Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R, S) / S5 (WP) (R) / S5 (PT) (R,S) Examination November 2024 (2019 Scheme)

Course Code: ECT 303

Course Name: DIGITAL SIGNAL PROCESSING

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1	Given x(n) = { 1, 2, -3, -4, 5, -1 }. Without calculating DFT find $\sum_{K=0}^{5} -1^{K} X(K)$	3
2	Calculate the number of real multiplications and additions involved in the computation of 32- DFT using direct computation.	3
3	FFT algorithm is an in-place algorithm. Justify the statement.	3
4	Distinguish between the butterflies used in DIT and DIF FFT algorithms.	3
5	Explain the significance of linear phase FIR filters. How they could be identified from impulse response.	3
6	Explain Gibb's phenomenon? How it could be eliminated.	3
7	Realize the filter using minimum number of multipliers $\mathbf{H(z) = (2 + 2z^{-1}) (0.5 - 0.25z^{-1} + 0.5z^{-2})}$	3
8	Why antialiasing filter is used in decimating systems?	3
9	Distinguish between fixed point and floating point arithmetic.	3
10	What is the range of Mantissa in floating point representation? Find the floating point representation of the number **1.5**	3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11	a)	In many signal processing applications, we often multiply an infinite length sequence by a window of length N. The time domain expression for such a window is $w(n) = \left(\frac{1}{2}\right) + \frac{1}{2}\cos\left(\frac{2\pi n}{N}\right)$. If X(k) is the DFT of the input sequence x(n), then what is the DFT of the windowed sequence y(n)=w(n)x(n)?	7
	b)	Determine response of a low-pass filter with impulse response h(n) = [1, 1] for an input x(n) = [1 ,0 ,3 ,2 ,0 ,1 ,4 ,1 ,2] using overlap save method.	7

12 a) $x[n] = [1,-1,2,3,0,0]$ and $X[K]$ is its 6 point DFT. Given that $Y[K]=W_3^{2K}X[K]$. Without computing IDFT, determine the time domain sequence $y[n]$. 4

b) i) State Circular frequency shift property. 4 – DFT of the signal $x(n) =\{a, b, c, d\}$ is $X(K)$.Using circular shift property find the IDFT of $X(K-2)$? 10

ii) Find linear convolution of the sequence {1,2,3,4} and {1,2,1} using circular convolution.

Module -2

13 a) Compute the DFT of the sequence {1, 1, 2, 4, 2, 3, 4, 1} using radix 2 DIT - FFT algorithm. 7

b) Explain how IFFT can be computed using FFT algorithm. And find the 4 point sequence whose DFT is (2, 1-j, 0, 1+j) using DIF-FFT algorithm. 7

14 a) Compute the DFT of the sequence {1, 2, 3, 4, 5, 6, 7, 8} using radix 2 DIF - FFT algorithm. 7

b) Given $x(n) =\{3, 0, 1, 1\}$ and $h(n) = \{2, 0, 1, 2\}$. Find the 4 point DFTs of these 2 sequences using a single 4 point DFT? 7

Module -3

15 a) Design a 6^{th} order linear phase FIR filter with following specifications using Hamming window. $|H(e^{j\omega})| = 1$ for $0 \leq |\omega| \leq 0.25\pi$
$|H(e^{j\omega})| = 0$ for $0.25\pi \leq |\omega| \leq \pi$ 8

b) Comment on the nature of group delay and phase delay in an FIR filter with symmetrical impulse response. And prove that the zeros of such a filter exist in reciprocal pairs? 6

16 a) Design a digital Butterworth Filter that has -2dB pass band attenuation at 250 Hz and at least -15dB stop band attenuation at 500 Hz. Sampling frequency is 2000 Hz. Find the cut off frequency by matching pass band criterion. Use Bilinear transformation (T = 1 sec). 10

b) Compare FIR and IIR Filters. 4

Module -4

17 a) Realize the system described by the difference equation
$y(n) = -0.1y(n - 1) + 0.72y(n - 2) + 0.7x(n) - 0.252x(n - 2)$ in Direct form 2, Cascade form and Parallel form? 11

b) Calculate the number of multiplications, additions and memory locations required for Direct form-II realization of the system
$y(n) = 2y(n - 1) + 3y(n - 2) + 2x(n) - 3x(n - 2)$. 3

18 a) Realize the system described by the difference equation 8
$y(n) = -0.1y(n - 1) + 0.2y(n - 2) + 3x(n) + 3.6x(n - 1) + 0.6x(n - 2)$ Cascade form and Parallel form?

b) Explain the process of interpolation and justify the relevance of anti-imaging filter during interpolation. 6

Module -5

19 a) With a neat diagram explain the architecture of TMS320C67xx processor. 8

b) A system is described by the transfer function $H(z) = 1 \div (1 - 0.9\ z^{-1} + 0.2z^{-2})$ 6
For the given IIR system find the location of poles before and after quantisation , when it is realised in Direct form 1 form. Assume a word length of 4 bits including sign bits while truncating.

20 a) Derive the expression for steady state noise power due to input quantisation by rounding and truncation. 8

b) Distinguish between zero input limit cycle oscillation and Overflow oscillations. 6

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