Total No. of Questions : 12]

P2925

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T.E. (Electronics)

DISCRETE TIME SIGNAL PROCESSING (2008 Course) (304211) (Semester - II)

(2000 00000)

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 $x(t) = \sin 10\pi t + 2 \sin 20\pi t + 2 \cos 30\pi t$

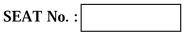
- i) What is the Nyquist rate of the signal?
- ii) If the signal is sampled at a rate of 20Hz, what is the folding frequency?
- iii) Write the equation of sampled signal.

[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]

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

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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. $x(n) = \{2121\}$ [6]
 - b) Compute circular convolution of two sequences using DFT IDFT method. [10]

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

OR

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

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

- b) For a discrete time sequence $x(n) = \{1 \ 2 \ 3 \ 4\}$.
 - DFT is given by X(K) = $\{10 \quad -2 + j^2 \quad -2 \quad -2 j^2\}$.

Compute the DFT of $x^{(n)} = \{3, 4, 2, 1\}$ 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

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

Determine h(n) for

- i) Causal system
- ii) Anticausal system &
- iii) Non causal system
- b) Determine the Z transform of

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)

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[8]

[8]

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 = 1 sec.

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

Assume
$$\frac{2}{T} = 1 \operatorname{sec.}$$
 [10]
 $0.9 \le \left| \operatorname{H}(e^{j\omega}) \right| < 1 \quad 0 \le \omega \le \frac{\pi}{2}$
 $\left| \operatorname{H}(e^{j\omega}) \right| \le 0.2 \quad 3\frac{\pi}{4} \le \omega < \pi$
OR

- **Q8)** a) Design a lowpass digital filter for a cut off frequency of $\omega_c = S\frac{\pi}{9}$. 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.

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. $\delta_p = 0.05$ $\delta_s = 0.01$
 - 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

\mathcal{L}	Q12) a)	Explain the	following units of a digital signal processor.	[9]
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- 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]

