(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR

END OF SEMESTER EXAMINATIONS
YEAR Two SEMESTER ONE EXAMINATIONS

FOR THE DEGREE OF
(COMPUTER SCIENCE)

COURSE CODE : CSC 227

COURSE TITLE : LOGIC PROGRAMMING

DATE: 08/10/2021 TIME: 09:00 A.M – 11:00 A.M

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTIONS ONE AND ANY OTHER TWO.

QUESTION ONE (COMPULSORY) [30 MARKS]

a. Describe the following Terms

   I. Horn Clause **[1 Mark]**

   II. Modus Ponens **[1 Mark]**

   III. Paradox **[1 Mark]**

   IV. Modus Tollens **[1 Mark]**

   V. Prolog **[1 Mark]**

   VI. Contradiction **[1 Mark]**

b. Describe what is meant by Skolemization **[4 Marks]**

c. Using propositional calculus, explain the resolution method for proving theorems **[4 Marks]**

d. Explain what unification means when matching patterns **[4 Marks]**

e. Why is negation, or the not predicate, unsound in Prolog? **[2 Marks]**

f. Translate the Following English to First Order Logic **[4 Marks]**

   I. You can fool some of the people all of the time.

   II. No purple mushroom is poisonous

   III. X is above Y if X is on directly on top of Y or else there is a pile of one or more other objects directly on top of one another starting with X and ending with Y.

   IV. There are exactly two purple mushrooms.

g. Describe the **TWO** types of CUT function **[6 Marks]**

QUESTION TWO [20 MARKS]

a. Explain Why is Prolog restricted to Horn clauses? **[2 Marks]**

b. Describe the DE Morgan's law of logic. **[4Marks]**

c. Suppose we consult the following database of facts and rules: **[6 Marks]**

a(1).

a(a).

b(2).

b (3).

c (X, X): - a(X).

c (X, Y): - a(X), b(Y).

c (X, X): - b(X).

List all of the possible solutions to the query

? -c (A, B).

in order.

d. Determine if the Following statements are True/False **[8 Marks]**

(a) $\forall x P(x) \Leftrightarrow \neg\exists x \neg P(x)$

(b) $\exists x P(x) \Leftrightarrow \neg\forall x P(x)$

(c) $\forall x \exists y P(x, y) \Leftrightarrow \exists y \forall x P(x, y)$

(d) $\exists!_x p(x) \Leftrightarrow \exists_x (p(x) \wedge \forall_y ((x \neq y) \rightarrow \neg p(y))$

QUESTION THREE [20 MARKS]

a. Describe the Term back tracking. Give an appropriate example to explain the back tracking concept **[6 Marks]**

b. Explain/define with respect to Prolog the terms: Predicate, Term, Fact, Compound Term, Query and rule. **[6 Marks]**

c. Describe how arithmetic is done in Prolog **[4 Marks]**

d. The not predicate can be represented in Prolog as follows.

not(P): - call(P), ! , fail.

not (_).

Show how cut can be represented with not. **[4 Marks]**

QUESTION FOUR [20 MARKS]

a. Describe main steps how Conjunctive Normal Form can be achieved. Give an appropriate example to explain the Concept **[4 Marks]**

b. Discuss the FOUR variations of implication giving an example for each case. **[8 mark]**

c. Consider the following Prolog program:

```
[1]  parent(john, sally).
[2]  parent(jim,  mike).
[3]  parent(carol, john).
[4]  parent(carol, sue).
[5]  parent(sally, jim).
[6]  parent(jim, bob).
[7]  sibling(X, Y) :- parent(Z, Y),  parent(Z, X),   X \== Y.
[8]  malelist([john, jim, mike,  bob]).
[9]  femalelist([sally, carol, sue]).
[10] mother(U, V) :- parent(U, V), female(U).
[11] father(U, V) :- parent(U, V), male(U).
[12] brother(U, V) :- sibling(U, V),  male(U).
[13] sister(U, V) :- sibling(U, V),  female(u).
```

Show what happens in solving the goal below. You may assume (for now) that goals of the form "male(X)." or "female(X)." become appropriately solved. Show the rule applied, the goal list, and the variable bindings after each application of a rule or fact (or, for instance, after solving a `male(X).' goal). Indicate backtracking should any be required.

?- brother(X, mike). **[8 Marks]**

QUESTION FIVE [20 MARKS]

a. Write a prolog program to calculate the total cost of products (use list). **[6 Marks]**

b. Using a relevant example explain conversion theorem **[4 Marks]**

c. Describe the Characteristics and Merits of Prolog **[6 Marks]**

d. Answer the following questions **[4 Marks]**

   I. Prove that $(\neg q \vee \neg r \vee p) \wedge (p \vee q) \wedge (r \vee p)$ and $p \vee q$ is not logically equivalent

   II. Prove that $(p \vee q) \wedge (r \vee p) \wedge (\neg q \vee \neg r \vee p) \equiv p$