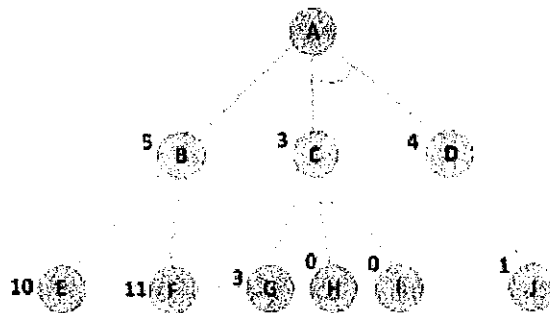


Note: (a) All questions are compulsory.

(b) Marks are indicated against each question in square brackets.

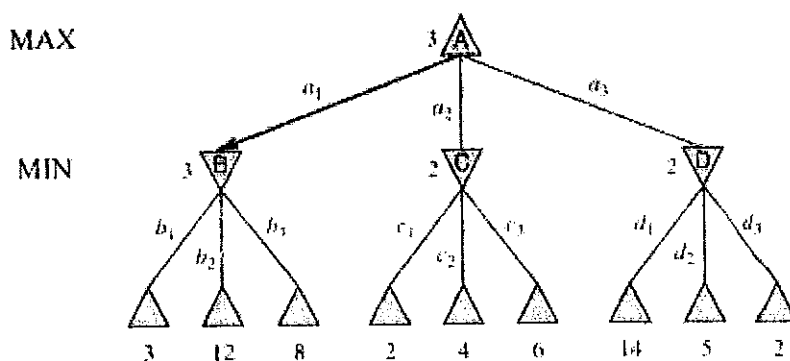
(c) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

1. Use AO* algorithm step by step to find the lowest cost path from the starting node to the goal node. It should be noted that the cost of each edge is the same as 1, and the heuristic cost to reach the goal node from each node of the graph is shown beside it.



[CO-1; 5 marks]

2. Use the Alpha-Beta pruning algorithm to prune the game tree shown below assuming child nodes are visited from left to right. Show all final alpha and beta values computed at root, each internal node explored, and at the top of pruned branches.



[CO-1; 5 marks]

3. Suppose a genetic algorithm uses chromosomes of the form $x = abcdefgh$ with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual x be calculated as: $f(x) = (a + b) - (c + d) + (e + f) - (g + h)$,

and let the initial population consist of four individuals with the following chromosomes:

$x_1 = 6\ 5\ 4\ 1\ 3\ 5\ 3\ 2$, $x_2 = 8\ 7\ 1\ 2\ 6\ 6\ 0\ 1$, $x_3 = 2\ 3\ 9\ 2\ 1\ 2\ 8\ 5$ and $x_4 = 4\ 1\ 8\ 5\ 2\ 0\ 9\ 4$

- (a) Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last.
- (b) Perform the following crossover operations:
 - (i) Cross the fittest two individuals using one-point crossover at the middle point.
 - (ii) Cross the second and third fittest individuals using a two-point crossover (points b and f).
 - (iii) Cross the first and third fittest individuals (ranked 1st and 3rd) using a uniform crossover.

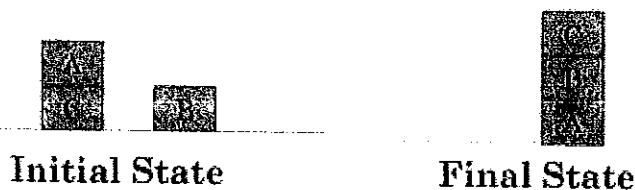
[CO-2; 2+3=5 marks]

4. 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 pairs of cities. For example, a link between London and Paris is represented by a single gene 'LP'. Let also assume that the direction in which we travel is not important, so that LP = PL.

- (a) How many genes will be used in a chromosome of each individual if the number of cities is 10?
- (b) How many genes will be in the alphabet of the algorithm?

[CO-2; 2+3=5 marks]

5. Find the solution to the following blocks world problem using steepest hill method. State the heuristics used. What are the limitations of hill climbing algorithms?



[CO-3; 5 marks]