Q/E/TX

Reg. No:

VIT
Vellore Institute of Technology

Final Assessment Test – May 2024

Course: **CSI3003 - Artificial Intelligence and Expert Systems**

Class NBR(s):**2468/2537** Slot: **F1+TF1**

Time: **Three Hours** Max. Marks: **100**

- **KEEPING MOBILE PHONE/ELECTRONIC DEVICES EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

General Instructions:

1. **No written or printed materials are allowed.**
2. **Read each question carefully and answer to the point.**
3. **Any assumption made, should be clearly mentioned at the beginning of an answer.**

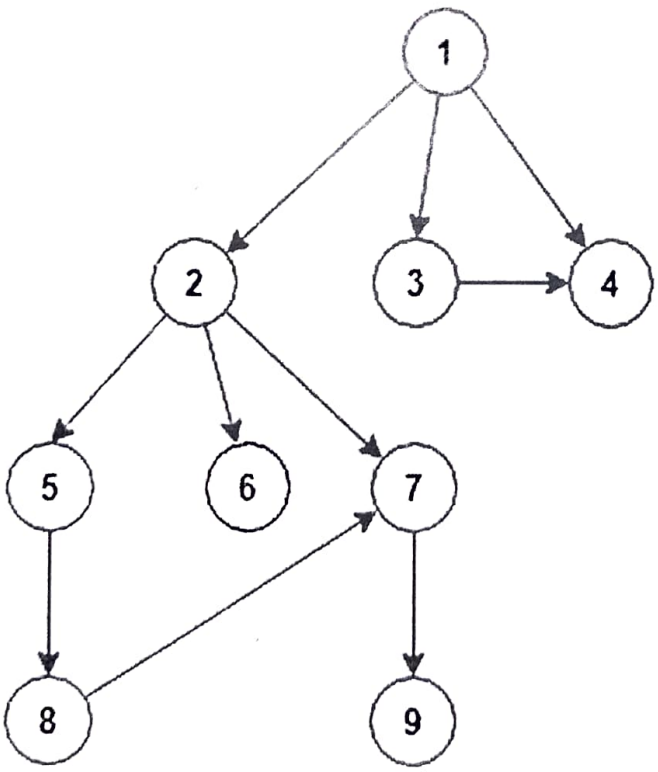
Answer any TEN Questions

(10 X 10 = 100 Marks)

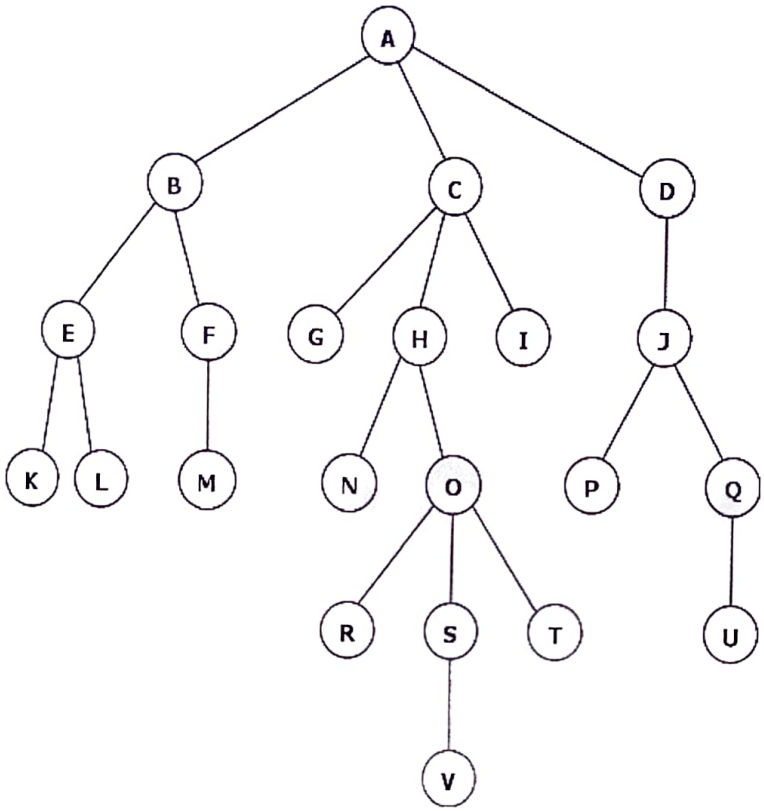
1. a) What are the different types of task environment? **[5]**

   b) Write down the PEAS description of the task environment for Virtual Personal Assistant (E.g. Siri, Alexa etc.). **[5]**

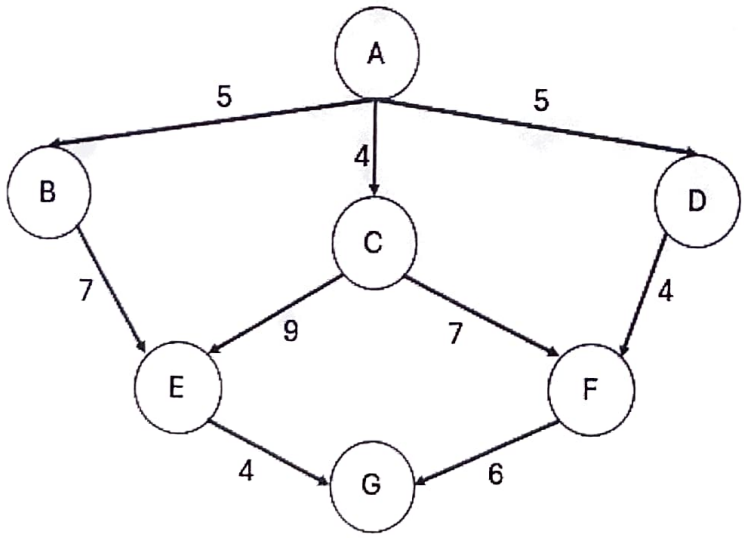
2. Perform the Depth-First Search (DFS) on the following graph to traverse all the nodes starting from node **1**. Show all the steps and write the final traversal path. Write the difference between DFS and Breadth First Search.



3. Perform the Iterative Deepening Depth-First Search (IDDFS) on the following graph. **A** is the start node and **O** is the goal node. Show all the steps. Write the traversal paths for each of the depth limits.



4. Find the optimal path from the start node **A** to goal node **G** using the Recursive Best First Search (RBFS). Path costs are given in the state space and the heuristic value for each node is given on the right side of the state space. Show all the steps.



A – 12
B – 12
C – 10
D – 7
E – 3
F – 6
G – 0

5. Explain all the steps associated with the Knowledge Engineering process through a suitable example.

6. a) Formulate First-Order Logic from the following kinship domain sentences – [5]

i. Brothers are siblings.

ii. Siblinghood is transitive.

iii. Siblinghood is symmetric.

iv. One's father is one's male parent.

v. One's mother is one's sibling's mother.

vi. A first cousin is a child of parent's sibling.

b) Sam and Bill are brothers. Bill and Tom are brothers. Sam is married to Emma and they have two boys John and Rick. Tom is married to Sally and they have a boy Dan. From the First-Order Logic deduced in part (a), prove that John and Dan are first cousins using forward chaining. Construct the appropriate proof tree. [5]

7. A robotic agent can make tea. First, it pours water into kettle to heat. Then it pours hot water into a cup. Then it adds tea bag to the cup. After few minutes, it removes the tea bag and there is Tea Liquor in the cup. Then it adds milk and sugar respectively. Then it mixes the tea. The agent uses the following predicates and actions for planning the tea making –

Predicates:

In(x,y): x is in y

Hot(x): x is hot

Actions:

Pour(x,y): Pour x into y

Remove(x,y): Remove x from y

Add(x): Add x to cup

Heat(x): Heat x

Mix(x): Mix the substances in x

Initial State: $\neg In(Water,Kettle) \wedge \neg In(Water,Cup) \wedge \neg In(Tea,Cup)$

Goal State: $In(Tea,Cup) \wedge \neg In(Water,Kettle) \wedge \neg In(TeaBag,Cup)$

Write the action schemas for the actions *Pour(Water,Kettle), Pour(Water,Cup), Remove(TeaBag, Cup), Add(TeaBag), Add(Milk), Add(Sugar), Heat(Kettle)* and *Mix(Cup)* with appropriate precondition and effect. Write down the action sequences of the plan for making tea. Can this plan be executed through Partial-Order planning? Justify your answer.

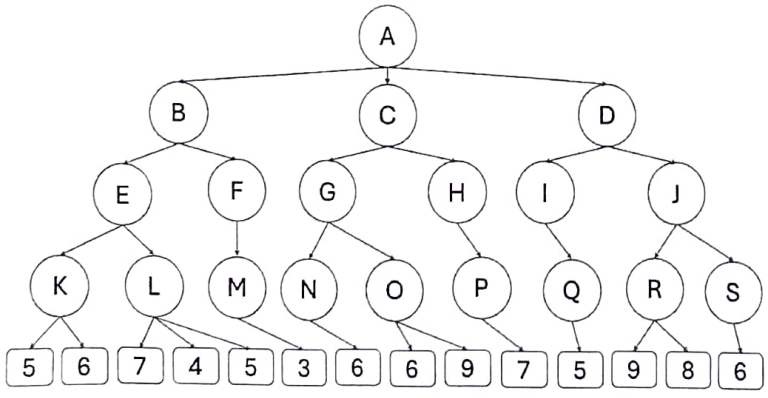
[**P.S.** Something can be poured into kettle or cup if the kettle or cup is empty. Kettle can be heated only after pouring water into it. Tea bag can be added in cup only after pouring hot water. Milk can be added to cup only after removing the tea bag. Sugar can be added to cup only after adding milk.]

8. A system's malfunction rate is 0.5%. There is a diagnostic test available to detect the malfunction. It correctly detects 98% of the malfunctions. The test has a false positive rate of 3%. What is the probability of the system having a malfunction given the test result is positive?

9. A student notices that on a hot day (Hot), a professor comes to class with cold drink (denoted by D) having a probability 0.7, and with no cold drink (N) having a probability 0.3. On the other hand, on a cold day (denoted by Cold), the professor comes to class with cold drink having a probability 0.2, and with no cold drink having a probability 0.8. If a day is hot, the probability of the next day being hot is 0.75 and being cold is 0.25. If a day is cold, the probability of the next day being cold is 0.7 and being hot is 0.3. When the student started the observations, it was cold day with probability 0.45, and a hot day with a probability 0.55.
Depending on the given information, construct a Hidden Markov Model (HMM) and point out the hidden states, observables, initial probabilities, transition probabilities, and emission probabilities.

10. Describe the various levels of an Expert Systems structure. Illustrate the functional integration of Expert Systems components with the help of a suitable diagram.

11. Perform Alpha Beta Pruning on the tree given below assuming that MAX starts the game at node A. After completing the algorithm, show node values, final alpha and beta values for each node, and determine the decision value. What are the pruned nodes in the tree?



12. Illustrate the MYCIN expert system with a suitable diagram.

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