

First Semester M.Tech. Degree Examination, January 2011
System Modeling and Simulation

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions.

1. a. Define discrete and continuous system, with an example. (02 Marks)
 b. Explain the various stages involved in a simulation study. (12 Marks)
 c. Consider the following continuously operating job shop. Inter arrival times of jobs are distributed as follows : (06 Marks)

Time between arrivals (Hours)	Probability
0	0.23
1	0.37
2	0.28
3	0.12

Processing times for jobs are normally distributed, with mean 50 minutes and standard deviation 8 minutes. Construct a simulation table and perform a simulation for 10 new customers.

Assume that, when the simulation begins, there is one job being processed (scheduled to be completed in 25 minutes) and there is one job with a 50 – minute processing time in the queue.

- i) What was the average time in the queue for the 10 new jobs?
 ii) What was the average processing time of the 10 new jobs?
 iii) What was the maximum time in the system for the 10 new jobs?
2. a. Explain the concepts in discrete event simulation. (08 Marks)
 b. 6 dump trucks are used to haul coal from the entrance of a small mine to the rail road. Each truck is loaded by one of the two loaders. After a loading, the truck immediately moves to the scale, to be weighed, as soon as possible. Both the loader and the scale have a FCFS waiting line (or queue) for trucks. Travel time from a loader to the scale is considered negligible. After being weighed, a truck begins a travel time (during which time the truck unloads) and then afterward returns to the loader queue. The distribution of loading time, weighing time, and travel time are given in table 2.1, 2.2 and 2.3, respectively. Together with the random digit assignment, for generating these variables, by using the random digits from table 2.4, estimate the loader and scale utilization (% of time busy) using simulation table.

2.1 : Distribution of loading time for the dump trucks

Loading time	5	10	15
Probability	0.30	0.50	0.20

2.2 : Distribution of weighing time for the dump trucks

Weighing time	12	16
Probability	0.70	0.30

2.3 : Distribution of travel time for the dump trucks

Travel time	40	60	80	100
Probability	0.40	0.30	0.20	0.10

2.4 : Random digits

Loading time	10	5	5	10	15	10	10
Weighing time	12	12	12	16	12	16	
Travel time	60	100	40	40	80		

(12 Marks)

- 3 a. Explain the discrete distributions, in detail. (10 Marks)
 b. A production process manufactures computer chips on the average at 2% nonconforming. Every day, a random sample of size 50 is taken from the process. If the sample contains more than two nonconforming chips, the process will be stopped. Compute the probability that the process is stopped by the sampling scheme. (10 Marks)
- 4 a. Suppose that the interarrival times and service times at a single chair, unisex hairstyling shop, have been shown to be exponentially distributed. The values of λ and μ are 2/hour and 3/hour, respectively. i.e, the time between arrivals averages 1/2 hour, exponentially distributed, and the service time average 20 minutes, also exponentially distributed. Compute the server utilization and the probabilities for 0, 1, 2, 3, and 4 or more customers. (08 Marks)
 b. Explain the networks of queues. (08 Marks)
 c. At Tony and Cleo's bakery, one kind of birthday cake is offered. It takes 15 minutes to decorate this particular cake, and the job is performed by one particular baker. In fact, it is all this the baker does. What mean time between arrivals (exponentially distributed) can be accepted, if the mean length of the queue for decorating is not to exceed five cakes. (04 Marks)
- 5 a. Explain tests for random numbers and explain Kalmogoiev Smirnov test. (10 Marks)
 b. Explain Poisson distribution. (05 Marks)
 c. Develop a random - variable generator for a random variable X with the pdf

$$f(x) = \begin{cases} e^{2x} & -\infty < x \leq 0 \\ e^{-2x} & 0 < x < \infty \end{cases} \quad (05 \text{ Marks})$$
- 6 Records pertaining to the monthly number of job - related injuries at an underground coalmine were being studied by a federal agency. The values for the past 100 months were as follows :
- | Injuries/Month | Frequency |
|----------------|-----------|
| 0 | 35 |
| 1 | 40 |
| 2 | 13 |
| 3 | 6 |
| 4 | 4 |
| 5 | 1 |
| 6 | 1 |
- i) Apply the chi-square test to these data to test the hypothesis that the underlying distribution is Poisson. Use the level of significance $\alpha = 0.05$.
 ii) Apply the Chi - square test to these data to test the hypothesis that the distribution is Poisson with mean 1.0. Again let $\alpha = 0.05$. (20 Marks)
- 7 a. Explain the output analysis for steady state simulation. (10 Marks)
 b. Write a note on quartiles. (10 Marks)
- 8 a. Explain the calibration and validation of models. (12 Marks)
 b. Explain the verification simulation models. (08 Marks)