

# **University of Rajshahi**

**Department of Computer Science & Engineering**

**B.Sc. Engineering Part IV Odd Semester Examination 2020**

**Course Code: CSE 4131**

**Course Title: Computer Simulation and Modeling**

**Full Marks: 52.5**

**Time: 3 Hours**

[Answer any SIX (06) questions taking THREE (03) from each section]

## **Section A**

1. a) Define entities, attributes and activities of a system with real-world examples. 3  
b) How do simulations improve our lives? Compare among live, virtual and constructive simulation. 2.75  
c) Explain continuous and discrete-event simulation. 3
  
2. a) Explain the properties of random numbers. 2.75  
b) What is meant by pseudo random number? Why are they called pseudo? 2  
c) Explain the Linear Congruential Generators for generating pseudo random number. Given, seed( $X_0$ )=27, constant multiplier ( $a$ )=17, increment ( $c$ )=43 and modulus ( $m$ )=100. Generate at least 6 pseudo random number using this information. (Apply Linear Congruential Generators). 4
  
3. a) Discuss about LCM as a pseudo random number generator. 1.50  
b) Why should we perform different types of tests on pseudo random numbers? Name some of such tests. 1.25  
c) Does the following random sequence properly maintain uniformity and independence property of randomness? Utilize corresponding tests as needed to justify your answer. (Consider,  $0.207 \leq \chi^2 \leq 14.86$  for degree of freedom,  $v = 4$  and the level of significance,  $\alpha = 0.05$  and the corresponding,  $Z_{\alpha/2} = 1.96$ )  
(Here, the range of numbers is = [1,99] and the count of numbers = 40)  

64	48	86	13	9	31	33	71	25	45
98	2	87	31	88	79	78	48	51	51
65	37	49	95	15	36	13	61	42	33
55	18	49	91	8	24	43	53	9	27
  
4. a) Consider a project having 6 well defined, non-overlapping individual activities named A, B, C, D, E, and F. Draw a network model of the project with respect to following restriction: 2.25  
  - (i) The project starts with A and B
  - (ii) A must proceed C
  - (iii) B must proceed D and F
  - (iv) D must proceed E and I
  - (v) C and E must proceed G
  - (vi) F must proceed H
  - (vii) The project ends with G, H and I  
b) Find out the critical path (nodes) and the critical activities of the project described by following table using forward pass and backward pass technique: 6.50

Activity No. (k)	Starting Node, S(k)	Finishing Node, F(k)	Time, T(k)
A	1	2	7.5
B	1	3	8.0
C	2	5	4.5
D	3	4	3.0
E	4	5	5.0
F	3	6	2.0
G	5	7	5.5

## Section B

5. a) Explain the underlying concepts of boundary-representation and space-partitioning as 3D object representation systems. 4.50  
 b) Note down the differences between 2-D models and 3-D models with examples. 2.25  
 c) What are the advantages of CAD? 2
6. a) What is a voxel? How is it related to space-partitioning 3D object representation system? 1.75  
 b) What is Blender? What kind of 3D object representation system does it use? 1.75  
 c) What are the advantages of wireframe modeling? 2.25  
 d) Discuss about constructive solid-geometry method of modeling with an example. 3
7. a) Explain the principles used in modeling with appropriate diagrams.  
 b) Describe the business-infrastructure of a manufacturing industry following the concepts of the corporate model. 3.75 5
8. a) Explain the parametric continuity conditions applicable for piecewise construction of a curve. 2.75  
 b) What is the difference between spine and spline? 1.50  
 c) List the differences between Bezier curve and B-Spline curve. 4.50

University of Rajshahi  
Department of Computer Science and Engineering  
B.Sc. (Engg.) Part-4, Odd Semester, Examination-2018  
Course: CSE4131 (Computer Simulation and Modeling)  
Marks: 52.5 Time: 3:00 Hours

[N.B. Answer any Six questions taking Three from each section]

Section - A

1. a) Which types of simulation are implemented in the applications of "Augmented Reality" and "Virtual Reality"? Justify your answer with examples. 3
- b) What does a system represent? What are the components of it? Explain with examples. 3
- c) Why is it necessary to decide on the boundary between a system and its environment? 1.25
- d) Is it possible to simulate a system without modeling any entity from outside the boundary of the system? Justify your answer with an appropriate example. 1.5
  
2. a) Define pseudo random number. Why is it named 'pseudo'? 2
- b) What are the statistical properties of random numbers? 2
- c) Write an algorithm to generate random numbers using linear congruential method. Hence, simulate the algorithm for seed=5, multiplier=3, increment=3 and modulus=7. 3
- d) What kind of problems may occur when generating pseudo random numbers? 1.75
  
3. a) Discuss about LCM as a pseudo random number generator. What are its strengths and weaknesses? 3
- b) Why should we perform different types of tests on pseudo random numbers? Name some of such tests. 1.25
- c) Mention the differences between "Runs Up-Down" and "Runs Above-Below" tests for pseudo random numbers. Perform these 2 tests on the following sequence of pseudo random numbers and decide upon whether the sequence displays the property of independence of randomness. 4.5  
(Consider the level of significance,  $\alpha = 0.05$  and the corresponding,  $Z_{\alpha/2} = 1.96$ )  
(Here, the range of numbers is = [1,50] and the count of numbers = 30)  

22	21	41	31	13	15	45	26	29	5
4	20	48	25	34	14	44	41	2	47
1	33	40	7	18	37	24	32	35	10
  
4. a) How do activities and their precedence relationship get represented in a network model of a project? Explain with appropriate figures. 2.5
- b) Discuss about the concept of a dummy activity. Why is it needed? 1.5
- c) Can there be multiple critical paths in a single project? If so, can the CPM method find all the critical paths of a project via only one cycle of both forward and backward pass? Explain with example. 4.75

## Section – B

5. a) Suppose that in a simulation, the decision-making systems of human are being modeled against some specific situations. What type of model is being used here? Why? Justify your answer. 3
- b) Discuss about space-partitioning as a 3D object representation system with a real-world example. What are the weaknesses of this system? 3
- c) What do you know about the concepts of geometric tables? Explain with an appropriate example. 2.75
6. a) Discuss about the different parametric continuity conditions with appropriate examples. 3
- b) Which models can be classified as corporate models? Briefly discuss about the internal components of the management segment of any corporate model. 3.75
- c) According to the principle of modeling, a balance should be achieved via 1st block building and finally aggregation. Why and how? Justify your answer. 2
7. a) Define self-similar, statistically self-similar, self-affine fractals with examples. 3
- b) The similarity of a self-similar fractal is described by its dimension, show that  $D = \frac{\ln(n)}{\ln(1/s)}$ , where D is the fractal dimension, n is the number of sub parts and s is the scaling factors. 2.75
- c) Explain the random midpoint displacement method for constructing fractal objects. 3
8. a) Discuss about the additional parameters introduced by Kochanek-Bartels splines to provide for further flexibility in adjusting the shape of curve sections. 4.5
- b) Note the distinct features of a b-spline curve when compared to a Bezier curve. 3
- c) How does CSG method work for solid modeling? Explain with an appropriate example. 1.25

# University of Rajshahi

Department of Computer Science and Engineering

B. Sc. Engg. Part-4, Odd Semester, Examination 2017

Course: CSE 4131 (Computer Simulation and Modelling)

Marks: 52.5

Time: 3 Hours

(Answer any three questions from each part)

## Part-A

- |    |  |                |
|----|--|----------------|
| 1. | a) Compare live, virtual and constructive simulation with examples.<br>b) Discuss the situations when simulation is not an appropriate tool.<br>c) Note down the steps of simulation study with appropriate flowchart.   | 3<br>1.75<br>4 |
| 2. | a) What are the properties of random numbers? Mention some uses of random numbers.<br>b) Discuss the similarities and dissimilarities between random number and pseudo random number.<br>c) Which points should be considered while designing a pseudo random number generator?<br>Explain why?  | 2.75<br>3<br>3 |
| 3. | a) Explain discrete random variables and continuous random variables.<br>b) Write down the names of different approaches of runs test. Define "run" with respect to runs test of pseudo random numbers.<br>c) Show that the following sequence of numbers may pass the $\chi^2$ test (perform the $\chi^2$ test too, to prove so), but still unable to be called a good random sequence:<br><br>0.08 0.09 0.23 0.29 0.42 0.55 0.58 0.72 0.89 0.91<br>0.11 0.16 0.18 0.31 0.41 0.53 0.71 0.73 0.74 0.84<br>0.02 0.09 0.30 0.32 0.45 0.47 0.69 0.74 0.91 0.95<br>0.12 0.13 0.29 0.36 0.38 0.54 0.68 0.86 0.88 0.91 | 2<br>2.75<br>4 |
| 4. | a) Discuss Bernoulli distribution with example.<br>b) Define in-degree and out-degree of an activity diagram with necessary figures.<br>c) What do you mean by the slack time of an activity with respect to the network model of a project? Which activities don't get any slack time and why?  | 4.75<br>1<br>3 |

## Part-B

- |    |   |                |
|----|---|----------------|
| 5. | a) What is modeling? What are the differences between physical modeling and mathematical modeling?<br>b) Is there a unique model of every system? Discuss about the tasks of deriving a model.<br>c) Discuss in detail the principals used in modeling. | 3<br>2.75<br>3 |
| 6. | a) What is fractal object?<br>b) Discuss different types of fractal objects.<br>c) How the dimension of a fractal object may be defined? Explain.   | 2<br>3.75<br>3 |
| 7. | a) What is meant by spline curve and why are cubic splines used frequently in computer graphics?<br>b) What are the properties of Bezier curve?<br>c) Discuss the major segments of a Corporate Model with diagram.                                     | 2.75<br>3<br>3 |

8. a) Write short notes on any three of the followings:
- (i) Poker test for random numbers
  - (ii) Model types of graph, blueprint of a house, statue, chemical formula, flowchart
  - (iii) Spline specifications with some commonly used splines
  - (iv) Geometric tables with respect to B-reps

**University of Rajshahi**  
**Department of Computer Science and Engineering**

B. Sc. Engg. Part-4, Odd Semester, Examination 2016

Course: CSE-4131 (Computer Simulation and Modelling)

Marks: 52.5

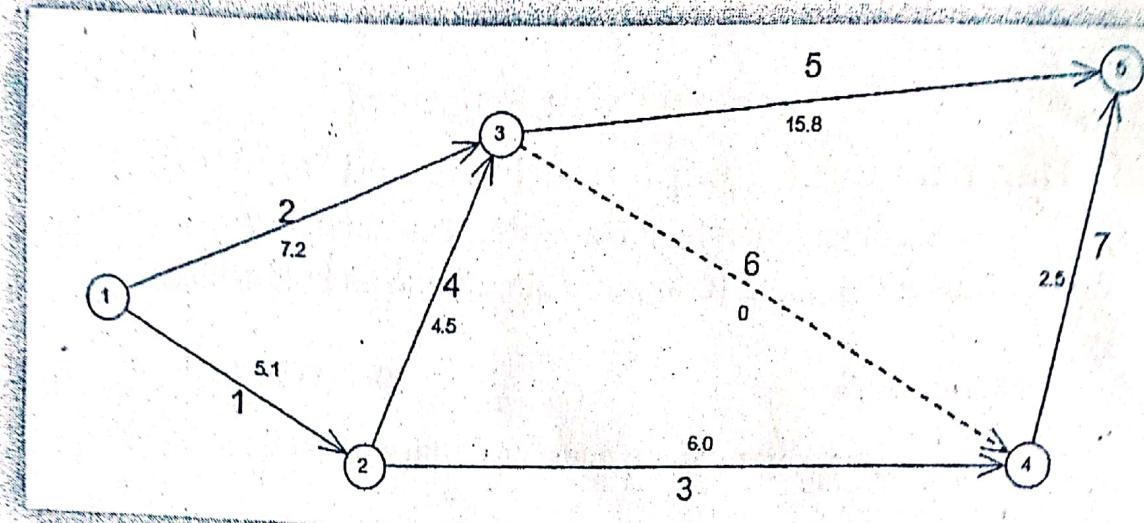
Duration: 3 hours

(Answer any three questions from each part)

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 University of Rajshahi.

**Part -A**

- |   |
|---|
| <ol style="list-style-type: none"> <li>1. a) Define System and Model. Note the different types of models. 2</li> <li>b) Discuss about the different components of a system. 2.75</li> <li>c) Give real-world examples of "Applications of Simulation and Modelling" in the areas of "Public Systems" and "Business Process Reengineering" with short descriptions. 4</li> </ol><br><ol style="list-style-type: none"> <li>2. a) What are the differences between discrete system simulation and continuous system simulation? Discuss some applications of continuous system simulation. 4</li> <li>b) What is meant by Pseudo Random Numbers? Why they are called Pseudo? 3</li> <li>c) Why do Random Numbers need to be tested? "There should be no favored number" - which test for Random Numbers ensures this property? 1.75</li> </ol><br><ol style="list-style-type: none"> <li>3. a) Are the random numbers from the following table acceptable as Pseudo Random Numbers that maintain uniformity and independence?<br/>                     Utilize all the following 3 tests to justify your answer:                     <ul style="list-style-type: none"> <li>(i) Chi-Square (Frequency) 2.75</li> <li>(ii) Runs Up-Down 3</li> <li>(iii) Runs Above-Below 3</li> </ul> </li> </ol> |
|---|
- Here, consider  $0.207 \leq \text{Chi-Square} \leq 14.86$  for degree-of-freedom,  $v = 4$  and level of significance,  $\alpha = 0.05$ ; thus,  $z_{\alpha/2} \rightarrow z_{0.025} = 1.96$
- |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|
| 0.23 | 0.16 | 0.44 | 0.39 | 0.15 | 0.08 | 0.39 | 0.67 | 0.50 | 0.47 |
| 0.32 | 0.46 | 0.62 | 0.95 | 0.52 | 0.83 | 0.89 | 0.44 | 0.38 | 0.10 |
| 0.85 | 0.24 | 0.03 | 0.03 | 0.88 | 0.24 | 0.56 | 0.62 | 0.05 | 0.17 |
| 0.45 | 0.17 | 0.53 | 0.39 | 0.67 | 0.36 | 0.26 | 0.48 | 0.41 | 0.36 |
4. a) Can you explain the network model of a project with a simple example? 2.75
  - b) For the following Activity Network, find the critical path of the project via combining Forward-Pass and Backward-Pass approaches. Also list the Slack-Times of the activities. 6



### Part -B

5. a) Compare between physical and mathematical model in brief. 3  
 b) Explain the concept of a Corporate model. 3.5  
 c) What do you know about 'Blobby objects'? 2.25
6. a) What do you mean by 'Hermit Interpolation'? 1  
 b) To ensure a smooth transition from one section of a piecewise parametric curve to the next, what are the parametric continuity conditions? 2.75  
 c) Derive the expression for the Hermit blending functions to generate spline curve. 5
7. a) What is B-spline? Right down the properties of B-spline. 4  
 b) What is Bezier patch? 2  
 c) Describe the different between interpreting spline and Bezier spline. 2.75
8. a) Write short notes on: (any three) 8.75  
 (i) Wireframe Model  
 (ii) 3D Object Representation  
 (iii) Fractal Object  
 (iv) Types of System Study

(Answer any three questions from each Part)

**Part-A**

- |    |  |      |
|----|--|------|
| 1. | a) Explain the terms (i) mean (ii) mode (iii) median (iv) probability density function and (v) probability distribution function.  | 3    |
| b) | What is random number generator? Write the properties of random numbers.   | 2.75 |
| c) | Explain the chi-square test for randomness.  | 2    |
| d) | Why pseudorandom numbers are suitable for simulation on computer?  | 1    |
| 2. | a) What do you understand by "Dummy Activity" in a network?<br>b) Explain with example, "The analysis of an activity network".<br>c) Explain the role of "cash flow" for resource allocation and cost consideration.   | 5.75 |
| 3. | a) Explain "Binomial distribution" as a statistical model for simulation.<br>b) A production process manufactures computer chips on the average at 2% non-conforming. Everyday a random sample of size 50 is taken from the process. If the sample contains more than two non-conforming chips, the process will be stopped. Determine the probability that the process is stopped by the sampling scheme. | 3.75 |
| 4. | a) Explain with a neat diagram the "Iteration process of calibrating a model".<br>b) Discuss validation of model assumptions for both "Structural assumptions" and "Data assumptions".   | 4.75 |

**Part-B**

- |    |   |                |
|----|---|----------------|
| 5. | a) Define Interpolation and Approximation splines.<br>b) Explain Cardinal spline interpolation method.<br>c) What are the properties of Bezier curve?   | 2<br>5<br>1.75 |
| 6. | a) What is fractal object? Explain how the dimension of a fractal may be defined?<br>b) Describe different types of fractal objects.<br>c) Describe the geometric construction of deterministic self-similar fractals.                            | 3<br>2.75<br>3 |
| 7. | a) Explain "Sweep Representation".<br>b) Define "cuberille".<br>c) Explain "Octrees" as a hierarchical variant of spatial-occupancy enumeration.  | 2.75<br>1<br>5 |
| 8. | Write short notes on: (any three).<br>(i). Key-frame systems for Computer Animation.<br>(ii). Random Midpoint-Displacement Methods for fractal construction.<br>(iii). Critical path computation of a PERT network.<br>(iv). Conceptual Modeling. | 8.75           |

University of Rajshahi  
Department of Computer Science and Engineering  
B.Sc. Engineering, Part-IV Examination 2014  
Course: CSE-4131 (Computer Simulation and Modeling)  
Marks: 52.5                  Time: 3 hrs

**Answer any Six(06) questions taking at least Three(03) from each part.**

**PART-A**

1. a) Define simulation. 1
- b) What do you mean by Entity, Attribute, Activity, State and Event as the components of a system? 2.75
- c) Explain a "Chemical Reactor Plant" as an example of a continuous system simulation. 5
  
2. a) What is pseudo-random number? What are the properties of random numbers? 3
- b) Test the following random numbers whether they are uniformly distributed or not using Kolmogorov-Smirnov test with 10% level of significance: 5.75  
0.078, 0.139, 0.356, 0.177, 0.268, 0.011, 0.108, 0.891, 0.62
  
3. a) Explain "Poisson distribution" as a statistical model in simulation. 3.75
- b) A computer terminal repair person is 'beeped' each time there is a call for service. 2  
The number of beeps per hour is known to occur in accordance with a Poisson distribution with a mean of  $\alpha=2$  per hour. What is the probability of 3 beeps in the next hour?
- c) Explain the steps Model building, Verification and Validation of simulation models. 3
  
4. a) Explain 'Morphing' as an animation technique for transformation of object shapes from one form to another. 5
- b) Write a short note on 'Goal Directed System' to explain the goals of the animation. 3.75

**PART-B**

5. a) What do you understand by 'Blobby objects'? 1
- b) To ensure a smooth transition from one section of a piecewise parametric curve to the next, what are the parametric continuity conditions? 2.75
- c) Explain "Hermite-Interpolation" method. 5
  
6. a) What do you understand by 'Fractal Geometry' methods? 2
- b) Define 'Self-similar' and 'Self-affine' fractals. 2.75
- c) Illustrate the Geometric Construction of Deterministic Self-Similar fractals. 4
  
7. a) What do you understand by 'Spatial Occupancy Enumeration'? 3
- b) Explain and illustrate the Polyhedra and Euler's formula. 5.75
  
8. Write short notes on: (any three) 8.75  
i) Relational database modeling, ii) Octree  
iii) Bezier Curve, iv) Chi-square test.