**BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI-Hyderabad Campus SECOND SEMESTER 2023 - 2024**

**COURSE HANDOUT (PART II)**

## Date: 09-01-2024

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* : Pratyush Chakraborty**

# Instructors : Pratyush Chakraborty,

# Venkateswaran Rajgopalan,

# Rajesh K. Tripathy,

# Sumit K. Chatterjee

**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 are required to review following mathematical topics: **Fourier Series, Fourier Transforms, Laplace Transform, Calculus, Complex variables and Statistic**s.

# 1.2: Learning outcomes:

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

## **Represent** both continuous-time and discrete-time signals as a Fourier series.

1. **Use** the Fourier transform and the Laplace transform to analyze continuous-time signals and systems.
2. **Explain** the importance of superposition and convolution in the analysis of linear time invariant systems.

## **Demonstrate** an understanding of the relationship between the stability and causality of systems and the region of convergence of their Laplace transforms

1. **Use** the discrete-time Fourier transform and the z-transform to analyze discrete-time signals and systems
2. **Use** FFT algorithm

# Text Book:

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

# 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.

# Course Plan:

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| --- | --- | --- | --- |
| **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 |
| 5-6 | 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 |
| 7 | Defining various systems | Classification of Systems, | Class notes and  T1: 1.6 & 1.7 |
| 8-9 | Obtaining of 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 |
| 10-11 | Signal representation using basis signals | Orthogonal Signal set & Fourier series | Class notes and  T1 :3.3  T1: 3.4 - 3.5 (self-  study) |
| 12-14 | Synthesize and analysis of various continuous time signals | Aperiodic Signal Representation, Fourier  Transforms & its 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 | Synthesize and analysis of various discrete time signals | Discrete Time Fourier Transform & its properties | Class notes and  T1: 10.2 - 10.5 |
| 23 – 24 | Analysis of discrete time systems | Z-transforms & its properties | Class notes and  T1 : 11.1 – 11.2 |
| 25 – 26 | z-transform solution of Linear difference equation | Z-transforms converting  difference equations into algebraic equations | Class notes and  T1 : 11.3 |
| 27 -28 | Numerical computation of  Discrete Fourier transform | DFT & its Properties | Class notes and  T1: 5.2 |
| 29- 30 | 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 |
| 31 - 33 | DFT method using FFT  algorithms | Fast Fourier Transform, DIT  FFT & DIF FFT algorithms | Class notes and  T1: 5.3 |

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| 34 - 37 | DFT & IDFT using FFT algorithms | DFT using FFT & Inverse  DFT, Discrete-time convolution using FFT | Class notes and  T1 : 10.6 |
| 38- 42 | Study of 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.**

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

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| --- | --- | --- | --- | --- | --- | --- |
| **EC**  **No.** | **Evaluation Component** | **Time Duration**  **(min)** | **Weightage (%)** | **Marks** | **Date & Time** | **Nature of Component** |
| 1 | Midsem Test | 90 | 30 | 60 | 15/03 - 9.30 - 11.00AM | OB |
| 2 | Quizzes | TBA | 30 | 60 | To be announced (TBA) in Class | CB |
| 3 | Comprehensive | 180 | 40 | 80 | 16/05 FN | CB |
|  | **Total** |  | **100** | **200** |  |  |

1. **Chamber Consultation Hours:** To be announced in the class.

# Make-up Policy:

Make-up for the midterm will be granted as per ID rules and regulations (in case of sickness it should be supported by a medical certificate endorsed by Hostel warden as per AUGSD rules). In all cases prior intimation must be given to IC.

## **Notices**: Notices regarding the course will be displayed in CMS/ Google Classroom.

1. **Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

# Instructor-in–charge