Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – WINTER 2013

Subject Code: 171003 Date: 07-12-2013

Subject Name: Digital Signal Processing

Time: 10:30 TO 01:00 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 and explain the conditions followed by all LTI (Linear Time Invariant) systems in general giving one example each of LTI and non-LTI systems. **07**

(b) Define impulse response of LTI system. Explain how from the impulse response the frequency response of the LTI system can be determined. **07**

Q.2 **(a)** Derive the criterion for sampling a continuous time signal, using Fourier Transform. Also explain the aliasing effect where the criterion is not followed. **07**

(b) Prove that convergence of absolute sum of the impulse response is a sufficient condition for BIBO (bounded input bounded output) stability of a LTI system. Show that this condition is also the necessary condition for BIBO stability. **07**

OR

(b) Define ACF (Auto-Correlation Function) of a sequence, explain ACF's main properties and relation with the PSD (Power Spectral Density) of the sequence. **07**

Q.3 **(a)** Determine the difference equation and the impulse response of a system with the z-transform, $H(z)=1/(1-0.5z^{-1})$, ROC:$0.5< |z|$. **07**

(b) Realize in Direct Form-II: $H(z)=(1+0.7z^{-1}+0.3z^{-2})/(1-0.2z^{-1})$, ROC:$0.2< |z|$. **07**

OR

Q.3 **(a)** Given two sequences x1[n]={1, 1}, and x2[n]={1, 2, 1}, find their z-transforms and sketch their corresponding pole-zero plots and try to relate them. **07**

(b) Derive an inverse system of the system characterized by y[n]=0.5*y[n-1]+x[n], assuming zero initial conditions. **07**

Q.4 **(a)** Give the equations for DTFT and inverse DTFT and show that DTFT is a lossless (distortion-free) transform. **07**

(b) Derive and sketch the DTFT of $x[n]= 5\cos(0.1\pi n) + 2\cos(0.2\pi n)$, over the radian-frequency interval $(-3\pi, 3\pi)$. **07**

OR

Q.4 **(a)** Explain the poly-phase decomposition of a system. **07**

(b) Explain the minimum-phase and all-pass decomposition of a system. **07**

Q.5 **(a)** Draw a signal flow graph representation of the DIT (Decimation-In-Time) FFT (Fast Fourier Transform) method for finding 8-point DFT. **07**

(b) Derive the impulse response of an ideal LPF (low pass filter) with cut-off frequency of ω_c (rad), based on the inverse DTFT. Explain the windowing method for designing an FIR filter. **07**

OR

Q.5 **(a)** Explain the impulse invariance and bilinear transform based methods for designing an IIR filter. **07**

(b) Explain the procedure to design a Butter-worth low-pass filter assuming that suitable specifications are given. **07**

****