

**Thapar University, Patiala**  
**Electronics and Communication Engineering Department**

End Semester Test  
Max. Marks: 100 (35%)  
Date: May 19, 2017  
Instructor: Dr. Kulbir Singh

UEC 404 (Signals and Systems)  
Time Allotted: 3 Hrs.  
B.E. 2<sup>nd</sup> year Mechatronics (MTX)

**Instructions:** You are expected to answer all (Five) questions. Organize your work, in a reasonably neat and coherent way. Mysterious or unsupported answers will not receive full credit. Calculator without graphing mode and alphanumeric memory is permitted. Assume any missing data/information, appropriately.

Q1.	a)	Differentiate Energy and Power signals with the help of example in each case. Also determine the energy and power of a unit step signal, $u(t)$ .	6
	b)	Comment upon the causality of the following systems: i) $y(t) = t x(t)$ ii) $y(n) = x(n^2)$	6
	c)	Consider a system $h(t) = t u(t)$ is excited by the input $x(t) = e^{-3t}u(t)$ . Calculate the output of the system for the given excitation using convolution.	8
Q2.	a)	Calculate the Fourier transform of the following continuous time domain signal: $x(t) = \begin{cases} 1 + \frac{t}{T} & \text{for } t = -T \text{ to } 0 \\ 1 - \frac{t}{T} & \text{for } t = 0 \text{ to } T \end{cases}$	10
	b)	Determine the Fourier series representation of the following discrete time signal. i) $x(n) = 2 \cos\sqrt{3}\pi n$ ii) $x(n) = 4 \cos \frac{\pi n}{2}$	10
Q3.	a)	Determine the Z-transform of the following discrete time domain signals. i) $x(n) = 0.5^n u(n) + 0.8^n u(-n-1)$ ii) $x(n) = \sin\omega n u(n)$	10
	b)	Determine the inverse Z-transform of: $X(z) = \frac{1}{1 - 0.8z^{-1} + 0.12z^{-2}}$ i) if ROC is , $ z  > 0.6$ ii) if ROC is , $ z  < 0.2$ iii) if ROC is , $0.2 <  z  < 0.6$	10

Q4.	a)	Demonstrate, using $x_1(n) = \{2, 1, 2, 1\}$ and $x_2(n) = \{1, 2, 3, 4\}$ , that the circular convolution can be calculated using DFT.	10
	b)	An 8-point sequence is given by $x(n) = \{2, 2, 2, 2, 1, 1, 1, 1\}$ . Compute 8-point DFT of $x(n)$ by using radix-2 DIT-FFT method with the help of well labeled sketch.	10
Q5.	a)	What is the physical significance of random signals? Discuss the power spectral density of a random process and its relationship to auto-correlation function. Also calculate the power of a wide sense stationary random process.	7
	b)	A random experiment consists of drawing two cards from a deck in succession (without replacing the first card drawn). Assign a value to the probability of obtaining two red aces in two draws.	6
	c)	A sinusoidal generator output voltage is $A \cos \omega t$ . This output is sampled randomly as shown in figure given below. The sampled output is an RV $x$ , which can take on any value in the range $(-A, A)$ . Determine the mean value and the mean square value of the sampled output $x$ .	7

