CHUKA   **UNIVERSITY**

UNIVERSITY EXAMINATIONS

RESIT/SPECIAL EXAMINATION

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE, COMPUTER SCIENCE AND APPLIED SCIENCE

COSC 102: DISCRETE STRUCTURES

STREAMS: BSC   **TIME: 2 HOURS**

DAY/DATE: TUESDAY 02/11/2021   **8.30 A.M – 10.30 A.M.**

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.
- Do not write on this question paper
- No use of mobile phones
- Write your answers legibly and use your time wisely.
- Scientific, non-programable Calculators may be used.

SECTION A: COMPULSORY
QUESTION 1[30 MARKS]
a) What is proposition, Give examples?   [4 marks]
b) Discuss proof by contradiction   [4 marks]
c) Give two areas in computer science where proof is useful   [2 marks]
d) Suppose there are 50 people in a room, how many of them must have their birthday in the same month?   [4 marks]
e) Each User on a computer system has a password which must be six to eight characters long.
   Each character is an uppercase letter or digit.
   Each password must contain at least one digit.
   How many passwords are there?   [6 marks]

f) Suppose variable names in a given programming language can be either a single uppercase letter or an uppercase letter followed by a

digit, find the number of possible variable names
[4marks]

g) How many bit strings of length 8 either start with a 1 or end with two bits 00? [2 marks]

h) Suppose a list A contains the 30 students in a mathematics class, and a list B contains the 35 students in an English class, and suppose there are 20 names on both lists. Find the number of students:
   (i).   Only on list A, (ii) only on list B, (iii) on list A or B (or both), (iv) on exactly one list. [4 marks]

SECTION B: ANSWER ONLY TWO QUESTIONS FROM THIS SECTION
Question 2 [20 marks]
With the use of direct proof or otherwise, prove the following:
   (a) The square of an even natural number is even [6 marks]
   (b) The square of an odd natural number is odd [4 marks]
   (c) The claim that if n is a positive integer, then the quantity n^2+3n+2 is even [4 marks]
   (d) With the use of relevant examples, discuss proof by induction [6 marks]

Question 3[20 marks]

   (a) Find the number of permutations of six objects, {A,B,C,D,E,F} taking three at a time [8 marks]
   (b) A farme 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 [12 marks]

Question 4[20 marks]

   (a) Let M, P and C be the sets of students taking Mathematics, Physics and Computer courses respectively in Chuka University. Take $|M| = 300$, $|P| = 350$, $|C| = 450$, $|M\cap P| = 100$, $|M\cap C| = 150$, and $|P\cap C|=75$, $|M\cap N\cap P\cap C| =10$. Determine the number of students taking exactly one of the above courses. [12 marks]
   (b) Joan is either a knight or a knave (not both). Knights always tell the truth, and only the truth; Knaves always tell lies, and only lies.

Someone asks Joan, "Are you a knight?" She replies, "If I am a knight then I will eat my hat." Determine the type Joan is and whether she will eat her hat.

[8 marks]

Question 5 [20 marks]

(a) The symmetric difference of two sets, A and B, is the set defined by **(A\B)∪(B\A)**. Draw a Venn diagram to show this difference.   [6 marks]

(b) The difference of A and B, is the set of all elements that belong to A but not to B. Use Venn diagram to demonstrate this difference.   [6 marks]

(c) For each of the sets A and B below, find A∪B and A∩B   [8 marks]
(i)   A = {3,2, a}, B ={2,3,a}
(ii)   A = {4,7, -1}, B = {7,3,4}