　　　　　　　　MCS-211

MASTER IN COMPUTER APPLICATIONS (MCA-NEW)
Term-End Examination
December, 2022

MCS-211 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 hours　　　　　　　*Maximum Marks : 100*

　　　　　　　　　　　　　　　　(Weightage : 70%)

*Note : Question no. **1** is **compulsory**. Attempt any **three** questions from the rest.*

1. (a) Write a mathematical definition of big omega (Ω). For the functions defined by $f(n) = 3n^3 + 2n^2 + 1$ and $g(n) = 2n^2 + 3$, verify that $f(n) = \Omega(g(n))$. *6*

   (b) Explain the principle of optimality in dynamic programming, with the help of an example. *6*

   (c) Apply a master method to give the tight asymptotic bounds of the following recurrences : *8*

   (i)　$T(n) = 4T(n/2) + n^2$

   (ii)　$T(n) = 9T(n/3) + n$

(d) Run the Prim's algorithm on the following graph. Assume that the root vertex is (a).
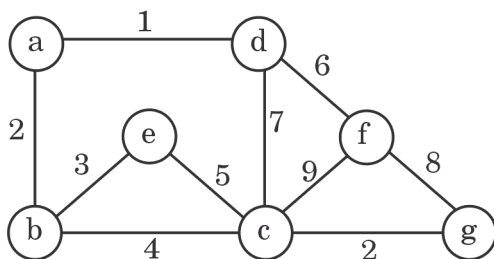
Derive the complexity of the algorithm.   *10*

(e) Apply Huffman's algorithm to construct a Huffman's tree and optimal binary prefix code for the letters and its frequencies as given in the following table :   *10*
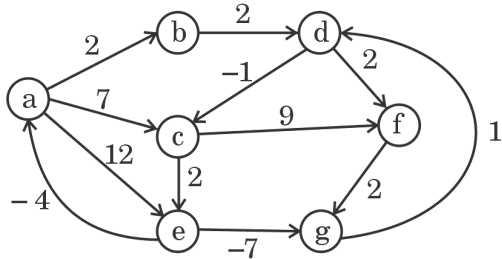
Letter	Frequency
A	15
B	6
C	7
D	5
E	12
I	13
Z	2

2. (a) Explain Cook-Levin's theorem on CNF-Safisfiability problem, with the help of an example.   *10*

(b) (i) Apply Dijkstra's single source shortest path algorithm to the following graph with (a) as starting vertex. Show all the intermediate steps. **7**

(ii) What is the significant feature of Bellman-Ford's algorithm which is not supported in Dijkstra's algorithm ? *3*

3. (a) Write and explain pseudocode for Ford-Fulkerson's algorithm for maximum bipartite matching. *10*

(b) Apply the partition procedure of Quicksort algorithm to the following array :

[35, 10, 40, 5, 60, 25, 45, 15]

Show all the intermediate steps. *10*

4. (a) Apply DFS to the complete graph on four vertices. List the vertices in the order they would be visited. *7*

(b) How many comparisons are needed for a binary search in a set of 512 elements ? *3*

(c) Apply Floyd-Warshall's algorithm to the following graph and show D^2. *10*
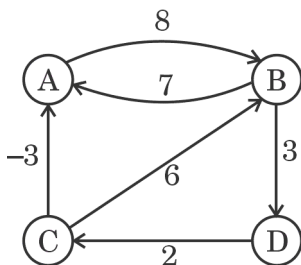
5. (a) Describe the task scheduling algorithm as an optimization problem and calculate its complexity. Consider the following jobs and its service times and apply the task scheduling algorithm to minimize the total amount of time spent in the system. *10*

Job	Service time
1	10
2	15
3	8
4	12
5	6

(b) Describe the basic principle of KMP algorithm for string matching. What is its advantage compared to Naive and Rabin-Karp's algorithm for string matching ? Calculate the time complexity of KMP algorithm. *10*

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