Eighth Semester B.E. Degree Examination, June/July 2013

System Modeling and Simulation

Time: 3 hrs.   Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting at least TWO questions from each part.*
2. *Use of simulation table given in Appendix of Text book "discrete-event system simulation" by Jerry Banks is allowed.*

PART – A

1 a. Explain the following component of simulation system with an example of bank system:
   i) system   ii) entity   iii) attribute   iv) activity   v) event   **(06 Marks)**

   b. List three situations when simulation is appropriate tool and is not appropriate tool.
                                                                                (06 Marks)

   c. Develop a manual simulation table for single server queuing system of a grocery shop for 6 customers and find :
   i) Average waiting time of customer
   ii) Idle time of server
   iii) Average time customer spends in system.
   Customer arrives at shop randomly from 1 to 8 minutes apart and has equal probability. Service time varies from 1 to 6 min. The random digits for IAT and ST are 425, 913, 727, 15, 948 and 84, 10, 74, 53, 17, 84 respectively.   **(08 Marks)**

ST	1	2	3	4	5	6
P	.1	.2	.3	.25	.1	.05

2 a. Explain the terms used in discrete event simulation with an example:
   i) Event   ii) Event notice   iii) FEL
   iv) Delay   v) Clock   vi) System state   **(06 Marks)**

   b. Develop manual simulation using event scheduling for dump-truck problem and find busy time of loader and scale for period of 1 hour (60 min). Also mention system state and event notices. Six dump trucks are used to haul coal from a mine to railroad. Each truck is loaded by one of two loaders. After loading, the truck immediately moves to scale, to be weighted. Both loaders and scale have first-come-first served queue. After being weighted a truck begins a travel time afterward returns to loader queue. The distribution for various time given below:

Loading time	5	10	15	Weighing time	12	16	Travel time	40	60	80	100
Probability	.3	.5	.2	P		.7	.3	P	.4	.3	.2	.1

   It is assumed that five trucks are at loaders and one at the scale at time t = 0. The activity times are given as follow:

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

                                                                                (14 Marks)

3 a. Explain any two discrete distributions and give equation for probability mass function. Also calculate mean and variance of same. **(08 Marks)**

b. The number of hurricanes hitting the coast of Florida has a Poisson distribution with mean of 0.8.
   i) What is probability that more than two hurricanes will hit the Florida coast in a year?
   ii) What is probability that only one hurricane will hit the coast in a year? **(06 Marks)**

c. The lifetime of a satellite placed in orbit is given by PDF, $f(x) = 0.4 \, e^{-0.4x}$, $x \geq 0$.
   i) What is probability that satellite is still alive after 5 years?
   ii) What is probability that the satellite dies between 3 and 6 years from the time placed in orbit? **(06 Marks)**

4 a. Explain Kendall's notation for parallel server queuing system A/B/C/N/K and also interprete meaning of M/M/2/∞/∞. **(10 Marks)**

b. Explain steady state parameters of M/G/1 queue. **(10 Marks)**

PART – B

5 a. Generate five random numbers using multiplicative congruential method with $X_0 = 5$, $a = 10$, $m = 64$. **(06 Marks)**

b. The six numbers 0.44, 0.66, 0.82, 0.16, 0.05, 0.92 are generated. Using Kolmogorov-Smirnov test with $\alpha = 0.05$ and check the hypothesis that the numbers are uniformly distributed on the interval [0, 1] can be rejected. **(08 Marks)**

c. For given size of data N = 100, use Chi-square test and check that random numbers are uniformly distributed. Assume $\alpha = 0.01$ and simulation table to check critical value.

Interval	1	2	3	4	5	6	7	8	9	10
Observed value	8	6	10	11	12	8	10	12	12	11

(06 Marks)

6 a. Suggest a step by step procedure to generate random variates using inverse transform technique for exponential distribution. **(06 Marks)**

b. Explain four methods of selecting input models without data. **(06 Marks)**

c. Records pertaining to the monthly number of jobs related injuries at an underground coalmine were being studied by a federal agency. The values of 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

Apply the chi-square test to these data to test the hypothesis that the underlying distribution is Poisson. Calculate the parameter $\overline{X}$ (mean) and use in the equation. Use level of significance 0.05. **(08 Marks)**

7 a. Briefly explain measure of performance of simulation system. **(10 Marks)**

b. Explain the distinction between terminating or transient simulation and steady state simulation. Give an example. **(10 Marks)**

8 a. Differentiate the processes of verification and validation and model building. **(10 Marks)**

b. With a neat diagram, explain iterative process of calibrating a model. **(10 Marks)**

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