

**PAN AFRICA CHRISTIAN UNIVERSITY
BACHELORS OF INFORMATION COMMUNICATION TECHNOLOGY
END OF TERM EXAMINATION**

DEPARTMENT: COMPUTING & INFORMATION TECHNOLOGY
COURSE CODE: BSIT405
COURSE TITLE: SIMULATION AND MODELING
CAMPUS: ROYSAMBU
EXAM DATE: **THURSDAY** xxxxx/AUGUST
TIME: START HOUR –5.30PM-8.30PM

INSTRUCTIONS

- This exam carry a total of SIX Questions of [10 Marks Each]
- Section One (I) is compulsory.
- Answer any 3(Three) Questions from Section Two (II)
- Read all questions carefully before attempting.

SECTION A

(Answer ALL questions in this section)

QUESTION ONE (10 Marks)

- a) Differentiate between Stochastic and deterministic simulation models. (2 marks)
- b) Discuss one characteristic of queuing system and give one practical application of queuing system. (2 marks)
- c) Explain the iterative process of calibrating a model with example. (2 marks)
- d) Discuss two properties of a good Arithmetic Number generator. (2 marks)
- e) With reference to a real system, describe the components of a system. (2 marks)

SECTION B

((Answer any THREE (3) questions in this section))

QUESTION TWO (10 Marks)

- a) Critically discuss the ethical considerations involved in using simulation models to support decisions in fields such as healthcare, defense, or autonomous vehicles. (4 marks)
- b) Perform a chi-square test to check for uniformity and auto correlation of the following numbers:- 07, 05, 96, 14, 14, 10, 90, 21, 15, 84, 28, 20, 78, 35, 25, 72, 42, 30, 66, 49, 55, 60, 56, 40, 54, 54, 63, 45, 98, 70, 50, 42, 77, 55, 36, 34, 60, 30, 91, 65, 24, 98, 70, 18, 75, 78, 84. (6 marks)

QUESTION THREE (10 marks)

a) Define the following terminologies.

- (i) Discrete system (2 marks)
- (ii) Continuous system (2 marks)
- (iii) Stochastic system (2 marks)

b) Consider the grocery store with one checkout counter. Prepare a simulation table for eight customers and find out average waiting time of customer in queue, idle time of server and average service time. The inter arrival time (IAT) and service time (ST) are given in minutes. Assume first customer arrives at time=0. (4 marks)

IAT	0	1	1	6	3	7	5	2	4	1
ST(min)	4	2	5	4	1	5	4	1	4	3

QUESTION FOUR (10 marks)

a) Describe three events in a single server model. (3 marks)

b) The time between arrivals at a drive through window of a fast food restaurant follows the distribution below. The service time distribution is also given in the table. Use the random numbers provided to simulate the activities of the first four arrivals. Assume that the window opens at 11:00 am and that the first arrival is after this based on the first inter-arrival time.

Time between Arrivals	Probability	Service Time	Probability
1	0.2	1	0.3
2	0.3	2	0.5
3	0.3	3	0.2
4	0.2		

Random numbers for arrivals: 14, 74, 27, 03

Random numbers for service times: 88, 32, 36, 24

What time does the fourth customer leave the system? (7 marks)

QUESTION FIVE (10 Marks)

a) A delivery company is having trouble with late and unpredictable deliveries in different cities. The company wants to use simulation to understand the problem and improve their operations. Two simulation approaches are being considered:

- **Option 1 – Discrete Event Simulation (DES):** This simulates each step of the delivery process, such as loading, driving, and unloading.
- **Option 2 – Agent-Based Simulation (ABS):** This simulates the behavior of individual delivery drivers as they make decisions in changing environments.

You have been asked to recommend which simulation approach the company should use.

- i) Explain how **DES** and **ABS** work in simple terms. (2 marks)
- ii) What **types of data** would the company need to make your chosen simulation work well? (2 marks)
- iii) Choose one method you think is better for this situation. Explain your choice with reasons. (3 marks)
- iv) Compare the **advantages and disadvantages** of both methods for this delivery problem. (3 marks)

QUESTION SIX (10 Marks)

- a) Analyze the merit and demerit of simulation technique. (2 marks)
- b) Discuss two circumstances under which simulation is the appropriate tool and two circumstances which simulation is not the appropriate tool. (8 marks)

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