BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER : VI**
BRANCH: AI & ML **SESSION : SP/2025**

SUBJECT: AI307 MODERN ARTIFICIAL INTELLIGENCE

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Explain the goal-based agent with the help of a diagram. Design a PEAS description for the following agents a) Medical diagnosis system b) Refinery Control	[3,2]	1	1,2
Q.1(b)	What does it mean for an AI agent to be rational? Give an example Describe the following types of environments an AI agent can operate in a) Fully vs. partially Observable b) Deterministic vs Stochastic	[2, 3]	1	1,2
Q.2(a)	What is a state space? You have given the water jug problem with jugs of capacity 4 and 3 gallons. You have to define the state space, start space, and goal state, list all legal actions, and outline the steps needed to reach a state where jug four contains exactly 2 gallons.	[1,4]	2	3
Q.2(b)	a) Give an example based on the breadth-first search algorithm. b) Solve the following cryptarithm where each letter represents a unique digit from 0-9. SEND + MORE = MONEY	[2.5X2]	2	3
Q.3(a)	In the Wumpus World, an agent is at location[1, 1], detecting no breeze. The agent uses the following knowledge base $B1,1 \Leftrightarrow (P1,2 \vee P2,1)$ $\neg B1,1$ Using resolution, prove that square [1, 2] does not contain a pit ($\neg P1,2$) .	[5]	3	3
Q.3(b)	a) What are the symbols of First-order logic? b) write in First order logic, “All kings are persons” c) write in First order logic, “Everybody loves somebody” d) write in First order logic, “One’s mother is one’s female parent” e) What is the difference between forward chaining and backward chaining?	[1X5]	3	3
Q.4(a)	Explain forward search and backward search in planning problems with the help of examples. In what situation would a backward search be more efficient than a forward search? Give an example.	[5]	4	1,2

	S	E	N	D
+	M	O	R	E
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M	O	N	E	Y

PTO

Q.4(b) Consider a Bayesian network for medical diagnosis with the following information [5] 4 3

Age influences cholesterol, blood pressure, and exercise habits.
Cholesterol (C), Blood Pressure (BP), and Exercise (E) influences heart diseases
Heart Disease (H) affects both Chest Pain (CP) and Test Result (T)
You are given the following
Age (A) = 60 years.
Cholesterol (C) = High.
Blood Pressure (BP) = High.
Exercise (E) = No
P(A=Young)=0.6 , P(A=Old)=0.4
Cholesterol (C), Blood Pressure (BP), and Exercise (E) conditioned on Age (A)

Age(A)	P(C=high)	P(BP=high)	P(E=Low)
Young	0.2	0.3	0.6
Old	0.6	0.7	0.9

Heart Disease (H) conditioned on Cholesterol (C), Blood Pressure (BP), and Exercise (E)

C	BP	E	P(H=Yes)
High	High	Low	0.8
High	High	High	0.9
High	Low	Low	0.7
Low	High	Low	0.7
Low	Low	High	0.4

Chest Pain (CP) conditioned on Heart Disease (H)

H	P(CP=Yes)
Yes	0.7
No	0.1

Test Result (T) conditioned on Heart Disease (H)

H	P(T=Positive)
Yes	0.9
No	0.2

a) Plot the Bayesian network graph based on the above information
b) Find the probability that the patient has Heart Disease (H).
P(H|A=60, C=High, BP=High, E=No)

Q.5(a) Find the intercept and slope of the following using a linear regression model using matrix form [5] 5 3

X	Y
1	5
2	7
3	9
4	11
5	13
6	15

You have given the following

inverse(X'*X) = $\begin{bmatrix} 0.8667 & -0.200 \\ -0.200 & 0.0571 \end{bmatrix}$

Q.5(b) a) Explain briefly the concept of Overfitting and underfitting with the help of a diagram [5] 5 3
b) A 3-input 2-output NN has the weight values w11 = 0.6, w12 = 1.1,
w21 = 0.7, w22 = 0.5, w31 = 0.8, and w32 = 0.2.
It is given an input of $[0.3 \quad 0.7 \quad 1.6]^T$.
What is the Neural network's output if the binary step function is used? Assume a threshold of 1.5.

::::::30/04/2025::::::M