CBCS SCHEME

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18CS645

Sixth Semester B.E. Degree Examination, July/August 2022
System Modeling and Simulation

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Missing data may be suitably assumed.***

Module-1

1 a. What is simulation? Explain with flowchart the steps involved in simulation study. **(08 Marks)**

b. A grocery store has one checkout counter. Customers arrive at this checkout counter at random from 1 to 8 min 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:
(i) Average waiting time for a customer
(ii) Probability that a customer has to wait
(iii) Probability of a server being idle
(iv) Average service time

Use time between arrival and the following sequence of random numbers:

Random digits for arrival		913	727	015	948	309	922	753	235	302
Random digit for service time	84	10	74	53	17	79	91	67	89	38

Assume that the first customer arrives at time 0. Depict the simulation in a tabular form. **(12 Marks)**

OR

2 a. Define: (i) Discrete system (ii) Continuous system (iii) Stochastic system (iv) Deterministic system (v) Entity **(10 Marks)**

b. Consider the grocery store with one checkout counter. Prepare the simulation table for eight customers and find out average waiting time of customer in queue, idle time of server and average service time. The Inter Arrival Time (IAT) and Service Time (ST) are given in minutes.
IAT : 3, 2, 6, 4, 4, 5, 8
ST (min) : 3, 5, 5, 8, 4, 6, 2, 3
Assume first customer arrives at time t = 0. **(10 Marks)**

Module-2

3 a. Explain any two discrete distributions and give equations for probability mass function. Also calculate mean and variables of same. **(10 Marks)**

b. Hurricane hitting east cost of India follows Poisson with a mean of 0.8 per year. Determine:
(i) The probability of more than two hurricanes in one year.
(ii) The probability of exactly one hurricane in one year.
(iii) The probability of hurricane not hitting in a year. **(10 Marks)**

OR

4 a. Explain any two long run measures of performance of queuing systems. **(08 Marks)**

b. Explain Kendall's notation for parallel server queuing system A/B/C/N/K and also interpret meaning of M/M/2/∞/∞. **(07 Marks)**

c. List different queuing notations. **(05 Marks)**

Module-3

5 a. What are the properties of random numbers? **(04 Marks)**

b. Use linear congruential method to generate a sequence of 5 random numbers with $X_0 = 27$, $C = 43$, $a = 17$, $m = 100$. **(07 Marks)**

c. Based on runs up and runs down, determine whether the following sequence of 40 numbers is such that the hypothesis of independence can be rejected where $a = 0.05$, $z_{0.025} = 1.96$.

0.41	0.68	0.89	0.94	0.74	0.91	0.55	0.62	0.36	0.27
0.19	0.72	0.75	0.08	0.54	0.02	0.01	0.36	0.16	0.28
0.18	0.01	0.95	0.69	0.18	0.47	0.23	0.32	0.82	0.53
0.31	0.42	0.73	0.04	0.83	0.45	0.13	0.57	0.63	0.29

(09 Marks)

OR

6 a. Explain the two different techniques used for generating random numbers with examples. **(07 Marks)**

b. Using suitable frequency test find out whether the random numbers generated are uniformly distributed on the interval [0, 1] can be rejected. Assume $\alpha = 0.05$ and $D_\alpha = 0.565$. The random numbers are 0.54, 0.73, 0.98, 0.11, 0.68. **(07 Marks)**

c. Develop a random variate generator for X with pdf given below:

$F(X) = X \quad 0 < X < 1$

$= 2 - X \quad 1 < X < 2$

$= 0 \quad$ otherwise **(06 Marks)**

Module-4

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

b. Explain with an example, importance of data distribution using histogram. **(08 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/month	0	1	2	3	4	5	6
Frequency of occurrences	35	40	13	6	4	1	1

(i) Apply Chi-square test to these data to test the hypothesis that the underlying distribution and Poisson. Use $\alpha = 0.05$.

(ii) Apply Chi-square test for Poisson distribution, with mean = 1.0 and $\alpha = 0.05$. **(08 Marks)**

OR

8 a. Differentiate between terminating and steady state simulation with respect to output analysis with an example. **(06 Marks)**

b. Explain output analysis for terminating simulation. **(07 Marks)**

c. Explain the confidence interval simulation method. **(07 Marks)**

Module-5

9 a. What do you mean by a verification and validation of simulation models? **(05 Marks)**

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

c. Write short notes on: (i) Optimization via simulation (ii) CPU simulation **(05 Marks)**

OR

10 a. Describe with a neat diagram, iterative process of calibrating a model. Which are the three steps that aid in the validation process? **(12 Marks)**

b. Explain any two output analysis for steady state simulation. **(08 Marks)**

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