SCHEME OF COURSE WORK

Faculty : Dr. M.V.S. Sai Ram, Professor,ECE

Course Details:

Course Title	:	**ADVANCED DIGITAL SIGNAL PROCESSING**
Course Code	:	**13EC2102** **L T P C : 4 0 0 3**
Program	:	**M.Tech** (EMBEDDED SYSTEMS & VLSI DESIGN)
Specialization	:	**Electronics and Communication Engineering**
Semester	:	**I SEM**
Prerequisites	:	**DSP**
Courses to which it is a prerequisite	:	**EMBEDDED SYSTEMS**

Course Outcomes (COs):

CO_1 Comprehend the DFTs and FFTs.

CO_2 Design and Analyze the digital filters.

CO_3 Acquire the basics of multi rate digital signal processing.

CO_4 Analyze the power spectrum estimation (4 or 5 methods).

CO_5 Comprehend the Finite word length effects in Fixed point DSP Systems.

Course Outcome Vs **Program Outcomes:**

COs	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}
CO_1	S	S	S	S	S	M	S	S	S	M	M
CO_2	S	S	M	S	M	M	S		S	M	M
CO_3	M	S	M	S	M	M			S	M	M
CO_4	M	M	M	M	M	M			S	M	M
CO_5	M	M	M	Sm	M	M			S	M	M

S - Strongly correlated, *M* - *Moderately* correlated, *Blank* - *No correlation*

Assessment Methods: Assignment / Seminar / Case Study / Mid-Test / End Exam

Teaching-Learning and Evaluation

Week	Topic / Contents	Course Outcomes	Sample questions	Teaching-Learning Strategy	Assessment Method & Schedule
UNIT-I: DISCRETE AND FAST FOURIER TRANSFORMS					
1	Properties of DFT, Linear Filtering methods based on the DFT, Overlapsave, Overlap -Add methods	CO_1	1. How many computations are required to compute the DFT directly? Explain how these computations can be reduced by using radix-2 FFT algorithm? 2. Determine the N-point DFT of the given finite duration sequence of length for N ≥ L $x(n)=\begin{cases}1, & 0\le n\le L-1\\ 0, & otherwise\end{cases}$	▫ Lecture ▫ Demo	Mid-1/Assignment -1
2	Frequency analysis of signals, Radix-2 FFT and Split-Radix FFT algorithms	CO_1	1. Explain the radix 2 decimation in time FFT algorithm and draw the diagram indicating the signal flow	▫ Lecture Problem solving	Mid-1/Assignment -1
3	The Goertzel and Chirp Z transform algorithms	CO_1	1. Explain Goertzel transform algorithm	▫ Lecture	Mid-1/Assignment -1
UNIT-II: **DESIGN OF IIR AND FIR FILTERS**					
4	Design of IIR filters using Butterworth & Chebyshev approximations, frequency transformation techniques	CO_2	1. Determine the order and the poles of a type-I lowpass Chebyshev filter that has a 1-dB ripple in the passband, a cutoff frequency $\Omega_p = 1000\pi$, a stopband frequency of 2000π, and an attenuation of 40dB or more for $\Omega \ge \Omega_s$.	▫ Lecture	Mid-1/Assignment -1
5	Structures for IIR systems – cascade, parallel, lattice & lattice-ladder structures, Fourier series method, Windowing techniques, design of digital filters based on least – squares	CO_2	1. What are various types windows used in the design FIR filters? Plot their spec and compare.	▫ Lecture	Mid-1/Seminar -1

	method, pade approximations				
6	Least squares design, wiener filter methods, structures for FIR systems –cascade, parallel, lattice & latticeladder structures.	CO_2	1. Convert the analog filter with the given system function into a digital IIR filter by means of the bilinear transformation. The digital filter is to have a resonant frequency of $\omega_r = \pi/2$. $H_a(s) = \frac{s+0.1}{(s+0.1)^2+16}$	▫ Lecture	Mid-1/Seminar -1
7	**MID-I**	CO_1 and CO_2			**MID TEST-I**
UNIT-III MULTI RATE SIGNAL PROCESSING					
8	Decimation by a factor D, Interpolation by a factor I	CO_3	1. What are multirate systen List out the applications whe multirate systems are used	▫ Lecture ▫ Discussion	Mid-2/Assignment -2
9	Sampling rate conversion by a rational factor I/D, Filter design & Implementation for sampling rate conversion	CO_3	1. Consider the sigı $x(n) = a^n u(n), \|a\| < 1$ Determine the spectrum X(The signal *x(n)* is applied tc decimator that reduces the r by a factor of 2. Determine t output spectrum.	▫ Lecture ▫ Discussion	Mid-2/Assignment -2
10	Filter banks, sub band coding, polyphase filters.	CO_3	1. What are polypha structures? Explain th importance in multira systems? What are applications?	▫ Lecture ▫ Discussion	Mid-2/Assignment -2
UNIT-IV POWER SPECTRAL ESTIMATION					
11	Estimation of spectra from finite duration observation of signals, Nonparametric methods: Bartlett, Welch & Blackman & Tukey methods	CO_4	1) What is finite word length effect? Why it occurs? Explain how it affects the performance of fixed point DSP processors	▫ Lecture ▫ Discussion	Mid-2/Assignment -2
12	Relation between auto correlation & model parameters, Yule-	CO_4	1. What is the relationship between autocorrelation and model parameters?	▫ Lecture ▫ Discussion	Mid-2/Assignment -2

	Walker& Burg Methods		Explain Burg method for estimating power spectrum		
13	MA & ARMA models for power spectrum estimation.	CO_4	1. What are AR, MA and ARMA models? What is their significance? Clearly	▫ Lecture ▫ Discussion	Mid-2/Assignment -2
UNIT-V : ANALYSIS OF FINITE WORD LENGTH EFFECTS IN FIXEDPOINT DSP SYSTEMS					
14	Fixed, Floating Point Arithmetic	CO_5	1. Write a short notes on: i. Fixed and Floating point Arithmetic ii. Quantization Noise	▫ Lecture ▫ Discussion	Mid-2/Assignment -2
15	ADC quantization noise & signal quality – Finite word length effect in IIR digital Filters	CO_5	1. Explain the source of occurrence for quantization noise in ADC. How can it be minimized?	▫ Lecture ▫ Discussion	Mid-2/Assignment -2
16	Finite wordlength effects in FFT algorithms.	CO_5	1. Write a short note on finite word length effects in FFT algorithms.	▫ Presentation ▫ Discussion	Mid-2/Assignment -2
17	**MID-II**	CO_3, CO_4 and CO_5			**MID TEST-II**
18/19	**END EXAM**				