



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

MAIN CAMPUS

**UNIVERSITY REGULAR EXAMINATIONS**

**2023/2024 ACADEMIC YEAR**

**SECOND YEAR 2<sup>ND</sup> SEMESTER EXAMINATION**

**BACHELOR OF SCIENCE IN**

**COMPUTER SCIENCE**

**COURSE CODE: BCS 227**  
**COURSE TITLE: LOGIC PROGRAMMING**

**DATE: TUESDAY 16<sup>TH</sup> APRIL, 2024**

**TIME: 8:00AM – 10:00AM**

**INSTRUCTIONS TO CANDIDATES:**

Answer Question ONE (1) and Any OTHER 2 questions

Ensure your answers/ideas are clearly expressed

All your answers must be clearly numbered

Write in ink. Rough work can be done (in answer booklet) in pencil and will not be marked.

Cross out any rough work.

Calculators, phones, tablets, computers not allowed

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

Paper Consists of 5 Printed Pages. Please Turn Over

**QUESTION ONE (COMPULSORY)****[30 MARKS]**

- a. Write a Prolog predicate to reverse a list using only built-in predicates. Provide both recursive and non-recursive solutions. **[4 Marks]**
- b. Explain the meaning of terms, atomic formulas, and the concept of well-formed formulas (wff) and how they are constructed in predicate calculus. **[4 Marks]**
- c. What are the fundamental principles of logic programming, and how does Prolog demonstrate these principles? **[4 Marks]**
- d. Describe the resolution principle and the steps involved in resolution algorithm **[4 Marks]**
- e. Create a Prolog program that prompts the user to input an integer value from the keyboard. Generate two files, "even.txt" and "odd.txt", and print all even and odd numbers below the input value and greater than zero into their respective files. Ensure the numbers are printed in a row-like format, separated by spaces. **[6 Marks]**
- f. Consider the following prolog predicates

`area_trapezium(Base1, Base2, Height, Area) :- Area is ((Base1 + Base2) * Height) / 2.`

Write down a goal that can be used to test this predicate using appropriate dummy values.

- g. Create a Prolog program to generate the Fibonacci series [defined by the following three equations:  $F_0 = 0$  (applies only to the first integer)  $F_1 = 1$  (applies only to the second integer)  $F_n = F_{n-1} + F_{n-2}$  (applies to all other integers)] up to a specified limit without using recursion, utilizing the cut predicate to enhance efficiency. **[6 Marks]**

**QUESTION TWO****[20 MARKS]**

- a. Differentiate between the following concepts as used in logic programming.
  - i Relations and atoms **[2 Marks]**
  - ii Facts and queries. **[2 Marks]**
  - iii Unification and evaluation **[2 Marks]**
- b. Discuss conjunction and disjunction of goals in Prolog using suitable examples. **[4 Marks]**
- c. Using relevant predicates differentiate between tail recursion and non-tail recursion as used in prolog **[4 Marks]**



- d. Write a Prolog program to solve the subset sum problem by finding all subsets of a given set that sum up to a specified target value, utilizing recursion and the cut predicate to prune unnecessary branches. [6 Marks]

### **QUESTION THREE**

**[20 MARKS]**

- a. Using relevant predicates differentiate between headless clauses and headed clauses. [2 Marks]
- b. Explain how unification, Evaluation Order and Backtracking is handled in logic based programs. [3 Marks]
- c. Write Prolog predicate to check if a list is a palindrome. [3 Marks]
- d. Explain whether the following statements will be evaluated if not. Give an appropriate reason to yours answers. [4 Marks]
- i 4+1 is 3+2.
  - ii 4+1 =:= 3+2.
  - iii X =:= 3+2.
  - iv X is Y + 1, Y = 3.
- e. Consider the prolog predicates below

Sum:- readint(X), readint(Y), sum is X+Y, write (sum).  
?- sum(3,5,S)  
S=8

Trace how S=8 is arrived at.

**[2 Marks]**

- f. Write prolog database of facts and rules that stores various items and their respective prices in a supermarket as a list, predicate that will generate the bill when a client selects a given sets of items from shelves. This bill need to be formatted and be printed on a notepad file named bill.txt as a receipt. [6 Marks]

### **QUESTION FOUR**

**[20 MARKS]**

- a. In a game, it is known that "If I win, then I'll be happy." If you are happy, what can you infer about whether you won or not using propositional logic? [4 Marks]
- b. You are in the process of simulating M-PESA services using prolog. Write predicate(s) that:
- i Create a new account with a given initial balance [2 Marks]
  - ii Deposit funds into an existing account [2 Marks]

- iii Withdraw funds from an existing account [2 Marks]
- iv Transfer funds from one account to another [2 Marks]
- v Check account balance [2 Marks]
- c. Explain how you will use the goals below to test the predicates in (b) above given that the predicates have addressed all necessary conditions. [3 Marks]
  - % create\_account('123456', 1000).
  - % deposit('123456', 500).
  - % withdraw('123456', 200).
  - % transfer('123456', '654321', 300).
  - % balance('123456').
- d. Explain how you will trace the outputs of the goals in (c) above [3 Marks]

#### **QUESTION FIVE**

**[20 MARKS]**

- a. Explain how a Cut Operator differ from Control Operators in prolog. [2 Marks]
- b. Explain the role of backtracking in Prolog and its significance in solving logical queries. [2 Marks]
- c. Discuss how logic programming languages can be employed to represent and reason about ontological relationships pointing out advantages logic programming offer in building intelligent semantic systems? [6 Marks]
- d. Develop a Prolog program to monitor the operational status of a manufacturing assembly line. The program should perform checks on various components and generate signals if any abnormalities are detected. Consider the following scenarios: The optimal speed of the conveyor belt should be set to 60 meters per minute and if the conveyor belt speed falls below 50 meters per minute, the program should generate a signal indicating "Low conveyor belt speed". The maximum safe temperature of the machinery should be set to 40 degrees Celsius and if the temperature of any machinery exceeds the maximum limit, the program should generate a signal indicating "High machinery temperature". The acceptable range of product dimensions should be between 10 and 20 centimeters and if any product exceeds this range, the program should generate a signal indicating "Product dimensions out of range". The minimum acceptable inventory level of raw materials should be set to 100 units and if the inventory level falls below this threshold, the program should generate a signal indicating



"Low raw material inventory". Ensure that your Prolog program allows input parameters for the conveyor belt speed, machinery temperatures, product dimensions, and raw material inventory level. It should then output a list of signals indicating any issues detected in the manufacturing assembly line.

**[10 Marks]**