FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **BACHELOR OF TECHNOLOGY (Electronics and Communication)**

Semester: **IV**

Course Code: **202060404**

Course Title: **Signals and Systems**

Course Group: Professional Core Course

Course Objectives: To understand the fundamental concept of Signal and System with its properties and operations. It is also aimed to develop better insight among the students regarding the Fourier series and Fourier transform and its application along with filter design.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50/18	50/17	25/9	25/9	150/53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Introduction of signals:** Definition of signal and system, The domain and range variables, continuous and discrete signals, continuous and discrete systems. Cont./discrete vs analog/digital. Signal classification and basic operations, Domain and range operations and transformations, and their effects upon signals. Examples and counter examples.	7
2	**Continuous Time (CT) Systems and Discrete Time (DT) Systems:** Characterization of CT and DT systems: Static and Dynamic systems, Causal and Non-causal system, Linear and Non-linear system, Time variant and invariant system, Stable and unstable system, Invertible and non-invertible system, LTI Systems, Examples.	7

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3	**Convolution and Correlation of Signals:** Evolution of the convolution integral and the convolution sum. Continuous time convolution and Discrete-time Convolution, Algebraic properties of the convolution operation. Block diagram representations for interconnections of systems. Characterizing a system from its impulse response. Characterizing interconnected systems. Auto correlation and Cross correlation of signals, Energy Spectral Density and Power Spectral Density (PSD), Examples.	**7**
4	**Fourier Series and Fourier Transform for Continuous Time Signal:** Vector representation of signal, Orthogonal signal space, Fourier series and its properties, trigonometric and exponential Fourier series, Magnitude and Phase Spectrum, Parseval's Theorem. Continuous time Fourier Transform and its properties.	**8**
5	**Z-Transforms:** The z-Transform, Region of Convergence, Inverse z-Transform, Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot, Properties of the z-Transform, Applications, and examples.	**8**
6	**Analog Filter Design:** Introduction, Classification of filters – LPF, HPF, BPF, BSF, Types of filters – Butterworth, Chebyshev, Elliptic, Bessel, Analytical Approximation, and design.	**8**
		45

List of Practicals / Tutorials:

1	Introduction of MATLAB and various commands for Signal and System perspective.
2	Generate and plot basic signals – Impulse, Unit Step, Ramp, Signum using MATLAB Toolbox. Further generate and plot various complex signals using time shifting, scaling and time reversal properties.
3	Generate the following continuous time domain signal and plot using MATLAB (i) Sine/Cosine signal (ii) Sinc function (iii) Triangle waveform (iv) Rectangular Pulse (v) Sawtooth Waveform (vi) Exponential function
4	To study and verify the following properties of signal/system using MATLAB (i) Linearity (ii) Stability (iii) Time invariant. Find the Energy and Power of the given signal. Separate Even and odd components of given signal and plot respectively.
5	To Study convolution of following different sequences using MATLAB (without using conv command) and plot the resultant signal. (i) Convolution between two rectangular signals. (ii) Convolution between rectangular and Triangular signals. (iii) Convolution between two Triangular signals.
6	To Study the Fourier series of Square, Sawtooth and Triangular waves using MATLAB and LabVIEW.
7	To Study Fourier Transform of a signal using FFT and IFFT command and plot magnitude and phase spectra of a signal using MATLA/LabVIEW.
8	To study Convolution Property of Fourier transform for signal using MATLAB / LabVIEW.
9	To study Correlation and Auto correlation of signal using MATLAB/LabVIEW.
10	To Study Z Transform and plot region of Convergence using MATLAB Toolbox.
11	To study Low Pass, High Pass and Band pass filter using discrete components and plot their characteristic.

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12	**Designed Based Open-Ended Problem:** Develop a small project where real time noisy signal is captured, and noise free signal will be reproduced after processing. [Use signal processing technique to remove noise] **Hint:** LabVIEW/MATLAB can be used for the processing of the captured signal.

Reference Books:

1	Oppenheim, Will sky, and Hamid, **Signals and Systems**, 2nd Edition, Prentice-Hall.
2	A. Anand Kumar, **Signals and Systems**, 3rd Edition, Prentice Hall Publication.
3	B.P. Lathi, **Principal of Signal Processing and Linear system**, 3rd Edition, Oxford Univ. Press.
4	Wai-Kai Chen, **Passive and Active Filters: Theory and Implementations**, 1st Edition, Wiley India.

Supplementary learning Material:	
1	NPTEL Video lectures
2	MIT courseware material.
3	Research papers from reputed Journals (IEEE, Elsevier, Springer etc.)

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
15	40	10	15	10	10	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage

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CO-1	To understand the various applications and operation of signals and systems.	**15**
CO-2	To study the analysis of signal using convolution and correlation functions.	**25**
CO-3	To study the Properties of Fourier and Z-transform and their application in the Communication field.	**20**
CO-4	To study about analysis of continuous time signals and systems.	**20**
CO-5	To develop an understanding for filter designing and its operations.	**20**

Curriculum Revision:	
Version:	**2.0**
Drafted on (Month-Year):	June -2022
Last Reviewed on (Month-Year):	-
Next Review on (Month-Year):	June-2025

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