

CHUKA



UNIVERSITY

**SUPPLEMENTARY/ SPECIAL EXAMINATIONS**

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

**COSC 102: DISCRETE STRUCTURES**

**STREAMS: BSC (COMP SCIE), BSC (ACMP) YIS2**

**TIME: 2 HOURS**

**DAY/DATE: WEDNESDAY03/02/2021**

**11.30 AM – 1.30 PM**

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**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[30MKS]**

- a) What is proposition, Give examples? [4 mks]
- b) Discuss proof by contradiction [4 mks]
- c) Give two areas in computer science where proof is useful [2 mks]
- d) Suppose there are 50 people in a room, how many of them must have their birthday in the same month? [4mks]
- 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?

[6mks]

- 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 [4mks]
- g) How many bit strings of length 8 either start with a 1 or end with two bits 00? [2mks]
- 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. [4mks]

**SECTION B: ANSWER ONLY TWO QUESTIONS FROM THIS SECTION**

**Question 2 [20mks]**

With the use of direct proof or otherwise, prove the following:

- (a) The square of an even natural number is even [6mks]
- (b) The square of an odd natural number is odd [4mks]
- (c) The claim that if  $n$  is a positive integer, then the quantity  $n^2+3n+2$  is even [4mks]
- (d) With the use of relevant examples, discuss proof by induction [6mks]

**Question 3[20mks]**

- (a) Find the number of permutations of six objects, {A,B,C,D,E,F} taking three at a time [8mks]
- (b) A farmer buys 3 cows, 2 pigs and 4 hens from a man who has 6 cows, 5 pigs, and 8 hens. Find the number of choices the farmer has to. [12mks]

**Question 4[20mks]**

- (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  $|P \cap C| = 75$ ,  $|M \cap P \cap C| = 10$ . Determine the number of students taking exactly one of the above courses. [12mks]

- (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. [8mks]

**Question 5 [20mks]**

- (a) The symmetric difference of two sets, A and B, is the set defined by  $(A \setminus B) \cup (B \setminus A)$ . Draw a Venn diagram to show this difference. [6mks]
- (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. [6mks]
- (c) For each of the sets A and B below, find  $A \cup B$  and  $A \cap B$  [8mks]
- (i)  $A = \{3, 2, a\}$ ,  $B = \{2, 3, a\}$
- (ii)  $A = \{4, 7, -1\}$ ,  $B = \{7, 3, 4\}$
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