Total No. of Questions : 12]

SEAT No. :

P2925

[Total No. of Pages : 5

[4958]-160
T.E. (Electronics)
DISCRETE TIME SIGNAL PROCESSING
(2008 Course) (304211) (Semester - II)

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

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate books.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
4) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) An analog signal is represented as $x(t) = \sin 10\pi t + 2 \sin 20\pi t + 2 \cos 30 \pi t$

i) What is the Nyquist rate of the signal?

ii) If the signal is sampled at a rate of 20Hz, what is the folding frequency?

iii) Write the equation of sampled signal.

[6]

b) Obtain direct form I & direct form II realizations for the system. **[6]**

$y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2)$.

c) Determine the zero input response of the system **[6]**

$$y(n) - \frac{1}{4} y(n-1) - \frac{1}{8} y(n-2) = x(n) + x(n-1)$$

OR

P.T.O.

Q2) a) Discrete time system $h_1(n) = \left\{\frac{1}{2}\ \frac{1}{4}\ \frac{1}{2}\right\}$ & $h_2(n) = \delta(n-2)$ are connected in cascade.

Determine the overall system function and impulse response. **[6]**

b) Define: **[6]**

i) Zero input response & zero state response.

ii) Energy signal & power signal.

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

Q3) a) Compute the four point DFT of the following sequence. $x(n) = \{2\,1\,2\,1\}$ **[6]**

b) Compute circular convolution of two sequences using DFT - IDFT method. **[10]**

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

OR

Q4) a) Compute 8 point DFT of the following sequence using radix –2, DIT - FFT algorithm. **[10]**

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

b) For a discrete time sequence $x(n) = \{1\quad 2\quad 3\quad 4\}$.

DFT is given by X(K) = $\{10\quad -2+j^2\quad -2\quad -2-j^2\}$.

Compute the DFT of $x^{\wedge}(n) = \{3,\quad 4,\quad 2,\quad 1\}$ using circular time shift property of DFT. **[6]**

Q5) a) A causal discrete time system is described by

$$y(n)-\frac{3}{4}y(n-1)+\frac{1}{8}y(n-2)=x(n)$$ **[8]**

i) Determine the system function 4(2)

ii) Compute the impulse response of the system.

b) The impulse response of the systems are given by **[8]**

$h_1(n) = (a)^n u(n)$ $h_2(n) = n(a)^n u(n)$

Compute Z – transform and comment on the stability of the system for a = 0.2, a = 1, & a = 2.

OR

Q6) a) The system is characterised by **[8]**

$$H(z)=\frac{3-4z^{-1}}{1-3.5z^{-1}+1.5z^{-2}}$$

Determine h(n) for

i) Causal system

ii) Anticausal system &

iii) Non - causal system

b) Determine the Z - transform of **[8]**

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

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

iii) $x(n) = nu(n)$ (use differentiation property)

SECTION - II

Q7) a) An analog filter has the transfer function $H(s)=\frac{1}{s+1}$. **[6]**

Using bilinear transformation, determine the transfer function of digital filter H(z) & also write the difference equation of the filter. Assume T = 1sec.

b) Design a digital butterworth filter that satisfies the following constraint using Bilinear transformation

Assume $\frac{2}{T}=1\text{sec}.$ **[10]**

$$0.9 \le \left|H\left(e^{j\omega}\right)\right| < 1 \quad 0 \le \omega \le \pi/2$$

$$\left|H\left(e^{j\omega}\right)\right| \le 0.2 \quad 3\pi/4 \le \omega < \pi$$

OR

Q8) a) Design a lowpass digital filter for a cut - off frequency of $\omega_c = S\pi/9$. using frequency sampling method. Length of filter = 9. **[10]**

b) Explain the different characteristics of window function. **[6]**

Q9) a) Explain the sampling rate conversion by a non-integer factor. **[8]**

b) Explain the application of multirate signal processing in compact Hi - fi system. **[8]**

OR

Q10)a) An audio signal is to be decimated by a factor of 30. Design a two stage decimeter with factors 15 & 2, that satisfy the following specifications.

Sampling frequency = 240 kHz. **[8]**

highest frequency of interest = 3.4 kHz.

δ_p = 0.05

δ_s = 0.01

b) Explain the polyphase structure used for interpolation. **[8]**

Q11)a) Explain the factors that influence the selection of a digital signal processor. **[10]**

b) Explain various architectures of digital signal processors. **[8]**

OR

Q12)a) Explain the following units of a digital signal processor. **[9]**

i) MAC

ii) Pipelining

iii) Barrel shifter

b) What is the difference between fixed point and floating point processor. Why is floating point representation preferred? **[9]**