SIDDHARTH INSTITUTE OF ENGINEERING & TECHHNOLOGY:: PUTTUR
(AUTONOMOUS)
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Subject with Code: DIGITAL SIGNAL PROCESSING (19EC0420)
Course & Branch: B.Tech – ECE & EEE
Year & Sem: III-B.Tech. & II-Sem.
Regulation: R19

UNIT –I
DISCRETE FOURIER TRANSFORM (DFT) & FAST FOURIER TRANSFORM (FFT)

1	a) What is the DFT expression and Relate the DFT to the Z-Transform.	[L2[CO1]	**[6M]**
	b) Compute the 4-point DFT of the sequence and plot magnitude and phase response. $x(n) = \begin{cases} 1; 0 \leq n \leq 2 \\ 0; otherwise \end{cases}$	[L3][CO1]	**[6M]**
2	a) Determine the 8 point DFT of the sequence $x(n) = \{1,1,1,1,1,1,0,0\}$	[L3][CO1]	**[8M]**
	b) State and prove the following properties of DFT: a. Periodicity and (ii) Linearity	[L3][CO1]	**[4M]**
3	State and Prove any 4 properties of DFT.	[L3][CO1]	**[12M]**
4	a) Compute the DFT of a sequence $x(n) = \{1,1,0,0\}$	[L3][CO1]	**[6M]**
	b) Find the IDFT of a sequence $Y(K) = \{1,0,1,0\}$.	[L3][CO1]	**[6M]**
5	a) Evaluate the output $y(n)$ of a filter whose impulse response is $h(n) = \{1,1,1\}$ and input signal $x(n) = \{3,-1,0,1,3,2,0,1,2,1\}$ using overlap add method.	[L5][CO1]	**[6M]**
	b) Calculate the output y(n) of a filter whose impulse response is $h(n) = \{1,2\}$ and input signal $x(n) = \{1,2,-1,2,3,-2,-3,-1,1,1,2,-1\}$ using overlap save method.	[L3][CO1]	**[6M]**
6	a) Explain Decimation in Time FFT algorithm with necessary expressions.	[L2][CO1]	**[6M]**
	b) Compare Radix-2 DIT-FFT and DIF-FFT algorithms.	[L5][CO1]	**[6M]**
7	a) Explain Decimation in Frequency FFT algorithm with necessary expressions.	[L2][CO1]	**[6M]**
	b) Compare DFT and FFT algorithms.	[L5][CO1]	**[6M]**
8	Compute 8-point DFT of the sequence $x(n) = \{1,2,3,4,4,3,2,1\}$ using Radix-2 DIT-FFT Algorithm.	[L3][CO1]	**[12M]**
9	Compute DFT of the sequence $x(n) = \{1,1,1,1,1,1,1,0\}$ using Radix-2 DIT FFT algorithm.	[L3][CO1]	**[12M]**
10	Compute 8-point DFT of the sequence $x(n) = \{0,1,2,3,4,5,6,7\}$ using Radix-2 DIF-FFT Algorithm.	[L3][CO1]	**[12M]**

UNIT –II
INFINITE IMPULSE RESPONSE FILTERS & REALIZATION OF IIR FILTER

1	a) Explain the steps in the design of analog Butterworth filter.	[L2][CO2]	**[6M]**
	b) For the given specifications, Determine $H(S)$ using Chebyshev approximation for the $\alpha_p = 3dB\ and\ \alpha_s = 16dB;\ f_p = 1KHz\ and\ f_s = 2KHz.$	[L3][CO2]	**[6M]**
2	a) For the given specification, $\alpha_p = 1dB;\ \alpha_s = 30dB; \Omega_p = 200\, rad/sec;\ \Omega_s = 600\, rad/sec.$ Determine the order of the filter by Butterworth model.	[L3][CO2]	**[6M]**
	b) Explain the steps in the design of an analog Chebyshev low pass filter.	[L2][CO2]	**[6M]**
3	a) Estimate the order of analog Butterworth filter that has 2 dB pass band attenuation at a frequency of 20 rad/sec and at least 10 dB stop band attenuation at 30 rad/sec.	[L5][CO2]	**[6M]**
	b) Evaluate the transfer function H(s) for analog Butterworth filter that has 2 dB pass band attenuation at a frequency of 20 rad/sec and at least 10 dB stop band attenuation at 30 rad/sec.	[L5][CO2]	**[6M]**
4	a) For the analog transfer function $H(S) = \frac{2}{(S+1)(s+2)}$, Determine $H(Z)$ using Impulse Invariance method. Assume T=1 Sec.	[L3][CO2]	**[6M]**
	b) Apply Bilinear transformation to $H(S) = \frac{2}{(S+1)(s+2)}$ with T=1 Sec and find $H(Z)$.	[L3][CO2]	**[6M]**
5	Apply the bilinear transformation, to design a high pass filter, monotonic in pass band with cut off frequency of 1000 Hz and down 10dB at 350 Hz. The sampling frequency is 5000Hz.	[L3][CO2]	**[12M]**
6	a) Describe impulse invariant method of designing IIR filter.	[L3][CO2]	**[6M]**
	b) Explain the different types of IIR filter realization with suitable example.	[L2][CO3]	**[6M]**
7	Develop a digital Chebyshev IIR digital low-pass filter transfer function that satisfies the constraints $\frac{1}{\sqrt{2}} \leq \lvert H(\omega)\rvert \leq 1\ ;\ \ 0 \leq \Omega \leq 0.2\pi\ and\ \ \lvert H(\omega)\rvert \leq 0.1\ ;\ 0.5\pi \leq \Omega \leq \pi$	[L6][CO2]	**[12M]**
8	a) Sketch the direct form I and direct form II realization of the LTI System described by the equation $y(n) = -\frac{3}{8}y(n-1) + \frac{3}{32}y(n-2) + \frac{1}{64}y(n-3) + x(n) + 3x(n-1)$	[L3][CO3]	**[6M]**
	b) What is frequency transformation? Explain the types of frequency transformations in brief.	[L2][CO3]	**[6M]**
9	a) An LTI System is described by the difference equation $y\ (n) +\ a_1y(n-1) = x(n) + b_1x(n-1).$ Construct its direct form I structure.	[L3][CO2]	**[6M]**
	b) Construct the cascade form structure of the system with difference equation $y(n) = \frac{3}{4}y(n-1) - \frac{1}{8}y(n-2) + x(n) + \frac{1}{3}x(n-1)$	[L3][CO2]	**[6M]**
10	a) Construct the 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][CO2]	**[6M]**
	b) List the Butterworth polynomials for order 1 to 5 and give its significance.	[L1][CO2]	**[6M]**

UNIT –III
FINITE IMPULSE RESPONSE FILTERS & REALIZATION OF FIR FILTER

1	a) What is linear phase filter? What are the conditions to be satisfied by the Impulse response of an FIR system in order to have a linear phase?	[L1][CO3]	**[4M]**
	b) Summarize the advantages and disadvantages of FIR Filters.	[L2][CO2]	**[4M]**
	c) Determine the linear phase realization of the system function. $H(Z) = \frac{1}{2} + \frac{1}{3}Z^{-1} + Z^{-2} + \frac{1}{4}Z^{-3} + Z^{-4} + \frac{1}{3}Z^{-5} + \frac{1}{2}Z^{-6}$	[L3][CO3]	**[4M]**
2	a) Explain briefly how zeros are located in FIR Filter?	[L2][CO2]	**[6M]**
	b) List the desirable characteristics of the window.	[L1][CO2]	**[6M]**
3	Compute the coefficients of a linear phase FIR filter of length N=15 which has a symmetric unit sample response and a frequency response that satisfies the conditions. $H\left(\frac{2\pi k}{15}\right) = 1 \ for \ k = 0,1,2,3$ $= 0 \ for \ k = 4,5,6,7$	[L3][CO3]	**[12M]**
4	Determine the coefficients h(n) of a linear phase FIR filter of length M = 15 which has a symmetric unit sample response and a frequency response that satisfies the condition. $H\left(\frac{2\pi k}{15}\right) = 1 \ for \ k = 0,1,2,3$ $= 0.4 \ for \ k = 4$ $= 0 \ for \ k = 5,6,7$	[L3][CO3]	**[12M]**
5	a) Explain the Fourier Series method of Designing FIR Filters.	[L2][CO3]	**[6M]**
	b) Distinguish between FIR and IIR Filter.	[L4][CO3]	**[6M]**
6	a) Explain the design steps of FIR filters using windows.	[L2][CO3]	**[6M]**
	b) State and explain the properties of FIR filters. State their importance.	[L1][CO3]	**[6M]**
7	Design an ideal Low pass filter with a frequency response $H_d(e^{jw}) = 1 \ \ for -\frac{\pi}{2} \le \lvert\omega\rvert \le \frac{\pi}{2}$ $= 0 \quad \frac{\pi}{2} \le \lvert\omega\rvert \le \pi$ Find the values of h(n) for N=11. Find H(Z) and plot the magnitude response	[L6][CO3]	**[12M]**
8	Design an ideal High pass filter with the frequency response $H_d(e^{jw}) = 1 \ \ for \ \frac{\pi}{4} \le \lvert\omega\rvert \le \pi$ $= 0 \quad \lvert\omega\rvert \le \frac{\pi}{4}$ Find the values of h(n) for N=11. Find H(Z) and plot the magnitude response	[L6][CO3]	**[12M]**
9	Design an ideal Band Pass Filter with the frequency response $H_d(e^{jw}) = 1 \ \ for \ \frac{\pi}{4} \le \lvert\omega\rvert \le \frac{3\pi}{4}$ = 0 $\quad Otherwise$ Find the values of h(n) for N=11. Find H(Z) and plot the frequency response	[L6][CO3]	**[12M]**
10	a) Determine the Direct form realization of system function $H(Z) = 1 + 2Z^{-1} - 3Z^{-2} - 4Z^{-3} + 5Z^{-4}$	[L3][CO3]	**[6M]**
	b) Construct the cascade realization of FIR Filters for the function $H(Z) = (1 + 2Z^{-1} - Z^{-2})(1 + Z^{-1} - Z^{-2})$	[L3][CO3]	**[6M]**

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UNIT –IV
FINITE WORD LENGTH EFFECTS

1	a) Represent the following numbers in floating point format with five bits for mantissa and three bits for exponent. a) 7_{10} b) 0.25_{10} c) -7_{10} d) -0.25_{10}	[L2][CO4]	**[6M]**
	b) Compare floating point with fixed point arithmetic.	[L2][CO4]	**[6M]**
2	a) What is quantization of analog signals? Derive the expression for the quantization error.	[L1][CO4]	**[6M]**
	b) Tabulate the Quantization error ranges of truncation and rounding for the various number representations.	[L1][CO5]	**[6M]**
3	a) Discuss in detail the errors resulting from rounding and truncation.	[L2][CO5]	**[6M]**
	b) Draw and explain the power density functions for truncation and rounding.	[L1][CO5]	**[6M]**
4	a) Discuss the various common methods of quantization.	[L2][CO4]	**[6M]**
	b) Explain in detail the effects of input quantization error.	[L2][CO4]	**[6M]**
5	a) What is quantization noise? Deduce the expression for quantization noise power.	[L4][CO4]	**[6M]**
	b) Summarize the various forms of representing the numbers in digital systems	[L2][CO5]	**[6M]**
6	a) Discuss steady state input noise power with relevant expressions and Quantization noise model.	[L2][CO5]	**[6M]**
	b) Discuss about the steady state output noise power with relevant expressions.	[L2][CO5]	**[6M]**
7	The output signal of an A/D converter is passed through a first order low pass filter with transfer function $H(Z) = \frac{(1-a)}{(Z-a)}\ for\ 0 < a < 1$. Find the steady state output noise power due to quantization at the output of the digital filter.	[L3][CO5]	**[12M]**
8	Discuss the characteristics of limit cycle oscillation with respect to the system described by the difference equation $y(n) = \alpha y(n-1) + x(n)$. Assume $\alpha = +\frac{1}{2}$, the system is excited by an input $x(n) = \begin{cases} 0.875\ for\ n = 0 \\ 0\ for\ otherwise \end{cases}$. Also, determine the dead band of the filter.	[L3[CO5]	**[12M]**
9	Explain the characteristics of a limit cycle oscillation with respect to the system described by the equation y(n)=0.95y(n-1) + x(n), when the product is quantized to 5 bits by rounding The system is excited by an input $x(n) = \begin{cases} 0.875\ for\ n = 0 \\ 0\ for\ otherwise \end{cases}$. Also, determine the dead band of the filter.	[L3][CO5]	**[12M]**
10	a) Conclude on steps to prevent limit cycle oscillations? Explain.	[L5][CO4]	**[6M]**
	b) What is a dead band of a filter? Explain.	[L1][CO4]	**[6M]**

UNIT –V
INTRODUCTION TO DIGITAL SIGNAL PROCESSORS

1	a) Summarize the overview of digital signal processors.	[L2][CO6]	**[6M]**
	b) Compare the various architectures employed in designing a digital signal processor.	[L2][CO6]	**[6M]**
2	With a neat sketch explain the architecture of TMS 320C50 processor.	[L2][CO6]	**[12M]**
3	a)What are the different buses of TMS320C5X and their functions?	[L1][CO6]	**[6M]**
	b) Draw and explain the architecture of von Neumann.	[L2][CO6]	**[6M]**
4	a) List the functional units in Central Processing Unit of 5X.	[L1][CO6]	**[6M]**
	b) Explain the function of CALU in detail.	[L2][CO6]	**[6M]**
5	a) What is meant by memory mapped register? How is it different from a memory?	[L1][CO6]	**[6M]**
	b) Discuss the various Circular Buffer Registers in detail.	[L2][CO6]	**[6M]**
6	a) List status register bits of 5X and their functions.	[L1][CO6]	**[6M]**
	b) Discuss the Block repeat registers (RPTC, BRCR, PASR and PAER).	[L2][CO6]	**[6M]**
7	a) List the various on-chip peripherals interfaced with 5X.	[L1][CO6]	**[6M]**
	b) Explain the function of Serial port interface.	[L2][CO6]	**[6M]**
8	a) Categorize the various interrupt types supported by 5X?	[L4][CO6]	**[6M]**
	b) List the on-chip memory in 5X and explain their functions.	[L1][CO6]	**[6M]**
9	a) Distinguish between the dual-access RAM and single-access RAM used in the on-chip memory of 5X.	[L4][CO6]	**[6M]**
	b) Discuss the advantages and disadvantages of VLIW architecture**.**	[L2][CO6]	**[6M]**
10	a) Explain in detail the application of PDSP's in the field of communication systems.	[L2][CO6]	**[6M]**
	b) Justify the role of PDSP in multimedia applications.	[L5][CO6]	**[6M]**

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