



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 C	Examination Marks				Total Marks
L	T	P		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	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



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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": Oppenheim, Schafer, Buck Pearson 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 Barrie W..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-II filters. i) Low Pass Filter iii) Band Pass Filter.



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	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>