ARTIFICIAL INTELLIGENCE
(MCA1103)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) In 8-Puzzle problem without heuristic the time complexity is
(a) $O(3^{20})$ (b) $O(10^{13})$ (c) $O(10^{24})$ (d) $O(13^{10})$

(ii) A* algorithm is based on
(a) Breadth-First-Search (b) Depth-First –Search
(c) Best-First-Search (d) Hill climbing

(iii) General algorithm applied on game tree for making decision of win/lose is defined by
(a) DFS/BFS Search Algorithms (b) Heuristic Search Algorithms
(c) Greedy Search Algorithms (d) MIN/MAX Algorithms

(iv) Consider a problem of preparing a schedule for a class of student. What type of problem is this?
(a) Search Problem (b) Backtrack Problem
(c) CSP (d) Planning Problem.

(v) Which is also called single inference rule?
(a) Reference (b) Resolution
(c) Reform (d) None of the mentioned.

(vi) What are the main components of the expert systems?
(a) Inference Engine (b) Knowledge Base
(c) Inference Engine & Knowledge Base (d) None of the mentioned.

(vii) Which algorithm will work backward from the goal to solve a problem?
(a) Forward chaining (b) Backward chaining
(c) Hill-Climb algorithm (d) None of the above

(viii) What are the two basic types of inferences?
(a) Reduction to propositional logic, Manipulate rules directly
(b) Reduction to propositional logic, Apply modus ponens
(c) Apply modus ponens, Manipulate rules directly
(d) Convert every rule to Horn Clause, Reduction to propositional logic.

(ix) What is the consequence between a node and its predecessors while creating Bayesian network?
(a) Functionally dependent
(b) Dependant
(c) Conditionally independent
(d) Both Conditionally dependant & Dependant.

(x) The process by which the brain orders actions needed to complete a specific task is referred as
(a) Planning problem
(b) Partial order planning
(c) Total order planning
(d) Both Planning problem & Partial order planning.

Fill in the blanks with the correct word

(xi) Artificial Intelligence has evolved extremely in all the fields except for _____.

(xii) The performance of an agent can be improved by _____.

(xiii) An agent is composed of _____.

(xiv) A _____ is used to demonstrate, on a purely syntactic basis, that one formula is a logical consequence of another formula.

(xv) Face Recognition system is based on _____ type of approach.

Group - B

2. (a) Draw the state space search tree (partial) of any of the following problems:
(i) Wolf-Goat-Cabbage (ii) Missionaries and Cannibals (iii) Tic-Tac-Toe.
[(CO2)(Apply/IOCQ)]

(b) Prove that given the consistency satisfied A* algorithm the cost f(n) is non-decreasing along any path. *[(CO2)(Understand/LOCQ)]*

(c) Explain the working principle of a Learning Agent with suitable diagram.
[(CO1)(Remember/LOCQ)]

5 + 3 + 4 = 12

3. (a) Explain the term heuristic with example based on (i) Euclidian Distance (ii) Manhattan Distance (iii) Number of misplaced tiles. *[(CO2) (Remember/LOCQ)]*

(b) Explain the basic features of Goal Based agent with relevant diagram
[(CO1)(Recognizing) /LOCQ)]

(2 + 2 + 2) + 6 = 12

Group - C

4. (a) Let p be the statement "The sun is shining" and q be the statement "It's a clear day." Suppose the truth values for p and q are as follows: p = 1 (True) q = 0 (False) Given the logical expression: $(p \wedge \neg q) \vee (\neg p \wedge q)$, evaluate the truth value of the expression based on the truth values of p and q provided above. *[(CO3)(Analyze/IOCQ)]*

   (b) Verify the following theorem by Wang's algorithm.
   $p \rightarrow (q \rightarrow r) \Leftrightarrow (p \wedge q) \rightarrow r$ *[(CO3)(Understand/LOCQ)]*

   (c) Let's consider the following premises:
   1. $P \rightarrow (Q \wedge R)$
   2. $Q \rightarrow S$
   3. $R \rightarrow T$

   Based on these premises, determine whether the following conclusion is valid:
   $P \rightarrow (S \wedge T)$
   Using the inference rules of propositional logic, show whether the conclusion can be validly inferred from the given premises. Assign a value of 1 for "valid inference" and 0 for "invalid inference." *[(CO3)(Apply/IOCQ)]*

4 + 4 + 4 = 12

5. (a) We have a pile of 5 stones and Alice and Bob are playing. Alice plays the first and Bob plays the second in an alternate fashion such that Alice removes odd number of stones and Bob removes even number of stones. Whoever makes the pile empty will win. Construct the Game-Tree for the above. *[(CO2,4)(Apply/IOCQ)]*

   (b) Apply backtracking in the context of 4 Queens Problem. *[(CO2,4)(Apply/IOCQ)]*

6 + 6 = 12

Group - D

6. (a) Convert each of the statements in FOL notation.
   "Someone is liked by everyone".
   "Some boys in the class are taller than all the girls".
   "Nobody likes everyone".
   "Some prime number is even number". *[(CO3)(Apply/IOCQ)]*

   (b) Explain the terms forward chaining and backward chaining in Rule based system with relevant example. *[(CO3)(Understand/LOCQ)]*

6 + 6 = 12

7. (a) Consider the following five statements:
   (i) John likes all kind of food.
   (ii) Apple and vegetables are food.
   (iii) Anything anyone eats and not killed is food.
   (iv) Anil eats peanuts and still alive.
   (v) Harry eats everything that Anil eats.
   Now prove by resolution that: "John likes peanuts". *[(CO3)(Apply/IOCQ)]*

(b) You are given two jugs having capacity of 8 gallon and 6 gallon. Neither has any measuring marker on it. You may fill the jugs with water. How can you get exactly 4 gallons of water into the 8- gallon jug? Write down the production rule and solve by forward chaining strategy. *[(CO4)(Design/HOCQ)]*

8 + 4 = 12

Group - E

8. (a) Explain the utility of 'Planning agent' with suitable diagram. *[(CO5)(Understand/LOCQ)]*
   (b) Explain goal-stack-planning with proper example. *[(CO5)(Remember/LOCQ)]*

6 + 6 = 12

9. (a) Explain Bayesian Belief Network with proper diagram. *[(CO5)(Explain/LOCQ)]*
   (b) A doctor is called to see a sick child. The doctor has prior information that 90% of sick children in that neighbourhood have the flu, while the other 10% are sick with measles. A well-known symptom of measles is a rash. Supposing that the probability of having a rash if one has measles is P (R | M) = 0.95. However, occasionally children with flu also develop rash, and the probability of having a rash if one has flu is P (R | F) = 0.08. Upon examining the child, the doctor finds a rash. Evaluate the probability that the child has measles? *[(CO5)(Evaluate/HOCQ)]*

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	48.96	40.61	10.43