Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER • 2015

Subject Code: 170804 **Date: 04/05/2015**

Subject Name: Discrete Time Signal Processing

Time:02.30pm-05.00pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Write major classification of signal in detail also explain Energy and Power signal with the help of example. **07**

(b) State and prove any three properties of Z-transform. **07**

Q.2 **(a)** Check whether the following system are linear and time invariant. **07**

$F[x(n)] = n[x(n)]2$

$F[x(n)] = a[x(n)]2 + bx(n)$

(b) Compute the convolution of the following signal. **07**

$x[n] = \begin{matrix} \alpha^n & -3 \le n \le 5 \\ 0 & \text{otherwise} \end{matrix}$ $h[n] = \begin{matrix} 1 & 0 \le n \le 4 \\ 0 & \text{otherwise} \end{matrix}$

OR

(b) Define periodic and unpatriotic signal. Determine whether the given sequence is periodic or not, if periodic determine fundamental period. **07**

$x(n) = \sin\left(\frac{6\pi n}{7}\right)$

Q.3 **(a)** Determine Z-transform and ROC of $x[n] = 2^n u(n) - 3^n u(n)$ **07**

(b) Determine the IDFT of $X(k) = \{3, 2+j, 1, 2-j\}$ **07**

OR

Q.3 **(a)** Find inverse Z- transform of $X(z) = \frac{z+3z^{-1}}{(1+z^{-1})\left(1+\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}$ also verify result for $0 \le n \le 3$. **07**

(b) Given $x(n) = a^n u(n)$ .Determine Fourier transform $X(w)$ of $x(n)$ **07**
Determine discreet Fourier transform X(k) ,How X(k) relate to $X(w)$

Q.4 **(a)** Find convolution using DFT and IDFT method of sequence **07**
$x1(n) = \{1,1,2,2\}$ $x2(n) = \{1,2,3,4\}$

(b) Use butterfly structure of DIF and Calculate output for each stage for given sequence. **07**
$x[n] = \{1,2,2,1,0,0,0,0\}$

OR

Q.4 **(a)** Draw the butterfly diagram of 8 point Inverse decimation in time FFT and use it to obtain the original sequence x(n). **07**

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

(b) Explain any three properties of DFT. What is twiddle factor of the DFT? **07**

Q.5 **(a)** Design a digital chebyshev filter to satisfy the constrains. Using bilinear transformation and assuming T = 1s. **07**

$0.707 \le \begin{matrix} |H(e^{j\omega})| \le 1 & 0 \le \omega \le 0.2\pi \\ |H(e^{j\omega})| \le 0.1 & 0.5\pi \le \omega \le \pi \end{matrix}$

(b) The desired response of a low-pass filter is given determine $Hd(e^{j\omega})$ for M = 7 using **07**

hamming window.

$$Hd(e^{j\omega}) = \begin{cases} e^{-3j\omega} & -\frac{3\pi}{4} \le \omega \le \frac{3\pi}{4} \\ 0 & \frac{3\pi}{4} \le \omega \le \pi \end{cases}$$

OR

Q.5 **(a)** Design digital filter using bilinear transformation for following analog transfer function. **07**

$H(s) = 1/(s^2 + \sqrt{2}\,s + 1)$

Obtain transfer function H(Z) of digital filter assuming 3db cutoff freq. w_p 150 Hz and sampling freq. 1.28 KHz.

(b) Determine coefficient of linear phase FIR filter of length N = 15 which has symmetrical unit sample response and a freq. response that satisfies condition. **07**

$$H\left[\frac{2\pi k}{15}\right] = \begin{cases} 1 & k=0,1,2,3 \\ 0.4 & k=4 \\ 0 & k=5,6,7 \end{cases}$$

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