CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATION
RESIT/SUPPLEMENTARY / SPECIAL EXAMINATIONS
EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE, COMPUTER SCIENCE & APPLIED COMPUTER SCIENCE

COSC 102: DISCRETE STRUCTURES

STREAMS: **TIME: 2 HOURS**

DAY/DATE: TUESDAY 10/08/2021 **11.30 A.M - 1.30 P.M.**

INSTRUCTIONS

- Answer **QUESTION 1** and any other **TWO QUESTIONS** from section B.

SECTION A: COMPULSORY

QUESTION 1 [30MARKS]

a) What is the Cartesian product of A = {1, 2} and B = {a, b}? [4 marks]

b) Determine the members of the set S = {x | x is the square of an integer and x < 100} [4 marks]

c) Let be a proposition be, P : I am in Student. , Q: I love football. What is will be: q -> p (q implies p)? [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) Construct the Truth table of the following compound proposition
$(P^{\vee}\neg Q)\rightarrow(P \wedge Q)$ [6 marks]

f) Given that variable names in a programming language can be either a single uppercase letter or an uppercase letter followed by a digit, find the number of possible variable names [4 marks]

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 the35 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: ATTEMPT ONLY TWO QUESTIONS FROM THIS SECTION

Question 2 [20marks]

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 $\mathbf{n^2+3n+2}$ is even [4 marks]

(d) With the use of relevant examples, discuss proof by induction [6 marks]

Question 3 [20marks]

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

(b) 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 [12 marks]

Question 4 [20marks]

(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) Migingo highland has two kinds of inhabitants, knightsand knaves. Knights always tell the truth, and only the truth; Knaves always tell lies, and only lies. John encountered two people on his visit to the highland, A and B. Determine what is A and B if A tells John " B is a Knight" and B "says The two of us are of opposite type" [8 marks]

Question 5 [20marks]

(a) Find the number M of seven letter words that can be formed using the word "BENZENE". [8 marks]

(b) Use Binomial theorem to Determine the coefficient of $x^{12}y^{13}$ in the expansion of $(x+y)^{25}$ [4 marks]

(c) Determine the expansion of $(x+y)^4$ using Binomial theorem [8 marks]