Total No. of Questions : 5] *[Total No. of Printed Pages : 4*

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EI - 603

B.E. VI Semester

Examination, June 2015

Digital Signal Processing

Time : Three Hours

Maximum Marks : 70

Note: i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.

ii) All parts of each questions are to be attempted at one place.

iii) All questions carry equal marks, out of which part A and B (Max.50 words) carry 2 marks, part C (Max.100 words) carry 3 marks, part D (Max.400 words) carry 7 marks.

iv) Except numericals, Derivation, Design and Drawing etc.

1. a) What is zero padding? Why it is used ?

   b) Write the properties of DFT.

   c) Given a sequence $x(n)$ for $0 \le n \le 3$, where $x(0) = 4$, $x(1) = 3$, $x(2) = 2$ and $x(3) = 1$, evaluate its DFT X(k).

   d) If $x_1(n)$ and $x_2(n)$ are periodic with period N with DFS coefficients $X_1(k)$ and $X_2(k)$, respectively. Show that the sequence with DFS coefficients $X(k) = X_1(k)\, X_2(k)$ is equal to the periodic convolution of $x_1(n)$ and $x_2(n)$ i.e.

$$x(n) = \sum_{k=0}^{N-1} x_1(k) x_2(n-k)$$

OR

Given the two sequence of length 4 are:

$$x(n) = \{0,1,2,3\}$$
$$h(n) = \{2,1,1,2\}$$

Find the circular convolution

2. a) What are the advantage in direct form I structure when compared to direct form II structure?

   b) Define canonic and non-canonic form realizations.

   c) Find the digital network in direct form II for the system described by the difference equation.

$$y(n) = x(n) + 0.5\,x(n-1) + 0.4\,x(n-2) - 0.6\,y(n-1) - 0.7\,y(n-2)$$

   d) Determine the cascade form realization of the system governed by the transfer function.

$$H(z) = \frac{\left(1+z^{-1}\right)\left(1-5z^{-1}-z^{-2}\right)}{\left(1+2z^{-1}+z^{-2}\right)\left(1+z^{-1}+z^{-2}\right)}$$

OR

The signal flow graph of fig.1 represents a linear difference equation with constant coefficients. Determine the difference equation that relates the output y(n) to the input x(n).

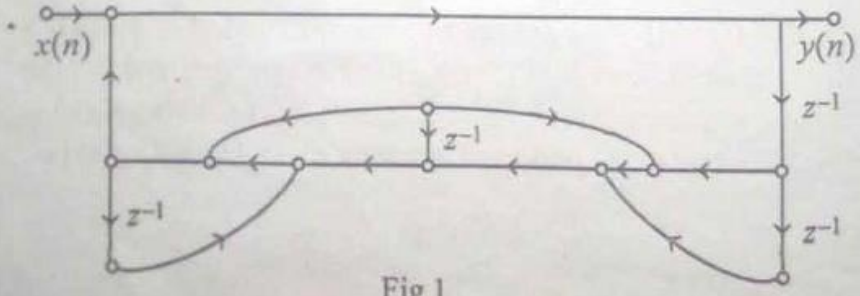

Fig 1

3. a) List the characteristics of FIR filters designed using windows.

   b) What are the quantization errors due to finite word length registers in digital filters.

   c) Distinguish between FIR and IIR filters.

   d) Prove that an FIR filter has linear phase if the unit sample response satisfies the condition

   $h(n) = \pm h(M-1-n),\ n = 0,1, \ldots\ldots M-1.$

   OR

   Determine the system function of the IIR digital filter for the analog transfer function. $H_a(s) = \dfrac{10}{(s^2+7s+10)}$

   With T = 0.2 second. Using impulse invariance method.

4. a) What are the Twiddle Factors of DFT?

   b) What are the applications of FFT algorithm.

   c) Draw and explain the basic butterfly diagram of DIT radix - 2 FFT.

   d) Derive and draw the 8 - point FFT - DIT butterfly structure.

   OR

   Explain decimation in frequency FFT algorithm.

5. a) What is a random process said to be mean ergodic?

   b) What is known as periodogram?

   c) A random variable x has a Probability Density Function.

$$P_x(x) = \begin{cases} \dfrac{1}{q}, & 0 \le x \le q \\ 0, & otherwise \end{cases}$$

   Find its mean, mean square and variance.

   d) A stationary discrete- time random process is given by $x(nT) = E\{x(nT)\} + x_0(nT)$.

   Where $x_0(nT)$ is a zero - mean process.

   Show that $r_x(0) = E\{x^2(nT)\}$.

   OR

   A random variable x has a probability (Rayleigh) distribution function given by.

$$P_x(x) = \begin{cases} xe^{-x^2/2a^2}, & 0 \le x \le \infty \\ 0, & otherwise \end{cases}$$

   Show that

   $E\{x^2\} = 2a^2$.

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