Con. 6047-09. T.E.(IT) Sem VI Digital Signal Processing SP-8150

(3 Hours) [Total Marks : 100

7/01/10

N.B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions. 2-30 to 5-30.

1. (a) Test the stability of DT system whose difference equation is $y(n) = \frac{1}{2} y(n-1) + x(n)$. 5
(b) State and prove convolution property of z-transform. 5
(c) Determine whether the systems given by following equations are linear/non linear, time variant/time invariant, causal/non causal. 6

(i) $y(n) = x(n) + \frac{1}{x-11}$

(ii) $y(n) = n\, x(n)$

(d) What do you understand by invertible and non invertible systems ? Give example of each. 4

2. (a) If $x(n) = \{1, 2, 3, 4\}$ and $h(n) = \{-3, 2, 1\}$. Determine convolution between $x(n)$ and $h(n)$ using circular convolution. 6
(b) Determine causal, non causal and both sided signal associated with the z-transform. 9

$$X(z) = \frac{1}{1 - 1 \cdot 5z^{-1} + 0 \cdot 5z^{-2}}$$

(c) Describe different window functions used in FIR filter design. 5

3. (a) Obtain Direct Form-I, Direct Form-II, cascade and parallel realisation of the DT system described by the transfer function. 12

$$H(z) = \frac{1 - \frac{1}{2} z^{-1}}{1 - z^{-1} + \frac{3}{16} z^{-2}}$$

(b) Find DFT of the following sequence using DIT-FFT. 8
$x(n) = \{1, 2, 1, 2, 0, 2, 1, 2\}$.

4. (a) (i) Find the DFT of the sequence, $x(n) = \{1, 2, 3, 4\}$. 8
(ii) Using the result obtained in (i) and not otherwise find DFT of,
$x_1(n) = \{1, -2, 3, -4\}$
$x_2(n) = \{3, 4, 1, 2\}$

(b) Convert $H(s) = \frac{2}{(s+1)(s+2)}$ with T = 1 sec. into H(z) using Bilinear Transformation. 8

(c) Compare FIR and IIR Filters. 4

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5. (a) Design a butterworth filter using the impulse invariance method for the following specification. 12

$$0 \cdot 8 \leq |H(e^{jw})| \leq 1, 0 \leq w \leq 0 \cdot 2\pi$$

$$|H(e^{jw})| \leq 0 \cdot 2, 0 \cdot 6\pi \leq w \leq \pi.$$

(b) Find the response of the filter whose impulse response is h(n) = { 1,1,1 } and input signal x(n) = { 3, –1, 0, 1, 3, 2, 0, 1, 2, 1 } using overlap-add method. 8

6. (a) Design a low past filter with 15

$$H_d(e^{-jw}) = e^{-j3w}, -\pi/2 \leq w \leq \pi/4$$

$$= 0 \quad , \quad \pi/4 < w \leq \pi.$$

using a Hanning window with N = 7.

(b) State and prove time shifting property of DFT. 5

7. Write a short notes on any **three** of the following :– 20

(a) DSP processors
(b) Properties of convolution
(c) Overlap - save method
(d) Hilbert transform.