Q. P. Code: 32504

Duration- 3 Hours **Total 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)** A bag contains 7 red and 3 black balls and another bag contains 4 red and 5 black balls. One ball is transferred from the first bag to the second bag and then a ball is drawn from the second bag. If this ball happens to be red, find the probability that a black ball was transferred. **(05)**

(B) Check whether the Random Process given by x(t)=A sin (t) + B cos (t) is ergodic, where A, B are Random Variables normally distributed with zero means and unit variances. **(05)**

(C) Write a short note on " Markov Chain." **(05)**

(D) Find 'P' of Binomial Distribution if n=6 and 9 P(X=4)=P(X=2). **(05)**

Q.2. **(A)** The Power Spectral Density of a WSS Process is given by, **(10)**

$$S_X(W) = \begin{cases} \dfrac{b}{a}(a-|w|) & |w| \le a \\ 0 & |w| \ge a \end{cases}$$ Find the Autocorrelation Function.

(B) Let X1,X2,X3,..... be sequence of Random variables. **(10)**

Define (i) Convergence almost everywhere
(ii) Convergence in probability
(iii) Convergence in distribution
(iv) Convergence in mean square sense
for the above sequence of Random variable X.

Q.3. **(A)** Prove that if input to an LTI system is Wide sense stationary (WSS) process then output is also WSS. **(10)**

(B) A binary communication transmitter sends data as one of two types of signal denoted by 0 or 1. Due to noise, sometimes a transmitted 1 is received as 0 and vice versa. If the probability that a transmitted 0 is correctly received as 0 is 0.9 and the probability that the 1 is received as 1 is 0.8 and if the probability of transmitting 0 is 0.45. Find the probability that 1) A 1 is received. 2) A 0 is received. 3)1 was transmitted given that 1 was received.
4) 0 was transmitted given that 0 was received. 5) The error has occurred. **(10)**

Q.4. **(A)** A random variable has the following exponential probability density function: $f(x) = Ke^{-|x|}$. Determine **(10)**
i) The value of K and ii) Mean and variance.

(B) The transition probability matrix of Markov Chain is given is given by , **(10)**

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

Find the limiting probabilities.

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Q.5. **(A)** The joint probability density function of two continuous random variable X and Y is given by, **(10)**

$$f_{xy}(xy) = \begin{cases} C\,e^{-x}\,e^{-y} & 0 < x < \infty \\ & 0 < y < \infty \\ 0 & \text{elsewhere} \end{cases}$$

Find 1) The value of C.

2) $f_X(X),\ f_Y(Y)$.

3) $f_{X/Y}(X/Y),\ f_{Y/X}(Y/X)$.

4) $E\left[Y/X = X\right],\ E\left[X/Y = Y\right]$

(B) Write a short note on " Little's Formula". **(10)**

Q.6. **(A)** State and prove Chapman-Kolmogorov equation. **(10)**

(B) Write a short note on the following distributions **(10)**
i) Poisson Distribution and (ii) Gaussian Distribution

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