NATIONAL INSTITUTE OF TECHNOLOGY ROURKELA

■ Data Structures and Algorithms ■ CS-2005 ■ Autumn–2021, End Sem

■ 50 Marks ■ Time: 2hrs ■ 1 Page ■ Answer ALL Questions

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1. A three-dimensional array A $[-15, \cdots, 75][-15, \cdots, 75][-15, \cdots, 75]$ is sorted in column major order with 425 as the base address. If each element occupies 1 byte of memory, then answer the following – [4 x 2.5]

   (a) How much memory is required to store the entire array ?

   (b) What is the location for A [25][25][25]?

   (c) What is the location of the 10^{th} element?

   (d) Which element is located at memory address 475?

2. The pre-order and post-order traversal sequence of a binary tree are given as follows. Construct the tree. Show each step clearly. After the construction, Find in-order traversal sequence of the tree. [10]

   Pre-order: E, B, A, D, C, G, F, J, I, H, K, L

   Post-order: A, C, D, B, I, H, J, K, F, L, G, E

3. An undirected graph G is represented by a variant of adjacency matrix P (as given below) in which each entry p_{ij} represents cost of the edge between vertex i and j. Find minimum cost spanning tree using **Prim's** algorithm, with starting vertex A in G. Show each step clearly. [15]

$$P = \begin{array}{c} \begin{matrix} \text{A} & \text{B} & \text{C} & \text{D} & \text{E} & \text{F} \end{matrix} \\ \begin{bmatrix} 0 & 16 & \infty & \infty & 19 & 21 \\ 16 & 0 & 5 & 6 & \infty & 11 \\ \infty & 5 & 0 & 10 & \infty & \infty \\ \infty & 6 & 10 & 0 & 18 & 14 \\ 19 & \infty & \infty & 18 & 0 & 33 \\ 21 & 11 & \infty & 14 & 33 & 0 \end{bmatrix} \end{array} \begin{matrix} \text{A} \\ \text{B} \\ \text{C} \\ \text{D} \\ \text{E} \\ \text{F} \end{matrix}$$

4. (a) Consider the infix expression $(7 \times (5 + 2)) - (4/(1 - 5))$

   Convert the above infix expression to equivalent post-expression, using stack. Processing of each element of the expression and the content of the stack in each step must be stated clearly. [8]

   (b) Given that a queue is implemented using array $Q[1, \cdots, n]$. Write the expressions for the following cases while performing enqueue and dequeue operations. [4.5]

   i. Condition to check Overflow

   ii. Condition to check Underflow

   iii. Condition to check queue contains exactly one element

   (c) Calculate the number of valid pointers and NULL pointers in a grounded two-way linked list containing 10 nodes. Answer if it is a circular one-way linked list. [2.5]