

Ex/SC/MATH/PG/DSE/TH/04/A13/2025

MASTER OF SCIENCE EXAMINATION, 2025

(2nd Year, 1st Semester)

MATHEMATICS

PAPER : DSE-04/A13

(Artificial Intelligence and Soft Computing)

Time : Two Hours

Full Marks : 40

(Symbols have usual meanings, if not mentioned otherwise)

Attempt Question 1 and any **three** from the rest :

1. What is commutative production system? Test whether the following production systems are commutative. Justify your answer.

(a) Knowledge base

If $A \& B$, then C .

If C , then D .

If $A \& D$, then E .

Initial $WM = \{A, B\}$.

(b) Knowledge base

If $A \& B$, then C .

If $X \& Y$, then C .

If A , then E .

If B , then F .

Initial $WM = \{A, B, X, Y\}$.

3+5+5=13

MATH-987

[Turn Over]

(2)

2. (a) Write Depth First Search (DFS) algorithm.
- (b) Deduce the time complexity and space complexity of the DFS algorithm.
- (c) Compare DFS and BFS with respect to time complexity and space complexity. $3+3+3=9$
3. Using the Euclidean distance of a node (x, y) from a fixed node $(2, 2)$, i.e., with the heuristic function

$$h = [(x - 2)^2 + (y - 2)^2]^{1/2},$$

solve the water-jug problem by A^* algorithm. Does this heuristic function return an optimal path? Can you call it an admissible heuristic? Justify your answer. $5+2+2=9$

4. Verify the theorem

$$(p \rightarrow q) \wedge (q \rightarrow p) \Leftrightarrow (p \wedge q) \vee (\neg p \wedge \neg q)$$

by Wang's algorithm. $5+4=9$

5. Prove that $\text{Dog}(\text{fido})$ follows from the following statements by the resolution theorem.

(a) $\forall X \text{ Barks}(X) \rightarrow \text{Dog}(X).$

(b) $\forall X \forall Y \exists Z \text{ Has-master}(X, Y) \wedge \text{Likes}(X, Y) \wedge$
 $\text{Unprecedented-situation}(Z) \rightarrow \text{Barks}(X).$

(c) $\text{Unprecedented-situation}(\text{noise}).$

(d) $\text{Likes}(\text{fido}, \text{jim}).$

(e) $\text{Has-master}(\text{fido}, \text{jim}).$

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(3)

6. Show that the following formula is valid.

$$(A(X) \vee B(Y)) \rightarrow C(Z) \Rightarrow (\neg A(X) \wedge \neg B(Y)) \vee C(Z),$$

where X, Y and Z are variables and A, B and C are predicates.

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