Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (S, FE) / S5 (PT) (S,FE) Examination June 2024 (2015 Scheme)

Course Code: EC301

Course Name: DIGITAL SIGNAL PROCESSING

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Consider x(n) ={1,2,-3,0,1,-1,4,2} with an 8 point DFT X(k). Evaluate the following without finding DFT. (9)

a) X(0) b)$\sum_{k=0}^{7} X(k)$ c) $\sum_{k=0}^{7} e^{-\frac{j3\pi k}{4}} X(k)$ d) $\sum_{k=0}^{7} |X(k)|^2$

b) Using equations, find the 4 point IDFT of X(k) = {2, 1+j , 0 , 1-j }. (6)

2 a) Find the output y(n) of a filter whose impulse response is h(n)={1,1,1} and input signal is x(n)={3,-1,0,1,3,2,0,1,2,1} using overlap add method . (10)

b) Perform circular convolution of the given sequences using concentric circle method: $x_1(n) = \{1, -1, -2, 3, -1\}$ & $x_2(n) = \{1, 2, 3\}$. (5)

3 a) Find DFT of a sequence x(n)={0,1,2,3,4,5,6,7} using DIT-FFT algorithm. (11)

b) Also compute the number of complex additions & multiplications required for conventional DFT & DIT FFT. (4)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Determine the low pass filter coefficients h(n) by frequency sampling method for N=7. (8)

$$H_d(e^{j\omega}) = \begin{cases} e^{-j\alpha\omega} & 0 \le |\omega| \le \frac{\pi}{2} \\ 0 & \frac{\pi}{2} \le |\omega| < \pi \end{cases}$$

b) For the analog transfer function, $H(s) = 2/(s^2 + 3s + 2)$,determine H(z) using Impulse Invariance Method. Assume T=1 sec. (7)

5 a) Design an ideal LPF with a frequency response given as follows. Find the values of h(n) for N=11. (8)

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

$$= 0 \; for \; \frac{\pi}{2} \le |\omega| \le \pi$$

b) Explain the characteristics of the following window functions: (4)

(i) Hamming Window (ii) Hanning Window

c) If H(z) represents a linear phase FIR filter and has zeros at $z_1 = \frac{1}{\sqrt{2}} + j\frac{1}{\sqrt{2}}$ and $z_2 =$ (3)

2. Find the remaining zeros and determine H(z).

6 a) For the given specifications, design an analog Butterworth filter. (10)

$0.9 \leq |H(j\Omega)| \leq 1$, for $0 \leq \Omega \leq 0.2\pi$ & $|H(j\Omega)| \leq 0.2$, for $0.4\pi \leq \Omega \leq \pi$

b) Explain pre-warping in bilinear transformation. (5)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Explain transposed form of a filter structure. Obtain the transposed direct form II for the given IIR filter. (10)

$$H(z) = \frac{1 + 2z^{-1} + z^{-2}}{1 - \frac{3}{4}z^{-1} + \frac{1}{8}z^{-2}}$$

b) Obtain the following realizations for the given FIR filter. (10)

(i) Direct form realization with minimum number of multipliers

(ii) Cascade realization with minimum number of multipliers

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

8 a) Obtain the cascade realization for the following system: (6)

$y(n) = \frac{3}{4}\, y(n-1) - \frac{1}{8}\, y(n-2) + x(n) + \frac{1}{3}\, x(n-1)$

b) Realize the system with difference equation $y(n) = -0.1\, y(n-1) + 0.72\, y(n-2) + 0.7x(n) - 0.252\, x(n-2)$ using direct form I, direct form II and parallel form. (14)

9 a) With an example, illustrate the error introduced by truncation and rounding in floating point representation of numbers. (6)

b) How is a floating-point number represented in a processor? Explain the operations of addition and multiplication of two floating point numbers with examples. (7)

c) Explain ADC quantization noise. Derive the variance of quantization noise in ADC with step size Δ. (7)

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