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06CS82

Eighth Semester B.E. Degree Examination, June/July 2011

System Modeling and Simulation

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What is system and system environment? Explain the components of a system with examples. **(10 Marks)**

b. Explain the various steps in simulation study, with the help of a neat flow diagram. **(10 Marks)**

2 a. With the help of a flow diagram, explain the simulation of a single channel queuing system. **(10 Marks)**

b. A large milling machine has three different bearings that fail in service. The cumulative distribution function of the life of each bearing is identical, as shown in Table.1. When a bearing fails, the mill stops, a repair-person is called and a new bearing is installed. The delay time of the repair-person's arriving at the milling machine is also a random variable, with the distribution given in Table.2. Downtime for the mill is estimated at $5/minute. The direct on-site cost of the repair-person is $15/hour. It takes 20 minutes to change 1 bearing, 30 minutes to change 2 bearings, 40 minutes to change 3 bearings. The bearing cost $16 each. A proposal has been made to replace all 3 bearings whenever a bearing fails. Management needs an evaluation of this proposal. Simulate the system for10,000 hours of operation under proposed method and determine the total cost of the proposed system.

Table.1 : Bearing life distribution

Bearing life (hrs)	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
Probability	0.10	0.13	0.25	0.13	0.09	0.12	0.02	0.06	0.05	0.05

Table.2 : Delay-time distribution

Delay (minutes)	5	10	15
Probability	0.6	0.3	0.1

Note : Consider the following sequence of random digits for bearing life-times.

Bearing 1	67	8	49	84	44	30	10	63
Bearing 2	70	43	86	93	81	44	19	51
Bearing 3	76	65	61	96	65	56	11	86

Consider the following sequence of random digits for delay time.

Delay	3	7	5	1	4	3	7	8

(10 Marks)

3 a. What do you mean by "world view"? Discuss the various types of world views. **(10 Marks)**

b. Suppose the maximum inventory level M, is 11 units and the review period, N, is 5 days. Estimate by simulation, the average ending units in inventory and number of days when a shortage condition occurs.

The number of units demanded per day is given by the following probability distribution. Assume that orders are placed at the close of business and are received for inventory at the beginning of business as determined by the lead-time. Initially simulation has started with inventory level of 3 units and an order of 8 units scheduled to arrive in two days time.

Demand	0	1	2	3	4
Probability	0.10	0.25	0.35	0.21	0.09

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Question No.3(b) continued…

Lead time is a random variable, with the following probability distribution:

Lead time (days)	1	2	3
Probability	0.6	0.3	0.1

Note : The sequence of random digits for demand and random digits for lead-time should be considered in the given order.

RD for demand	24	35	65	81	54	3	87	27	73	70	47	45	48	17	9
RD for lead time	5	0	3												

(10 Marks)

4 a. What is the role of maximum density and maximum period in generation of random numbers? With given seed 45, constant multiplier 21, increment 49 and modulus 40, generate a sequence of five random numbers. **(10 Marks)**

b. For the following sequence can the hypothesis that the numbers are independent can be rejected on the basis of length of runs up and down when $\alpha = 0.05$, $z_{0.025} = 1.96$.

0.34	0.90	0.25	0.89	0.87	0.44	0.12	0.21	0.46	0.67
0.83	0.76	0.79	0.64	0.70	0.81	0.94	0.74	0.22	0.74
0.96	0.99	0.77	0.67	0.56	0.41	0.52	0.73	0.99	0.02
0.47	0.30	0.17	0.82	0.56	0.05	0.45	0.31	0.78	0.05
0.79	0.71	0.23	0.19	0.82	0.93	0.65	0.37	0.39	0.42

(10 Marks)

PART – B

5 a. What is inverse transform technique? Derive an expression for exponential distribution. **(10 Marks)**

b. A sequence of 1000 four digit numbers has been generated and analysis indicates the following combinations and frequencies. Based on poker test check whether the numbers are independent. Use $\alpha = 0.05$, $x^2_{0.05,2} = 5.99$.

Combination (i)	O_i
Four different digits	565
One pair	392
Two pairs	17
Three like digits	24
Four like digits	2

(10 Marks)

6 a. What is acceptance-rejection technique? Generate three Poisson variates with mean $\alpha = 0.2$. **(10 Marks)**

b. For the given sequence of +'s and –'s, can the hypothesis that the numbers are independent be rejected on the basis of the length of runs above and below the mean at $\alpha = 0.05$? The critical value is given as 5.99. **(10 Marks)**

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+ – – + – + – – – + + + + – – – – – + –

7 a. What do you mean by verification and validation of simulation models? Explain calibration and validation of models with the help of diagram. **(10 Marks)**

b. Discuss types of simulations with respect of output analysis with examples. **(10 Marks)**

8 Write short notes on : **(20 Marks)**

a. Characteristics of queuing system
b. Errors while generating pseudorandom numbers
c. Network of queue
d. Optimization via simulation.

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Eighth Semester B.E. Degree Examination, December 2011

System Modeling and Simulation

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer any FIVE full questions, selecting at least TWO questions from each part.*
2. *Statistical tables A.6 and A.8 from the text book can be provided.*

PART – A

1 a. List any five circumstances, when the simulation is the appropriate tool and when it is not. **(10 Marks)**

b. Explain the steps in a simulation study, with the flow chart. **(10 Marks)**

2 a. One company uses 6 trucks to haul manganese ore from Kolar to its industry. There are two loaders, to load each truck. After loading, a truck moves to the weighing scale to be weighed. The queue discipline is FIFO. When it is weighed, a truck travels to the industry and returns to the loader queue. The distribution of loading time, weighing time and travel time are as follows :

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

Calculate the total busy time of both the loaders, the scale average loader and scale utilization. Assume 5 trucks are at the loaders and one is at the scale, at time "0". Stopping time $T_E = 64$ min. **(10 Marks)**

b. Explain simulation in GPSS, with a block diagram, for the single server queue simulation. **(06 Marks)**

c. Explain the following :
i) System ii) Event list iii) Entity iv) Event. **(04 Marks)**

3 a. Explain discrete random variables and continuous random variables, with examples. **(10 Marks)**

b. Explain any two discrete distributions. **(05 Marks)**

c. Explain the following continuous distribution :
i) Uniform distribution
ii) Exponential distribution. **(05 Marks)**

4 a. Explain the characteristics of a queuing system. List different queuing notations. **(10 Marks)**

b. Explain any two long-run measures of performance of queuing systems. **(10 Marks)**

PART – B

5 a. Explain the two different techniques used for generating random numbers, with examples. **(10 Marks)**

b. The sequence of numbers 0.44, 0.81, 0.14, 0.05, 0.93 has been generated. Use the Kolmogonov-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. Compare F(X) and $S_N(X)$ on a graph. **(10 Marks)**

6 a. Explain inverse-transform technique of producing random variates for exponential distribution. **(05 Marks)**

b. Generate three Poison variates with mean $\alpha = 0.2$. **(05 Marks)**

c. Explain the types of simulation with respect to output analysis. Give at least two examples. **(10 Marks)**

7 a. Explain Chi-square goodness of fit test. Apply it to Poisson assumption with $\alpha = 3.64$. Data size = 100 and observed frequency O_i = 12, 10, 19, 17, 10, 8, 7, 5, 5, 3, 3, 1. **(10 Marks)**

b. List the steps involved in the development of a useful model of input data. **(05 Marks)**

c. Explain Chi-square goodness-of-fit test for exponential distribution, with an example. **(05 Marks)**

8 a. Explain, with a neat diagram, model building, verification and validation. **(10 Marks)**

b. Explain any two output analysis for steady-state simulations. **(10 Marks)**

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