

2974

8

(b) Describe the following search strategies used in AI problem solving, with one suitable example each:

(i) Informed Search

(ii) Means-End Analysis (4+3)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2974

L

Unique Paper Code : 2343570005

Name of the Paper : Artificial Intelligence (DSE)

Name of the Course : **B.Sc. (Hons.) Computer Science**

Semester : IV

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. 1 is compulsory in **Section-A**.
3. Attempt any **four** questions from **Section-B**.
4. Parts of a question should be attempted together.

Section A

1. (a) Describe the task environment of an intelligent agent. What are the properties of a task environment? Explain any three properties with one example each. (3)
- (b) Define and distinguish between the following with one example each :
 - (i) Weak AI
 - (ii) Narrow AI
 - (iii) Artificial General Intelligence (AGI) (3)
- (c) Transform the following sentence into Conjunctive Normal Form (CNF) :

$$(\neg A \ \& \ B) \vee (A \ \& \ \neg B)$$
 (3)
- (d) What are Production Rules in knowledge representation? How do production rules differ from logic-based representations? (3)

6. (a) Explain the process of Natural Language Understanding in AI. Discuss the major stages involved, including lexical analysis, syntactic analysis, semantic analysis, and pragmatic analysis with examples. (8)
- (b) Explain Frames as a knowledge representation technique. Design a frame network for an educational institution and provide one fully detailed frame for a college that includes slots for: name, type, location, departments, faculty strength, and affiliated university. (7)
7. (a) (i) Write the following statements in First-Order Predicate Logic (FOPL):

All humans are mortal.

Socrates is a human.

Every student who studies hard passes the exam.
- (ii) Using the resolution principle, prove that Socrates is mortal. Write all steps, including conversion to CNF, negation of the goal, and derive the empty clause. (4+4)

- (b) Explain the A* algorithm using $f(n) = g(n) + h(n)$. State the admissibility condition and discuss what happens when the heuristic overestimates the cost. Also briefly explain Best-First Search and how it differs from A*. (7)
5. (a) Write the Chomsky Hierarchy of Grammars with one example each for Type 0, Type 1, Type 2, and Type 3 grammars. How does it relate to natural language processing in AI? (7)
- (b) Implement a parse tree for the sentence: "The young student solved a difficult problem" using the following grammar rules:
- $S \rightarrow NP VP$; $NP \rightarrow DET N \mid DET ADJ N$; $VP \rightarrow V NP$
- $DET \rightarrow the \mid a$; $ADJ \rightarrow young \mid difficult$; $N \rightarrow student \mid problem$; $V \rightarrow solved$
- Based on this parse tree, also draw the corresponding Recursive Transition Network (RTN).

- (e) What is a Horn Clause in Prolog? Give two examples of Horn clauses and explain their significance in logic programming. (3)
- (f) Differentiate between Depth-First Search (DFS) and Breadth-First Search (BFS) with the help of an example. (3)
- (g) Define Modus Ponens rule in propositional logic. Elaborate with a suitable example. (3)
- (h) What are the benefits and risks of AI? Write three benefits and risks of AI in today's world. (3)
- (i) Differentiate between Symbolic AI and Data-Driven AI with examples. (3)
- (j) Write a Prolog program to implement `generate_fib(N, T)` where T is the Nth term of the Fibonacci series. (3)

Section B

2. (a) What is an Intelligent Agent? Describe the structure of an intelligent agent with a neat diagram. Explain the following types of agents with one example each :

(i) Goal-Based Agent

(ii) Learning Agent (8)

- (b) Briefly explain the Hill Climbing search algorithm. Discuss in detail its three failure situations: Local Maximum, Plateau, and Ridge. How can each of these problems be overcome? (7)

3. (a) (i) Discuss the major ethical challenges of Artificial Intelligence. Write issues related to bias, privacy, unemployment, accountability, and misuse of AI systems.
- (ii) Draw a Semantic Network for the following facts :

Tweety is a canary.

A canary is a bird.

A bird has wings and can fly.

Tweety is yellow and can sing.

A canary cannot fly as fast as an eagle.

(4+4)

- (b) Differentiate between a fully observable and a partially observable task environment. Give one example of each. Also describe what is meant by a deterministic versus a stochastic environment. (7)

4. (a) Define the PEAS framework for designing a task environment. Develop a complete PEAS description for any two of the following agents :

(i) An Autonomous Car

(ii) An Internet Shopping Agent

(iii) A Chess-Playing Program (8)