EX - 703

B.E. VII Semester

Examination, December 2014

Digital Signal Processing

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt five questions in all, taking one question from each unit. All questions carry equal marks.

Unit - I

1. a) For the following discrete time system plot the nature of curve $x(n) = a^n$, when

   i) $|a| > 1$ and n is positive

   ii) $|a| < 1$ and n is positive

   iii) $|a| > 1$ and n is negative

   iv) $|a| < 1$ and n is negative

   b) Determine if the system described by the following expressions are linear time invariant causal system or not:

   i) $y(n) = x(2n)$

   ii) $y(n) = x(n)\, u(2 - n)$

OR

2. Find the output $y(n)$ of a causal discrete-time LTI System which is characterized by the difference equation

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

for input $x(n) = \left(\frac{1}{4}\right)^n u(n)$

Unit - II

3. a) The z-transform of a particular discrete time signal $x(n)$ is expressed as

$$X(Z) = \frac{1 + \frac{1}{2}Z^{-1}}{1 - \frac{1}{2}Z^{-1}}$$

   Determine the $x(n)$ using time shifting property.

   b) Discuss at least two methods of finding out the inverse Z-transform of a given H(Z). Support your answers with suitable examples.

OR

4. a) Compute the convolution $x(n)$ of the signals

$x_1(n) = \{4, -2, 1\}$

$$x_2(n) = \begin{cases} 1 \text{ for} & 0 \le n \le 5 \\ 0 \text{ for} & \text{otherwise} \end{cases}$$

   b) Determine the causal signal $x(n)$ whose z-transform is given by:

   i) $X(z) = \dfrac{1}{(1+z^{-1})(1-z^{-1})^2}$

   ii) $X(z) = \log(1+az^{-1})$

Unit - III

5. Given a sequence $x(n) = \{0, 1, 2, 3, 4, 5, 6, 7\}$, determine $x(k)$ using DIT FFT algorithm.

OR

6. Compute
   a) Linear and
   b) Circular periodic convolutions of two sequences $x_1(n) = \{1, 1, 2, 2\}$ and $x_2(n) = \{1, 2, 3, 4\}$
   c) Also find circular convolution using the DFT and IDFT.

Unit - IV

7. a) An analog filter has the following system function convert this filter into a digital filter using backward difference for the derivative given as:

$$H(s)=\frac{1}{(s+0.1)^2+9}$$

   b) If $H(s)=\frac{1}{(s+1)(s+2)}$, find the corresponding H(z) using impulse invariance method for sampling frequency of 5 samples/sec.

OR

8. Explain the designing of IIR filter by the bilinear transformation method.

Unit - V

9. a) Determine direct form and cascade form realisations for the transfer function of an FIR filter which is given by:

$$H(z)=\left(1-\frac{1}{4}z^{-1}+\frac{3}{8}z^{-2}\right)\left(1-\frac{1}{8}z^{-1}-\frac{1}{2}z^{-2}\right)$$

   b) An FIR filter is given by the difference equation

$$y(n)=2x(n)+\frac{4}{5}x(n-1)+\frac{3}{2}x(n-2)+\frac{2}{3}x(n-3)$$

   Determine its lattice form.

OR

10. a) Explain the procedure for designing FIR filter using windows.

   b) The frequency response of an FIR filter is given by the following expression:

$$H\left(e^{j\omega}\right)=e^{-j3\omega}\left[2+1.8\cos 3\omega+1.2\cos 2\omega+0.5\cos\omega\right]$$

   Determine the impulse response $h(n)$ of the filter in the form of a sequence.

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