Paper Code: EC-011 **Roll No.** | | | | | | | | | | |

B.Tech.
(SEM VI) EVEN SEMESTER EXAMINATION, 2015-16
DIGITAL SIGNAL PROCESSING

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

Note- Attempt All questions. All questions carry equal marks.

Q.1. Attempt any ***two*** parts of the following:- **[10x2=20]**

(a) (i) Determine the cascade realization structure for the system

$$y(n) = -0.1y(n-1) + 0.72y(n-2) + 0.7x(n) - 0.25x(n-1)$$

(ii) Differentiate direct form-I and direct form-II realization of an IIR systems.

(b) (i) Design the ladder structure for the second order filter given by

$$H(Z) = \frac{1 - 0.6Z^{-1} + 1.2Z^{-2}}{1 + 0.15Z^{-1} + 0.64Z^{-2}}$$

Also check whether the system is stable.

(ii) Mention the necessary steps for designing the digital filter from an analog filter.

(c) (i) Draw the block diagram representation of the direct form-I and form-II realization for a third order IIR transfer function

$$H(z) = \frac{0.28Z^2 + 0.319Z + 0.04}{0.5Z^3 + 0.3Z^2 + 0.17Z - 0.2}$$

(ii) The transfer function of a causal IIR filter is given by

$$H(Z) = \frac{5z(3z-2)}{(z+0.5)(2z-1)}$$

Determine the values of the multiplier coefficients of the realization shown in figure

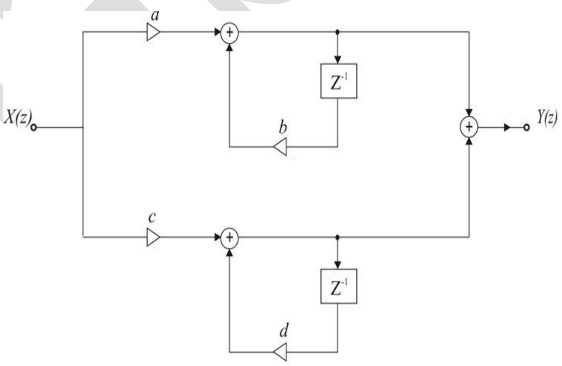

Fig.1

Q.2. Attempt any ***two*** parts of the following:- **[10x2=20]**

(a) Determine H(Z) for a Butterworth filter satisfying the following constraints

$$0.9 \le \left|H(e^{j\omega})\right| \le 1 \qquad 0 \le \omega \le \frac{\pi}{2}$$
$$\left|H(e^{j\omega})\right| \le 0.2 \qquad \frac{3\pi}{4} \le \omega \le \pi$$

For T=1sec.Apply Bilinear transformation.

(b) Convert the analog filter into digital filter whose system function

$$H(S) = \frac{S + 0.2}{(S + 0.2)^2 + 9}$$

using impulse invariant technique for T=1sec.Alsocomment on the stability of backward difference approximation for the derivative method of transformation.

(c) Determine the digital Chebyshev filter to satisfy the constraints for T=1sec using impulse invariant method

$$0.8 \le \left|H(e^{j\omega})\right| \le 1 \qquad 0 \le \omega \le 0.2\pi$$
$$\left|H(e^{j\omega})\right| \le 0.2 \qquad 0.65\pi \le \omega \le \pi$$

Q.3. Attempt any ***two*** parts of the following:- **[10x2=20]**

(a) The desired response of a Low pass filter is $H_d(e^{j\omega}) = \begin{cases} e^{-j3\omega}, -3\Pi/4 \le \omega \le 3\Pi/4 \\ 0, 3\Pi/4 \le |\omega| \le \Pi \end{cases}$

Determine the filter coefficient h_d(n) and $h(n)$. Also determine the frequency $H(e^{j\omega})$ for M=7 using Hamming Window.

(b) A Low Pass filter is to be designed with the following desired frequency response

$$H_d(e^{j\omega}) = \begin{cases} 0, -\Pi/4 \le \omega \le \Pi/4 \\ e^{-j2\omega}, \Pi/4 \le |\omega| \le \Pi \end{cases}$$

Determine the filter coefficient h_d(n) and h (n) if the window function is defined as

$$W(n)=\begin{cases} 1, & 0 \le n \le 4 \\ 0, & otherwise \end{cases}$$

Also determine the frequency response $H(e^{j\omega})$ of the desgined filter.

(c) Design a Low Pass Digital FIR Filter using Kaiser window satisfying the specifications given:

Pass band cut-off frequency, $f_p = 150 H_Z$, Stop band cut-off frequency, $f_s = 250 H_Z$, Pass band ripple, $A_p = 0.1dB$,Stop band attenuation, $A_s = 40dB$ and sampling frequency, $F = 1000\, H_Z$.

Q.4. Attempt any ***two*** parts of the following:- **[10x2=20]**

(a) Determine the output response $y(n)$ if $h(n) = \{1,1,1\}; x(n) = \{1,2,3,1\}$ by using

(i) Linear Convolution

(ii) Circular Convolution using graphical representation

(iii) Circular Convolution with zero padding

(b) Prove any five properties of DFT and find IDFT of $X(K) = \{5,0,1-j,0,1,0,1+j,0\}$ for N=8.

(c) Derive the DFT of the sample data sequence x(n)={1,1,2,2,3,3} and compute the amplitude and phase spectrum.

Q.5. Attempt any ***two*** parts of the following:- **[10x2=20]**

(a) Discuss phase factor of DFT and enlist its properties. Find the X(K) using DIF FFT algorithm for $x(n) = n + 1$ and N=8.

(b) Compute the 8-Point DFT of the sequence $x(n) = 2^n$ using DIT FFT algorithm.

(c) (i) Determine $x(n)$ using IFFT algorithm for N=8

$$X(K)=\{20, -5.828 - j2.414, 0, -0.172 - j0.414, 0, -0.172 + j0.414, 0, -5.828 + j2.414\}$$

(ii) Write short notes on any two of the following

(p) Gibbs Oscillation

(q) Frequency Wraping

(r) Stability of backward difference approximation