

(3 Hours)

[Total Marks: 80]

**N.B.:** (1) Question No.1 is Compulsory.

- (2) Attempt **any three** questions from **remaining** questions.
- (3) Assume **suitable** data wherever required but **justify** the same.
- (4) **Figures** to the **right** indicate **full marks**.
- (5) Answer to each new question to be started on a **fresh page**.

1. (a) Define Simulation. Explain when simulation is an appropriate tool and when it is not. (10)
- (b) Explain in detail Verification of Simulation Model. (10)
  
2. (a) Consider a drive in restaurant where carhops take order and bring food to the car. Cars arrive according to the inter-arrival distribution of cars. There are two carhops, Able and Baker. Able is better able to do the job and works a bit faster than Baker. The distribution of their service time is also given. (10)

<b>Time Between Arrivals (min)</b>	2	3	4	5	6
<b>Probability</b>	0.18	0.25	0.27	0.17	0.13

<b>Able's Service Time</b>	2	3	4	5	<b>Baker's Service Time</b>	3	4	5	6
<b>Probability</b>	0.1	0.2	0.2	0.3	<b>Probability</b>	0.1	0.2	0.3	0.3
<b>y</b>	7	4	9	0	<b>y</b>	8	2	0	0

Develop the simulation table and analyze the system by simulating the arrival and service of 10 customers. Random digits for inter-arrival time and service time are as follows:

<b>Customer</b>	1	2	3	4	5	6	7	8	9	10
<b>R.D. for Interarrival Time</b>	--	32	66	41	21	37	79	18	60	98
<b>R.D. for Service Time</b>	49	53	34	17	30	52	22	62	56	73

- (b) Describe the Event scheduling / Time advance algorithm. Give the system snapshots. (10)
  
3. (a) An industrial chemical that will retard the spread of fire in paint has been developed. The local sales representative has determined from past experience that 48% of the sales calls will result in an order. (10)
  - i) What is the probability that the first order will come on the fourth sales call of the day?
  - ii) If eight sales calls are made in a day, what is the probability of receiving exactly six orders?
  - iii) If four sales calls are made before lunch, what is the probability that one or less results in an order?

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- (b) By using Inverse Transform Technique which of the distributions random variates can be generated? Develop a random variate generator for random variable X with pdf (10)

$$f(x) = \begin{cases} e^{2x}, & -\infty < x \leq 0 \\ e^{-2x}, & 0 < x < \infty \end{cases}$$

4. (a) Test the following random numbers for independence by runs up and runs down test. (10)  
Take  $\alpha = 0.05$  and the critical value  $Z_{0.025} = 1.96$ .  
{0.12, 0.01, 0.23, 0.28, 0.89, 0.31, 0.64, 0.28, 0.33, 0.93}

- (b) In stock brokerage, the following 20 time gaps were recorded between customers buy and sell orders (in seconds): (10)

1.95	1.75	1.58	1.42	1.28	1.15	1.04	0.93	0.84	0.75
0.68	0.61	11.98	10.79	9.71	14.02	12.62	11.36	10.22	9.20

Assuming exponential distribution is a good model for the individual gaps, calculate lag-1 autocorrelation.

5. (a) Suppose that the inter-arrival times and service times at a single chair unisex hair-styling shop have been shown to be exponentially distributed with values 2 per hour and 3 per hour respectively. Compute (10)

- The utilization of server
- The time-average number of customers in the system
- The time-average number of customers in the queue
- The average time customer spends in the system
- The average time customer spends in the queue
- The probability of zero, one, two, three, and four or more customers in the shop.

- (b) Explain Inventory system. Discuss the cost involved in inventory systems. (10)

6. Write short notes on (any two): (20)

- Issues in simulation of manufacturing systems.
- Steps in simulation study.
- Output analysis for steady state simulation.
- Poisson Process and its properties.