MA-8451 Probability and Random Processes

Important 13Mark Questions

Unit I

1. Derive the moment generating function of Poisson distribution and hence find its first three central moments.
2. The length of time a person speaks over phone follows exponential distribution with mean 6 mins. What is the probability that the person will talk for (1) more than 8 mins (2) between 4 and 8 mins.

Unit II

1. Assume that the random variable S is the sum of 48 independent experimental values of the random variable X whose PDF is given by
   $f_x(x) = \begin{cases} \frac{1}{3}, & 1 \le x \le 4 \\ 0, & \text{otherwise} \end{cases}$
   Find the probability that S lies in the range (108, 126).
2. Give the following bivariate probability distribution obtain
   (1) Marginal distributions of x and y
   (2) Conditional distribution of x given y = 2.

Unit III

1. Prove that the inter arrival time of a Poisson process with parameter λ has an exponential distribution with mean $\frac{1}{\lambda}$.
2. Using limiting behavior of homogeneous Markov chain, find steady state probability of the chain given by the transaction probability matrix. $\mathbf{P} = \begin{vmatrix} 0.1 & 0.6 & 0.3 \\ 0.5 & 0.1 & 0.4 \\ 0.1 & 0.2 & 0.7 \end{vmatrix}$

Unit IV

1. A stationary random process {X(t)} has the power special density $S_{xx}(w) = \frac{24}{w^2+16}$. Find the mean-square value of the process by Brute-Force method.
2. Find the mean, variance and Root-mean square value of the process whose auto correlation function is $R_{xy}(t) = \frac{25x^2+36}{6.25t^2+4}$.

Unit V

1. X(t) is a Wide-Sense stationary process that is the input to a linear system with the transfer function $H(w) = \frac{1}{a+jw}$ where a>0. If X(t) is a zero mean white noise with power spectral density $\frac{N_0}{2}$, determine the following
   (1) The impulse response h(t) of the system
   (2) The cross-power spectral density $S_{xx}(w)$ of the input process and the output process Y(t)
   (3) The cross-correlation function $R_{xx}(t)$ of Y(t) and X(t)

(4) The power spectral density $S_{yy}(w)$ of the output process.

2. If the input to a time invariant stable linear system is a wide sense stationary process, prove that the output will also be a wide sense stationary process.