Seat No.: ________ Enrolment No.__________

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER 2012

Subject code: 712903N **Date: 12/01/2013**

Subject Name: Digital Signal Controller

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.**

Q.1 (a) State the sampling theorem. Given $x(t) \xleftrightarrow{FT} X(w)$,for the spectrum of the continuous-time signal, shown in Fig.1, consider the three cases $f_s = 2f_x$; $f_s > 2f_x$ and $f_s < 2f_x$; draw the spectra, indicating aliasing for all three cases. **06**

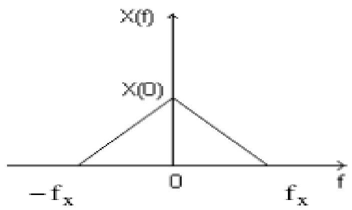

Fig.1

(b) Do as directed : (02 marks each) **08**

(i) Draw low-pass filter magnitude characteristics with all necessary tolerance limits.

(ii) Define IDFT. State its two applications.

(iii) Discuss significance of Nyquist rate for sampling.

(iv) For the signal shown in the fig.2 .Evaluate the integral $\int_{-\pi}^{\pi} \left|X\left(e^{j\omega}\right)\right|^2 d\omega$.

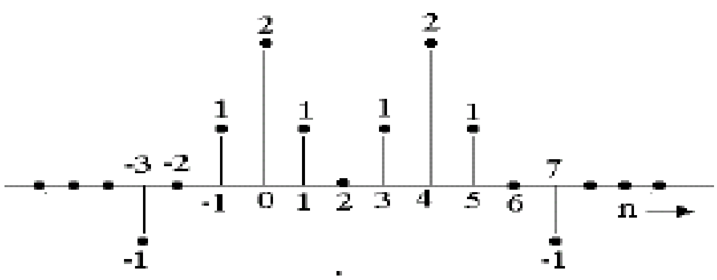

Fig.2

Q.2 (a) Describe any one type of DSP architecture. **07**

(b) Describe the Kaiser window filter design procedure for a high pass filter. **07**

OR

(b) Enlist various window sequences for FIR filter design. Explain any one of them in detail. **07**

Q.3 (a) For the two four-point sequences $x(n) = \cos(n\pi/2)$ and $y(n) = \sin(n\pi/2)$. Obtain linear convolution of x(n) with y(n) directly. **06**

(b) Consider a causal system whose input and output satisfy the difference equation $y(n)- a\,y(n-1) = x(n)$. **06**

(i) Find H(z) , ROC and condition(s) for stability.
(ii) Plot detailed pole-zero diagram.
(iii) Given system is IIR or FIR? Why?

(c) State and prove differentiation property of Fourier Transform. **02**

OR

Q.3 (a) An LTI system is characterized by $y(n) - ay(n-1) = x(n)$; determine its frequency and impulse response using DTFT. **06**

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

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

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

(c) State conditions of convergence for Fourier transform. **02**

Q.4 (a) Consider a LTI system with system function as follows: **07**
$Z(s) = (1+2z^{-1} + z^{-2}) / (1 - 0.75 z^{-1} + 0.125 z^{-2})$. Obtain
(i) Direct form –I and (ii) Direct form –II structure. Comments on the result obtained.

(b) Obtain impulse response of a digital filter to correspond to an analog filter with impulse response $h(t) = 0.5\, e^{-2t}$ and with a sampling rate of 0.1kHz using impulse invariant method only. **07**

OR

Q.4 (a) With help of signal flow graph, discuss structure of Linear phase FIR system. **07**

Q.4 (b) For linear phase FIR filters, how constant group and phase delay is achieved? Also, enlist various design techniques for linear phase FIR filter. **07**

Q.5 (a) State and prove the following properties of DFT: **08**
(i) linearity (ii) duality (iii) periodicity (iv) circular convolution

(b) Consider a stable causal LTI system whose input x(n) and output y(n) are related through difference equation , **06**

$$y(n) - (3/4)\, y(n-1) + (1/8)\, y(n-2) = 2x(n).$$

Determine the response if $x(n) = (1/4)^n u(n)$.

OR

Q.5 (a) (i) Find the IDFT of Y(k) ={1,0,1,0}. **08**
(ii) Find the 4- point DFT of the sequence x(n) ={1,1,0,0}.

(b) (i) Compare FIR filter with IIR filter in tabular form. **06**
(ii) What are the possible types of impulse response for linear phase FIR filters?

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