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**Question Paper Code : 95409**

5 Year M.Sc. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Seventh Semester

Software Engineering

XCS 472/10677 SW 702 — MODELLING AND SIMULATION

(Common to 5 Year M.Sc. Computer Technology and M.Sc. Information Technology)

(Regulations 2003/2010)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List any two advantages and any two disadvantages of simulation.
2. Identify entities, attributes, activities, state variables in the simulation of
  - (a) a cafeteria
  - (b) a taxicab company.
3. A discrete probability distribution for the random experiment is given by :

$x_i :$	1	2	3	4	5	6
$P(x_i) :$	1/21	2/21	3/21	4/21	5/21	6/21

Find  $E(X^2)$  and  $\sigma_x$ .

4. Is the geometric distribution memoryless? Justify.
5. Write down the secondary properties of random numbers.
6. Write the uniform random variate on interval (0, 1).
7. Mention any three important factors in the selection of simulation software.
8. Write any three significant features of a simulation language.
9. Write about time series input model.
10. Define a queue in a queuing system.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Draw a flow chart describing the steps of simulation study. (8)
- (ii) Construct a table of inter arrival times, service times for 10 customers for a single server queue. Calculate average of non zero wait times, average idle time of server, average queue length. Assume times so that all of the above statistics are non zero. (8)

Or

- (b) (i) Describe the components of a simulation system using 3 different examples. (8)
- (ii) Simulate a single item inventory system for 10 days. Assume the following parameters.

The demands are 12, 23, 17, 34, 28, 31, 27, 18, 11, 25. Reorder size = 50. Reorder point = 25. Lead time = 2 days. Only one outstanding order is allowed. Initial inventory = 40. Calculate the average shortage. (8)

12. (a) (i) A bus arrives every 20 minutes at a specified stop beginning at 6.40 am, and continuing until 8.40 am. A certain passenger does not know the schedule, but arrives randomly between 7.00 am and 7.30 am every morning. What is the probability that the passenger waits more than 5 minutes for a bus? (8)
- (ii) The time to pass through a queue to begin self-service at a cafeteria has been found to be  $N(15, 9)$ . Find the probability that an arriving customer waits between 14 and 17 minutes. (8)

Or

- (b) (i) For the random variables  $X_1$  and  $X_2$  which are exponentially distributed with parameter  $\lambda = 1$ , compute  $P(X_1 + X_2 > 2)$ . (8)
- (ii) Suppose that an average of 30 customers per hour arrive at a shop in accordance with a Poisson process. What is the probability that more than 5 minutes will elapse before both of the next two customers walk through the door? (8)

13. (a) (i) A sequence of 1000 three digits number has been generated and an analysis indicates that 550 have three different digits, 289 contain exactly one pair of like digits and 161 contain three like digits. Based on the Poker test, are these numbers independent with  $\alpha = 0.10$ ? (8)

- (ii) Test the independence of the following numbers using runs up and runs down test. (8)

.08	.09	.23	.29	.42	.55	.58	.72	.89	.91
.11	.16	.18	.31	.41	.53	.71	.73	.74	.84
.02	.09	.30	.32	.45	.47	.69	.74	.91	.95
.12	.13	.29	.36	.38	.54	.68	.86	.88	.91

Or

- (b) (i) Develop a random variate generator for a uniform distribution with pdf of  $X$  is given by  $f(x) = \begin{cases} \frac{1}{b-a} & a \leq x \leq b \\ 0 & \text{otherwise.} \end{cases}$  (8)
- (ii) Develop a generator for a triangular distribution with range (1, 10) a mean of 4. (8)
14. (a) (i) Using a simulation language or otherwise make a flow chart for the following problem. People arrive at a cafeteria with an inter arrival time of  $10 \pm 5$  seconds. There are 2 serving areas, one for hot food and the other for sandwiches. The hot food area is selected by 80% of customers and it has 6 servers. The sandwich area has only one server. Hot food takes one minute to serve and sandwiches take  $1/2$  minute. When they have been served, the customers move into the cafeteria, which has a seating capacity for 200 people. The time to eat hot meal is  $30 \pm 10$  minutes and sandwich it is  $15 \pm 5$  minutes. Measure the queues for service and the distribution of time to finish eating, from the time of arrival. Simulate for 1000 departures. (8)
- (ii) Write any four salient features of a simulation language you are familiar with. (8)

Or

- (b) (i) Using a simulation language make a flow chart for the following simulation. Ships arrive at a harbor at the rate of one every  $1 \pm \frac{1}{2}$  hour. There are 6 berths in the harbor. They also need the services of a crane for unloading and there are 5 cranes. After unloading 10% of the ships stay to refuel before leaving. Other ships leave immediately. Ships do not require cranes for refueling. Simulate the queue of ships for berths and cranes. Assume it takes  $7\frac{1}{2} \pm 3$  hours to unload and  $1 \pm \frac{1}{2}$  hours to refuel. Simulate for 100 ships to clear the harbor. (8)

- (ii) Jiffy car wash is a five-stage operation that takes  $2 \pm 1$  minutes for each stage. There is room for 6 cars to wait to begin the car wash. Car wash facility holds 5 cars which moves through the system in order, one car can move ahead only if the car ahead moves. Cars arrive every  $2.5 \pm 2$  minutes for a wash. If the car cannot get into the system, it drives across to another wash facility. Estimate the balking rate per hour. Simulate for 12 hours. (8)

15. (a) Records pertaining to the monthly number of repairs of a computer system were being studied. The values for the past 100 months were as follows :

Repairs per month	Frequency of occurrence
0	35
1	40
2	13
3	6
4	4
5	1
6	1

Apply the Chi-square test to these data to test the hypothesis that the underlying distribution is Poisson with  $\alpha = 0.1$ .

Or

- (b) (i) Explain about verification and validation of simulation model. (8)

- (ii) The following data are randomly generated from a gamma distribution :

88.3   40.7   36.3   27.3   36.8   91.7   67.3   7.0   45.2   23.3  
 98.8   90.1   17.2   23.7   97.4   32.4   87.8   69.8   62.6   99.7

Determine the estimators  $\hat{\beta}$ ,  $\hat{\theta}$ . (8)