System Simulation and Modeling VTU Question Paper Set

USN | | | | | | | | | | |

10CS82

Eighth Semester B.E. Degree Examination, Dec.2015/Jan.2016
System Modeling and Simulation

Time: 3 hrs. Max. Marks: 100

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

PART – A

1 a. Define simulation. Explain when simulation is an appropriate tool and not an appropriate tool. **(12 Marks)**

b. Name the entities, attributes, activities, events and state variables for the system shown below:
i) Library ii) Bank iii) Airport iv) Grocery store. **(08 Marks)**

2 a. Explain event scheduling/ time advance algorithm. **(10 Marks)**

b. Six dump trucks are used to haul coal from entrance of a small mine to the rail road. Each truck is loaded by one of the two loaders. After loading truck immediately moves to the scale to be weighed as soon as possible. Both loaders and scale have FCFS for trucks. Travel time from loader to scale is negligible. After being weighed, a truck begins a travel time and then returns to loader queue. Simulate for clock = 20. Find average loader utilization and average scale utilization. The activity times are given in the following table:

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

(10 Marks)

3 a. Find mean and variance of the die tossing experiment. Assume the die is loaded so that the probability that given face land up in proportional to the number of spots showing. **(10 Marks)**

b. The time to failure of a light bulb is Weibull distributed with V = 1.8×10^3 hours. $\beta = 1/2$ and $\alpha = 1/3 \times 10^3$ hours.
(i) What fraction of bulbs are expected to last longer than mean lifetime?
(ii) What is the median lifetime of a light bulb? **(10 Marks)**

4 a. Explain the characteristics of queueing system. **(10 Marks)**

b. List the steady state parameters of M | M | 1 queue. **(05 Marks)**

c. Explain terms used in queueing notation of the form A | B | C | N | K. **(05 Marks)**

PART – B

5 a. Explain generation of pseudo random numbers with examples. Mention the important considerations in selecting a method for generating random numbers. **(10 Marks)**

b. Use Chi square test with $\alpha = 0.05$ to test whether data shown below is uniformly distributed or not. Assume critical value $\chi^2_{0.05,9} = 16.9$

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
0.99	0.17	0.99	0.46	0.05	0.66	0.10	0.42	0.18	0.49
0.37	0.51	0.54	0.01	0.81	0.28	0.69	0.34	0.75	0.49
0.72	0.43	0.56	0.97	0.30	0.94	0.96	0.58	0.73	0.05
0.06	0.39	0.84	0.24	0.40	0.64	0.40	0.19	0.79	0.62
0.18	0.26	0.97	0.88	0.64	0.47	0.60	0.11	0.29	0.78

(10 Marks)

6 a. Explain the steps involved in the development of a useful model of input data. **(10 Marks)**

b. Explain the different ways of selecting input models when data is not available. **(10 Marks)**

7 a. Explain the calibration and validation of models. **(10 Marks)**

b. Explain the suggestions given for use in verification process. **(10 Marks)**

8 Write short notes on :

a. World views

b. Network of Queues

c. Optimization via Simulation

d. List Processing **(20 Marks)**

* * * * *

USN | | | | | | | | | | |

10CS82

Eighth Semester B.E. Degree Examination, June/July 2016
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. With a neat flow chart, explain various steps in a simulation study. **(10 Marks)**

b. Briefly explain the advantages and disadvantages of simulation. **(10 Marks)**

2 a. A computer technical support center is staffed by two people, Able and Baker, who take calls and try to answer questions and solve computer problems. The time between calls ranges from 1 to 4 minutes with the distribution as shown in Table 1.1. Able is more experienced and can provide service faster than Baker, which means that, when both are idle, Able takes the call. The distribution of their service times are shown in Table 1.2 and Table 1.3 respectively.

Table 1.1: Inter arrival time (IAT) distribution

IAT (mins)	1	2	3	4
Probability	0.25	0.40	0.20	0.15

Table 1.2: Service time distribution of Able

Service time (mins)	2	3	4	5
Probability	0.30	0.28	0.25	0.17

Table 1.3: Service time distribution of Baker

Service time (mins)	3	4	5	6
Probability	0.35	0.25	0.20	0.2

Random digits for inter-arrival times are : 26, 98, 90, 26, 42, 74, 80, 68, 22, 48, 34, 45, 24, 34.
Random digits for service time are : 95, 21, 51, 92, 89, 38, 13, 61, 50, 49, 39, 53, 88, 01, 81.
Simulate this system for 10 customers, by finding

i) Average waiting time for a customer
ii) Average Inter Arrival time
iii) Average service time of Able
iv) Average service time of Baker
v) Average waiting time of those who wait. **(12 Marks)**

b. Explain the various concepts used in discrete-event simulation with an example. **(08 Marks)**

3 a. Explain simulation in Java. **(06 Marks)**

b. A company used 6 trucks to haul manganese from Kolar to 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 (mins)	10	5	5	10	15	10	10	15
Weighing Time (mins)	8	12	8	16	12	8		
Travel Time (mins)	30	60	80	40	50	70		

End of simulation is completion of four weighing from the scale. Calculate the total busy time of both loaders, scale, average loader and scale utilization. Assume that four trucks are at the loaders and Two are at the scale, at time "0". The shopping of simulation is after 10 iterations. **(14 Marks)**

4 a. What is Poisson process? With example explain the properties of Poisson process. **(06 Marks)**

b. Explain the characteristics of a queuing system. **(08 Marks)**

c. Explain the various steady state parameters of M/G/1 Queue. **(06 Marks)**

PART – B

5 a. Use linear congruential method to generate a sequence of 5 random numbers, with given seed 27, increment 43, and constant multiplier 17, modulus 100. **(04 Marks)**

b. The sequence of random numbers 0.54, 0.73, 0.98, 0.11 and 0.68 has been generated. Use K – S test with $\alpha = 0.05$ to determine if the hypothesis that the numbers are uniformly distributed on the interval [0, 1] can be rejected. Take $D\alpha = 0.565$. **(08 Marks)**

c. Test whether the 2^{nd}, 9^{th}, 16^{th} ..... Numbers in the following sequence are auto correlated by taking $\alpha = 0.05$. Take $Z_{\alpha/2} = 1.96$.

0.38, 0.48, 0.36, 0.01, 0.54, 0.34, 0.96, 0.06, 0.61, 0.85, 0.48, 0.86, 0.14, 0.86, 0.89, 0.37, 0.49, 0.60, 0.04, 0.83, 0.42, 0.83, 0.37, 0.21, 0.90, 0.89, 0.91, 0.79, 0.77, 0.99, 0.95, 0.27, 0.41, 0.81, 0.96, 0.31, 0.09, 0.06, 0.23, 0.77, 0.73, 0.47, 0.13, 0.55, 0.11, 0.75, 0.36, 0.25, 0.23, 0.72, 0.60, 0.84, 0.70, 0.30, 0.26, 0.38, 0.05, 0.19, 0.73, 0.44. **(08 Marks)**

6 a. Explain acceptance – rejection technique for Poisson distribution. Generate 5 Poisson variates with mean $\alpha = 0.25$. Random numbers are: 0.073, 0.693, 0.945, 0.739, 0.014, 0.342. **(10 Marks)**

b. Test whether the following data follows Poisson distribution using the chi-square test of goodness of fit. With mean $\alpha = 0.05$. Take $\lambda^2_{0.05,5} = 11.1$ **(10 Marks)**

Arrivals /period	0	1	2	3	4	5	6	7	8	9	10	11
Frequency	12	10	19	17	10	8	7	5	5	3	3	1

7 a. Explain the replication method for steady – state simulations. **(10 Marks)**

b. Differentiate between point estimation and interval estimation. **(05 Marks)**

c. Differentiate between terminating and steady state simulations by giving one example each. **(05 Marks)**

8 a. Explain components of verification and validation process. Explain with neat diagram, model building, verification and validation process. **(12 Marks)**

b. With neat diagram, explain the iterative process of calibrating a model. **(08 Marks)**

* * * * *

USN | | | | | | | | | | |

10CS82

Eighth Semester B.E. Degree Examination, Dec.2014/Jan.2015
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 statistical tables is permitted.

PART – A

1 a. With a neat flow diagram, explain the steps in a simulation study. **(10 Marks)**

b. A computer technical support center is staffed by two people, Able and Baker, who take calls and try to answer questions and solve computer problems. The time between calls ranges from 1 to 4 minutes with the distribution as shown in Table 1b(1). Able is more experienced and can provide service faster than Baker, which means that, when both are idle, Able takes the call. The distribution of their service times are shown in Table 1b(2) and Table 1b(3) respectively.

Table 1b(1) Interarrival time distribution

Interarrival time (minutes)	1	2	3	4
Probability	0.25	0.40	0.20	0.15

Table 1b(2) Service time distribution of Able

Service time (minutes)	2	3	4	5
Probability	0.30	0.28	0.25	0.17

Table 1b(3) Service time distribution of Baker

Service time (minutes)	3	4	5	6
Probability	0.35	0.25	0.20	0.20

Random digits for inter-arrival times are: 26, 98, 90, 26, 42, 74, 80, 68, 22, 48, 34, 45, 24, 34
Random digits for service times are: 95, 21, 51, 92, 89, 38, 13, 61, 50, 49, 39, 53, 88, 01, 81
Simulate this system for 10 customers, by finding (i) Average inter arrival time (ii) Average service time of Able (iii) Average service time of Baker (iv) Average waiting time of all the customers (v) Average waiting time of those who wait. **(10 Marks)**

2 a. Explain the following terms used in discrete event simulation: (i) List (ii) Event notice (iii) Delay (iv) Clock **(04 Marks)**

b. Explain Event scheduling/Time Advance algorithm by generating system snapshots at clock = t and clock = t_1 . **(06 Marks)**

c. 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 for weighing. Both loaders and scale have First In First Out queue discipline. After being weighed, the truck travels to the rail road (begins travel time), unloads and later returns to the loader queue. The distribution of loading time, weighing time and travel time are given in Table 2c(1), Table 2c(2) and Table 2c(3) respectively. It is assumed that 5 trucks are at the loaders and one is at the scale at time t = 0.

Table 2c(1)

Loading time	Probability
5	0.3
10	0.5
15	0.2

Table 2c(2)

Weighing time	Probability
12	0.7
16	0.3

Table 2c(3)

Travel time	Probability
40	0.4
60	0.3
80	0.2
100	0.1

The activity times are given in Table 2c(4)

Table 2c(4)

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

Simulate the system for 25 minutes to estimate the loader and scale utilization. **(10 Marks)**

3 a. Define random variable. What are the different types of random variables? Explain with at least one example in each case. **(05 Marks)**

b. A production process manufactures computer chips one the average at 2% nonconforming. Everyday a random sample of size 50 is taken from the process. If the sample contains more than 2 nonconforming chips, the process will be stopped. Compute the probability that the process is stopped by the sampling scheme. Also find the mean and variance. **(08 Marks)**

c. Find the mean and variance of exponential distribution. Suppose that the life of an industrial lamp, in thousands of hours, is exponentially distributed with failure rate $\lambda = 1/3$ (one for every 3000 hours, on the average). Find the probability that the lamp will last longer than its mean life. **(07 Marks)**

4 a. Explain the characteristics of queuing system. Also explain the queuing notation in general. **(10 Marks)**

b. Explain the steady state parameters of M/G/1 queue. **(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. Consider the sequence of random numbers 0.12, 0.01, 0.23, 0.28, 0.89, 0.31, 0.04, 0.28, 0.83, 0.93, 0.99, 0.15, 0.33, 0.35, 0.91, 0.41, 0.6, 0.27, 0.75, 0.88, 0.68, 0.49, 0.05, 0.43, 0.95, 0.58, 0.19, 0.36, 0.69, 0.87.
Test whether 3^{rd}, 8^{th}, 13^{th} and so on numbers in the above sequence are auto correlated. At significance level $\alpha = 0.05$, normal table value is given as 1.96. **(08 Marks)**

c. Explain inverse transform technique for exponential and uniform distributions. **(06 Marks)**

6 a. List the steps involved in development of a useful model of input data. **(04 Marks)**

b. 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

Apply the chi-square test to these data to test the hypothesis that the underlying distribution is Poisson. Take $\alpha = 0.05$. **(08 Marks)**

c. Let X_1 represent the average lead time (in months) to deliver and X_2 the annual demand, for industrial robots. The following data are available on demand and lead time for the last ten years.

Lead time	6.5	4.3	6.9	6.0	6.9	6.9	5.8	7.3	4.5	6.3
Demand	103	83	116	97	112	104	106	109	92	96

Find the dependency between lead time and demand. **(08 Marks)**

7 a. Explain the replication method for steady-state simulations. **(10 Marks)**

b. Differentiate between point estimation and interval estimation. **(05 Marks)**

c. Differentiate between terminating and steady state simulations by giving one example each. **(05 Marks)**

8 a. With a neat flow diagram, explain the concept of model building, verification and validation of simulation models. **(10 Marks)**

b. Describe the three step approach of Naylor and Finger in the validation process. **(10 Marks)**

* * * * *

USN | | | | | | | | | | |

10CS82

Eighth Semester B.E. Degree Examination, June/July 2015
System Modeling and Simulation

Time: 3 hrs. Max. Marks:100

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

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

b. Write the flow chart with respect to single channel queue:
i) Execution of the arrival event
ii) Execution of the departure event. **(06 Marks)**

c. One company uses 6 trucks of 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		

Depict the simulation table and estimate the loader and scale utilization. Assume 5 trucks are at the loaders and one is at the scale, at time '0'. Stopping time $T_E = 76$ min. **(10 Marks)**

3 a. Explain discrete random variable and continuous random variable with example. **(08 Marks)**

b. Explain the following discrete distribution:
i) Binomial distribution ii) Poisson distribution. **(06 Marks)**

c. Explain the following continuous distribution:
i) Uniform distribution ii) Exponential distribution. **(06 Marks)**

4 a. Explain queue behavior and queue discipline and list queuing notation for parallel server systems. **(12 Marks)**

b. What is network of queue? Mention the general assumption for a stable system with infinite calling population. **(08 Marks)**

PART – B

5 a. Explain combined linear congruential generator. **(06 Marks)**

b. Explain inverse-transform technique of producing random variates for
i) Exponential distribution ii) Weibull distribution. **(08 Marks)**

c. Generate three Poisson variates with mean $\alpha = 0.2$.
[Random number : 0.4357, 0.4146, 0.8353, 0.9952, 0.8004]. **(06 Marks)**

6 a. 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 in the interval [0, 1] can be rejected. Compare F(x) and $S_N(x)$ on a graph. [N = 5, $D_{0.05} = 0.565$]. **(10 Marks)**

b. 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] $\left[\chi^2_{0.05} = 14.1\right]$. **(10 Marks)**

7 a. What are pseudo random numbers? What are the problems that occur while generating pseudo random number? **(06 Marks)**

b. Enlist the steps involved in development of a useful model of input data and number of ways to select input models without data. **(08 Marks)**

c. List any 6 suggested estimators for distributions often used in simulation. **(06 Marks)**

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

b. Explain the iterative process of calibrating a model. **(10 Marks)**

* * * * *

USN | | | | | | | | | | |

10CS82

Eighth Semester B.E. Degree Examination, June/July 2014
System Modeling and Simulation

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define system. Explain the components of a system with an example. **(10 Marks)**

b. With a neat flow diagram, explain the steps in simulation study. **(10 Marks)**

2 a. Describe queuing system with respect to arrival and service mechanisms, system capacity, queue discipline, flow diagrams of arrival and departure events. **(10 Marks)**

b. A small shop has one check out counter. Customers arrive at this checkout counter at random from 1 to 10 minutes apart. Each possible value of inter-arrival time has the same probability of occurrence equal to 0.10. Service times vary from 1 to 6 minutes with probability shown below:

Service time	1	2	3	4	5	6
Probability	0.05	0.10	0.20	0.030	0.25	0.10

Develop simulation table for 10 customers. Find: i) Average waiting time; ii) Average service time; iii) Average time, customer spends in system.
Take the random digits for arrivals as 91, 72, 15, 94, 30, 92, 75, 23, 30 and for service times are 84, 10, 74, 53, 17, 79, 91, 67, 89, 38 sequentially. **(10 Marks)**

3 a. Explain the event scheduling/time advance algorithm with an example. **(08 Marks)**

b. A company uses 6 trucks to haul manganese are from Kolar to 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 loaders, the scale, average loader and scale utilization. Assume 5 trucks are at the loader and one is at the scale, at time "0". Stopping event time TE = 64min. **(12 Marks)**

4 a. Explain the following continuous distributions:
i) Uniform distribution
ii) Exponential distributions. **(10 Marks)**

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

PART – B

5 a. Explain linear congruential method. Write three ways of achieving maximal period. **(05 Marks)**

b. The sequence of random numbers 0.54, 0.73, 0.98, 0.11 and 0.68 has been generated. Use 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. Take $D_\alpha = 0.565$. **(05 Marks)**

c. What is acceptance-rejection technique? Generate three Poisson variates with mean $\alpha = 0.2$. The random numbers are 0.4357, 0.4146, 0.8353, 0.9952, 0.8004, 0.7945, 0.1530. **(10 Marks)**

6 a. Explain different steps in the development of a useful model of input data. **(10 Marks)**

b. Explain Chi-square goodness of fit test. Apply it to Poisson assumption with alpha = 3.64, Data size = 100. Observed frequency O_i : 12 10 19 17 10 8 7 5.5 3 3 1. Take level of significance $\alpha = 0.05$. **(10 Marks)**

7 a. Explain the types of simulation with respect to output analysis. Give examples. **(07 Marks)**

b. Briefly explain the confidence-interval estimation method. **(07 Marks)**

c. Explain output analysis for termination simulation. **(06 Marks)**

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

b. Explain three step approach for validation process as formulated by Nayler and Finger. **(10 Marks)**

* * * * *