

**Third Semester B. E. (Computer Science and Engineering)
Examination**

DATA STRUCTURES AND ALGORITHMS

Time : 3 Hours]

[Max. Marks : 60

Instructions to Candidates :—

- (1) All questions carry marks as indicated.
- (2) Assume suitable data wherever necessary and provide appropriate trace of algorithms.

1. Solve any Two :

- (a) Discuss the functionality of the following code fragment :

```
int f1 (int a[], int n, int x)
{
    int i, j, k ;
    i = 0; j = n -1;
    while (i <= j) {
        k = (i + j)/2
        if (x==a[k]), return k;
        if (x > a [k]), i = k + 1;
        else j = k -1;
    }
    return -1;
}
```

Compute the best case, worst case and average case time complexity of the above code fragment. Explain your answers. 5(CO1)

- (b) Develop a recursive algorithm to count the number of elements in an array. Explain the advantages and disadvantages of using the recursive formulation of the algorithm compared to non-recursive formulation. 5(CO1)

- (c) Consider an array A of size [5x7x6]. Compute value of each of the following expression. Assume that array begins at location 1000 and that each array element occupies four bytes of memory.

(1) A [3, 4, 2] (using row major form)

(2) A [2, 3, 5] (using column major form) 5(CO1)

2. (a) Convert expression $A + (B * C - (D/E^F) * G) * H$ into its equivalent reverse polish notation form. Evaluate the converted expression by considering $A = 2, B = 3, C = 4, D = 4, E = 2, F = 2, G = 3, H = 2$. Show stack contents on each stage of conversion and evaluation. 5(CO2)
- (b) A Double- Ended Queue, DQUE is to be implemented using an array of size N. Write C functions.
- (1) To implement DQUE as an output restricted deque.
- (2) To implement DQUE as an input restricted deque.

Write conditions for queue empty and queue full. 5(CO2)

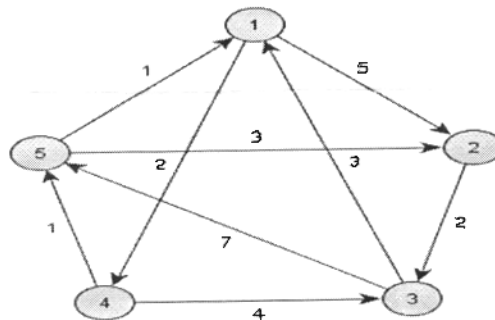
3. Solve any **Two** :—

- (a) Write C program to insert a node at immediate left of j^{th} node in a singly linked list. Your program should first create a singly linked list with 'n' nodes and then should carry out specified insertion operation (using function). 5(CO2)
- (b) Give a linked list sorted in ascending sequence according to a key field in the nodes. Write C function to delete all the nodes in the list which have key values between two k_1 and k_2 . 5(CO2)
- (c) Build C functions to realize a linked stack in constant time. Write a program using these functions to simulate Stack ADT. The program should perform basic operations on ADT. 5(CO2)

4. Solve any **Two** :—

- (a) Write an algorithm to order a list using modified bubble sort. Your algorithm should ensure non-quadratic running time when the input has all keys equal. 5(CO3)
- (b) Write pseudocode to implement recursive MERGESORT. Demonstrate the recursive Merge Sort algorithm to sort the given data {38, 27, 43, 3, 9, 82, 10, 12, 19, 22, 89}. Also draw recursion tree and indicate the order in which steps are processed. 5(CO3)

- (c) Consider given list $L = \{68, 66, 71, 69, 65, 72, 67, 70\}$. Sort the list in descending order using a tree based sorting method. Show intermediate configurations while carrying out the sort. 5(CO3)
5. (a) If you have given the post-order and in-order of nodes, show that the binary tree structure can be constructed. Write C function to achieve the construction of binary tree as above. 5(CO3,4)
- (b) Show the results of inserting the keys F, S, Q, K, C, L, H, T, V, W, M, R, N, P, A, B, X, Y, D, Z, E in the given sequence into an empty B+ – tree with each node storing maximum of 3 Keys, Draw the configurations of the tree before some node get split, and also draw the final configuration. Also, show configurations of B+Tree while removing the keys V and T. 5(CO3,4)
6. (a) For a given graph, determine shortest path cost matrix and path matrix by considering all pairs of vertices as source and destination. Name the algorithm used for solving the above problem and also, write pseudo-code. 5(CO3,4)



- (b) List out factors considered for good hash function. Explain various hash functions with example. For the set of keys $\{1015, 2025, 3025, 2028, 4049, 5052, 8094, 4421, 4068, 1017, 9080, 7523, 6192\}$, obtain a hash table of size 13 using quadratic probing by considering division hash function. 5(CO3,4)