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UNIVERSITY EXAMINATIONS 2023/2024

THIRD YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SECURITY AND FORENSIC, BACHELOR OF SCIENCE IN COMPUTER SCIENCE, BACHELOR OF SCIENCE IN DATA SCIENCE, BACHELOR OF SCIENCE INFORMATION TECHNOLOGY AND BACHELOR OF BUSINESS INFORMATION TECHNOLOGY
AND
FOURTH YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER TECHNOLOGY, BACHELOR OF METHEMATICS AND COMPUTER SCIENCE AND BACHELOR OF SCIENCE IN MATHEMATICS

SMS 3450/CIT 3358: SIMULATION AND MODELLING/COMPUTER SIMULATION AND MODELLING

DATE: APRIL 2024 **TIME: 2 HOURS**

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

a) Define the following
   i. Entity (2 Marks)
   ii. Attribute (2 Marks)
   iii. Activity (2 Marks)

b) State the types of simulation models in existence. (4 Marks)

c) Generate 10 one-digit random numbers. Hence simulate random observations for each of the following situations.
   i. Throwing an unbiased coin. (4 Marks)

ii. The colour of a traffic light found by a randomly arriving car, when green is 50% of the time yellow is 10% of the time and red is 40% of the time. (5 Marks)

d) Customer arrive at a watch repair shop according to a position process at a rate of one per every 10 min and the service time is an exponential random variable with mean 8 min

Find.

i. Mean number of customers in the system. (3 Marks)

ii. Mean time a customer spends in the system. (2 Marks)

iii. Average time a customer spends in the shop. (2 Marks)

iv. Suppose the arrival rate of customer, increase by 5% compute the above measures of performance. (4 Marks)

QUESTION TWO (20 MARKS)

a) i. Write algorithm to simulate discrete random variate. (4 Marks)

ii. Demonstrate in excel (2 Marks)

b) random variables x and y are distributed as follows.

$X \sim 10 \pm 6$ (uniform)

$y \sim 10 \pm 8$ (uniform)

generate pairs of random variables of the following.

i. $z = XY$ (4 Marks)

ii. $k = 5(X + Y)$ (3 Marks)

c) Explain how monte-carlo method is used to solve, the following integrals

i. $I = \int_0^1 x dx$ (4 Marks)

ii. $I = \int_0^5 {}^{x^4}\!/_2 \, dx$ (3 Marks)

QUESTION THREE (20 MARKS)

a) Generate a sequence of 5 random numbers between 0 and 40 given $a = 9, x0 = 12c = 53$ using.

i. Mixed congruential method (3 Marks)

ii. Multiplicative congruential method. (3 Marks)

b) Discuss the random numbers Generators commonly used in Computer Simulation. (8 Marks)

c) Highlight the properties of a good random number Generator. (6 Marks)

QUESTION FOUR (20 MARKS)

a) Discuss the methods used to generate random numbers. (6 Marks)

b) Briefly explain the methods used to test for random numbers. (9 Marks)

c) Explain how random numbers can be generated from the following

i. $f(x) = \frac{1}{b-a} \qquad 5 \leq x \leq 10$ (3 Marks)

ii. $F(x) = 1 - e^{-\lambda x}, x > 0, \lambda > 0$ (2 Marks)

QUESTION FIVE (20 MARKS)

a) Given the distribution of inter-arrival time in a single server model is

T:	1	2	3
$f(t)$:	$1/4$	$1/2$	$1/4$

The distribution of service time

S:	1	2	3
$f(s)$:	$1/4$	$1/2$	$1/4$

Generate pairs of random numbers to simulate the system for the next 3 arrivals. (8 Marks)

b) A flow line production system with inter stage inventory buffers has been simulated. The simulation model has been run for three different capacities C_1, C_2 and C_3 of inter stage buffers. The number of units produced per hour is the measure of performance of the production line. Ten replications have been executed for each level of inter stage buffer. The mean production rates and their standard deviation have been obtained as follows

Inter stage buffer Capacity	No of replications	Mean production	Std deviation
4 units	10	35.3	22.34
6 units	10	39.1	19.16
8 units	10	42.2	17.54

Data shows that as the inter stage buffer capacity increase, the production rate increase buffer capacity increase, the production rate increase. Does this data provide sufficient evidence to support this hypothesis. (10 Marks)