POSSESION OF MOBILES IN EXAM IS UFM PRACTICE

Name_____ **Enrollment No.**_____

Jaypee Institute of Information Technology, Noida
End Term Examination, 2024
B.Tech, IV Semester

Course Title: Algorithms and Problem Solving **Maximum Time: 2 Hr**
Course Code: 15B11CI411 **Maximum Marks: 35**

CO1	Demonstrate a familiarity of complexity classes, the notion of algorithm, asymptotic analysis, and problem solving approaches.
CO2	Apply a standard algorithm for solving fundamental problems such as sorting, searching, and graph based problems.
CO3	Analyze and identify an appropriate data structure and/or algorithm design strategy for a given problem.
CO4	Design an efficient algorithm to solve a given problem.

Note: Attempt all the questions.

Q1. Differentiate between different complexity classes. Explain NP complete and NP hard problems with example. **[CO1 (Understanding), 2 Marks]**

Q2. A scheduling system for a university's final exams is to be developed. There are multiple courses for which exams are taking place on the same day, however it is to be ensured that no two courses have exams with overlapping students are scheduled at the same time. Propose a backtracking based algorithm to schedule the exams such that no two courses having common students share the same time slot. **[CO2 (Applying), 5 Marks]**

a) Provide a pseudo-code representation of your algorithm and explain how it ensures that no two overlapping exams are scheduled at the same time.

b) Test your algorithm with the following example:

Name of Courses: Math, Physics, Chemistry, and Biology

Details of overlapping students (cell value 1 shows that there is at least one student common to the two courses):

	MATHS	PHYSICS	CHEMISTRY	BIOLOGY
MATHS	0	1	1	0
PHYSICS	1	0	1	1
CHEMISTRY	1	1	0	1
BIOLOGY	0	1	1	0

Q3. Given a pattern string "ABABABC" from the alphabet set {A, B, C}. **[CO2 (Applying), 3 Marks]**

a) Compute the hash value using a prime number = 13. Convert the string to a number using the ASCII code for encoding each character.

b) Build deterministic finite automata that accept a string that contains the given pattern.
c) Generate the prefix array using the prefix function of KMP algorithm for string matching.

Q4. 10 cities and their connectivity are represented as a weighted undirected graph. Starting city (node) is 'A' and the city to reach is 'J'. The heuristic cost of each node is also provided.

[CO2 (Applying), 6 marks]

	h(n)	List of adjacent cities with costs
A	10	B (6), F(3)
B	8	A(6), C(3), D(2)
C	5	B(3), D(1), E(5)
D	7	B(2), C(1), E(8)
E	3	C(5), D(8), I(5), J(5)
F	6	A(3), G(1), H(7)
G	5	F(1), I(3)
H	3	F(7), I(2)
I	1	E(5), G(3), H(2), J(3)
J	0	E(5), I(3)

a) Generate the search tree using Best First Search algorithm and find the path cost.
b) Generate the search tree using A* search algorithm and find the path cost.
c) Generate the search tree using Hill Climbing search algorithm and find the path cost.

Q5. Given an unsorted array of **n** distinct numbers, where k^{th} ranked item is the k^{th} smallest item in the list. Propose an efficient algorithm to return sorted list of numbers between two ranks. Also compute the number of your proposed algorithm takes to output a sorted list of all numbers with rank between $(n/2 - \sqrt{n})$ and $(n/2 + \sqrt{n})$. **[CO3 (Analyzing), 5 marks]**

Q6. A farmer wants to sell his sugarcane in the market as a single unit. But buyers in the market are not showing interest in buying the whole sugarcane. So, he decides to cut the sugarcane in pieces in the multiple of inches and associates price based on their lengths (large pieces not necessarily priced high). The sugarcane should be cut in a way that leads to maximum profit earned by the farmer. Design an efficient recursive algorithm using dynamic programming approach. Explain it's working with a suitable example and compute it' time complexity.

[CO4 (Creating), 7 Marks]

Q7. A research lab is working on developing a method to identify the longest repeated substring within genomic data, which can then be compared to identify repetitive sequences associated with genetic disorders or diseases. How can suffix tree be utilized for the same?

[CO4 (Creating), 7 Marks]

a) Design an algorithm to identify repetitive sequences in a given DNA string using suffix tree.

b) Apply the algorithm on a given DNA string "ATGCATGCTA" to find the longest repeating substring.