

UNIVERSITY EXAMINATIONS

1ST SEMESTER 2022/2023 ACADEMIC YEAR

FIRST YEAR EXAMINATION FOR THE DEGREES OF
BACHELOR OF SCIENCE (COMPUTER
SCIENCE)/BACHELOR OF SCIENCE (ICT)

COMP 114: DISCRETE STRUCTURES

STREAM: R

TIME: 2 HRS

DAY: TUESDAY [2.30PM – 4.30PM] DATE: 06/12/2022

THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

SECTION A: (COMPULSORY) TOTAL MARKS FOR THIS SECTION IS (30 MARKS)

QUESTION ONE

- (a) Prove the following Boolean expression using truth tables (3 marks)

$$X + YZ = (X + Y)(X + Z)$$

- (b) Using examples explain the following connectives in propositional logic (6 marks)

- Negation/ NOT ($\neg$),
- Implication / if-then ($\rightarrow$),
- If and only if ($\Leftrightarrow$).

- (c) Define what is a set and describe the two ways a set can be represented (3 marks)

- (d) Draw a graph G for the given incidence matrix. (3 marks)

	e_1	e_2	e_3	e_4
V_1	1	1	1	0
V_2	1	0	0	0
V_3	0	1	0	1
V_4	0	0	1	1

- (e) Represent the following statement into predicate logic using quantifiers (3 marks)

- no cats are reptiles
- If a thing is a whale, then it's a mammal.
- Wherever one goes one finds competition.

- (f) A boy lives at X and wants to go to School at Z. From his home X he has to first reach Y and then Y to Z. He may go X to Y by either 3 bus routes or 2 train routes. From there, he can either choose 4 bus routes or 5 train routes to reach Z. How many ways are there to go from X to Z?

(5 marks)

- (g) Given the following set $X = \{1, 2, 3, 4, 5, 6\}$ and $Y = \{1, 2\}$. Giving reason determine if the given sets are

(3 marks)

- (i) Subset
- (ii) Proper subset
- (iii) Equal set

(h) Simplify the following equation using the theorems and postulates of Boolean Algebra:
(6 marks)

i. $\overline{A(A+B)} + B\bar{A}$

ii. $F = (A B + B' C) + B (C' + A')$

iii. $\overline{A+B+A*B}$

(i) Describe the difference between standard form (e.g sum of product) and canonical form (e.g sum of minterm)?
(3 marks)

SECTION TWO: TOTAL MARKS FOR THIS SECTION IS 40

ANSWER ANY TWO QUESTIONS FROM THIS SECTION. EACH QUESTION IN THIS SECTION CARRIES 20 MARKS

QUESTION TWO

(a) Explain the following terms as used in discrete structures (6 marks)

- (i) Contradictions
- (ii) Contingency
- (iii) Propositional equivalence

(b) Express the following logical function to its standard Sum of Product (4 marks)

$$A(B+CD) + BC'$$

(c) Consider the following conditional statement:

If the flood destroys my house or the fires destroy my house, then my insurance company will pay me.

Write the converse, inverse, and contrapositive of the statement. (4 marks)

(d) Discuss reasoning rules used to prove if an argument form is valid. (6 marks)

QUESTION TWO

- (a) Write the following statement in symbolic form using quantifiers:
- (i) All students have taken a course in mathematics. (1 mark)
 - (ii) Some students are intelligent, but not hardworking. (1 mark)
- (b) Find truth table of the propositions:
- i). $(A \rightarrow B) \wedge (B \rightarrow A)$, (2 marks)
 - ii). $(P \wedge Q) \leftrightarrow (S \vee T)$ (2 marks)
- (c) Consider the given Boolean expression and obtained the output logic for the circuit
- $$f(x, y, z) = ((x + y + \bar{z})(x + y)\bar{z})(\bar{x} + y + z)(\bar{x}\bar{z}).$$
- (3 marks)
- (d) Graph traversal is the problem of visiting all the vertices of a graph in some systematic order. Describe ways one can traverse a graph. (4 marks)
- (e) Find the Cartesian product of $A = \{12, 42, x\}$ and $B = \{y, a, b\}$? (3 marks)
- (f) A professor writes 40 discrete mathematics true/false questions. Of the statements in these questions, 17 are true. If the questions can be positioned in any order, how many different answer keys are possible? (4 marks)

QUESTION FOUR

- (a) Minimize the following Boolean expression using Boolean identities:
- $$F(A, B, C) = A'B + BC' + BC + AB'C'$$
- (6 marks)
- (b) What do you mean by graph isomorphism, show it by example? (4 marks)
- (c) Prove if the following three propositions are tautologies: (6 marks)
- i. $p \leftrightarrow p$
 - ii. $p \rightarrow (p \vee q)$
 - iii. $(p \wedge q) \rightarrow (q \wedge p)$
- (d) Describe the different application areas of Breath First Search (4 marks)

QUESTION FIVE

- (a) Differentiate between the Eulerian graph & Hamiltonian graph with example (6 marks)
- (b) Explain the difference between the following broadly categories Mathematics can be classified (4 marks)
- (i) Continuous Mathematics
 - (ii) Discrete Mathematics
- (c) The exam will be graded out of 100 points, thus, the possible scores are in the range 0 .. 100. Find the minimum number of students that guarantee that there will be at least two students graded with the same score (4 marks)
- (d) Discuss the different Representation of Relations used in graphs Graph (6 marks)

