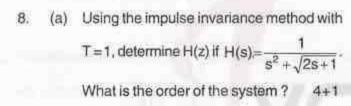
-6

(a) How many complex additions and complex multiplications are required for the direct computation of an N-point DFT?

Discuss the radix -2 DIT FFT algorithm. 6

-> D

Determine the direct form I and direct form II realization of an LTI system given as 2y(n)+y(n-1)-4y(n-3)=x(n)+3x(n-5). How can you realize a unit delay in hardware?



(b) Derive the variance of the Bartlett power spectrum estimate.
5 Total number of printed pages - 8

B. Tech

CPEC 5302

Sixth Semester Examination - 2009

DIGITAL SIGNAL PROCESSING

Full Marks - 70

Time: 3 Hours

Answer either from Set-A or Set-B, but not from both.

SET - A

Answer Question No. 1 which is compulsory and any five from the rest.

> The figures in the right-hand margin indicate marks.

- Answer the following questions :
 - Find out if a system with the input-output relation given by y(n) = αx(n) +β is linear. Justify.

2×10

- (b) Determine whether a system described with y(n) = nx(n) is time invariant.
- (c) Draw the transfer function of an ideal low pass filter with proper labeling.
- (d) What is the period of x(t) = 20sin 25πt?
- (e) Give an example of a recursive system and explain why it is recursive?
- (f) What is the magnitude response of a system described with the following input-output relationship y(n)=0.5[x(n)+ x(n-1)]?
- (g) What is the z-transform of a sequence x(n) = {1, 2, 4, 6} ?
- (h) What is the DFT of a real and even sequence?
- (i) If a finite duration sequence of length M₁ excites an FIR filter with a length of M₂, what is the length of the output sequence?
- (j) When an FIR filter is said to have a linear phase ?

 (a) Determine the range of values of α for which an LTI system described with the following impulse response is stable.

$$h(n) = \alpha^n \cos(n\omega_0)u(n)$$
 7

(b) Express the sequence defined by

$$x(n) = \begin{cases} -2, n = -1,0,1 \\ 4, n = -2,2 \\ 0 \text{ otherwise} \end{cases}$$

as a weighted sum of unit sample sequences. 3

- (a) Find out the response of the relaxed system having an impulse response of $\left(\frac{1}{2}\right)^n u(n)$ to the input signal $2^n u(n)$.
 - (b) Give a block schematic of a system having the following input-output relationship y(n) = x(n) + ay (n−1) + by(n−2). How many additions and multiplications are performed per sample?
- 4. (a) Find out the z-transform and ROC of the signal $x(n) = \left(\frac{1}{3}\right)^n u(n)$.

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Contd.

- (b) Determine the transfer function of a system described by $y(n) = \frac{3}{2}y(n-1) + 2x(n)$. 4
- (a) Compute the DFT of a sequence defined by x(n) = {-2,2,1-1}
 - (b) Compute the N point DFT a sequence given as x(n) = e⁻ⁿ, 0 ≤ n ≤ 4.
- (a) How many complex additions and complex multiplications are required for the direct computation of an N-point DFT?
 - (b) Discuss the radix –2 DIT FFT algorithm. 6
- Determine the direct form I and direct form II realization of an LTI system given as 2y(n)+ y(n-1) 4y(n-3) = x(n) + 3x(n-5). How can you realize a unit delay in hardware?
- 8. (a) Using the impulse invariance method with T=1, determine H(z) if $H(s)=\frac{1}{s^2+\sqrt{2s+1}}$. What is the order of the system? 4+1
 - (b) Derive the variance of the Bartlett power spectrum estimate.

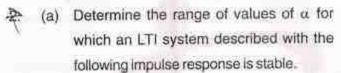
SET - B (IT Branch)

Answer Question No. 1 which is compulsory and any five from the rest.

The figures in the right-hand margin indicate marks.

- Answer the following questions: 2×10
 - (a) Find out if a system with the input-output relation given by y(n) = αx(n) + β is linear. Justify.
 - (b) Determine whether a system described with y(n) = nx(n) is time invariant.
- (c) Draw the transfer function of an ideal low pass filter with proper labeling.
 - (d) What is the period of $x(t) = 20\sin 25\pi t$?
 - (e) Give an example of a recursive system and explain why it is recursive?
 - (f) What is the magnitude response of a system described with the following inputoutput relationship y(n)=0.5[x(n)+x(n-1)]?
 - (g) Prove the periodicity property of DFT.

- (h) What is the DFT of a real and even sequence?
- (i) If a finite duration sequence of length M₁ excites an FIR filter with a length of M₂, what is the length of the output sequence?
- (j) When an FIR filter is said to have a linear phase ?



$$h(n) = \alpha^n \cos(n\omega_0)u(n)$$

0

Express the sequence defined by

$$x(n) = \begin{cases} -2, n = -1, 0, 1 \\ 4, n = -2, 2 \\ 0 \text{ otherwise} \end{cases}$$

as a weighted sum of unit sample sequences. 3

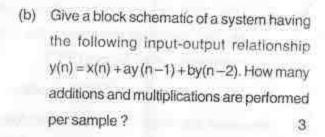


having an impulse response of $\left(\frac{1}{2}\right)^n u(n)$ to the input signal $2^n u(n)$.

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Contd.



(a) Determine the frequency response and magnitude spectrum of a system characterized by y(n) = 1.8y(n-1)-0.81y(n-2) + x(n)+0.95x(n-1)

(b) Convert the analog filter with system function $H_a(s) = \frac{s + 0.1}{(s + 0.1)^2 + 16} \text{ into a digital IIR}$ filter by means of bilinear function. Give the location of poles and zeros.



(a) Compute the DFT of a sequence defined by $x(n) = \{-2, 2, 1, -1\}$

(b) Compute the N point DFT a sequence given as x(n) = e⁻ⁿ, 0 ≤ n ≤ 4.

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(a) V

P.T.O.