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RN-7383

B. E. - IV (Sem. - VII) (E & C) Examination

May / June – 2010

Digital Signal Processing

Time : **3** Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. - 4 (SEM. - 7) (E & C)**

Name of the Subject :

☛ **DIGITAL SIGNAL PROCESSING**

☛ Subject Code No. : **7 3 8 3** ☛ Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

(2) Assume suitable data wherever found necessary and clearly mention them.

(3) The symbols and acconyms carry usual meaning.

(4) Figures to the right indicate full marks.

(5) Use of programmable calculators is not allowed.

SECTION – I

1 Do as directed :

(1) Prove that discrete time sinusoidal signal is periodic only if its frequency can be expressed as ratio of two integers. **2**

(2) Consider the discrete time system exited by the sequence, **4**

$x(n) = 1$ for $0 \le n \le 3$

$= 0$ 0/w

if output is $y(n)$, find $y(n)$ if

(i) $y(n) = 2x(n)$ (ii) $y(n) = x(n^2)$

(3) State whether following system are classified as follows. Justify your answer. **6**

System	Linear/ nonlinear	Time invariant/ time variant	Stable unstable

(i) $y(n) = x(n^2)$ (ii) $y(n) = nx(n)$

(4) State and prove following properties of z-transform 8

(a) scaling in z domain

(b) time convolution.

2 (a) Consider the inter connection of LTI system as shown in **fig. 1**.

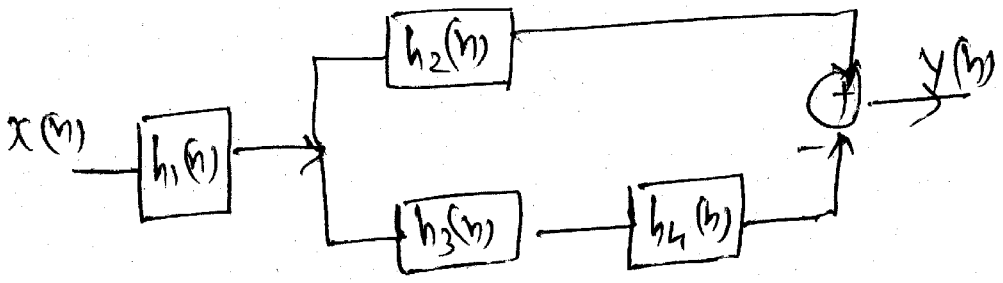

Fig. 1

(i) Express the overall response in terms of $h_1(n), h_2(n), h_3(n)$ and $h_4(n)$ **2**

(ii) Determine $h(n)$ when **6**

$$h_1(n)=\left\{\frac{1}{2},\frac{1}{a},\frac{1}{2}\right\},\quad h_2(n)=h_3(n)=(n+1)4(h)$$

$$h_4(n)=\delta(n-2)$$

(iii) Determine the response of the system in part (b) if $x(n)=\delta(n+2)+3\delta(n-1)-4\delta(n-3)$ **6**

(b) Compute the convolution $y(n)$ of the following pairs to signals. **4**

$x(n)=a^n\,u(n)$

$h(n)=b^n u(n)$

Case I $a \neq b$

Case II $a=b$

OR

2 (a) Determine the solution of the difference equation **5**

$$y(n)=\frac{5}{6}y(n-1)-\frac{1}{6}(n-2)+x(n)$$

with $x(n)=2^n u(n)$

(b) Determine direct forms II retalization of LTI system. **6**

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

(c) Derive the range of valves of the parameter a for which LTI system with impulse response. **4**

$$h(n)=\begin{cases}a^n & n\geq 0,\ \text{even}\\ 0 & 0/w\end{cases}$$

is stable system.

3 Attempt : (any **two**) **12**

(a) Determine all possible signals $x(n)$ associated with z-transform.

$$x(z)=\frac{5z^{-1}}{\left(1-2z^{-1}\right)\left(3-z^{-1}\right)}$$

(b) Determine convolution of the following pairs of signals by means of z transform.

$*x_1(n)=n\,u(n)$ and $*x_2(n)=2^n\,u(n-1)$

(c) Determine z transform for the following

$$x(n)=\frac{1}{2}\left(n^2+n\right)\left(\frac{1}{3}\right)^{n-1}u(n-1)$$

SECTION – II

4 (a) Give the answers of the following : **10**

(1) Mathematically describe FIR and IIR filter with the base of LTI system equation.

(2) Calculate the DFT of the following time sequence

$x(n)=\left\{\underset{\uparrow}{4},0,0,0\right\}$

(3) What is the importance of Bit Reversal in Radix 2 FFT ?

(4) Discuss Sampling theorem and digital frequency.

(5) Briefly discuss truncation and windowing in context with FIR filter.

(b) Find N point DFT on $x(n)=a^n$ for $0<a<1$. **5**

(c) How DSP processors are different from other processors ? Discuss the architecture of DSP processor in brief. **5**

5 Answer the following questions :

(a) Given input $x(n)=\{\underset{\uparrow}{1}, 2, 3, 0\}$ and system function $h(n)=\{\underset{\uparrow}{1}, 2, 0, 0\}$. Use FFT method to calculate output $y(n)$ using DIT algorithm for FFT and verify its answer using circular convolution. **10**

(b) Justify the statement "Ideal Filters and Non Causal and partically Non Realizable." **5**

OR

5 Answer the following questions :

(a) Let $x(n)=\{\underset{\uparrow}{1}, 2, 3, 3, 4, 5\}$ and $h(n)=\{\underset{\uparrow}{1}, 1, 1\}$. Compute the convolution of long data sequence using Overlap Add method and verify its answer with linear convolution using tabular (sum by column) method. **7**

(b) Convert analog band-pass filter with system function $Ha(S)=\dfrac{1}{(s+0.1)^2+16}$ into a digital IIR filter using approximation of derivative method. **8**

6 Attempt any **three** : **15**

(1) Steps for designing digital IIR filter from analog filter.

(2) Designing digital FIR filter using Windowing method.

(3) Discuss Paley Weiner Theorem.

(4) Prove that computational complexity of FFT is less than DFT.

(5) What is decimation and interpolation ? State their importance in Multi Rate Signal Processing.
