



**KAIMOSI FRIENDS UNIVERSITY
THIRD YEAR SECOND SEMESTER UNIVERSITY
EXAMINATIONS**

2025/2026 ACADEMIC YEAR

**SPECIAL EXAMINATIONS
FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER
SCIENCE**

COURSE TITLE: SIMULATION AND MODELING

COURSE CODE: BIT 323E

DATE: 24/6/2026

TIME: 3-5PM

INSTRUCTIONS TO STUDENTS

1. **ANSWER QUESTION ONE AND ANY OTHER TWO FROM THE CHOICES GIVEN.**
2. **PHONES, SMART WATCHES, EAR PHONES OR ANY OTHER UNAUTHORIZED DIGITAL AND AI GADGETS AND APPLICATIONS ARE NOT ALLOWED IN THE EXAMINATION ROOM.**
3. **ANSWER ALL QUESTIONS IN THE EXAM ANSWER BOOKLET PROVIDED.**
4. **DO NOT WRITE ON THIS QUESTION PAPER.**
5. **ALL KAFU EXAMINATION RULES AND REGULATIONS APPLY.**
6. **DURATION OF EXAMINATION: TWO (2) HOURS**

KAFU observes ZERO tolerance to examination cheating.



QUESTION ONE (COMPULSORY) – 30 MARKS

Case Study: Improving Operations at Kaimosi Regional Hospital

Kaimosi Regional Hospital has been experiencing long patient waiting times in its outpatient department, inconsistent doctor utilization, and unpredictable congestion during peak hours.

The hospital administration intends to use simulation modeling to analyze the system and evaluate alternative configurations such as increasing staff, redesigning patient flow, and introducing appointment scheduling.

You have been contracted as a Simulation Analyst.

Required:

- a. Formulate the problem in simulation terms by identifying the system boundaries, key components, decision variables, performance measures, and assumptions necessary for model development. (6 marks)
- b. Develop an appropriate conceptual model of the outpatient department. Clearly justify whether the system should be treated as deterministic or stochastic, static or dynamic. (5 marks)
- c. The arrival of patients follows a random pattern. Analyze how probability distributions and random variables would be incorporated into the model to represent arrival and service processes. (4 marks)
- d. The hospital collected historical arrival data. Explain how input data analysis, parameter estimation, and goodness-of-fit testing would be used before implementing the simulation. (4 marks)
- e. Design a discrete-event simulation (DES) structure for this system, explaining state variables, events, and time-advance mechanisms. (5 marks)
- f. After running the simulation, waiting times and utilization rates are generated. Examine how statistical output analysis, confidence intervals, and comparison of alternative staffing scenarios would support managerial decision-making. (4 marks)
- g. Briefly evaluate one limitation of simulation modeling in healthcare systems and propose how model credibility can be strengthened. (2 marks)

QUESTION TWO – 20 MARKS

A logistics company seeks to simulate its warehouse distribution process.

- a. Analyze the warehouse as a system, identifying inputs, processes, outputs, boundaries, and environment. (6 marks)
- b. Critically examine the importance of abstraction and model simplification in large-scale systems. (6 marks)
- c. Compare deterministic and stochastic modeling approaches in the context of logistics operations. (4 marks)



- d. Discuss how conceptual modeling errors can compromise simulation results.
(4 marks)

QUESTION THREE – 20 MARKS

- a. Examine the role of pseudo-random number generators in computer-based simulation and evaluate the properties required for effective simulation experiments. (6 marks)
- b. Analyze statistical tests that can be applied to assess the quality of random number sequences. (4 marks)
- c. Compare the inverse transform method and acceptance–rejection method in random variate generation. (6 marks)
- d. Discuss how improper random variate generation may distort simulation outcomes. (4 marks)

QUESTION FOUR – 20 MARKS

A manufacturing plant wants to model temperature changes in a chemical reactor over time.

- a. Analyze how continuous simulation differs from discrete-event simulation in representing system dynamics. (6 marks)
- b. Examine the role of differential equations in modeling continuous systems. (4 marks)
- c. Evaluate the key stages in the simulation model development life cycle, emphasizing verification and validation. (6 marks)
- d. Discuss how poor documentation affects model credibility and decision acceptance. (4 marks)

QUESTION FIVE – 20 MARKS

A transport authority is evaluating alternative traffic control strategies using simulation.

- a. Analyze performance measures suitable for transportation systems and explain how they are derived from simulation outputs. (6 marks)
- b. Examine how confidence intervals and variance reduction techniques improve reliability of simulation conclusions. (6 marks)
- c. Evaluate how scenario analysis and sensitivity analysis support strategic planning. (4 marks)
- d. Discuss how Artificial Intelligence or Digital Twin technology enhances modern simulation practice. (4 marks)

