

Code No: C9303

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech I - Semester Examinations, March/April -2011

RANDOM PROCESS AND TIME SERIES ANALYSIS

(SYSTEMS &amp; SIGNAL PROCESSING)

Time: 3hours

Max. Marks: 60

Answer any five questions

All questions carry equal marks

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1. a) A random process is defined as  $X(t) = A \cdot \cos(\omega t + \theta)$ , where “ $\theta$ ” is a uniform random variable over  $(0, 2\pi)$ . Check the process for ergodicity in the Mean sense and Auto correlation sense.
- b) State and prove the Properties of Auto correlation function of a Stationary Random Process. [6+6]
2. a) “A” and “B” are two uncorrelated, zero mean random variables with same variance and “ $\omega$ ” is a constant. Verify that the random processes  $X(t) = A \cdot \cos \omega t + B \cdot \sin \omega t$  and  $Y(t) = A \cdot \cos \omega t - B \cdot \sin \omega t$  are jointly stationary.
- b) A random Process  $X(t)$  is defined as  $X(t) = A \cdot \cos 2\pi fct$ , where “A” is a Gaussian Distributed random variable with zero mean and Variance  $\sigma^2$ . This random process  $X(t)$  is applied to an ideal integrator, which integrates  $X(t)$  between  $(0, t)$ . Check the output process of the integrator for stationarity and Ergodicity. [6+6]
3. Derive the expression for the density of two jointly Gaussian random Variables. [12]
4. State and Prove Wiener-Khintchine Relation for a Stationary Random Process. [12]
5. a) State and Prove the Properties of PSD of a Stationary Random Process.
- b) Verify that if  $X(t)$  and  $Y(t)$  are two independent Random Processes with constant mean, their Cross Spectral Density is an Impulse Function. [8+4]
6. a) A White noise process with PSD of “K” w/Hz is applied to an ideal Band Pass Filter with system function defined as  $H(\omega) = 1$  for  $|\omega| \leq \omega_c - \omega_m$ , where  $\omega_c$  is the center frequency. Find and plot the Autocorrelation function of the output of the filter.
- b) White Noise with PSD “ $\eta$ ” is passed through an RC LPF, and then through an ideal amplifier which provides a gain of 10. Find the Mean square value of the output of the amplifier. [6+6]
7. a) State the Properties of Markov Chains.
- b) A game of chance has a probability “p” of winning and probability “q = 1-p” of losing. If a gambler wins, the house pays him a dollar and if he loses, he pays the house, the same amount. If the gambler, who initially has 2 dollars, decides to play until he is either broke or doubles his money, represent the activity by Markov Chain, by giving the corresponding state diagram and Transition Matrix. [12]
8. Prove that the sum of two independent Poisson processes is also a Poisson Process, but their difference is not. [12]

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