INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
ROORKEE – 247 667
Data Structures (CS 102), B.Tech CSE and ECE

Assignment: 3 Spring Semester 2015-16

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1. In an $n \times n$ **a-matrix,** all the co-efficient other than those in row 1, column 1, column *n* and anti-diagonal are zero.

   (i) Write a 5×5 **a-matrix**

   (ii) How many non-zero elements can you find in an $n \times n$ **a-matrix?**

   (iii) Write a C++/JAVA Program to find the sum of two **a-matrices** A and B with the help of above question 2 (ii). In a usual matrix addition, you require $O(n^2)$ algorithm. Propose an *O(n)* algorithm to add two **a-matrices** of size $n \times n$.

2. Write a C++/JAVA program to check whether given matrix is idempotent or not.

3. Write a C++/JAVA program to find the maximum element of a given matrix.

4. Write and test the function that rotate 90 and 180 degrees clockwise a two dimensional square array of integers.

5. In C++, What is meant by **lists in STL** (Standard Template Libraries). Explain.

6. Use arrays to implement the following functions:
   (i) **`void magic_square(int N);`** `// where N is the dimension of the Magic square and used numbers are lies between [1,N*N]. Repetition of numbers is not allowed.`
   (ii) `void search_ugly_no(int A)`
   `// where A is the 2-dimension array and ugly numbers are those numbers whose prime factors are only 2, 3 or 5( for example: 2, 3, 4, 5, 6, 8, 9, 10, 12, 15,...)`

7. Using pointers and arrays concept, find the results for the following code

```
main()
{
    int c[ ]={2.8,3.4,4,6.7,5};
    int j,*p=c,*q=c;
    for(j=0;j<5;j++)
    {
        cout<<*c;
        ++q;
    }
    for(j=0;j<5;j++)
    {
        cout<<*p;
        ++p;
    }
}
```

8. Write a C++/JAVA program to partially reverse the linked list depending upon *n* (< length of linked list). [Hint: If *n*=2 and A=1 3 6 8 9 2 10 then output will be B=3 1 8 6 2 9 10 and if *n*=3 then A becomes B=6 3 1 2 9 8 10].

9. Write a C++/JAVA program to find a new linked list from two linked list A and B such that every element of B is inserted onto the Prime position in A.

10. Write a C++/JAVA program to remove all the nodes of even position in doubly linked list. Print the resultant doubly linked list. Assume that the index starts from one.

11. Implement Strassen's matrix multiplication algorithm using divide and conquer method. What is the time complexity of this algorithm. You can find the algorithm in
    (i) http://www.stoimen.com/blog/2012/11/26/computer-algorithms-strassens-matrix-multiplication/
    (ii) http://www.geeksforgeeks.org/strassens-matrix-multiplication/

    (Take your own time till the end of this course to implement and this is an Extra Credit problem)