BRAINWARE UNIVERSITY

Term End Examination 2024-2025
Programme – BCA-Hons-2023
Course Name – Design and Analysis of Algorithm
Course Code - BCA47111 (T)
(Semester IV)

Full Marks : 40 **Time : 2:0 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A
(Multiple Choice Type Question)

1. *Choose the correct alternative from the following :* 1 x 10=10

(i) Choose the correct relation among asymptotic notations when analyzing an algorithm.
a) Θ(n) is a subset of O(n)
b) O(n) is a subset of Ω(n)
c) Ω(n) is equivalent to o(n)
d) O(n) and Θ(n) are always equal

(ii) Choose the key advantage of the Knuth-Morris-Pratt (KMP) string matching algorithm over the naive approach.
a) It uses brute force searching
b) It preprocesses the pattern to avoid unnecessary comparisons
c) It searches in O(n log n) time
d) It works only for binary strings

(iii) How would you demonstrate that the Hamiltonian Cycle problem is NP-complete?
a) Show that it is in P
b) Reduce a known NP-complete problem to it in polynomial time
c) Use a divide-and-conquer approach to solve it efficiently
d) Show that no solution exists

(iv) Calculate the total number of edges in a complete graph with 6 vertices.
a) 12
b) 20
c) 18
d) 15

(v) Find the time complexity of the code snippet below:

```
int i, j, k;
for (i = 0; i < n; i++)
{
for (j = 0; j < n; j++)
{
printf("%d %d", i, j);
}
}
```

a) O(n)
b) O(log n)
c) $O(n^2)$
d) O(n log n)

(vi) What is the time complexity of the Floyd-Warshall algorithm?
a) O(V log V)
b) O(VE)
c) $O(V^3)$
d) O(E log V)

(vii) Show the asymptotic complexity of the function : $f(n) = 3n^2 + 4n + 5$.
a) O(n)
b) O(log n)
c) $O(n^2)$
d) O(n log n)

(viii) Show the time complexity of the function: $f(n) = 2^n + n^3$.

a) $O(n^2)$
b) $O(n^3)$
c) $O(2^n)$
d) None of the mentioned.

(ix) Show the time complexity of the code snippet below:

```
int i, j;

for (i = 1; i < n; i *= 2)
{
  for (j = 1; j < n; j++)
  {
    printf("%d %d",i,j);
  }
}
```

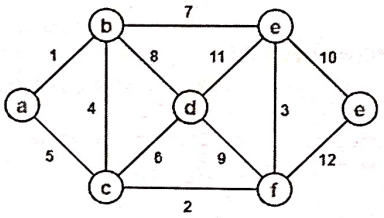
a) O(n)
b) O(log n)
c) O(n log n)
d) $O(n^2)$

(x) Choose the number of comparisons made in the best case for the recursive Max-Min problem using Divide and Conquer strategy.

a) 2n - 2
b) 3n/2 - 2
c) n log n
d) n^2

Group-B
(Short Answer Type Questions) 3 x 5=15

2. Write down the steps of Prim's algorithm to find a minimum spanning tree of the graph shown in the figure: (3)



3. Calculate the time complexity of the given recurrance relation using the recursion tree method. $T(n) = 2T(n/2) + n$, $T(1) = 1$ (3)
4. Apply job sequence with deadline and then formulate the solution for the given instances. (3)

Job	J1	J2	J3	J4	J5
Deadline	2	1	3	2	1
Profit	60	100	20	40	20

5. Determine the suitable solutions for the given Boolean SAT problem: $(A \vee B) \wedge (\neg A \vee C)$ (3)

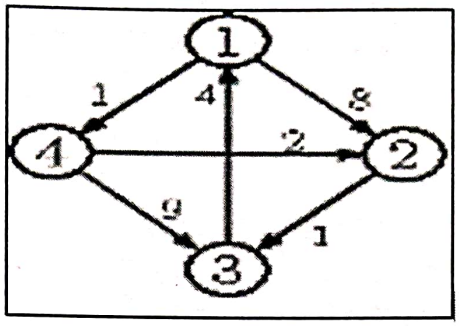
6. Justify why solving an NP-complete problem efficiently would impact all of NP. (3)

OR

Assess the usefulness of approximation algorithms for solving NP-hard problems. (3)

Group-C
(Long Answer Type Questions) 5 x 3=15

7. Write the step-by-step solution to the above problem using the Floyd-Warshall algorithm to find the shortest paths between all pairs of vertices in the weighted graph. (5)

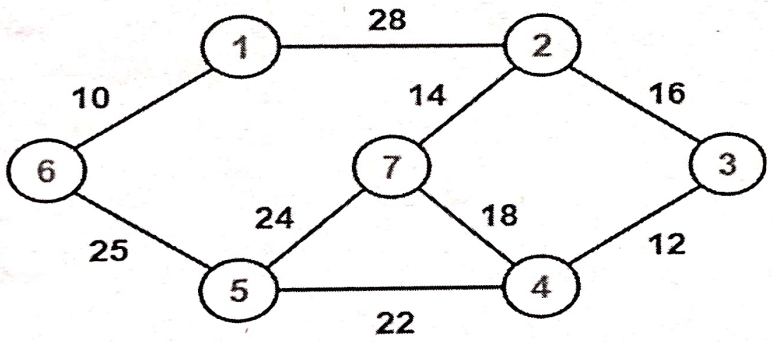


8. A **freelancer** has **10 hours available** to work on projects for the week. There are multiple **projects** to choose from, each with a required time and a payment amount. The freelancer wants to **maximize earnings** while staying within the available work hours. (5)

Project	Payment (₹)	Time Required (hours)
P1	5,000	2
P2	7,500	3
P3	3,000	1
P4	12,000	5
P5	9,000	4

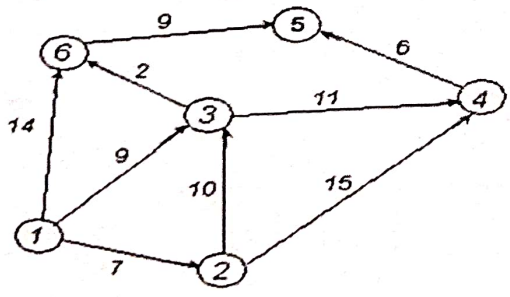
Using dynamic programming, determine the maximum earnings (₹) the freelancer can achieve and which projects they should select within the 10-hour limit.

9. Using Kruskal's algorithm, illustrate the minimum spanning tree (MST) for the given graph. (5)



OR

Apply Dijkstra's algorithm to determine the shortest path from node 1 to all other nodes in a given weighted graph. (5)



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