SASTRA

School of Computing
First CIA Exam – March 2023
Course Code: CSE209 Course Name: Data Structures & Algorithms
Duration: 90 minutes Max Marks: 50

PART A

Answer all the questions (10 x 2 = 20)

1. Find the bound for the following algorithm:

Algorithm func1(n)

1. $i = 1, sum = 0$
2. $x = 3, y = 5$
3. $while\ i \leq n$
4. $\quad if\ sum\%2 = 0$
5. $\quad\quad sum = sum + y$
6. $\quad else$
7. $\quad\quad sum = sum + x$
8. $\quad end\ if$
9. $\quad i = i * 2$
10. $end\ while$
11. $return\ sum$

2. Trace the following recursive algorithm for $m = 35\ and\ n = 120$.

Algorithm Rec_func(m, n)

1. $if\ n \geq m$
2. $\quad return\ Rec\_func(n, m)$
3. $else\ if\ n = 0$
4. $\quad return\ m$
5. $else$
6. $\quad return\ Rec\_func(n, m\%n)$
7. $end\ if$

3. Rearrange the following functions in the increasing order of their order of growth: $100n^5$, $35\log_2 n$, $n\log_2 n$, $n^2\log_2 n$, $4n$, 2^n, $300n^2$, $n!$, 4^n

4. Identify the basic operation in the following algorithm and determine how many times it is repeated for $n = 64$. Also find the return value.

Algorithm find_sum(n)

1. $i = n,\ sum = 0$
2. $while\ i \geq 1$
3. $\quad sum = sum + i$
4. $\quad i = i/2$
5. $end\ while$
6. $return\ sum$

5. Consider the following matrix of order 4x6. It is stored as 2-D array A in row major order starting from location 2000 and assume that each element is stored using 2 bytes. Find the address of the element A(3,5)=35 will be stored using the formula.

$$\begin{pmatrix} 1 & 40 & 9 & 2 & 4 & 29 \\ 8 & 27 & 16 & 8 & 21 & 1 \\ 3 & 30 & 2 & 3 & \mathbf{35} & 60 \\ 22 & 5 & 7 & 20 & 24 & 17 \end{pmatrix}$$

6. Write the recursive algorithm for finding the sum of n elements of a given array.
7. Consider the following operations on an empty stack of size 3. What will be the contents of stack after each operation?

i.	Push X	vi.	Pop
ii.	Push V	vii.	Push E
iii.	Push M	viii.	Push K
iv.	Push R	ix.	Pop
v.	Pop	x.	Pop

8. Assume $a = 5, b = 7, c = 10, d = 18, e = 6$. Evaluate the following postfix expression using stack: $abc * de/+ *$. Draw the stack content after each operation.
9. Write the algorithm for pushing all the elements of a file into a stack.
10. The queue of size 5 is shown below. Draw the contents of the queue after performing Enqueue(72), Dequeue, Enqueue(37), Dequeue operations along with front and rear values.

	1	2	3	4	5
Q	35	11	45	32	

front=1, rear=4

PART B

Answer all the questions **(2 x 15 = 30)**

11. Write the non-recursive algorithm using stack for finding the minimum number of movements required to move N discs of increasing diameter from source needle A to destination needle B using intermediate needle C with the following two constraints:
    (i) Only one disc can be moved at a time and placed in any one of the needles.
    (ii) A larger diameter disc should not be placed on top of a lower diameter disc at any point of time during the movement.
12. Convert the following infix expression into postfix expression using stack: $(d * (k + t)/f - u/(r + x) - h)$. Write the contents of stack for each iteration.

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Second CIA Exam – May 2023

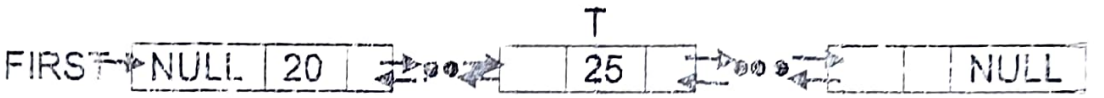
Course Code: CSE209 Course Name: Data Structures & Algorithms

Duration: 90 minutes Max Marks: 50

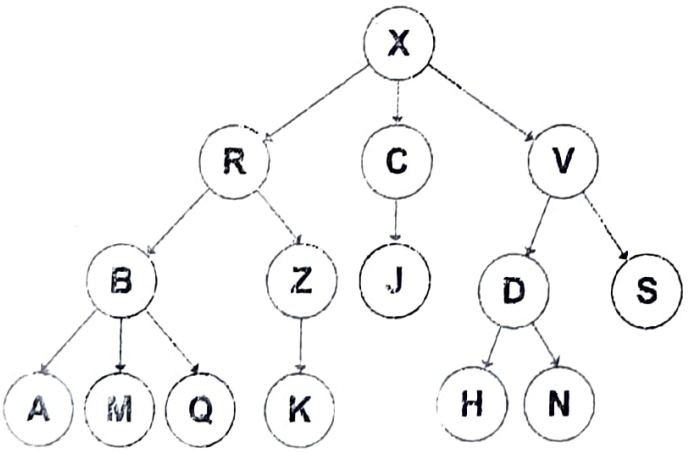
PART A

Answer all the questions (10 x 2 = 20)

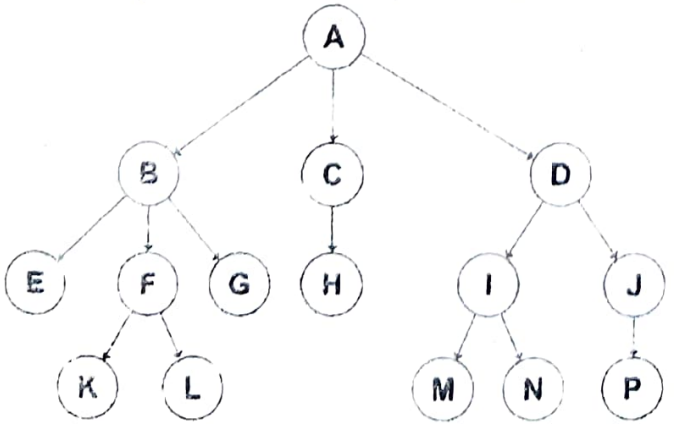
1. Write an algorithm to insert an element into beginning of a singly linked list.
2. Write the algorithm to attach a new ploynomial term at the end of the polynomial which is stored as a singly linked list.
3. Let T be the address of the node to be deleted from a non-empty doubly linked list as shown below. Write the pseudocode to delete the node T.



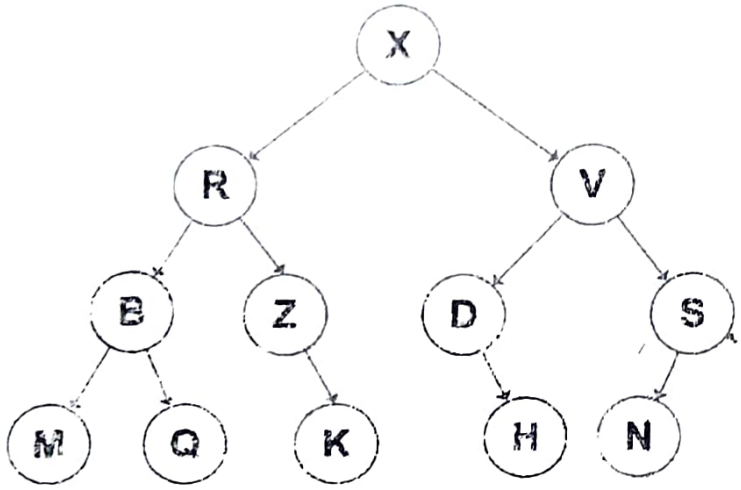
4. Identify the siblings of **Q** in the following general tree.



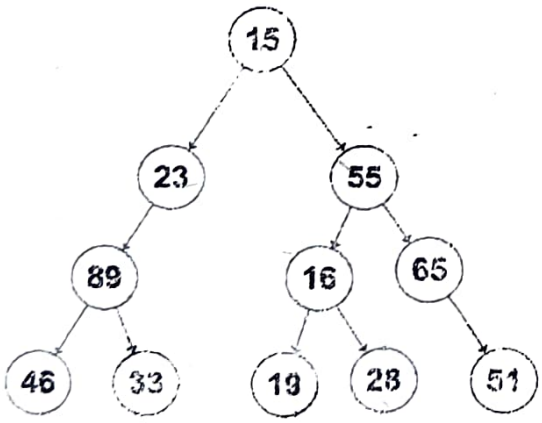
5. Write the parenthetical representation for the following general tree:



6. Represent the following binary tree as a sequential array.



7. Define height of a binary tree.
8. What is the maximum number of nodes in a binary tree of height h?
9. Find the incrder traversal of the following binary tree



10. Write the algorithm to find the maximum element in a binary search tree.

PART B

Answer any THREE questions **(3 x 10 = 30)**

11. Write the algorithm for adding two polynomials represented using singly linked list that store non-zero terms.
12. Write the algorithms to perform insertion, deletion, and search operations in an ordered singly linked list with first pointer.
13. Write the algorithms to perform insertion at beginning, insertion at end, insertion at specific location into a circular doubly linked list.
14. Construct a binary search tree for the following input sequence:
45, 11, 34, 87, 56, 72, 89, 51, 68, 35, 22, 19, 69, 9

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Third CIA Exam – June 2023

Course Code: CSE209 Course Name: Data Structures & Algorithms

Duration: 90 minutes Max Marks: 50

PART A

Answer all the questions (10 x 2 = 20)

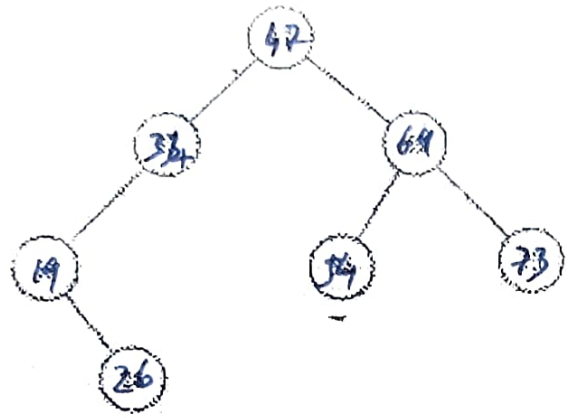
1. Find the complexity of the following algorithm:

```
Algorithm GE(A, n)
1.  for k = 1 to n − 1
2.    for i = k + 1 to n
3.      if A[k, k] ≠ 0
4.        r = A[i, k]/A[k, k]
5.        for j = k to n + 1
6.          A[i, j] = A[i, j] − r ∗ A[k, j]
7.        end for
8.      end if
9.    end for
10. end for
11. return
```

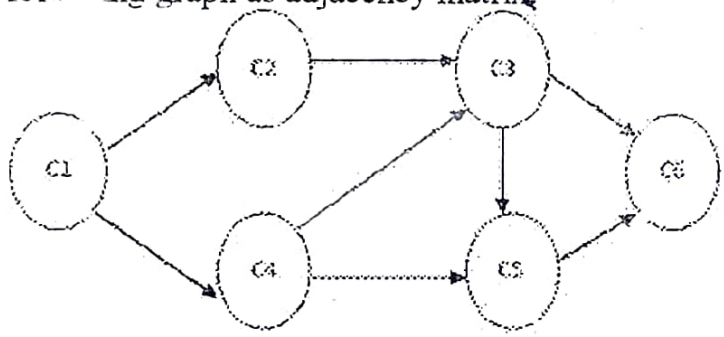
2. Trace the algorithm and find the return value when x=2 and y=5:

```
Algorithm Compute(x, y)
1.  if x == 0
2.    return 0
3.  if y == 1
4.    return x
5.  term = func2(x, ⌊y/2⌋)
6.  if y%2 == 0
7.    return term ∗ term
8.  else
9.    return term ∗ term ∗ x
```

3. Define Ω-Notation.
4. Evaluate the following postfix expression when a=7, b=18, c=3, d=10 **using stack**: $abc/+d*$. Write the contents of stack at each step of evaluation.
5. Represent the following polynomial using singly linked list:
   $P = x^{10} - 3x^8 + 17x^4 + 6x^3 - 7x + 20$
6. Write an algorithm to search for the position of a given element x in a singly linked list
7. Draw the general tree whose parenthetical representation is:
   (1 (2 (3 (4 5) 6) 7 (8 (9) 10) 11 (12 13 14 (15 16) 17)))
8. Search for 26 in the following splay tree and draw the resultant tree after splaying.



9. Represent the following graph as adjacency matrix.



10. Perform first three iterations of selection sort on the following input sequence: 15, 12, 25, 17, 20, 9, 11, 8, 10, 4

PART B

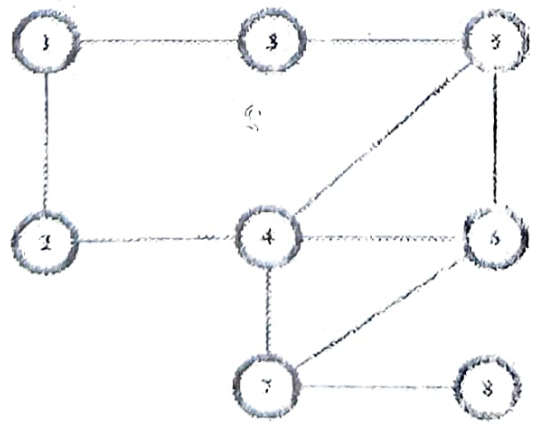
Answer any TWO questions **(2 x 10 = 20)**

11. Write the algorithm for converting infix expression into postfix using stack.
12. Write the algorithms to perform insertion, deletion, and search operations in an ordered doubly linked list.
13. Construct an AVL tree for the following input sequence: 25, 32, 64, 11, 78, 50, 9, 3, 61, 75, 47, 39

PART – C

Answer all the questions **(1 x 10 = 10)**

14. (i) Represent the following graph as adjacency list and perform breadth first traversal. (6 Marks)



(ii) Sort for the following input sequence using heap sort: 8, 41, 34, 7, 56, 12, 81, 56, 60 (4 Marks)