GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171003

Semester – VII
Subject Name: Digital Signal Processing

Type of course: Professional Core Course

Prerequisite: Signal and System and Mathematics

Rationale: The primary objective of this course is to provide a thorough understanding and working knowledge of design, implementation and analysis DSP systems.

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	**Discrete-Time Signals and Systems:** Discrete-Time Signals, Discrete-Time Systems, LTI Systems, linear convolution and its properties, Linear Constant Co- efficient Difference equations, Frequency domain representation of Discrete-Time Signals & Systems, Representation of sequences by discrete time Fourier Transform, (DTFT), correlation of signals	7
2	**The Z- Transform and Analysis Linear Time-of Invariant System:** Z-Transform, Properties of ROC for Z-transform, the inverse Z-transform methods, Z-transforms properties, Analysis of LTI systems in time domain and stability considerations. Frequency response of LTI system, System functions for systems with linear constant-coefficient Difference equations, Freq. response of rational system functions relationship between magnitude & phase, All pass systems, inverse systems, Minimum/Maximum phase systems, systems with linear phase.	10
3	**Structures for Discrete Time Systems:** Block Diagram and signal flow diagram representations of Linear Constant- Coefficient Difference equations, Basic Structures of IIR Systems, Transposed forms, Direct and cascade form Structures for FIR Systems, Effects of Co-efficient quantization.	7
4	**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.	7

5	**Discrete-Fourier Transform:** Representation of Periodic sequences: The discrete Fourier Series and its Properties Fourier Transform of Periodic Signals, Sampling the Fourier Transform, The Discrete-Fourier Transform, Properties of DFT, Linear Convolution using DFT.	**7**
6	**Fast Fourier Transform:** FFT-Efficient Computation of DFT, Goertzel Algorithm, radix2 and radix Decimation-in-Time and Decimation-in-Frequency FFT Algorithms.	**7**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
5	**15**	**15**	**15**	**10**	**10**

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. "Discrete Time Signal Processing":Oppeheim, Schafer, BuckPearson education publication, 2nd Edition, 2003.
3. Digital Signal Processing fundamentals and Applications,Li Tan , Jean Jiang, Academic Press,2nd edition,2013
4. Digital Signal Processing – A computer based Approach, S.K.Mitra, Tata McGraw Hill,3rd edition,2006
5. Fundamentals of digital Signal Processing –Lonnie c.Ludeman, Wiley
6. Digital Signal processing-A Practical Approach,second edition, Emmanuel I. feacher, and BarrieW..Jervis, Pearson Education
7. Digital Signal Processing, S.Salivahanan, A.Vallavaraj, C.Gnapriya TMH
8. Digital Signal Processors, Architecture, programming and applications by B. Venkatramani, M Bhaskar, Mc-Graw Hill

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Course Outcomes:
By the end of this course, the student will be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Formulate engineering problems in terms of DSP tasks	10
CO-2	Analyse digital and analog signals and systems	30
CO-3	Analyse discrete time signals in frequency domain	30
CO-4	Design digital filters	30

List of Experiments:

Sr.No.	Experiment Name
1	Write a program to illustrate: i) The effect of up-sampling in frequency domain. ii) The effect of Interpolation process.
2	Write a program to find the linear convolution of two sequences. i) Without using convolution function. ii) Using function.
3	Write a program to obtain i) Partial fraction expansion of rational Z-transform. ii) Z-transform from partial fraction expansion. iii) Power series expansion of Z-transform. iv) Stability test for Z-transform
4	Write a program to obtain: i) N-point DFT of sequence. ii) N-point IDFT of sequence. iii) Linear convolution by DFT
5	Write a program to design following Butterworth filters. i) Low Pass Filter iii) Band Pass Filter . ii) High Pass Filter iv) Band Reject Filter.
6	Write a program to design following Chebyshev-I filters. i) Low Pass Filter iii) Band Pass Filter. ii) High Pass Filter. iv) Band Reject Filter
7	Write a program to design following Chebyshev-I filters. i) Low Pass Filter iii) Band Pass Filter.

	ii) High Pass Filter iv) Band Reject Filter
8	Write a program to design FIR filter using following window. i) Rectangular window. iv) Blackman window. ii) Kaiser window. v) Hanning window. iii) Bartlett window. vi) Hamming window.
9	Write a program to perform circular convolution of two sequences using DFT.
10	Write a program to demonstrate the time shifting and frequency shifting property of DTFT.

List of Software: Code Composer Studio

List of Open Source Software/learning website:
www.nptel.in
http://ocw.mit.edu,
https://cnx.org/content