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

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main 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.

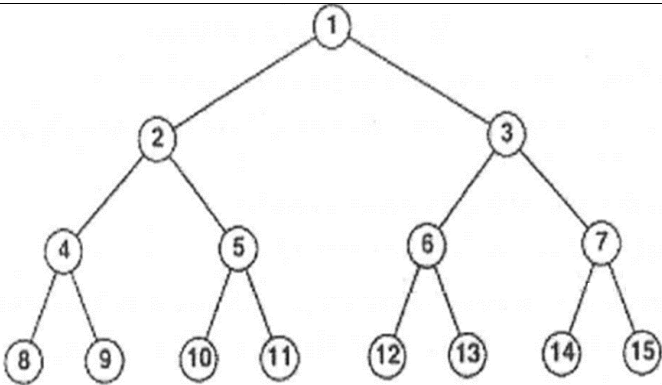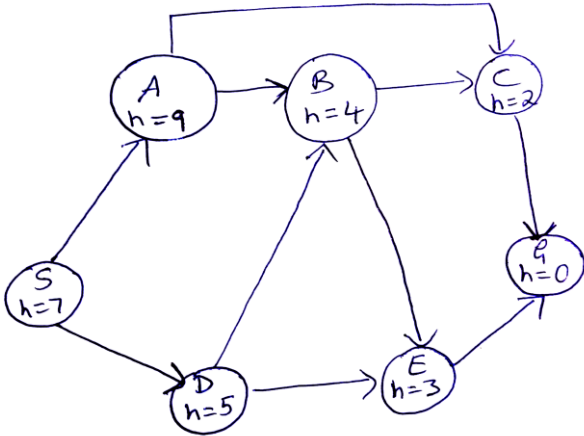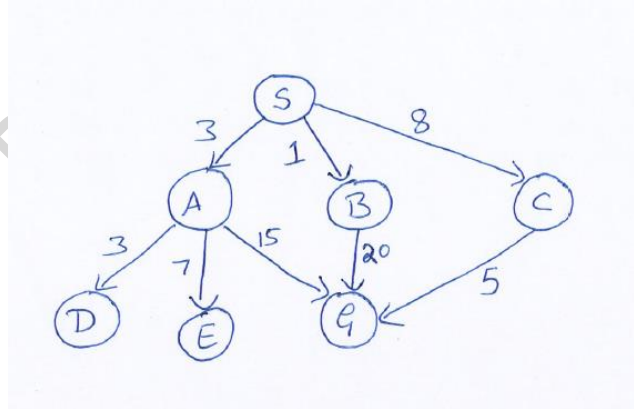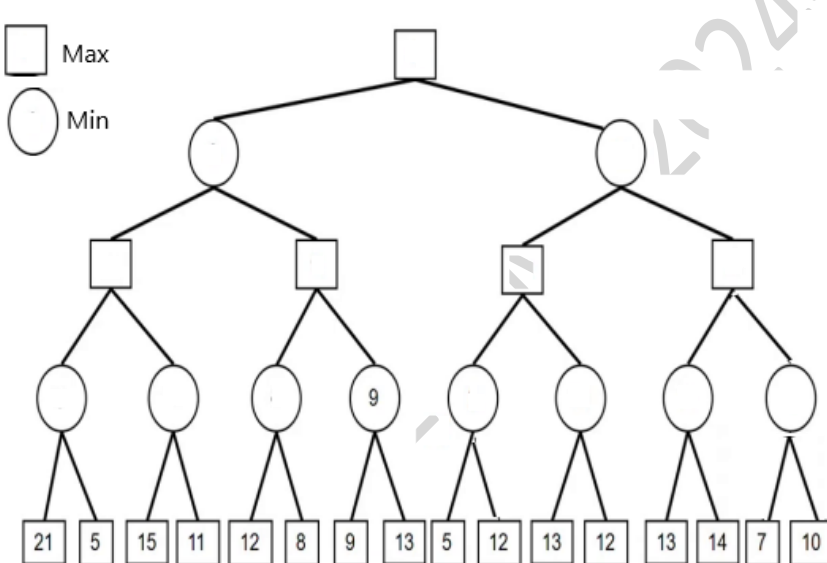|				CO	PO	Marks
			UNIT - I	*CO*	*PO*	**Marks**
1	a)		With neat diagram describe Utility-based agent architecture.	*CO1*	*PO1*	**10**
	b)		The missionaries and cannibals problem is usually stated as follows. Three missionaries and three cannibals are on one side of a river, along with a boat that can hold one or two people. Find a way to get everyone to the other side without ever leaving a group of missionaries in one place outnumbered by the cannibals in that place. Give the Initial state, Goal state, Operators (or Actions) and write the state space diagram showing at least one solution.	*CO3*	*PO3*	**10**
			OR			
2	a)		List and explain different properties of task environment.	*CO1*	*PO1*	**10**
	b)		A 3-foot-tall monkey is in a room where some bananas are suspended from the 8-foot ceiling. She would like to get the bananas and specifically end up on the ground with the bananas. The room contains two stackable, movable, climbable 3-foot-high crates, which you can call P and Q. The monkey is initially on the ground, as are both of the crates, and nothing is under the bananas initially. Assume that the monkey wants to accomplish the task with the fewest possible actions. Give the Initial state, Goal state, Operators (or Actions) and write the state space diagram showing at least one solution.	*CO3*	*PO3*	**10**
			UNIT - II			

3	a)		Consider the graph given below. If the goal state is numbered '11', list the order in which the states will be visited using
			
			   i. Depth First search
			   ii. Breadth first search and
			   iii. Depth limited search with limit 2 (depth of root is 0)
				CO2	*PO2*	**5**

	b)	Prove that A* (A-star) search algorithm is Optimal.	CO2	PO2	**5**
	c)	Write Greedy Best First Search Algorithm. Apply Greedy Best First Search Algorithm for the following graph to find solution path from S to G. Write all steps as well as open and closed lists.	CO2	PO2	**10**
		OR			
4	a)	For the following graph, apply Uniform cost search to find path from S to G. Show the solution steps completely and clearly.	CO1	PO1	**5**
	b)	Compare Iterative deepening depth first search and Breadth first search	CO2	PO2	**5**
	c)	Apply A* (A-star) search algorithm for 8-Puzzle problem with Start state and Goal state as shown below. Design the state space	CO3	PO3	**10**

			diagram. In the state space diagram show the cost function f(n) value calculation for each node.			

2	8	3
1	6	4
7		5

Start State

1	2	3
8		4
7	6	5

Goal State

UNIT - III

5	a)	Consider a Knowledge Base (KB) that contains the following propositional logic sentences: P ∨ ¬Q ¬R ⇒ Q (Q ∨ R) ⇒ P i. Construct a truth table that shows the truth value of each sentence in KB and indicate the models in which the KB is true. ii. Does KB entail P? Justify your answer. iii. Does KB entail R? Justify your answer. iv. Does KB entail R ⇒ P? Justify your answer	CO2	PO2	**10**
	b)	Represent the following statements using First Order logic (FOL). i. All Students are smart. ii. There exists a smart student. iii. Bill takes either Analysis or Geometry course (but not both). iv. John's social security number is the same as Mary's. v. All the courses in the Food Processing department are easy.	CO1	PO1	**10**

OR

6	a)	Let p, q, r be: p: Raj is a software Engineer q: Raj is a Basketball player r: Raj has big car The knowledge Base (KB) contains the facts: Raj is either Software Engineer or a Basketball player If he is a Software Engineer, then he has the big car. Raj does not have big car. Represent the above sentences in propositional logic. Apply truth table approach to show whether the KB entails query "Is Raj a Basketball player?"	CO2	PO2	**6**
	b)	List and explain different types of Quantifiers in First order logic.	CO1	PO1	**4**
	c)	Represent the following statements using First Order logic (FOL) i. All students are intelligent. ii. Penguins are birds but cannot fly. iii. Anyone who kills an animal is loved by no one. iv. There are no leafy vegetables that are tasty and starchy. v. Everyone who owns a dog is an animal lover.	CO1	PO1	**10**

			UNIT - IV			
	7	a)	With an example describe the Prisoner's Dilemma problem.	*CO1*	*PO1*	**8**
		b)	Convert the following statements into FOL statements and prove the following statement using both forward and backward chaining. As per the law, it is illegal for a citizen of Country X to export endangered animals to foreign nations. Country Y, which has a history of harming wildlife, recently received a shipment of endangered animals. The shipment was confirmed to have been sent by Alex, a citizen of Country X. Prove that "Alex violated the law."	*CO3*	*PO3*	**12**
			OR			
	8	a)	Apply the Alpha-Beta search algorithm to find value of root node and path to root node (MAX node). Identify the paths which are Pruned (or cut off) for exploration. 	*CO2*	*PO2*	**8**
		b)	Convert the following statements into FOL statements and prove the following statement using Resolution. Given the Knowledge Base (KB) or Premises: Everyone who likes Science also likes Physics or Mathematics. Anyone who likes Mathematics also likes Statistics. Alice likes Science. Bob likes Physics. If someone likes Statistics, then they like Data Analysis. Prove by resolution that: Alice likes Data Analysis.	*CO3*	*PO3*	**12**
			UNIT - V			
	9	a)	Solve the following problems **i.** In a factory that produces bolts, three machines—A, B, and C—are responsible for manufacturing 25%, 35%, and 40% of the total bolts, respectively. The defect rates of these machines differ: machine A produces 5% defective bolts, machine B produces 4% defective bolts, and machine C produces 2% defective bolts. A bolt is randomly selected from the overall production, and it is	*CO2*	*PO2*	**10**

found to be defective. Find the probability that this defective bolt was produced by machine B.

ii. A newly constructed bridge may fall down either due to wrong designing or by inferior material used in construction. The chance that the design is faulty is 10% and the probability of its collapse if the design is faulty is 95% and that due to bad material it is 45%. If the bridge collapses. Find the probability that it was due to wrong designing.

b) Given the full joint distribution shown in table below, calculate the following
 	
   i.   P(toothache)
   ii.   P(cavity)
   iii.   P (toothache | cavity)
   iv.   P (cavity | toothache ∨ catch)
	CO3	PO3	**10**

	toothache		¬toothache	
	catch	¬catch	catch	¬catch
cavity	0.108	0.012	0.072	0.008
¬cavity	0.016	0.064	0.144	0.576

OR

10	a)	Solve the following problems **i.** There are three bags containing 3 white and 2 black balls; 2 white and 3 black balls; 1 black and 4 white balls respectively. There is an equal probability of each bag being chosen. One ball is chosen at random with equal probability. Find the probability that a white ball is drawn. **ii.** A car manufacturing company operates two plants, X and Y. Plant X produces 70% of the cars, while Plant Y produces 30%. Out of the cars manufactured, 80% at Plant X and 90% at Plant Y are rated as standard quality. If a car is selected at random and found to be of standard quality, find the probability that it was produced by Plant X.		CO2	PO2	**10**
	b)	Consider the Bayesian network given below and solve the following problems i. Find the probability that the alarm has sounded but neither a Burglary nor the Earthquake has occurred, and both John and Mary Calls. ii. Find the probability that John calls.		CO3	PO3	**10**

B	E	P(A|B,E)
T	T	.95
T	F	.94
F	T	.29
F	F	.001

P(B) .001

P(E) .002

A	P(J|A)
T	.90
F	.05

A	P(M|A)
T	.70
F	.01

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