Name: _____ **Student ID**: _____

Indian Institute of Technology Jammu
Mid-Term Examination
MTech Ist Semester
October 08, 2023

Course Title: Artificial and Computational Intelligence **Maximum Time: 3 Hrs**
Course Code: COL001P1M **Maximum Marks: 100**

Instructions:

- Conditions of Examination: Closed book; No dictionary; Non-programmable calculator is allowed.
- This question paper contains total of 5 Questions.

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1. **[10+5+5]**
   Design an algorithm to search an infinite graph which follows DFS (Depth First Search) and BFS (Breadth First Search) in alternate steps. Explain the time and space complexity of the proposed algorithm. Execute the proposed algorithm on a finite Graph given in figure 1.

2. **[20]**
   The current state of IIT Jammu is given as <3C, 2H, 0R, 3L> where C, H, R, and L represents Classroom, Hostel, Residence and Laboratory entities respectively. Using an informed search approach, find the fastest and economic solution to achieve the goal state <6C, 3H, 1R, 6L>. At any stage, you are allowed to schedule exactly two activities. An activity is termed as the construction of an entity. The cost of constructing each entity is given in the following Table 1.

   Table 1: Entity and cost

Entity	**Units**	**Cost (in lacs)**
Classroom (C)	1	5
Hostel (H)	1	18
Residence (R)	1	30
Labs (L)	1	6

   Choose between the following two heuristics to achieve the efficient solution:

   i) The difference between the cost of goal state and the current state.

   ii) The difference between the number of entities in the goal state and the current state.

3. **[10 + 10 + 20]**
   a) [10] Apply UCS (Uniform Cost Search) algorithm on the graph given in Figure 1 to find an optimal path from S→G. Compute the selected path after each step of the algorithm.

   b) [10] Apply Best First Search (Uniform Cost Search) algorithm on the graph given in Figure 1 to find a path from S→G. Compute the selected path after each step of the algorithm. The heuristic values $h(n)$ (i.e. cost from node n to goal node G) are provided in the array given below in Table 2.

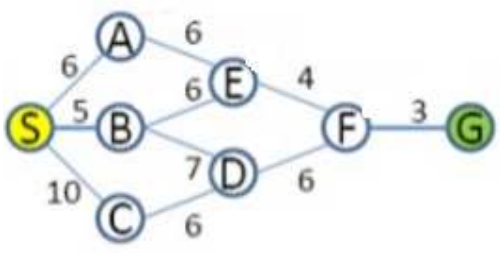

Figure 1: Graph for Search Algorithms

S	A	B	C	D	E	F	G
16	10	12	4	2	4	1	0

Table 2: Heuristics values

c) [20] Apply the UCS algorithm with modified cumulative cost $f(n)$ for reach a node n on the graph given in Figure 1 where $f(n) = g(n) + h(n)$. The function g(n) computes the cost of reaching node n from the start node following a path and $h(n)$ represents the heuristic cost from node n to the goal node G. Discuss the algorithm in terms of time complexity, space complexity, completeness and quality of the solution.

4. **[2 + 8]**
You are given two containers of 5 litre and 3 litre capacity. None of these containers has any measuring marked on it. There is a pump, which can be used to fill the containers with water.

a) [2] Generate possible actions as per your convenience to transition from one state to the other.

b) [8] Apply BFS strategy to measure 4 litres of water in a 5 litre container.

5. **[6 + 4]**
Differentiate between Depth Limited Search and Iterative Deepening search in terms of time complexity, space complexity, completeness and quality of the solution. Justify your answer with an example.