Full Marks: 70
Time: 3 hours
Question No. 1 is compulsory. Answer any five from the rest.

Q1. Answer all questions [2 X 10]

(a) With examples show how discrete-time model of a system differs from its continuous-time model.
(b) In problem solving, discuss the circumstances under which Analytical methods are preferred over Simulation, and vice versa.
(c) What is Monte Carlo simulation? Give an example.
(d) What is a " system"? In this context explain the concept of its " Environment".
(e) Differentiate between 'Balking'& 'Reneging'.
(f) Explain the statement:
$a \equiv b \pmod N$
(g) Discuss the concept of Probability Density functions of continuous and discrete random variables, with examples of few standard distributions.
(h) What is the probability of getting 12 heads in tossing an unbiased coin 20 times?
(i) Give expressions for Estimators of Mean and Standard Deviation of a random variable.
(j) Classify Simulation models, giving examples of each instance.

Q2. (a) What are the major applications areas of Simulation technique? Give examples of instances where Simulation is the only possible solution. [5]
(b) What is a " Model"? Why models are required for real systems?. Discuss the typical characteristics of a Simulation model. [5]

Q3. (a) Discuss steps to be followed in conducting a Simulation experiment. [6]
(b) What is the difference between 'validation' and 'verification' of a model? Can you obtain a unique model for a real system? If not, why? [4]

Q4. (a) Explain the significance of random numbers in a simulation study. What is a Random number Generator and what properties the sequence of random numbers it generates must satisfy to be acceptable in a simulation study?

Discuss a Linear Congruential Generator and show that it could generate sequences of uniformly distributed "pseudo" random numbers with arbitrary "period", provided its parameters are "properly" chosen. [6]

(b) Generate a sequence of 5 random numbers between (0,1) using LCG with parameters:
A=13, M=64, X(0)=3, C=0. [4]

Q5. (a) Explain the meaning of uniformity of distribution with examples and the steps to test this characteristics of a random number set. [5]
(b) Discuss Acceptance-Rejection Techniques for generating random variates.
Using A-R Technique simulate a random variable that takes one of the values:
1, 2, 3, 4…,10 with respective probability: 0.11,0.12, 0.09, 0.08, 0.12, 0.10,0.09,0.09,0.10, 0.10 . [5]

P.T.O.

Q6. (a) What is Discrete Event Simulation? Explain how the evolution of the dynamic model over time is tracked in DES. Discuss the mechanism by using a single server service facility as the model. [6]

(b) Give a GPSS block diagram for the single server queue simulation. [4]

Q7. (a) Enumerate few special purpose simulation packages. Compare use of general purpose Programming languages with dedicated simulation languages in conducting simulation experiments. [4]

(b) What are the desirable properties of random numbers that are needed to be tested? Briefly discuss the standard tests.

Five numbers: 0.44, 0.81, 0.14, 0.05, 0.93 were generated. Test these numbers for uniformity. Given: level of significance α=0.05, and corresponding Kolmogorov-Smirnov critical value for Degree of freedom N=5 is 0.565. [6]

Q8. (a) Simulation studies aim at generating "large" number of output data streams by performing "large" number of independent simulation runs. What is the nature of these output data, and what kinds of analysis are conducted on them?

How to decide when to stop generating new data, i.e terminate the simulation? [4]

(b) Derive estimators for Mean and Standard Deviation of a random variable out of its collected independent sample values. Discuss how using Variance reduction techniques improved estimators could be obtained. Give an example. [6]