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SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION (S), FEBRUARY 2024
ROBOTICS AND AUTOMATION
(2020 SCHEME)

Course Code : **20RBT401**

Course Name: **Algorithms and Data Structures**

Max. Marks : **100** **Duration: 3 Hours**

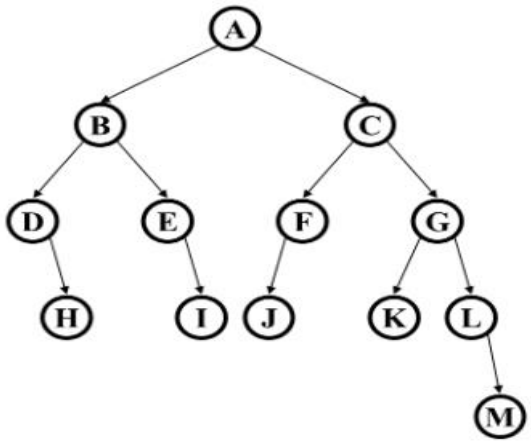
PART A

(Answer all questions. Each question carries 3 marks)

1. How many times statement 1 will get executed? Find the time complexity in Big O for the following code snippet.

```
for (i = 1; i <n; i ++)
  for (j = 1; j <n; j ++)
    for (k = 1; k <n; k ++)
      Statement 1.
```

2. Define non-linear data structures. Give an example.
3. Write the advantages and disadvantages of arrays.
4. The initial configuration of a simple queue is a, b, c, d (where *a* is the *front* of the queue). Write the minimum number of insertions and deletions needed to get the configuration d, a, b, c.
5. Compare spanning tree and minimum spanning tree with an example.
6. Consider the tree given below and answer the following questions with reason



   a. What is the height of the tree ?
   b. List out all the nodes at level 2.
   c. List out the siblings of F.
7. Write notes on B+ trees.
8. What is hashing. Give examples.
9. Name the different algorithm design techniques.
10. Define P, NP hard, NP complete.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Using Masters theorem and aassuming T(1) =1, solve the recurrence relation: $4T(n/2)+n^3$ (6)

    b) Explain different asymptotic notations. Write the order of growth of following functions (ascending order) $3n^3$, cn, n! n^4, nlogn, log n, n^2 (8)

OR

12. a) With necessary examples, explain different types of recursive algorithms. (8)

    b) Explain time complexity & space complexity with example. (6)

MODULE II

13. a) Design algorithms to perform following operations on a doubly linked list:
    i) Insert a node with data 'p' after a node whose data is 'q'.
    ii) Delete a node whose data is 'x'. (8)

    b) Explain Sparse matrix and its representation. (6)

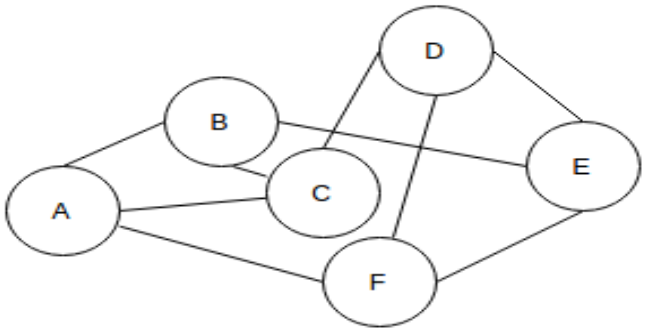
OR

14. a) Write an algorithm to convert an *infix* notation to its corresponding *postfix* notation and convert the following expression to *postfix* notation: **(A/B^C^D*E-A*C).** Evaluate the post fix expression if A= 2, B=1, C=3, D=2, E=3. Show how the stack gets populated at each intermediate steps. (9)

    b) Consider the following sequence of elements:
    (20, 45,67, 89,35,100).
    Perform the following operations on a stack S and Queue Q, both of which are initially empty.
    a. Push all the elements in the same order to S.
    b. Enqueue the elements from index 0 to 5 to the Q in order.
    c. Pop an element from S
    d. Dequeue an element from Q.
    e. Pop an element from S.
    f. Dequeue an element from Q (5)
    g. Dequeue an element from Q and push the same element to S.
    h. Repeat operation 'g' three times.
    i. Pop an element from S.
    j. Pop an element from S .
    Show the contents of stack and queue after the execution of all the above operations.

MODULE III

15. a) Consider the graph below:



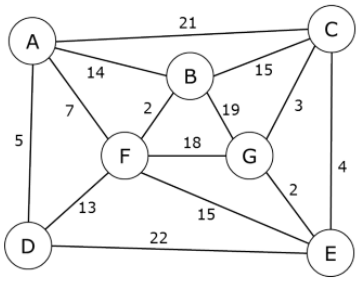
(8)

List the nodes visited while performing DFS in the graph starting at node A. Write an algorithm to perform DFS in a graph.

b) Explain various tree traversal algorithms(recursive) with example. (6)

OR

16. a) Compute the minimum spanning tree using the Prim's algorithm on the following graph:



(7)

What is the weight of the spanning tree that you constructed?

b) Illustrate various graph traversal algorithms. (7)

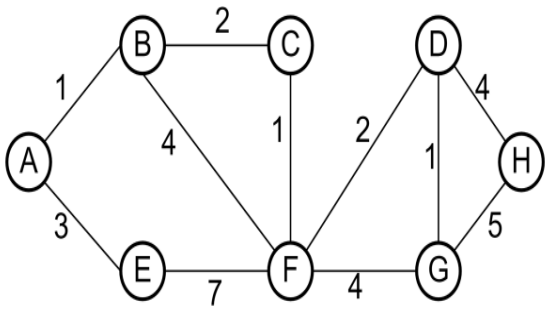
MODULE IV

17. a) Consider a hash table of size 11 with the hash function h(x) = (x +10) % 11 with the hash key x. Draw the corresponding hash table with keys 10, 4, 13, 50, 15, 24 and 43. Apply Chaining method if any collisions. (5)

b) Draw the binary search tree that results from inserting the numbers given below and write the in order, preorder, and post order traversal of the constructed binary search tree. 70, 11,47, 81,20, 61, 10, 12, 13, 62. (9)

OR

18. a) For the graph given below



(14)

Give the order in which Dijkstra's Algorithm would visit each vertex, starting from vertex A. Sketch the resulting shortest paths tree.

MODULE V

19. a) Explain greedy algorithm. Mention its advantages and disadvantages. (7)

b) Explain divide and conquer approach in detail. (7)

OR

20. a) Write notes on NP complete problems. (7)
b) Explain dynamic programming in detail. (7)

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