



MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR
BACHELOR OF SCIENCE (MATHEMATICS AND COMPUTER SCIENCE)

BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)

SCO 303 / SMA 496: SIMULATION AND MODELLING

DATE: 23/3/2021

TIME: 8:30 – 10:30 AM

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Define the following terms, in the context of modelling and simulation: (3 marks)
 - i. Verification
 - ii. Validation
 - iii. Credibility
- b) List five major Pitfalls in simulation modelling. (5 marks)
- c) Define the following terms: (5 marks)
 - i. Experiment
 - ii. Sample space
 - iii. Probability mass function of discrete random variable X
 - iv. Joint probability mass function of two discrete random variables X and Y
- d) Mention five application areas of simulation and modelling (5 marks)
- e) Using simple diagrams, explain the difference between discrete and continuous systems as used in simulation and modelling (6 marks)
- f) Consider an M/M/1 queuing system with an arrival rate $\lambda=0.4$ and service rate $\mu=0.5$.
 - i. Compute the system load and tell if the system is stable or not? (3 marks)
 - ii. Compute the average number of customers in the system? (3 marks)

QUESTION TWO (20 MARKS)

- a) As a student of Machakos University taking a simulation and modelling experiment, is it possible to verify and validate a simulation model and vice-versa? Investigate your answer with an example for each. (5 marks)
- b) 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 $F(x)$ (5 marks)
- iii. Compute $P(1.9999 \leq X \leq 4.0001)$ (3 marks)
- iv. Compute $E(X)$ (2 marks)
- v. Compute $\text{Var}(X)$ (3 marks)

QUESTION THREE (20 MARKS)

- a) Briefly describe the following concepts: (6 marks)
- i. Trace-driven simulation
 - ii. Empirical distributions
 - iii. Fitting (theoretical) distributions
- b) Mention the advantages and disadvantages of each of the above methods in (a) (8 marks)
- c) Describe THREE types of tests that can be utilized to test for uniformity and independence of random number numbers (6 marks)

QUESTION FOUR (20 MARKS)

- a) Explain what you understand by the term simulation and modelling (4 marks)
- b) Briefly explain three types of models used in simulation and modelling (6 marks)
- c) Discuss five techniques for verification of simulation computer programs. (10 marks)

QUESTION FIVE (20 MARKS)

- a) Describe the state of a system in the discrete-event simulation (2 marks)
- b) Briefly describe any four components of a system as used in simulation and modelling (8 marks)
- c) Discuss five techniques for increasing model validity and credibility. (10 marks)