



UNIVERSITY EXAMINATIONS

SECOND SEMESTER 2023/2024 ACADEMIC YEAR

**FOURTH YEAR EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE (ICT) AND BACHELOR OF
COMPUTER SCIENCE**

COMP 429: SIMULATION AND MODEL BUILDING

STREAM: R

TIME: 2 HRS

DAY: TUESDAY[2.30 – 4.30 P.M]

DATE: 09/04/2024

THIS QUESTION PAPER CONSISTS OF THREE (3) PAGES

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INSTRUCTIONS: ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS**QUESTION ONE (30 MARKS)**

- a) What is a model and what is the purpose of a models [3 Marks]
- b) Define the following terms [6 Marks]
- i. Attribute
 - ii. Event
 - iii. Activity
- c) Differentiate static and stochastic models [3 Marks]
- d) Discuss steps to follow when simulating any real phenomenon [6 Marks]
- e) Explain how simulation and modelling can be used to assist in the war against COVID - 19 virus [4 Marks]
- f) Write a code to compute π using Monte Carlo methods [5 Marks]
- g) Differentiate validation and verification as used in simulation [3 Marks]

QUESTION TWO (20 MARKS)

- a) When is it appropriate to use simulation instead of experimental means [5 Marks]
- b) A ball is dropped from a height β meters and weighing γ grams simulate the event by
- i. Write a mathematical model to represent the problem. [4 Marks]
 - ii. State all assumptions made [4 Marks]
 - iii. Write a code to simulate the event. [7 Marks]

QUESTION THREE (20 MARKS)

- a) Discuss ways of testing randomness in random numbers [6 Marks]
- b) Define the term simulation [2 Marks]
- c) Find the sequence of pseudorandom numbers generated by the linear congruential method with modulus $m = 9$, multiplier $a = 7$, increment $c = 4$, and seed $x_0 = 3$ [6 Marks]
- d) Give three advantages and disadvantages of Monte Carlo simulation [6 Marks]



QUESTION FOUR (20 MARKS)

- a) Discuss terminologies used in a queuing system **[5 Marks]**
- b) List pros and cons of digital verses manual simulation **[4 Marks]**
- c) Consider the following information of a grocery system. Manually simulate the above system to determine the percent of time the teller is idle and the average time a customer spends at the bank. **[11 Marks]**

Customer	Time of Arrival (Minutes)	Service Time (Minutes)
1	3.2	3.8
2	10.9	3.5
3	13.2	4.2
4	14.8	3.1
5	17.7	2.4
6	19.8	4.3
7	21.5	2.7
8	26.3	2.1
9	32.1	2.5
10	36.6	3.4

QUESTION FIVE (20 MARKS)

- a) Discuss Compartmental vs agent based models **[4 Marks]**
- b) There is an outbreak of an infectious flu in JKUAT community. You are mandated to come up with a mathematical model to describe the flu.
 - i. Discuss the assumptions, parameters and equations you can use when modelling the disease **[5 Marks]**
 - ii. Implement the model and simulate for a year duration **[6 Marks]**
- c) Discuss methods of testing random number if they meet the required standards **[5 Marks]**

