National University of Computer and Emerging Sciences

Lahore Campus

Simulation and Modeling (CS 4056)

Final Review

Due Date: December 20, 2025 (Before Exam)

Course Instructor(s)

Dr. Mirza Mubasher Baig

Total Time (Hrs):

Total Weight: 5

Total Questions: 5

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Roll No Section Student Signature

Instructions: Answer All Questions

In Case of any missing values state your assumptions clearly

Review Questions: [Discrete Even System Simulation]

1) **[Queues]**
   Describe the primary components of a Queuing system
2) **[Random Number/Variable Generation]**
   a) A linear congruential generator (LCG) is defined as $X_{i+1} = (5.X_i + 3) \bmod 16$
      If ($X_0 = 7$), generate the next **two** random numbers and scale them to the range (0 1).
   b) Use an example to describe the **Inverse Transform Method** for generating a random variable having a specific distribution.
3) **[Input Modeling]**
   a) Define **input modeling** in the context of discrete event simulation.
   b) Give an example to describe the main steps of input modeling as given in chapter 9 of the book on Discrete Event System Simulation
   c) Use an example to describe a method to estimate parameters of a distribution.
   d) Describe a statistical test that can be used to check the goodness of fit of an input model.
   e) **Read the book and** briefly distinguish between **data-driven** and **assumption-driven** input modeling.
4)
   a) What is a **dynamical system**?
   b) Write a first-order ODE model for each of the following systems (no solution required)
      i) Population growth proportional to current population
      ii) Cooling of a hot object in a room of constant temperature
      iii) Motion of a particle with velocity proportional to displacement
      iv) Radioactive decay of a substance
   c) Explain the difference between an **IVP** and a **boundary value problem (BVP)**.
   d) Consider the IVP ***dy/dt = y + t, y(0) = 1***
      i) Identify whether this ODE is **linear** or **nonlinear**. Justify your answer.
      ii) Apply **Euler's method** with step size (h = 0.1) to compute y(0.1).
      iii) How the RK4 method improves accuracy over Euler's method without using higher derivatives?

5)

a) Describe your implementation details (description of your assignment code) of the Conway's Game of Life using Cellular Automata.
b) Describe some famous rules like Rule 110 that are used to generate interesting computation using CA
c) How can we simulate a CA using a Network model?
d) Is it possible to simulate a CA using agent based modeling? Describe.

6)

a) What is an **Agent-Based Model (ABM)**?
b) What is the purpose of the **separation rule** in Boids?
c) How does the **alignment rule** influence boid motion?
d) What role does **cohesion** play in flock formation?
e) How is ABM different from **Cellular Automata**?
f) How does a **network model** differ from an **agent-based model**?