Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R, S) / S5 (PT) (R, S) Examination December 2023 (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	State and prove Parseval's theorem.	3
2	Obtain linear convolution of the sequences $x(n) = \{1,2,3\}$ & $h(n) = \{-1,-2\}$ using circular convolution.	3
3	Find the number of complex multiplications involved in the calculation of a 64-point DFT using (i) direct computation (ii) radix-2 FFT algorithm	3
4	What is twiddle factor ?	3
5	Derive the mapping between s and z in bilinear transformation.	3
6	Given the specification pass band attenuation is 1 dB , stop band attenuation is 30 dB, pass band edge frequency 200 rad/sec and stop band edge frequency 600 rad/sec . Determine the order of the Butterworth Analog filter?	3
7	Draw the direct form realization of FIR system.	3
8	Why antialiasing filter is used in decimating systems?	3
9	What are the different stages in pipelining?	3
10	Compare Von Neumann and Harvard architecture.	3

PART B

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

Module -1

11	a)	Consider the length -12 sequence defined for $0 \leq n \leq 12$ is x(n) = {3, -1, 2, 4, -3, -2, 0, 1, -4, 6, 2,5} with a 12-point DFT .Evaluate the following functions of X(k) without computing DFT:	8

a. X(0)

b. X(6)

c. $\sum_{k=0}^{11} X(k)$

d. $\sum_{k=0}^{11} |X(k)|^2$

b) State and prove time shifting property of DFT. 6

12 a) Find the convolution of x(n) = {1, 2, 3, 4, 5, 6, 7, 8, 9} and h(n) = {2, 4, 6} using overlap add method. 7

b) Find the 4-DFT of the sequence {1, 1, 1, 0} and plot |X(K)|. 7

Module -2

13 a) Given $(n) = (n + 1)\ for\ 0 \leq n \leq 7$. Find (k) using DIT – FFT algorithm. 8

b) Compare DIT and DIF algorithms. 6

14 a) Explain how a 2N point DFT of a 2N point real-valued sequence can be found by computing a single N point DFT. 6

b) Find the IDFT of the sequence $X(k) = \{4, 1 - j2.414, 0, 1 - j0.414, 0, 1 + j0.414, 0, 1 + j2.414\}$ using DIF – FFT algorithm 8

Module -3

15 a) Design a Butterworth filter using bilinear transformation. 8

Specifications of desired LPF are

$$0.9 \leq |H(w)| \leq 1; \quad 0 \leq w \leq \Pi/2$$
$$|H(w)| \leq 0.2, \quad 3\Pi/4 \leq w \leq \Pi$$

$$T = 1\ sec, Ap = 0.9, As = 0.2, wp = \frac{\Pi}{2}, ws = 3\Pi/4$$

b) Derive equations for magnitude and phase responses of FIR filter whose impulse response is symmetric and length N even. 6

16 a) The desired frequency response of LPF is $Hd(w) = \begin{cases} e^{-3jw}, & |w| \leq 3\Pi/4 \\ 0, & else \end{cases}$ 10

Determine the frequency response of FIR filter if hamming window is used. (N = 7)

b) Convert the analog filter H(s) given below in to a second order Butterworth digital filter using impulse invariance technique. 4

$$H(s) = \frac{1}{s^2 + \sqrt{2}s + 1}$$

Module -4

17 a) When is a cascade form realization preferred in FIR filters? 7

Obtain cascade realization with minimum number of multipliers for the system function

$$H(z) = \left(\frac{1}{2} + z^{-1} + \frac{1}{2}z^{-2}\right)\left(1 + \frac{1}{3}z^{-1} + z^{-2}\right)$$

b) How upsampling and downsampling affect the frequency spectrum of a signal x(n) with frequency spectrum $X(e^{j\omega})$? Explain the need of low pass filter prior to downsampling 7

18 a) What are multirate DSP systems? Give the output of decimation by M system in time domain. 4

b) Obtain the cascade and parallel form realization for the system 10

$$y(n) = -0.1y(n-1) + 0.2\,y(n-2) + 3\,x(n) + 3.6\,x(n-1) + 0.6\,x(n-2)$$

Module -5

19 a) Explain the effects of coefficient quantization in IIR and FIR filters. 7

b) What are the main features of a DSP processor? Give the significance of MAC unit in a DSP processor. 7

20 a) Draw the block diagram of TMS320C67XX and briefly explain the function of each block. 10

b) Write a short note on finite word length effects in DSP systems. 4

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