*Total number of printed pages: 60* **Programme(UG)/5th/UCSE513**

**2023**

# Artificial Intelligence

*Full Marks : 100*

Time : Three hours

***The figures in the margin indicate full marks for the questions.***

*Answer **any five** questions.*

**1. Answer the following questions:**

**a)** What is the difference between artificial and natural intelligence. **4**

**b)** What kind of challenges was occurred after the Turing test? **5**

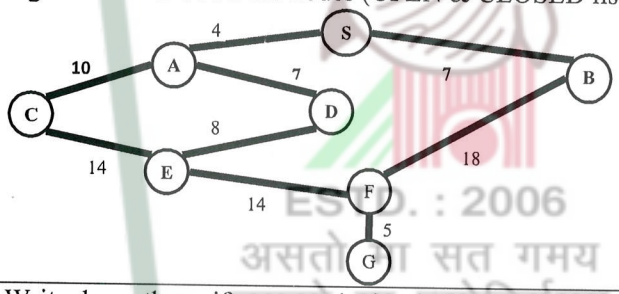
**c)** Write down the rules for executing the action in north and east direction. **5**

**d)** Which one of the training set input for learning to move in South ($x_2\overline{x_3}$) direction? **6**

| Input Number | Sensory vector (s1 s2 s3 s4 s5 s6 s7 s8) |
|---|---|
| 1 | 00011000 |
| 2 | 11100000 |
| 3 | 00100000 |
| 4 | 11100000 |
| 5 | 00001000 |
| 6 | 01100000 |

* (here, S1 to S9 are the agent's cell position ('0' (free cell) & '1'(shaded cell)

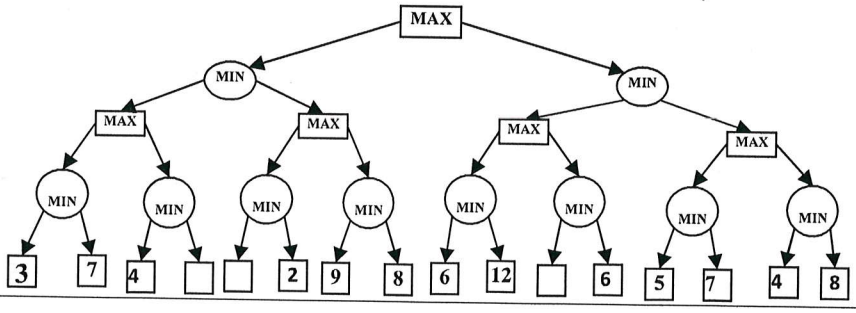
**2. a)** Find the shortest path from start node **(S)** to goal node **(G)** using the uninformed search algorithm. List down the nodes (OPEN & CLOSED list) after the expansion. **8**




**b)** Write down the uniform search algorithm steps. **12**

**3. a)** The heuristic path algorithm is a best-first search in which the objective function is f(n) = (1-w)g(n) + wh(n). For what values of w is this algorithm guaranteed to be optimal? (You may assume that h is admissible.) What kind of search does this perform when w = 0 and w = 1? **4**

**b)** Apply alpha-beta (α-β) pruning algorithm to find out the α & β values. **8**



| | | | |
|---|---|---|---|
| | **c)** | What is the problem reduction search? Describe the formulation using AND/OR graph with dimension and cost? | **4** |
| | **d)** | What is hill climbing search and describe the drawbacks of hill climbing. | **4** |
| | | | |
| **4.** | **a)** | Write down the 6 rule of inferences for generating new wffs from the existing wffs. | **6** |
| | **b)** | Decide whether each of the following sentences is 'VALID' or 'SATISFIABLE'. Verify your decisions using truth tables or the equivalence rules.<br>**a.** *Smoke* $\Rightarrow$ *Smoke*<br>**b.** *Smoke* $\Rightarrow$ *Fire*<br>*e.* *(Smoke* $\Rightarrow$ *Fire)* $\Rightarrow$ *(*$\neg$ *Smoke* $\Rightarrow$ $\neg$*Fire)*<br>**d.** *Smoke* $\vee$ *Fire V* $\neg$*Fire*<br>**e.** *((Smoke*$\wedge$ *Heat)* $\Rightarrow$ *Fire)* $\Leftrightarrow$ *((Smoke* $\Rightarrow$ *Fire)* $\vee$ *(Heat* $\Rightarrow$ *Fire))*<br>**f.** *(Smoke* $\Rightarrow$ *Fire)* $\Rightarrow$ *((Smoke* $\wedge$ *Heat)* $\Rightarrow$ *Fire)*<br>***(Hint:*** *Given Truth Table (*Standard logical equivalences)<br>Standard logical equivalences:<br>$(\alpha \wedge \beta) \equiv (\beta \wedge \alpha)$ (commutativity of $\wedge$)<br>$(\alpha \vee \beta) \equiv (\beta \vee \alpha)$ (commutativity of $\vee$)<br>$((\alpha \wedge \beta) \wedge \gamma) \equiv (\alpha \wedge (\beta \wedge \gamma))$ (associativity of $\wedge$)<br>$((\alpha \vee \beta) \vee \gamma) \equiv (\alpha \vee (\beta \vee \gamma))$ (associativity of $\vee$)<br>$\neg(\neg\alpha) \equiv \alpha$ (double negation elimination)<br>$(\alpha \Rightarrow \beta) \equiv (\neg\beta \Rightarrow \neg\alpha)$ (contrposition)<br>$(\alpha \Rightarrow \beta) \equiv (\neg\alpha \vee \beta)$ (implication elimination)<br>$(\alpha \Leftrightarrow \beta) \equiv ((\alpha \Rightarrow \beta) \wedge (\beta \Rightarrow \alpha))$ (biconditional elimination)<br>$\neg(\alpha \wedge \beta) \equiv (\neg\alpha \vee \neg\beta)$ (De Morgan's Law)<br>$\neg(\alpha \vee \beta) \equiv (\neg\alpha \wedge \neg\beta)$ (De Morgan's Law)<br>$(\alpha \wedge (\beta \vee \gamma)) \equiv ((\alpha \wedge \beta) \vee (\alpha \wedge \gamma))$ (distributivity of $\wedge$ over $\vee$)<br>$(\alpha \vee (\beta \wedge \gamma)) \equiv ((\alpha \vee \beta) \wedge (\alpha \vee \gamma))$ (distributivity of $\vee$ over $\wedge$) | **10** |
| | **c)** | The given knowledge base *(KB):* All dogs like bones, dogs eat everything they like, and Rocky is a dog.<br>In First order Logic (FOL), *KB* =<br>(1) $\forall x$ *Dog*$(x) \Rightarrow$ *Likes*$(x,$ *Bone*$)$<br>(2) $\forall x\ \forall y$ *(Dog*$(x) \wedge$ *Likes*$(x, y)) \Rightarrow$ *Eats* $(x, y)$<br>(3) Dog (*Rocky*)<br>**Query**: Does Rocky eats Bone?<br>*(Hint: Use Generalized Modus Ponens (GMP))* | **4** |
| | | | |
| **5.** | Write short notes on the following (***any four***): | | **4x5=20** |
| | **a)** | Perception-action cycle | |
| | **b)** | Non-Monotone Heuristic | |
| | **c)** | Simulated annealing | |
| | **d)** | Genetic algorithm | |
| | **e)** | Local search algorithm | |
| **6.** | Differentiate between the following (***any four***): | | **4x5=20** |
| | **a)** | State space graph and decision tree | |
| | **b)** | BFS and DFS | |
| | **c)** | Single layer Neural Network and Multilayer Neural Network | |
| | **d)** | Alpha and Beta (Pruning algorithm) | |
| | **e)** | Propositional logic and Predicate logic | |