(Knowledge for Development)

KIBABII UNIVERSITY
(KIBU)

UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR
SPECIAL/SUPPLEMENTARY EXAMINATIONS
YEAR THREE SEMESTER TWO EXAMINATIONS

FOR THE DEGREE OF
BACHELORS OF SCIENCE
(COMPUTER SCIENCE)

COURSE CODE: CSC 366E.

COURSE TITLE: SIMULATION AND MODELING

DATE: 10/01/2022   **TIME:** 02.00 P.M. – 4.00 P.M.

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS

QUESTION ONE (COMPULSORY) [30 MARKS]

a. Define the following terms and concepts as used in simulation and modelling: [5 marks]

    i. System

    ii. Event

    iii. Simulation

    iv. Delay

    v. Modelling

b. What is the difference between:

    i. A discrete and a continuous system   **[2 marks]**

    ii. Analytical models and numerical models.   **[2 marks]**

c. Briefly explain the steps followed in the simulation process.   **[6 marks]**

d. Define congestion in a queuing system, and describe its major characteristics. **[4 marks]**

e. Describe five key components of a Discrete Event simulation   **[5 marks]**

f. Describe the process of model building, verification, and validation in brief.   **[6 marks]**

QUESTION TWO [20 MARKS]

a. Consider a simple queuing network where customers enter the system with Exponential inter-arrival times with expectation 1 minute. One server then serves the incoming people with a service time uniform between 0.3 and 0.5 minutes. After that service people leave the system with probability 80% whereas with probability 20% they have to join the queue again to wait for another service. The simulation should start with an empty system and last for 4 hours.

i. What are the entities and what are the resources and what are the events for this simple network?

                                                                  [6 marks]

ii. What are two variables you can use as state variable for that system?   **[2 marks]**

iii. Is the system transient or steady state? Explain   **[2 marks]**

b. The average response time for http requests at a web server is 2 minutes. The system busy time was measured to be 50 seconds during a one minute observation interval. Use an M/M/1 model for the system to determine the following.

i. What is the average service time per transaction   **[4 marks]**

ii. What is the probability there are more than one http request in the system.   **[2 marks]**

iii. On average, how many requests are in the system   **[2 marks]**

iv. What is the average time a request spends in the queue? [2 marks]

QUESTION THREE [20 MARKS]

a. What is meant by the "System State" in a simulation? What can change the system state in a single server queuing system? [4 marks]

b. Describe five key components of a Discrete Event simulation [8 marks]

c. The simulation model-building (or simulation life cycle) can be broken into four phases. Explain briefly the main tasks of each of these phases? [8 marks]

QUESTION FOUR [20 MARKS]

a. State and explain when Simulation and modelling is appropriate. [6 marks]

b. What is world view? Discuss different types of world view. [4 marks]

c. Discuss the verification process. [4 marks]

d. Distinguish between the following: [4 marks]

    i   Terminating and non-terminating simulation

    ii   Random number and random variate

e. State the desirable features of simulation software [2 marks]

QUESTION FIVE [20 MARKS]

a. Evaluate the integral. $I = \int_a^b g(x)\,dx$. Where $g(x)$ is a real valued function [2 marks]

b. What are major simulation software in manufacturing applications? Also discuss modeling system randomness. [5 marks]

c. Discuss in detail, why validating a model of a computer system might be easier that validating a military combat model. Assume that the computer system of interest is similar to an existing one. [5 marks]

d. Briefly describe each of the following and their respective application in real life:

    i.   Cobweb model [2 marks]

    ii. Manufacturing and material handling system [2 marks]

    iii. Supermarket model [2 marks]

    iv. Acceptance-rejection techniques [2 marks]