KENYATTA UNIVERSITY
EXAMINATION FOR THE DEGREE OF BACHELOR OF INFORMATION TECHNOLOGY

SIT 108 : INTRODUCTION TO LOGIC

2ND SEMESTER 2023/2024 TIME: 2 HOURS

INSTRUCTIONS:

Attempt question ONE and any other TWO questions

QUESTION ONE

a) When is a standard form categorical syllogism said to be true? **(2 marks)**

b) Read the following sentences carefully. Indicate in each case whether the sentence is a proposition or not. In each case, give a reason for your answer.

i) Read the sentence carefully. **(1 mark)**

ii) $x + y = z$ **(1 mark)**

iii) What time is the meeting? **(1 mark)**

iv) Johannesburg is the capital city of Zimbabwe. **(1 mark)**

v) I am a penguin **(1 mark)**

c) Verify whether the following sentence is a contingency, contradiction or a tautology. **(2 marks)**

"If I'll go to a cinema then I'll take a bus, or if I'll take a bus then I'll go to a cinema".

d) Determine whether the following arguments are valid. **(2 marks)**

$p \rightarrow q$

$q \rightarrow r$

Therefore $(p \vee q) \rightarrow r$

e) Given:

Universe of discourse for the variable x is all students.

C(x): x is taking SIT108.

M(x): X is a SIT108 major.

Write $\forall x(M(x) \wedge C(x))$ in English. **(3 marks)**

f) Translate each of the sentence into language of predicate logic. Give translation scheme for each translation.

i) Everyone who walks is calm **(2 marks)**

ii) Everyone who Mary loves loves someone who is happy **(2 marks)**

iii) All roaches are crunchy **(2 marks)**

g) Write the inverse, converse and contrapositive of each statements. Next to each, write the correct symbolic notation.

i) James come to the stadium whenever there is going to be a match between Mamelody Sundowns and Olando Pirates. **(3 marks)**

ii) When I stay home, it is necessary that I visit my friend. **(3 marks)**

h) Write the original statements in "if-then" form. Then write its converse, inverse, and contrapositive. Also, identify the truth value of each statement.

i. Original: Every equilateral triangle is also an isosceles triangle **(2 marks)**

ii. Original: $\sim s \supset \sim r$ **(2 marks)**

QUESTION TWO

a) Use Demorgan's theorem to determine whether the following statements are logically equivalent.

i) $\sim(\sim p \rightarrow q)$, $p \vee \sim q$ **(3 marks)**

ii) $\sim(p \vee q) \rightarrow r$, $(\sim p \wedge \sim q) \rightarrow r$ **(3 marks)**

b) For each of the following statements, construct a truth-table to determine whether it is a tautology, a contradiction or a contingent statement. Label the statement accordingly. Provide a complete truth-table for each statement.

i) $(P \rightarrow ((q \rightarrow p))$ **(2 marks)**

ii) $\sim(p \vee q) \leftrightarrow (\sim p \vee \sim q)$ **(2 marks)**

iii) $(p \rightarrow (q \wedge \sim q))$ **(2 marks)**

c) Consider the following argument:

1. If George Bush is a Republican, then he is not a Democrat.
2. George Bush is not a Democrat.
3. George Bush is a Republican.

i) Are all of the premises true? **(1 mark)**

ii) Is the conclusion true or false? **(1 mark)**

iii) Is the argument deductively valid or deductively invalid and why? **(3 marks)**

iv) Is the argument sound? Explain, giving the definition of a sound argument. **(3 marks)**

QUESTION THREE

a) When are two propositions said to be contraries? **(2 marks)**

b) Which of these five syllogistic forms commit the fallacy of four terms?
(EEE-1, OOO-2, EEE-3, OOO-4, EEA-1) **(4 marks)**

c) Translate the following sentences into a set of propositional formulas:

i) "chose one of three roads: short, medium or long" **(2 marks)**

ii) "the medium road is not comfortable, but fast" **(2 marks)**

iii) "the long road is comfortable" **(2 marks)**

iv) "the chosen road should be comfortable." **(2 marks)**

d) Test the validity of the following arguments

i) James is either a policeman or a footballer. If he's a policeman then he has big feet. James hasn't got big feet so he's a footballer. **(3 marks)**

ii) If I graduate in June then I'll go on holiday in the summer. In the summer I'll get a job or I'll go on holiday. I won't go on holiday in the summer so I won't graduate in June. **(3 marks)**

QUESTION FOUR

a) If "Some merchants are not pirates" is true, what may be inferred about the truth or falsehood of the following propositions? That is, which could be known to be true, which known to be false, and which would be undetermined?

i) No pirates are merchants. **(2 marks)**

ii) Some nonmerchants are nonpirates. **(2 marks)**

iii) Some nonpirates are not nonmerchants. **(2 marks)**

iv) No merchants are pirates. **(2 marks)**

b) Specify the mood and figure in the following forms. Determine whether the forms are valid

i)

1. Some P are M.
2. All S are M.

so

3. Some S are P. **(2 marks)**

ii)

1. Some M are P.
2. Some M are S.

so

3. Some S are P. **(2 marks)**

iii)

1. ALL P are M.
2. No M are S.

so

3. No S are P. **(2 marks)**

c) Consider the following propositions:

p : All dogs are fierce .

q : Spiders hate algebra.

Write the compound propositions symbolized by the following compound sentences.

i) $\sim (q \wedge p)$ **(2 marks)**

ii) $\sim p \rightarrow q$ **(2 marks)**

iii) $\sim p \leftrightarrow \sim q$ **(2 marks)**

QUESTION FIVE

a) Consider the two propositions:

p : James has a new car.

q : All dogs are fierce.

Under what circumstances is the compound proposition 'If James has a new car then all dogs are fierce' false? Give reason for your answer. **(2 marks)**

b) Determine the truth-value of the following implication? **(2 marks)**

"a sufficient condition for $2 < 3$ is $2 + 2 = 8$"

c) For each question, assume that the given proposition is true, perform the required inference, and state the resultant proposition and its truth value.

i) What is the contrary of "All joggers are escapists"? **(2 marks)**

ii) What is the contradictory of "Some tillers are not Snappers"? **(2 marks)**

iii) What is the subaltern of "No logic teachers are exciting persons"? **(2 marks)**

iv) What is the subaltern of "No disco music is acid rock"? **(2 marks)**

v) What is the superaltern of "Some funny cars are dragsters"? **(2 marks)**

vi) What is the subcontrary of "Some soft drinks are not nutritional goods"? **(2 marks)**

d) Determine if the compound proposition $p \leftrightarrow q \Lambda q$ logical entails p. Give reason for your answer. **(4 marks)**.

TABLE 6 Logical Equivalences.	
Equivalence	*Name*
$p \wedge \mathbf{T} \equiv p$ $p \vee \mathbf{F} \equiv p$	Identity laws
$p \vee \mathbf{T} \equiv \mathbf{T}$ $p \wedge \mathbf{F} \equiv \mathbf{F}$	Domination laws
$p \vee p \equiv p$ $p \wedge p \equiv p$	Idempotent laws
$\neg(\neg p) \equiv p$	Double negation law
$p \vee q \equiv q \vee p$ $p \wedge q \equiv q \wedge p$	Commutative laws
$(p \vee q) \vee r \equiv p \vee (q \vee r)$ $(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$	Associative laws
$p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$ $p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$	Distributive laws
$\neg(p \wedge q) \equiv \neg p \vee \neg q$ $\neg(p \vee q) \equiv \neg p \wedge \neg q$	De Morgan's laws
$p \vee (\wedge q) \equiv p$ $q) \equiv p$	Absorption laws
	Negation laws

TABLE 7 Logical Equivalences Involving Conditional Statements.
$p \rightarrow q \equiv \neg p \vee q$
$p \rightarrow q \equiv \neg q \rightarrow \neg p$
$p \vee q \equiv \neg p \rightarrow q$
$p \wedge q \equiv \neg(p \rightarrow \neg q)$
$\neg(p \rightarrow q) \equiv p \wedge \neg q$
$(p \rightarrow q) \wedge (p \rightarrow r) \equiv p \rightarrow (q \wedge r)$
$(p \rightarrow r) \wedge (q \rightarrow r) \equiv (p \vee q) \rightarrow r$
$(p \rightarrow q) \vee (p \rightarrow r) \equiv p \rightarrow (q \vee r)$
$(p \rightarrow r) \vee (q \rightarrow r) \equiv (p \wedge q) \rightarrow r$

TABLE 8 Logical Equivalences Involving Biconditionals.
$p \leftrightarrow q \equiv (p \rightarrow q) \wedge (q \rightarrow p)$
$p \leftrightarrow q \equiv \neg p \leftrightarrow \neg q$
$p \leftrightarrow q \equiv (p \wedge q) \vee (\neg p \wedge \neg q)$
$\neg(p \leftrightarrow q) \equiv p \leftrightarrow \neg q$