



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (Part Time)

Subject Code: 2951102

Semester – V

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	<b>Discrete-Time Signals and Systems:</b> 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	8
2	<b>The Z- Transform and Analysis Linear Time-of Invariant System:</b> 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	<b>Structures for Discrete Time Systems:</b> 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.	8
4	<b>Filter Design Techniques:</b> 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.	8



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5	<b>Discrete-Fourier Transform:</b> 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.	8
6	<b>Fast Fourier Transform:</b> FFT-Efficient Computation of DFT, Goertzel Algorithm, radix2 and radix Decimation-in-Time and Decimation-in-Frequency FFT Algorithms.	8

**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
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, BuckPearson education publication, 2nd Edition, 2003.
3. Digital Signal Processing fundamentals and Applications,Li Tan , Jean Jiang, Academic Press,2<sup>nd</sup> edition,2013
4. Digital Signal Processing – A computer based Approach, S.K.Mitra, Tata McGraw Hill,3<sup>rd</sup> 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

## Course Outcomes:

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



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Sr. No.	CO statement	Marks % weightage
CO-1	Formulate engineering problems in terms of DSP tasks	20
CO-2	Analyse digital and analog signals and systems	20
CO-3	Analyse discrete time signals in frequency domain	10
CO-4	Design digital filters	20
CO-5	Change sampling rate of the signal	10
CO-6	Apply digital signal processing algorithms to various areas	20

## List of Experiments:

Sr.No.	Experiment Name
1	Write a MATLAB program to illustrate: i) The effect of up-sampling in frequency domain. ii) The effect of Interpolation process.
2	Write a MATLAB program to find the linear convolution of two sequences. i) Without using MATLAB convolution function. ii) Using MATLAB function.
3	Write a MATLAB 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 MATLAB program to obtain: i) N-point DFT of sequence. ii) N-point IDFT of sequence. iii) Linear convolution by DFT
5	Write a MATLAB 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 MATLAB program to design following Chebyshev-I filters. i) Low Pass Filter                      iii) Band Pass Filter. ii) High Pass Filter.                      iv) Band Reject Filter



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<b>7</b>	Write a MATLAB program to design following Chebyshev-I filters. i) Low Pass Filter                      iii) Band Pass Filter. ii) High Pass Filter                      iv) Band Reject Filter
<b>8</b>	Write a MATLAB 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.
<b>9</b>	Write a program to perform circular convolution of two sequences using DFT.
<b>10</b>	Write a program to demonstrate the time shifting and frequency shifting property of DTFT.

**List of Software:** MATLAB/Code Composer Studio

**List of Open Source Software/learning website:** MATLAB/Code Composer Studio,  
[www.nptel.edu](http://www.nptel.edu), <http://ocw.mit.edu>, <https://cnx.org/content>