

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2013****Subject code: 1724707****Date: 05-06-2013****Subject Name: Mechatronics Signal Processing****Time: 10.30 am – 01.00 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 Perform the circular convolution of signal **14**
 $x_1(n) = \{2, 1, 2, 1\}$, $x_2(n) = \{1, 2, 3, 4\}$, $0 \leq n \leq 3$ using DFT and IDFT.

Q:2 (a) Compute the inverse Z transform by partial fraction for the following Z **07**
transform:

$$X(Z) = \frac{Z(Z^2 + 2Z)}{(Z + 2)(Z^2 + 4Z + 5)}$$

(b) Prove that the following discrete time system is nonlinear system **07**
 $y(n) = x^2(n) - x(n-1)x(n+1)$

OR

(b) Derive the relationship between Z transform and DFT. **07**

Q:3 (a) Explain the various properties of DFT. With suitable example discuss **07**
any one of them.

(b) Discuss the bandpass sampling of band limited signal centered at $f_c =$ **07**
20 MHz with band width 5 MHz.

OR

Q:3 Perform a 8 point DFT on a continuous input signal $x(t)$, for sampling **14**
frequency of 8000 samples/second.

$$x(t) = \sin(2\pi \cdot 1000 \cdot t) + 0.5 \sin(2\pi \cdot 2000 \cdot t + 3\pi/4).$$

Also prove that the IDFT of your DFT gives original time domain signal.

Q:4 (a) Find the position of poles, zeros, region of convergence and Z **07**
transform for the following:

$$x(n) = (0.3)^n u(n) + (-0.2)^n u(n)$$

(b) Find the response of forced vibration of a single degree of freedom **07**
system (LTI system).

OR

Q:4 What do you understand by FFT? Explain the various steps to compute **14**
the FFT of eight point sequence.

Q:5 (a) Discuss the design of Linear Phase FIR filter using windows. **07**

- (b)
1. Why the Digital Signal Processing is important for Mechatronics Engineers? **03**
 2. Determine even and odd part of the following continuous time signals: **04**
 - a. $x(t) = e^{-2t} \cos t$
 - b. $x(t) = 5 + 3t + 4t^2$

OR

Q:5 Discuss the various techniques used to design discrete time IIR filters from continuous time filters. **14**
