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Total No. of Pages : 4

MT/D11 : 8906

M.Tech 1.2 : Digital Signal Processings

Time : Three Hours

Maximum Marks : 60

Note:- Attempt any FIVE questions by selecting at least ONE question from each section.

UNIT-I

Q.1 a) Determine the impulse response h(n) for the system described by second order difference Equation, 7

$y(n) - 3y(n-1) - 4y(n-2) = x(n) + 2x(n-1)$

b) Compute the auto correlation of signal 4

$x(n) = a^n u(n);\ 0 < a < 1$

c) Discuss the correlation of periodic sequences? 4

Q.2 a) Determine and sketch the convolution y(n) of signals given below; 6

$$x(n) = \left\{ \begin{matrix} \frac{n}{3} \le 0\ n \le 6 \\ 0;\ \text{Otherwise} \end{matrix} \right\}$$

$$h(n) = \left\{ \begin{matrix} 1;\ -2 \le n \le 2 \\ 0;\ \text{Otherwise} \end{matrix} \right\}$$

b) The discrete time system $y(n) = ny(n-1) + x(n);\ n \ge 0$ is at rest (i.e. $y(-1) = 0$). Check if the system is linear time invariant and BIBO stable? 6

c) Discuss the properties of real valued sequences in detail? 3

UNIT - II

Q.3 a) Show that the roots of a polynomial with real coefficients are real or form complex conjugate pairs. The inverse is not true in general? 7

b) Determine x(n) for the function given below: 8

$X(z) = 3/[1-(10/3)Z^{-1} + Z^{-2}]$

; if X(z) converges on unit circle?

Q.4 a) Determine the stability region for the causal system, 8

$H(z) = 1/[1 + a_1 Z^{-1} + a^2 Z^{-2}]$

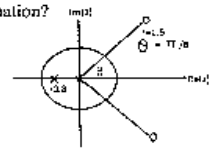
By computing its poles and restricting them to be inside the unit circle?

b) Consider a causal system defined by pole-zero pattern show in figure below:

i) Determine system function and impulse response of the system given that $H(z)|_{z=1} = 1$? 6

ii) Check the system stability? 7

iii) Implement the system and determine its difference equation?



UNIT - III

Q.5 a) Describe Goertzal' algorithm using necessary mathematical expressions? 7

b) Compute 16-point DFT of the sequence $x(n) = \cos(n\pi/2);\ 0 \le n \le 15$ using radix-4 decimation. In time algorithm? 8

Q.6 a) Explain how DFT can be used to compute 'N' equispaced sample of the z-transform of an N-point sequence on a circle of radius 'r'? 8

b) Perform the circular convolution of the following two sequences & draw sketches: 7

$X_1(n) = \{2, 1, 2, 1\}$

$X_2(n) = \{1, 2, 3, 4\}$

UNIT - IV

Q.7 a) The desired frequency response of a low pass filter is

$$H_d(e^{j\omega}) = \left[\begin{matrix} e^{-3j\omega};\ -\frac{3\pi}{4} \le \omega \le \frac{3\pi}{4} \\ 0;\ 3\pi/4 < |\omega| \le \pi \end{matrix} \right]$$

Determine $H(e^{j\omega})$ for M=7 using a Hamming Window? 8

b) Convert the analog filter with system function

$$H(s) = \frac{(s+0.1)}{(s+0.1)^2 + 9}$$

Into a digital IIR filter using Bilinear transformation. The digital filter should have a resonant frequency of $\omega r = \pi/4$? 7

Q.8 a) Draw the structures of cascade and parallel realizations of the following function: 8

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

b) Explain the procedure of designing digital filters using Kaiser Window function, in detail? 7