U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

April 2025 Semester End Make-Up Examinations

Programme: B.E. **Semester: V**

Branch: Computer Science and Engineering **Duration: 3 hrs.**

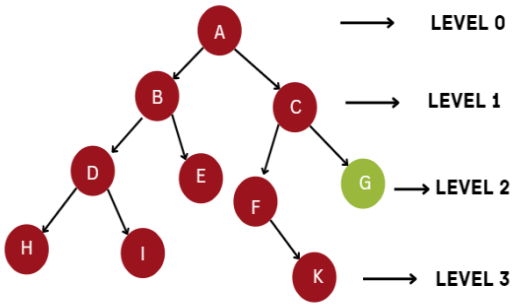
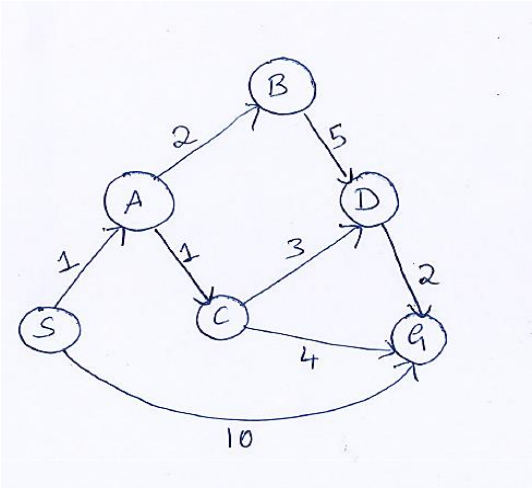
Course Code: 23CS5PCAIN / 22CS5PCAIN **Max Marks: 100**

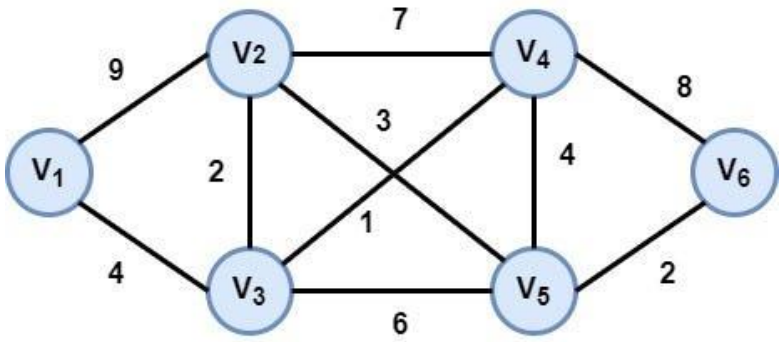
Course: Artificial Intelligence

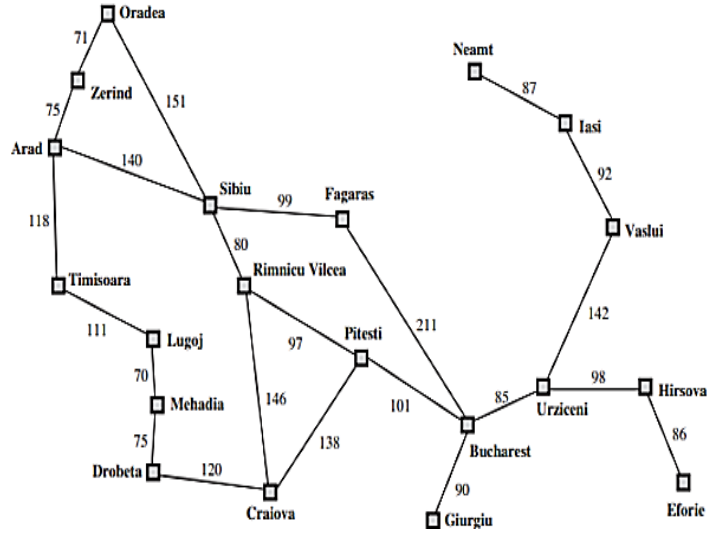
Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Develop the PEAS description and properties of the task environment for i) Shopping for used AI books on the Internet ii) Mathematician' s theorem proving assistant	*CO1*	*PO1*	**6**
	b)	A logistics company aimed to enhance its delivery services by implementing autonomous drones that could deliver packages to customers' doorsteps. The company wanted to reduce human labor costs, increase efficiency, and speed up delivery times. However, to achieve this, they needed an intelligent agent capable of navigating the environment, making decisions, and completing deliveries autonomously, based on predefined goals such as the delivery of a specific package to a specific address. Demonstrate an agent architecture suitable for the given scenario. Justify your answer.	*CO1*	*PO1*	**6**
	c)	Assume that there is one 3-liter jug, one 5-liter jug and an unlimited supply of water. The goal is to get exactly one liter of water into either jug. Either jug can be emptied or filled, or poured into the other. Give the initial state, goal state, operators and path cost function for the problem and also draw the state space diagram.	*CO1*	*PO1*	**8**
		OR			
2	a)	Develop the PEAS description and properties of the task environment for i) Exploring the subsurface oceans of Titan ii) Automated Car Driver	*CO1*	*PO1*	**6**
	b)	An automotive company is developing an autonomous vehicle (self-driving car) that can safely navigate roads and make driving decisions without human intervention. The company wants to create an intelligent system that can dynamically make decisions about acceleration, braking, and steering while accounting for	*CO1*	*PO1*	**6**

			varying traffic conditions, obstacles, road signs, and other factors to optimize both safety and driving efficiency. Demonstrate an agent architecture suitable for the given scenario. Justify your answer.			
		c)	Assume that there are some missionaries and some carnivals will be at a side of a river. They want to cross the river. But there is only one boat available to cross the river. The capacity of the boat is 2 and no one missionary or no Carnivals can cross the river together. Give the initial state, goal state, operators and path cost function for the problem and also draw the state space diagram.	*CO1*	*PO1*	**8**
			UNIT - II			
	3	a)	Explain the importance of local search algorithm along with its state-space landscape with a neat diagram.	*CO1*	*PO1*	**6**
		b)	Point out the algorithm that combines the advantages of breadth first search and depth first search algorithms. Under what circumstances the algorithm would be a better choice. Show the iterations computed to find the goal node G from A by applying the algorithm chosen. Comment on the completeness and optimality of the algorithm.  	*CO2*	*PO2*	**6**
		c)	Traverse the graph using A* algorithm and find the optimal path from S to G. Comment on the completeness and optimality of the algorithm. Calculate the time and space complexity of the same.  	*CO2*	*PO2*	**8**

			<table><tr><th>State</th><th>h(n)</th></tr><tr><td>S</td><td>5</td></tr><tr><td>A</td><td>3</td></tr><tr><td>B</td><td>4</td></tr><tr><td>C</td><td>2</td></tr><tr><td>D</td><td>6</td></tr><tr><td>G</td><td>0</td></tr></table>			
			OR			
	4	a)	A significant drawback of Hill climbing algorithm is that it gets stuck in local maxima. This happens when the algorithm reaches a peak that is higher than its immediate neighbors but lower than the highest peak. Point out the algorithm that allows to escape states that lead to local maxima. Explain the working of the same.	*CO1*	*PO1*	**6**
		b)	Consider the graph representing a roadmap of a country, in which there are six cities (vertices — nodes) and a couple of edges connecting these cities.  Analyze the graph to apply uniform cost search algorithm to go from the city V1 to V6 following the path with the smallest cost. Show step by step graph traversal. Comment on the time and space complexity of the same.	*CO2*	*PO2*	**6**
		c)	Consider the following map of Romania along with its straight-line distance heuristics.	*CO2*	*PO2*	**8**

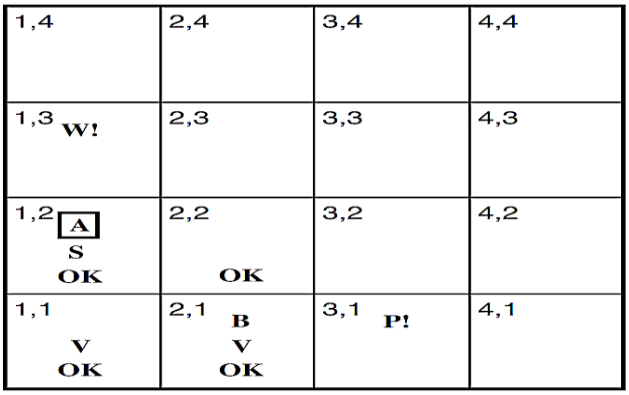


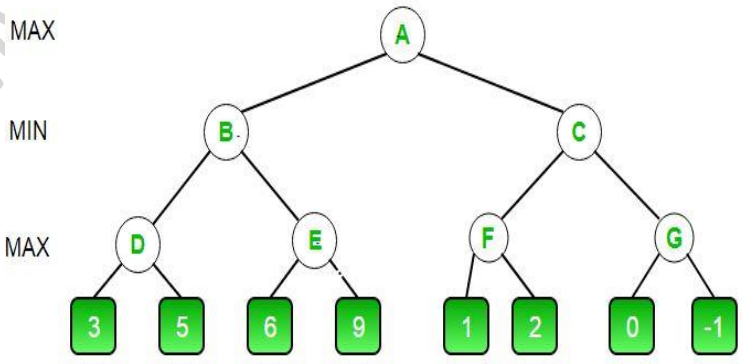
Arad	366	Mehadia	241
Bucharest	0	Neamt	234
Craiova	160	Oradea	380
Drobeta	242	Pitesti	100
Eforie	161	Rimnicu Vilcea	193
Fagaras	176	Sibiu	253
Giurgiu	77	Timisoara	329
Hirsova	151	Urziceni	80
Iasi	226	Vaslui	199
Lugoj	244	Zerind	374

Values of h_{SLD}—straight-line distances to Bucharest.

Show the sequences of cities visited while traversing from Arad to Bucharest by applying greedy best search algorithm. Comment on the optimality, completeness and complexity of the algorithm when applied to the given scenario.

		UNIT - III			
5	a)	Point out the syntactic elements of first order logic. Differentiate between the Universal instantiation and Existential instantiation.	*CO1*	*PO1*	**6**
	b)	Let x, y and z be: x: Robert is a policeman y: Robert is a footballer z: Robert has big feet. The Knowledge Base contains the facts: • Robert is either a policeman or a footballer. • If he is a policeman, then he has big feet. • Robert has not got big feet. Perform the following. a. Represent these facts in prepositional logic. b. If the query is "Is Robert a footballer?", using truth table approach show the query is entitled by the Knowledge Base.	*CO2*	*PO2*	**6**

		c)	Illustrate Backus-Naur Form grammar of sentences in propositional logic along with operator precedence. Suppose the agent has progressed to the point shown in Figure having perceived nothing in [1,1], a breeze in [2,1], and a stench in [1,2], and is now concerned with the contents of [1,3], [2,2], and [3,1]. Each of these can contain a pit, and at most one can contain a Wumpus. Design the worlds in which the KB is true and those in which each of the following sentences is true: α2 = "There is no pit in [2,2]." α3 = "There is a Wumpus in [1,3]." Hence show that KB |= α2 and KB |= α3. 	*CO2*	*PO2*	**8**
			OR			
	6	a)	Consider a vocabulary with the following symbols: Occupation (p, o): Predicate. Person p has occupation o. Customer (p1, p2): Predicate. Person p1 is a customer of person p2. Boss (p1, p2): Predicate. Person p1 is a boss of person p2. Doctor , Surgeon, Lawyer , Actor : Constants denoting occupations. Emily, Joe: Constants denoting people. Use these symbols to write the following assertions in first-order logic: a. Emily is either a surgeon or a lawyer. b. Joe is an actor, but he also holds another job. c. All surgeons are doctors. d. Joe does not have a lawyer (i.e.,is not a customer of any lawyer). e. Emily has a boss who is a lawyer. f. There exists a lawyer all of whose customers are doctors	*CO1*	*PO1*	**6**
		b)	Analyze whether the following statements are a tautology, contradiction, or neither? i) (A ∨ B) ∧ (¬B ∨ C) ⇒ (A ∨ C) ii) (A ⇒ B) ⇔ (¬B ⇒ ¬A) iii) ¬ (¬gas_in_tank ∧ (gas_in_tank ∨ ¬car_starts) ⇒ ¬car_starts)	*CO2*	*PO2*	**6**
		c)	You are walking and all of a sudden you find yourself in front of three possible roads: the road on your left is paved with gold, the one in front of you is paved with marble, while the one on your right is made of small stones. Each street is protected by a guard. You talk to the guard and this is what they tell you: • The guard of the gold street: "This road will bring you straight to the center. Moreover, if the stones	*CO2*	*PO2*	**8**

			take you to the center, then also the marble takes you to the center." • The guard of the marble street: "Neither the gold nor the stones will take you to the center." • The guard of the stone street: "Follow the gold and you'll reach the center, follow the marble and you will be lost." Given that you know that all the guards are liars, can you choose a road being sure that it will lead you to the centre? If this is the case, which road you choose? Formalize the puzzle in Propositional Logic and solve using truth table.			
			UNIT - IV			
	7	a)	List out the condition for unification. Consider the following statements. (i) If it is a pleasant day you will do strawberry picking (ii) If you are doing strawberry picking you are happy. Prove that "If it is a pleasant day, you are happy." and draw the and-or graph.	*CO1*	*PO1*	**6**
		b)	Suppose a new pet, Fritz, is delivered in an opaque box along with two facts about Fritz: Fritz croaks Fritz eats flies The goal is to decide whether Fritz is green, based on a rule base containing the following four rules: If X croaks and X eats flies – Then X is a frog If X chirps and X sings – Then X is a canary If X is a frog – Then X is green If X is a canary – Then X is yellow Apply backward chaining to infer the goal.	*CO2*	*PO2*	**6**
		c)	Given a game tree representing possible moves in a two-player zero-sum game determine the optimal move for Player 1 (Max) using the minimax algorithm with alpha-beta pruning. Show the branches that could be pruned. Write the algorithm for the same.  	*CO2*	*PO2*	**8**
			OR			
	8	a)	Imagine two neighboring countries, Country A and Country B, that share a border along a river. Both countries have large	*CO1*	*PO1*	**6**

<table>
<tr><td></td><td></td><td></td><td>industrial sectors, and the industries release pollutants into the river, which negatively impacts the environment and public health in both countries. However, both countries are facing a dilemma regarding how to handle the pollution. Analyze the dilemma faced by both the countries. Demonstrate the possible choices available to handle the dilemma and the effect caused by each choice.</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>b)</td><td>Apply Expectiminimax algorithm to analyze which choice of investment would be better to be made based the following payoff data table. Show step by step tree diagram.
<table><tr><td></td><td>Growing</td><td>Declining</td></tr><tr><td>Stocks</td><td>70</td><td>-13</td></tr><tr><td>Mutual Funds</td><td>53</td><td>-5</td></tr><tr><td>Bonds</td><td>20</td><td>20</td></tr><tr><td>Probability</td><td>0.4</td><td>0.6</td></tr></table></td><td>CO2</td><td>PO2</td><td>6</td></tr>
<tr><td></td><td></td><td>c)</td><td>Consider the following set of sentences
(a) Marcus was a man.
(b) Marcus was a Roman.
(c) All men are people.
(d) Caesar was a ruler.
(e) All Romans were either loyal to Caesar or hated him (or both).
(f) Everyone is loyal to someone.
(g) People only try to assassinate rulers they are not loyal to.
(h) Marcus tried to assassinate Caesar.
Resolve the query” Who hated Caesar?” by applying forward chaining technique. Follow the necessary steps.</td><td>CO2</td><td>PO2</td><td>8</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - V</td><td></td><td></td><td></td></tr>
<tr><td></td><td>9</td><td>a)</td><td>Examine absolute independence with respect to probability assertions on a fully joint distribution table with an example.</td><td>CO1</td><td>PO1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>A desk lamp produced by The Luminar Company was found to be defective (D). There are three factories (A,B,C) where such desk lamps are manufactured. A Quality Control Manager (QCM) is responsible for investigating the source of found defects. This is what the QCM knows about the company's desk lamp production and the possible source of defects:
<table><tr><td>Factory</td><td>% of total production</td><td>Prob. Defective lamps</td></tr><tr><td>A</td><td>0.35</td><td>0.015</td></tr><tr><td>B</td><td>0.35</td><td>0.010</td></tr><tr><td>C</td><td>0.30</td><td>0.020</td></tr></table>Which factory A,B or C has the highest conditional probability of producing a defective lamp?</td><td>CO2</td><td>PO2</td><td>6</td></tr>
<tr><td></td><td></td><td>c)</td><td>You are given two different Bayesian network structures 1 and 2, each consisting of 5 binary random variables A, B, C, D, E. Each variable corresponds to a gene, whose expression can be either “ON” or “OFF”.</td><td>CO3</td><td>PO3</td><td>8</td></tr>
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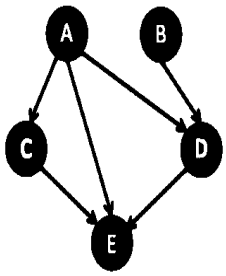
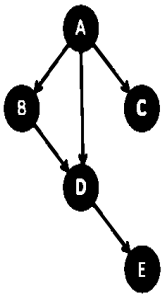
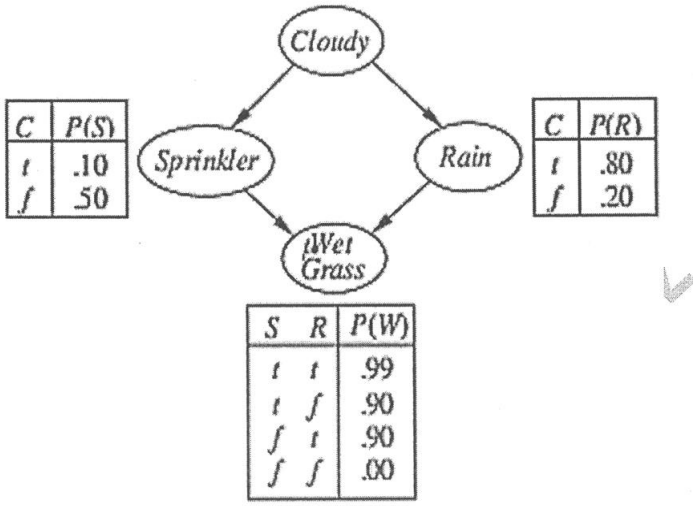
			 Network 1  Network 2 The joint probability over all the variables could be factored into terms of conditional probabilities. Write the expression for the joint probability distribution P(A,B,C,D,E) as a product of conditional probabilities and also calculate the number of parameters required to in both network1 and network 2. Using Network 2 and the probabilities given below, $P(A=ON)=0.6$ $P(B=ON\mid A)=\begin{cases}0.1, & A=OFF\\ 0.95, & A=ON\end{cases}$ $P(C=ON\mid A)=\begin{cases}0.8, & A=OFF\\ 0.5, & A=ON\end{cases}$ $P(D=ON\mid A,B)=\begin{cases}0.1 & A=OFF,B=OFF\\ 0.9 & A=ON,B=OFF\\ 0.3 & A=OFF,B=ON\\ 0.95 & A=ON,B=ON\end{cases}$ $P(E=ON\mid D)=\begin{cases}0.8, & D=OFF\\ 0.1, & D=ON\end{cases}$ calculate the probability of the following i) P(A=ON, B=ON, C=ON, D=ON, E=ON) ii) P(E = ON | A = ON)			
			OR			
	10	a)	Examine how Bayes theorem could be applied to answer probabilistic queries conditioned on a single piece of evidence with an example.	*CO1*	*PO1*	**6**
		b)	Three industries produce ICs to supply the market. Industry X produces 20%, 50% of the ICs are produced in Y industry and 30% in Industry Z. 2% of the ICs produced in X, 1% of the ICs produced in Y and 3% of the ICs produced in Z are defective. An IC is selected at random in the market and found to be defective. what is the probability that this was produced by Y?	*CO2*	*PO2*	**6**
		c)	A Bayesian network shown below along with conditional Probabilities. Compute the probability P(W) and P(S|W).	*CO3*	*PO3*	**8**



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