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Question Paper Code : 30244

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Third/Fourth Semester

Bio Medical Engineering

MA 3355 – RANDOM PROCESSES AND LINEAR ALGEBRA

(Common to : Electronics and Communication Engineering/Electronics and Telecommunication Engineering/Medical Electronics)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Statistical Tables should be provided

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Two fair dice are tossed. Find the probability of the outcome of the second die is greater than the outcome of the first die.

2. A bag contains eight red balls, four green balls, and eight yellow balls. A ball is drawn at random from the bag, and it is not a red ball. What is the probability that it is a green ball?

3. Given two random variables X and Y with the joint CDF $F_{XY}(x,y)$ and marginal CDFs $F_x(x)$ and $F_y(y)$, respectively, compute the joint probability that X is greater than a and Y is greater than b.

4. The joint PMF of two random variables X and Y is given by $P_{XY}(x,y)=\begin{cases}\frac{1}{18}(2x+y), & x=1,2;\ y=1,2\\ 0, & \textit{otherwise}\end{cases}$. What is the marginal PMF of X?

5. Customers arrive at a grocery store in a Poisson manner at an average rate of 10 customers per hour. The amount of money that each customer spends is uniformly distributed between \$8.00 and \$20.00. What is the average total amount of money that customers who arrive over a two-hour interval spend in the store?

6. What are the four basic types of Markov processes?

12. (a) The joint CDF of two discrete random variables X and Y is given as follows: (16)

$$F_{xy}(x,y)=\begin{cases}\frac{1}{8}, x=1, y=1\\ \frac{5}{8}, x=1, y=2\\ \frac{1}{4}, x=2, y=1\\ 1, x=2, y=2\end{cases}$$

Determine the joint PMF of X and Y; Marginal PMF of X and Marginal PMF of Y.

Or

(b) The joint PDF of the random variables X and Y is defined as follows:

$$f_{x,y}(x,y)=\begin{cases}25e^{-5y}, & 0<x<0.2,\ y>0\\ 0, & elsewhere\end{cases}$$

What is the covariance of X and Y? (16)

13. (a) A company cafeteria opens daily on weekdays at 8 a.m. Studies indicate that the employees arrive at the cafeteria over its normal business hours in a Poisson manner. However, the arrival rate varies with the time of the day. In particular, the following observation has been made:

(i) During the first three hours from when the cafeteria opens for business, there is a steady increase in the customer arrival rate from 4 per hour to 16 per hour.

(ii) Then the arrival rate remains constant at 16 customers per hour for the next two hours.

(iii) Finally the arrival rate uniformly declines to 0 per hour in the next 2 hours.

(1) What is the probability that no employee arrives at the cafeteria during the first two hours?

(2) What is the expected number of arrivals during the first four hours? (16)

Or