MACHAKOS UNIVERSITY

University Examinations for 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN MATHEMATICS AND COMPUTER SCIENCE

BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

SIT 372/ SCO303/SMA496: SIMULATION AND MODELLING

DATE: **TIME:**

Instructions
This paper consists of FIVE questions
*Answer **question one** and other **two** questions.*

QUESTION ONE (COMPULSORY-30 MARKS)

a) Describe the Kendall notation for queues (4 marks)

b) You have been hired by Safaricom Ltd to advise on the operations of their call centre. You are informed that the performance measure of interest for this assignment is the percentage of calls successfully answered by an operator (or percentage of lost calls). Discuss **THREE** ways in which this performance measure can be improved. (6 marks)

c) Briefly explain TWO fixed increment time advance mechanism giving the circumstances under which it is valid. (6 marks)

d) Describe the Monte Carlo simulation, hence outline an area where it would be applicable (4 marks)

e) Explain the following types of models:

i) Simulation Models (2 marks)

ii) Heuristic Models (2 marks)

iii) Deterministic Models (2 marks)

f) Elucidate TWO reasons why it is not advisable to perform experiment with a real system. (4 marks)

QUESTION TWO (20 MARKS)

a) Explain what sensitivity analysis is and thus highlight what is the best way to perform sensitivity analysis on a model. (6 marks)

b) Describe THREE types of tests that can be utilized to test for uniformity and independence of random number
(8 marks)

c) Discuss THREE techniques for verification of simulation models. (6 marks)

QUESTION THREE (20 MARKS)

a) The University is contemplating setting up a desk at the main gate where drive-in clients would be attended to before they are directed to various offices. Management estimates that customers will arrive at the rate of 12 per hour. The receptionist whom the University is considering to man the desk can serve customers at the rate of one every three minutes. Determine:

(i) Average number of customers in system (3 marks)

(ii) Average number of customers waiting for service (3 marks)

(iii) Time spent in the system (3 marks)

(iv) Time spent waiting for service (3 marks)

(v) Idle time (2 marks)

b) Using simple diagrams, explain the difference between discrete and continuous systems as used in simulation and modelling (6 marks)

QUESTION FOUR (20 MARKS)

a) Almost all real systems contain one or more sources of randomness. In order to carry out a simulation using random inputs such as inter-arrival times, we have to specify their probability distributions. Discuss FOUR such distributions applicable in simulation.
(8 marks)

b) Discuss THREE main steps of performing statistical analysis for terminating simulations.
(6 marks)

c) Use a linear congruential random number generator with a=67, m=31, c=17 and seed X_0 = 117 to generate the first FIVE random variates on [0,1]. (6 marks)

QUESTION FIVE (20 MARKS)

a) Explain FOUR desirable properties of a good arithmetic random-number generator.

(8 marks)

b) Samson sells insurance on a part-time basis. His records on the number of policies sold per week over a 50 week period are given as shown in the table below.

No. of Policies sold per week	**Frequency**
0	8
1	15
2	17
3	7
4	3
Total	50

Required:

i. Develop a cumulative frequency probability and assign random number intervals corresponding to it; (3 marks)
ii. Perform two simulations for the 5-day period for Policies sold by Samson. (3 marks)
iii. Determine the average number of policies per day for each 5-day simulation period? (3 Marks)
iv. Compare simulated average to the expected number of policies based on the two simulation data. (3 marks)

NB: The random number are obtained from the table for 1st Simulation: 73, 41, 52, 63, 39 and 2nd simulation: 64, 20, 81, 94, 25.