Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Regular Examination January / February 2011

Subject Name: 712903N
Subject code: Digital Signal Controller

Date: 02 /02 /2011 **Time: 02.30 pm – 05.00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Notations / symbols used have usual meaning.**

Q.1 **(a)** Determine whether the system described by relationship **05**
$T\{ x(n)\} = x(n - n_o)$ is (i) memory –less (ii) stable (iii) causal (iv) linear and (v) time - invariant or not.

(b) Let $X (e^{jw})$ denote the Fourier Transform of the signal x (n) shown in Fig 1 . **05**

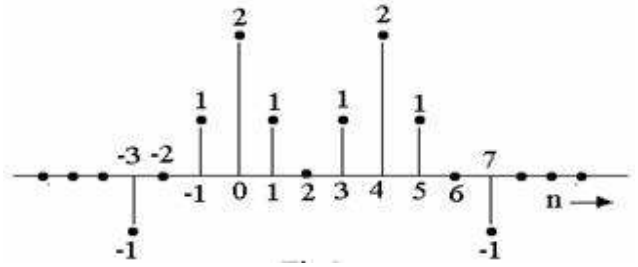

Fig. 1

Without explicitly finding out $X(e^{jw})$ find the following :-

(i) X (1) (ii) X (-1)

(iii) Evaluate $\int_{-\pi}^{\pi} X(e^{j\omega})\,d\omega$

(iv) The sequence y (n) whose Fourier Transform is the real part of $X (e^{jw})$.

(v) Evaluate $\int_{-\pi}^{\pi} |X(e^{j\omega})|^2\,d\omega$.

(c) Consider a LTI system with system function **04**

$$H (z) = (1+ 2 z^{-1} + z^{-2}) / (1 - 0.75 z^{-1} + 0.125 z^{-2}).$$

Obtain the parallel form structure both for first order as well as for second order sections.

Q.2 **(a)** Develop Decimation In Time - FFT algorithm for N= 4 using signal flow graph. **07**

(b) Draw the block diagram of basic generic hardware architecture for signal processing. Explain the same in detail. **07**

OR

(b) Describe implementation of DSP algorithms for FIR digital filter. **07**

Q.3 **(a)** Define Interpolation. Explain the reconstruction of a band - limited signal from its samples. **07**

(b) Define aliasing. The sequence x(n)= cos(nπ/4) , $-\infty < n < \infty$; was obtained by sampling a continuous- time signal $x_c(t) = \cos(\Omega_o t)$, $-\infty < t < \infty$; at a sampling rate of 1000 samples / sec. What are two possible positive values of Ω_o that could have resulted in the sequence x(n)? **07**

OR

Q.3 **(a)** The system function of a causal linear time invariant system is **07**

$$H(z) = \frac{(1 - z^{-1})}{(1 + 0.75\, z^{-1})}$$

The input to the system is $x(n) = (1/3)^n u(n) + u(-n-1)$.

(i) Find the impulse response to the system.

(ii) Find the output y (n).

(iii) Is the system stable?

(b) Define sampling. The continuous-time signal $x_c(t) = \cos(4000\pi t)$ is sampled with a sampling period of T to obtain a discrete – time signal x(n)=cos(πn/3). (i) Determine a choice of T consistent with this information. (ii) Is the choice for T in part (i) unique? If, not specify another choice of T consistent with information given. **07**

Q.4 **(a)** Design a Butter- worth digital filter with pass band magnitude within 1dB for frequency $0 \le w \le 0.2\pi$ and stop band attenuation greater than 15dB for frequency $0.3\pi \le |w \le \pi$ using Bi-linear Transformation approach. **10**

(b) Compare FIR filter with IIR filter in tabular form. **04**

OR

Q.4 **(a)** Describe the Kaiser window filter design method for : **10**

(i) A low pass filter and

(ii) A high pass filter.

(b) Compare linear convolution with circular convolution. **04**

Q.5 **(a)** State and prove the following properties of DFT. **08**

(i) Linearity (ii) Duality (iii) Symmetry (iv) Circular shift of a sequence.

(b) Find inverse Z –transform of **06**

(i) $X(z) = \frac{1}{(1 - 0.25z^{-1})(1 - 0.5\, z^{-1})}$ $\quad |z| > (1/2).$

(ii) $X(z) = \log(1 + a\, z^{-1})$ $\quad |z| > |a|.$

OR

Q.5 **(a)** For the two four-point sequences x(n) = cos(n π/2) and **08**
y(n) = sin(n π/2) .Calculate circular convolution of x(n) with y(n) directly.

(b) Write short note on: Hilbert Transform. **06**

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