Maharaja Surajmal Institute

Affiliated to GGSIPU & NAAC 'A' grade accredited

DEPARTMENT OF COMPUTER APPLICATIONS

DATA STRUCTURE & ALGORITHMS USING C

PRACTICAL FILE

SUBJECT CODE – BCA

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Practical 1

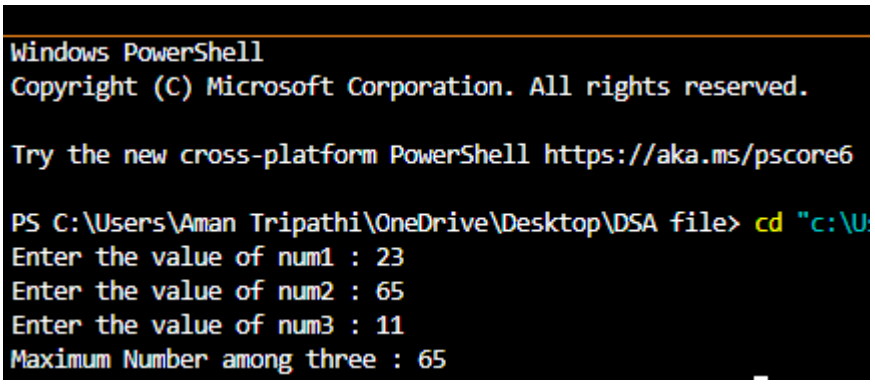
Code:-

// Q 1. WAP to find the greatest among 3 numbers using conditional operator.

```
#include <stdio.h>
void main()
{
    int num1 = 0;
    int num2 = 0;
    int num3 = 0;
    int max = 0;

    // input from user
    printf("Enter the value of num1 : ");
    scanf("%d", &num1);
    printf("Enter the value of num2 : ");
    scanf("%d", &num2);
    printf("Enter the value of num3 : ");
    scanf("%d", &num3);

    // logic for program
    max = (num1 > num2)
     ? (num1 > num3 ? num1 : num3)
                    : (num2 > num3 ? num2 : num3);
```

```
    // Output of Program
    printf("Maximum Number among three : %d", max);
    printf("\n");
}
```

Output:-



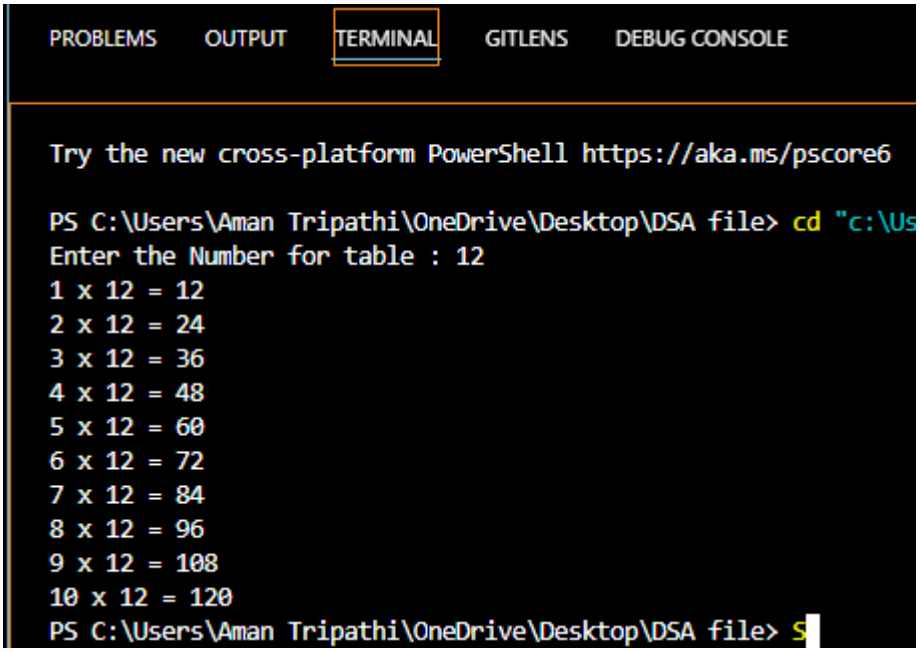
Practical 2

Code:-

```
/*
Q 2. WAP to print table of a number using do while loop.
*/


#include <stdio.h>
void main()
{
    int num = 0;
    // User Input
    printf("Enter the Number for table : ");
    scanf("%d", &num);

    // Logic
    int i = 1;
    int temp = 0;
    do
    {
        temp = i * num;
        printf("%d x %d = %d", i, num, temp);
        printf("\n");
        i++;
    } while (i <= 10);
    temp = 0;
```

}

Output:-

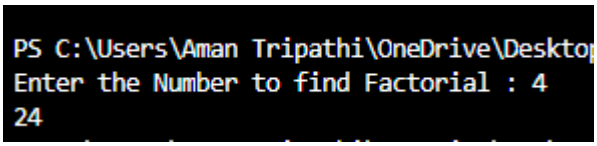

PROBLEMS
OUTPUT
TERMINAL
GITLENS
DEBUG CONSOLE
Try the new cross-platform PowerShell https://aka.ms/pscore6
PS C:\Users\Aman Tripathi\OneDrive\Desktop\DSA file> cd "c:\Us
Enter the Number for table : 12
1 x 12 = 12
2 x 12 = 24
3 x 12 = 36
4 x 12 = 48
5 x 12 = 60
6 x 12 = 72
7 x 12 = 84
8 x 12 = 96
9 x 12 = 108
10 x 12 = 120
PS C:\Users\Aman Tripathi\OneDrive\Desktop\DSA file> S

Practical 3

Code:-

```
// Q 3. WAP to calculate the factorial of a number.
#include <stdio.h>
int fact(int num)
{
    if (num == 0)
        return 1;
    else
        return num * fact(num - 1);
}
void main()
{
    int num = 0;
    printf("Enter the Number to find Factorial : ");
    scanf("%d", &num);
    int fac = fact(num);
    printf("%d", fac);
}
```

Output:-



Practical 4

Code:-

```
// Q 4. WAP to print Fibonacci series using function.

// 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, ...

#include <stdio.h>

void fibonacci(int range)

{

   int a = 0, b = 1, c;

   while (a <= range)

   {

      printf("%d\t", a);

      c = a + b;

      a = b;

      b = c;

   }

}

void main()

{

   int limit = 0;
```

```
    printf("Enter the Limit of the series : ");
    scanf("%d", &limit);
    printf("The fibonacci series is : ");
    fibonacci(limit);
}
```

Output:-

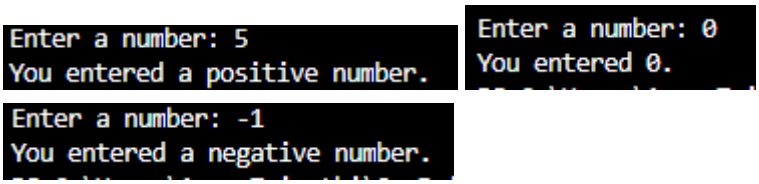
Practical 5

Code:-

```
/*
Q 5. WAP to enter given list of numbers and find how many
positive, negative or zero.
*/
#include <stdio.h>
int main()
{
    double num;
    printf("Enter a number: ");
    scanf("%lf", &num);

    if (num < 0.0)
```

```
        printf("You entered a negative number.");
    else if (num > 0.0)
        printf("You entered a positive number.");
    else
        printf("You entered 0.");
    return 0;
}
```

Output:-



Practical 6

Code:-

```
// Q 6. WAP to sort a given list of no in ascending order and print
#include <stdio.h>
// Sort the array in ascending order
void sort(int arr[], int length)
{
    int temp = 0;
    for (int i = 0; i < length; i++)
    {
        for (int j = i + 1; j < length; j++)
        {
```

```
            if (arr[i] > arr[j])
            {
                temp = arr[i];
                arr[i] = arr[j];
                arr[j] = temp;
            }
        }
    }
}
int main()
{
    // Initialize array
    int n = 0;
    printf("Enter the Size of array : ");
    scanf("%d", &n);
    int arr[n];
    printf("Enter the Element of the Array: ");
    for (int i = 0; i < n; i++)
    { scanf("%d", &arr[i]); }
    // Calculate length of array arr
    int length = sizeof(arr) / sizeof(arr[0]);
    // Displaying elements of original array
    printf("Elements of original array: \n");
    for (int i = 0; i < length; i++)
    { printf("%d ", arr[i]); }
    sort(arr, length);
    printf("\n");
```

```
    // Displaying elements of array after sorting
    printf("Elements of array sorted in ascending order: \n");
    for (int i = 0; i < length; i++)
    {
        printf("%d ", arr[i]);
    }  return 0;
}
```

Output:-

```
Enter the Size of array : 5
Enter the Element of the Array: 2
1
3
4
5
Elements of original array:
2 1 3 4 5
Elements of array sorted in ascending order:
1 2 3 4 5
```

Practical 7

Code:-

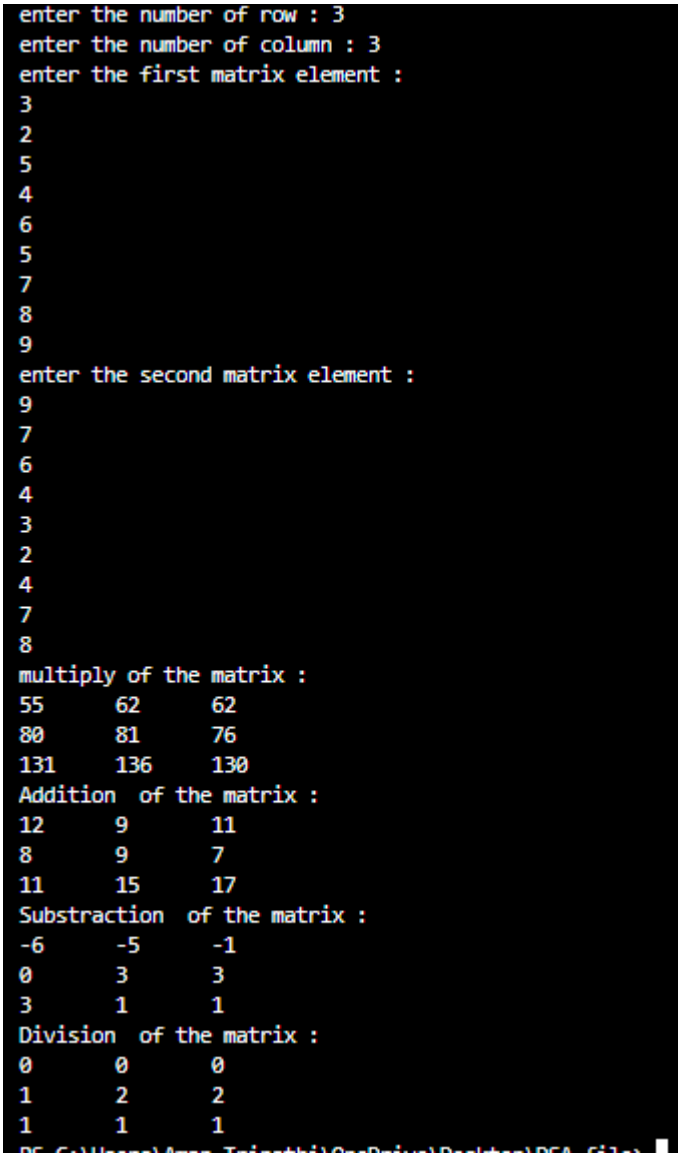
```
/*Q 7. WAP to calculate addition, subtraction, multiplication of
matrix.*/
#include <stdio.h>
#include <stdlib.h>
int main()
{
    int a[10][10], b[10][10], mul[10][10], r, c, i, j, k;
```

```
system("cls");
printf("enter the number of row : ");
scanf("%d", &r);
printf("enter the number of column : ");
scanf("%d", &c);
printf("enter the first matrix element : \n");
for (i = 0; i < r; i++)
{
   for (j = 0; j < c; j++)
   {
      scanf("%d", &a[i][j]);
   }
}
printf("enter the second matrix element : \n");
for (i = 0; i < r; i++)
{
   for (j = 0; j < c; j++)
   {
      scanf("%d", &b[i][j]);
   }
}

printf("multiply of the matrix : \n");
for (i = 0; i < r; i++)
{
   for (j = 0; j < c; j++)
   {
```

```
        mul[i][j] = 0;
        for (k = 0; k < c; k++)
        {
            mul[i][j] += a[i][k] * b[k][j];
        }
    }
}

// for printing result
for (i = 0; i < r; i++)
{
    for (j = 0; j < c; j++)
    {
        printf("%d\t", mul[i][j]);
    }
    printf("\n");
}

// Addition of Matrix
printf("Addition  of the matrix : \n");
for (i = 0; i < r; i++)
{
    for (j = 0; j < c; j++)
    {
        printf("%d\t", a[i][j] + b[i][j]);
    }
    printf("\n");
```

```
    }
    // Substraction of Matrix
    printf("Substraction  of the matrix : \n");
    for (i = 0; i < r; i++)
    {
        for (j = 0; j < c; j++)
        {
            printf("%d\t", a[i][j] - b[i][j]);
        }
        printf("\n");
    }
    //  Division of Matrix
    printf("Division  of the matrix : \n");
    for (i = 0; i < r; i++)
    {
        for (j = 0; j < c; j++)
        {
            printf("%d\t", a[i][j] / b[i][j]);
        }
        printf("\n");
    }
    return 0;
}
```

Output:-


enter the number of row : 3
enter the number of column : 3
enter the first matrix element :
3
2
5
4
6
5
7
8
9
enter the second matrix element :
9
7
6
4
3
2
4
7
8
multiply of the matrix :
55 62 62
80 81 76
131 136 130
Addition of the matrix :
12 9 11
8 9 7
11 15 17
Substraction of the matrix :
-6 -5 -1
0 3 3
3 1 1
Division of the matrix :
0 0 0
1 2 2
1 1 1

Practical 8

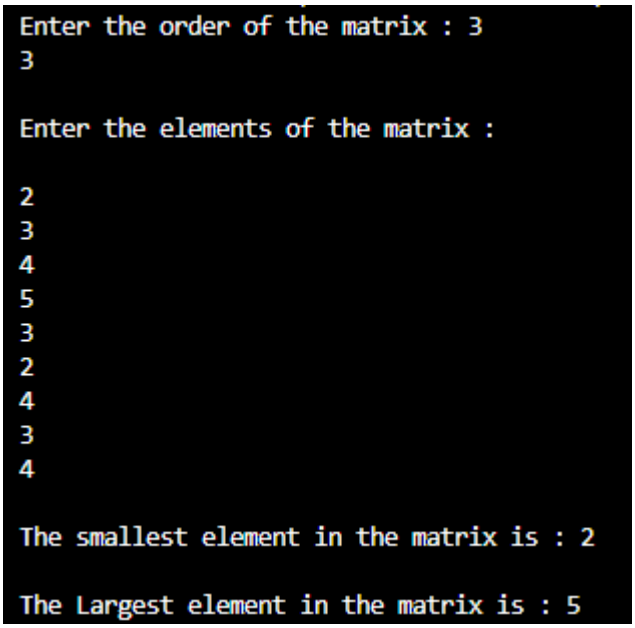
Code:-

// Q 8. WAP to find largest/smallest element of matrix.

```
#include <stdio.h>
void main()
{
    int mat[10][10];
    int i, j, row, col, small, big;

    printf("Enter the order of the matrix : ");
    scanf("%d %d", &row, &col);
    printf("\nEnter the elements of the matrix : \n\n");
    for (i = 0; i < row; i++)
        for (j = 0; j < col; j++)
            scanf("%d", &mat[i][j]);
    big = mat[0][0];
    small = mat[0][0];
    for (i = 0; i < row; i++)
    {
        for (j = 0; j < col; j++)
        {
            if (mat[i][j] < small)
                small = mat[i][j];
            if (mat[i][j] > big)
```

```
            big = mat[i][j];
        }
    }
    printf("\nThe smallest element in the matrix is : %d\n\n", small);
    printf("The Largest element in the matrix is : %d", big);
}
```

Output:-



Practical 9

Code:-

```
// Q 9. WAP to calculate sum of each rows and columns and total
//of all elements of the matrix.
#include <stdio.h>

int main()
{
   int rows, cols, sumRow, sumCol;



   //Initialize matrix a
   int a[][3] = {
                  {1, 2, 3},
                  {4, 5, 6},
                  {7, 8, 9}
               };

   //Calculates number of rows and columns present in given matrix
   rows = (sizeof(a)/sizeof(a[0]));
   cols = (sizeof(a)/sizeof(a[0][0]))/rows;
```

```
    //Calculates sum of each row of given matrix
    for(int i = 0; i < rows; i++){
        sumRow = 0;
        for(int j = 0; j < cols; j++){
          sumRow = sumRow + a[i][j];
        }
        printf("Sum of %d row: %d\n", (i+1), sumRow);
    }

    //Calculates sum of each column of given matrix
    for(int i = 0; i < cols; i++){
        sumCol = 0;
        for(int j = 0; j < rows; j++){
          sumCol = sumCol + a[j][i];
        }
        printf("Sum of %d column: %d\n", (i+1), sumCol);
    }

    return 0;
}
```

Output:-

```
Sum of 1 row: 6
Sum of 2 row: 15
Sum of 3 row: 24
Sum of 1 column: 12
Sum of 2 column: 15
Sum of 3 column: 18
```

Practical 10

Code:-

```
// Q 10. WAP to search element form array using linear search.

#include <stdio.h>

int search(int arr[], int n, int x)

{

    int i;

    for (i = 0; i < n; i++)

        if (arr[i] == x)

            return i;

    return -1;

}

int main(void)

{

    int arr[] = {2, 3, 4, 10, 40};

    int x = 10;

    int n = sizeof(arr) / sizeof(arr[0]);

    // Function call
```

```
    int result = search(arr, n, x);
    (result == -1)
        ? printf("Element is not present in array")
        : printf("Element is present at index %d", result);
    return 0;
}
```

Output:-

```
Element is present at index 3
```

Practical 11

Code:-

```
// Q 11. WAP to search element form array using binary search.

#include <stdio.h>

int binarySearch(int arr[], int l, int r, int x)
{
    while (l <= r)
    {
        int m = l + (r - l) / 2;

        // Check if x is present at mid
        if (arr[m] == x)
            return m;
```

```
        // If x greater, ignore left half
        if (arr[m] < x)
            l = m + 1;

        // If x is smaller, ignore right half
        else
            r = m - 1;
    }
    return -1;
}

int main(void)
{
    int arr[] = {2, 3, 4, 10, 40};
    int n = sizeof(arr) / sizeof(arr[0]);
    int x = 10;
    int result = binarySearch(arr, 0, n - 1, x);
    (result == -1) ? printf("Element is not present"
                            " in array")
                   : printf("Element is present at "
                            "index %d",
                            result);
    return 0;
}
```

Output:-

```
Element is present at index 3
```

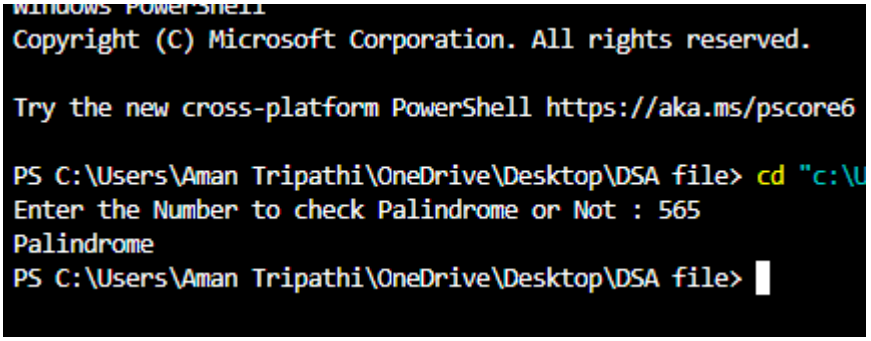
Practical 12

Code:-

```
// Q 12. WAP to check weather number is palindrome.

#include <stdio.h>

int palindrome(int num)

{

   int temp = 0;

   int duplicate = num;

   while (num > 0)

   {

      int d = num % 10;

      temp = temp * 10 + d;
```

```
        num = num / 10;
    }
    // printf("%d",temp);
    if (duplicate == temp)
    {
        return 1;
    }
    else
        return 0;
}
void main()
{
    int num = 0;
    printf("Enter the Number to check Palindrome or Not : ");
    scanf("%d", &num);
    // palindrome(num);
    int ans = palindrome(num);
    if (ans == 0)
        printf("Not Palindrome");
    else if (ans == 1)
        printf("Palindrome");
}
```

Output:-



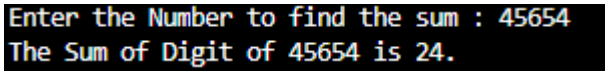
Practical 13

Code:-

```
//  Q 13. WAP to calculate sum of digit of number.

#include <stdio.h>

int sumOfDigit(int num)

{
```

```
    int sum = 0;
    while (num > 0)
    {
        int d = num % 10;
        sum += d;
        num /= 10;
    }
    return sum;
}
int main(int argc, char const *argv[])
{
    int num = 0;
    printf("Enter the Number to find the sum : ");
    scanf("%d", &num);
    int sum = sumOfDigit(num);
    printf("The Sum of Digit of %d is %d.", num, sum);
    return 0;
}
```

Output:-



Practical 14

Code:-

```
// Q14. WAP to for Bubble Sort to Sort Elements in An Order.

#include <stdio.h>


void print(int a[], int n) // function to print array elements

{

   int i;

   for (i = 0; i < n; i++)

   {

      printf("%d ", a[i]);

   }

}

void bubble(int a[], int n) // function to implement bubble sort

{

   int i, j, temp;

   for (i = 0; i < n; i++)

   {

      for (j = i + 1; j < n; j++)

      {

         if (a[j] < a[i])

         {

            temp = a[i];

            a[i] = a[j];

            a[j] = temp;
```

```
            }
        }
    }
}
void main()
{
    int i, j, temp;
    int a[5] = {10, 35, 32, 13, 26};
    int n = sizeof(a) / sizeof(a[0]);
    printf("Before sorting array elements are - \n");
    print(a, n);
    bubble(a, n);
    printf("\nAfter sorting array elements are - \n");
    print(a, n);
}
```

Output:-

```
Before sorting array elements are -
10 35 32 13 26
After sorting array elements are -
10 13 26 32 35
```

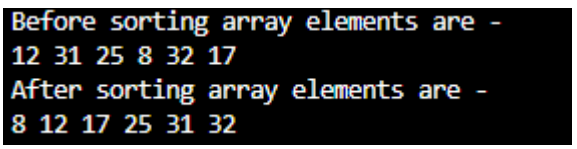
Practical 15

Code:-

```
// Q15. WAP to for insertion Sort to Sort Elements in An Order.

#include <stdio.h>


void insert(int a[], int n) /* function to sort an aay with insertion sort */

{

   int i, j, temp;

   for (i = 1; i < n; i++)

   {

      temp = a[i];

      j = i - 1;


      while (j >= 0 && temp <= a[j]) /* Move the elements greater than temp to one position ahead from their current position*/

      {

         a[j + 1] = a[j];

         j = j - 1;

      }

      a[j + 1] = temp;

   }

}
```

```
void printArr(int a[], int n) /* function to print the array */
{
    int i;
    for (i = 0; i < n; i++)
        printf("%d ", a[i]);
}

int main()
{
    int a[] = {12, 31, 25, 8, 32, 17};
    int n = sizeof(a) / sizeof(a[0]);
    printf("Before sorting array elements are - \n");
    printArr(a, n);
    insert(a, n);
    printf("\nAfter sorting array elements are - \n");
    printArr(a, n);

    return 0;
}
```

Output:-



Practical 16

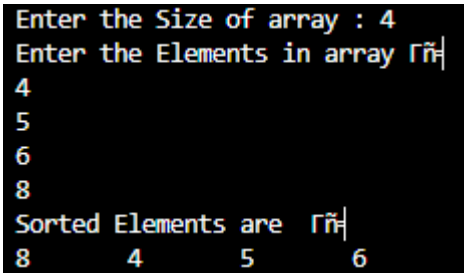
Code:-

```
// WAP to for selection Sort to Sort Elements in An Order.


#include <stdio.h>
void swap(int arr[], int first, int second)
{
   int temp = arr[first];
   arr[first] = arr[second];
   arr[second] = temp;
}
int getMaxIndex(int arr[], int start, int end)
{
   int max = start;
   for (int i = start; i < end; i++)
   {
      if (arr[max] < arr[i])
      {
```

```
            max = i;
        }
    }
    return max;
}
void selectionSort(int arr[], int length)
{

    for (int i = 0; i < length; i++)
    {
        // find the max item in remaining array and swap with correct with correct index
        int last = length - i - 1;
        int maxIndex = getMaxIndex(arr, 0, last);
        swap(arr, maxIndex, last);
    }
}

void main()

{
    int size = 0;
    printf("Enter the Size of array : ");
    scanf("%d", &size);
    int array[size];
    int length = sizeof(array) / sizeof(int);
    printf("Enter the Elements in array ↘");
    printf("\n");
```

```
    for (int i = 0; i < size; i++)
    {
        scanf("%d", &array[i]);
    }
    selectionSort(array, size);
    printf("Sorted Elements are ↘ ");
    printf("\n");
    for (int i = 0; i < size; i++)
    {
        printf("%d\t", array[i]);
    }
}
```

Output:-



Practical 17

Code:-

```
// Q17. WAP to for merge Sort to Sort Elements in An Order.


#include <stdio.h>

#include <stdlib.h>
```

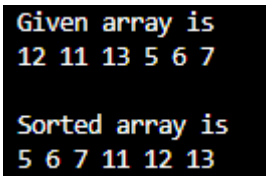
```
// Merges two subarrays of arr[].
// First subarray is arr[l..m]
// Second subarray is arr[m+1..r]
void merge(int arr[], int l, int m, int r)
{
    int i, j, k;
    int n1 = m - l + 1;
    int n2 = r - m;

    /* create temp arrays */
    int L[n1], R[n2];

    /* Copy data to temp arrays L[] and R[] */
    for (i = 0; i < n1; i++)
        L[i] = arr[l + i];
    for (j = 0; j < n2; j++)
        R[j] = arr[m + 1 + j];

    /* Merge the temp arrays back into arr[l..r]*/
    i = 0; // Initial index of first subarray
    j = 0; // Initial index of second subarray
    k = l; // Initial index of merged subarray
    while (i < n1 && j < n2) {
        if (L[i] <= R[j]) {
            arr[k] = L[i];
            i++;
```

```
        }
        else {
            arr[k] = R[j];
            j++;
        }
        k++;
    }

    /* Copy the remaining elements of L[], if there
    are any */
    while (i < n1) {
        arr[k] = L[i];
        i++;
        k++;
    }

    /* Copy the remaining elements of R[], if there
    are any */
    while (j < n2) {
        arr[k] = R[j];
        j++;
        k++;
    }
}

/* l is for left index and r is right index of the
sub-array of arr to be sorted */
```

```
void mergeSort(int arr[], int l, int r)
{
    if (l < r) {
        // Same as (l+r)/2, but avoids overflow for
        // large l and h
        int m = l + (r - l) / 2;

        // Sort first and second halves
        mergeSort(arr, l, m);
        mergeSort(arr, m + 1, r);

        merge(arr, l, m, r);
    }
}

/* UTILITY FUNCTIONS */
/* Function to print an array */
void printArray(int A[], int size)
{
    int i;
    for (i = 0; i < size; i++)
        printf("%d ", A[i]);
    printf("\n");
}

/* Driver code */
int main()
```

```
{
    int arr[] = { 12, 11, 13, 5, 6, 7 };
    int arr_size = sizeof(arr) / sizeof(arr[0]);

    printf("Given array is \n");
    printArray(arr, arr_size);

    mergeSort(arr, 0, arr_size - 1);

    printf("\nSorted array is \n");
    printArray(arr, arr_size);
    return 0;
}
```

Output:-



Practical 18 & 19

Code:-

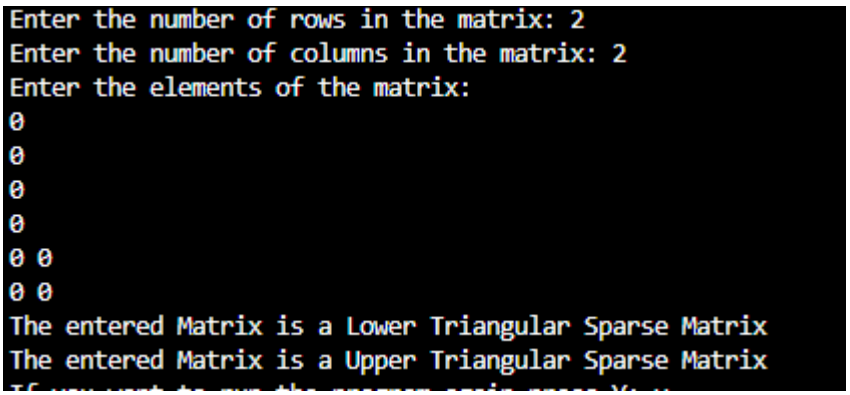
```
#include <stdio.h>
#include <stdlib.h>

int main()
{
    char ans;
    ans='Y';
    while(ans=='Y'||ans=='y'){
    int rows,cols;
    printf("Enter the number of rows in the matrix: ");
    scanf("%d", &rows);
    printf("Enter the number of columns in the matrix: ");
    scanf("%d", &cols);
    int arr[rows+1][cols+1];
    int flag, flag1;
    flag=0;
    flag1=0;
    printf("Enter the elements of the matrix: \n");
    for(int i=0;i<rows;++i)
    {
        for(int j=0;j<cols;++j)
        {
            scanf("%d", &arr[i][j]);
```

```
    }
}
for(int i=0;i<rows;++i)
{
    for(int j=0;j<cols;++j)
    {
        printf("%d ", arr[i][j]);
    }
    printf("\n");
}
for(int i=0;i<rows;++i)
{
    for(int j=0;j<cols;++j)
    {
        if(j>i && arr[i][j]!=0)
        {
            flag=1;
            break;
        }
    }
}

if(flag==0)
{
    printf("The entered Matrix is a Lower Triangular Sparse Matrix\n");
}
else
```

```
{
   printf("The entered Matrix is not a Lower Triangular Sparse Matrix\n");
}

for(int i=0;i<rows;++i)
{
   for(int j=0;j<cols;++j)
   {
      if(j<i &&  arr[i][j]!=0)
      {
         flag1=1;
         break;
      }
   }
}

if(flag1==0)
{
   printf("The entered Matrix is a Upper Triangular Sparse Matrix\n");
}
else
{
   printf("The entered Matrix is not a Upper Triangular Sparse Matrix\n");
}

printf("If you want to run the program again press Y: ");
scanf(" %c", &ans);
```

```
    if(ans!='Y'&& ans!='y')
    {
        printf("Exiting the program");
        exit(0);
    }
    printf("\n");
}
    return 0;
}
```

Output:-



Practical 20

Code:-

```
 #include <stdio.h>
#include <stdlib.h>
struct node
{
   int data;
   struct node *link;
};
struct node *root = NULL;
int len;

void append()
{
   struct node *temp;
   temp = (struct node *)malloc(sizeof(struct node));
   printf("Enter the Node Data: ");
   scanf("%d", &temp->data);
   temp->link = NULL;
   if (root == NULL)
   {
      root = temp;
   }
   else
   {
```

```
        struct node *p;
        p = root;
        while (p->link != NULL)
        {
          p=  p->link;
        }
        p->link = temp;
    }
}
int length()
{
    int count = 0;
    struct node *temp;
    temp = root;
    while (temp != NULL)
    {
        count++;
        temp = temp->link;
    }
    return count;
}
void display()
{
    struct node *temp;
    temp = root;
    if (temp == NULL)
    {
```

```
        printf("List Empty \n\n");
    }
    else
    {
        while (temp != NULL)
        {
            printf("%d   ", temp->data);
            temp = temp->link;
        }
        printf("\n\n");
    }
}
void addAfter()
{
    struct node *temp;
    struct node *p;
    int loc, len, c = 1;
    printf("Enter Location: ");
    scanf("%d",&loc);
    len = length();
    if (loc > len)
    {
        printf("Invalid Location\n");
        printf("Currently List is having %d nodes", len);
    }
    else
    {
```

```
        p = root;
        while (c < loc)
        {
            p = p->link;
            c++;
        }
        temp = (struct node *)malloc(sizeof(struct node));
        printf("Enter Node Data :");
        scanf("%d",&temp->data);
        temp->link = p->link;
        p->link = temp;
    }
}
void addAtBegin(){
printf("Sorry! No function found...");
}
void delete(){
    struct node * temp;
    int loc;
printf("Enter Location to delete: ");
scanf("%d",&loc);
if (loc>length())
{
  printf("Invalid Location \n");
}
else if (loc==1)
{
```

```
    temp=root;
    root=temp->link;
    temp->link=NULL;
    free(temp);

}
else{
    struct node * p = root,*q;
    int i = 1;
    while (i<loc-1)
    {
        p=p->link;
        i++;

    }
    q=p->link;
    p->link=q->link;
    q->link=NULL;
    free(q);


}
}
void main()
{
    int ch;
    while (1)
```

```
{
    printf("Single Linkedlist operations: \n");
    printf("1. Append \n");
    printf("2. Add at beginning \n");
    printf("3. Add after \n");
    printf("4. Length \n");
    printf("5. Display \n");
    printf("6. Delete \n");
    printf("7. Quit \n");
    printf("Enter Your Choice :");
    scanf("%d", &ch);
    switch (ch)
    {
    case 1:
        append();
        break;
    case 2:
        addAtBegin();
        break;
    case 3:
        addAfter();
        break;
    case 4:
        len = length();
        printf("Length: %d\n", len);
        break;
    case 5:
```

```
            display();
            break;
        case 6:
            delete ();
            break;
        case 7:
            exit(1);
            break;
        default:
            printf("Invalid Input \n");
            break;
        }
    }
}
```

Output:-

```
Single Linkedlist operations:
1. Append
2. Add at beginning
3. Add after
4. Length
5. Display
6. Delete
7. Quit
Enter Your Choice :1
Enter the Node Data: 56
Single Linkedlist operations:
1. Append
2. Add at beginning
3. Add after
4. Length
5. Display
6. Delete
7. Quit
Enter Your Choice :1
Enter the Node Data: 56
Single Linkedlist operations:
1. Append
2. Add at beginning
3. Add after
4. Length
5. Display
6. Delete
7. Quit
Enter Your Choice :1
Enter the Node Data: 68
```

```
Single Linkedlist operations:
1. Append
2. Add at beginning
3. Add after
4. Length
5. Display
6. Delete
7. Quit
Enter Your Choice :156
Invalid Input
Single Linkedlist operations:
1. Append
2. Add at beginning
3. Add after
4. Length
5. Display
6. Delete
7. Quit
Enter Your Choice :1
Enter the Node Data: 67
Single Linkedlist operations:
1. Append
2. Add at beginning
3. Add after
4. Length
5. Display
6. Delete
7. Quit
Enter Your Choice :5
56   56   68   67
```

Practical 21

Code:-

```
#include <stdio.h>
#include <stdlib.h>

struct node
{
   int data;
   struct node *left;
   struct node *right;
};

struct node *root=NULL;
struct node *tail=NULL;
int len;

void append();
void addatbegin();
void display();
int length();
void delaloc();
void addafter();

int main()
```

```
{
    int ch;
    while(1)
    {
        printf("\nDouble Linked List Operations: \n");
        printf("1. Append\n");
        printf("2. Add At Beginning\n");
        printf("3. Length\n");
        printf("4. Display\n");
        printf("5. Add after a Particular Location\n");
        printf("6. Delete at a Certain Location\n");
        printf("7. Quit\n");
        printf("Enter your choice: ");
        scanf("%d", &ch);
        switch(ch)
        {
            case 1:append();
            break;
            case 2:addatbegin();
            break;
            case 3:len=length();
            printf("Length is: %d\n", len);
            break;
            case 4:display();
            break;
            case 5:addafter();
            break;
```

```
            case 6: delaloc();
                    display();
            break;
            case 7:exit(1);
            default:printf("Invalid Input");
        }
    }

    return 0;
}

void append()
{
    struct node *temp;
    temp=(struct node*)malloc (sizeof(struct node));
    printf("Enter node data: ");
    scanf("%d", &temp->data);
    temp->left=NULL;
    temp->right=NULL;
    if(root==NULL)
    {
        root=temp;
    }
    else
    {
        struct node *p;
        p=root;
```

```
        while(p->right!=NULL)
        {
            p=p->right;
        }
        p->right=temp;
        temp->left=p;
        tail=temp;
    }
}

void addatbegin()
{
    struct node *temp;
    temp=(struct node*)malloc(sizeof(struct node));
    printf("Enter node data: ");
    scanf("%d", &temp->data);
    temp->left=NULL;
    temp->right=NULL;
    if(root==NULL)
    {
        root=temp;
    }
    else
    {
        temp->right=root;
        root->left=temp;
        root=temp;
```

```
    }
}

int length()
{
    struct node *temp=root;
    int count=0;
    while(temp!=NULL)
    {
        ++count;
        temp=temp->right;
    }
    return count;
}

void display()
{
    struct node *temp=root;
    if(temp==NULL)
    {
        printf("List is Empty\n");
    }
    else
    {
        while(temp!=NULL)
        {
            printf("%d ",temp->data);
```

```
            temp=temp->right;
        }
    }
}



void addafter()
{
    struct node *temp, *p;
    int loc,len,i=1;
    printf("Enter Location: ");
    scanf("%d", &loc);
    len=length();
    if(loc>len)
    {
        printf("Invalid Location\n");
    }
    else
    {
        temp=(struct node*)malloc(sizeof(struct node));
        printf("Enter node data: ");
        scanf("%d", &temp->data);
        temp->left=NULL;
        temp->right=NULL;
        p=root;
        while(i<loc)
        {
```

```
            p=p->right;
            ++i;
        }
        temp->right=p->right;
        p->right->left=temp;
        temp->left=p;
        p->right=temp;
    }
}


void delaloc()
{
    int loc,len;
    printf("Enter the location to delete from: ");
    scanf("%d", &loc);
    len=length();
    if(len==0)
    {
        printf("Empty List\n");
    }
    else if(loc>len)
    {
        printf("Invalid Location\n");
    }
    else if(root==tail)
    {
```

```
    struct node *temp;
    temp=root;
    root=NULL;
    tail=NULL;
    free(temp);
}
else if(loc==1)
{
    struct node *temp;
    temp=root;
    root=root->right;
    root->left=0;
    free(temp);
}
else if(loc==len)
{
    struct node *temp;
    temp=tail;
    tail=tail->left;
    tail->right=0;
    free(temp);
}
else
{
    struct node *p, *q;
    p=root;
    int i=1;
```

```
        while(i<loc-1)
        {
            p=p->right;
            ++i;
        }
        q=p->right;
        p->right=q->right;
        q->right->left=p;
        free(q);

    }
}
```

Output:-

```
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 1
Enter node data: 21

Double Linked List Operations:
1. Append
2. Add At Beginning
3. Length
4. Display
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 1
Enter node data: 21

Double Linked List Operations:
1. Append
2. Add At Beginning
3. Length
4. Display
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 1
Enter node data: 32

Double Linked List Operations:
1. Append
2. Add At Beginning
3. Length
4. Display
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 2
Enter node data: 43

Double Linked List Operations:
1. Append
2. Add At Beginning
3. Length
4. Display
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 3
Length is: 4

Double Linked List Operations:
1. Append
2. Add At Beginning
3. Length
4. Display
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 4
43 21 21 32
Double Linked List Operations:
1. Append
2. Add At Beginning
3. Length
4. Display
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 5
Enter Location: 3
Enter node data: 43

Double Linked List Operations:
1. Append
2. Add At Beginning
3. Length
4. Display
```

Practical 22

Code:-

```
#include <stdio.h>
#include <stdlib.h>

struct node
{
   int data;
   struct node *link;
};

struct node*root=NULL;
struct node *tail=NULL;
int len;

void append();
int length();
void display();
void addafter();
void reverse_list();
void addatbeg();
void sort1();
void sort2();
void delete();
```

```
void main()
{
   int ch;
   while(1)
   {
      printf("\nSingle Circular Linked List Operations: \n");
      printf("1. Append\n");
      printf("2. Add After\n");
      printf("3. Length\n");
      printf("4. Display\n");
      printf("5. Delete\n");
      printf("6. Add At Beginning\n");
      /*printf("8. Selection Sort\n");
      printf("9. Bubble Sort\n");*/
      printf("7. Quit\n");
      printf("Enter your choice: ");
      scanf("%d", &ch);
      switch(ch)
      {
         case 1:append();
         break;
         case 2:addafter();
         break;
         case 3:len=length();
         printf("Length is: %d\n", len);
         break;
```

```
            case 4:display();
            break;
            case 5:delete();
            break;
            case 6: addatbeg();
            break;
            case 7:exit(1);
            default:printf("Invalid Input");
        }
    }

}
void append()
{
    struct node *temp;
    temp=(struct node*)malloc(sizeof(struct node));
    printf("Enter the node data: ");
    scanf("%d", &temp->data);
    temp->link=NULL;
    if(root==NULL)
    {
        root=temp;
        tail=temp;
        temp->link=root;
    }
    else
    {
```

```
        struct node *p;
        p=root;
        while(p->link!=root)
        {
           p=p->link;
        }
        p->link=temp;
        temp->link=root;
        tail=temp;
    }
}

int length()
{
    int count=0;
    struct node *temp;
    temp=root;
    while(temp->link!=root)
    {
        ++count;
        temp=temp->link;
    }
    return count+1;
}

void display()
{
```

```
    struct node *temp;
    temp=root;
    if(temp==NULL)
    {
        printf("List is empty\n\n");
    }
    else
    {
        while(temp->link!=root)
        {
            printf("%d ", temp->data);
            temp=temp->link;
        }
        printf("%d ", temp->data);
        printf("\n\n");
    }
}

void addafter()
{
    struct node *temp;
    struct node *p;
    int loc, len,i;
    i=1;
    printf("Enter Location: ");
    scanf("%d", &loc);
    len=length();
```

```
    if(loc>len)
    {
        printf("Invalid Location\n");
        printf("Currently list is having %d nodes: ", len);
    }
    else
    {
        p=root;
        while(i<loc)
        {
            p=p->link;
            ++i;
        }
        temp=(struct node*)malloc(sizeof(struct node));
        printf("Enter node data: ");
        scanf("%d", &temp->data);
        temp->link=p->link;
        p->link=temp;
    }

}

void delete()
{
    struct node *temp;
    int loc;
    printf("Enter Location to Delete: ");
```

```
scanf("%d", &loc);
if(loc>length())
{
   printf("Invalid Location\n");
}
else if(loc==1)
{
   temp=root;
   root=temp->link;
   tail->link=root;
   free(temp);
}
else
{
   struct node *p=root;
   struct node *q;
   int i=1;
   while(i<loc-1)
   {
      p=p->link;
      ++i;
   }
   if(loc==length())
   {
      tail=p->link;
      q=p->link;
      p->link=q->link;
```

```
            free(q);
        }
        else
        {
            q=p->link;
            p->link=q->link;
            free(q);
        }
    }
}

void addatbeg()
{
    struct node *temp;
    temp=(struct node*)malloc(sizeof(struct node));
    printf("Enter data: ");
    scanf("%d", &temp->data);
    if(root==NULL)
    {
        root=temp;
    }
    else
    {
        temp->link=root;
        root=temp;
        tail->link=temp;
    }
```

}

Output:-

```
Single Circular Linked List Operations:
1. Append
2. Add After
3. Length
4. Display
5. Delete
6. Add At Beginning
7. Quit
Enter your choice: 1
Enter the node data: 65
```

```
Single Circular Linked List Operations:
1. Append
2. Add After
3. Length
4. Display
5. Delete
6. Add At Beginning
7. Quit
Enter your choice: 6
Enter data: 23
```

```
Single Circular Linked List Operations:
1. Append
2. Add After
3. Length
4. Display
5. Delete
6. Add At Beginning
7. Quit
Enter your choice: 1
Enter the node data: 65
```

```
Single Circular Linked List Operations:
1. Append
2. Add After
3. Length
4. Display
5. Delete
6. Add At Beginning
7. Quit
Enter your choice: 5
Enter Location to Delete: 3
```

```
Single Circular Linked List Operations:
1. Append
2. Add After
3. Length
4. Display
5. Delete
6. Add At Beginning
7. Quit
Enter your choice: 2
Enter Location: 1
Enter node data: 65
```

```
Single Circular Linked List Operations:
1. Append
2. Add After
3. Length
4. Display
5. Delete
6. Add At Beginning
7. Quit
Enter your choice: 4
23 65 65
```

```
Single Circular Linked List Operations:
1. Append
2. Add After
3. Length
4. Display
5. Delete
6. Add At Beginning
7. Quit
Enter your choice: 4
65 65 65
```

```
Single Circular Linked List Operations:
1. Append
2. Add After
3. Length
4. Display
5. Delete
6. Add At Beginning
7. Quit
Enter your choice: 3
Length is: 3
```

Practical 23

Code:-

```
#include <stdio.h>
#include <stdlib.h>

struct node
{
   int data;
   struct node *left;
   struct node *right;
};

struct node *root=NULL;
struct node *tail=NULL;
int len;

void append();
void display();
int length();
void addatbegin();
void addafter();
void delaloc();

int main()
{
```

```
int ch;
while(1)
{
   printf("\nDouble Circular Linked List Operations: \n");
   printf("1. Append\n");
   //printf("2. Add At Beginning\n");
   printf("2. Add At Beginning\n");
   printf("3. Length\n");
   printf("4. Display\n");
   printf("5. Add after a Particular Location\n");
   printf("6. Delete at a Certain Location\n");
   printf("7. Quit\n");
   printf("Enter your choice: ");
   scanf("%d", &ch);
   switch(ch)
   {
      case 1:append();
      break;
      case 2:addatbegin();
      break;
      case 3:len=length();
      printf("Length is: %d\n", len);
      break;
      case 4:display();
      break;
      case 5:addafter();
      break;
```

```
            case 6: delaloc();
                    display();
            break;
            case 7:exit(1);
            default:printf("Invalid Input");
        }
    }

    return 0;
}

void append()
{
    struct node *newnode;
    newnode=(struct node*)malloc(sizeof(struct node));
    printf("Enter data: ");
    scanf("%d", &newnode->data);
    newnode->left=NULL;
    newnode->right=NULL;
    if(tail==NULL)
    {
        tail=newnode;
        root=newnode;
        tail->right=newnode;
        root->left=newnode;
    }
    else
```

```
    {
        newnode->left=tail;
        newnode->right=root;
        tail->right=newnode;
        tail=newnode;

    }

}

void display()
{
    struct node *temp;
    if(root==NULL)
    {
        printf("Empty List\n");
    }
    else if(root==tail)
    {
        printf("%d\n", root->data);
    }
    else
    {
        temp=root;
        while(temp!=tail)
        {
            printf("%d ", temp->data);
```

```
            temp=temp->right;
        }
        printf("%d ", temp->data);
    }


}


int length()
{
    struct node *temp=root;
    int count=0;
    while(temp!=tail)
    {
        ++count;
        temp=temp->right;
    }
    return count+1;
}

void addatbegin()
{
    struct node *temp;
    temp=(struct node*)malloc(sizeof(struct node));
    printf("Enter node data: ");
    scanf("%d", &temp->data);
```

```
    temp->left=NULL;
    temp->right=NULL;
    if(root==NULL)
    {
        root=temp;
        tail=temp;
        temp->right=tail;
        temp->left=tail;
    }
    else
    {
        temp->left=tail;
        temp->right=root;
        root->left=temp;
        tail->right=temp;
        root=temp;

    }
}

void addafter()
{
    struct node *temp, *p;
    int loc,len,i=1;
    printf("Enter Location: ");
    scanf("%d", &loc);
    len=length();
```

```
if(loc>len)
{
   printf("Invalid Location\n");
}
else
{
   temp=(struct node*)malloc(sizeof(struct node));
   printf("Enter node data: ");
   scanf("%d", &temp->data);
   temp->left=NULL;
   temp->right=NULL;
   p=root;
   while(i<loc)
   {
      p=p->right;
      ++i;
   }

   if(loc==len)
   {
      temp->right=p->right;
      p->right->left=temp;
      temp->left=p;
      p->right=temp;
      tail=temp;
   }
   else
```

```
        {
            temp->right=p->right;
            p->right->left=temp;
            temp->left=p;
            p->right=temp;
        }
    }
}

void delaloc()
{
    int loc,len;
    printf("Enter the location to delete from: ");
    scanf("%d", &loc);
    len=length();
    if(len==0)
    {
        printf("Empty List\n");
    }
    else if(loc>len)
    {
        printf("Invalid Location\n");
    }
    else if(root==tail)
    {
        struct node *temp;
        temp=root;
```

```
    root=NULL;
    tail=NULL;
    free(temp);
}
else if(loc==1)
{
    struct node *temp;
    temp=root;
    root=root->right;
    root->left=tail;
    free(temp);
}
else if(loc==len)
{
    struct node *temp;
    temp=tail;
    tail=tail->left;
    tail->right=root;
    free(temp);
}
else
{
    struct node *p, *q;
    p=root;
    int i=1;
    while(i<loc-1)
    {
```

```
            p=p->right;
            ++i;
        }
        q=p->right;
        p->right=q->right;
        q->right->left=p;
        free(q);

    }
}
```

Output:-

```
Double Circular Linked List Operations:
1. Append
2. Add At Beginning
3. Length
4. Display
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 2
Enter node data: 56

Double Circular Linked List Operations:
1. Append
2. Add At Beginning
3. Length
4. Display
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 1
Enter data: 63

Double Circular Linked List Operations:
1. Append
2. Add At Beginning
3. Length
4. Display
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 1
Enter data: 54

Double Circular Linked List Operatic
1. Append
2. Add At Beginning
3. Length
4. Display
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 5
Enter Location: 5
Invalid Location
```

```
Double Circular Linked List Operations:
1. Append
2. Add At Beginning
3. Length
4. Display
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 1
Enter data: 58

Double Circular Linked List Operations:
1. Append
2. Add At Beginning
3. Length
4. Display
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 3
Length is: 4

Double Circular Linked List Operations:
1. Append
2. Add At Beginning
3. Length
4. Display
5. Add after a Particular Location
6. Delete at a Certain Location
7. Quit
Enter your choice: 4
56 63 54 58
```

Practical 24

Code:-

```
#include <stdio.h>

#include <stdlib.h>

// #define Max 5;

int Max = 5;

int stack[5];

int top = -1;


int isEmpty() { return (top == -1) ? 1 : 0; }

int isFull() { return (top == Max - 1) ? 1 : 0; }


void push(int data)

{

   if (isFull() == 1)

   {

      printf("Overflow");

   }

   else

   {

      top += 1;

      stack[top] = data;

      printf("Push Successfully");

   }

}
```

```
int pop()
{
    int temp;
    if (isEmpty() == 0)
    {
        temp = stack[top];
        top -= 1;
    }
    else
        printf("Underflow");
    return temp;
}
void peek()
{
    if (isEmpty() == 0)
    {
        printf("%d", stack[top]);
    }
    else
        printf("Stack is Empty");
}
void display()
{
    if (isEmpty() == 0)
    {
        for (int i = top; i >= 0; i--)
        {
```

```
            printf("%d \n", stack[i]);
        }
    }
}
void main()
{
    int input;
    int data;
    while (1)
    {
        printf(" \n0. Exit \n");
        printf("1. Push \n");
        printf("2. Pop \n");
        printf("3. peek \n");
        printf("4. Display \n");
        printf("5. Check Empty or not \n");
        printf("6. Check Full or not \n");
        scanf("%d", &input);
        switch (input)
        {
        case 0:
            exit(0);
            break;
        case 1:
            printf("Enter data to push: ");
            scanf("%d", &data);
            push(data);
```

```
    break;
case 2:
    printf("Deleted element is %d.", pop());
    break;
case 3:
    peek();
    break;
case 4:
    display();
    break;
case 5:
    if (isEmpty() == 1)
        printf("Stack is Empty");
    else
        printf("Stack is not Empty");
    break;
case 6:
    if (isFull() == 1)
    {
        printf("Stack is full");
    }
    else
        printf("Stack is not full");

    break;
default:
    printf("Wrong input");
```

```
            break;
        }
    }
}
```

Output:-

```
0. Exit
1. Push
2. Pop
3. peek
4. Display
5. Check Empty or not
6. Check Full or not
1
Enter data to push: 56
Push Successfully
0. Exit
1. Push
2. Pop
3. peek
4. Display
5. Check Empty or not
6. Check Full or not
2
Deleted element is 56.
0. Exit
1. Push
2. Pop
3. peek
4. Display
5. Check Empty or not
6. Check Full or not
1
Enter data to push: 69
Push Successfully
```

```
0. Exit
1. Push
2. Pop
3. peek
4. Display
5. Check Empty or not
6. Check Full or not
3
85
0. Exit
1. Push
2. Pop
3. peek
4. Display
5. Check Empty or not
6. Check Full or not
5
Stack is not Empty
0. Exit
1. Push
2. Pop
3. peek
4. Display
5. Check Empty or not
6. Check Full or not
6
Stack is not full
```

Practical 25

Code:-

```
#include <stdio.h>
#include <stdlib.h>

struct stack
{
   int data;
   struct stack *link;
};
struct stack *top = 0;
void push(int item)
{
   struct stack *newNode;
   newNode = (struct stack *)malloc(sizeof(struct stack));
   newNode->data = item;
   newNode->link = top;
   top = newNode;
}
int pop()
{
   struct stack *temp;
   temp = top;
   if (top == NULL)
      printf("Stack is Empty");
```

```
    else
    {
        top = temp->link;
        // top= top->link;
        free(temp);
    }
    return top->data;
}
void peek()
{
    if (top == NULL)
    {

        printf("Stack is Empty");
    }
    else
    {
        printf("%d", top->data);
    }
}
void display()
{
    struct stack *temp = top;
    while (temp != NULL)
    {
        printf("%d \n", temp->data);
        temp = temp->link;
```

```
    }
}
void main()
{
    int input;
    int data;
    while (1)
    {
        printf(" \n0. Exit \n");
        printf("1. Push \n");
        printf("2. Pop \n");
        printf("3. peek \n");
        printf("4. Display \n");
        printf("5. Check Empty or not \n");
        printf("6. Check Full or not \n");
        scanf("%d", &input);
        switch (input)
        {
        case 0:
            exit(0);
            break;
        case 1:
            printf("Enter data to push: ");
            scanf("%d", &data);
            push(data);
            break;
        case 2:
```

```
            printf("Deleted element is %d.", pop());
            break;
        case 3:
            peek();
            break;
        case 4:
            display();
            break;
        default:
            printf("Wrong input");
            break;
        }
    }
}
```

Output:-

```
0. Exit
1. Push
2. Pop
3. peek
4. Display
5. Check Empty or not
6. Check Full or not
1
Enter data to push: 56
Push Successfully
0. Exit
1. Push
2. Pop
3. peek
4. Display
5. Check Empty or not
6. Check Full or not
2
Deleted element is 56.
0. Exit
1. Push
2. Pop
3. peek
4. Display
5. Check Empty or not
6. Check Full or not
1
Enter data to push: 69
Push Successfully
```

```
0. Exit
1. Push
2. Pop
3. peek
4. Display
5. Check Empty or not
6. Check Full or not
3
85
0. Exit
1. Push
2. Pop
3. peek
4. Display
5. Check Empty or not
6. Check Full or not
5
Stack is not Empty
0. Exit
1. Push
2. Pop
3. peek
4. Display
5. Check Empty or not
6. Check Full or not
6
Stack is not full
```

Practical 26

Code:-

```
#include <stdio.h>

#define n 5

int main()

{

   int queue[n],

      ch = 1,

      front = 0,

      rear = 0,

      i,

      j = 1,

      x = n;

   printf("Queue using Array");

   printf("\n1.Insertion \n2.Deletion \n3.Display \n4.Exit");

   while (ch)

   {

      printf("\nEnter the Choice:");

      scanf("%d", &ch);

      switch (ch)

      {

      case 1:

         if (rear == x)

            printf("\n Queue is Full");

         else
```

```
    {
        printf("\n Enter no %d:", j++);
        scanf("%d", &queue[rear++]);
    }
    break;
case 2:
    if (front == rear)
    {
        printf("\n Queue is empty");
    }
    else
    {
        printf("\n Deleted Element is %d", queue[front++]);
        x++;
    }
    break;
case 3:
    printf("\nQueue Elements are:\n ");
    if (front == rear)
        printf("\n Queue is Empty");
    else
    {
        for (i = front; i < rear; i++)
        {
            printf("%d", queue[i]);
            printf("\n");
        }
```

```
            break;
        case 4:
            exit(0);
        default:
            printf("Wrong Choice: please see the options");
        }
      }
   }
   return 0;
}
```

Output:-

```
Queue using Array
1.Insertion
2.Deletion
3.Display
4.Exit
Enter the Choice:1

 Enter no 1:56

Enter the Choice:2

 Deleted Element is 56
Enter the Choice:1

 Enter no 2:66

Enter the Choice:3

Queue Elements are:
 66
```

Practical 27

Code:-

```
#include <stdio.h>
#include <stdlib.h>

struct node
{
   int data;
   struct node *next;
};

struct node *front = NULL;
struct node *rear = NULL;

void display();
void enqueue(int);
void dequeue();

int main()
{
   int n, ch;
   do
   {
      printf("\n\nQueue Menu\n1. Add \n2. Remove\n3. Display\n0. Exit");
      printf("\nEnter Choice 0-3? : ");
```

```
        scanf("%d", &ch);
        switch (ch)
        {
            case 1:
                printf("\nEnter number ");
                scanf("%d", &n);
                enqueue(n);
                break;
            case 2:
                dequeue();
                break;
            case 3:
                display();
                break;
        }
    }while (ch != 0);
}

void enqueue(int item)
{
    struct node *nptr = malloc(sizeof(struct node));
    nptr->data = item;
    nptr->next = NULL;
    if (rear == NULL)
    {
        front = nptr;
        rear = nptr;
```

```
    }
    else
    {
        rear->next = nptr;
        rear = rear->next;
    }
}

void display()
{
    struct node *temp;
    temp = front;
    printf("\n");
    while (temp != NULL)
    {
        printf("%d\t", temp->data);
        temp = temp->next;
    }
}

void dequeue()
{
    if (front == NULL)
    {
        printf("\n\nqueue is empty \n");
    }
    else
```

```
    {
        struct node *temp;
        temp = front;
        front = front->next;
        printf("\n\n%d deleted", temp->data);
        free(temp);
    }
}
```

Output:-

```
Queue Menu
1. Add
2. Remove
3. Display
0. Exit
Enter Choice 0-3? : 1

Enter number 236


Queue Menu
1. Add
2. Remove
3. Display
0. Exit
Enter Choice 0-3? : 1

Enter number 265


Queue Menu
1. Add
2. Remove
3. Display
0. Exit
Enter Choice 0-3? : 3

236     265
```

```
Queue Menu
1. Add
2. Remove
3. Display
0. Exit
Enter Choice 0-3? : 2
```

Practical 28

Code:-

```
/*static circular queue*/

#include <stdio.h>

#define size 5


void insertq(int[], int);

void deleteq(int[]);

void display(int[]);


int front =  - 1;

int rear =  - 1;


int main()

{

   int n, ch;

   int queue[size];

   do

   {

      printf("\n\n Circular Queue:\n1. Insert \n2. Delete\n3. Display\n0. Exit");

      printf("\nEnter Choice 0-3? : ");

      scanf("%d", &ch);

      switch (ch)

      {

         case 1:
```

```
            printf("\nEnter number: ");
            scanf("%d", &n);
            insertq(queue, n);
            break;
        case 2:
            deleteq(queue);
            break;
        case 3:
            display(queue);
            break;
      }
   }while (ch != 0);
}


void insertq(int queue[], int item)
{
   if ((front == 0 && rear == size - 1) || (front == rear + 1))
   {
      printf("queue is full");
      return;
   }
   else if (rear ==  - 1)
   {
      rear++;
      front++;
   }
```

```
    else if (rear == size - 1 && front > 0)
    {
        rear = 0;
    }
    else
    {
        rear++;
    }
    queue[rear] = item;
}

void display(int queue[])
{
    int i;
    printf("\n");
    if (front > rear)
    {
        for (i = front; i < size; i++)
        {
            printf("%d ", queue[i]);
        }
        for (i = 0; i <= rear; i++)
            printf("%d ", queue[i]);
    }
    else
    {
        for (i = front; i <= rear; i++)
```

```
            printf("%d ", queue[i]);
    }
}

void deleteq(int queue[])
{
    if (front ==  - 1)
    {
        printf("Queue is empty ");
    }
    else if (front == rear)
    {
        printf("\n %d deleted", queue[front]);
        front =  - 1;
        rear =  - 1;
    }
    else
    {
        printf("\n %d deleted", queue[front]);
        front++;
    }
}
```

Output:-

```
 Circular Queue:
1. Insert
2. Delete
3. Display
0. Exit
Enter Choice 0-3? : 1

Enter number: 2


 Circular Queue:
1. Insert
2. Delete
3. Display
0. Exit
Enter Choice 0-3? : 1

Enter number: 2


 Circular Queue:
1. Insert
2. Delete
3. Display
0. Exit
Enter Choice 0-3? : 3

2 2
```

```
 Circular Queue:
1. Insert
2. Delete
3. Display
0. Exit
Enter Choice 0-3? : 2

 2 deleted
```

Practical 29

Code:-

```
#include<stdio.h>
#include<stdlib.h>
struct node
{
	int data;
	struct node* next;
};
struct node *f = NULL;
struct node *r = NULL;
void enqueue(int d) //Insert elements in Queue
{
	struct node* n;
	n = (struct node*)malloc(sizeof(struct node));
	n->data = d;
	n->next = NULL;
	if((r==NULL)&&(f==NULL))
	{
		f = r = n;
		r->next = f;
	}
	else
	{
		r->next = n;
```

```
                r = n;
                n->next = f;
        }
}
void dequeue() // Delete an element from Queue
{
        struct node* t;
        t = f;
        if((f==NULL)&&(r==NULL))
                printf("\nQueue is Empty");
        else if(f == r){
                f = r = NULL;
                free(t);
        }
        else{
                f = f->next;
                r->next = f;
                free(t);
        }


}
void print(){ // Print the elements of Queue
        struct node* t;
        t = f;
        if((f==NULL)&&(r==NULL))
                printf("\nQueue is Empty");
```

```
	else{
		do{
			printf("\n%d",t->data);
			t = t->next;
		}while(t != f);
	}
}
int main()
{
	int opt,n,i,data;
	printf("Enter Your Choice:-");
	do{
		printf("\n\n1 for Insert the Data in Queue\n2 for show the Data in Queue \n3 for Delete the data from the Queue\n0 for Exit");
		scanf("%d",&opt);
		switch(opt){
			case 1:
				printf("\nEnter the number of data");
				scanf("%d",&n);
				printf("\nEnter your data");
				i=0;
				while(i<n){
					scanf("%d",&data);
					enqueue(data);
					i++;
				}
				break;
```

```
                case 2:
                        print();
                        break;
                case 3:
                         dequeue();
                        break;
                case 0:
                        break;
                default:
                        printf("\nIncorrect Choice");

            }
        }while(opt!=0);
return 0;
}
```

Output:-

```
Enter the number of data 5

Enter your data
34
33
22
76
32


1 for Insert the Data in Queue
2 for show the Data in Queue
3 for Delete the data from the Queue
0 for Exit 3


1 for Insert the Data in Queue
2 for show the Data in Queue
3 for Delete the data from the Queue
0 for Exit 2

33
22
76
32

1 for Insert the Data in Queue
2 for show the Data in Queue
3 for Delete the data from the Queue
0 for Exit
```

Practical 30

Code:-

```
#include <stdio.h>
#define size 5
int deque[size];
int f = -1, r = -1;
//  insert_front function will insert the value from the front
void insert_front(int x)
{
   if((f==0 && r==size-1) || (f==r+1))
   {
      printf("Overflow");
   }
   else if((f==-1) && (r==-1))
   {
      f=r=0;
      deque[f]=x;
   }
   else if(f==0)
   {
      f=size-1;
      deque[f]=x;
   }
   else
   {
```

```
        f=f-1;
        deque[f]=x;
    }
}

// insert_rear function will insert the value from the rear
void insert_rear(int x)
{
    if((f==0 && r==size-1) || (f==r+1))
    {
        printf("Overflow");
    }
    else if((f==-1) && (r==-1))
    {
        r=0;
        deque[r]=x;
    }
    else if(r==size-1)
    {
        r=0;
        deque[r]=x;
    }
    else
    {
        r++;
        deque[r]=x;
    }
```

```
}

// display function prints all the value of deque.
void display()
{
   int i=f;
   printf("\nElements in a deque are: ");

   while(i!=r)
   {
      printf("%d ",deque[i]);
      i=(i+1)%size;
   }
    printf("%d",deque[r]);
}

// getfront function retrieves the first value of the deque.
void getfront()
{
   if((f==-1) && (r==-1))
   {
      printf("Deque is empty");
   }
   else
   {
      printf("\nThe value of the element at front is: %d", deque[f]);
```

```
    }

}

// getrear function retrieves the last value of the deque.
void getrear()
{
    if((f==-1) && (r==-1))
    {
        printf("Deque is empty");
    }
    else
    {
        printf("\nThe value of the element at rear is %d", deque[r]);
    }

}

// delete_front() function deletes the element from the front
void delete_front()
{
    if((f==-1) && (r==-1))
    {
        printf("Deque is empty");
    }
    else if(f==r)
    {
```

```
        printf("\nThe deleted element is %d", deque[f]);
        f=-1;
        r=-1;

    }
     else if(f==(size-1))
     {
         printf("\nThe deleted element is %d", deque[f]);
         f=0;
     }
     else
     {
          printf("\nThe deleted element is %d", deque[f]);
          f=f+1;
     }
}

// delete_rear() function deletes the element from the rear
void delete_rear()
{
    if((f==-1) && (r==-1))
    {
        printf("Deque is empty");
    }
    else if(f==r)
    {
        printf("\nThe deleted element is %d", deque[r]);
```

```
        f=-1;
        r=-1;

    }
     else if(r==0)
     {
         printf("\nThe deleted element is %d", deque[r]);
         r=size-1;
     }
     else
     {
          printf("\nThe deleted element is %d", deque[r]);
          r=r-1;
     }
}

int main()
{
    insert_front(20);
    insert_front(10);
    insert_rear(30);
    insert_rear(50);
    insert_rear(80);
    display();  // Calling the display function to retrieve the values of deque
    getfront();  // Retrieve the value at front-end
    getrear();  // Retrieve the value at rear-end
    delete_front();
```

```
    delete_rear();
    display(); // calling display function to retrieve values after deletion
    return 0;
}
```

Output:-

```
Elements in a deque are: 10 20 30 50 80
The value of the element at front is: 10
The value of the element at rear is 80
The deleted element is 10
The deleted element is 80
Elements in a deque are: 20 30 50
```

Practical 31 & 32

Code:-

```
#include <stdio.h>

#define Size 5


int deque_arr[Size];

int front = -1;

int rear = -1;


/*Begin of insert_rear*/

void insert_rear()

{

   int added_item;

   if ((front == 0 && rear == Size - 1) || (front == rear + 1))

   {

      printf("Queue Overflow\n");

      return;

   }

   if (front == -1) /* if queue is initially empty */

   {

      front = 0;

      rear = 0;

   }

   else if (rear == Size - 1) /*rear is at last position of queue */

      rear = 0;
```

```
    else
        rear = rear + 1;

    printf("Input the element for adding in queue : ");
    scanf("%d", &added_item);
    deque_arr[rear] = added_item;
}
/*End of insert_rear*/

/*Begin of insert_front*/
void insert_front()
{
    int added_item;
    if ((front == 0 && rear == Size - 1) || (front == rear + 1))
    {
        printf("Queue Overflow \n");
        return;
    }
    if (front == -1) /*If queue is initially empty*/
    {
        front = 0;
        rear = 0;
    }
    else if (front == 0)
        front = Size - 1;
    else
        front = front - 1;
```

```
    printf("Input the element for adding in queue : ");
    scanf("%d", &added_item);
    deque_arr[front] = added_item;
}
/*End of insert_front*/

/*Begin of delete_front*/
void delete_front()
{
    if (front == -1)
    {
        printf("Queue Underflow\n");
        return;
    }
    printf("Element deleted from queue is : %d\n", deque_arr[front]);
    if (front == rear) /*Queue has only one element */
    {
        front = -1;
        rear = -1;
    }
    else if (front == Size - 1)
        front = 0;
    else
        front = front + 1;
}
/*End of delete_front*/
```

```
/*Begin of delete_rear*/
void delete_rear()
{
   if (front == -1)
   {
      printf("Queue Underflow\n");
      return;
   }
   printf("Element deleted from queue is : %d\n", deque_arr[rear]);
   if (front == rear) /*queue has only one element*/
   {
      front = -1;
      rear = -1;
   }
   else if (rear == 0)
      rear = Size - 1;
   else
      rear = rear - 1;
}
/*End of delete_rear*/

/*Begin of input_que*/
void display_queue()
{
   int front_pos = front, rear_pos = rear;

   if (front == -1)
```

```
{
    printf("Queue is empty\n");
    return;
}
printf("Queue elements :\n");
if (front_pos <= rear_pos)
{
    while (front_pos <= rear_pos)
    {
        printf("%d ", deque_arr[front_pos]);
        front_pos++;
    }
}
else
{
    while (front_pos <= Size - 1)
    {
        printf("%d ", deque_arr[front_pos]);
        front_pos++;
    }
    front_pos = 0;
    while (front_pos <= rear_pos)
    {
        printf("%d ", deque_arr[front_pos]);
        front_pos++;
    }
}
```

```
    printf("\n");
}
/*End of display_queue*/

/*Begin of input_que*/
void input_que()
{
    int choice;
    do
    {
        printf("1.Insert at rear\n");
        printf("2.Delete from front\n");
        printf("3.Delete from rear\n");
        printf("4.Display\n");
        printf("5.Quit\n");
        printf("Enter your choice : ");
        scanf("%d", &choice);

        switch (choice)
        {
        case 1:
            insert_rear();
            break;
        case 2:
            delete_front();
            break;
        case 3:
```

```
            delete_rear();
            break;
        case 4:
            display_queue();
            break;
        case 5:
            break;
        default:
            printf("Wrong choice\n");
        }
    } while (choice != 5);
}
/*End of input_que*/

/*Begin of output_que*/
void output_que()
{
    int choice;
    do
    {
        printf("1.Insert at rear\n");
        printf("2.Insert at front\n");
        printf("3.Delete from front\n");
        printf("4.Display\n");
        printf("5.Quit\n");
        printf("Enter your choice : ");
        scanf("%d", &choice);
```

```
        switch (choice)
        {
        case 1:
            insert_rear();
            break;
        case 2:
            insert_front();
            break;
        case 3:
            delete_front();
            break;
        case 4:
            display_queue();
            break;
        case 5:
            break;
        default:
            printf("Wrong choice\n");
        }
    } while (choice != 5);
}
/*End of output_que*/

/*Begin of main*/
main()
{
    int choice;
```

```
    printf("1.Input restricted dequeue\n");
    printf("2.Output restricted dequeue\n");
    printf("Enter your choice : ");
    scanf("%d", &choice);
    switch (choice)
    {
    case 1:
        input_que();
        break;
    case 2:
        output_que();
        break;
    default:
        printf("Wrong choice\n");
    }
}
/*End of main*/
```

Output:-

```
***** MAIN MENU *****
1.Input restricted deque
2.Output restricted deque
Enter your option : 1
INPUT RESTRICTED DEQUEUE
1.Insert at right
2.Delete from left
3.Delete from right
4.Display
5.Quit
Enter your option : 1
Enter the value to be added : 5
Enter the value to be added : 10
Enter your option : 2
The deleted element is : 5
Enter your option : 5
```

Practical 33

Code:-

```
#include<stdio.h>
#include<stdlib.h>
struct node {
    int data ;
    struct node *next ;
    struct node *prev ;

};
struct node *head ;
void insertatFront(int x){
    struct node *newnode = (struct node *)malloc(sizeof (struct node));
    newnode ->data = x;
    newnode->next = NULL;
    newnode->prev = NULL;
    if(head == NULL){
        head = newnode;

    }
    else{
        head ->prev = newnode;
        newnode->next = head;
        head = newnode;
    }
```

```
}
void insertAtEnd(int x){
    struct node *newnode ;
    newnode= (struct node*)malloc(sizeof(struct node));
    newnode->data = x;
    newnode->next = NULL ;
    newnode->prev = NULL;

    if(head == NULL){
        head = newnode;
    }
    else{
        struct node *temp ;
        temp = head ;
        while(temp->next != NULL){
            temp = temp ->next ;

        }
        temp ->next = newnode;
        newnode->prev = temp ;
        newnode->next = NULL;
    }

}

void deletefromfront(){
    struct node *temp = head;
```

```
    if(head == NULL){
        printf("The list is Empty !");
    }
    else{
        temp = head;
        head = head->next ;
        head->prev = NULL ;
        printf("\nThe deleted element is : %d\n",temp->data);
        free(temp);
    }
}
void deletefromend(){
    struct node *temp = head;
    if(head == NULL){
        printf("The list is Empty !");

    }
    else if(head ->next == NULL){
        head = NULL;
    }
    else{
        while(temp ->next != NULL){
            temp = temp ->next ;

        }
        temp->prev->next = NULL;
        free(temp);
```

```
    }
}

void insertAtposition(int x , int pos){
    int i = 1;
    struct node *newnode = (struct node *)malloc(sizeof(struct node));
    newnode->data = x;
    newnode->next = NULL;
    newnode->prev= NULL;
    if(head == NULL){
        head = newnode;
        newnode->prev = NULL ;
        newnode->next = NULL ;
    }
    else if(pos== 1){
        insertatFront(x);
    }
    else{
        struct node *temp = head;
        while(i<pos-1){
            temp = temp->next ;
            i++;
        }
        newnode->next = temp ->next ;
        newnode->prev = temp ;
        temp ->next = newnode;
        temp->next ->prev = newnode;
```

```
    }
    printf("The element get inserted at index %d\n",pos);
}

void deletefrompos(int pos){
    struct node *position ;

    int i = 1;
    if(head == NULL){
        printf("The list is Empty !");
    }
    else if (pos==1){
        deletefromfront();
    }
    else{
        struct node *temp = head;
        while (i < pos-1 ){
            temp = temp->next ;
            i++;
        }
        position= temp->next ;
        if(position->next != NULL){
            position->next ->prev = temp ;
        }
        temp->next =  position ->next ;
        printf("The node at index %d is %d deleted Now !\n",pos,position->data);
        free(position);
```

```
    }

}

void display(){
    struct node *temp ;
    if(head ==NULL){
        printf("The list is Empty ! ");
    }
    else{
        temp = head;
        while(temp!=NULL){
            printf("%d\n",temp ->data );
            temp = temp->next ;
        }
    }
}
int main(){
    insertatFront(10);
    insertatFront(20);
    insertatFront(30);
    insertAtEnd(100);
    insertAtEnd(200);
    insertAtEnd(300);
    insertAtposition(10000,3);
    printf("\nBefore deletion operation ! ---------\n");
```

```
    display();
    printf("After the deletion Operation !-----");
    // deletefromfront();
    // deletefromfront();
    deletefrompos(3);
    // deletefromend();
    // deletefromend();
    display();
    return 0;
}
```

Output:-

```
The element get inserted at index 3

Before deletion operation ! ---------
30
20
10000
10
100
200
300
After the deletion Operation !-----The node at index 3 is 10000 deleted Now !
30
20
10
100
200
300
PS C:\Users\Aman Tripathi\OneDrive\Desktop\DSA file\Stack_&_Queue>
```

Practical 34

Code:-

```
// C program to Demonstrate Priority Queue
#include <stdio.h>
#include <limits.h>
#define MAX 100
int idx = -1;
int pqVal[MAX];
int pqPriority[MAX];
int isEmpty()
{
    return idx == -1;
}
int isFull()
{
    return idx == MAX - 1;
}

void enqueue(int data, int priority)
{
    if (!isFull())
    {

        // Increase the index
        idx++;
```

```
        // Insert the element in priority queue
        pqVal[idx] = data;
        pqPriority[idx] = priority;
    }
}

int peek()
{
    int maxPriority = INT_MIN;
    int indexPos = -1;

    // Linear search for highest priority
    for (int i = 0; i <= idx; i++)
    {
        // If two items have same priority choose the one with
        // higher data value
        if (maxPriority == pqPriority[i] && indexPos > -1 && pqVal[indexPos] < pqVal[i])
        {
            maxPriority = pqPriority[i];
            indexPos = i;
        }
        else if (maxPriority < pqPriority[i])
        {
            maxPriority = pqPriority[i];
            indexPos = i;
        }
```

```
    }

    // Return index of the element where
    return indexPos;
}

void dequeue()
{
    if (!isEmpty())
    {
        // Get element with highest priority
        int indexPos = peek();
        for (int i = indexPos; i < idx; i++)
        {
            pqVal[i] = pqVal[i + 1];
            pqPriority[i] = pqPriority[i + 1];
        }

        // reduce size of priority queue by 1
        idx--;
    }
}

void display()
{
    for (int i = 0; i <= idx; i++)
    {
```

```
        printf("(%d, %d)\n", pqVal[i], pqPriority[i]);
    }
}
// Driver Code
int main()
{
    // To enqueue items as per priority
    enqueue(5, 1);
    enqueue(10, 3);
    enqueue(15, 4);
    enqueue(20, 5);
    enqueue(500, 2);

    printf("Before Dequeue : \n");
    display();

    // Dequeue the top element
    dequeue(); // 20 dequeued
    dequeue(); // 15 dequeued

    printf("\nAfter Dequeue : \n");
    display();

    return 0;
}
```

Output:-

```
Before Dequeue :
(5, 1)
(10, 3)
(15, 4)
(20, 5)
(500, 2)

After Dequeue :
(5, 1)
(10, 3)
(500, 2)
```

Practical 35

Code:-

```
#include <stdio.h>
#include <stdlib.h>

struct node
{
   int priority;
   int info;
   struct node *link;
} *front = NULL;

void insert(int item, int item_priority);
int del();
void display();
int isEmpty();

int main()
{
   int choice, item, item_priority;
   while (1)
   {
      printf("\n1.Insert\n");
      printf("2.Delete\n");
      printf("3.Display\n");
      printf("4.Quit\n");
      printf("\nEnter your choice : ");
      scanf("%d", &choice);

      switch (choice)
      {
      case 1:
         printf("\nInput the item to be added in the queue : ");
         scanf("%d", &item);
         printf("\nEnter its priority : ");
         scanf("%d", &item_priority);
         insert(item, item_priority);
         break;
      case 2:
         printf("\nDeleted item is %d\n", del());
         break;
      case 3:
         display();
```

```
            break;
        case 4:
            exit(1);
        default:
            printf("\nWrong choice\n");
        } /*End of switch*/
    }    /*End of while*/

    return 0;
} /*End of main()*/

void insert(int item, int item_priority)
{
    struct node *tmp, *p;

    tmp = (struct node *)malloc(sizeof(struct node));
    if (tmp == NULL)
    {
        printf("\nMemory not available\n");
        return;
    }
    tmp->info = item;
    tmp->priority = item_priority;
    /*Queue is empty or item to be added has priority more than first element*/
    if (isEmpty() || item_priority < front->priority)
    {
        tmp->link = front;
        front = tmp;
    }
    else
    {
        p = front;
        while (p->link != NULL && p->link->priority <= item_priority)
            p = p->link;
        tmp->link = p->link;
        p->link = tmp;
    }
} /*End of insert()*/

int del()
{
    struct node *tmp;
    int item;
    if (isEmpty())
    {
        printf("\nQueue Underflow\n");
        exit(1);
    }
```

```
    else
    {
        tmp = front;
        item = tmp->info;
        front = front->link;
        free(tmp);
    }
    return item;
} /*End of del()*/

int isEmpty()
{
    if (front == NULL)
        return 1;
    else
        return 0;

} /*End of isEmpty()*/

void display()
{
    struct node *ptr;
    ptr = front;
    if (isEmpty())
        printf("\nQueue is empty\n");
    else
    {
        printf("\nQueue is :\n");
        printf("\nPriority       Item\n");
        while (ptr != NULL)
        {
            printf("%5d       %5d\n", ptr->priority, ptr->info);
            ptr = ptr->link;
        }
    }
} /*End of display() */
```

Output:-

```
1.Insert
2.Delete
3.Display
4.Quit

Enter your choice : 1

Input the item to be added in the queue : 32

Enter its priority : 2

1.Insert
2.Delete
3.Display
4.Quit

Enter your choice : 1

Input the item to be added in the queue : 23

Enter its priority : 1

1.Insert
2.Delete
3.Display
4.Quit

Enter your choice : 1

Input the item to be added in the queue : 23

Enter its priority : 1

1.Insert
2.Delete
3.Display
4.Quit
```

```
1.Insert
2.Delete
3.Display
4.Quit

Enter your choice : 3

Queue is :

Priority       Item
    1           23
    1           23
    2           32

1.Insert
2.Delete
3.Display
4.Quit

Enter your choice : 2

Deleted item is 23

1.Insert
2.Delete
3.Display
4.Quit

Enter your choice : 4
PS C:\Users\Aman Tripathi\O
```

Practical 36

```
#include <stdio.h>

// variable to store maximum number of nodes
int complete_node = 15;


// array to store the tree
char tree[] = {'\0', 'D', 'A', 'F', 'E', 'B', 'R', 'T', 'G', 'Q', '\0', '\0', 'V', '\0', 'J', 'L'};


int get_right_child(int index)
{
    // node is not null
    // and the result must lie within the number of nodes for a complete binary tree
    if (tree[index] != '\0' && ((2 * index) + 1) <= complete_node)
        return (2 * index) + 1;
    // right child doesn't exist
    return -1;
}


int get_left_child(int index)
{
    // node is not null
    // and the result must lie within the number of nodes for a complete binary tree
    if (tree[index] != '\0' && (2 * index) <= complete_node)
        return 2 * index;
    // left child doesn't exist
    return -1;
```

```
}

void preorder(int index)
{
   // checking for valid index and null node
   if (index > 0 && tree[index] != '\0')
   {
      printf(" %c ", tree[index]);      // visiting root
      preorder(get_left_child(index));  // visiting left subtree
      preorder(get_right_child(index)); // visiting right subtree
   }
}

void postorder(int index)
{
   // checking for valid index and null node
   if (index > 0 && tree[index] != '\0')
   {
      postorder(get_left_child(index));  // visiting left subtree
      postorder(get_right_child(index)); // visiting right subtree
      printf(" %c ", tree[index]);       // visiting root
   }
}

void inorder(int index)
{
   // checking for valid index and null node
```

```
    if (index > 0 && tree[index] != '\0')
    {
        inorder(get_left_child(index));  // visiting left subtree
        printf(" %c ", tree[index]);     // visiting root
        inorder(get_right_child(index)); // visiting right subtree
    }
}

int main()
{
    printf("Preorder:\n");
    preorder(1);
    printf("\nPostorder:\n");
    postorder(1);
    printf("\nInorder:\n");
    inorder(1);
    printf("\n");
    return 0;
}
```

Output:-

```
Preorder:
 D  A  E  G  Q  B  F  R  V  T  J  L
Postorder:
 G  Q  E  B  A  V  R  J  L  T  F  D
Inorder:
 G  E  Q  A  B  D  V  R  F  J  T  L
```