



# MACHAKOS UNIVERSITY

University Examinations for 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

SCO 303: SIMULATION AND MODELLING

DATE: 18/4/2019

TIME: 8.30-10.30 AM

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## 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)