

## DIGITAL SIGNAL PROCESSING LABORATORY

<b>VI Semester: ECE</b>																																										
Course Code	Category	Hours / Week			Credits	Maximum Marks																																				
AEC107	Core	L	T	P	C	CIA	SEE	Total																																		
		-	-	3	2	30	70	100																																		
<b>Contact Classes: Nil</b>		<b>Tutorial Classes: Nil</b>		<b>Practical Classes: 45</b>			<b>Total Classes: 45</b>																																			
<p><b>I. COURSE OVERVIEW:</b>            This course provides practical hands on exposure to mathematical operations on linear time invariant systems. It covers analysis of signals by fast Fourier transform algorithms, implementation of IIR filters in MATLAB using various digital transformation techniques such as Butterworth and bilinear transformation techniques. Implementation of FIR filters in MATLAB using window methods and frequency sampling method. The significant applications of digital signal processing are done by sampling rate conversion.</p> <p><b>II. OBJECTIVES:</b>  <b>The course should enable the students to:</b></p> <p style="margin-left: 20px;">I The analysis of signals in frequency domain by using DFT and FFT algorithms.</p> <p style="margin-left: 20px;">II The designing of IIR and FIR filters using transformation techniques by using MATLAB tool.</p> <p style="margin-left: 20px;">III IIR and FIR Filter Implementation using DSP Kits.</p> <p><b>III. COURSE OUTCOMES:</b>  <b>After successful completion of the course, students should be able to:</b></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 15%;">CO 1</td> <td style="width: 60%;">Examine the overlap add and overlap save convolution methods for long duration sequence.</td> <td style="width: 25%;">Apply</td> </tr> <tr> <td>CO 2</td> <td>Compute the FFT algorithms for reducing computational complexity of discrete Fourier transform.</td> <td>Apply</td> </tr> <tr> <td>CO 3</td> <td>Implement digital FIR and IIR filters using digital transformation technique.</td> <td>Analyze</td> </tr> <tr> <td>CO 4</td> <td>Analyse the DTMF tone generation and detection using Goertzel algorithm.</td> <td>Analyze</td> </tr> <tr> <td>CO 5</td> <td>Apply decimation and interpolation methods for sampling rate conversion.</td> <td>Apply</td> </tr> <tr> <td>CO 6</td> <td>Design the IIR and FIR Filter algorithms using DSP Kits.</td> <td>Create</td> </tr> </table> <p><b>IV. SYLLABUS:</b></p> <p style="text-align: center;"><b>LIST OF EXPERIMENTS</b></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 15%;"><b>WEEK - 1</b></td> <td><b>CONVOLUTION</b></td> </tr> <tr> <td colspan="2">a) Generation of linear convolution without using built in function and the function conv in MATLAB b) Generation of circular convolution without using built in function in MATLAB</td> </tr> <tr> <td><b>WEEK-2</b></td> <td><b>DISCRETE FOURIER TRANSFORM</b></td> </tr> <tr> <td colspan="2">Compute the Discrete Fourier Transform and IDFT with and without fft and ifft in MATLAB</td> </tr> <tr> <td><b>WEEK-3</b></td> <td><b>APPLICATION OF DFT</b></td> </tr> <tr> <td colspan="2">Implementation of Linear convolution using DFT (Overlap-add and Overlap-Save methods)</td> </tr> <tr> <td><b>WEEK - 4</b></td> <td><b>DIT - FAST FOURIER TRANSFORM</b></td> </tr> <tr> <td colspan="2">Implementation of Decimation-in-time radix-2 FFT algorithm</td> </tr> </table>									CO 1	Examine the overlap add and overlap save convolution methods for long duration sequence.	Apply	CO 2	Compute the FFT algorithms for reducing computational complexity of discrete Fourier transform.	Apply	CO 3	Implement digital FIR and IIR filters using digital transformation technique.	Analyze	CO 4	Analyse the DTMF tone generation and detection using Goertzel algorithm.	Analyze	CO 5	Apply decimation and interpolation methods for sampling rate conversion.	Apply	CO 6	Design the IIR and FIR Filter algorithms using DSP Kits.	Create	<b>WEEK - 1</b>	<b>CONVOLUTION</b>	a) Generation of linear convolution without using built in function and the function conv in MATLAB b) Generation of circular convolution without using built in function in MATLAB		<b>WEEK-2</b>	<b>DISCRETE FOURIER TRANSFORM</b>	Compute the Discrete Fourier Transform and IDFT with and without fft and ifft in MATLAB		<b>WEEK-3</b>	<b>APPLICATION OF DFT</b>	Implementation of Linear convolution using DFT (Overlap-add and Overlap-Save methods)		<b>WEEK - 4</b>	<b>DIT - FAST FOURIER TRANSFORM</b>	Implementation of Decimation-in-time radix-2 FFT algorithm	
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<b>WEEK -5</b>	<b>DIF - FAST FOURIER TRANSFORM</b>
Implementation of Decimation-in-frequency radix-2 FFT algorithm	
<b>WEEK -6</b>	<b>IIR - BUTTERWORTH FILTER</b>
Implementation of IIR digital filter using Butterworth method and bilinear transformation	
<b>WEEK -7</b>	<b>IIR - CHEBYSHEV FILTER</b>
Implementation of IIR digital filter using Chebyshev (Type I and II) method	
<b>WEEK -8</b>	<b>FIR FILTER - WINDOW TECHNIQUES</b>
Implementation of FIR digital filter using window (Rectangular, Hamming, Hanning, Bartlett) methods	
<b>WEEK-9</b>	<b>FIR FILTER – SAMPLING TECHNIQUE</b>
Implementation of FIR digital filter using frequency sampling method	
<b>WEEK-10</b>	<b>FIR FILTER – OPTIMUM EQUIRIPPLE</b>
Implementation of optimum equiripple FIR digital filter using window methods	
<b>WEEK-11</b>	<b>DUAL TONE MULTI FREQUENCY</b>
DTMF Tone Generation and Detection Using Goertzel Algorithm	
<b>WEEK-12</b>	<b>SAMPLING RATE CONVERTERS</b>
Implementation of sampling rate conversion by decimation, interpolation and a rational factor using MATLAB	
<b>WEEK-13</b>	<b>DFT AND SINEWAVE USING TMS320C6713 KIT</b>
a) Implementation of DFT b) Sine wave generation using lookup table with values generated from MATLAB	
<b>WEEK-14</b>	<b>FILTERS USING TMS320C6713 KIT</b>
IIR and FIR Filter Implementation using DSP Kits	
<b>Reference Books:</b>	
<ol style="list-style-type: none"> <li>1. John G. Proakis, Dimitris G. Manolakis, “Digital signal processing, Principles, Algorithms and Applications”, Prentice Hall, 4<sup>th</sup> Edition, 2007.</li> <li>2. B. Preetham Kumar, “Digital Signal Processing Laboratory”, CRC Press, 2<sup>nd</sup> Edition, 2010.</li> <li>3. B.Venkata Ramani, M.Bhaskar, “ Digital Signal Processors- Architecture, Programming and applications”, TMH, 2<sup>nd</sup> Edition, 2002.</li> </ol>	
<b>Web References:</b>	
<ol style="list-style-type: none"> <li>1. <a href="http://eceweb1.rutgers.edu/~orfanidi/ece348/">http://eceweb1.rutgers.edu/~orfanidi/ece348/</a></li> <li>2. <a href="http://www.eecs.umich.edu/courses/eecs452/refs.html">http://www.eecs.umich.edu/courses/eecs452/refs.html</a></li> <li>3. <a href="http://www.dsp.sun.ac.za/lab-reference-guide/">http://www.dsp.sun.ac.za/lab-reference-guide/</a></li> <li>4. <a href="http://www.iare.ac.in">http://www.iare.ac.in</a></li> </ol>	
<b>Course Home Page:</b>	
<b>SOFTWARE AND HARDWARE REQUIRED FOR A BATCH OF 36 STUDENTS</b>	
<b>HARDWARE:</b>	36 numbers of Desktop Computer Systems with 2 GB RAM
<b>SOFTWARES:</b>	a) MATLAB b) C6713 DSK Code Composer Studio

**LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 36 STUDENTS**

<b>S.No</b>	<b>Name of the Equipment</b>	<b>Range</b>
1	TMS320C6713 DSP Starter Kit (DSK)	225 MHz device delivering up to 1800 million instructions per second (MIPs)
2	USB Cable	--
3	Universal Power Supply	+5V
4	AC Power Cord(s)	--