Total No. of Questions : 12]

SEAT No. :

P1398

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T.E. (Electronics)

Discrete Time Signal Processing

(2008 Pattern) (Semester - II)

Time : 3 Hours] ***[Max. Marks : 100***

Instructions to the candidates:

1) ***Answer any three question from each section.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
6) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) An analog signal is given by **[6]**

$x(t) = 3 \cos 100 \pi t + 2\sin 300 \pi t - 4 \cos 100 \pi t$

i) What is the Nyquist rate for this signal?

ii) Write the equation of sampled signal.

iii) If the signal is sampled at a rate of 200 sam/sec. What is the discrete time signal obtained after sampling?

b) What are the advantages of discrete time signal processing over analog signal processing? **[6]**

c) Explain Direct form II structures for realization of LTI discrete time systems. **[6]**

OR

Q2) a) Discrete time systems $h_1(n)$ & $h_2(n)$ are connected in cascade. **[6]**

$$h_1(n) = \left\{ \frac{1}{2} \ \frac{1}{4} \ \frac{1}{2} \right\} \qquad h_2(n) = \delta(n-2)$$

Determine the response of the overall system to the input

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

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b) A difference equation of discrete time system is given below : **[6]**

$$y(n)-\frac{2}{5}y(n-1)+\frac{3}{7}y(n-2)=2x(n)+\frac{2}{3}x(n-1)$$

Draw direct form I & direct form II structures.

c) Determine the impulse response of the systems described by the difference equation. **[6]**

$$y(n) = 0.6y(n-1) - 0.08y(n-2) + x(n)$$

Q3) a) Compute the 4 - point DFT of the following sequence $x(n)=\{1 \quad 1 \quad 1 \quad 1\}$. **[4]**

b) Compute the circular convolution of the following sequences. **[4]**

$$x_1(n)=\{4 \quad 3 \quad 2 \quad 1\} \quad x_2(n)=\{1 \quad 2 \quad 1 \quad 2\}$$

c) Explain the following properties of DFT. **[8]**

i) Linearity

ii) Time shifting

iii) Circular convolution

OR

Q4) a) Compute the 8-point DFT of the following sequence using DIT FFT algorithm. **[10]**

$$x(n)=\{1 \quad 2 \quad 2 \quad 1 \quad 1 \quad 2 \quad 1 \quad 1\}$$

b) Find IDFT of the following sequence. **[6]**

$$x(k)=\{7 \quad -2-j \quad 1 \quad -2+j\}$$

Q5) a) State and explain the condition of causality and stability of the discrete time system. **[6]**

b) Compute the z-transform of **[10]**

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

ii) $x_r(n)=a^{|n|}$

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

OR

Q6) a) Compute the z-transform of **[4]**

$$x(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$$

for i) ROC : |z| > 1 ii) ROC : |z| < 0.5

b) Determine the impulse response of the system. **[6]**

$$H(z) = \frac{1 - z^{-1}}{1 - 0.2z^{-1} - 0.15z^{-2}}$$

c) Sketch the following sequences. **[6]**

compute z - transforms

plot pole zero plots for following sequences

i) $x(n) = (1)^n\ u(n)$ ii) $x(n) = (-1)^n\ u(n)$

SECTION - II

Q7) a) Convert the analog filter with system function **[5]**

$$H_a(s) = \frac{s + 0.1}{(s + 0.1)^2 + 9}$$

into digital IIR filter by means of Bilinear transformation. The digital filter should have resonant frequency of $w_r = \pi/4$.

b) Explain frequency warping in Bilinear transformation. What are the advantages of Bilinear transformation over Impulse Invariance transformation? **[5]**

c) Design a single pole low pass digital filter with a 3-dB bandwith of 0.2 π using bilinear transformation applied to the analog filter. **[8]**

$$H(s) = \frac{\Omega c}{s + \Omega c}$$

where Ωc is 3-dB bandwidth of analog filter. Also compute the magnitude at w = 0 & w = 0.2π.

OR