Reg No.:_____ Name:_____

06000EC301012302

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (S, FE) / S5 (PT) (S, FE) Examination December 2023 (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) Compute the 4 point IDFT of $X(k) = \{1,0,1,0\}$ (3)

b) Find the linear convolution of x(n)= {1, 2, 1, 2, 1, 2, 1, 2, 1, 2,1} and h(n) = {1,3,1} using overlap save method. (8)

c) State and prove Parseval's theorem. (4)

2 a) Compute 8 point DFT using DIT FFT for the sequence $x(n) = 2^n ; 0 \leq n \leq 7$ (8)

b) Find 4 point DFT of the sequences $x_1(n)$= {4,3,1,5} and $x_2(n)$={6,-4,2, 5} using single DFT. (7)

3 a) Find 8 point DFT of the sequence x(n)= {0,1,2,3,4,5,6,7} using radix-2 DIF-FFT algorithm. (8)

b) Find the linear convolution of x(n)= {3, -1, 0, 1, 3, 2, 0, 1, 2, 1} and h(n) ={1, 1, 1} using overlap add method. (7)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Design a band pass filter to pass frequencies in the range 1 to 2 rad/sec using Hanning window with N=5 (7)

b) Explain the procedure for designing FIR filters using frequency sampling method. (5)

c) Write any three comparisons between the design methods used for Linear Phase FIR Filters (3)

5 a) Design an analog Butterworth filter for the given specification (6)

$$0.9 \leq |H(j\Omega)| \leq 1 \quad for \quad 0 \leq \Omega \leq 0.2\pi$$

$$|H(j\Omega)| \leq 0.2 \quad for \quad 0.4\pi \leq \Omega \leq \pi$$

b) Design a Butterworth low pass digital IIR filter with a pass band edge frequency of 0.25π with a ripple not exceeding 0.5dB and a minimum stop band attenuation 15dB with a stop band edge frequency of 0.55π. Use bilinear transformation. (9)

6 a) An analog filter has a transfer function $Ha(s) = \frac{(s+0.1)}{(s+0.1)^2+9}$. Design a digital filter equivalent to this using impulse invariant method. Assume T=1 sec (7)

b) The desired frequency response of a LPF is (8)

$$H_d(\omega) = \begin{cases} e^{-3j\omega} & ; \quad |\omega| \leq \frac{3\pi}{4} \\ 0 & ; \quad otherwise \end{cases}$$

Determine filter coefficients for N=7 using hamming window.

PART C

Answer any two full questions, each carries 20 marks.

7 a) Obtain the direct form I, direct form II, cascade and parallel form realization for the system with transfer function (20)

$$H(z) = \frac{3 + 3.6z^{-1} + 0.6z^{-2}}{1 + 0.1z^{-1} - 0.2z^{-2}}$$

8 a) Obtain the expression for the output y(n) when an input sequence x(n) is first applied to an interpolator with upsampling factor L=5 , then to a decimator with a downsampling factor M=10 and again upsampled by a factor L=2. (5)

b) Explain finite word length effects in IIR digital filter (10)

c) Differentiate fixed point and floating point arithmetic. (5)

9 a) Draw the architectural block diagram of TMS320C67XX DSP processor and explain each block. (10)

b) Explain the effect in the spectrum of a signal x(n) when it is (5)

(i) Decimated by a factor 2

(ii) Interpolated by a factor 2

c) Explain round off errors (5)

****