

M. E. Software Engg. Examination 2024

(1st Semester)

ALGORITHMS & DATA STRUCTURE

Time: Three hours

Full Marks-100

Attempt any **five (5)** questions

1.

[3+5+4+8]

- Prove that $o(g(n)) \cap \omega(g(n))$ is the empty set.
- Use the master theorem to find the value of the following expressions.
 - $T(n) = 4T(n/2) + n^2$.
 - $T(n) = 4T(n/2) + n^3$.
- Show that for any real constants a and b , where $b > 0$,
 $(n + a)^b = O(n^b)$.
- Compute the average case complexity of the 'quick sort' method and clearly state your assumptions.

2.

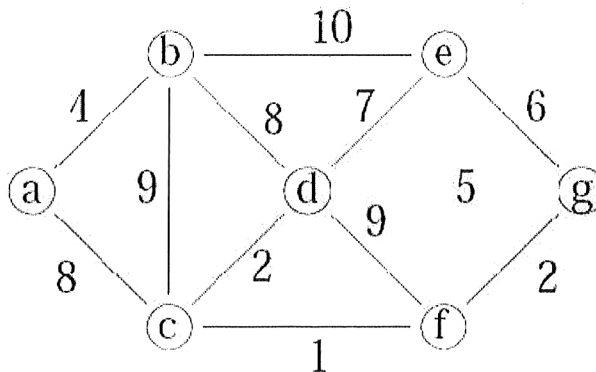
[6+6+(3+5)]

- A binary search tree node has two fields: i) integer number and ii) no_nodes. 'no_nodes' represents the number of nodes in the tree rooted at that node. Give a method to locate the i^{th} smallest number.
- Insert 14, 17, 11, 7, 53, 4, 13 into an empty AVL tree then insert 12 and 8 after this remove 53 and 11. Show the step-by-step result.
- Give the ADT of liner list. Give a method to reverse a single link list.

3.

[(4+6)+(5+5)]

- Determine the structure of an optimal solution of the longest common subsequence problem using dynamic programming approach. Find the LCS from $X = (A, B, C, B, D, A, B)$ and $Y = (B, D, C, A, B, A)$ using above approach.
- Describe a greedy method to find a minimal spanning tree from a given weighted graph. Also, find a minimum spanning tree from the following graph using your method.



[Turn over

4. [5x2 + (4+6)]
- a. Define the following problems (any five)
- i) Travelling salesman problem
 - ii) Independent set problem
 - iii) circuit satisfiability problem
 - iv) Fraction knapsack problem
 - v) Longest path problem
 - vi) Sorting problem
- b. Describe 'tail function call' with suitable example. Consider the following code
- ```

int fact(int x){
 if (x==0)
 return 1;
 else
 return x*fact(x-1);
}

```
- Does the recursive call is a tail call? Justify your answer.
5. [2+2+7+(3+6)]
- a. What are the operations associated with dictionary.
  - b. What is the objective of hashing?
  - c. What is primary clustering problem in hashing, describe with an example. How primary clustering problem can be resolved?
  - d. What is universal hashing? Prove that average complexity of unsuccessful search in hashing with chaining is  $O(1 + \alpha)$ .
6. [(2+2)+6+10]
- a. Define the class NP. Prove that vertex cover problem belongs to class NP.
  - b. Assume complete subgraph problem is NP-complete and prove that vertex cover problem is NP-hard.
  - c. Prove that 3SAT problem is NP-complete
7. [2+5+4+9]
- a. Define approximation algorithm.
  - b. Give a method to test whether a given graph is bipartite or not.
  - c. Give a 'polynomial time 1-absolute approximation method' for planar graph colouring problem.
  - d. Give a 2-approx method for vertex cover problem.