BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE

BSc HONOURS DEGREE IN COMPUTER SCIENCE/SOFTWARE ENGINEERING/INFORMATION TECHNOLOGY

CS401/CSH219/SWE217: DESIGN AND ANALYSIS OF ALGORITHMS

DURATION: 2HOURS...30 MINUTES. TOTAL MARKS: ...100...

INSTRUCTIONS TO CANDIDATES

NOV 2024

This paper consists of six(6) questions.
Answer all questions.

Question 1

a. Define complexity of an algorithm and give a detailed explanation of your understanding of Worst case complexity of an algorithm. [8]

b. Show that:

i. $f(n) = n^2 + n$ is $O(n^3)$ [3]

ii. $f(n) = n^3 + 4n^2$ is $\Omega(n^2)$ [4]

c. For an $O(N^K)$ algorithm, where k is a positive integer, an instance of size M takes 32 seconds to run. Suppose you run an instance of size 2M and find that it takes 512 seconds to run. What is the value of k? [4]

d. Compute the time complexities for the following algorithms:

i.
```
int function5(int A[], int B[], int n) {
        int i=0, j=0;
        while (i < n) {
        while (j < n && A[i] > B[j]) j++;
                i++;
        }
        return j;
}
```
[3]

ii.
```
int function6(int A[], int B[], int n) {
int i=0,j;
while (i < n) {  j=0;
        while (j < n && A[i] > B[j]) j++;
                i++;
}
return j; }
```
[3]

Question 2

Using the weighted graph in figure1 below, list the edges in the order which they are added to the minimum spanning tree

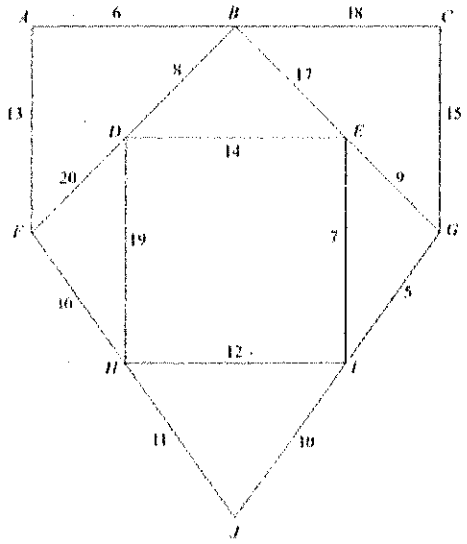

Figure1: Weighted graph

a. After running Prim's algorithm starting from vertex A. [9]

b. After running Kruskal's algorithm. [9]

c. Draw the minimum spanning tree [3]

Question 3

a. Using Dijkstra's algorithm, find a shortest path on the graph in figure 2 below from A and G, showing your work by completing Table 1, which shows the progression of the algorithm. [10]

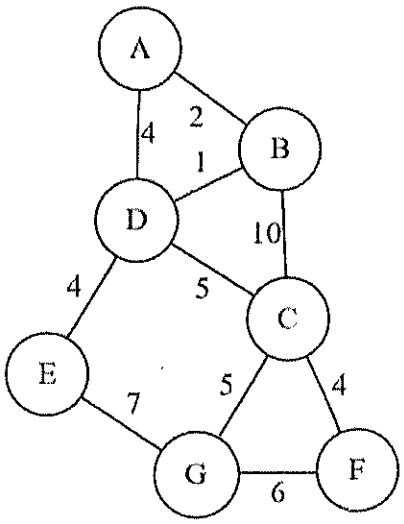

Figure 2: Shortest path graph

Table 1: Algorithm progression

Vertex	Order Visited? e.g 1, 2, 3....	Distance updates
A		
B		
C		
D		
E		
F		
G		

b. State the shortest path and its length [3]

Question 4

Give the algorithm for bubble sort and explain how its worst case complexity is determined.

[12]

Question 5

a. Give a formal definition of the ***string matching problem.*** [3]

b. Explain with the aid of illustrations, how the Knuth-Morris-Pratt and boyer moore algorithms would search for the pattern P = ababac in the string T = ababbabaabbac. [15]

Question 6

A thief broke into a shop with a knapsack of capacity 8kg only to discover that there are four indivisible items at his disposal as in table 2 below:

Table 2: Shop items

Item	Value	Weight
1	15	1
2	10	5
3	9	3
4	5	4

a. Use dynamic programming to find the maximum possible value of the thief's loot. [9]

b. State the key feature of a problem that makes dynamic programming a good candidate for finding a solution? [2]

**********END OF PAPER**********