Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2014

Subject code: 1724707   **Date: 23-06-2014**
Subject Name: Mechatronics Signal Processing
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**	Explain and derive the various properties of linear convolution.	07
	B	Perform the circular convolution of the following two sequences: $x_1(n) = \{2,1,2,1\} \quad x_2(n) = \{1,2,3,4\}$	07
Q:2	**A**	Discuss any one specific application of DSP in field of Mechanical / Mechatronics Engineering.	07

	B	With example, explain difference between
		  1. time invariant and time variant system
		  2. causal and non-causal system
		  3. static and dynamic system
			07

OR

Q:2	**B**	Derive and draw the Fourier transform of following continuous signals:
		  1. $x(t) = A*sin(2 *p*t)$
		  2. $x(t) = e^{-t}, t \times 0, > 0$
		  3.
			07

Q:3		Discuss the Z transform, its properties and importance of ROC for LTI system. Find the Z transform, ROC, poles and zeros of the following systems. Also represent ROC, poles and zeros graphically.
		  1. $x(n) = \alpha^n u(n)$
		  2. $x(n) = -\beta^n u(-n-1)$
		  3. $x(n) = \alpha^n u(n) - \beta^n u(-n-1)$
		Differentiate these systems based on their ROC and write your comments.
			14

OR

Q:3	**A**	Find the inverse Z- transform using partial fraction expansion: $$H(z) = \frac{3 + Z^{-1} + Z^{-2}}{1 + 3Z^{-1} + 2Z^{-2}}$$	07
	B	Find the inverse Z- transform using residue methods: $$X(z) = \frac{Z^2 + Z}{(Z-1)^2}$$	07
Q:4		Determine eight point Discrete Fourier Transform of the following signal. The sampling frequency of the signal is 8000 Hz. $$x(t) = \cos(2\pi \bullet 3000 \bullet t) + 0.5\cos(2\pi \bullet 2000 \bullet t + 3\frac{\pi}{4})$$ Also discuss all properties of DFT for this signal.	14

OR

Q:4	**A**	Find the eight point FFT of the following signal, sampling frequency is 8000Hz: $$x(t) = \sin(2\pi \bullet 1000 \bullet t) + 0.5\sin(2\pi \bullet 2000 \bullet t + 3\frac{\pi}{4})$$	10

B	Explain the sampling of band limited signal.	**04**

Q:5   **A**   Explain FIR filters and importance of different windows in design of FIR filters.   **07**

      B   Discuss the design of FIR filters for low pass, high pass and band pass frequency.   **07**

<div align="center">OR</div>

Q:5   Explain IIR filters and various methods to design IIR filters with suitable example.   **14**

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