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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

Accelerated Semester

MID TERMEXAMINATION- 2026

B.Tech-VII Semester (CSE/IT)

COURSE CODE (CREDITS): 18B1WCI742 (2) MAX. MARKS: 50

COURSE NAME: ARTIFICIAL INTELLIGENCE

COURSE INSTRUCTORS: VANI SHARMA MAX. TIME: 2 Hours

Note: *(a) All questions are compulsory.*

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

(c) Calculator is allowed

Q.No	Question	CO	Marks
Q1	a) Explain the role of selection, crossover, and mutation in a Genetic Algorithm. How do these operators help in improving the quality of solutions across generations? b) Consider a Genetic Algorithm where chromosomes are represented as binary strings of length 6. The fitness function is defined as: f(x)=Number of 1s in the chromosome. The initial population is given as: $x_1 = 101011$ $x_2 = 110001$ $x_3 = 011010$ $x_4 = 100111$ (i) Calculate the fitness of each chromosome. (ii) Identify the two fittest chromosomes. (iii) Perform **one-point crossover** at position 3 on the two fittest chromosomes and write the resulting offspring.	3	[4+6]
Q2	a) Show that the propositional formula $(\neg p) \wedge (\neg(p \wedge q))$ is logically equivalent to $\neg p$. b) Represent all the following statements in First-Order Logic. 1. Lucy is a professor. 2. All professors are people. 3. John is the dean. 4. All deans are professors. 5. All professors consider the dean a friend or do not know him. 6. Everyone is a friend of someone. 7. People only criticize people who are not their friends. 8. Lucy criticized John. Verify: Is John not a friend of Lucy?	3	[5+5]

<table>
<tr><td>Q3</td><td>a) Explain intelligent agents with architecture diagrams. Identify and explain the characteristics of a problem that an intelligent system must solve. Illustrate your answer by classifying the problem environment in terms of observability, determinism, episodic vs sequential, and static vs dynamic nature.

b) A medical test is used to detect a disease.
• The probability that a person has the disease is 0.02.
• If a person has the disease, the test correctly detects it with probability 0.95.
• If a person does not have the disease, the test incorrectly gives a positive result with probability 0.05.
Using Bayes' Theorem, calculate the probability that a person actually has the disease given that the test result is positive.</td><td>1,2</td><td>[6+3]</td></tr>
<tr><td>Q4</td><td>Write the problem characteristics of 8 - puzzle problem. How many minimum steps are required formoving from initial state to final state in the below described problem:

Initial State<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>8</td><td>6</td><td>4</td></tr><tr><td>7</td><td></td><td>5</td></tr></table>Final State<table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>8</td><td></td><td>4</td></tr><tr><td>7</td><td>6</td><td>5</td></tr></table></td><td>2</td><td>[5]</td></tr>
<tr><td>Q5</td><td>Consider the following statements are true in a given knowledge base in Propositional Logic.

Bob likes programming and he likes mathematics. If he likes programming and he likes data structures, then he will become a software engineer. If he likes data structures and likes algorithms, he will clear technical interviews. He does not like mathematics or he likes algorithms. He does not like operating systems and databases.
Is the statement true/false: "Bob will become a software engineer"? Prove.</td><td>3</td><td>[6]</td></tr>
<tr><td>Q6</td><td>In the context of Ant Colony Optimization (ACO), explain the following, clearly defining all symbols used:
a) The probability of the kth ant moving from city i to city j.

b) If the pheromone value on an edge is $\tau = 0.5$, heuristic value $\eta = 4$, $\alpha = 1$, $\beta = 2$, and the sum of probabilities is 10, calculate the probability of selecting that edge.</td><td>4</td><td>[4+6]</td></tr>
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