

**ARTIFICIAL INTELLIGENCE  
(INFO 4111)**

**Time Allotted : 3 hrs**

**Full Marks : 70**

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.*

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

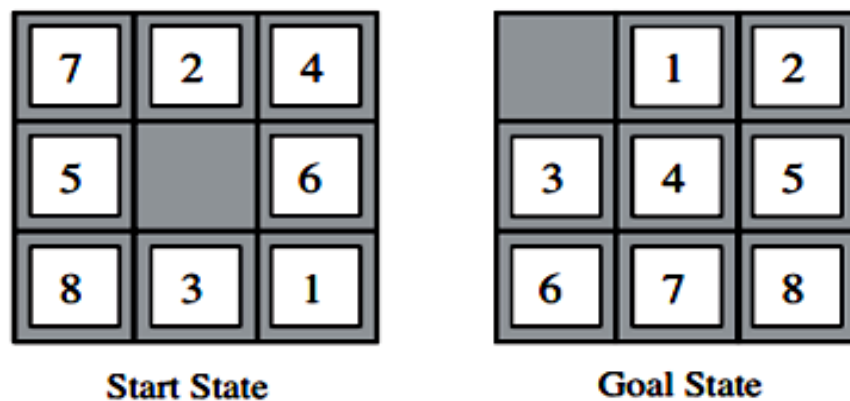
**Group – A  
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The application/applications of Artificial Intelligence is/are  
(a) expert systems (b) gaming (c) vision systems (d) all of the above.
  - (ii) Among the given options, which is not the required property of knowledge representation?  
(a) Inferential Efficiency (b) Inferential Adequacy  
(c) Representational Verification (d) Representational Adequacy.
  - (iii) Which algorithm is used in the Game tree to make decisions of Win/Lose?  
(a) Heuristic search algorithm (b) DFS/BFS algorithm  
(c) Greedy search algorithm (d) Min/Max algorithm.
  - (iv) Which rule is applied for the simple reflex agent?  
(a) Simple-action rule (b) Simple & Condition-action rule  
(c) Condition-action rule (d) None of the above.
  - (v) Which term describes the common-sense of the judgmental part of problem-solving?  
(a) Values-based (b) Critical (c) Analytical (d) Heuristic.
  - (vi) The search algorithm which is similar to the minimax search, but removes the branches that don't affect the final output is known as \_\_\_\_\_  
(a) Depth-first search (b) Breadth-first search  
(c) Alpha-beta pruning (d) None of the above.
  - (vii) Which algorithm takes two sentences as input and returns a Unifier?  
(a) Inference (b) Hill-Climbing (c) Unify algorithm (d) Depth-first search.
  - (viii) First order logic Statements contains \_\_\_\_\_  
(a) Predicate and Preposition (b) Subject and an Object  
(c) Predicate and Subject (d) None of the above.
  - (ix) \_\_\_\_\_ number of informed search method are there in Artificial Intelligence.  
(a) 4 (b) 3 (c) 2 (d) 1

- (x) The total number of proposition symbols in AI are \_\_\_\_\_
- (a) 3 proposition symbols (b) 1 proposition symbols  
 (c) 2 proposition symbols (d) None of the above.

**Group- B**

2. (a) State the definition of rational agent. Are reflex actions (such as flinching from a hot stove) rational? [(CO1)(Remember/LOCQ)]  
 (b) Describe the PEAS (Performance, Environment, Actuators, Sensors) description of medical diagnosis system. [(CO1)(Understand/LOCQ)]  
 (c) Describe a model-based reflex agent with diagram and program. [(CO1)(Analyze/IOCQ)]  
**(2 + 1) + 4 + 5 = 12**
3. (a) What's the difference between a world state, a state description, and a search node? [(CO2)(Remember/LOCQ)]  
 (b) Describe standard components of 8-puzzle problem formulation with following instance. [(CO2)(Analyze/IOCQ)]

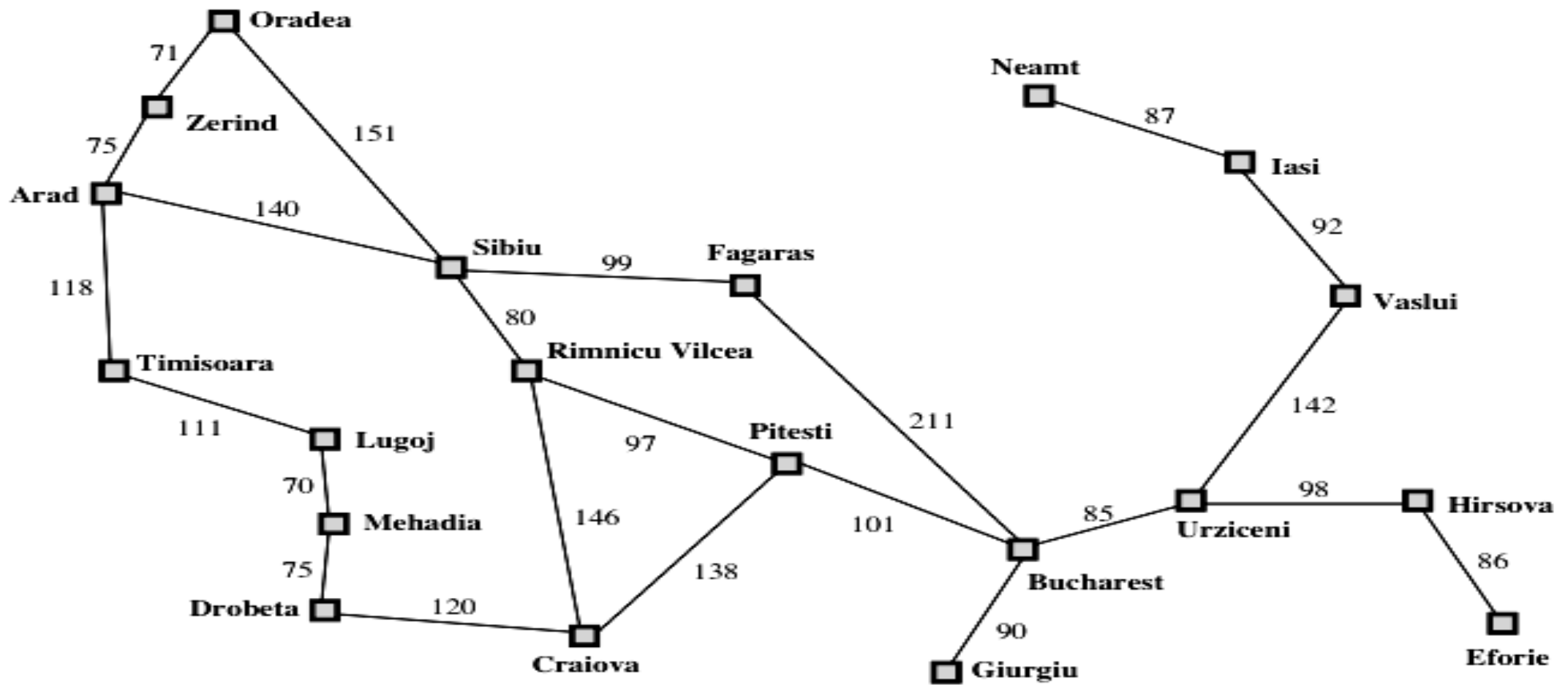


- (c) Describe syntax and semantics of propositional logic. [(CO4)(Understand/LOCQ)]  
**3 + 4 + 5 = 12**

**Group - C**

4. Generate a significant number of 8-puzzle and 8-queens instances and solve them (where possible) by
- (i) Hill climbing (steepest-ascent and first-choice variants)  
 (ii) Hill climbing with random restart  
 (iii) Simulated annealing. [(CO3)(Evaluate/HOCQ)]  
**(4 + 4 + 4) = 12**
5. Suppose two friends live in different cities on a countries map given below. On every turn, we can simultaneously move each friend to a neighboring city on the map. The amount of time needed to move from city i to neighbor j is equal to the road distance d(i, j) between the cities, but on each turn the friend that arrives first must wait until the other one arrives (and calls the first on his/her cell phone) before the next turn can begin. We want the two friends to meet as quickly as possible.
- (i) Write a detailed formulation for this search problem.  
 (ii) Let D(i, j) be the straight-line distance between cities i and j. Which of the following heuristic functions are admissible? (i) D(i, j); (ii) 2 · D(i, j); (iii) D(i, j)/2.

- (iii) Are there completely connected maps for which no solution exists?
- (iv) Are there maps in which all solutions require one friend to visit the same city twice?



[(CO3)(Evaluate/HOCQ)]  
 (5 + 2 + 2 + 3) = 12

**Group - D**

- 6. (a) Describe the steps of knowledge engineering process in brief. [(CO4)(Remember/LOCQ)]
- (b) From Likes(Jerry, IceCream) it seems reasonable to infer  $\exists x$  Likes(x, IceCream). Write down a general inference rule, **Existential Introduction**, that sanctions this inference. State carefully the conditions that must be satisfied by the variables and terms involved. [(CO4)(Analyze/IOCQ)]
- (c) Give a forward-chaining proof of the sentence  $7 \leq 3 + 9$  based on below mentioned axioms. Again, show only the steps that lead to success.
  - 1.  $0 \leq 3$ .
  - 2.  $7 \leq 9$ .
  - 3.  $\forall x x \leq x$ .
  - 4.  $\forall x x \leq x + 0$ .
  - 5.  $\forall x x + 0 \leq x$ .
  - 6.  $\forall x, y x + y \leq y + x$ .
  - 7.  $\forall w, x, y, z w \leq y \wedge x \leq z \Rightarrow w + x \leq y + z$ .
  - 8.  $\forall x, y, z x \leq y \wedge y \leq z \Rightarrow x \leq z$ .

[(CO1)(Analyze/IOCQ)]  
 4 + 4 + 4 = 12
- 7. (a) We have a bag of three biased coins a, b, and c with probabilities of coming up heads of 20%, 60%, and 80%, respectively. One coin is drawn randomly from the bag (with equal likelihood of drawing each of the three coins), and then the coin is flipped three times to generate the outcomes X1, X2, and X3.
  - (i) Draw the Bayesian network corresponding to this setup and define the necessary CPTs.

- (ii) Calculate which coin was most likely to have been drawn from the bag if the observed flips come out heads twice and tails once. [(CO5)(Evaluate/HOCQ)]
- (b) Describe Fuzzy logic and Fuzzy control with example. [(CO5)(Understand/LOCQ)]
- (3 + 3) + (3 + 3) = 12**

### Group - E

8. (a) Consider the problem faced by an infant learning to speak and understand a language. Explain how this process fits into the general learning model. Describe the percepts and actions of the infant, and the types of learning the infant must do. Describe the subfunctions the infant is trying to learn in terms of inputs and outputs, and available example data. [(CO5)(Analyse/IOCQ)]
- (b) Suppose we generate a training set from a decision tree and then apply decision-tree learning to that training set. Is it the case that the learning algorithm will eventually return the correct tree as the training-set size goes to infinity? Why or why not? [(CO5)(Analyse/IOCQ)]
- (c) Define linear regression with example. **(2 + 2 + 2) + (2 + 1) + 3 = 12**
9. (a) Suppose that the optimistic reachable set of a high-level plan is a superset of the goal set; can anything be concluded about whether the plan achieves the goal? What if the pessimistic reachable set doesn't intersect the goal set? Explain. [(CO6)(Analyse/IOCQ)]
- (b) Rule-based systems often contain rules with several conditions in their left sides.
- (i) Why is this true in MYCIN?
- (ii) Why is this true in RI? [(CO6)(Analyse/IOCQ)]
- (3 + 3) + (3 + 3) = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	33.33	30.20	36.45

#### Course Outcome (CO):

After the completion of the course students will be able to

1. Explain the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.
2. Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
3. Explore various searching algorithms (uninformed, informed, heuristic, Adversarial Search etc).
4. Represent knowledge using propositional and first-order predicate logic in order to solve complex problems based on the intelligent behavior of humans.
5. Use different machine learning techniques to design AI machine and developing applications for real world problems.
6. Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.

\*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.