𝕿𝖗𝖎𝖇𝖍𝖚𝖛𝖆𝖓 𝖀𝖓𝖎𝖛𝖊𝖗𝖘𝖎𝖙𝖞
Institute of Science and Technology
2067
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Bachelor Level/ Third Year/ Fifth Semester/ Science   Full Marks: 60
Computer Science and Information Technology (CSc. 302)   Pass Marks: 24
(Simulation and Modeling)   Time: 3 hours

Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.

Group A

Long Answer Questions:

Attempt any two questions: (2x10=20)

1. What is model? What are the different types of models? Give example for each.

2. What do you mean by Queuing system? Explain the characteristics of Queuing system with example.

3. Explain the independence test. A sequence of 1000 four digit numbers has been generated and an analysis indicates the following combinations and frequencies.

Combination (i)	Observed frequency (Oi)
Four different digits	560
One pair	394
Two pairs	32
Three digits of a kind	13
Four digits of a kind	1
	1000

Based on poker test, test whether these numbers are independent. Use $\alpha = 0.05$ and $N = 4$ is 9.49.

Group B

Short Answer Questions:

Attempt any eight: (8x5=40)

4. What are the advantages and disadvantages of simulation?

5. What do you mean by Pseudo random numbers?

6. Explain non-uniform random number generation.

7. Define a Markov chains and its application.

8. Use the linear congruential method to generate a sequence of three two-digit random integers.
    Let $X_0 = 29$, $a = 9$, $c = 49$ and $m = 100$.

9. Why do we use verification and validation in simulation?

10. Explain the data and control statement in CSMP.

11. Explain the iterative process of calibrating a model.
12. Write short note on:

    a. GPSS
    b. Server Utilization

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Group A

Long Answer Questions:

Attempt any two questions: (2x10=20)

1. Differentiate between dynamic physical models and static physical models with example.

2. Define the queuing system. Explain the elements of queuing system with example.

3. What is the main objective of gap test? Explain gap test algorithm with example.

Group B

Short Answer Questions:

Attempt any eight: (8x5=40)

4. Differentiate between discrete and continuous system.

5. What do you mean by Multi Server Queues?

6. What are the key features of Markov Chains?

7. Explain the congruence method of generating random numbers.

8. What do you mean by calibration and validation of models?

9. What are the Kendall notation of Queuing System?

10. What do you mean by Hybrid Simulation?

11. Use the mixed congruential method to generate a sequence of three two digit random numbers with $X_o = 37$, $a = 7$, $c = 29$ and $m = 100$.

12. Explain GPSS with example.

13. Write short note on:
    a. Replication of Runs
    b. Simulation tools

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Group A

Long Answer Questions:

Attempt any two questions: (2x10=20)

1. Define simulation. What are the various steps in simulation study? Explain.

2. Explain Markov Chains with example.

3. What are the properties of random number? The sequence of numbers 0.54, 0.73, 0.98, 0.11 and 0.68 has been generated. Use the Kolmogorov – Smirnov test $\alpha = 0.05$ to determine if the hypothesis that the numbers are uniformly distributed on the interval 0 to 1 can be rejected. (Note that the critical value of D for $\alpha = 0.05$ and N = 5 is 0.565).

Group B

Short Answer Questions:

Attempt any eight: (8x5=40)

4. When is simulation appropriate and when it is not?

5. What do you mean by server utilization?

6. What do you mean by non-uniform random number?

7. Why an auto-correlation test is needed in random number?

8. What do you mean by calibration and validation?

9. When is estimation method appropriate? Explain.

10. Explain Hybrid simulation with example.

11. Use the multiplicative congruential method to generate a sequence of four three-digit random numbers. Let $r_0 = 118$, a = 4 and m = 1000.

12. Explain the distributed lag model.

13. Write short note on:

    a. Queuing discipline
    b. CSMP

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Group A

Long Answer Questions:

Attempt any two questions: (2x10=20)

1. Why do we perform the analysis of simulation output? Explain how do you use simulation run statistics in the output analysis.   (4+6)

2. Describe the linear congruential method for random number generation. Use the Multiplicative congruential method to generate a sequence of four-three digit random integers, with seed=117, constant multiplier=43 and modulus=1000.   (4+6)

3. Consider that a machine tool in a manufacturing shop is turning out parts at the rate of one every 5 minutes. As they are finished, the parts go to an inspector, who takes 4±3 minutes to examine each one and rejects about 10% of the parts. Now, develop a block diagram and write the code for simulating the above problem using GPSS, and also explain the function of each block used in the block diagram in detail.   (3+3+4)

Group B

Short Answer Questions:

Attempt any eight: (8x5=40)

4. Differentiate between analytical models and numerical models.   (5)
5. Define congestion in a queuing system, and describe its major characteristics.   (1+4)
6. Describe the process of model building, verification, and validation in brief.   (5)
7. Explain, how do you update the clock time in system simulation.   (5)
8. What are the different phases that are employed in system simulation study? Explain in brief.   (5)

9. The sequence of numbers 0.54, 0.73, 0.97, 0.10, and 0.67 has been generated. Use the Kolmogorov – smirnov test $\alpha=0.05$ to determine if the hypothesis that the numbers are uniformly distributed on the interval [0, 1] can be rejected. (Note that critical value of D for $\alpha=0.05$ and $\mu=5$ is 0.565).   (5)

10. Describe different types of statements, used in CSMP, with suitable examples.   (5)
11. "To simulate is to experiment". Justify it.   (5)
12. Name the entities, attributes, activities, events, and state variables for the following systems :   (1+1+1+1+1)
    a. Cafeteria
    b. Inventory
    c. Banking
    d. A hospital emergency room
    e. Communication.
13. Write short note on: (2.5+2.5)
    a. System, boundary and system environment
    b. Real time simulation

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Group A

Long Answer Questions:

Attempt any two questions: (2x10=20)

1. Explain the steps in simulation study. What are the limitations of simulation?

2. Explain the Markov chains with examples and its applications.

3. What do you mean by uniformity test? Explain the poker test with example.

Group B

Short Answer Questions:

Attempt any eight: (8x5=40)

4. What are the types of simulation models?

5. What are the elements of queuing system?

6. What do you mean by pseudo random numbers?

7. Explain the process of testing for auto-correlation test.

8. Explain with example of calibration and validation of model.

9. Explain the replication of runs.

10. Use the multiplicative congruential method to generate of five digit random integers. $X_0=118$, $a=45$ and $m=1000$.

11. What do you mean by simulation tool?

12. Explain with example verification of simulation models

13. Write short note on:
    a. Discrete systems modeling
    b. Feedback systems

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Group A

Long Answer Questions:

Attempt any two questions: (2x10=20)

1. What do you understand by analog method of system simulation? Explain it with suitable example. [3+7]

2. Define physical model. Explain the dynamic physical model with the help of suitable diagrams and expressions.   [2+8]

3. Define frequency test for random numbers. Develop the Poker test for four digit numbers, and use it to test whether a sequence of following 1000-four digit numbers are independent. [2+4+4]
   (Use $\propto=0.05$ and N=4 is 9.49)

Combination i	Observed frequency O_i
Four different digits	565
One pair	392
Two pairs	17
Three like digits	24
Four like digits	2
	1000

Group B

Short Answer Questions:

Attempt any eight questions.   (8x5=40)

4. Verification is concerned with building the "model right" and validation is concerned with building the "right model". Justify it with suitable reasons.   [5]

5. How do you use estimation method in the analysis of simulation output? Explain in brief.   [5]

6. Explain any four program control statements that are used in GPSS.   [5]

7. Describe the rejection method of generating the random numbers.   [5]

8. Define queuing discipline. Describe different types of queuing disciplines with example.   [5]

9. How do you eliminate the effect of transient and initial bias in simulation output?   [5]

10. Differentiate between clock time and simulation time used in system simulation.   [5]

11. Describe the distributed lag model with the help of any practical example.   [5]

12. Identify, with reasons, four different problems from your own experience that you think should be solved using digital simulation rather than analytically.   [5]

13. Write short notes on: [2.5+2.5]
    a. Markov Chain
    b. Feedback systems

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Group A

Long Answer Questions:

Attempt any two questions: (2x10=20)

1. Define and describe Markov chain in detail with the help of suitable examples. Also describe at least three areas of application of Markov chain.

2. Define and develop a Poker test for four-digit random numbers. A sequence of 10,000 random numbers, each of four digits has been generated. The analysis of the numbers reveals that in 5120 numbers all four digits are different, 4230 contain exactly one pair of like digits, 560 contain two pairs, 75 have three digits of a kind and 15 contain all like digits. Use Poker test to determine whether these numbers are independent> (Critical value of chi-square test for $\propto=0.05$ and N=4 is 9.49).

3. Define congestion. Describe different types of components, characteristics and queueing disciplines of a queueing system.

Group B

Short Answer Questions:

Attempt any eight: (8x5=40)

4. Define model. Describe different types of simulation models in brief.

5. Describe the importance of differential/Partial differential equations in simulation.

6. What do you understand by interactive system? Explain.

7. Define activity, event and state variables. List out the activities and events for the following systems; A. Super market B. Inventory control C. Hospital.

8. Describe the process of calibration and validation in detail with example.

9. Draw and describe the different types of GPSS blocks that are used to gather statistics?

10. Differentiate between fixed time step and event to event model with the help of suitable examples.

11. Why do we need the analysis of simulation output? How do you use simulation run statistics in output analysis? Explain.

12. Write a computer program in C that will generate four digit random numbers using the multiplicative congruential method. Allow the user to input values of X_0, a, c and m.

13. Describe the basic nature of simulation in brief.