FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **BACHELOR OF TECHNOLOGY (Electronics and Communication)**

Semester: **V**

Course Code: **202060502**

Course Title: **Digital Signal Processing**

Course Group: **Professional Core Course**

Course Objectives: This course provides an understanding of the fundamental concept of Digital Signal and System with its properties and operations. It is also aimed to develop better insight among the students regarding Frequency domain approach with its application along with digital filter design. Further it explores the domain of multi-rate and adaptive signal processing with architecture of DSP processors and applications.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		
Lecture	Tutorial	Practical		Internal	External	Internal	External	Total
3	0	2	4	50/18	50/17	25/9	25/9	150/53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Introduction to D**igital **Signal Processing (DSP)**: Discrete-time Signals and Systems, Basic elements of DSP, Analog Signal Processing versus Digital Signal Processing, Review of z-Transform, History of DSP and Applications.	3
2	**Discrete-time Systems:** Introduction, classification of discrete-time systems, Representation and time-response of Discrete-time LTI systems, linear convolution, inverse system and deconvolution, cross and auto correlation.	6
3	**Discrete-time Fourier Transform (DTFT);** Discrete Time Fourier Series – representation, properties; Discrete Time Fourier Transform - representation, properties; Analysis of LTI Discrete-time system using DTFT, Relationship between z-Transform and DTFT.	6

Opp. Shastri Maidan, Beside BVM College, Vallabh Vidyanagar, Dist: Anand, Gujarat - 388120
(O): 02692-238001 | Email: adminoffice@cvmu.edu.in | www.cvmu.edu.in

4	**Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT):** Representation of DFT, Frequency Domain Sampling, Properties of DFT, Relation between DFT, DTFT and Z-Transform, Circular convolution, Efficient computation of DFT – Fast Fourier Transform, FFT Algorithms – Decimation in time and Decimation in Frequency, FFT Algorithm in Linear filtering, Goertzel Algorithm, Chirp Z Transform Algorithm.	**8**
5	**Digital Filter Realization:** Block diagram representation, Structure for IIR Systems – Direct form – I, Direct from-II, Cascade and parallel, Transposed Structure, Structure for FIR Systems – Direct from, cascade form, Linear-phase, Poly phase, Lattice structure.	**8**
6	**Digital Filter Design Techniques:** FIR filters – characteristic and frequency response of Linear phase FIR filters, FIR filter design using windows – rectangular, triangular, Hanning, Hamming, Kaiser, FIR filter by frequency sampling techniques. IIR filters – characteristic and frequency response of IIR filters, Design techniques of IIR filters – Approximation of derivatives, Impulse Invariance, Bilinear Transformation. Finite World Length effects in digital filters.	**8**
7	**DSP Processors & Applications**: Harvard architecture, pipelining, Multiplier accumulator (MAC) hardware, architectures of fixed and floating point (various Texas processors such as TMS320C6713, TMS320C6416) DSP processors. Applications.	**6**
		45

List of Practicals / Tutorials:

1	Introduction to MATLAB/SCILAB/Python: Signal Processing Toolbox, Simulink.
2	To study Discrete-Time Signals & Operation on Signals using MATLAB.
3	To study Linear Convolution of Discrete-Time Signals.
4	To study Discrete-time System Responses.
5	To study Discrete Fourier Transform (DFT) & Inverse DFT, .
6	To study FFT Algorithms – DIT and DIF.
7	Design FIR filter using windowing method.
8	Design Digital filter: IIR Butterworth filter.
9	To study Up-sampling and Down-sampling.
10	DSP Processor study (Using DSP Kit).
11	To implement any one application using DSP Processor.

Reference Books:

1	J. G. Proakis and D. G. Manolakis, **Digital Signal Processing: Principles, Algorithms and Applications**, 4th edition, Pearson, 2007.
2	A. V. Oppenheim and R. W. Shafer, **Discrete-Time Signal Processing**, 3rd edition, Pearson, 2010.
3	A. Nagoor Kani, **Digital Signal processing**, 2nd edition, Mc Graw Hill Publication, 2012.

Opp. Shastri Maidan, Beside BVM College, Vallabh Vidyanagar, Dist: Anand, Gujarat - 388120
(O): 02692-238001 | Email: adminoffice@cvmu.edu.in | www.cvmu.edu.in

4	S. K. Mitra, **Digital Signal Processing: A Computer-Based Approach**, 4th edition, Tata McGraw Hill, 2013.
5	Ifeachor and Jervis, **Digital Signal Processing: A Practical Approach**, 2nd Edition, Pearson Education, 2001.
	Ashok Ambardar, **Digital Signal Processing: A Modern Introduction**, 1st Edition, Cengage, 2007.

Supplementary learning Material:	
1	NPTEL and Coursera Video lectures.
2	Research papers from reputed Journals (IEEE, Elsevier, Springer etc.).

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
15	40	10	15	10	10	

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.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the basic digital signal processing concepts and their applications.	25
CO-2	Understand the digital system design.	25
CO-3	Analyze discrete-time signals and systems in time and frequency domain.	25
CO-4	Design and simulate digital filters and their applications.	25

Curriculum Revision:	
Version:	2.0
Drafted on (Month-Year):	June -2022

Opp. Shastri Maidan, Beside BVM College, Vallabh Vidyanagar, Dist: Anand, Gujarat - 388120
(O): 02692-238001 | Email: adminoffice@cvmu.edu.in | www.cvmu.edu.in

Last Reviewed on (Month-Year):	-
Next Review on (Month-Year):	June-2025

Opp. Shastri Maidan, Beside BVM College, Vallabh Vidyanagar, Dist: Anand, Gujarat - 388120
(O): 02692-238001 | Email: adminoffice@cvmu.edu.in | www.cvmu.edu.in