

S/K/TY



VIT
Vellore Institute of Technology

Final Assessment Test – November 2025
Course: **BITE201L** - Data Structures and Algorithms
Class NBR(s): **3025/3029/3036/3040**
Time: **Three Hours**

Reg. No: **240570209**

Slot: **B1+TB1**

Max. Marks: **100**

- **KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

COs	CO Statements
CO1	Identify user defined data types, linear data structures for solving real world problems.
CO2	Analyse and derive time and space complexity for algorithms designed.
CO3	Illustrate various techniques for searching, sorting and hashing.
CO4	Write modular programs on nonlinear data structures and algorithms for solving engineering problems efficiently.
CO5	Design new algorithms or modify existing algorithms for new applications and reason about the efficiency of the result.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions
(10 X 10 = 100 Marks)

1. a) Explain how stack ADT is used in recursion using Towers of Hanoi [6] CO1 BL6
problem. (assume no of disks n=3)
- b) Evaluate the following prefix expression and show the result. [4]
-,+,7,*,4,5,+,2,0

2. a) Perform the following for the given code. CO1 BL2

```
struct node
{ char data;
  struct node *next;
};
main( ) {
  struct node *n1, *n2, *n3,*temp;
  n1= (struct node*) malloc(sizeof (struct node));
  n2= (struct node*) malloc(sizeof (struct node));
  n3= (struct node*) malloc(sizeof (struct node));
  n1->next=n2;
  n2->next=n1;
  n3->next=n2;
  temp=n3->next;
}
```

- i) Mention the successor node for each of the 3 nodes created in the above program. [2]
- ii) Which node is the successor for 2 nodes? [1]
- iii) Which is the node pointed to by "(temp->next)->next" [1]
- iv) From which node if you start, you will be able to visit (display) all the three nodes, by following the links? [2]
- b) Write a code snippet to count the number of nodes in circular singly linked list and illustrate it. [4]
3. a) Solve the following recurrence relation using substitution method. [4] CO2 BL4
- $$T(n) = \begin{cases} 1 & \text{if } n=0 \\ T(n-1) + n & \text{if } n > 0 \end{cases}$$
- b) void function(int n) [3]
- ```

{ int i,j,k,count=0;
for(i=n/2;i<=n;i++)
{for(j=1;j<=n;j=j*2)
{ count++;
}}
for(k=1;k<n;k=k*2)
printf("%d",count); }
```
- Analyze the time complexity of the above code snippet with appropriate proof.
- c) Prove the following:
- i)  $f(n) = n^3 + 20n$  is  $\Omega(n^2)$  [1.5]
- ii)  $f(n) = n^3 + 20n + 1$  is not  $O(n^2)$  [1.5]
4. a) Which is not an in-place sorting algorithm? [2] CO3 BL2
- b) Derive the worst case time complexity for the algorithm mentioned in 4(a). [3]
- c) The keys 76, 93, 40, 47, 10, 55 are inserted into an initially empty hash table by using Double hashing method. What is the resultant hash table? [5]
- Let the array size be the next prime number greater than the number of elements to be hashed.

5.

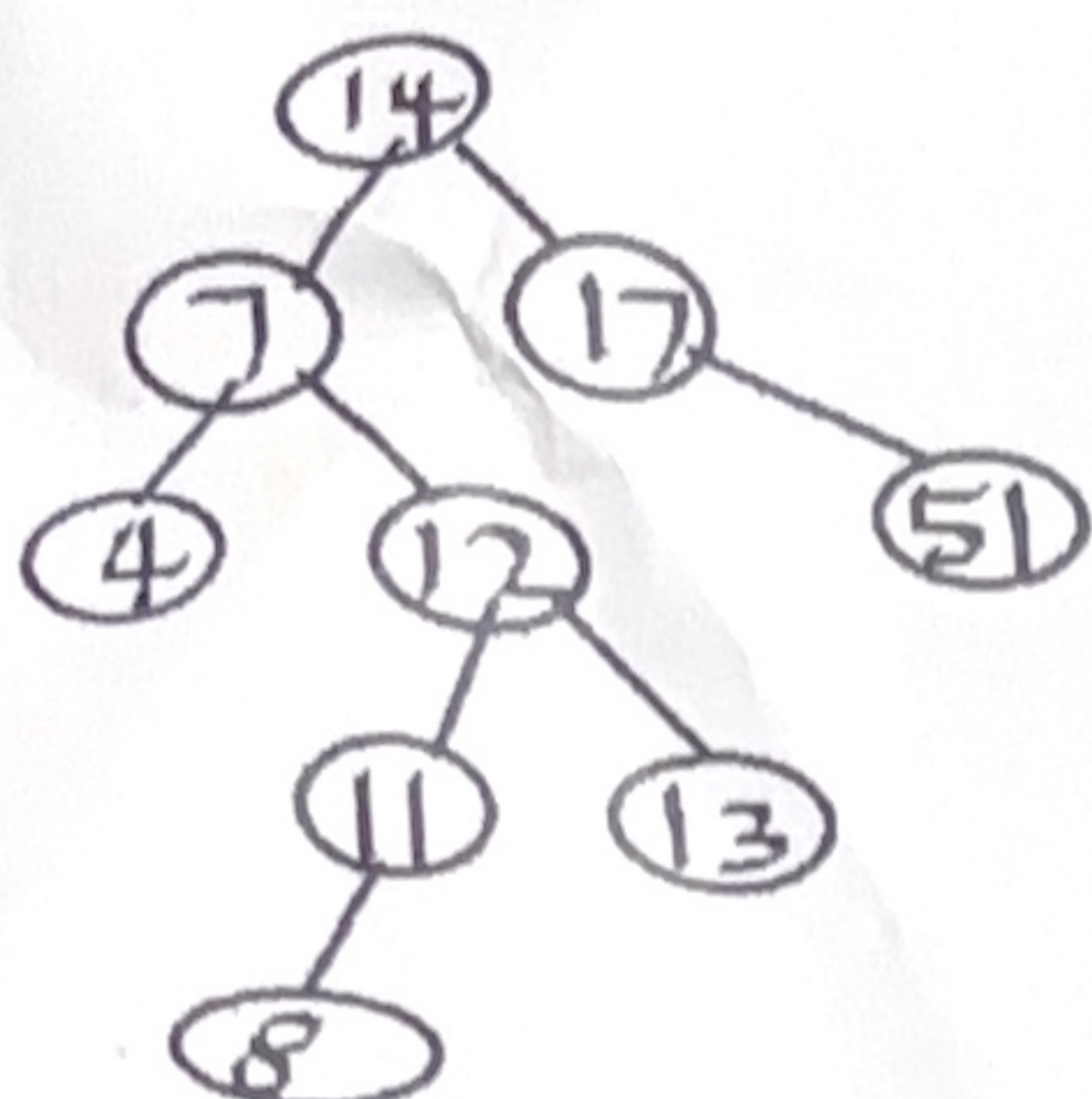
a)

[3] CO4 BL6

i) Whether the following AVL tree is balanced or not if it is not balanced use appropriate rotations to balance it.

ii) Insert 81 and 6 into the balanced tree of 5a. (i) and show the final balanced tree.

[3]



b) Construct a binary tree from the following traversals.

[4]

Preorder : ABDGHKCEF

Post order : GKHDBEFCA

6.

CO4 BL3

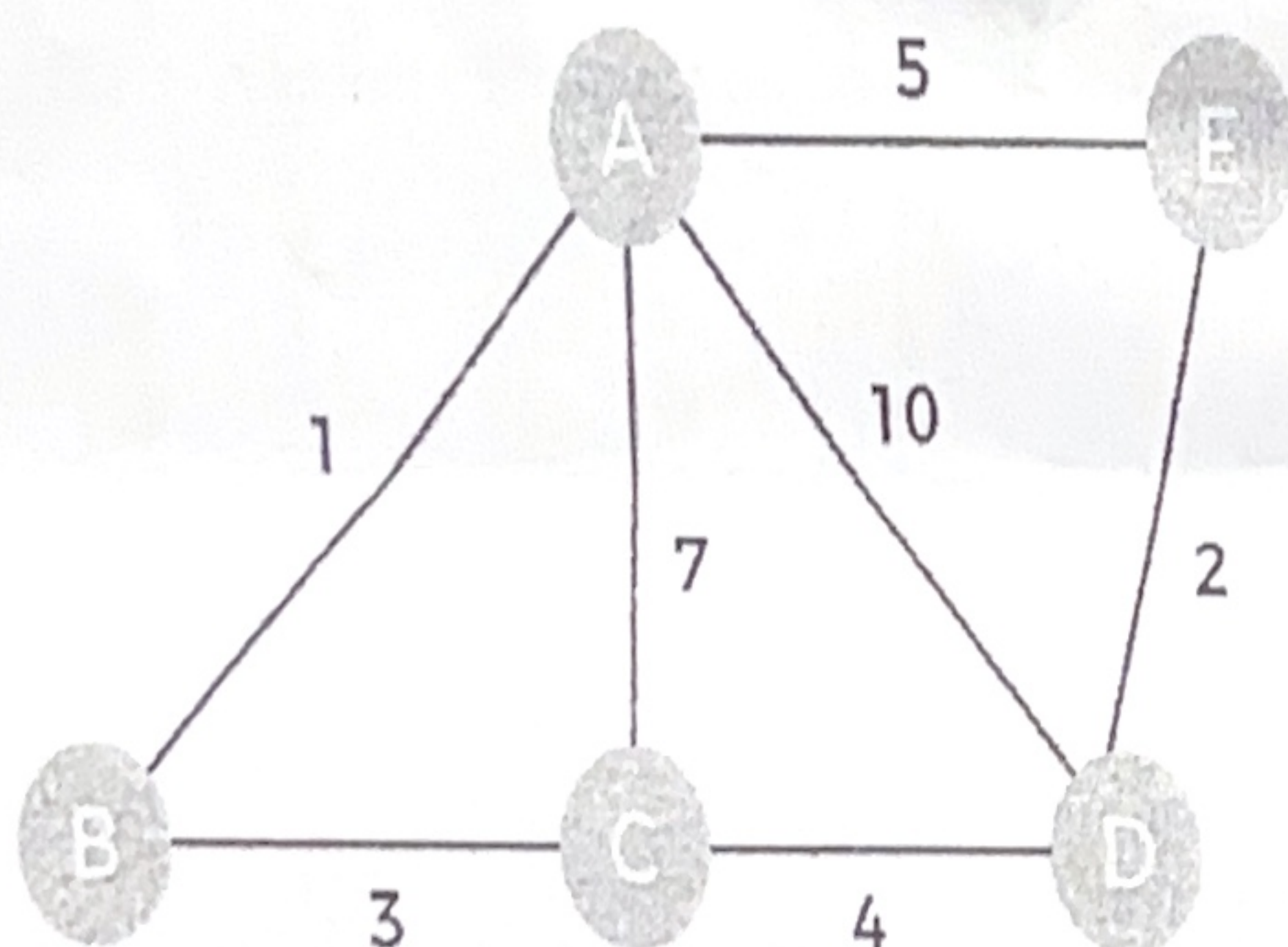


Fig. 1

a) Find out shortest path tree using Dijkstra's algorithm. (Assume A as source).

[5]

b) Propose an algorithm which helps to find cycle in a graph Explain it with an example (Use Fig. 1)

[5]

7.

Apply a suitable encoding method to the given data as per the Greedy principle and obey the rule of most generated character will get a small code and least generated character will get a large code.

CO5 BL6

| character | frequency |
|-----------|-----------|
| a         | 10        |
| e         | 15        |
| i         | 12        |
| o         | 3         |
| u         | 4         |
| s         | 13        |
| t         | 1         |

8. i) What is the running time of the following recursive function (specified as a function of the input value)? Write the recurrence formula and then find its complexity. [5] CO2 BL4

```
function(int n)
{
 if (n <= 1)
 return ;
 for (int i=1 ; i <= 5; i++)
 function(n/5);
}
```

- ii) What is the condition for a function  $f(n)$  to be called as theta of another function  $g(n)$ ? Explain it. [2]

- iii) void prefixsum(int x[], int n) [3]

```
{
 int i , s, sum;

 for(i = n-1; i >=0; i--)
 {
 sum = 0;
 for (j=0; j<=i; j++)
 sum = sum + x[j];
 x[i] = sum;
 }
}
```

Analyze the time complexity of above code segment.

- 9.a) i) Explain gap insertion sort and trace its execution for the following input [7] CO3 BL3

23,14,15,66,44,12,39,55,90,7,32,83,24

ii) Which searching algorithm uses divide and conquer strategy. Prove how many times we must divide our original array with in size (n) . [3]

OR

9.b) i) Let key  $x$  be stored in the position  $f(x) = t$  of the array. Look into the following hash table and find the value of  $t$ . Assume inserting the following values and assess whether that leads to collision or not. In case of collision apply the following: [8] CO3 BL3

- I. Linear probing method and show final table.
- II. A method which solves primary clustering problem and show final table

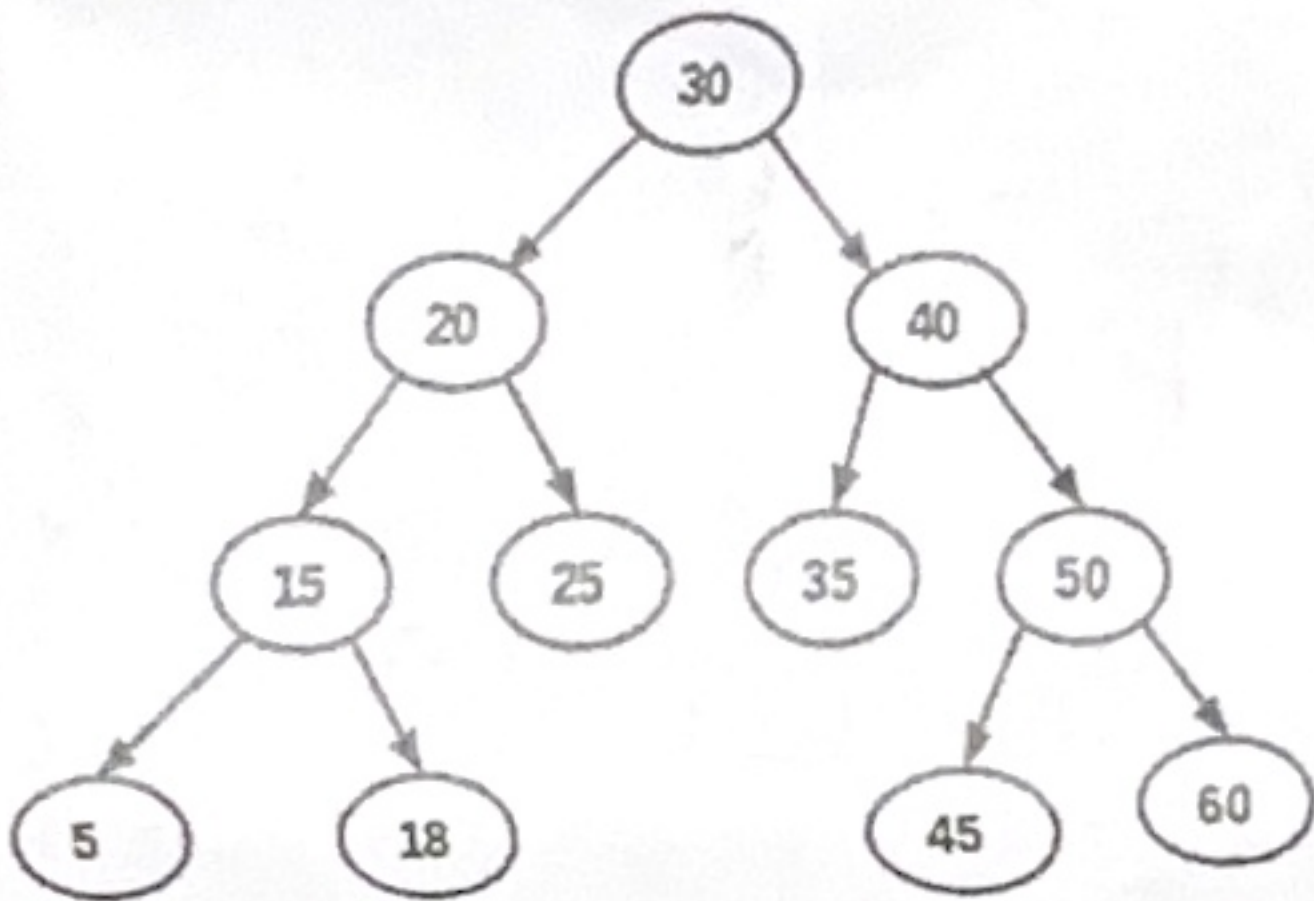
|   |   |    |   |   |    |    |   |   |     |    |      |    |    |    |
|---|---|----|---|---|----|----|---|---|-----|----|------|----|----|----|
| 0 | 1 | 2  | 3 | 4 | 5  | 6  | 7 | 8 | 9   | 10 | 11   | 12 | 13 | 14 |
|   |   | 47 |   |   | 35 | 36 |   |   | 129 | 25 | 2501 |    |    | 29 |

Insert 65, Insert 16, Insert 14, Insert 99, Insert 127.

ii) Consider the sorting algorithms Bubble sort, Insertion sort, selection sort and merge sort. Which of these are stable algorithms. [2]

10.a)

CO4 BL1



- i) Perform inorder, preorder and postorder traversals for the given BST tree [3]
- ii) Delete 25 and then 30 in the above BST tree. [3]
- iii) What is the height of 30? [1]
- iv) Insert 12 and 90 in the above BST tree. [2]
- v) Write the siblings of 20. [1]

OR

10.b) Draw the B-tree of order 3 and order 4 created by inserting the following data arriving in sequence. [10] CO4 BL1

92, 24, 6, 7, 11, 8, 22, 4, 5, 16, 19, 20, 78

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