



MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIFTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

EMM 420: SIMULATION AND MODELLING

DATE: 18/8/2021

TIME: 2.00-4.00 PM

INSTRUCTIONS

Answer question ONE and any other two questions.

QUESTION ONE (30 MARKS)

- a) Define the following terms
- i. Modelling (2 marks)
 - ii. Simulation (2 marks)
- b) Define the following systems as classified according to time frame and give an example in each
- i. Discrete system (2 marks)
 - ii. Continuous system (2 marks)
 - iii. Hybrid system (2 marks)
- c) **Figure Q.1 (C)** shows a mechanical system with two masses and two springs.
- i. Obtain the mathematical model of the system (10 marks)
 - ii. Develop a Matlab script to simulate the model (10 marks)

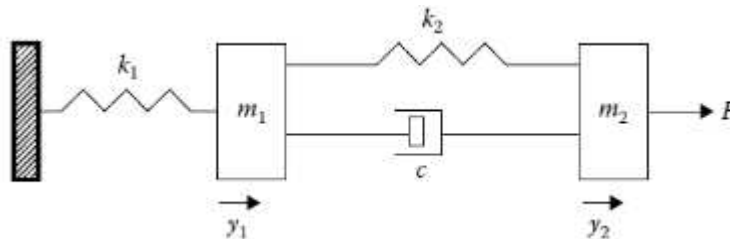


Figure Q.1(C)

QUESTION TWO (20 MARKS)

- a) Discuss the three main categories of models (6 marks)
- b) With the use of necessary examples, briefly discuss the main classes of simulation (6 marks)
- c) Briefly discuss the attributes of a good model (6 marks)
- d) Differentiate between static and dynamic system (2 marks)

QUESTION THREE (20 MARKS)

- a) **Figure Q3 (a)** shows an electrical circuit consisting of a capacitor, an inductor and a resistor. The inductor and the capacitor are connected in parallel. A voltage V_a is applied to the circuit. Derive a mathematical model for the system (8 marks)
- b) Consider the circuit shown in **Figure Q3 (b)**.
 - i. Draw a circuit showing all the currents flowing in the circuit and their directions (2 marks)
 - ii. Derive a 6x6 matrix that can be used in Matlab to solve for the values of the obtained currents (10 marks)

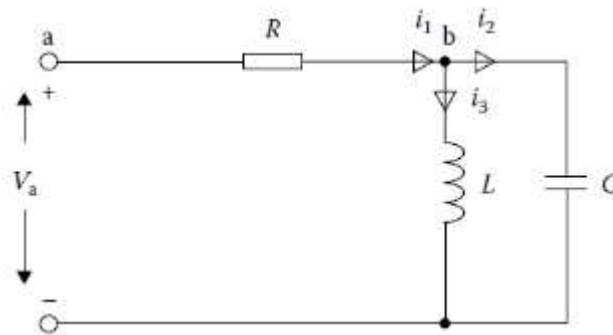


Figure Q3 (a)

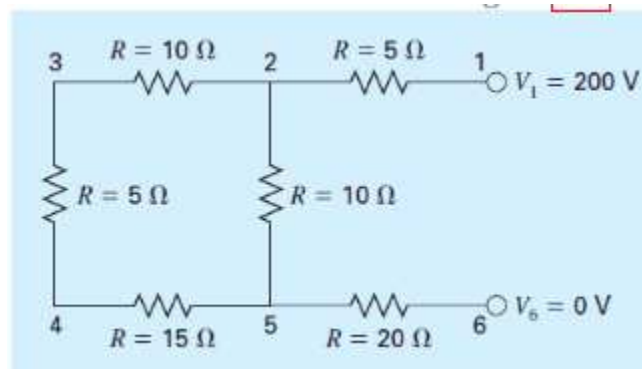


Figure Q 3 (b)

QUESTION FOUR (20 MARKS)

In an office, there are two typists in a typing pool. Each typist can type at an average of 6 letters/hour. If the letters arrive for typing at the rate of 10 letters/hour, calculate,

- a) What fraction of time are all the two typists busy? (6 marks)
- b) What is the average number of letters waiting to be typed? (3 marks)
- c) What is the waiting time for a letter to be typed? (3 marks)
- d) Briefly describe why Monte Carlo technique is popular in simulating uncertain events (8 marks)