



COLLEGE
(A Constituent College of Chuka University)
UNIVERSITY EXAMINATIONS

**EXAMINATION FOR THE AWARD OF DEGREE OF
BACHELOR OF SCIENCE IN COMPUTER SCIENCE**

COSC 102: DISCRETE STRUCTURES

STREAMS: BSC (COSC)

TIME: 2 HOURS

DAY/DATE: TUESDAY 07/04/2020

11.30 AM – 1.30 PM

INSTRUCTIONS:

- Answer **QUESTION 1** and any other **TWO QUESTIONS** from section B.
- This is a **CLOSED BOOK EXAM**, No reference materials allowed in examination room. Mobile phones must be switched off.
- Do not write on this question paper
- Write your answers legibly and use your time wisely.
- Scientific, non-programmable Calculators may be used.

SECTION A: COMPULSORY

QUESTION 1 (30 marks)

- a) In the context of discrete structures, define the following terms AND give an example of each.
- Set
 - Set cardinality
 - Graph
 - Universe of discourse (8 marks)
- b) What is the Cartesian product $A \times B \times C$ where, $A = \{0,1\}$, $B = \{1,2\}$ and $C = \{a, b, c\}$? (4 marks)
- c) In a survey of 60 people, it was found that 25 read Nation, 26 read times, and 26 read fortune. Also 9 read both Nation and times, 8 read both times and fortune, and 8 read none of the magazines.
- Find the number of people who read all the 3 magazines. (2 marks)
 - Draw the Venn diagram to represent the above information. (2 marks)
 - Determine the number of people who read exactly one magazine. (2 marks)

- d) Show that $A = \{2,3,4,5\}$ is a proper subset of $C = \{1,2,3,4, 5\dots 8,9\}$ (3 marks)
- e) Show that the propositions $\neg p \vee q$ and $p \rightarrow q$ are logically equivalent. (4 marks)
- f) Given the Set $B = \{0,1,2,3\}$ and R is its relation on Set A such that, $R = \{(0,0), (0,1), (0,3), (1,0), (1,1), (2,2), (3,0), (3,3)\}$. Construct a diagraph for R . (5 marks)

SECTION B: ATTEMPT ONLY TWO QUESTIONS FROM THIS SECTION

Question 2 (20 marks)

- a) Define the terms propositional-logic and predicate-logic AND clearly show how they differ from each other (4 marks)
- b) Differentiate between a tautology and a contradiction. Give an example in each case (4 marks)
- c) A famer buys 3 cows, 2 pigs and 4 hens from a man who has 6cows, 5pigs, and 8 hens. Find the number of choices the farmer has to make. (8 marks)
- d) Prove by mathematical induction method that $1+2+3+4+\dots +n=n(n+1)/2$. (4 marks)

Question 3 (20 marks)

- a) Differentiate between Reflexivity, symmetry, and transitivity in a relation. (6 marks)
- b) Write the converse, inverse and the contra positive of the following sentence. “If the Sun shines brightly today, then it will set early”. (4 marks)
- c) Write each of the following quantified statements in simple English statements
- i. $\forall s (s \text{ is a student} \Rightarrow \forall q (q \text{ is a question in this exam} \Rightarrow s \text{ can solve } q \text{ correctly})$ (2 marks)
 - ii. $\exists x \in \mathbb{R}^+, \forall y \in \mathbb{R}^+, y \geq x$, where \mathbb{R}^+ is the set of positive real numbers (2 marks)
- d) Three cards are chosen one after the other from a 52-card deck. Find the number **M** of ways this can be done: (a) with replacement; (b) without replacement. (6 marks)

Question 4 (20 marks)]

- a) What is a recursive algorithm? And Under which circumstances would you opt for a recursive algorithm? (5marks)
- b) The recursive Fibonacci algorithm has been criticized. Describe these criticisms. (5marks)
- c) Write a non-recursive function to generate Fibonacci numbers such that it avoids the pitfalls in (b) above. (5 marks)
- d) Define a recursive algorithm that generates factorials (5 mark)

Question 5 (20 marks)

- a) Distinguish between deductive validity and inductive validity. Give examples as appropriate (5marks)
- b) Find the number of combinations of 4 objects, A, B, C, D, taken 3 at a time. (5 marks)
- c) Construct the Truth table of the following compound proposition
 $(P \vee \neg Q) \rightarrow (P \wedge Q)$ (5 marks)
- d) With the use of direct proof or otherwise, prove the following that the square of an even natural number is even. (5 marks)
