

## Eighth Semester B.E. Degree Examination, May/June 2010

### System Modeling and Simulation

Time: 3 hrs.

Max. Marks:100

**Note: Answer any FIVE full questions, selecting at least TWO questions from each part.**

#### PART- A

- 1 a. What is simulation? Explain with flowchart, the steps involved in simulation study. (10 Marks)
- b. Differentiate between continuous and discrete systems. (05 Marks)
- c. What is system and system environment? List the components of a system, with example. (05 Marks)
- 2 a. A grocery store has one checkout counter. Customers arrive at this checkout counter at random from 1 to 8 minutes apart and each interval time has the same probability of occurrence. The service times vary from 1 to 6 minutes, with probability given below :

Service (minutes)	1	2	3	4	5	6
Probability	0.10	0.20	0.30	0.25	0.10	0.05

Simulate the arrival of 6 customers and calculate :

- Average waiting time for a customer  
 Probability that a customer has to wait  
 Probability of a server being idle  
 Average service time and  
 Average time between arrival.

Use the following sequence of random numbers :

Random digit for arrival	913	727	015	948	309	922
Random digit for service time	84	10	74	53	17	79

Assume that the first customer arrives at time  $\theta$ . Depict the simulation in a tabular form.

- (10 Marks)
- b. Briefly define any four concepts used in discrete event simulation. (04 Marks)
- c. Explain event scheduling algorithm by generating system snapshots at clock= $t$  and clock =  $t_1$ . (06 Marks)
- 3 a. Six dump trucks are used to have coal from the entrance of a mine to a railroad. Each truck is loaded by one of the two loaders. After loading, a truck immediately moves to the scale, to be weighed as soon as possible. Both the loader and the scale have first-come first-served waiting line for trucks. Travel time from a loader to scale is considered negligible. After being weighed, a truck begins travel time [during which time truck unloads] and then afterwards return to loader queue. The activities of loading, weighing and travel time are given in the following table :

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

End of simulation is completion of two weighings from the scale. Depict the simulation table and estimate the loader and scale utilizations. Assume that five of the trucks are at the loaders and one is at the scale at time  $\theta$ . (05 Marks)

- b. Define a discrete random variable. Explain the binomial distribution. (05 Marks)
- c. A production process manufactures alternators for outboard engines used in recreational boating. On the average, 1% of the alternators will not perform up to the required standards when tested at the engine assembly plant. When shipment of 100 alternators is received at the plant, they are tested, and if more than two are non confirming; the shipment is returned to the alternators manufacturer. What is the probability of returning a shipment? (10 Marks)

- 4 a. Explain the characteristics of a queuing system. List different queuing notations. (10 Marks)  
 b. A tool crib has exponential interarrival and service times, and it serves a very large group of mechanics. The mean time between arrivals is 4 minutes. It takes 3 minutes on the average for a tool crib attendant to service a mechanic. The attendant is paid \$ 10 per hour and the mechanic is paid \$ 15 per hour. Would it be advisable to have a second tool-crib attendant? (10 Marks)

### PART- B

- 5 a. What are pseudo random numbers? What are the problems that occur while generating pseudo random numbers? (06 Marks)  
 b. Explain combined linear congruential method for random number generation. (06 Marks)  
 c. The sequence of numbers 0.54, 0.73, 0.98, 0.11 and 0.68 has been generated. Use the Kolmogorov-Smirnov test with  $\alpha = 0.05$  to determine if the hypothesis that the numbers are uniformly distributed on the interval  $[0, 1]$  can be rejected. (08 Marks)
- 6 a. Suggest a step by step procedure to generate random variates using inverse transform technique for exponential distribution. (06 Marks)  
 b. Enlist the steps involved in development of a useful model of input data. (04 Marks)  
 c. Records pertaining to the monthly number of job-related injuries at an underground coal mine, were being studied by a federal agency. The values for the past 100 months were as follows :

Injuries per month	0	1	2	3	4	5	6
Frequency of occurrence	35	40	13	6	4	1	1

- i) Apply the chi-square test to these data to test the hypothesis, that, underlying distribution is Poisson. Use a level of significance of  $\alpha = 0.05$ .  
 ii) Apply the chi-square test to these data to test the hypothesis, that, the distribution is Poisson with mean 1.0. Again let  $\alpha = 0.05$ . (10 Marks)
- 7 a. Briefly explain the measure of performance of a simulation system. (10 Marks)  
 b. Explain the distinction between terminating or transient simulation and steady state simulation. Give examples. (10 Marks)
- 8 a. Explain with a neat diagram, model building, verification and validation process. (10 Marks)  
 b. Describe the three steps approach to validation by Naylor and Finger. (10 Marks)

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