Course Code : CAT 201 / CCT 203 **EZFY/RW – 22 / 1233**

Third Semester B. Tech. (Computer Science and Engineering / Artificial Intelligence and Machine Learning / Cyber Security) Examination

DATA STRUCTURES / DATA STRUCTURE AND ALGORITHMS

Time : 3 Hours] [Max. Marks : 60

Instructions to Candidates :—

(1) Assume suitable data wherever necessary.
(2) All questions carry marks as indicated.

1. (a) Identify the types of Data Structures best suitable for the following scenarios and explain in brief to justify your answer :—

(1) Representing the list of Names of 10 students in a class.

(2) Representing the indices of documents in the search engine where document indices are frequently added and deleted.

(3) A college bus moving between different routes in working days is as follows : Route1(R1), Route2(R2), Route3(R3), Route4(R4), Route5(R5). Represent the way through which the college bus moves between different stops listed above using an appropriate data structure. 1+2+2(CO1)

(b) Suppose a 3 – dimensional array A is defined as below —

$A[1:6, -5:2, 4:10]$.

Size of each element in A is 4 and base address of A is 1200 :

(1) Compute the address of the element stored at $A[3, -3, 7]$ using RMO form.

(2) Compute the address of the element stored at $A[2, -2, 5]$ using CMO form. 5(CO1)

2. (a) Suppose that you are part of a team developing a financial application. One of the functions used in the application is a calculator, for infix arithmetic expressions. Write an algorithm for this calculator function using two stacks. Trace the stack content to solve the following expression —

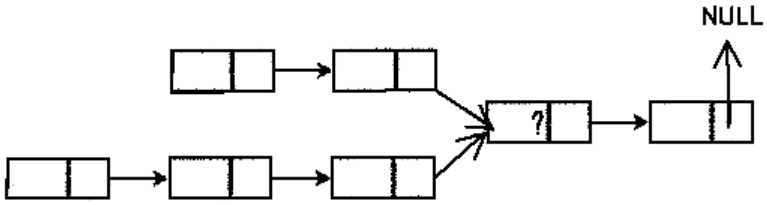
$5 * (((9 + 8) * (4 * 6)) + 7)$ 5(CO2)

(b) At the Covid vaccination center, people are registering and waiting outside the room to get vaccinated. Those who have registered online are allowed to enter directly in the room and get vaccinated, however offline registered people have to wait in the sequence as per their registration :

(a) Identify the suitable data structure and write an algorithm to efficiently perform vaccination activity at the center.

(b) Explain your approach with an example. 5(CO2)

3. (a) Suppose there are two singly linked lists both of which intersect at some point and become a single linked list. The head or start pointers of both the lists are known, but the intersecting node is not known. Also, the number of nodes in each of the lists before they intersect is unknown. ***List1*** may have n nodes before it reaches the intersection point, and ***List2*** might have *m* nodes before it reaches the intersection point where *m* and n may be $m = n$, $m < n$ or $m > n$.



Write an algorithm for finding the merging point using the STACK data structure. 5(CO2)

(b) Given two polynomial numbers represented by a linked list. Write a C function to find addition of two polynomials represented using linked list. Explain steps to add following polynomials.

$a = 4x^5 - 7x^3 + 2x^2 - 1$

$b = 5x^3 + 4x^2 - 5$ 5(CO2)

4. (a) What do you understand by a stable sort and an in – place sort ? What is the running time of heap sort for pre-sorted input ? Show the heap at various stages of sort for the input —

142, 543, 123, 65, 453, 879, 572, 434, 111, 242, 811, 102

5(CO3)

(b) What is hashing ? Explain the following collision resolution techniques in brief :

(1) Separate Chaining.

(2) Linear Probing.

(3) Quadratic Probing.

(4) Double Hashing. 5(CO3)

5. (a) For the Binary tree T,

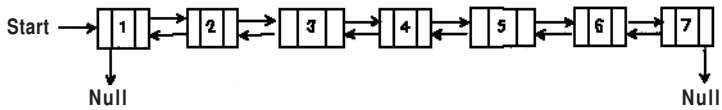
Preorder traversal sequence is – **100, 34, 16, 9, 8, 38, 11, 4, 81**

Postorder traversal sequence is – **34, 9, 11, 4, 38, 81, 8, 16, 100.**

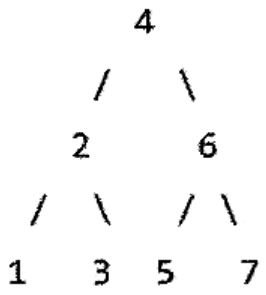
If all the non-leaf nodes of T have two children. Draw the binary tree T. 5(CO4)

(b) Write an algorithm to convert the given sorted doubly linked list into a separate balanced binary search tree.

Example :
Doubly Linked List :–

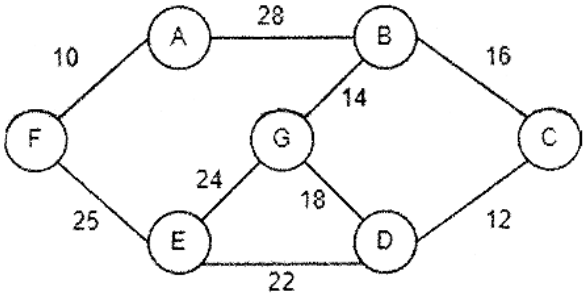


Balanced BST :



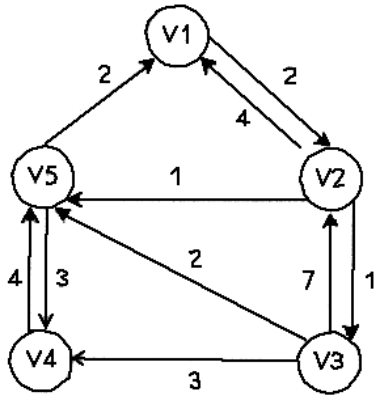
5(CO4)

6. (a) Differentiate between Prim's and Kruskal's minimum spanning tree algorithms. Find the minimum cost spanning tree for the below undirected graph using Prim's and Kruskal's approach ; and show all steps.



5(CO4)

(b) For the weighted graph given below, find all pairs shortest paths using Floyd's algorithm.



5(CO4)