Vellore Institute of Technology
(Deemed to be University under section 3 of the UGC Act, 1956)

Reg. No. : 22BAI1266

Final Assessment Test(FAT) - Nov/Dec 2024

Programme	**B.Tech.**	Semester	**Fall Semester 2024-25**
Course Code	**BCSE306L**	Faculty Name	**Prof. Abirami S**
Course Title	**Artificial Intelligence**	Slot	**C1+TC1**
		Class Nbr	**CH2024250102608**
Time	**3 hours**	Max. Marks	**100**

General Instructions

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

Course Outcomes

1. Evaluate Artificial Intelligence (AI) methods and describe their foundations.
2. Apply basic principles of AI in solutions that require problem-solving, inference, perception, knowledge representation and learning.
3. Demonstrate knowledge of reasoning, uncertainty, and knowledge representation for solving real-world problems
4. Analyse and illustrate how search algorithms play a vital role in problem-solving

Section - I

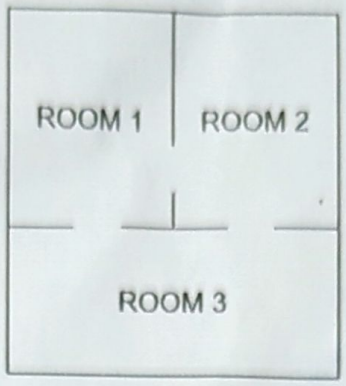
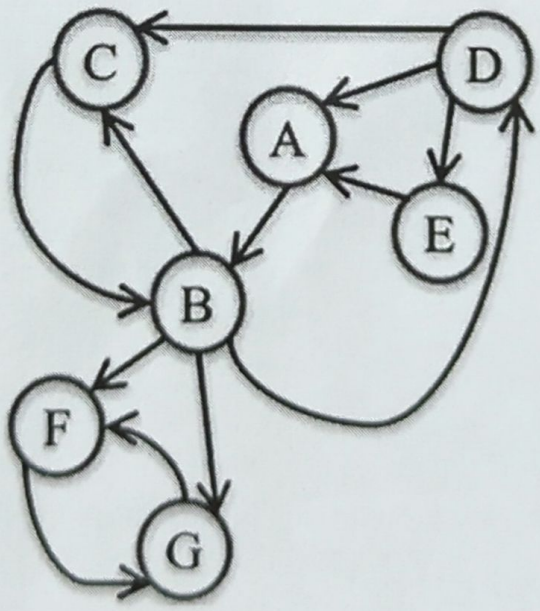
Answer all Questions (7 × 10 Marks) *M - Marks

Q.No	Question	*M	CO	BL
01.	In a hi-tech city, a robot is tasked with delivering an important package to the central hub. However, it finds itself lost in a sprawling maze filled with obstacles (walls). The goal is to navigate through the maze and reach the delivery point while avoiding walls. The maze is represented as a 4x6 grid, where each cell can either be 0 or 1. 0 and 1 denotes open space and a wall respectively. The maze has walls that the robot cannot pass through and it can move up, down, left or right. A robot requires to navigate through a 4x6 grid maze to reach a goal position at (0,5) from the starting position at (3,0).	10	4	2

	(0,0)	(0,1)	(0,2)	(0,3)	(0,4)	(0,5)
(0,0)	0	0	1	1	0	0
(1,0)	1	0	1	0	0	1
(2,0)	0	0	0	0	1	1
(3,0)	0	1	1	0	0	1

a) Construct the state space tree for finding the path between initial and goal position (6 marks).
b) Determine which search technique, breadth-first search or depth-first search is more suitable for solving the given problem (4 marks)

02.	Eight numbered tiles (1–8) and one blank space make up the 3x3 grid given . Starting from a specified initial state, the objective is to move the tiles about the grid in order to reach a particular configuration, or target state. Think of the number of misplaced tiles as the cost to travel from node "n" to the goal state, and the depth of the node as the true cost to get from the starting node to node "n." Initial State: 2 8 3 / 1 6 4 / 7 _ 5 Goal State: 1 2 3 / 8 _ 4 / 7 6 5 a) Derive the problem formulation for the given 8 puzzle problems. (2 Marks) b) Identify and apply the suitable heuristic based search algorithm to find the most cost-effective path to reach from initial state to goal state. (8 Marks)	10	4	2
03.	ABC designs a complex mechanical structure whose performance is a non-linear function of its height and is given by $f(x)=4x4+x3-4x2+x+9$. Help ABC to identify the height at which this structure's performance will be maximum in the range (-2, 2) using suitable local optimization search method. He assumes the random number used to compare against the evaluated probability to be always 0.5 and Boltzmann constant K = 1. He also chooses the initial temperature to be 100 and reduces it by 15 units in every iteration. a) Use the step value of +1 starting from the lower range value till 0 and the step value of +0.5 thereafter. Finally, provide the table of height value, objective function value and temperature value for each iteration. Round all the calculations to two decimal places. (8 marks) b) What happens if the range is different from the original setup i.e, if X is initialized as 10 and proceeded with a random step value further. (2 marks)	10	4	2
04.	XYZ is designing an AI system for a two-player zero-sum game. Root node A being the max operation node has 3 children B, C and D. Each leaf node represents a possible outcome of the game with a utility value. B, C and D have 3 children each - B1, B2, B3 and C1, C2, C3 and D1, D2, D3 respectively. B1 has 3 leaf nodes with values 4, 7 and 9. B2 has 3 leaf nodes with values 2, 6 and 5. B3 has 3 leaf nodes with values 1, 3 and 8. C1 has 3 leaf nodes with values 3, 4 and 7. C2 has 3 leaf nodes with values 5, 10 and 0. C3 has 3 leaf nodes with values 2, 6 and 4. D1 has 3 leaf nodes with values 5, 1 and 2. D2 has 3 leaf nodes with values 9, 7 and 3. D3 has 3 leaf nodes with values 5, 4 and 6. By not traversing through all nodes unnecessarily, help XYZ in knowing the best move for player at root node A by finding out the values of α, β and the resultant utility value.	10	1	1
05.	Consider the below given Bayesian belief network, C ← A → B → D P(C|A): A=T → 0.8; A=F → 0.3 P(A): 0.4 P(B|A): A=T → 0.8; A=F → 0.3 P(D|B): B=T → 0.8; B=F → 0.3 a) Describe the variables included in the BBN and elucidate their relationships in terms of dependencies. (3 marks) b) Calculate the joint probability distribution P(B=T, C=T) (3 marks) c) Calculate the conditional probability distribution P(P(A=T | C=T) (4 marks)	10	3	3

06.	Examine the planning realm that follows. Room 1, Room 2, and Room 3 are the three interconnected rooms as shown in the figure.  Room 1 is where the cleaning robot agent begins. While Rooms 1 and 3 are filthy and have rubbish on the floor, Room 2 is spotless. If the robot is in the same room as the trash, it can walk between the rooms and collect it. A room can only be cleaned by the robot once all of the trash has been removed. The robot is supposed to clean every room and make sure that all of the waste is taken out. a) Write down the PDDL (Planning Domain Definition Language) representation of the initial state and goal state. (2 marks) b) Write actions schema in PDDL for the actions: Move, PickUpTrash, CleanRoom. (6 marks) c) Construct a plan for cleaning all rooms. (2 marks)	10	2	3
07.	Imagine you are part of a team working on a knowledge-sharing platform that links users through various informational pages. To improve the platform's recommendation engine, the team is implementing the Random Surfer Model to rank pages according to user activity. The platform contains seven interconnected informational pages: A, B, C, D, E, F, and G, as illustrated below.  Your objective is to model how users move between these pages using the Random Surfer Model. Users have two options: they either follow a link to another page 85% of the time or randomly jump to any page 15% of the time. a) Represent the initial rank of each page and outline the steps for calculating the PageRank values based on the Random Surfer Model. (2 Marks) b) Calculate the PageRank values for each page after two iterations, showing your calculations and reasoning. (8 Marks)	10	3	3

Section - II

Answer all Questions (2 × 15 Marks) *M - Marks

Q.No	Question	*M	CO	BL
08.	To improve traffic flow, an Automated Traffic Management System (ATMS) will be created. The technology keeps an eye on traffic conditions in real time, detects congestion, and dynamically modifies traffic lights to enhance flow. Additionally, it makes it easier to communicate with linked cars, giving drivers real-time updates and ideas for alternate routes. By effectively regulating traffic patterns and reacting quickly to accidents, ATMS improves road safety, shortens commutes, and helps create a more sustainable environment. i) Identify a suitable type of agent for this scenario and design an architecture diagram for the identified agent, embedding the actions it performs. (6 marks) ii) Provide a detailed PEAS description of the given task environment. (4 marks) iii) Identify and justify the type of AI for the below given scenarios. (5 Marks) • Virtual assistants like Siri, Alexa, or Google Assistant are designed to act in ways that mimic human behavior, primarily through voice interactions • Woebot is an AI-powered chatbot that provides mental health support through cognitive-behavioral therapy techniques. • Amazon Prime Air is an autonomous drone used for delivering packages to customers and are equipped with AI systems that make rational decisions based on environmental factors such as weather conditions, traffic patterns, and obstacles in the air. • Automated Legal Document Review System assists lawyers and legal professionals by reviewing contracts and other legal documents	15	1	1
09.	a) For below set of sentences, convert them into FOL and then into CNF form and then list out the clauses. (9 marks) • If Fahad is young, then he is energetic or dynamic. • If and only if Fahad is dynamic, he proposes ideas or thrives on challenges or stimulates changes in the current system. • Anyone who is energetic stimulates changes in the current system. • There are some people who are either lazy or inactive. • If and only if Fahad is inactive, he is slothful or quiet. • If Fahad stimulates changes in the current system, he progresses his society. • Fahad is dynamic. • Fahad does not propose ideas. • Fahad does not progress his society. b) Is it provable by refutation that Fahad thrives on challenges ? Explain. (4 marks) c) Illustrate 'Modus Tollens' inference rule from any of the above premises and deduce its conclusion. (2 marks)	15	2	3

BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating, 6.Creating)