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B.Tech DEGREE EXAMINATION, MAY 2024

Third Semester

18AIC202J - DATA STRUCTURE AND ITS APPLICATIONS

(For the candidates admitted during the academic year 2018-2019 to 2021-2022)

Note:

- i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
- ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours

Max. Marks: 100

PART - A (20 × 1 = 20 Marks)

Marks BL CO

Answer all Questions

- | | | | |
|--|---|---|---|
| <p>1. Consider the following input sequence for binary searching technique “2, 4, 6, 8, 10, 11, 17, 18, 20, 23”. To search an element 23 in the above given sequence, What would be the middle element in the second pass?</p> <p>(A) 17 (B) 20
(C) 18 (D) 23</p> | 1 | 2 | 1 |
| <p>2. Consider the following linked list & the code snippet:
10->20->30->40->50->60->70.
 <pre> struct node { int data; struct node *next; } *start = NULL; void search() { struct node *cur=start; int i,j; for(i=0; i<3;i++) Cur=cur->next; j=cur->next->next->next->data } </pre> What is the value of variable j?</p> <p>(A) 40 (B) 50
(C) 60 (D) 70</p> | 1 | 2 | 1 |
| <p>3. Which of the following indicates a list L with one item including header node?</p> <p>(A) Header->next = null (B) Header= null
(C) Header->Next!= null (D) Header!= null</p> | 1 | 1 | 1 |

4. Consider the following function which takes head of SLL as argument, what will be the flag value, if the list contains 10 nodes. 1 2 1
- ```

void middlenode(struct node *head)
{
 struct node *p, *q;
 int flag = 0;
 q = p = head;
 while (q->next != NULL)
 {
 q = q->next;
 if (flag)
 {
 p = p->next;
 }
 flag = !flag;
 }
}

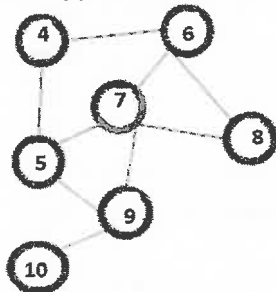
```
- (A) 0 (B) 1  
(C) 2 (D) 3
5. The following postfix expression with single digit operands is evaluated using a stack: 6 2 1 ^ / 4 6 \* + 3 9 \* - Note that ^ is the exponentiation operator. The top two elements of the stack after the first \* is evaluated are 1 2 2
- (A) 3,24 (B) 24,3  
(C) 6,24 (D) 6,6
6. The Five items: 1,2,3,4 and 5 are pushed in a stack, one after the other starting from 1. The stack is popped four times and each element is inserted in a queue. Then two elements are deleted from the queue and pushed back on the stack. Now one item is popped from the stack. The popped item is \_\_\_\_\_. 1 2 2
- (A) 5 (B) 3  
(C) 4 (D) 2
7. Which of the following sequences of array elements forms a max heap? 1 2 2
- (A) {23,17,14,6,13,10,1,12,7,5} (B) {23,17,14,6,13,10,1,5,7,12}  
(C) {23,17,14,7,13,10,1,5,6,12} (D) {23,17,14,7,13,10,1,12,5,7}
8. Which one of the following is the overflow condition if linear queue is implemented using an array with a size MAX\_SIZE? 1 1 2
- (A) rear = front (B) rear = front + 1  
(C) rear = MAX\_SIZE - 1 (D) rear = MAX\_SIZE
9. The following numbers are inserted into an empty binary search tree in the given order: 11, 2, 4, 6, 16, 13, 17. What is the height of the binary search tree (the height is the maximum distance of a leaf node from the root)? 1 2 3
- (A) 4 (B) 2  
(C) 1 (D) 3
10. In full binary search tree every internal node has exactly two children. If there are 150 leaf nodes in the tree, how many internal nodes are there in the tree? 1 2 3
- (A) 149 (B) 151  
(C) 140 (D) 75
11. While inserting the elements 80,7,90,8,89,93,91 in an empty binary search tree (BST) in the sequence shown, the element in the lowest level is \_\_\_\_\_ 1 2 3
- (A) 7 (B) 91  
(C) 8 (D) 89
12. Which of the following property is mandatory for a tree to be heap? 1 1 3
- (A) Full binary tree (B) Binary search tree  
(C) Red black tree (D) Complete tree

13. Write the worst case time complexity of Prim's algorithm if adjacency matrix is used 1      2      4  
 (A)  $O(\log V)$  (B)  $O(V^2)$   
 (C)  $O(E^2)$  (D)  $O(V \log E)$

14. Kruskal's algorithm is used to \_\_\_\_\_ 1      1      4  
 (A) find minimum spanning tree (B) find single source shortest path  
 (C) find all pair shortest path algorithm (D) traverse the graph

15. Consider a complete graph G with 4 vertices. The graph G has \_\_\_\_\_ spanning trees. 1      1      4  
 (A) 15 (B) 8  
 (C) 16 (D) 13

16. After applying BFS in the following graph, the ancestor of the child 8 is 1      2      4



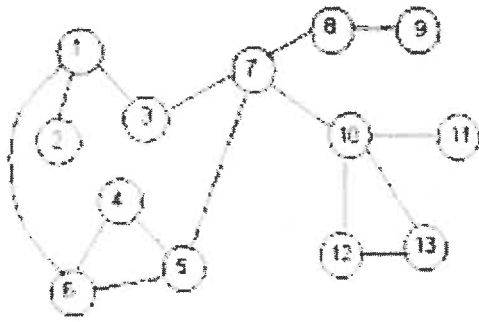
- (A) 7 (B) 6  
 (C) 5 (D) 9
17. A hash table contains 10 buckets and uses linear probing to resolve collisions. The key values are integers and the hash function used is  $\text{key} \% 10$ . If the values 43, 165, 62, 123, 142 are inserted in the table, in what location would the key value 142 be inserted? 1      2      5  
 (A) 5 (B) 4  
 (C) 3 (D) 6
18. A hash table of length 10 uses open addressing with hash function  $h(k) = k \bmod 10$ , and linear probing. After inserting 6 values into an empty hash table which is shown below, which one of the following choices gives a possible order in which key values could have been inserted in the table 1      3      5

|   |    |
|---|----|
| 0 |    |
| 1 |    |
| 2 | 42 |
| 3 | 23 |
| 4 | 34 |
| 5 | 52 |
| 6 | 46 |
| 7 | 33 |
| 8 |    |
| 9 |    |

- (A) 46, 42, 34, 52, 23, 33 (B) 34, 42, 23, 52, 33, 46  
 (C) 46, 34, 42, 23, 52, 33 (D) 42, 46, 33, 23, 34, 52
19. Consider a double hashing scheme in which the primary hash function is  $h_1(k) = k \bmod 23$ , and the secondary hash function is  $h_2(k) = 1 + (k \bmod 19)$ . Assume that the table size is 23. Then the address returned by probe 1 in the probe sequence (assume that the probe sequence begins at probe 0) for key value  $k=90$  is \_\_\_\_\_ 1      3      5  
 (A) 13 (B) 21  
 (C) 15 (D) 23

20. Find the number of Bi-connected components of the given graph

1 2 5



- (A) 4  
(C) 6

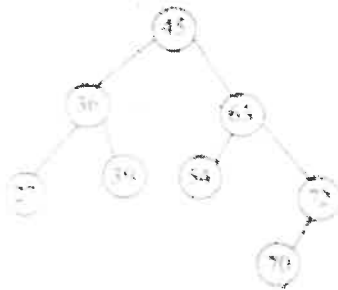
- (B) 5  
(D) 7

**PART - B ( $5 \times 4 = 20$  Marks)**

Answer any 5 Questions

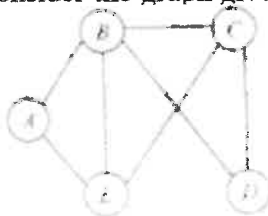
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- |                                                                                                                                                     |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|
| 21. State the difference between array and linked list with proper illustration.                                                                    | 4 | 2 | 1 |
| 22. Write the algorithm for evaluating the postfix expression and show the result for the following expression. $2\ 3\ 4\ *\ 6\ /\ +$               | 4 | 2 | 2 |
| 23. Create a binary search tree with the input given below and calculate the height of the tree<br>98, 2, 48, 12, 56, 32, 4, 67, 23, 87, 23, 55, 46 | 4 | 3 | 3 |
| 24. Balance the AVL tree given below, after inserting an element 30 at the right child of 27                                                        | 4 | 2 | 3 |



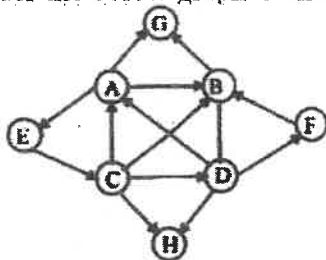
25. Consider the graph given below and find out the degree of each node

4 2 4



26. Consider the below graph G and find the adjacency matrix of G

4 2 4



27. Consider a hash table with size= 10. Using linear probing insert the keys 72, 27, 36, 24, 63, 81, 92 and 101 into the table.

4 3 5

**PART - C ( $5 \times 12 = 60$  Marks)**

Answer all Questions

Marks BL CO

28. (a) Describe the following operations of singly linked list with an example. 12 3 1  
 (i) Deleting a node at the beginning  
 (ii) Deleting a node at the end  
 (iii) Deleting a node after a given node  
 (OR)

(b) Write a program with function which takes head pointer and value to be inserted as arguments. Insert the value in a sorted doubly linked list then display the updated list.

29. (a) (i) Illustrate the step by step process of infix to postfix conversion and write the algorithm. 12 3 2  
 $A (B + D) / E - F * (G + H / K)$   
 (ii) Elaborate the enqueue performed in circular queue with necessary algorithms.

(OR)

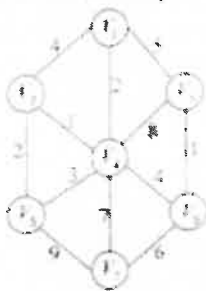
(b) Write a program to perform the following operations in the circular queue.  
 i. Enqueue  
 ii. Dequeue

30. (a) Construct the AVL tree with the following numbers and calculate the height of the tree. (Indicate the case and rotation name, whenever it is required; Show the constructed tree at each step) 12 3 3  
 85, 4, 7, 100, 102, 25, 92, 1, 27, 79, 3, 18

(OR)

(b) Write the algorithm for red-black tree construction. Construct the Red-Black tree with the following numbers and calculate the height of the tree. (Indicate the case and rotation name, whenever it is required; Show the constructed tree at each step)  
 96, 12, 98, 14, 50, 31, 45, 6, 21, 80, 25, 74

31. (a) Write the Prim's algorithm to construct minimum spanning tree for the following graph, 12 3 4



(OR)

(b) Generate the minimum spanning tree for the below undirected graph using Kruskal's algorithm.

32. (a) For a hash table of size:9 with the hash function  $h(x)=x \bmod 9$ , insert the following elements 5,28,19,15,20,33,12,17,10. Illustrate the contents of hash table, how the collisions are resolved using 12 3 5  
 1. Linear Probing  
 2. Double hashing, where the second hash function is  $h_2(x)=7-(x \bmod 7)$ .

(OR)

(b) Construct a hashing table with the table size as your last two digit registration number to store the following data 10246, 11287, 12348, 13380, 14392, 15467, 16562, 17583, 18597, 19643 using folding hashing function. Use **linear probing** for collision resolution.

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