Q.P. Code: 23105

(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.**

Q.1. (A) State the three axioms of probability. **(05)**

(B) State Central limit theorem and give its significance. **(05)**

(C) State various properties of autocorrelation function and power spectral density function. **(05)**

(D) Define and explain Moment Generating Function. **(05)**

Q.2. (A) In a communication system a zero is transmitted with probability 0.4 and a one is transmitted with probability 0.6. Due to noise in the channel a zero can be received as one with probability 0.1 and as a zero with probability 0.9, similarly one can be received as zero with probability 0.1 and as a one with probability 0.9. If one is observed, what is the probability that a zero was transmitted? **(10)**

(B) 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)**

Q.3. (A) A distribution has unknown mean μ and variance 1.5. Using Central Limit Theorem find the size of the sample such that the probability that difference between sample mean and the population mean will be less than 0.5 is 0.95. **(10)**

(B) Explain Strong law of large numbers and weak law of large numbers. **(05)**

(C) If $Z=X/Y$, determine $f_Z(Z)$. **(05)**

Q.4. (A) Explain power spectral density function. State its important properties and prove any two of the property. **(10)**

(B) Explain (i) M/G/1 Queuing system.
(ii) M/M/1/∞ Queuing system. **(05)**

(C) Write short notes on the following special distributions. **(05)**
i) Poisson distribution
ii) Gaussian distribution.

Q.5. (A) State and prove Chapman-Kolmogorov equation. **(10)**

(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)**

P.T.O.

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Q.6. (A) Prove that if input to LTI system is w.s.s. then the output is also w.s.s. **(10)**

(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?

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