B.E. Metallurgical and Material Engineering - Third Year - Second Semester
Artificial Intelligence
(Open Elective offered by CSE Department)
Full Marks 100

*Answer all questions* .   Time: Three hours

1. Entries in the first column of the following table have to be suitably paired with the entries in its second column so that which aspect of intelligent behaviour is truly exhibited by which app/tool can be made clear.

App/Tool	Aspect of intelligent behaviour
Chat GPT	perception
Curiosity rover on Mars	reasoning
Solitaire (Classic card game)	learning
YouTube Recommendation system	acting in a complex environment
Face lock in mobile phones	communication

5

2(a) Consider the following State space graph. The numbers labelling edges represent the costs of traversing the respective edges. Find the most effective path to reach the goal state J from the start state A, using A* algorithm. Also mention the cost of the path so found.
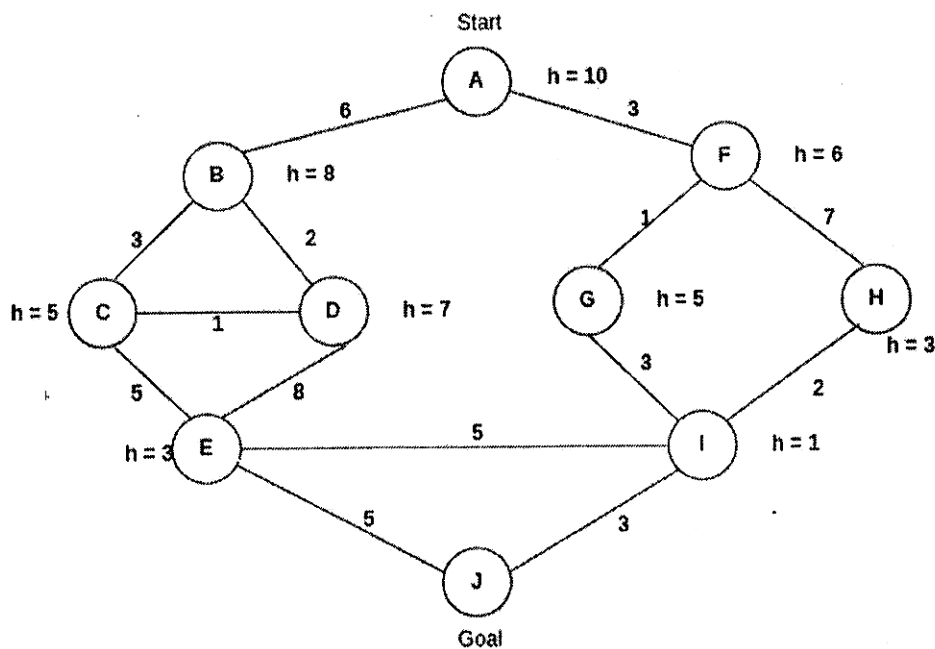
(b) How a path in a State space is selected under Hill Climbing search? Under which condition Hill Climbing search is terminated? What is the major problem with Hill Climbing search? Why heuristics may be of help in conducting State space search?

(c) To solve what kind of problems Genetic Algorithms (Gas) are applied? Write the major steps of operation of Simple Genetic Algorithm (SGA).

Consider the problem of finding the shortest route through several cities such that each city is visited only once and in the end return to the starting city (the Travelling Salesman problem). Suppose that in order to solve this problem, we use a Genetic algorithm, in which genes represent links between pair of cities. For example, a link between London and Paris is represented by a single gene 'LP'. Let us assume that the direction in which we travel is not important, so that LP=PL.

How many genes will be used in a chromosome of each individual if the number of cities is 10? What will be the total number genes for this problem?

10+4+(5+4)

3(a) Represent the following sentences with Predicate calculus Well formed formulas:

Every book has some author. Apples and bananas are nourishing. Not every integer is positive. No prime number is a perfect square.

(b) Find a most general unifier (mgu) of {P[f(x),y,g(y)], P[f(x),z,g(x)]}

(c) Convert the following Well formed formula into clauses:

$$(\forall x) [\sim(\forall y) \{P(f(x,y)) \wedge (\exists z) (\sim Q(y,z) \Rightarrow P(g(z)))\} \wedge P(x)]$$

(d) Consider the following sentences:

Any one passing AI and doing research on ML is happy. Anyone who studies or is lucky can pass all. Anyone who is lucky does research on ML. John did not study but is lucky. Use resolution to answer the question "Is John happy?" Also mention the control strategy you followed for resolution refutation.

4+3+7+8

4(a) Mention few sources of uncertainty in real world knowledge. Why Predicate calculus is not sufficient for reasoning under uncertainty?

(b) Derive Bayes' rule for evidence E and hypotheses H and ~H.
In a neighborhood, 90% children were falling sick due to flu and 10% due to measles. The probability of observing rashes for measles is 0.95 and for flu is 0.08. If a child develops rashes, find the child's probability of having flu.

(c) For some patient, the focus of diagnosis is restricted within the set
U={hep,cirr,gall,pan}. In this, **hep** stands for hepatitis, **cirr** for cirrhosis, **gall** for gall-stone, and **pan** for pancreatic cancer. Two different sources of evidence support the following beliefs, denoted by m_1 and m_2:
m_1{hep,cirr}=0.6, m_2{cirr,gall,pan}=0.7
Use Dempster-Shafer theory to find the combined beliefs for various combinations of diagnoses.

4+10+6

5(a) Give a geometric interpretation of the working of a Perceptron as a linear classifier.
 (b) What is the major limitation of a Perceptron as pointed out by Minsky and Papert (1969)?
 (c) Give the major steps of operation of Back Propagation learning algorithm.
 (d) What are training set, validation set and test set?
 (e) Explain the problem of Over-fitting in a neural network. How can you manage this problem while training a Multi Layer Perceptron?

8+4+8+3+7