Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER-1 (NEW) EXAMINATION – WINTER 2016

Subject Code: 2712910 **Date:06/01/2017**

Subject Name: DISCRETE TIME SIGNAL PROCESSING

Time: 2:30 pm to 5:00 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 Do as directed: (02 marks each) **14**

(i) State equation for a backward difference systems. will it be causal?

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

(iii) Define DFT. State its two applications.

(iv) Discuss significance of Nyquist rate for sampling.

(v) State and prove differentiation property of Fourier Transform.

(vi) Write the expression for discrete convolution.

(vii) Prove that $\delta(n-4) * \delta(n+4) = 1$.

Q.2 **(a)** An LTI system has impulse response $h(n) = 5\,(-1/2)^{n}\,u(n)$. Determine Fourier Transform to find the output of this system when the input is $x(n) = (1/3)^{n}\,u(n)$. **07**

(b) Draw and explain the block diagram of basic generic hardware architecture for digital signal processor. **07**

OR

(b) Describe Implementation of a DSP algorithm. **07**

Q.3 **(a)** Explain the changing of the sampling rate using discrete time processing. **07**

(b) Find inverse Z –transform of **07**

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

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

OR

Q.3 **(a)** **07**

State the sampling theorem. Given $x(t) \overset{FT}{\longleftrightarrow} X(w)$, 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.

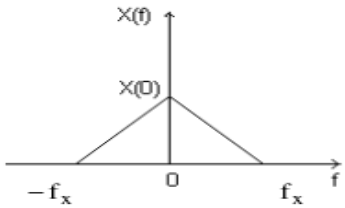

Fig.1

(b) State and prove initial value and final value theorem for Z-transform. Obtain the initial value for $x(z) = 2+3z^{-1}+4z^{-2}$. **07**

Q.4	**(a)**	Consider a LTI system with system function as follows: $Z(s) = (1+2z^{-1} + z^{-2}) / (1 - 0.75 z^{-1} + 0.125 z^{-2})$. Obtain (i) Direct form –I and (ii) Direct form –II structure. Comments on the result obtained	**07**
	(b)	An LTI system is characterized by $y(n)=ay(n-1) +bx(n)$;$0< a <1$ determine magnitude and phase of the frequency response of the system.	**07**
		OR	
Q.4	**(a)**	For linear phase FIR filter, how constant group and phase delay is achieved? Also, enlist various design techniques for linear phase FIR filter.	**07**
	(b)	Find the inverse Fourier transform of the first order filter $H(w) = (1-ae^{-jw})^{-1}$.	**07**
Q.5	**(a)**	State and prove the following properties of DFT: (i) linearity (ii) duality (iii) periodicity (iv) Circular shift of a sequence	**07**
	(b)	Perform circular convolution of the two sequences $x_1(n) = \{\underline{\mathbf{2}},1,2,1\}$ and $x_2(n) = \{\underline{\mathbf{1}},2,3,4\}$.	**07**
		OR	
Q.5	**(a)**	Explain DIF- FFT Algorithm using signal flow graphs for N=4.	**07**
	(b)	Describe the Kaiser window filter design procedure for a high pass filter.	**07**

****