals & Systems*, Second Edition TMH, 2001.

4. Course Plan:

Lecture No.	Learning Objectives	Topics to be covered	Chapter in the Text Book
1	Importance of the signals & Systems course	Introduction to course	-------
2 - 4	Introduction about function, understanding different types of continuous-time signals, and performing different time signal operations	Classification of Signals & Signal operations	Class notes and T1: 1.1 - 1.5
5	Defining various systems	Classification of Systems	Class notes and T1: 1.6 & 1.7
6-7	Obtaining LTI system output for any arbitrary input signal using impulse response	Linear Time-Invariant (LTI) Systems, Properties of LTI Systems**,** Linear convolution (LC) & LC using Fourier Transform	Class notes and T1: 2.4 & 4.3-6
8-10	Signal representation using basis signals	Orthogonal Signal set & Fourier series	Class notes and T1 :3.3 T1: 3.4 - 3.5 (self-study)
11-14	Synthesize and analysis of various continuous-time signals	Aperiodic Signal Representation, Fourier Transforms & their properties	Class notes and T1: 4.1-4.3 (exclude : 4.3-6)
15 - 16	Studying exponentially growing signals and analyzing stable systems	Laplace transform & its properties	Class notes and T1: 6.1 - 6.2
17	Analyzing stable systems	Solution of LTI continuous-time systems using Laplace transforms	Class notes and T1: 6.3
18 - 20	Sampling of continuous-time signals and their recovery	Sampling & reconstruction	Class notes and T1: 5.1
21 - 22	Understanding different types of discrete-time signals and performing different time signal operations	Discrete-time signals & Signal operations	Class notes and T1: 8.1 - 8.4
23 - 24	Synthesize and analysis of various discrete-time signals	Discrete-Time Fourier Transform & its properties	Class notes and T1: 10.2 - 10.5
25 – 26	Analysis of discrete-time systems	Z-transforms & its properties	Class notes and T1 : 11.1 – 11.2
27 – 28	Z-transform solution of Linear difference equation	Z-transforms converting difference equations into algebraic equations	Class notes and T1 : 11.3
29 -31	Numerical computation of Discrete Fourier transform	DFT & its properties	Class notes and T1: 5.2
32- 33	Obtaining output for discrete time systems for any arbitrary discrete input signal	Discrete-time systems, Discrete-time convolution (graphical procedure)	Class notes and T1 : 9.4-1
34 - 36	DFT method using FFT algorithms	Fast Fourier Transform, DIT FFT & DIF FFT algorithms	Class notes and T1: 5.3

37 - 40	DFT & IDFT using FFT algorithms	DFT using FFT & Inverse DFT, Discrete-time convolution using FFT	Class notes and T1 : 10.6
41- 42	Study of the frequency response of different systems	Introduction to analog filters	Class notes and T1: 7.1, 7.4 & 7.5

***The primary reference for the coverage (breadth and depth)/nomenclature/notations for a particular topic would be as per the lecturers/tutorials. Students are advised to take class notes during the lectures.**

5. Evaluation Scheme (CB-Closed book and OB-Open Book)

EC No.	Evaluation Component	Time Duration (min)	Weightage (%)	Marks	Date & Time	Nature of Component
1	Midsem Exam	90	30	60	03/03 2.00 - 03.30PM	OB
2	Quizzes	TBA	30	60	To be announced (TBA) in Class	CB
3	Comprehensive	180	40	80	02/05FN	CB
	Total		**100**	**200**		

6. Chamber Consultation Hours: To be announced in the class.

7. Make-up Policy:

Make-up for the midterm will be granted as per institute rules and regulations (in case of sickness, it should be supported by a valid medical certificate endorsed by the Hostel warden as per AUGSD rules). In all cases, prior intimation from IC is necessary. No make-up will be given for the quizzes.

8. Notices: Notices regarding the course will be displayed in LMS/ Google Classroom.

9. Academic Honesty and Integrity Policy: Academic honesty and integrity should be maintained by all the students throughout the semester, and no type of academic dishonesty is acceptable.

Prof. Nitish Kumar Gupta
Instructor-in–charge