B.E. Seventh Semester (Information Technology) (CGS)

10747 : Digital Signal Processing : 7 IT 01

P. Pages : 3 | AU - 2918

Time : Three Hours | Max. Marks : 80

Notes : 1. Due credit will be given to neatness and adequate dimensions.
2. Assume suitable data wherever necessary.
3. Illustrate your answer necessary with the help of neat sketches.
4. Use of pen Blue/Black ink/refill only for writing the answer book.

1. a) The analog signal x(t) is given below **8**

$$x(t) = 2\cos 2000\pi t + 3\sin 7000\pi t + 8\cos 10000\pi t$$

i) Calculate Nyquist sampling rate.

ii) If the given x(t) is sampled at a rate of $f_s = 5000\,Hz$. What is discrete time signal.

iii) What is analog signal y(t), we can reconstructed from the sample. If ideal interpolation method.

b) A discrete time sequence x(n) is given as : **6**

$$x(n) = \left\{ 1, \underset{\uparrow}{1}, 1, 1, \frac{1}{2}, \frac{1}{2} \right\}$$

Sketch & label each of the following sequences.

i) $x(n-2)$ ii) $x(4-n)$

iii) $x(n).u(2-n)$ iv) $x(1-n).\delta(n-3)$

OR

2. a) A discrete time signal x(n) is defined as **7**

$$x(n) = \begin{cases} \frac{n}{3}, & -3 \le n \le -1 \\ 1, & 0 \le n \le 3 \\ 0, & \text{elsewhere} \end{cases}$$

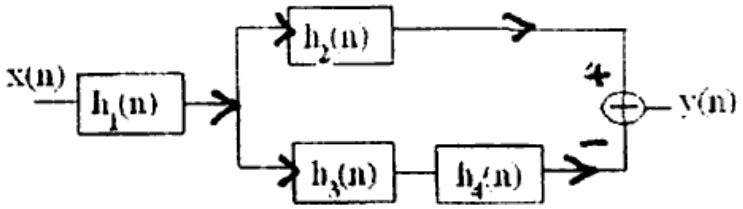
Sketch the signals $x(n)$, $x(n-2)$ & $x(n+1)$.

b) Determine if the system described by the following input output equations are linear, causal, time-invariant **7**

i) $y(n) = x(n) - x(n-1)$

ii) $y(n) = e^{x(n)}$

3. Express the overall impulse response. 13



$h_1(n) = \{\underset{\uparrow}{1/2}, 1/4, 1/4\}$, $h_2(n) = h_3(n) = \{1, \underset{\uparrow}{2}, 3, 4\}$, $h_4(n) = \delta(n-2)$

OR

4. a) Determine zero input response for following second order difference equation 6
$y(n) - 3y(n-1) + 4y(n-2) = 0$ with initial condition $y(-1) = 5,\ y(-2) = 4$.

b) Find the particular solution of input of 7
$x(n) = 3^n;\ n \geq 0,\ y(n) = x(n) + \frac{5}{6}y(n-1) - \frac{1}{6}y(n-2)$

5. a) Using z-transform, determine the unit sample response of the system characterized by the 6
difference equation $y(n) = 2.5\,y(n-1) - y(n-2) + x(n) - 5x(n-1) + 6x(n-2)$.

b) Determine the impulse response of a DT LTI system described by the difference equation: 7
$y(n) - \frac{1}{2}y(n-1) = x(n) + \frac{1}{3}x(n-1)$ for $n \geq 0$ where all initial conditions are zero.

OR

6. a) Determine inverse z – transform $x(z) = \frac{5z}{6z^2 - z - 1}$ for ROC $\frac{1}{3} < z < \frac{1}{2}$. 6

b) Solve the difference equation using Z-transform $2x(n-2) - 3x(n-1) + x(n) = 3^{n-2}$, with 7
initial conditions $x(-1) = -1/3$ and $x(-2) = -4/9$.

7. a) Draw radix 2 butterfly flow graph for 8 – point DIT – FFT & hence find FFT of 8
$x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$

b) Compute the 4. point DFT of the sequence $x(n) = \cos\frac{\pi}{2}n, \qquad 0 \leq n \leq 3$ 5
Using radix – 2 DIT – FFT algorithm.

OR

8. a) Explain the following properties of Fourier transform. 6

i) Time Shifting

ii) Frequency shifting

b) Find DFT of discrete sequence x(n) = {1, 1, 0, 0} Sketch its magnitude and phase spectrum. **7**

9. a) For the analog transfer function **6**

$$Ha(s) = \frac{1}{(s+3)(s+5)}$$

Determine H(Z) using Impulse invariant method for T = 1 sec.

b) Design Ist order Low Pass Butterworth filter for the following specification: **7**
Sampling frequency = 60 Hz
Notch frequency = 20Hz

$$Ha(s) = \frac{1}{(s+1)}$$

OR

10. a) Design digital filter if analog filter is $Ha(s) = \frac{1}{(s+1)}$, if sampling duration T = 0.001 Sec and Pass-Band edge frequency is 50Hz. **7**

b) For the analog transfer function **6**

$$Ha(s) = \frac{1}{(s+4)}$$

Determine H(z) using approximation of derivative method for T = 1 sce.

11. a) Obtain the direct form I, direct from II, structures of IIR for the following difference equation: $y(n) - \frac{5}{4}y(n-1) + \frac{1}{6}y(n-2) = x(n) + \frac{1}{3}x(n-1)$ **7**

b) Obtain Direct II & parallel structures of IIR filter for the following difference equation. **7**

$$y(n) + \frac{3}{8}y(n-1) - \frac{3}{22}y(n-2) - \frac{1}{64}y(n-3) = x(n) + 3x(n-1) + 2x(n-1)$$

OR

12. a) Draw lattice structure for FIR filters **7**

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

b) Realize the given equation in direct form **7**
$y(n) = x(n) - 1/8\,x(n-1) + 3/16\,x(n-2)$

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