SIDDARTHA INSTITUTE OF SCIENCE AND TECHNOLOGY:: PUTTUR-517583
(AUTONOMOUS)
ECE & EEE
DIGITAL SIGNAL PROCESSING (18EC0414)
QUESTION BANK

UNIT –I
10 MARKS

1. a) State and prove the following properties of DFT
   (i) Linearity (ii) Complex conjugate property
   (iii) Circular convolution (iv) Time reversal **[L1] [CO1] [7M]**
   b) Compare DFT and FFT algorithms. **[L2] [CO1] [3M]**
2. Determine the 8 point DFT of the sequence x(n)={1,1,0,0,0,0,0,0} **[L3][CO1][10M]**
3. a) Compute the DFT of a sequence x(n)={1,-2,3,2 } **[L3] [CO1] [5M]**
   b) Compute the IDFT of a sequence Y(K)={4,2,0,4 } **[L3] [CO1] [5M]**
4. a) Identify the output y(n) of a filter whose impulse response is h(n)=[1,-1] and input signal x(n)= [1,-2,2,-1,3,-4,4,-3] using overlap add method. **[L2] [CO1] [5M]**
   b) Identify 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 save method **[L2] [CO1] [5M]**
5. Compute 8-point DFT of the sequence x(n)= {0,1,2,3,4,5,6,7,8} using radix-2 DIT-FFT Algorithm. **[L3][CO1] [10M]**
6. Compute 8-point DFT of the sequence x(n)= {1,2,3,4,4,3,2,1} using radix-2 DIF-FFT Algorithm. **[L3][CO1] [10M]**
7. Compute IDFT of the sequence x(n)= {4,1-j2.414,0,1-j0.414,0,1+j0.414,0,1+j2.414} using DIT FFT algorithm. **[L3][CO1] [10M]**
8. a) Compute the 4-point DFT of the sequence and plot magnitude and phase response
   $x(n) = 1 \; ; 0 \le n \le 2$
   $= 0$; otherwise **[L3] [CO1] [7M]**
   b) Explain the relationship between DFT to the Z-Transform **[L3] [CO1] [3M]**
9. a) Explain decimation in time FFT algorithm with necessary expressions. **[L2] [CO1] [7M]**
   b) Compare radix-2 DIT-FFT and DIF-FFT algorithms. **[L2] [CO1] [3M]**
10. a) Explain decimation in frequency FFT algorithm with necessary expressions. **[L2] [CO1] [7M]**
    b) Summarize the differences and similarities between DIF & DIT FFT algorithms**?** **[L2] [CO1][3M]**

2 MARKS

1. What is the need for the frequency domain sampling? **[L1] [CO1] [2M]**
2. Define DFT& IDFT of a discrete sequence. **[L1] [CO1] [2M]**
3. List few applications of DFT. **[L1] [CO1] [2M]**
4. What is the relationship between Fourier series coefficients of a periodic sequence and DFT? **[L1] [CO1] [2M]**
5. Find the DFT of a sequence x(n)={1,1,0,0 } **[L1] [CO1] [2M]**
6. What is the relation between Z-transform and DFT? **[L1] [CO1] [2M]**
7. How to find IDFT from DFT. **[L1] [CO1] [2M]**
8. Compute the DFT of x(n) =δ(n). **[L3] [CO1] [2M]**
9. What is zero padding? Why it is needed? **[L1] [CO1] [2M]**
10. Define circular convolution. **[L1] [CO1] [2M]**
11. How to find the linear convolution from circular convolution. **[L1] [CO1] [2M]**
12. Distinguish between linear and circular convolution of two sequences. **[L4] [CO1] [2M]**
13. State the differences betweenoverlap-save method &

overlap-add method. **[L1] [CO1] [2M]**

14. What is need for FFT algorithm? **[L1] [CO1] [2M]**

15. Describe Decimation in Time algorithm briefly? **[L2] [CO1] [2M]**

16. Describe Decimation in Frequency algorithm briefly? **[L2] [CO1] [2M]**

17. What is meant by radix-2 FFT? **[L1] [CO1] [2M]**

18. Identifythe differences and similarities between DIF and DIT algorithms? **[L2] [CO1] [2M]**

19. How to compute IDFT using radix-2 FFT? **[L1] [CO1] [2M]**

20. Draw the basic butterfly structure for DIT-FFT & DIF-FFT algorithms. **[L1] [CO1] [2M]**

UNIT-II
10 MARKS

1. a. For the given specification determine the order of the filter by Butterworth model
   αp = 1 dB αs = 30 dB
   Ωp = 200 rad / sec Ωs = 600 rad / sec. **[L3] [CO2] [6M]**
   b. Explain the steps to be followed to design an analog chebyshev low pass filter. **[L2] [CO2] [4M]**
2. a. Calculate the order of analog Butterworth filter that has 2 dB passband attenuation at a frequency of 20 rad/sec and atleast 10 dB stopband attenuation at 30 rad/sec. **[L3] [CO2] [3M]**
   b. Determine the transfer function H(s) for analog Butterworth filter that has 2 dB passband attenuation at a frequency of 20 rad/sec and atleast 10 dB stopband attenuation at 30 rad/sec. **[L3] [CO2] [7M]**

3. a. Explain the steps to be followed to design an analog Butterworth filter. **[L2] [CO2] [3M]**
   b. For the given specifications, Determine H(s) using Chebyshev approximation for the αp = 3 dB and αs = 16 dB; fp=1 KHz and VVfs= 2 KHz. **[L3] [CO2] [7M]**
4. 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][10M]**
5. 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] [5M]**
   b. Apply bilinear transformation to H(s)=$\frac{2}{(S+1)(s+2)}$ with T=1 Sec and find H(z). **[L3] [CO2] [5M]**
6. Determine an analog chebyshev filter transfer function that satisfies the constraints
   $\frac{1}{\sqrt{2}} \le |H(j\Omega)| \le 1; 0 \le \Omega \le 2$
   $|H(j\Omega)| < 0.1; \Omega \ge 4$ **[L3][CO2][10M]**
7. a. Sketch the direct form I and direct form II realization of the LTI System governed 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. An LTI System is described by the governing equation $y(n)+a_1 y(n-1)=x(n)+b_1 x(n-1)$. Determine its direct form II structure. **[L3] [CO3] [4M]**
8. a. An LTI System is described by the governing equation $y(n)+a_1 y(n-1)=x(n)+b_1 x(n-1)$. Realize it in direct form I structure. **[L3] [CO3] [5M]**
   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] [CO3] [5M]**

9. a. Describe impulse invariant method of designing IIR filter **[L2] [CO2] [3M]**
   b. Explain the different types of IIR filter realization with suitable example **[L2] [CO3] [7M]**
10. a. Construct the parallel 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] [CO3] [7M]**

   b. List the Butterworth polynomials for order 1 to 5 and give its significance. **[L1] [CO2] [3M]**

2 MARKS

1. What are the requirements for an analog filter to causal and stable? **[L1] [CO2] [2M]**
2. Compare IIR and FIR filters. **[L2] [CO2] [2M]**
3. List the characteristics of IIR filter. **[L1] [CO2] [2M]**
4. List the properties of Butterworth filter. **[L1] [CO2] [2M]**
5. List the properties of Chebyshev filter. **[L1] [CO2] [2M]**
6. How can you design digital filters from analog filters? **[L1] [CO2] [2M]**
7. What is the main objective of impulse invariant transformation? **[L1] [CO2] [2M]**
8. Describe impulse invariant method of designing IIR filter briefly. **[L2] [CO2] [2M]**
9. State the limitations of impulse invariance mapping technique. **[L1] [CO2] [2M]**
10. What is Bilinear transformation? **[L1] [CO2] [2M]**
11. What are the properties of bilinear transformation? **[L1] [CO2] [2M]**
12. What are the advantages and disadvantagesof bilinear transformation? **[L1] [CO2] [2M]**
13. Illustrate the effect of warping on magnitude and phase response. **[L2] [CO2] [2M]**
14. What is the necessity of Pre-warping? **[L1] [CO2] [2M]**
15. List the different types of structures for realizations for IIR systems **[L1] [CO3] [2M]**
16. What is the main disadvantage of direct form realization? **[L1] [CO3] [2M]**
17. Why direct form-II is called canonical structure? **[L1] [CO3] [2M]**
18. What is the advantage of direct form-II over direct form-I? **[L1] [CO3] [2M]**
19. What is parallel form realization? **[L1] [CO3] [2M]**
20. What is the advantage of cascade and parallel form structures? **[L1] [CO3] [2M]**

UNIT-III
10 MARKS

1. a. Explain the Fourier Series method of Designing FIR Filters **[L2] [CO2] [5M]**

   b. Distinguish between FIR and IIR Filter **[L2] [CO2] [5M]**

2. a. Explain briefly.how the zeros are located in FIR Filter? **[L3] [CO2] [4M]**

   b. Summarize the advantages and disadvantages of FIR Filters **[L2] [CO2] [3M]**
   c. List the desirable characteristics of the window **[L1] [CO2] [3M]**

3. Develop an ideal High pass filter with the frequency response

$H_d(e^{jw})=1 \; for \; \frac{\pi}{4}\le|\omega|\le\pi$

$= 0 \qquad |\omega|\le\frac{\pi}{4}$ **[L3] [CO2] [10M]**

   Find the values of h (n) for N=11. Find H (z) and plot the magnitude response

4. Develop an ideal Low pass filter with a frequency response

$$H_d(e^{jw}) = 1 \; for \; -\frac{\pi}{2} \le |\omega| \le \frac{\pi}{2}$$

$$= 0 \; \frac{\pi}{2} \le |\omega| \le \pi$$ **[L3] [CO2] [10M]**

Find the values of h(n) for N=11. Find H (z) and plot the magnitude response.

5. Determine 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(2 πk/15) = 1 for k=0,1,2,3
= 0 for k=4, 5, 6, 7 **[L3] [CO2] [10M]**

6 .a. Determine the Direct form realization of system function **[L3] [CO3] [5M]**
H(z) = 1 + 2 z-1 – 3 z-2 – 4 z-3 + 5 z-4

b. Construct the linear phase realization of the system function **[L3] [CO3] [5M]**
H(z) = ½ + 1/3 z-1 + z-2 + ¼ z-3 + z-4 + 1/3 z-5 + ½ z-6

7. 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 **[L3] [CO2] [10M]**

H(2 πk/15) = 1 for k = 0, 1, 2, 3
= 0.4 for k = 4
= 0 for k = 5, 6, 7

8. a. Explain the design steps of FIR filters using windows. **[L2] [CO3] [5M]**
b. State and explain the properties of FIR filters. State their importance. **[L1] [CO3] [5M]**

9. a. Construct the cascade realization of FIR Filters for the function **[L3] [CO3] [5M]**
H(z) = (1 + 2 z-1 – z-2) (1 + z-1 – z-2)

b. 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] [5M]**

10. a. Develop an ideal Band pass filter with the frequency response **[L3] [CO2] [10M]**

$$H_d(e^{jw}) = 1 \; for \; \frac{\pi}{4} \le |\omega| \le \frac{3\pi}{4}$$

$$= 0 \; Otherwise$$

Find the values of h(n) for N=11. Find H(z) and plot the frequency response

2MARKS

1. What are the advantages and disadvantages of FIR filters? **[L1] [CO2] [2M]**
2. Why the FIR filter is always stable? **[L1] [CO2] [2M]**
3. State and explain the properties of FIR filters. **[L1] [CO2] [2M]**
4. Distinguish between FIR and IIR filters. **[L2] [CO2] [2M]**
5. What is the necessary and sufficient condition for linear phase characteristic in FIR filter? **[L1] [CO2] [2M]**
6. List the design methods of linear phase FIR filters. **[L1] [CO2] [2M]**
7. What is the basis for Fourier series method? Why truncation is necessary? **[L1] [CO2] [2M]**
8. List the steps to design a FIR filter using Fourier series method. **[L1] [CO2] [2M]**
9. What are the disadvantages of Fourier series method? **[L1] [CO2] [2M]**
10. Define Gibb's phenomenon. **[L1] [CO2] [2M]**
11. Summarize the procedure for designing FIR filters using windows. **[L1] [CO2] [2M]**
12. What are the desirable characteristics of windows? **[L1] [CO2] [2M]**
13. Write the characteristic features of rectangular window. **[L3] [CO2] [2M]**
14. Write the characteristic features of Hanning window. **[L3] [CO2] [2M]**

15. Write the characteristic features of Hamming window. **[L3] [CO2] [2M]**
16. Compare rectangular and Hanning window **[L3] [CO2] [2M]**
17. What is the principle of designing FIR filter using frequency sampling method? **[L1] [CO2] [2M]**
18. What is recursive and non-recursive realization? **[L1] [CO3] [2M]**
19. Show the direct form realization of FIR system. **[L1] [CO2] [2M]**
20. When cascade form realization is preferred in FIR filters. **[L1] [CO2] [2M]**

UNIT-IV
10 MARKS

1. a. Express the following numbers in floating point format with five bits for mantissa and three bits for exponent. a) 710 b) 0.2510 c) -710 d) -0.2510 **[L2] [CO5] [5M]**
   b. Discuss the various common methods of quantization. **[L2] [CO5] [5M]**
2. a. What is quantization of analog signals? Derive the expression for the quantization error. **[L1] [CO5] [5M]**
   b. Explain in detail the effects of input quantization error. **[L2] [CO5] [5M]**
3. a. How to prevent limit cycle oscillations? Explain. **[L1] [CO5] [5M]**
   b. What is a dead band of a filter? Explain. **[L1] [CO5] [5M]**
4. a. Compare floating point with fixed point arithmetic. **[L2] [CO5] [5M]**
   b. What is quantization noise? Derive the expression for quantization noise power. **[L1] [CO5] [5M]**
5. a. Tabulate the Quantization error ranges of truncation and rounding for the various number representations. **[L1] [CO5] [5M]**
   b. Sketch and explain the power density functions for truncation and rounding. **[L3] [CO5] [5M]**
6. Explain the characteristics of limit cycle oscillation with respect to the system. described by the difference equation $y(n) = 0.7\ y(n-1) + x(n)$. Determine the dead band range of the system. **[L3] [CO5] [10M]**
7. The output signal of an A/D converter is passed through a first order low pass filter with transfer function $H(Z) = (1-a)z/\ (z-a)$ for $0< a <1$. Determine the steady state output noise power due to quantization at the output of the digital filter. **[L3] [CO5] [10M]**
8. a. With relevant expressions and Quantization noise model discuss steady state input noise power. **[L2] [CO5] [5M]**
   b. Discuss about the steady state output noise power. **[L2] [CO5] [5M]**
9. a. Discuss in detail the errors resulting from rounding and truncation. **[L2] [CO5] [5M]**
   b. Summarize the various forms of representing the numbers in digital systems **[L1] [CO5] [5M]**
10. 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 $x(n)=0.75$ for $n=0$ and $x(n)=0$ for $n\neq0$. **[L3] [CO5] [10M]**

2 MARKS

1. List the different types of arithmetic used in digital systems. **[L1] [CO4] [2M]**

2. What are the different types of fixed-point number representations? **[L1] [CO4] [2M]**
3. Write short notes on sign-magnitude representation. **[L1] [CO4] [2M]**
4. What is meant by floating point representation? **[L1] [CO4] [2M]**
5. What is meant by block floating point representation? What are its advantages? **[L1] [CO4] [2M]**
6. Compare the fixed and floating point arithmetic. **[L3] [CO4] [2M]**
7. What are the errors that arise due to quantization of numbers? **[L1] [CO5] [2M]**
8. What is coefficient quantization error? What is its effect? **[L1] [CO5] [2M]**
9. Why rounding is preferred to truncation in realizing digital filters? **[L1] [CO5] [2M]**
10. What are the errors generated by A/D process? **[L1] [CO4] [2M]**
11. What is the effect of quantization on pole location? **[L1] [CO5] [2M]**
12. What are limit cycles and list the types of limit cycles in DSP? **[L1] [CO5] [2M]**
13. What is Dead band of a filter? **[L1] [CO5] [2M]**
14. What is meant by rounding? Discuss its effect on all types of number systems? **[L1] [CO5] [2M]**
15. How the sensitivity of frequency response to quantization of filter coefficients is minimized? **[L1] [CO5] [2M]**
16. How to prevent limit cycle oscillations. **[L1] [CO5] [2M]**
17. Compare fixed and floating-point arithmetic. **[L1] [CO4] [2M]**
18. What is meant by input quantization error? **[L1] [CO5] [2M]**
19. What is overflow oscillations? **[L1] [CO5] [2M]**
20. What is meant by saturation arithmetic? **[L1] [CO4] [2M]**

UNIT –V
10 MARKS

1. With a neat sketch explain the architecture of TMS 320C50 processor **[L1] [CO6] [10M]**
2. a. What are the different buses of TMS320C5X and their functions **[L1] [CO6] [5M]**
   b. Discuss briefly about the overview of digital signal processors(a) List t he functional units in Central Processing Unit of 5X. **[L2] [CO6] [5M]**
3. a. List the functional units in Central Processing Unit of 5X. b) Explain the function of CALU in detail. [L1] **[CO6] [5M]**
4. a. What is meant by memory mapped register? How is it different from a memory? **[L1] [CO6] [5M]**
   b. Discuss the various Circular Buffer Registers in detail **[L2] [CO6] [5M]**
5. a. List status register bits of 5X and their functions. **[L1] [CO6] [5M]**
   b. Discuss the Block repeat registers (RPTC, BRCR, PASR and PAER. **[L2] [CO6] [5M]**
6. a. List the various on-chip peripherals interfaced with 5X. **[L1] [CO6] [5M]**
   b. Explain the function of Serial port interface. **[L2] [CO6] [5M]**
7. a. Classify the various interrupt types supported by 5X? **[L2] [CO6] [5M]**
   b..Sketch and explain the architecture of von Neumann **[L2] [CO6] [5M]**
8. a. Distinguish between the dual-access RAM and single-access RAM used in the on-chip memory of 5X. **[L2] [CO6] [5M]**
   b. Discuss the advantages and disadvantages of VLIW architecture. **[L2] [CO6] [5M]**
9. a. Explain in detail the application of PDSP's in the field of communication systems. **[L3] [CO6] [5M]**
   b. Discuss the role of PDSP in multimedia applications. **[L2] [CO6] [5M]**
10. a. List the on-chip memory in 5X and explain their functions. **[L1] [CO6] [5M]**
    b. Compare the various architectures employed in designing a digital signal processor. **[L2] [CO6] [5M]**

2 MARKS

1.	Mention the applications of PDSP's.	**[L1] [CO6] [2M]**
2.	What are the different buses of TMS320C5X?	**[L1] [CO6] [2M]**
3.	Draw the block diagram of VonNumann Architecture?	**[L1] [CO6] [2M]**
4.	What are the advantages and disadvantages of VLIW architecture?	**[L1] [CO6] [2M]**
5.	Define Pipelining?	**[L1] [CO6] [2M]**
6.	Mention some examples of fixed and floating point DSP's.	**[L1] [CO6] [2M]**
7.	What are the factors that influence the selection of DSP's/	**[L1] [CO6] [2M]**
8.	What are the different buses of TMS320C5x and their functions?	**[L1] [CO6] [2M]**
9.	What is Pipelining and pipeline depth?	**[L1] [CO6] [2M]**
10.	What are the elements that the CPU of C5x consists of?	**[L1] [CO6] [2M]**
11.	Why PDSPs are preferred over advanced microprocessors and the RISC processors?	**[L1] [CO6] [2M]**
12.	What area the applications of on_chip timer?	**[L1] [CO6] [2M]**
13.	Define the addressing modes are specifically tailored for DSP applications	**[L1] [CO6] [2M]**
14.	What is the function of PLU?	**[L1] [CO6] [2M]**
15.	What does CALU consist of?	**[L1] [CO6] [2M]**
16.	What is the function of hardware timer?	**[L1] [CO6] [2M]**
17.	Write short notes on ARAU.	**[L3] [CO6] [2M]**
18.	What are the special addressing modes in PDSP's?	**[L1] [CO6] [2M]**
19.	List various types of interrupts supports by TMS320C5x?	**[L1] [CO6] [2M]**
20.	Discuss briefly about circular addressing mode.	**[L2] [CO6] [2M]**

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