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(University of Choice)

MASINDE MULIRO UNIVERSITY OF

SCIENCE AND TECHNOLOGY

(MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

MAIN EXAM

2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATION

FOR THE DEGREE OF BACHELORS OF SCIENCE IN

(COMPUTER SCIENCE)

COURSE CODE: BCS 227

COURSE TITLE: LOGIC PROGRAMMING

DATE: Wednesday 27th April, 2022

TIME: 8:00-10:00AM

**INSTRUCTIONS TO CANDIDATES:
ANSWER QUESTIONS ONE AND ANY OTHER TWO.**

MMUST observes ZERO tolerance to examination cheating

Paper Consists of 4 Printed Pages. Please Turn Over

QUESTION ONE (COMPULSORY)

[30 MARKS]

- a. Explain the difference between Imperative programming and declarative programming paradigm. Give at least 2 examples of programming languages in each paradigm. [4 marks]
- b. By defining the aspects of logic, differentiate between **logic** and **logic programming**. [3 marks]
- c. State any three attributes that make Logic Programming important and powerful. [3 marks]
- d. Briefly explain the difference between computation and deduction and explain the connection of the two to logic programming. [5 marks]
- e. What is symbolic logic? Give the general pattern used in representing symbolic logic. [3 marks]
- f. Differentiate between Modus Ponens and Modus Tollens using relevant arguments. [4 marks]
- g. Given the following statements and sentences:

Mary is married to James
Lilian is married to John
Shantel, Voke, Lydia and mike are children of Mary
Janet is a child of Lilian

Convert these sentence into:

- i Well-formed formulas (wff). [2 marks]
- ii Facts and rules. [2 marks]
- h. Write a prolog program to correspond to the mathematical function factorial. The factorial of a positive integer N is defined as the product of all the integers from 1 to N inclusive, Example the factorial of 6 will read 120: $1 \times 2 \times 3 \times 4 \times 5 \times 6 = 720$. [4 marks]

QUESTION TWO

[20 MARKS]

- a. Three students Andrew, Brian and Christian are accused of introducing a virus in the SCI computer Lab. During the interrogation they make the following claims:

Andrew says: "*Brian did it and Christian is innocent*"
Brian says: "*If Andrew is guilty then Christian is guilty too*".
Christian says: "*I did not do it. One of the others or maybe both of them did it*"

- i. Write a formula in propositional logic then represents the conjunction of the three above claims using the following atomic propositions: A: Andrew is guilty, B: Brian is guilty and C: Christian is guilty. [3 marks]

- ii. Are the three above statements contradictory? Justify. [3 marks]
- iii. Assuming that nobody lied, who is innocent and who is guilty? Justify [2 marks]
- b. Differentiate between propositional and predicate logic and explain any two limitations of propositional logic that can be overcome by predicate logic. [3 marks]
- c. To make the transition from inference rules to logic programming a particular strategy need to be imposed. Discuss the two fundamental strategies used by the Inference Engine. [4 marks]
- d. State the characteristics of Prolog programming language and discuss the elements of a logic language like Prolog. [5 marks]

QUESTION THREE

[20 MARKS]

- a. What kinds of knowledge can be represented in propositional logic? [2 marks]
- b. Explain how judgment and proofs are handled in logic programming. [2 marks]
- c. Why is George Boole considered as the “father of symbolic logic”? [2 marks]
- d. Express the following statements in predicate logic
- i. “Everybody must take a discrete mathematics course or be a computer science student”. [2 marks]
- ii. There is someone loved by everyone [2 marks]
- e. First Order Predicate Calculus is the basis of almost all knowledge representation and reasoning in every area of symbolic Artificial Intelligence (AI). Give at least four area of AI where this can be applied. [4 marks]
- f. Discuss the concept of conflict resolution and its implementation in predicate logic. [6 marks]

QUESTION FOUR

[20 MARKS]

- a. Using examples explain the difference between Atomic formulas and Compound formulas as used in predicate logic [4 marks]
- b. Explain how the prolog compiler will treat each of the following statements. [3 marks]

X is X+1.

X1 is X+1.
X1 = X+1.

- c. Explain how a goal driven system and a data driven system work in relation to an expert system. [4 marks]
- d. Write a prolog program to reverse the elements of a list. [2 marks]
- e. Find a refutation from the following set of clauses using resolution and factoring techniques. [4 marks]
- $\{P(x, b), P(a, y)\} \{-P(x, b), \neg P(c, y)\} \{-P(x, d), \neg P(a, y)\}$
- f. Write a prolog program to sum up Even numbers between zero to a number N example given number N as 9 the program gives $8+6+4+2=20$. [3 marks]

QUESTION FIVE

[20 MARKS]

- a. What is first order logic? [1 marks]
- b. Explain the meaning of syntax and semantic validity as used in logic programming. [3 marks]
- c. Define the following concepts as used in the study of PROLOG: [3 marks]
- Binding Variables
 - Backtracking
 - Cut function
- d. Define and test a predicate which takes two arguments, both numbers, and calculates and outputs the following values: [4 marks]
- Their average
 - The square root of their product
- g. You are provided with the information lung diseases. Study it and answer the questions that follow:

- Tuberculosis** is a lung disease whose symptoms are persistent cough, constant fatigue, weight loss, loss of appetite, fever, coughing up blood, night sweats.
- Pneumonia** is a disease whose symptoms are cough, fever, shaking chills, shortness of breath.
- Byssinosis** is a disease whose symptoms are chest tightness, cough, wheezing.
- Pertusis** is a disease whose symptoms are runny nose and mild fever.
- Pneumoconiosis** is a disease whose symptoms are chronic cough and shortness of breath.

- i** Write the prolog code to show how the diseases and their respective symptoms will be stored in the knowledge base. **[5 marks]**
- ii** Write down a prolog query that will return the Symptoms for Pertusis. **[2 marks]**
- iii** Explain how prolog compiler arrives at the solution of the (ii) query above. **[2 marks]**