

Institute of Information Technology
Jahangirnagar University
B.Sc. (Hons.) in Information Technology
3rd year 1st semester examination 2019

Course Code: IT-3109
Course Title: Simulation and Modelling

Time: 3 hours
Full Marks: 60

Answer any FIVE Questions

1. a) What is *simulation*? Explain the discrete and continuous systems. 2
- b) What is a model, what is the goal of a model, and why do we build models? 2
- c) Consider the following *single-server queueing* system from time = 0 to time = 10 sec. Arrivals and service times are: 6
 - Customer #1 arrives at $t = 1$ second and requires 2 seconds of service time
 - Customer #2 arrives at $t = 2$ second and requires 2 seconds of service time
 - Customer #3 arrives at $t = 5$ seconds and requires 2 seconds of service time
 - Customer #4 arrives at $t = 8$ seconds and requires 2 seconds of service timeFind the throughput (X), total busy time (B), mean service time (T_s), utilization (U) for the system.
- d) Classify simulation models in to these different dimensions. 2
2. a) When a simulation called Discrete-Event Simulation or Continuous-Event Simulation? 4
- b) Explain a single-server queue and its different states 4
- c) Write some advantages and disadvantages of simulation. 4
3. a) If notation t_i , A_i , S_i , D_i , C_i and e_i are used to explain a single-server queue for time of arrival of i th customer, interarrival time between $(i-1)$ st and i th customers, service-time requirement of i th customer, delay in queue of i th customer, time i th customer completes service and departs and time of occurrence of the j th event respectively then write their relationships and draw the system in a diagram. 4
- b) Suppose virtual customers are arrived with the following inter-arrival time and service time 4
$$A_1 = 0.4, S_1 = 2.0 \quad A_2 = 1.6, S_2 = 0.7 \quad A_3 = 0.4, S_3 = 0.3$$
$$A_4 = 1.1, S_4 = 1.1 \quad A_5 = 0.2, A_6 = 1.4, A_7 = 1.3$$

If $Q(t)$ is the queue length at time t and $B(t)$ is the busy function against t . Construct the function queue length $Q(t)$ and server business $B(t)$.
- c) What is Time-Average Queue Length? Calculate it from the above example. 4

4. a) When and why a probability distribution associated with simulation? Give examples of the use of discrete and continuous probability distribution in simulation. 4
- b) Explain Different Kinds of Queuing Systems along with their parameters. State and explain Little's law and utilization law in queuing system. 4
- c) Write the probability function of exponential distribution with its mean and variance. Why is this distribution called memory-less distribution? 4
5. a) Define Negative Binomial Distribution and geometric distribution. Write the application of these distribution in simulation. 4
- b) Chi-square Goodness-of-fit Test is widely used after a simulation performed, what are the process of conduction this test and why do researchers use this test? 4
- c) What are the application of Q-Q and P-P plot? Construct a Q-Q plots for the inter arrival time of customers 10, 12, 18, 22 in seconds. 4
6. a) Briefly explain the terms: Trace-driven simulation, Linear Congruential Generators 4
- b) What is uniform test and correlation test of random number? 4
- c) Write the process of inverse transform method to generate random numbers? Write the problems with the inverse transform method 4
7. a) What is Monte Carlo simulation? 4
- b) Explain briefly three basic types of parameters to describe the distribution. 3
- c) Explain following two distribution: 2
 - i) Binomial distribution
 - ii) Geometric distribution
- d) Consider an M/M/1 queuing system with an arrival rate $\lambda=0.4$ and service rate $\mu=0.5$. Compute the system load and show that the system is stable or not. 3