



KENYATTA UNIVERSITY

**DIGITAL SCHOOL OF VIRTUAL AND OPEN LEARNING (DSVOL)
EXAMINATION FOR THE DIPLOMA IN INFORMATION TECHNOLOGY**

SIT 028: INTRODUCTION TO LOGIC

2ND TRIMESTER 2023/2024

TIME: 2 HOURS

INSTRUCTIONS: Attempt question 1 and any other **TWO** questions

QUESTION 1 (30 marks)

- a) Define the following terms
 - i. Logic
 - ii. Proposition
 - iii. Statement (6 mark)
- b) What is the negation of the following propositions :
 - i. Abby has more than 300 friends on facebook (2 marks)
 - ii. A messaging package for a cell phone costs less than \$20 per month(2marks)
 - iii. $4.5 + 2.5 = 6$ (2 marks)
- c) Write the contrapositive, converse, and inverse of the following: If you try hard, then you will win. (3marks)
- d) Explain why the negation of "Al and Bill are absent" is not "Al and Bill are present" (3 marks)
- e) Write the following in symbols:
 - i. Using c for "it is cold" and d for "it is dry", write "It is neither cold nor dry" in symbols. (3marks)
 - ii. Using c for "it is cold" and r for "it is rainy", write "It is rainy if it is not cold" in symbols. (3marks)
 - iii. Using c for "it is cold" and w for "it is windy", write "To be windy it is necessary that it be cold" in symbols. (3marks)

- iv. Using c for “it is cold”, r for “it is rainy”, and w for “it is windy”, write “It is rainy only if it is windy and cold” in symbols. (3marks)
- f) Prove that $p \rightarrow q$ and its converse are not logically equivalent. (3marks)

QUESTION 2

- a) Determine whether the compound propositions in the following are satisfiable.
- i) $(\neg p \vee \neg q) \wedge (p \rightarrow q)$ (2 marks)
- ii) $(p \rightarrow q) \wedge (q \rightarrow \neg p) \wedge (p \vee q)$ (2marks)
- b) Give three different equivalence relations on the set $\{a, b, c, d\}$. (6marks)
- c) Show that the hypotheses “I left my notes in the library or I finished the rough draft of the paper” and “I did not leave my notes in the library or I revised the bibliography” imply that “I finished the rough draft of the paper or I revised the bibliography”. (6marks)
- d) Give a direct proof of the following: “If x is an odd integer and y is an even integer, then $x + y$ is odd”. (4 marks)

QUESTION 3

- a) In a particular school, students must choose at least one of three optional subjects: art, psychology or history. Consider the following propositions
- a : I choose art, p : I choose psychology, h : I choose history.
- Write, in words, the compound proposition

$$\neg h \Rightarrow (p \vee a).$$

(4 marks)

b)

Complete the truth table for $\neg a \Rightarrow p$.

a	p	$\neg a$	$\neg a \Rightarrow p$
T	T	F	
T	F	F	
F	T	T	
F	F	T	

(2 marks)

- c) Find a proposition with three variables p , q , and r that is true when p and r are true and q is false, and false otherwise. (3 marks)
- d) Find a proposition with three variables p , q , and r that is never true. (3marks)
- e) Prove that the proposition “if it is not hot, then it is hot” is equivalent to “it is hot”. (3 marks)
- f) Determine whether the following two propositions are logically equivalent:
 $p \vee (q \wedge r)$, $(p \wedge q) \vee (p \wedge r)$. (5 marks)

QUESTION 4

- a) Translate the following English sentences into predicate logic where the universe is the set of people and the allowable predicates are:
- $S(x)$: x is a student (2 marks)
 - $F(x, y)$: x and y are friends (2 marks)
 - $O(x, y)$: x is older than y (2 marks)
- b) Determine whether the following argument is valid:
- She is a Math Major or a Computer Science Major.
 - If she does not know discrete math, she is not a Math Major.
 - If she knows discrete math, she is smart.
 - She is not a Computer Science Major.
- Therefore, she is smart. (4 marks)
- c) List and explain areas where logic can be applied in computer science (10 marks)

QUESTION 5

- a) Translate the given statement into propositional logic using the propositions provided: On certain highways in the Washington, DC metro area you are allowed to travel on high occupancy lanes during rush hour only if there are at least three passengers in the vehicle. Express your answer in terms of :“You are traveling during rush hour.” t:“You are riding in a car with at least three passengers.” and h:“You can travel on a high occupancy lane.” (7 marks)
- b) A student is asked to give the negation of “all bananas are ripe”.
- The student responds “all bananas are not ripe”. Explain why the English in the student’s response is ambiguous. (2 marks)
 - Another student says that the negation of the statement is “no bananas are ripe”. Explain why this is not correct. (2 marks)
 - Another student says that the negation of the statement is “some bananas are ripe”. Explain why this is not correct. (2 marks)
 - Give the correct negation. (2 marks)
- c) Show that the hypotheses “I left my notes in the library or I finished the rough draft of the paper” and “I did not leave my notes in the library or I revised the bibliography” imply that “I finished the rough draft of the paper or I revised the bibliography”. (5 marks)