THE UNIVERSITY OF ZAMBIA
School of Natural Sciences
Department of Computer Science

# CSC 2901
# DISCRETE STRUCTURES

## FINAL EXAMINATION

| | |
|---|---|
| Date: | 10th JULY, 2018 |
| Time: | 14:00 hrs – 17:00 hrs |
| Duration: | 3 Hours |
| Venue: | P207 |

**INSTRUCTIONS**

1. This exam has two sections A and B.
2. Answer **ALL** the questions from **Section A.**
3. Answer **ANY three (3)** questions from Section B.
4. **Total number of questions answered should be five (5).**
5. Clearly identify the problem being solved.

**SECTION A: THERE ARE FIVE (5) QUESTIONS IN THIS SECTION AND YOU ARE REQUIRED TO ANSWER ALL OF THEM. [40 MARKS]**

76
+16
10
6

Question A1. By showing your work clearly and without using a calculator, find the following

a) Inverse of $7(mod\ 24)$ [4 Marks]

b) $7^8(mod\ 39)$ [4 Marks]

Question A2. Prove, by contraposition, that for a positive integer $n$, if $n^2$is divisible by 2, then n is divisible by 2 [6 Marks]

Question A3. Let A and B be subsets of U. show that

a) $A \subseteq B \Rightarrow A-(A-B) = A$ [6 marks]

b) $(A-B)-(C \cup B')$ is a null set. [4 marks]

Question A4. Given that $S = \{1,2,3,4\}$ and $R = \{(1,2), (2,3), (3,4), (4,2)\}$

a) Draw the digraph for R. [2 marks]

b) Find $R^+$, the connectivity relation of R [6 marks]

c) Draw the digraph for $R^+$ [2 marks]

20
10
8
8

Question A5. Show that the function f:R R, defined as

$$f(x) = 3x + 3$$

is a bijection [6 Marks]

**SECTION B: THERE ARE FIVE (5) QUESTIONS IN THIS SECTION AND YOU ARE REQUIRED TO ANSWER ONLY THREE (3) OF THEM IN ANY ORDER. [60 MARKS]**

Question B1.

a) Consider the following algorithm.

```
Algorithm sum(n: positive integer)
        s := 0
          fori := 1 to n do
            forj := 1 to i do
              s := s + j
          end for
          end for
        returns.
end.
```

i) Draw the flowchart for this algorithm [10 Marks]

ii) Use a table to simulate how $sum(4)$ is evaluated. [6 marks]

iii) How many times is the statement $s := s + j$executed in ii) above? [4 marks]

Question B2.

a) Define the following

i) A one to one function $f$

ii) An onto function $f$ [4 marks]

iii) An inverse of a function $f$ [4 Marks]

[4 Marks]

b) Prove that if $f(x) = \log_2(x)$ and $g(x) = 2^x$, then $g$ *and* $f$ are inverses of each other [4 marks]

c) Let the function $f: Z^2 \rightarrow Z$ be defined as $f(x, y) = xy$

Show that $f$ is onto but not one to one [4 marks]

Question B3.

a) Let $(A, ., +, ', 0, 1)$ be a Boolean algebra. Let $x, y \in A$. Prove the following identities analytically.

i) $(x.y)' = x' + y'$ [6 marks]

ii) $xy + xy' = x$ [4 marks]

b) Let $F(x, y) = (x + y)(x'y)' + y$

i) Draw the Logic network for F. [2 marks]

ii) Simplify the expression [8 Marks]

Question B4.

a) State the sum rule for two sets [4 Marks]

b) How many 3 digit numbers are divisible by

i) 5? [4 Marks]

ii) 3? [4 Marks]

iii) 5 and 3? [4 Marks]

iv) 5 or 3 [4 marks]

Question B5.

a) Assume that you are in a class of 20 students and your Discrete mathematics lecturer wants to constitute a team of 7.

i) In how many ways can these teams be constituted? [5 marks]

ii) In how many ways can you be a member of the team? [5 Marks]

iii) Hence, what is the probability that you are chosen? [4 Marks]

b) You pick two marble, one after the other, without replacing, from a bag containing 6 blue marbles and 4 red ones. What is the probability that the second marble picked is blue, given that the first one was red? [6 Marks]

***************END OF EXAMINATION**************



Scanned by CamScanner