GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3150912

Semester – V
Subject Name: Signals and Systems

Type of course: Engineering Science Course

Prerequisite:

Rationale: Automation in industries and domestic level has made engineers to understand about various systems and signals. The interfacing of the machines with the different controllers specifically needs to calculate and estimate the basics about the signals and systems. Every domain expects engineers to be fundamentally clear about the signals and systems. This subject clears mainly the classification of the signals and systems with their various time and frequency domain analysis for future applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Introduction to Signals and Systems:** Signals and systems everyday life, biomedical, instrumentation domestic and industries. Representations of Signals, Classifications of Signals – Continuous time, Discrete time, comparison among Analog, Digital and Discrete Signals, Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, and the complex exponential. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.	**06**
2	**Mathematical operations on Signals and Systems:** Addition, subtraction, multiplication and division of the signals, parallel and series combinations of the systems, cascading of the systems,impulse response characterization and convolution integral for CT- LTI system, signal responses to CT-LTI system, properties of convolution, LTI system response properties from impulse response, Examples. Impulse response characterization and convolution sum, Causal signal response to DT-LTI systems. Properties of convolution summation, Impulse response of DT-LTI system. DT-LTI system properties from Impulse response. System analysis from difference equation model, examples.	**10**
3	**Fourier, Laplace and z-transforms:** Representation of periodic functions, Fourier series, Frequency spectrum of aperiodic	**14**

	signals, Fourier Transform, Relation between Laplace Transform and Fourier Transform and its properties. Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.	
4	**Sampling & reconstruction:** The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.	**05**
5	**Applications based on IoT:** Introduction of the Internet of Things, Types of sensors, Types of actuators, Introduction of Arduino Interfacing of the sensors and actuators with Arduino. Programming in Arduino. Signals storage and its analysis using Arduino, Design of a minor project based on Arduino.	**05**

Suggested Specification table with Marks (Theory): (For PDDC only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	**20**	**30**	**10**	**5**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

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.

Reference Books:

1. Signals and Systems by Alan V. Oppenheim, Alan S. Wilsky and Nawab, Prentice Hall
2. Signals and Systems by K. Gopalan, Cengage Learning (India Edition)
3. Signals and Systems by Michal J. Roberts and Govind Sharma, Tata Mc-Graw Hill Publications
4. Signals and Systems by Simon Haykin and Bary Van Veen, Wiley- India Publications
5. Linear Systems and Signals by B.P.Lathi, Oxford University Press
6. Signal, Systems and Transforms by Charles L. Philips, J. M. Parr and E. A. Riskin, Pearson Education
7. Signal and Systems by Anand Kumar, 3rd Edition, PHI
8. Internet of Things: Technologies, Applications, Challenges and Solutions by B. K. Tripathy & J. Anuradha, CRC Press, 2017.

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Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Describe the type of system and signal in Industries and Domestic level for Interfacing.	40
CO-2	Derive mathematical model of the systems and signals for the applications.	30
CO-3	Analyze the response of system for the efficient usage of the systems.	15
CO-4	Design of the system from the available input signals and expected output signals of the industrial model.	15

List of Experiments:

1. Generations and capturing various continuous time signals from sensors.
2. Generation and capturing of discrete time signals and plot them.
3. Discretization using different sampling rate and observing aliasing effect.
4. Observing the effects of lower sampling rate and higher sampling rate on CT signal.
5. Performing various operations on the signal using circuits and computational software.
6. Using digital circuit building block to perform operations on signals.
7. Simulation of continuous time LTI system.
8. Simulation of discrete time LTI systems.
9. Obtaining impulse response of the systems.
10. Computing FT and DTFT of the CT signals and DT sequences.
11. Interfacing of the IR sensors and measurement of distance using arduino.
12. Automation of single phase load using Arduino.

Design based Problems (DP)/Open Ended Problem:

1. Design of active noise removal / cancellation circuit.
2. Design of digital building blocks to perform various operations on discrete time sequences and singals.
3. Design of efficient and accurate signal converter.
4. Design of sample and hold circuits
5. Design of a system for the Industrial applications from the input and out put signals.

Major Equipments:

Analog & Digital signal generator kits, CRO, DSO, Mathematical operations kit using OPAMP, sensors, actuators, Arduino and necessary interfacing wires, relays, switches, etc.

List of Open Source Software/learning website:

- http://www.scilab.org/
- http://www.gnu.org/software/octave/
- http://www.vlab.co.in
-http://www.arduino.cc