SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B. Tech. Semester V

Subject Name: **Digital Signal Processing and Applications** **Subject Code: BTEC13502**
Type of course: PCC
Prerequisite: Signals & Systems , Mathematics
Rationale: This course aims at introducing the students to the fundamentals of digital signal processing useful for various signal processing applications. The lectures will focus on mathematical principles and the intuitive understanding behind it, and there will be coding based implementation.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. no.	Topics	Teaching Hrs.	Module % Weightage
1.	**Review of Discrete-Time Signals and Systems:** Representation of Discrete-Time signals, Elementary Discrete-time signals, Basic operations on Discrete-time signals, Classification of Discrete-time signals, Review of Discrete-time systems, Classification of Discrete-time systems, Discrete time Convolution and Correlation	6	10
2.	**Review of Discrete Time Transforms:** **Z –Transform -** Z-Transform and its advantages, Convergence of z-Transform, Properties of z-Transform, Inverse z-Transform, Solution of Difference equations using z-Transform. **Review of DTFT -** Relation between DTFT and FT, Relation between DTFT and Z transform.	6	10
3.	**System Realization**: Realization of Discrete-time systems, Structures for the realizations of IIR systems, Structures for the realization of FIR systems.	4	10
4.	**Discrete Fourier Transform:** Relation between DFT and Z transform, Comparison between DTFT and DFT, Computation of DFT and IDFT, Properties of DFT.	6	20

5.	**Fast Fourier Transform (FFT):** Introduction to FFT, Decimation in Time (DIT) radix-2 FFT, FFT, Decimation in Frequency (DIF) radix-2 FFT, Computing 8 point DFT using radix-2 DIF FFT,	4	10
6.	**Filter Design Techniques** **Infinite –duration Impulse Response (IIR) Filters :** Requirement for transformation, Designing IIR filters using methods like an approximation of derivatives, Impulse invariant transformation and Bilinear transformation, **Finite –duration Impulse Response (FIR) Filters:** Characteristics of FIR Filters with linear phase, Frequency response of linear phase FIR filters, Design techniques for FIR filters, Fourier series method, Design of FIR filters using Windowing techniques	10	20
7.	**Introduction to Advance Digital Signal Processing:** Multi-Rate Digital signal processing, Up sampling, Down sampling, Sampling rate conversions, poly phase decompositions **Adaptive filters and applications of DSP:** Introduction, Basic principles of Forward Linear Predictive filter and applications in audio , speech , image , video and biomedical signal processing	5	10
8.	**The Architecture of DSP Processors & Applications:** Harward architecture, pipelining, Multiplier-accumulator (MAC) hardware, architectures of fixed and floating point (TMSC6000). DSP processors applications.	4	10

Suggested Specification table with Marks (Theory):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	20	20	20	15	10

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **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 Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Digital Signal Processing: Principles, Algorithm & Applications	Proakis and Manolakis	PEA	2003	4th

2.	Digital Signal Processing	Anand Kumar	PHI	2012	2nd
3.	Digital Signal Processing Fundamentals and Applications	Li Tan	Elsevier Academic Press	2013	2nd
4.	Discrete-Time Signal Processing	Oppeheim Schafer	Buck Pearson Education	2003	2nd
5.	Digital Signal Processing,	S. Salivahanan	TMH	2019	4th
6.	Digital Signal Processing A computer-based Approach	S.K.Mitra	Tata McGraw Hill	2006	3rd

Course Outcome:

Sr. No.	CO Statement After learning this subject students will be able to	Marks % weightage
CO-1	Evaluate different types of signals and systems	15
CO-2	Apply Discrete Time Transforms in analysis of signals and system	25
CO-3	Evaluate various filter structure Realizations	10
CO-4	Apply DFT and FFT operations to solve basic problems	20
CO-5	Design FIR and IIR Filters for given specifications	15
CO-6	Explain operations and the architecture of DSP Processors including the basic Multi-Rate operations.	10

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	3	2	2	2	2	2	1	2	1	2	2	2	3	3
CO-2	3	2	2	3	3	3	2	-	1	1	3	3	3	3	2
CO-3	2	2	2	3	3	2	2	1	2	3	3	2	3	2	3
CO-4	3	3	1	2	2	2	1	-	2	2	2	2	2	3	2
CO-5	3	3	3	3	3	3	2	2	2	3	3	2	3	3	3
CO-6	2	2	2	3	3	2	2	1	1	2	2	2	2	2	2

List of practical:

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.

Major Equipment:

- DSP processor, TMS320XX

List of Open Source/learning websites

- https://nptel.ac.in/courses/117102060 Digital Signal Processing
- https://ocw.mit.edu/courses/res-6-008-digital-signal-processing-spring-2011/

List of Open Sources of software

- SCILAB