Paper / Subject Code: 30601 / RANDOM SIGNAL ANALYSIS

(3 Hours) **Max Marks: 80**

Note:
1. **Question No. 1 is compulsory.**
2. **Out of remaining questions, attempt any three questions.**
3. **Assume suitable additional data if required.**
4. **Figures in brackets on the right hand side indicate full marks.**

1. (A) Explain Strong and weak law of large numbers. (05)
   (B) If A and B are two independent events then prove that $P(A \cap \overline{B}) = P(A).P(\overline{B})$. (05)
   (C) Define Power spectral density and prove any two properties. (05)
   (D) State and explain Bayes Theorem. (05)

2. (A) State and prove Chapman-Kolmogorov equation. (10)
   (B) In a factory, four machines A_1, A_2, A_3 and A_4 produce 35%, 10%, 25% and 30% of the items respectively. The percentage of defective items produced by them is 3%, 5%, 4% and 2%, respectively. An item is selected at random. (10)
   (i) What is the probability that the selected item will be defective?
   (ii) Given that the item is defective what is the probability that it was produced by machine A_4?

3. (A) Suppose X and Y are two random variables. Define covariance and correlation of X and Y. When do we say that X and Y are (10)
   (i) Orthogonal,
   (ii) Independent, and
   (iii) Uncorrelated?
   Are uncorrelated variables independent?
   (B) Prove that if input to LTI system is w.s.s. then the output is also w.s.s. (10)

4. (A) A random variable has the following exponential probability density function: $f(x) = Ke^{-|x|}$. Determine the value of K and the corresponding distribution function. (10)
   (B) State Central limit theorem and give its significance. (05)
   (C) If $Z=X/Y$, determine $f_Z(Z)$. (05)

5. (A) Write short notes on the following special distributions. (10)
   i) Uniform distribution.
   ii) Gaussian distribution.
   (B) The transition probability matrix of Markov Chain is given by , (10)

$$P = \begin{array}{c} \\ 1 \\ 2 \\ 3 \end{array} \begin{array}{c} \begin{array}{ccc} 1 & 2 & 3 \end{array} \\ \begin{bmatrix} 0.5 & 0.4 & 0.1 \\ 0.3 & 0.4 & 0.3 \\ 0.2 & 0.3 & 0.5 \end{bmatrix} \end{array}$$

   Find the limiting probabilities?

6. (A) Explain (i) M/G/1 Queuing system. (10)
   (ii) M/M/1/∞ Queuing system.
   (B) Explain Ergodicity in Random Process. (10)
   A Random process is given by $X(t) = 10cos(50t + Y)$ where ω is constant and Y is a Random variable that is Uniformly distributed in the interval (0, 2π). Show that $X(t)$ is a WSS process and it is Correlation ergodic.

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