CBCS SCHEME

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18CS645

Sixth Semester B.E. Degree Examination, June/July 2024
System Modelling and Simulation

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. What is Simulation? State the situations when simulation is considered as an appropriate tool. **(10 Marks)**

b. Dr. Ramesh is a dentist who schedules all patients for 30 minutes appointments. Some of the patients take more or less than 30 minutes depending on the type of dental work to be done. The following table shows the various categories of work, their probabilities, time actually needed to complete the work and the fees charged for each.

Category	Filling	Crowning	Cleaning	Extraction	Checkup
Time taken (in min)	45	60	15	45	15
Probability of category	0.35	0.15	0.10	0.25	0.15
Fees charged	Rs.200	Rs.200	Rs.60	Rs.100	Rs.50

Simulate the dentist's clinic for 10 patients and determine the average waiting time for patients, total idle time for the doctor and the total fees collected. Assume that patients arrive at the clinic at exactly their scheduled time starting at 8.00am. Use the following random numbers to handle this problem 55, 18, 91, 01, 25, 86, 71, 39, 93, 48. **(10 Marks)**

OR

2 a. State the advantages and disadvantages of simulation. **(10 Marks)**

b. Simulate a single server queuing system using event scheduling for 15 minutes and find i) Server utilization ii) Number of customers who spend more than 3 minutes in the system. The interarrival times and service times are as given below:

Interarrival Time	5	1	1	1	5	3	5	3	3
Service Time	4	1	3	3	2	1	3	1	4

(10 Marks)

Module-2

3 a. Explain any two discrete and two continuous probability distributions with diagrams. **(10 Marks)**

b. Explain the characteristics of a queuing system. **(10 Marks)**

OR

4 a. A production process manufactures computer chips on the average at 2% non conforming. Every day, a random sample of size 50 is taken from the process. If the sample contains more than two non conforming chips, the process with be stopped. Compute the probability that the process is stopped by the sampling scheme. **(10 Marks)**

b. Illustrate with an example the queuing notation of Kendall. **(05 Marks)**

c. Given the number of customers in the system at time, t, how do you compute the long-run time-average number of customers in system and in queue? **(05 Marks)**

Module-3

5 a. State the important considerations while developing random number generators. **(05 Marks)**

b. Use the mixed congruential method to generate a sequence of five, two digit random integers between 0 and 24 and corresponding random numbers with $x_0 = 13$, a = 19 and c = 35. **(05 Marks)**

c. Elaborate the need for generating random variates. Given probability mass function (pmf) of random variates and a set of uniform random numbers over the range (0, 1), describe the process of generating random variables. **(10 Marks)**

OR

6 a. Develop a random variate generator for a random variable X with the pdf.

$$f(x) = \begin{cases} e^{2x} & \text{for } -\infty < x << 0 \\ e^{-2x} & \text{for } 0 < x < \infty \end{cases}$$ **(10 Marks)**

b. Explain acceptance-rejection technique using Poisson distribution. **(10 Marks)**

Module-4

7 a. List the properties of any eight probability distributions. **(08 Marks)**

b. The number of vehicles arriving at an intersection in a 5-minute period between 8:00am and 8:05am was monitored for five workdays over a 20-week period and the results are shown in the table. After analysis, it appeared to follow a poisson distribution. Using Chi-square test, should we accept or reject the hypothesis that it is Poisson-distributed at a level of significance $\alpha = 0.05$.

Arrivals/period	0	1	2	3	4	5	6	7
Frequency	16	19	21	17	10	8	6	3

(12 Marks)

OR

8 a. What are the suggested estimators for Poisson, exponential, Gamma, Normal and Lognormal distributions? **(05 Marks)**

b. What are the steps in the development of a useful model of input data? What is the importance of histograms in this process? **(05 Marks)**

c. Highlight the features of the types of simulations with respect to output analysis with examples for each. **(10 Marks)**

Module-5

9 a. Explain model building, verification and validation with respect to simulation models. **(10 Marks)**

b. Which are the measures of performance of a simulated system? How do you estimate them? **(10 Marks)**

OR

10 a. Explain any two output analysis methods for steady state simulations. **(10 Marks)**

b. Explain the Naylor and Finger 3-step approach to aid in the validation process. **(10 Marks)**

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