SIDDARTHA INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)
Siddharth Nagar, Narayanavanam Road – 517583

Subject with Code: DIGITAL SIGNAL PROCESSING (23EC0419)

Course & Branch: B.Tech – ECE

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UNIT –I
Introduction to discrete time signals and systems

1	**a)**	Sketch the discrete time signal is x(n)= u(n-2)	[L1][CO1]	**[2M]**
	b)	Define Discrete time LTI system	[L1][CO1]	**[2M]**
	c)	Define Z-transform	[L1][CO1]	**[2M]**
	d)	What is BIBO stability**?**	[L1][CO1]	**[2M]**
	e)	What is meant by inverse Z-transform**?**	[L1][CO1]	**[2M]**
2	**a)**	Explain about the block diagram of digital signal processing.	[L2][CO1]	**[6M]**
	b)	Write the advantages and applications of DSP.	[L1][CO1]	**[4M]**
3	**a)**	Discuss the various classifications of discrete time signals with examples	[L2][CO1]	**[5M]**
	b)	What are the types of representation of discrete-time signals? Represent a sequence in all types.	[L1][CO1]	**[5M]**
4		What are the basic operations on discrete-time signals? Illustrate with an example.	[L3][CO1]	**[10M]**
5	**a)**	Describe the classifications of Discrete Time systems with examples	[L2][CO1]	**[6M]**
	b)	Explain the frequency-domain representation of discrete-time signals and systems.	[L3][CO1]	**[4M]**
6	**a)**	Find the energy and power for the given signal x(n)=$(1/2)^n$ u(n).	[L2][CO1]	**[5M]**
	b)	Define ROC and describe any five properties of ROC.	[L3][CO1]	**[5M]**
7	**a)**	Explain any three properties of Z-Transform.	[L2][CO1]	**[6M]**
	b)	With a neat z-plane diagram, explain the concept of poles and zeros of a system.	[L2][CO1]	**[4M]**
8	**a)**	Determine the transfer function of a DTS described by the difference equation y(n)=1/3 y(n-1)-1/5 y(n-2)+x(n)-x(n-2)	[L3][CO1]	**[4M**
	b)	Find the system Response for unit impulse, step and ramp signals using Z-transform	[L3][CO1]	**[6M]**
9		Solve the difference equation y(n)+2y(n-1)=x(n) with input x(n)=$(1/3)^n$ u(n) and the initial condition y(-1)=1	[L3][CO1]	**[10M]**
10		A discrete-time LTI system is described by the difference equation is y (n)-0.7 y (n-1)+0.12 y(n-2)= x(n)+0.5x(n-1). a) Obtain the transfer function H(z). b) Find the poles and zeros of the system. c) Comment on the stability of the system.	[L3][CO1]	**[10M]**
11		Find the inverse Z- transform of $X(Z) = \frac{1}{3} - 4Z^{-1} + Z^{-2}$; ROC$\lvert z \rvert > 1$	[L3][CO1]	**[10M]**

UNIT-II
DISCRETE FOURIER TRANSFORM

1	**a)**	Define Discrete Fourier Series	[L1][CO2]	**[2M]**
	b)	What is DFT? Give its significance with necessary equations.	[L1][CO2]	**[2M]**
	c)	What is FFT	[L1][CO3]	**[2M]**
	d)	Define Inverse FFT	[L1][CO3]	**[2M]**
	e)	Compare the Radix-2 DIT and DIF FFTs.	[L1][CO3]	**[2M]**
2		State and Prove any four properties of DFS	[L3][CO2]	**[10M]**
3		State and prove the following properties of DFT i)Linearity ii) Periodicity iii) Parsevels theorem iv) Time reversal	[L3][CO2]	**[10M]**
4		Determine the 8-point DFT of the sequence $x(n) = \{1,1,0,0,0,0,0,0\}$.	[L3][CO2]	**[10M]**
5	**a)**	Find the IDFT of the sequence $X(K) = \{1,0,1,0\}$.	[L3][CO2]	**[6M]**
	b)	Explain the difference between linear convolution and circular convolution**.**	[L2][CO2]	**[4M]**
6		Determine the Linear convolution of the sequences using DFT and IDFT. x(n)={1, 2}, h(n)={2,2}	[L3][CO2]	**[10M]**
7	**a)**	State the sampling theorem and its significance in DSP.	[L1][CO2]	**[5M]**
	b)	Explain the process of quantization and its effects on a signal.	[L2][CO2]	**[5M]**
8		Explain about the Decimation in Time FFT algorithm with necessary diagram.	[L2][CO3]	**[10M]**
9		Compute 8-point DFT of the sequence $x(n) = \{1,2,3,4,4,3,2,1\}$ using Radix-2 DIT-FFT Algorithm.	[L3][CO3]	**[10M]**
10		Compute DFT of the sequence $x(n) = \{1,1,1,1,1,1,1,0\}$ using Radix-2 DIT FFT algorithm.	[L3][CO3]	**[10M]**
11		Compute 8-point DFT of the sequence $x(n) = \{0,1,2,3,4,5,6,7\}$ using Radix-2 DIF-FFT Algorithm.	[L3][CO3]	**[10M]**

UNIT-III

IIR FILTERS

1	**a)**	What are the basic types of filters and on what basis are they classified?	[L1][CO4]	**[2M]**
	b)	List the filter types in designing the IIR filters?	[L1][CO4]	**[2M]**
	c)	Compare impulse invariant and bilinear transformaion.	[L1][CO4]	**[2M]**
	d)	List the different types of structures for realization of IIR systems.	[L1][CO4]	**[2M]**
	e)	compare direct form-I and direct form-II	[L2][CO4]	**[2M]**
2		Design an analog Butterworth filter that has 2dB pass band attenuation at a Frequency of 20 rad/sec and atleast 10dB stop band attenuation at 30 rad/sec.	[L3][CO4]	**[10M]**
3	**a)**	Explain the steps in the design of an analog Chebyshev lowpass filter.	[L2][CO4]	**[5M]**
	b)	Design an analog filter usingChebyshev approximation for the specifications α_p=3dB and α_s=16dB; f_p=1KHz and f_s=2KHz.	[L3][CO4]	**[5M]**
4		Illustrate the conversion steps in Impulse Invariance & Bilinear transformation method?	[L3][CO4]	**[10M]**
5	**a)**	For the analog transfer function $$H(S) = \frac{2}{(S+1)(S+3)}$$ Determine (Z) using Impulse Invariance method. Assume T=1Sec.	[L3][CO4]	**[5M]**
	b)	Apply Bilinear transformation to $$H(S) = \frac{4}{(S+3)(S+4)}$$ With T =0.5Sec and find (Z).	[L3][CO4]	**[5M]**
6		Design a digital Butterworth IIR filter satisfying the following constraints. Let T=1s, apply Impulse Invariant Transformation. $0.8 \le \|H(w)\| \le 1$; $0 \le w \le 0.2\pi$ $\|H(w)\| \le 0.2$; $0.32\pi \le w \le \pi$	[L3][CO4]	**[10M]**
7	**a)**	Explain the frequency transformation technique in analog domain for converting lowpass to lowpass filter and lowpass to highpass filter with frequency response.	[L2][CO4]	**[5M]**
	b)	Transform the prototype lowpass filter with following system function into a high pass filter with acut off frequency Ω_C^* $$H(S) = \frac{\Omega_C}{S + 2\Omega_C}$$	[L2][CO4]	**[5M]**
8	**a)**	What are the basic elements used to construct the block diagram of a discrete time system? Draw their symbols.	[L1][CO4]	**[4M]**
	b)	Construct the block diagram for the discrete-time systems whose input output relations are described by the following difference equations: (i) $y(n) = 0.7x(n) + 0.3x(n-1)$ (ii) $y(n) = 0.5y(n-1) + 0.8x(n) + 0.4x(n-1)$	[L3][CO4]	**[6M]**
9		Explain and draw the following generalized realization structures of IIR filter i) Direct form-I ii) Direct form-II	[L3][CO4]	**10M**
10		Construct the Direct form I and Direct form II, of the LTI System described by the equation $$y(n) = -\frac{3}{4}y(n-1) + \frac{3}{32}y(n-2) + \frac{1}{64}y(n-3) + x(n) + 3x(n-1)$$	[L3][CO4]	**[10M]**
11		Construct the cascade and parallel form structure of the system with difference equation $y(n)=-0.1y(n-1)+0.72y(n-2)+0.7x(n)-0.252x(n-2)$	[L3][CO4]	**[10M]**

UNIT–IV
FIR FILTERS

1	**a)**	What are the advantages of FIR filters?	[L1][CO5]	**[2M]**
	b)	What is the necessary and sufficient condition for the linear phase characteristic of a FIR filter?	[L1][CO5]	**[2M]**
	c)	Compare Hamming and Hanning window.	[L2][CO5]	**[2M]**
	d)	What is the advantage of linear phase realization of FIR systems?	[L2][CO5]	**[2M]**
	e)	List the different types of structures for realizing FIR systems.	[L2][CO5]	**[2M]**
2	**a)**	Discuss the characteristics of FIR filters with linear phase.	[L2][CO5]	**[5M]**
	b)	The following transfer function characterizes an FIR filter ($N = 9$). Determine the magnitude response and show that the phase and group delays are constant. $$H(Z) = \sum_{n=0}^{N-1} h(n) Z^{-n}$$	[L3][CO5]	**[5M]**
3	**a)**	Explain the frequency response of linear phase FIR filters and classify them based on impulse response symmetry.	[L2][CO5]	**[5M]**
	b)	Explain the Procedure for designing FIR filters using windowing Technique.	[L2][CO5]	
4		Design an FIR digital filter to approximate an ideal Lowpass filter with passband gain of unity,cutoff frequency of 1KHz,and working at a sampling frequency f_s=4KHz.The length of the impulse response should be 11. Use Fourier series method.	[L3][CO5]	**[10M]**
5	**a)**	Explain the Procedure for designingFIR filters usingwindows.	[L2][CO5]	**[4M]**
	b)	Give the equations for Rectangular, Hanning and Hamming window and blackman.	[L2][CO5]	**[6M]**
6		A Low pass filter is to be designed with the following desired frequency response using rectangular window forN=11. $$H(e^{jw}) = 1 \quad for \; -\frac{\pi}{2} \le \omega \le \frac{\pi}{2}$$ $$= 0 \quad for \quad \frac{\pi}{2} \le \lvert\omega\rvert \le \pi$$ Determine the filter coefficients h(n) if the window function is defined as $$w(n) \quad =1 \; for \; -5 \le n \le 5$$ $$= 0 \; othewise$$ Also determine the frequency response H(z) of the designed filter.	[L3][CO5]	**[10M]**
7		Design a filter with following data, using a Hamming window with N=7. $$H_a(e^{jw}) = 1 \; for - \frac{\pi}{4} \le \omega \le \frac{\pi}{4}$$ $$= 0 \;\; for \;\; \frac{\pi}{4} \le \lvert\omega\rvert \le \pi$$	[L3][CO5]	**[10M]**
8		Design an ideal High pass filter using Hanning window with the frequency response $$H_d(e^{jw}) = 1 \; for \;\; \frac{\pi}{4} \le \omega \le \pi$$ $$= 0 \;\; for \;\; \lvert\omega\rvert \le \pi$$ Find the values of h(n) for N=11 and find H(z).	[L3][CO5]	**[10M]**
9		Draw the Linear Phase Structure and transversal structures for realizing the FIR filters and explain.	[L2][CO5]	**[10M]**
10	**a)**	Construct the Direct form realization of system function. $$H(Z)=1+2Z^{-1}-3Z^{-2}-4Z^{-3}+5Z^{-4}$$	[L3][CO5]	**[5M]**

	b)	Construct the cascade realization of the system function. $$H(Z) = 1 + \frac{5}{2} Z^{-1} + 2Z^{-2} + 2Z^{-3}$$	[L3][CO5]	**[5M]**
11	**a)**	Realize the H(Z) with minimum number of multipliers $$\mathbf{H(Z) = 1 + \frac{1}{2} Z^{-1} + \frac{1}{8} Z^{-2} + \frac{3}{4} Z^{-3} + \frac{1}{8} Z^{-4} + \frac{1}{2} Z^{-5} + Z^{-6}}$$	[L3][CO5]	**[5M]**
	b)	Discuss the comparison between IIR and FIR sytems	[L3][CO5]	**[5M]**

UNIT–V
Architectures for Programmable DSP Devices

1	**a)**	What are general purpose DSPs? Give one example.	[L1][CO6]	**[2M]**
	b)	What is the function of Parallel Logic Unit?	[L1][CO6]	**[2M]**
	c)	What are memory-mapped registers?	[L1][CO6]	**[2M]**
	d)	What are the applications of on-chip timer?	[L1][CO6]	**[2M]**
	e)	How many buses does C5X architecture have? Name them.	[L1][CO6]	**[2M]**
2	**a)**	Explainthe two categories of DSP's in detail.	[L2][CO6]	**[5M]**
	b)	What are the advantages of the DSP processors over conventional microprocessors?	[L1][CO6]	**[5M]**
3		Draw and Explain the architecture of TMS320C5X digital signal processor in brief.	[L2][CO6]	**[10M]**
4	**a)**	Describe about the bus structure of TMS320C5x DSP processor	[L2][CO6]	**[5M]**
	b)	Describe the Auxiliary Register ALU (ARAU) and explain its role in address generation.	[L2][CO6]	**[5M]**
5		Explain the Central Arithmetic Logic Unit of TMS320C5x DSP with its components and functions.	[L2][CO6]	**[10M]**
6	**a)**	Explain the function of Index Register and Block Move Address Register in TMS320C5x architecture.	[L3][CO6]	**[5M]**
	b)	Explain the Parallel Logic Unit of TMS320C5x DSP and its importance in DSP operations.	[L2][CO6]	**[5M]**
7	**a)**	What are memory-mapped registers? Explain their role in TMS320C5x DSP.	[L2][CO6]	**[5M]**
	b)	Explain the program controller of TMS320C5x DSP and its main functions.	[L2][CO6]	**[5M]**
8		Explain the some flags of status register of TMS320C5x DSP.	[L1][CO6]	**[10M]**
9	**a)**	Explain On-Chip memory of TMS320C5x in details.	[L2][CO6]	**[5M]**
	b)	Discuss the various interrupts of TMS320C5X	[L2][CO6]	**[5M]**
10		Explain On-Chip Peripherals of TMS320C5x in details.	[L2][CO6]	**[10M]**
11		Explain about the Central Processing unit of TMS320C5X	[L2][CO6]	**[10M]**