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B.Tech 8th Semester Examination
DIGITAL SIGNAL PROCESSING
Paper : E-402

Time : 3 Hours]

[Max. Marks : 60

Instructions :

(i) *Part-I is compulsory and all questions carry equal marks.*

(ii) *Attempt any four questions from Part-II.*

PART–I

1. (a) Find the power of the given signal below : (2)

$$X(n) = \begin{cases} 12(-1)^n, & n \geq 0 \\ 0 & , \ n < 0 \end{cases}$$

(b) What is quantization error and also state sampling theorem? (2)

(c) Find the DTFT of a sequence $x(n) = \{1, \underset{\uparrow}{1}, 2, 2\}$ (2)

(d) What are the properties of chebyshev filter? (2)

(e) By impulse invariant method obtain the digital filter transfer function and the differential equation of the analog filter $h(s) = 1/s + 1$. (2)

(f) State and prove time convolution property of DTFT. (2)

(g) Check the BIBO stability for the impulse response of a digital system given by : (2)

$$h(n) = 3a^n u(n).$$

(h) What conditions are to be satisfied by the impulse response of an FIR system in order to have a linear phase? (2)

(i) What are the applications of multi rate DSP? (2)

(j) Compare of FIR and IIR filters. (2)

PART–II

2. (a) Compute the signal energy for $x(t) = e^{-4t} u(t)$. (5)

(b) Find convolution of given signals: (5)

$x(n) = 2^n u(-n-1)$ and $h(n) = [1/5]^n u(n-1)$

3. (a) Show that the following systems are non-linear and time invariant. (5)

$$y(n) - x(n-1)\, y(n-3) = x(n)$$

$$y(n+2) + y(n) = x(n+1)+3.$$

(b) Find the response of discrete time LTI system with impulse response $h(n) = (1/2)^n u(n)$ for input $x(n) = (3/n)^n u(n)$. (5)

4. (a) State and prove differentiation property of z-transform. Using differentiation property, determine the z-transform of $x(n) = 2n^3 u(n)$. (5)

(b) Determine the inverse z-transform of (5)

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

if region of convergence are

(a) $|z| > 1$ (b) $|z| < \frac{1}{3}$ (c) $\frac{1}{3} < |z| < 1$.

5. (a) Obtain the cascade and parallel realisation structures for the following signal : (5)

$$H(z) = \frac{2(1-z^{-1})(1+\sqrt{2z^{-1}}+z^{-2})}{(1-0.5z^{-1}(1-0.9z^{-1}+0.81z^{-2})}.$$

(b) Derive the mapping formula for the approximation of derivatives method using backward difference. (5)

6. (a) The sequence $x(n) = [0, 2, 4, 6, 8]$ is interpolated using interpolation sequence $b_k = [1/2, 1, 1/2]$ and the interpolation factor is 2. Find the interpolated sequence $y(m)$. (5)

(b) Design an ideal high pass filter with a frequency response (5)

$$H_d(e^{jw}) = \begin{cases} 1 \text{ for } \pi/4 \le |w| \le \pi \\ 0 \text{ for } |w| \le \pi/4 \end{cases}$$

Find the values of $h(n)$ for N = 11 using Hamming window. Find H(z) and determine the magnitude response.

7. Write a short note on the following :

(a) Filter Structures. (5)

(b) Reconstruction of bandlimited signal from its samples. (5)