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**ALUPE UNIVERSITY COLLEGE**

*...Bastion of Knowledge....*

OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

# UNIVERSITY EXAMINATIONS

# 2021 /2022 ACADEMIC YEAR

## FIRST YEAR SECOND SEMESTER REGULAR EXAMINATION

# FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE

**COURSE CODE:    COM 123**

**COURSE TITLE:   MATHEMATICS FOR COMPUTER SCIENCE II**

**DATE: 8ᵀᴴ JUNE, 2022          TIME: 1400 – 1700 HRS**

## INSTRUCTION TO CANDIDATES

- **SEE INSIDE**

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COM 123

## REGULAR- MAIN EXAM

## COM 123:  MATHEMATICS FOR COMPUTER SCIENCE II

**STREAM: COM**                                                          **DURATION: 3 Hours**

### INSTRUCTION TO CANDIDATES

Answer **ALL** questions from section A and any **THREE** from section B.

### Question One (12 Marks)

a). Define the following:                                                          **(6 Marks)**

    (i) Quantifier

    (ii) Logical equivalence

    (iii) Conditional statement

    (iv) Contrapositive of a conditional statement

    v) An existential statement

    vi) A universal statement

b). Use truth tables to show the logical equivalence of the statement forms $p \vee q \rightarrow r$ and $(p \rightarrow r) \wedge (q \rightarrow r)$. Annotate the table with a sentence of explanation.          **(6Marks)**

### Question Two (12 Marks)

a). Use De Morgan's laws to write the negation of $-1 < x = 4$.          **(2 Marks)**

b). Write each of the following sentences symbolically, letting $h$ = "It is hot" and $s$ = "It is sunny."          **(4 Marks)**

    i)   It is not hot but it is sunny.
    ii)  It is neither hot nor sunny.

c). Show that the statement forms $\sim(p \wedge q)$ and $\sim p \wedge \sim q$ are not logically equivalent. **(6 Marks)**

**Question Three (12 Marks)**

a). Rewrite the following statement as a conjunction of two if-then statements:

"This computer program is correct if, and only if, it produces correct answers for all possible sets of input data".                                                           **(2 Marks)**

b). Construct a truth table for the statement form $(p \wedge q) \vee \sim r$ .                   **(6 Marks)**

b). Show that the statement form $p \vee \sim p$ is a tautology and that the statement form $p \wedge \sim p$ is a contradiction.                                                                                    **(4 Marks)**

**Question Four (12 Marks)**

a). Write a formal and an informal contrapositive, converse, and inverse for the following statement: "If a real number is greater than 2, then its square is greater than 4."    **(6 Marks)**

b). Let $P(x)$ be the predicate "$x^2 > x$" with domain the set **R** of all real numbers. Write $P(2)$, $P(1/2)$, and $P(-1/2)$, and indicate which of these statements are true and which are false.
                                                                                                                **(6 marks)**

**Question Five (12 Marks)**

a) Rewrite each of the following statements formally. Use quantifiers and variables. **(6 Marks)**

   i)   All triangles have three sides.
   ii)  No dogs have wings.
   iii) Some programs are structured.

b). Verify the logical equivalence $\sim(\sim p \wedge q) \wedge (p \vee q) \equiv p$.                   **(6 Marks)**

**Question Six (12 Marks)**

a). The logician Raymond Smullyan describes an island containing two types of people: knights who always tell the truth and knaves who always lie. You visit the island and are approached by two natives who speak to you as follows:

$A$ says: $B$ is a knight.
$B$ says: $A$ and I are of opposite type.
What are $A$ and $B$?

                                                                                                                **(7 Marks)**

b). Show that the following argument form is valid:

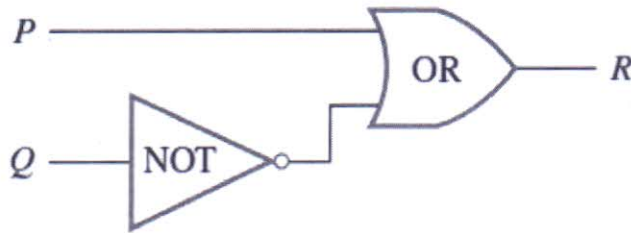$\sim p \rightarrow \mathbf{c}$, where $\mathbf{c}$ is a contradiction

$\therefore p$

                                                                                                                **(5 Marks)**

**Question Seven (12 Marks)**

a). Construct the input/output table for the following circuit.                          (6 Marks)



b). Rewrite the following formal statements in a variety of equivalent but more informal ways.
Do not use the symbol $\forall$ or $\exists$.                          (6 Marks)

   i)  $\forall x \in \mathbf{R}, x^2 \geq 0$.
   ii)  $\forall x \in \mathbf{R}, x^2 \neq -1$.
   iii)  $\exists m \in \mathbf{Z}^+$ such that $m^2 = m$.