

**B.Tech. Semester VII (IC)**

**Subject Name: Digital signal Processing**

**Subject Code: BTIC13701**

**Type of course: Professional Core Course(PCC)**

**Prerequisite (if any):** Signals and systems, Analog signal processing, differential equations, convolution, Fourier Transforms

**List of Courses where this course will be prerequisite :**  
Biomedical signal processing and Image processing

**Rationale:** It is very important to understand the signal characteristics and system behaviour when the signals are digitized. Noises from the signals can be removed by designing filters using software. So, it is very important to understand the fundamentals of processing of complex signals. This subject will provide better understanding of discrete-time and digital signal in time and frequency domain. Students will also be able to design and implement FIR and IIR filters with different structures. Students will also be introduced to digital signal processor.

**Teaching and Examination Scheme:**

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

**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

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**BSC: basic science course /ESC: Engineering Science Course /HSM: Humanities and management /PCC: Professional Core course /PEC: professional Elective course /OEC: Open Elective course/ TOE: Transdisciplinary open elective/ MD: mandatory non-credit course**



**Content:**

Sr. No.	Content	Total Hrs	
1.	<b>Introduction to DSP:</b> Overview: Signals, systems and signal processing, elements of digital signal processing system, Analog to Digital and Digital to analog conversion, Sampling theorem, Quantization.	4	10%
2.	<b>Discrete time systems described by difference equation:</b> Recursive and non recursive discrete time systems, LTI Systems characterized by constant co-efficient difference equation, Solution of linear constant co-efficient differential equation.	6	13%
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	10	22%
4.	<b>Discrete Fourier transform : Its properties and application</b> Frequency –Domain Sampling (The Discrete Fourier Transform): frequency domain sampling and reconstruction of discrete – time signals, discrete Fourier transform (DFT), the DFT as a linear transformation, relationship of the DFT with other transformation Properties of the DFT: periodicity, linearity, symmetry, multiplication of two DFTs and circular convolution Linear Filtering Methods Based on the DFT: use of DFT in linear filtering, filtering of long data sequence; Frequency Analysis of Signals Using the DFT	10	22%
5.	<b>Fast Fourier Transform ,Efficient Computation of DFT:(FFT Algorithm):</b> Direct computation of a DFT, divide & conquer approach to computation of DFT, radix2 and radix 4 FFT Algorithms	6	13%
6.	<b>Filter Design Techniques</b> Design of Discrete-Time IIR filters from Continuous-Time filters- Approximation	9	20%

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	by derivatives, Impulse Invariance and Bilinear Transformation methods; Design of FIR filters by windowing techniques, Illustrative design examples of IIR and filters.		
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**Suggested Specification table with Marks (Theory):**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	21	14	21	7	0

**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:**

Sr no	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Digital Signal Processing: Principles, Algorithm & Application	Proakis, Manolakis	Pearson, 9788131710005	2007	4th edition
2	Discrete Time Signal Processing	Oppeheim, Schafer	Buck Pearson education Publication, 978-0132146357	2003	2nd Edition
3	Digital Signal Processing	Dr P Ramesh Babu	Scitech Publications (India) Pvt Ltd, 978-8183710817	2011	4th edition
4	Digital Signal Processing	S.Salivahanan, A.Vallavaraj,C. Gnapriya	McGraw-Hill Education (India) Pvt Limited 9780074639962	2011	2nd Edition

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**Course Outcomes:**

Sr. No.	CO statement	Marks % weightage
	At the end of the course the student will be able to:	
CO-1	analyse and discretize continues signals and systems in the discrete time domain .	20%
CO-2	implement and realize the filters using different structures.	25%
CO-3	analyse DT signals in frequency domain using DFT and FFT.	30%
CO-4	design FIR and IIR filters.	25%

**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	PSO1	PSO2	PSO3
CO1	3												3	3	
CO2	3												3	3	
CO3	3	2											3	3	
CO4	3	2							2		2		3	3	
CO5	3	2							2		2		3	3	

**Rationale\* : Explaining why it is matching this particular program outcome**

**List of Open learning website: NPTEL courses for Digital Signal Processing**

**List of Open Source Software:**

**Scilab /Octave simulation software**



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**FOR LAB SESSIONS:**

**List of Experiments:**

- 1) Perform different operation on the Discrete time signal.
- 2) Perform Addition/Multiplication of Two Discrete time signal of equal/different Length.
- 3) Find out Convolution using Equation method for two Discrete time signals.
- 4) Compute N point DFT of a given sequence and to plot magnitude and phase spectrum.
- 5) Convert analog filter to digital filter using BLT and Impulse invariance method.
- 6) Find out frequency components of a given signal using FFT.
- 7) Perform circular convolution of two sequences using DFT.
- 8) Perform linear convolution using DFT.
- 9) Design low pass Butterworth filter to remove high frequency noise .
- 10) Design High pass FIR filter for the given specification.

**Major Equipment Needed:**

Computers, Simulation software like Scilab/ Matlab

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*w.e.f. AY 2021-22*