PAN AFRICA CHRISTIAN UNIVERSITY

Where Leaders are Made

UNIVERSITY EXAMINATIONS: 2025/2026

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

BSIT405

SIMULATION AND MODELLING

DATE: 11.00AM-2.00PM,FRIDAY,APRIL, 2026 **TIME: 2 HOURS**

INSTRUCTIONS: Question One is Compulsory, Choose Three Other Questions

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SECTION A (COMPULSORY)

Question ONE (15 marks)

a) Discuss factors that need to be considered when selecting a simulation software (3 Marks)

b) Explain the benefits and limitations of using simulation to investigate business problems compared with the use of mathematical formulae (3 marks)

c) Differentiate between Deterministic and stochastic models (2 marks)

d) Propose statistical tests to verify the quality of pseudo-random numbers and explain its importance. (3 marks)

e) Discuss two real world problems in business where simulation is applied and their solution

methods (4marks)

SECTION B

(ANSWER ANY THREE (3) QUESTIONS IN THIS SECTION)

a) Discuss the features that make MATLAB a good simulation software (5 marks)

b) The production line turns out about 50 trucks per day. Fluctuations in production occur for many reasons. The production can be described by a probability distribution as follows:-

Production day	Probability
45	0.03
46	0.05
47	0.07
48	0.10
49	0.15
50	0.20
51	0.15
52	0.10
53	0.07
54	0.05
55	0.03

Finished trucks are transported by train at the end of the day. The train capacity is only 51 trucks. Required:

a) Using the following random numbers, simulate the production for the next 5 days. (10 marks) 5,34,78,56,45

Question Three (15 marks)

a) Discuss ethical and professional implications of presenting simulation results without validating randomness assumptions. (5 marks)

b) Explain the steps involved in a simulation study and describe the importance of each step. (5 marks)

c) Write pseudocode for simulating a simple population growth model using difference equations. (5 marks)

Question Four (15 marks)

a) Describe the elements of a basic queuing system using a real-life example. (5 marks)

b) Explain Kendall's notation and interpret the model M/M/1. (4 marks)

c) A single-server queue has arrival rate $\lambda = 4$ customers per hour and service rate $\mu = 6$ customers per hour.

i. Compute system utilization (ρ).

ii. Calculate the average number of customers in the system (L).
iii. Interpret the results. (6 marks)

Question Five (15 marks)

A manufacturing company is experiencing unpredictable production delays. Management proposes building a simulation model to identify bottlenecks.

a) Critically evaluate whether simulation is the most appropriate tool for this problem compared to analytical modeling or direct experimentation.
(5 marks)

b) Identify key system boundaries, assumptions, and variables that must be defined before developing the model. Justify your choices. (5 marks)

c) Discuss possible limitations and risks of using simulation for managerial decision-making in this case. (5 marks)

Question Six (15 marks)

A government agency uses a simulation model to predict traffic congestion in a major city.

a) Differentiate between verification, validation, and accreditation in this context. (5 marks)

b) Critically evaluate the risks of policy decisions based on an unvalidated model. (5 marks)

c) Propose a structured three-step validation framework suitable for public infrastructure projects. (5 marks)