T. E. (EXTC) ~~CBGS~~ old

22/11/16

Sem VI

Random Signal Analysis

QP Code : 79996

(3 Hours) [Total Marks : 100

N.B. : (1) Question No.1 is compulsory.
(2) Solve any four from the remaining six questions.
(3) Assume suitable data wherever necessary.

1 (a) State and explain the three axioms of probability. 5
(b) Define random Variable and random process. 5
(c) Write two characteristics of the Normal distribution. 5
(d) When is a stochastic process said to be ergodic? 5

2. (a) Define probability distribution function of random variable. State important properties of it and prove. 10
(b) Suppose $f_X(x) = 2x/\pi^2$, $0 < x < \pi$, and $Y = \sin X$. Determine $f_Y(y)$. 10

3. (a) Suppose X and Y are two random variables. Define covariance and correlation coefficient of X and Y. When do we say that X and Y are 10
(i) orthogonal
(ii) independent and
(iii) uncorrelated? Are uncorrelated random variables independent?
(b) A stationary process is given by $X(t) = 10 \cos [100t + \Theta]$ where Θ is a random variable with uniform probability distribution in the interval $[-\pi, \pi]$. Show that it is a wide sense stationary process. 10

4. (a) State and prove Bayes Theorem. 10
(b) Obtain the Mean and Autocorrelation of the output process Y (t) if WSS input is applied to LTI systems. 10

5. (a) Explain Power Spectral Density. State its important properties and prove any one property. 10
(b) State and prove Chapman-kolmogorov equation. 10

6.(a) A random variable has the following exponential probability density function $f_X(x) = Ke^{-|x|}$ Determine the value of K and corresponding distribution function. 10

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b)Three boys A,B and C are throwing a ball to each other .A always throws the ball to B and B always throws the ball to C, but C is just as likeiy to throw the ball to B as to A. Show that the process is Markovian.Find the transition matrix and classify the states. 10

7) Write short notes on 20

a) Central limit theorem.
b) Moment generating function.
c) Ergodic process.
d) Sequence of random variable.

T.E (EXTC) Sem V (Old course) 13/12/2016
R 2007 **Q. P. Code : 586501**

Signals & Systems (3 Hours) OTR [Total Marks: 100]

N. B.: (1) Question No. 1 is compulsory.
(2) Attempt any four questions from remaining five questions.
(3) Assume suitable data if necessary.
(4) Figures to the right indicate full marks.

1. (a) State and prove convolution property of Laplace transform. **20**

(b) Check whether the following signal is energy or power signal

$$x(n) = \left(-\frac{1}{2}\right)^n u(n)$$

(c) Derive the relationship between Z-transform, DTFT and DFT.

(d) Check the following system for linearity and time invariance

$$y(t) = t^2 x(t) + 3$$

2. (a) Obtain inverse Z-transform for all possible ROC conditions **10**

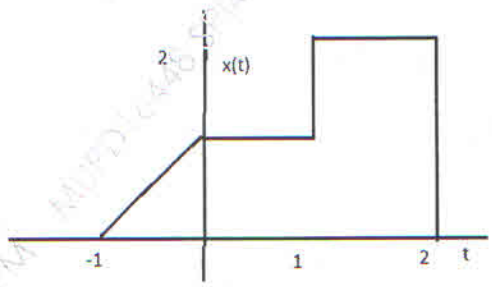
$$H(z) = \frac{3(z^2+6z+8)}{(z-1/2)(z-2)(z-4)}$$

(b) A continuous time system is described by the following differential equation **10**

$$\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 8y(t) = 5\frac{dx(t)}{dt} + 3x(t)$$

(i) Determine transfer function.
(ii) Obtain impulse response.
(iii) Obtain response of the system for input $x(t) = t$.

3. (a) Obtain even and odd parts of the following signal **06**



(b) Derive the relation to find transfer function model from state space **06**

(c) Perform convolution of following signals using graphical method **08**

$x(t) = u(t)$ and $h(t) = e^{-3t}\, u(t)$

4. (a) Obtain linear convolution of following signals **05**

$$x(n) = -2\delta(n+3) - 3\delta(n+2) + \delta(n) + 3\delta(n-1) \quad \text{and}$$
$$h(n) = -3\delta(n+2) + 6\delta(n+1) + 2\delta(n-1) + 5\delta(n-2)$$

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(b) A discrete time system is described by following difference equation 10
$y(n) - 7y(n-1) + 12y(n-2) = x(n-1) + 2x(n)$
$y(-1) = -1 \text{ and } y(-2) = 1$
Determine (i) zero input response
(ii) zero state response for the input $x(n) = \left(1/2\right)^n u(n)$
(iii) Total response of the system.

(c) State and prove properties of Z-transform. 05

5. (a) Obtain convolution of 05
$x_1(n) = [3, -1, 2, -3]$ and $x_2(n) = [-2, 4, -2, 1]$

(b) Using Laplace transform and inverse Laplace transform, find convolution of following signals 10
$x(t) = 2e^{-3t}u(t)$ and $h(t) = 3e^{-2t}u(t) + 2e^{4t}u(-t)$

(c) Write a short note on sampling theorem. . 05

6. (a) State and prove properties of Fourier transform. 05

(b) Prove that the power of energy signal is infinity. 05

(c) Find the relation between Laplace transform, Z transform and Fourier transform. 05

(d) Determine whether the following signals are periodic or not 05
(i) $x(n) = 5\sin\left(\sqrt{2}\pi n\right)$
(ii) $x(t) = \cos(2t) + \sin(2\pi t)$

7. (a) Explain recursive and nonrecursive systems with examples 06

(b) State and prove properties of Laplace transform. 06

(c) Realize the following transfer function using Direct form –I, II, parallel and Cascade forms 08

$$X(z) = \frac{2z^2 + 1}{z^3 - 6z^2 + 11z - 6}$$

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