CHUKA   **UNIVERSITY**

UNIVERSITY EXAMINATIONS

CHUKA & EMBU

**FIRST YEAR EXAMINATIONS FOR THE AWARD OF MASTERS
OF SCIENCE IN APPLIED COMPUTER SCIENCE**

COSC 811: MODELING AND SIMULATION

STREAMS: BSC (AGRI, AGEC & AGED) Y3S1   **TIME: 3 HOURS**

DAY/DATE: TUESDAY 06/04/2021   **2.30 P.M. – 5.30 P.M.**

INSTRUCTIONS: Answer Any Three Questions

QUESTION ONE

a. Explain the following terms giving examples in each case

  i.   Iconic models   [2 marks]

  ii.   Analogue models   [2 marks]

  iii.   Symbolic models.   [2 marks]

  iv.   deterministic models   [2 marks]

  v.   Stochastic models.   [2 marks]

b.   Explain the steps involved on Frequency test for pseudo random numbers hence use the

   frequency test to compute the P-value of the bit string: 1011010101 .   (6 marks)

c. Given the probability density function   (4 marks)

$$f(x) = \begin{cases} 3x^2 & , \ 0 \le x \le 1 \\ 0 & , \ \text{otherwise} \end{cases}$$

   Use the inverse transformation method to generate the random variates

QUESTION TWO

a. Define the term system in general, and state the five main features of a system   [7 marks]

b. Explain the Four requirements of a conceptual model   [8 marks]

c. Define the following terms

    i.   Reliability   function

    ii.   The mean time to failure function (MTTF)

    iii.   The failure rate function

d. The lifetime distribution function follows an exponential distribution with parameter λ , given as

$$F(t) = 1 - \exp(-\lambda t),$$

    Calculate the mean time to failure function (MTTF)   [5 marks]

QUESTION THREE

a. Briefly explain the following methods of generating random numbers

    i.   Composite generators   [3 marks]

    ii.   Tausworthe generators   [3 marks]

    iii.   The lagged Fibonacci generators   [3 marks]

b. Define the following terms as used in modeling   [4 marks]

    i.   The real system

    ii.   The experimental frame model

    iii.   The base model

    iv.   lumped model

c. Explain black Black-box modeling by the aid of a diagram   [3 marks]

d. Given that the a hardware system has been working for 1000 hours during which the system failed 30 times and the total repair time for all the failures is 150 hours. If the hardware failure time and repair time follow the exponential distributions. Determine the reliability function.   [3 marks]

e. Outline at least   four main methods of representation in a the conceptual model   [4 marks]

QUESTION FOUR

a.   Explain the key components of the conceptual model   [8 marks]

b.   Given that a computing system has three states after each run. The states are perfect,

degraded, and failed states denoted by state 1, 2 and 3. The state of the current run will

affect the state of the next run and the matrix of one step transition probability is given as

$$P = \begin{bmatrix} 0.7 & 0.2 & 0.1 \\ 0.3 & 0.5 & 0.2 \\ 0.1 & 0.3 & 0.6 \end{bmatrix}$$

     i.   Obtain the two-step transition matrix according to the Chapman-Kolmogorov model

             equation.   [3 marks]

     ii.   If the system initially stays at a perfect state, and the probability that the system

             still stays at that state after 2 runs is given as

$$p_{11}(0,2) = 0.56.$$

             Obtain the four-step transition matrix and determine the probability that the

             system does not stay at the failed state after 4 runs   [3 marks]

c.   Define the probability density function   of the following methods of generating stochastic

variates giving the expressions for the cumulative density function,   the expectation and

variance.

     i.   The uniform distribution   [3 marks]

     ii.   The Exponential distribution: [3 marks]

QUESTION FIVE

a.   Define the term pseudo-random numbers and state the conditions to be satisfied by an

acceptable method for generating random number sequences or bits.   [6 marks]

b.   State the advantages of the congruential method of generating random numbers and explain

the recursive relationship it uses to generate the random numbers.   [5 marks]

c.   Given that

$$f(x) = \begin{cases} 5x & 0 \le x \le 4 \\ x-2 & 4 < x \le 10 \end{cases}$$

Apply the inverse transformation method and devise specific formulae that yield the value

of variety x given a random number r. Note that f(x) needs to be normalized.)   [9 marks]