

Full Marks: 70  
Time: 3 hours

Question No. 1 is compulsory. Answer any five from the rest.  
The figures in the right hand margin indicate marks.

[2×10]

Q1. Answer all questions.

- Differentiate between deterministic and stochastic activities with suitable examples.
- List two advantages of digital simulation over analog simulation.
- What are pseudo-random number generators? Write the recursive formula for a linear congruential generator.
- Generate two random numbers using multiplicative congruential method with  $X_0 = 63$ ,  $a = 19$  and  $m = 100$ .
- Develop a random-variate generator for 'X' with pdf  $f(x) = 3x^2 / 2$  on the interval  $-1 \leq x \leq 1$ .
- List the common queuing disciplines in a queuing system.
- What is blocking method?
- List two considerations for a good random number sequence.
- What are SNAs? Give some examples.
- What is the difference in the functions of GATE and TEST blocks in GPSS?

Q2. a) Draw a block diagram and write a CSMP III program to calculate the value of displacement 'x' for the wheel suspension system of an automobile whose equation is given by:

$$M\ddot{x} + D\dot{x} + Kx = KF(t)$$

[5]

- Three points are chosen at random on the circumference of a circle. Estimate the probability that they all lie on the same semicircle by Monte Carlo sampling method. Perform 5 replications.

[5]

Q3. a) Define a stochastic variable. Explain the numerical computation technique for discrete models with a suitable example.

[5]

- Explain the rejection method of generating random numbers with a suitable example.

[5]

Q4. a) Give GPSS block diagram and write a GPSS program to explain the simulation of a manufacturing shop. Illustrate the difference in the use of facilities and storages.

[6]

- Perform runs test on the following sequence of numbers with  $\alpha = 0.05$  and given the critical value is 1.96.

[4]

0.99 0.15 0.33 0.35 0.91 0.41 0.60 0.27 0.75 0.88

Q5. a) Discuss the standard tests for random numbers.

Does the following sequence pass the Kolmogorov-Smirnov test with  $\alpha = 0.05$  and critical value 0.565?

[5]

0.68 0.49 0.05 0.43 0.95

- Explain the simulation of a two-server queue with a suitable example.

[5]

P.T.O.

Q6. a) Give GPSS block diagram and write a GPSS program for the following:

Customers arrive at a single-server counter with an average inter-arrival time of  $20 \pm 10$  seconds. They purchase from 1 to 4 items with the following probabilities :

Item 1 : 0.5, Item 2 : 0.2, Item 3 : 0.2, Item 4 : 0.1

It takes 5 seconds to purchase each item. Tabulate the distribution of time for serving the first 100 customers. [5]

b) Explain the simulation of a scheduling system with a suitable example. [5]

Q7. a) Explain and derive the formula for the run length of a static and dynamic stochastic simulation. [5]

b) List different methods for elimination of transients. Explain the blocking method. [5]

Q8. Write short notes on ( any two ) :

- Mid-square method.
- Verification vs validation of simulation models.
- Variance reduction techniques.

[5×2]