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B.TECH.**THEORY EXAMINATION (SEM-VI) 2016-17****DIGITAL SIGNAL PROCESSING****Time : 3 Hours****Max. Marks : 100****Note : Be precise in your answer. In case of numerical problem assume data wherever not provided.****SECTION – A****1. Explain the following:****10 x 2 = 20**

- What do you understand by Discrete- time systems?
- Test whether the following signal is periodic or not and if periodic then find period of signal: $X[n] = \cos(n\pi/5) + \sin(n\pi/6)$
- What is Nyquist sampling theorem? How reconstruction of signal is done?
- Discuss discrete time processing of continuous time signal and continuous time processing of discrete time signal.
- What is all pass system? Draw its typical pole-zero plot?
- What do you understand by multirate signal processing?
- How sampling & Reconstruction of Discrete Time signal is done?
- Explain Twiddle factor.
- Discuss the relationship of DFT with Z-transform
- Discuss 8-point Radix-2 decimation-in-time FFT algorithms.

SECTION – B**2. Attempt any five of the following questions:****5 x 10 = 50**

- Compute 8-point DFT of the sequence using radix-2 decimation-in-frequency algorithm:

$$X(n) = \{1/2, 1/2, 1/2, 1/2, 0, 0, 0, 0\}$$

- Determine the Z-transform $W(z)$ of the Hanning window

$$w(n) = \frac{1 - \cos\left(\frac{2\pi n}{N-1}\right)}{2}$$

What is the effect of finite Register Length?

- Consider a causal IIR system with the system function

$$H(z) = \frac{1 + 2z^{-1} + 3z^{-2} + 2z^{-3}}{1 + 0.9z^{-1} - 0.8z^{-2} + 0.5z^{-3}}$$

Determine the equivalent lattice-ladder structure.

- Find the transposed direct form II realization of the system described by the difference equation.

$$y(n) = 0.5y(n-1) - 0.25y(n-2) + x(n) - 2x(n-1) + x(n-2)$$

- The desired response of a low pass filter is

$$H_d(e^{j\omega}) = e^{-j3\omega}; \quad -\pi/4 \leq \omega \leq \pi/4$$

$$= 0; \quad \pi/4 < |\omega| < \pi$$

Determine $H(e^{j\omega})$ for $M=7$ using a Hamming window.

- Convert following analog filters into digital filters.

$$H(s) = (s+0.1)/((s+0.1)^2 + 9)$$
 using bilinear transformation.

The digital filter should have a resonant frequency of $\omega_r = \pi/4$

- (g) Drive conversion formula of digital filter from Analog filter by using Bilinear Transformation method. Also establish relationship between frequencies in two domains.
- (h) How IIR filter Designing can be done by the use of following methods. Discuss each methods-
- Approximation of Derivatives Method.
 - Impulse Invariance Method.
 - Bilinear Transformation Method.

SECTION – C

Attempt any two of the following questions:

2 x 15 = 30

- 3 Determine the cascade and parallel realizations for the system described by the system function

$$H(z) = \frac{10\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - \frac{2}{3}z^{-1}\right)\left(1 + 2z^{-1}\right)}{\left(1 - \frac{3}{4}z^{-1}\right)\left(1 - \frac{1}{8}z^{-1}\right)\left(1 - \left(\frac{1}{2} + j\frac{1}{2}\right)z^{-1}\right)\left(1 - \left(\frac{1}{2} - j\frac{1}{2}\right)z^{-1}\right)}$$

- 4 Develop cascade & parallel realization structure of following transfer function:

$$H(z) = \{z/6 + 5/24 + 5/24z + 1/24z^2\} / \{1 - 1/2z + 1/4z^2\}$$

- 5 A low pass filter is to be designed with following desired frequency response

$$\begin{aligned} H_d(e^{j\omega}) &= e^{-j2\omega}, & \pi/4 \leq \omega \leq \pi/4 \\ &= 0, & \pi/4 < |\omega| < \pi \end{aligned}$$

Determine the filter coefficient $h_d[n]$ if the window function is defined as

$$\begin{aligned} W[n] &= 1; & 0 \leq n \leq 4 \\ &= 0; & \text{Otherwise} \end{aligned}$$