Question Paper

MANIPAL ACADEMY OF HIGHER EDUCATION

FOURTH SEMESTER B.TECH. (INFORMATION TECHNOLOGY) DEGREE EXAMINATIONS - JUNE 2024
SUBJECT: ICT 2222/ICT_2222- DESIGN AND ANALYSIS OF ALGORITHMS

Marks: 50   **Duration: 180 mins.**

Answer all the questions.

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1A)	i) In priority scheduling, each process is assigned a priority value, and the scheduler selects the process with the highest priority for execution. When an existing process completes its execution, the scheduler selects the process with the next highest priority and so on. Consider the processes P1 to P10 with their priority values {1, 6, 7, 5, 4, 3, 2, 10, 9, 8}. Consider priority 1 as the highest priority and priority 10 as the lowest priority. Analyse the given situation and discuss how heap can be used for scheduling of the given processes. Also, display the heap's initial contents and the heap's contents after the two processes of highest priorities finish their execution. ii) Construct AVL tree for the following data 21, 26, 30, 9, 54, 14, 28, 18,15	(5)
1B)	Apply the back substitution method to solve the recurrence relation	(3)

$$T(n) = \begin{cases} 1, & \text{if } n = 1 \\ T(n/2) + n, & \text{if } n > 1 \end{cases}$$

1C)	Prove or Disprove using formal definitions of asymptotic notations (do not use limit theorems)	(2)

i) $100n^3 + 2000 \neq O(n^2)$
ii) $19n3 + 6^{10}n^2 = O(n^3)$

2A)	Solve the all pair shortest-path problem for the following directed graph:	(5)
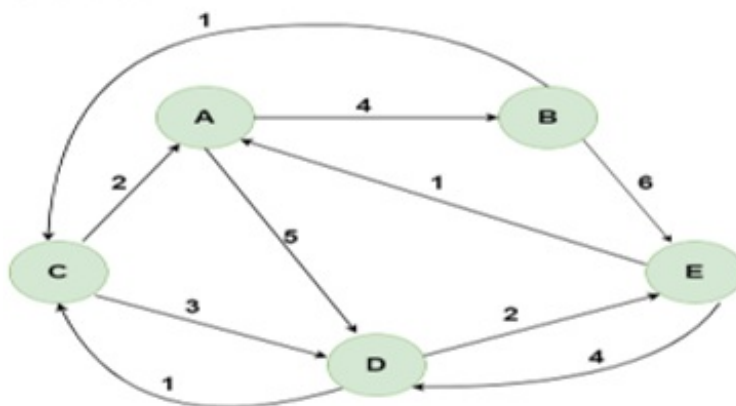
2B)	Write an algorithm for breadth first search. Find it's time and space complexity.	(3)
2C)	Write an algorithm for binary search and Analyze its time complexity using the substitution method.	(2)
3A)	Generate a hash table for the following values: 11, 9, 6, 28, 19, 46, 34, 14. Assume the table size is 9 and the primary hash function is h(k) = k % 9. i) Hash table using quadratic probing ii) Hash table with a secondary hash function of h2(k) = 7 - (k % 7)	(5)

3B) Formulate the recurrence relation for the given algorithm and analyze the worst-case time complexity of the algorithm using substitution method. (3)

ALGORITHM Mergesort(A[0..n - 1])
//Sorts array A[0..n - 1] by recursive mergesort
//Input: An array A[0..n - 1] of orderable elements
//Output: Array A[0..n - 1] sorted in nondecreasing order
if n > 1
   copy A[0..⌊n/2⌋ – 1] to B[0..⌊n/2⌋ – 1]
   copy A[⌊n/2⌋..n – 1] to C[0..⌊n/2⌋ – 1]
   Mergesort(B[0.. ⌊n/2⌋ – 1])
   Mergesort(C[0.. ⌊n/2⌋ – 1])
   Merge(B, C, A)

3C) Obtain the solution to knapsack problem by Dynamic Programming method for Knapsack capacity=8 for the following values. (2)

| Item	Weight	Value/Profit
1	3	2
2	4	3
3	6	1
4	5	4

4A) What is the time complexity of two large integers multiplication using traditional approach? Given a=123456 and b=654321, multiply "a" and "b" analyze using divide and conquer approach. Using Master's theorem determine the improved time complexity. (5)

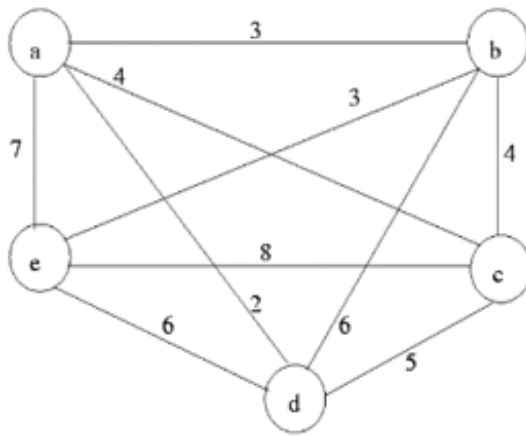**4B)** Construct a Huffman code for the following data: (3)

symbol	A	B	C	D	_
frequency	0.4	0.1	0.2	0.15	0.15

Encode ABACABAD using the code generated from the above information.

4C) Solve using Prim's algorithm determine the MST from the following graph. (2)
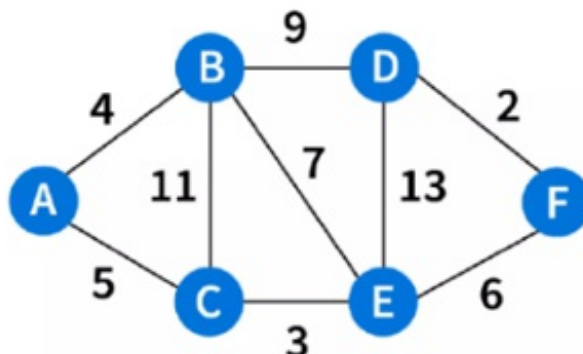
5A) Analyze the optimal solution for TSP using Branch and Bound. (5)

| 5B) | Analyze the time complexity in Checking element uniqueness in an array using Brute force approach. Demonstrate presort Element Uniqueness algorithm and determine the improved time complexity. | (3) |
| 5C) | With a suitable example differentiate between P and NP type problems. | (2) |

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