GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3724707
Semester – II
Subject Name: Mechatronics Signal Processing (Prog. Elective – IV)

Type of course: Engineering

Prerequisite: N.A.

Rationale: This subject deals with fundamentals of Signal Processing and its applications, which are useful for Mechatronics engineers.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				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: Signals, systems and signal processing, classification of signals, elements of digital signal processing system, concept of frequency in continuous and discrete time signals, Periodic Sampling, Frequency domain representation of sampling, sampling low pass signals, sampling bandpass signals, spectral inversion in bandpass sampling, general applications of DSP	**06**
2	Discrete-Time Signals and Systems: Discrete-Time Signals, Discrete-Time Systems, LTI Systems, Properties of LTI Systems, linear convolution and its properties, Linear Constant Coefficient Difference equations.	**05**
3	The Z- Transform and its Application in to Analysis of LTI System: Z-Transform, Properties Z-transform, Rational Z-transform, the inverse Z-transform methods, Analysis of LTI systems in Z domain	**06**
4	Discrete-Fourier Transform and Fast Fourier Transform: Discrete Fourier transform and its properties, Inverse DFT, Fourier Transform of Periodic Signals, Linear Convolution using DFT, efficient computation of DFT:FFT, Frequency analysis of continues and discrete time signal, Properties of discrete time Fourier Transform, and correlation of signals, Fourier Transform Theorem	**08**
5	Filter Design Techniques: Design of Discrete-Time IIR filters from Continuous-Time filters Approximation by derivatives, Impulse invariance and Bilinear Transformation methods; Design of FIR filters by windowing techniques, Illustrative design examples of IIR and filters	**07**
6	Signal Processing Techniques for Mechatronics Engineers : Envelope Analysis, Adaptive Filters, Introduction of random signal, Correlation functions,	**07**

	Spectral density function.	

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

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	**30**	**20**	**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. "Digital Signal Processing: Principles, Algorithm & Application", 4th edition, Proakis, Manolakis, Pearson
2. "Understanding Digital Signal Processing", 2nd edition, Richard G Lyons, Pearson Education
3. Digital Signal Processing: A Computer-Based Approach, S K Mitra, McGraw-Hill
4. Discrete Time Signal Processing, Oppenheim, Schafer, Buck Pearson education publication, 2nd Edition, 2003.
5. Fundamentals of Signal Processing for Sound and Vibration Engineers, Kihong Shin Joseph K. Hammond John Wiley & Sons, Ltd.

Course Outcomes:

After learning the course the students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Represent discrete-time signals analytically and visualize them in the time domain.	30
CO-2	Understand the meaning and implications of the properties of systems and signals.	20
CO-3	Understand the Transform domain and its significance and problems related to computational complexity.	30
CO-4	Specify and design any digital filters using MATLAB.	20

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List of Experiments:

The experiments will be carried out using MATLAB / Labview software. Experiments will be based on

1. Signal generation: Periodic Signal generation and Random signal generation
2. Study of discretization of signals and implementation
3. Implement Z transform of signal
4. Study and analyze DFT of signal
5. Study of DFT properties
6. Evaluate FFT of given signal
7. Study and understand implementation of FIR and IIR filters
8. Signal capturing from actual system and processing
9. Study the role of adaptive filtering
10. Envelope analysis of actual signal

Major Equipment:

MATLAB/Labview software

List of Open Source Software/learning website:

NPTEL