



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

SCO 303: SIMULATION AND MODELLING

DATE: 13/11/2020

TIME: 2:00 – 4:00 PM

INSTRUCTIONS

Answer question ONE and any other TWO questions.

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Define a model. (2 marks)
- b) Describe THREE types of tests that can be utilized to test for uniformity and independence of random number numbers. (6 marks)
- c) Briefly by use of simple diagrams and providing examples, distinguish between discrete and continuous systems in simulation and modelling. (4 marks)
- d) For an M/M/1 queue, the mean number of customers in the system (L) is equal to the utilization divided by one minus the utilization. Using basic laws and relationships, derive; (For full credit, your expressions need to be simplified). (6 marks)
 - i. the mean wait in the system (W),
 - ii. the mean number of customers in the queueing area (L_q),
 - iii. the mean wait in the queuing area (W_q) as a function of arrival rate and service rate.
- e) Distinguish between **clc** and **clear** commands used in MATLAB. (2 marks)
- f) Suppose that X is a discrete random variable with the probability mass function given by

$$p(i) = \frac{i}{15} \quad i = 1, 2, 3, 4, 5$$

- i. Plot $p(x)$. (2 marks)
- ii. Compute and plot $F(x)$. (2 marks)
- iii. Compute $P(1.9999 \leq X \leq 4.0001)$. (2 marks)
- iv. Compute $E(X)$. (2 marks)
- v. Compute $\text{Var}(X)$ 15i. (2 marks)

QUESTION TWO (20 MARKS)

- a) Distinguish between model Validation and Verification. (4 marks)
- b) Describe any THREE components of a system in simulation and modelling. (6 marks)
- c) Explain THREE main advantages and TWO disadvantages of Monte Carlo simulation. (5 marks)
- d) A matrix was generated using;
`>> M = ceil(10.4);`
Which of the following statement is **not** valid in MATLAB? (2 marks)
- i. `M + M *2`
 - ii. `sin(M)`
 - iii. `exp(M)`
 - iv. `M(1,:) ^ 2`
 - v. `error`
- e) Suppose x is a new variable, with the following MATLAB command,
`>> x = [-10:-1:-15; -2:3];` Determine the size of x. (3 marks)

QUESTION THREE (20 MARKS)

- a) Explain FOUR types of systems in simulation and modelling. (4 marks)
- b) Identify the steps that can be followed in performing Simulation Analysis. (5 marks)
- c) Discuss THREE types of models used in simulation and modelling. (6 marks)
- d) Let

$$A = \begin{bmatrix} 11 & -2 & 3 \\ 4 & 0 & 4 \\ 1 & 9 & 5 \end{bmatrix}; \quad B = \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}; \quad C = \begin{bmatrix} -5 & 12 & 4 \\ 3 & -6 & 2 \end{bmatrix}; \quad D = \begin{bmatrix} 5 & -2 & 0 \\ 8 & 7 & 6 \end{bmatrix};$$

$$E = [1 \ 3 \ 5 \ 7 \ 6 \ 8 \ 0 \ 9 \ 4 \ 2]$$

- i. Write a command for matrix Multiplication of CD. (1 mark)
- ii. Write a command to arrange the element of the vector E in ascending order. (1 mark)
- iii. Write a command to return the smallest element of vector E. (1 mark)
- iv. Delete 2nd column from matrix C. (1 mark)
- v. Use Left division to solve $X = A^{-1}B$. (1 mark)

QUESTION FOUR (20 MARKS)

- a) Explain TWO advantages of simulation models as compared to analytical models. (2 marks)
- b) Briefly describe Monte Carlo simulation technique. (3 marks)
- c) Discuss FIVE techniques for verification of simulation computer programs. (5 marks)
- d) Describe FIVE key features of Discrete Event Simulation. (5 marks)
- e) Identify the errors in the following MATLAB commands and correct them. (3 marks)
- i. `>>P =linespace(2,3)`
 - ii. `>>P[ 1, 2] = 4`
 - iii. `>>K= ones(1;3)`
- f) Ali went to the market. He bought 5kg of carrots (4Ksh/kg), 2kg of apples (7Ksh/kg), 6 lettuces (2 for 4Ksh) and 6 Pepsi (2Ksh each). Calculate the total amount in MATLAB form. (2 marks)

QUESTION FIVE (20 MARKS)

- a) Describe a random variable. (2 marks)
- b) Distinguish between Static model and Dynamic model. (4 marks)
- c) After performing experiments using simulation and modelling, list SIX major Pitfalls faced in simulation modelling. (6 marks)
- d) Write the MATLAB command for the following line. (5 marks)
- $$Y = |Xe^{aX} - \cos(bX)| \text{ for } a = 11, \quad b = \pi \text{ and } X = \{2,4,6,8\}$$
- e) Write the output of the following MATLAB Commands. (3 marks)
- i. `>> a = 3;b = 2; c = a + b`
 - ii. `>> d = 1:5; 2*d(3:4)`
 - iii. `>> who`