K.S SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SESSION: 2022-23 (EVEN SEMESTER)

CO-PO MAPPING

Course Title: Digital Signal Processing			
Type: Core		**Course Code:** 21EC42	
No of Hours			
Theory (Lecture Class)	Practical/Field Work/Allied Activities	Total hours/Week	Total teaching hours
3	2	5	0
Marks			
Internal Assessment	Examination	Total	Credits
50	50	100	4

Aim/Objective of the Course:

1. To understand the frequency domain sampling and reconstruction of discrete time signals.
2. To Study the properties and the development of efficient algorithms for the computation of DFT.
3. To realize of FIR and IIR filters in different structural forms.
4. To learn the procedures to design of IIR filters from the analog filters using impulse invariance and bilinear transformation.
5. To study the different windows used in the design of FIR filters and design appropriate filters based on the specifications.

Course Learning Outcomes

After completing the course, the students will be able to

CO1	**Make use of** Linear transformation and apply properties of DFT	**Applying (K3)**
CO2	**Make use of** FFT Algorithm for computation of DFT and IDFT, Utilize linear filtering techniques	**Applying (K3)**
CO3	**Design** and Realize various IIR Filters for given specifications.	**Applying (K3)**
CO4	**Design** and Realize various FIR Filters for given specifications.	**Applying (K3)**
CO5	**Examine** the architecture and working of DSP processor	**Applying (K3)**

Syllabus Content:	
Module 1: Discrete Fourier Transforms (DFT): Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms. Properties of DFT, multiplication of two DFTs- the circular convolution. **Laboratory Experiments:** Computation of N Point DFT, Circular Convolution and its Properties, Linear and Circular Convolution using DFT and IDFT **LO**: At the end of this session the student will be able to, 1. Apply Linear transformation to obtain DFT and IDFT 2. Understand Sampling and reconstruction of the signal 3. Identify suitable properties to solve the given problem with less complexity 4. Write Programs to Compute N Point DFT of a sequence, compute Linear and Circular Convolution using DFT properties.	**CO1** 10hrs PO1-3 PO2-3 PO3-3 PO5-3 PO6-2 PO9-2 PO12-1 PSO1-2 PSO2-2
Module 2: Linear filtering methods based on the DFT: Use of DFT in Linear Filtering, Filtering of Long data Sequences. Fast-Fourier-Transform (FFT) algorithms: Efficient Computation of the DFT: Radix-2 FFT algorithms for the computation of DFT and IDFT–decimation-in-time and decimation-in-frequency algorithms. **Laboratory Experiments:** Verification of DFT Properties, Parseval's Theorem **LO**: At the end of this session the student will be able to, 1. Understand FFT algorithms and its importance 2. Compare computational efficiency between DFT and FFT 3. Apply DIT-FFT and DIF-FFT to compute DFT 4. Write Programs in MATLAB to verify various properties of DFT, and use FFT algorithms to calculate the DFT.	**CO2** 10 hrs PO1-3 PO2-3 PO3-3 PO5-3 PO6-2 PO9-2 PO12-1 PSO1-2 PSO2-2

Module 3: Design of FIR Filters: Characteristics of practical frequency – selective filters, Symmetric and Antisymmetric FIR filters, Design of Linear-phase FIR filters using windows - Rectangular, Hamming, Hanning, Bartlett windows. Design of FIR filters using frequency sampling method. Structure for FIR Systems: Direct form, Cascade form and Lattice structures. **Laboratory Experiments:** Design and Implement Low pass and high pass FIR Filters. **LO**: At the end of this session the student will be able to, 1. Realize different FIR structures 2. Design FIR filter for the given specifications using Windows. 3. Write MATLAB code to design Lowpass and Highpass FIR filters using different Window techniques, to meet given specifications.	**CO4** 10 hrs PO1-3 PO2-3 PO3-3 PO4-1 PO5-3 PO6-2 PO9-2 PO12-1 PSO1-2 PSO2-2
Module 4: IIR Filter Design: Infinite Impulse response Filter Format, Bilinear Transformation Design Method, Analog Filters using Lowpass prototype transformation, Normalized Butterworth Functions, Bilinear Transformation and Frequency Warping, Bilinear Transformation Design Procedure, Digital Butterworth Filter Design using BLT. Realization of IIR Filters in Direct form I and II. **Laboratory Experiments:** Design and Implementation of Butterworth IIR Lowpass and Highpass Filters. **LO**: At the end of this session the student will be able to, 1. Realize different IIR structures 2. Design IIR Analog filter for the given specification (Butterworth) 3. Design IIR Digital filter for the given specifications using Bilinear Transformation 4. Write MATLAB code to design and implement Lowpass and Highpass Butterworth IIR filters using Bilinear Transformation.	**CO3** 10 hrs PO1-3 PO2-3 PO3-3 PO4-1 PO5-3 PO6-2 PO9-2 PO12-1 PSO1-2 PSO2-2
Module 5: Digital Signal Processors: DSP Architecture, DSP Hardware Units, Fixed point format, Floating point Format, IEEE Floating point formats, Fixed point digital signal processors, Floating point processors, FIR and IIR filter implementations in Fixed point systems. LO: At the end of this session the student will be able to, **Laboratory Experiments:** Computation of N point DFT, Linear and Circular Convolution. **LO**: At the end of this session the student will be able to, 1. Understand and Explain the architecture and various blocks of a DSP Hardware	**CO5** 10hrs PO1-3 PO2-3 PO3-3 PO4-1 PO5-3 PO6-2 PO9-2 PO12-1 PSO1-2

2. Differentiate between fixed- and floating-point number formats and express numbers in them. 3. Implement FIR and IIR Filters in Fixed point systems. 4. Write programs in C-language for the DSP Processor kits, to evaluate N point DFT, Linear and Circular Convolution of sequences.	PSO2-2

Text Books: - (specify minimum two foreign authors text books)

1. Proakis & Monalakis, "Digital signal processing – Principles Algorithms & Applications", 4th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317-1000-9.
2. Li Tan, Jean Jiang, "Digital Signal processing – Fundamentals and Applications", Academic Press, 2013, ISBN: 978-0-12-415893.

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Reference Books:

1. Sanjit K Mitra, "Digital Signal Processing, A Computer Based Approach", 4th Edition, McGraw Hill Education, 2013,
2. Oppenheim & Schaffer, "Discrete Time Signal Processing" , PHI, 2003.
3. D.GaneshRao and Vineeth P Gejji, "Digital Signal Processing" Cengage India Private Limited, 2017, ISBN: 9386858231

Useful Websites

https://www.tutorialspoint.com/digital_signal_processing/

https://nptel.ac.in/courses/108105055/

https://nptel.ac.in/courses/117102060

Useful Journals

https://www.journals.elsevier.com/digital-signal-processing

https://www.sciencedirect.com/journal/digital-signal-processing

Teaching and Learning Methods:

Lecture class: 50 hrs.

Practical classes: 3hrs (Separate practical class in curriculum)

Assessment:

Type of test/examination: Written examination
Continuous Internal Evaluation(CIE) : :1) Three Tests each of 20 marks (duration 1 hour)

2) Two assignments each of 10 Marks

3) Programming Labs and IA - 20 Marks

Total CIE: 50 Marks

Semester End Exam(SEE) : 100 marks (students have to answer all main questions) which will be reduced to 50 Marks.

Test duration: 1 hrs

Examination duration: 3 hrs

CO to PO Mapping

PO1: Science and engineering Knowledge **PO2:** Problem Analysis **PO3:** Design & Development **PO4:**Investigations of Complex Problems **PO5:** Modern Tool Usage **PO6:** Engineer & Society	**PO7:**Environment and Society **PO8:**Ethics **PO9:**Individual & Team Work **PO10:** Communication **PO11:**Project Mngmt & Finance **PO12:**Life long Learning

PSO1: Be able to acquire knowledge and apply concepts in the field of Engineering and interdisciplinary subjects

PSO2: Be able to identify the existing problems, effectively utilize tools to provide solutions and disseminate the information

CO	PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO
21 EC52															
CO1	K3	3	3	3	-	3	2	-	-	2	-	-	1	2	2
CO2	K3	3	3	3	-	3	2	-	-	2	-	-	1	2	2
CO3	K3	3	3	3	1	3	2	-	-	2	-	-	1	2	2
CO4	K3	3	3	3	1	3	2	-	-	2	-	-	1	2	2
CO5	K3	3	3	3	1	3	2	-	-	2	-	-	1	2	2

Course In charge

Head of the Department

Professor & Head
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K. S. School of Engineering & Management
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Principal

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