VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

Data Structures using C Lab

(23CS3PCDST)

Submitted by

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in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING

B.M.S. COLLEGE OF ENGINEERING
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Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "Data Structures using C Lab (23CS3PCDST)" carried out by **SANTHOSH N(1BM23CS302),** who is bonafide student of **B.M.S.College of Engineering.** It is in partial fulfillment for the award of **Bachelor of Engineering inComputer Science and Engineering** of the Visvesvaraya Technological University, Belgaum. The Lab report has been approved as it satisfies the academic requirements in respect of Data Structures using C Lab (23CS3PCDST) work prescribed for the said degree.

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Github Link: https://github.com/SANTHoshN302/1BM23CS302-SANTHOSH_N-.git

Program 1

Write a program to simulate the working of stack using an array with the following:

a) Push

b) Pop

c) Display

The program should print appropriate messages for stack overflow, stack underflow

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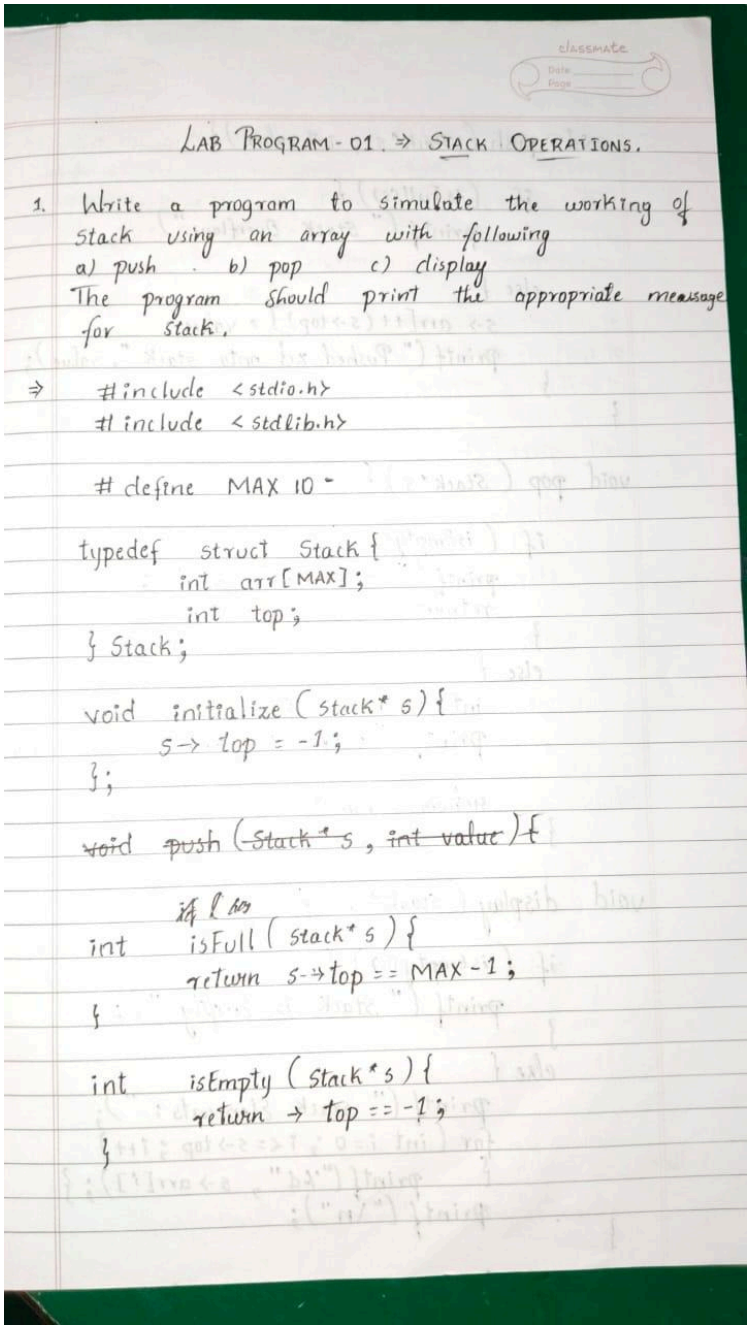


LAB PROGRAM - 01 ⇒ STACK OPERATIONS.

1. Write a program to simulate the working of stack using an array with following
a) push b) pop c) display
The program should print the appropriate meaisage for stack.

⇒

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

#define MAX 10

typedef struct Stack {
        int arr[MAX];
        int top;
} Stack;

void initialize (Stack* s){
     s-> top = -1;
};

void push (Stack* s, int value){

     if (
int  isFull (Stack* s){
     return s->top == MAX-1;
}

int  isEmpty (Stack* s){
     return -> top == -1;
}
```

```
void push (Stack *s, int value) {
    if (isFull(s)) {
        printf ("Stack Overflow")
    else {
        s-> arr[++(s->top)] = value;
        printf ("Pushed %d onto stack", value);
    }
}

void pop (Stack *s) {
    if (isEmpty(s)) {
        printf ("Stack Underflow");
        return -1;
    }
    else {
        int value = s-> arr[(s->top)--];
        printf ("popped %d from stack", value);

        return value;
    }

void display (Stack *s) {
    if (isEmpty(s)) {
        printf ("Stack is Empty");
    }
    else {
        printf ("Stack Elements: ");
        for (int i=0; i<=s->top; i++)
        { printf ("%d", s->arr[i]); }
        printf ("\n");
}
```

```
int main()
{
    stack s;
    initialize(&s);

    push(&s, 10);
    push(&s, 35);
    display(&s);

    pop(&s);
    display(&s);

    return 0;
}
```

Output:

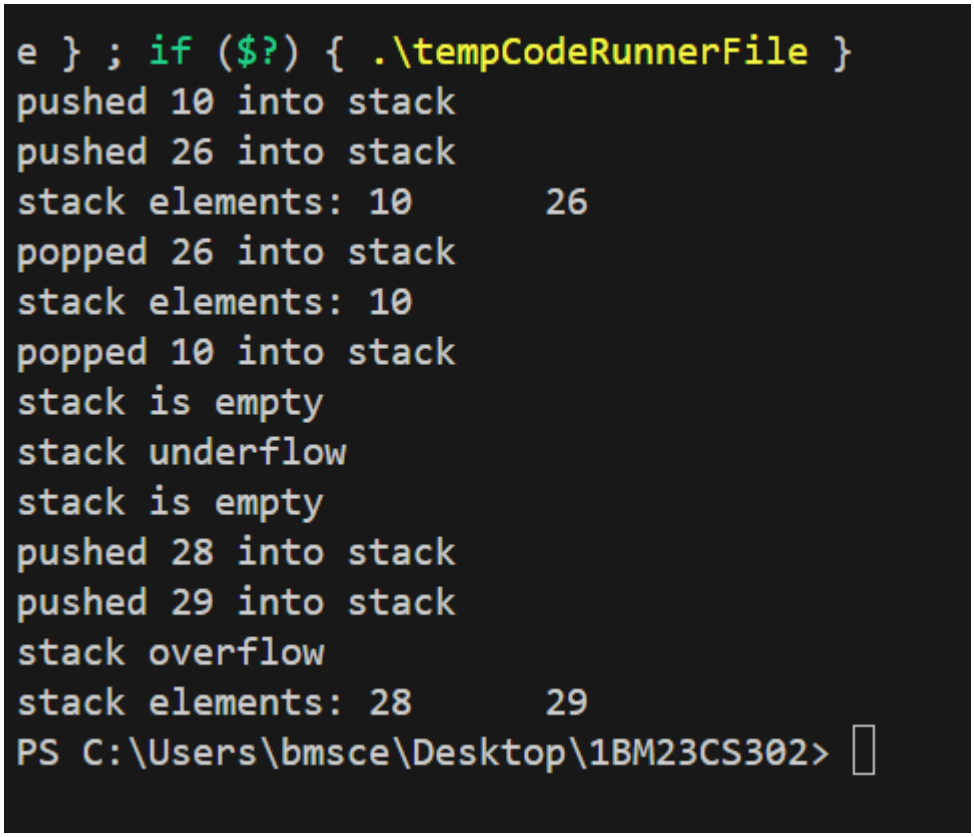
```
Pushed 10 onto Stack
Pushed 35 onto Stack
Stack Elements : 10 35
Popped 35 from Stack
Stack Elements : 10
```

Code:

```c
#include<stdio.h>
#include<stdlib.h>
#define MAX 2
typedef struct stack{
    int arr[MAX];
    int top;
}stack;

void initialize(stack* s){
    s-> top=-1;
}
int isFull(stack* s){
    return s-> top == MAX-1;
}
int isEmpty(stack* s){
    return s-> top == -1;
}
void push(stack* s, int value){
    if (isFull(s)){
        printf("stack overflow\n");
    }
    else{
        s->arr[++(s->top)]=value;
        printf("pushed %d into stack\n",value);
    }
}
int pop(stack* s){
    if (isEmpty(s)){
        printf("stack underflow\n");
        return -1;
    }
    else{
        int value = s->arr[(s->top)--];
        printf("popped %d into stack\n",value);
        return value;

    }
}
void display(stack* s){
    if (isEmpty(s)){
```

```
        printf("stack is empty\n");
    }
    else{
        printf("stack elements: ");
        for(int i=0; i<=s->top;i++){
            printf("%d\t",s->arr[i]);
        }
        printf("\n");
    }
}
int main(){
    stack s;
    initialize(&s);

    push(&s,10);
    push(&s,26);
    display(&s);

    pop(&s);
    display(&s);
    pop(&s);
    display(&s);
    pop(&s);
    display(&s);

    push(&s,28);
    push(&s,29);
    push(&s,30);
    display(&s);

    return 0;

}
```

OUTPUT:


e } ; if ($?) { .\tempCodeRunnerFile }
pushed 10 into stack
pushed 26 into stack
stack elements: 10 26
popped 26 into stack
stack elements: 10
popped 10 into stack
stack is empty
stack underflow
stack is empty
pushed 28 into stack
pushed 29 into stack
stack overflow
stack elements: 28 29
PS C:\Users\bmsce\Desktop\1BM23CS302>

Program 2:

WAP to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus), - (minus), * (multiply) and / (divide).

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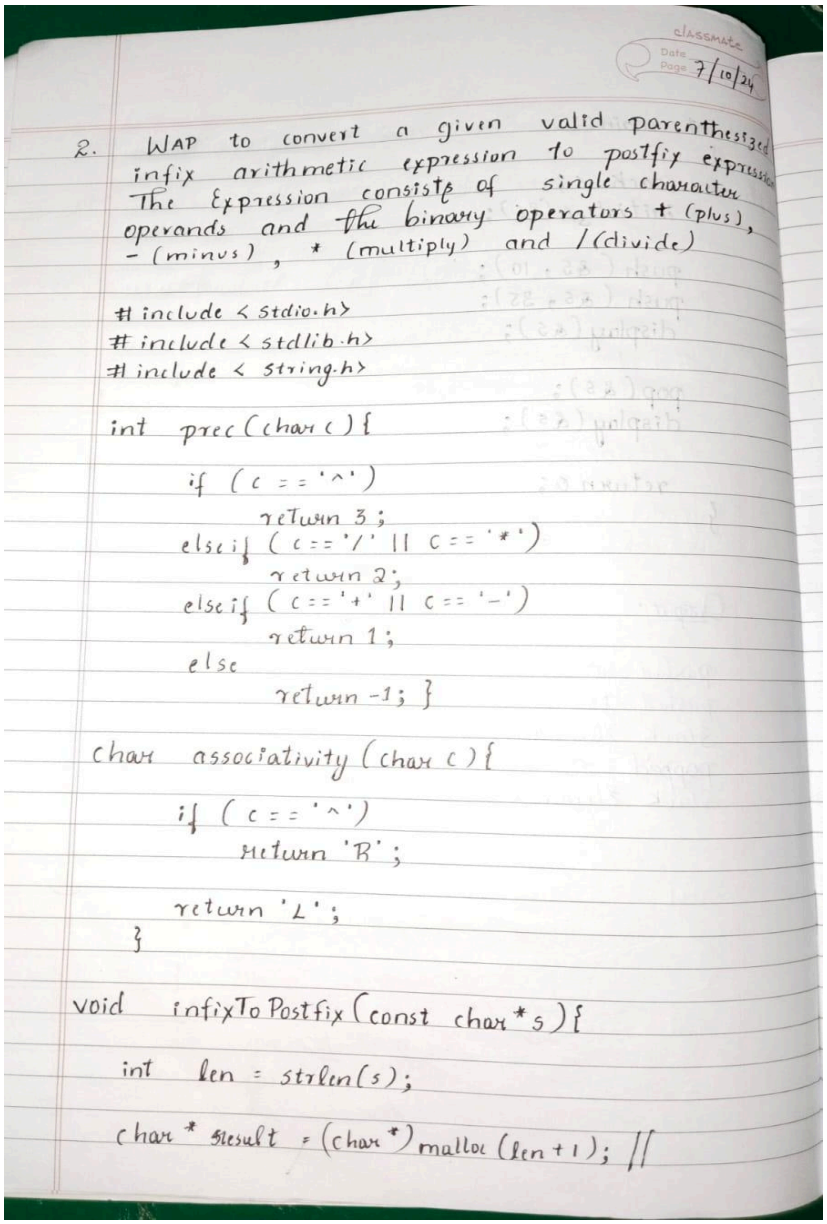

```
2. WAP to convert a given valid parenthesized
infix arithmetic expression to postfix expression
The Expression consists of single character
operands and the binary operators + (plus),
- (minus), * (multiply) and /(divide)

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

int prec(char c){
    if (c == '^')
        return 3;
    else if (c == '/' || c == '*')
        return 2;
    else if (c == '+' || c == '-')
        return 1;
    else
        return -1; }

char associativity(char c){
    if (c == '^')
        return 'R';
    return 'L';
}

void infixToPostfix(const char *s){
    int len = strlen(s);
    char * result = (char *) malloc (len + 1); //
```

```
char* stack = (char*)malloc(len);

int resultIndex = 0;
int stackIndex = -1;

if (!result || !stack){
    printf("Memory allocation failed!\n");
    return;
}

for(int i=0; i<len; i++){
    char c = s[i];

if((c>='a' && c<='z') || (c>='A' && c<='Z')
    || (c>='0' && c<='9')){
    result[resultIndex++] = c;
}
else if (c=='('){
    stack[++stackIndex] = c;
}
else if (c==')'){
    while(stackIndex>=0 && stack[stackIndex]
        !='('){
        result[resultIndex++] = stack[stackIndex--];
    }
    stackIndex--;
}
else{
    while(stackIndex>=0 && (prec(c)<prec(stack[stackIndex])
        || (prec(c)==prec(stack[stackIndex]))
    && associativity(c)=='L')){

        result[resultIndex++] = stack[stackIndex--];
    }
    stack[++stackIndex] = c;
}
```

```
while(stackIndex >= 0){
        result[resultIndex++] = stack[stackIndex--];
}
result[resultIndex] = '\0';
printf("%s\n", result);
free(result);
free(stack);

int main(){
    char exp[] = "a+b*(c^d-e)^(f+g*h)-i";
infixToPostfix(exp);
return 0;
}
```

O/p: ~~abcd^e-fgh*+^*+i-~~
abcd^e-fgh*+^*+i-

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CODE :

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

int prec(char c){
    if(c=='^'){
        return 3;
    }
    else if(c=='/'||c=='*'){
        return 2;
    }
    else if (c=='+' || c=='-'){
        return 1;
    }
    else{return -1;}

}
char associativity(char c){
    if (c=='^'){return 'R';}

    return 'L';
}
void infixToPostfix(const char*s){
    int len=strlen(s);
    char result[100];
    char  stack[100];

    int resultIndex=0;
    int stackIndex=-1;
    for (int i=0;i<len;i++){
        char c=s[i];

        if((c>='a'&&c<='z')||(c>='A'&&c<='Z')||(c>='0'&&c<='9')){
            result[resultIndex++]=c;
        }
        else if(c=='('){
            stack[++stackIndex]=c;
        }
```

```
        else if(c==')'){
            while(stackIndex>=0 && stack[stackIndex]!='('){
                result[resultIndex++]=stack[stackIndex--];
            }
            stackIndex--;
        }
        else{
            while(((stackIndex>=0) &&
(prec(c)<prec(stack[stackIndex]))||(prec(c)==prec(stack[stackIndex])))&&associativi
ty(c)=='L'){
                result[resultIndex++]=stack[stackIndex--];
            }
            stack[++stackIndex]=c;
        }
    }
    while(stackIndex>=0){
        result[resultIndex++]=stack[stackIndex--];
    }
    result[resultIndex]='\0';
    printf("%s\n",result);

}
int main(){
    char exp[100];
    printf("enter any expression\n");
    gets(exp);
    infixToPostfix(exp);
    return 0;
}
```

OUTPUT:

```
enter any expression
a+b*(c^d-e)^(f+g*h)-i
abcd^e-fgh*+^*+i-
PS C:\Users\bmsce\Desktop\1BM23CS302>
```

PROGRAM 3A

WAP to simulate the working of a queue of integers using an array. Provide the following operations:
Insert,
Delete,
Display.
The program should print appropriate messages for queue empty and queue overflow conditions.

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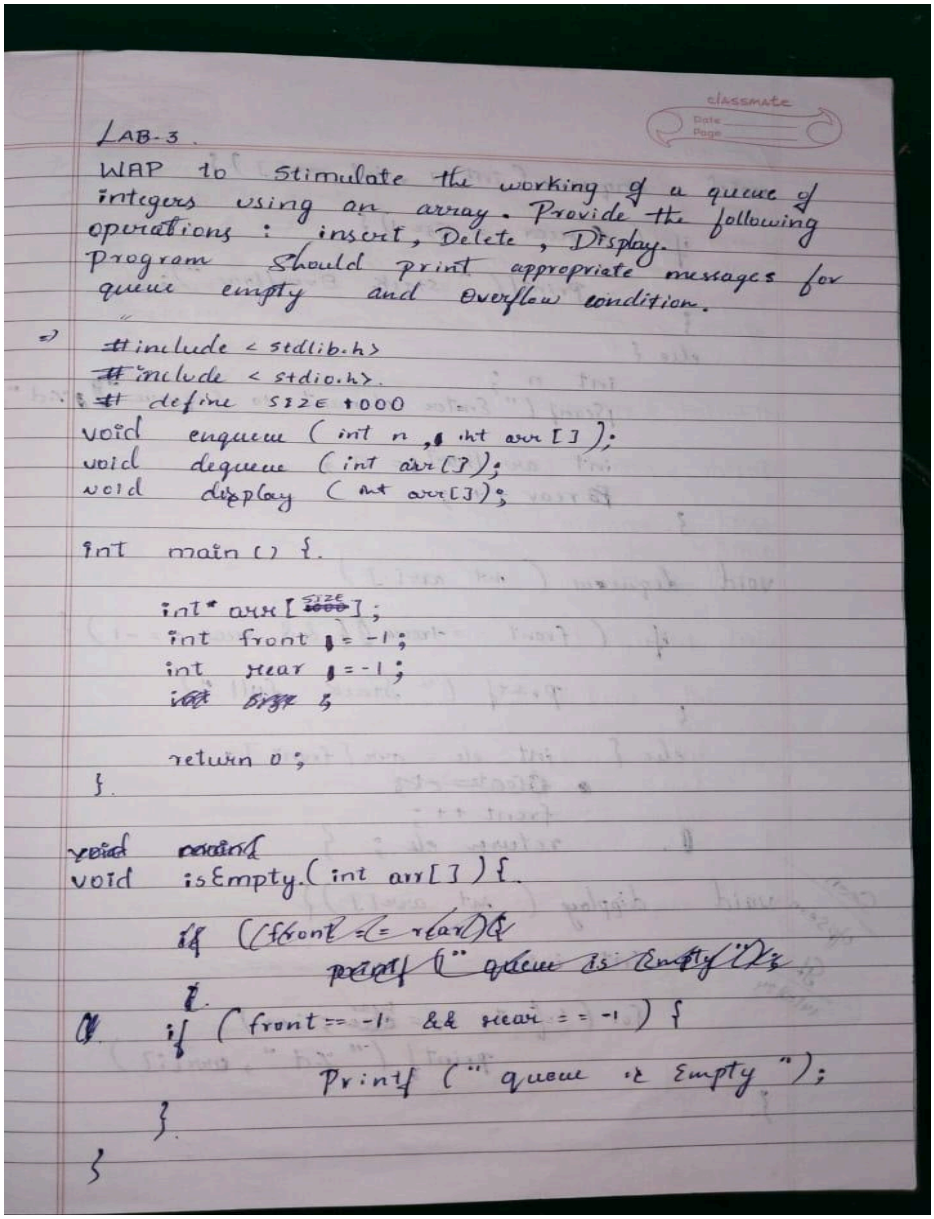


LAB-3.

WAP to Stimulate the working of a queue of integers using an array. Provide the following operations : insert, Delete, Display. Program should print appropriate messages for queue empty and Overflow condition.

```
#include <stdlib.h>
#include <stdio.h>
#define SIZE 1000
void enqueue (int n, int arr[]);
void dequeue (int arr[]);
void display (int arr[]);

int main () {

    int* arr[SIZE];
    int front = -1;
    int rear = -1;

    return 0;
}

void isEmpty(int arr[]){
    if ((front == rear)&&
        printf("queue is Empty");
    }
    if (front == -1 && rear == -1) {
        Printf ("queue is Empty");
    }
}
```

```
void enqueue (int n, int arr[]) {
    if ( rear == size-1) {
        printf (" Stack Overflow ");
    }
    else {
        int n ;
        scanf (" Enter element to Enqueue : %d ", &n);
        int arr [rear] = n ;
        rear ++ ;
    }

void dequeue ( int arr[] )
    if ( front == -1 && rear == -1 ) {
        printf (" Stack full ")
    }
    else { int ele = arr [front] ;
        front ++ ;
        return ele ; }

void display ( int arr[] ) {
    int i ;
    for ( i=front; i<= rear ; i++)
        printf (" %d ", arr[i] )
}
```

14/10/24

Output :

⇒ enqueued : 5
enqueued : 6
enqueued : 7
Queue is overflow.
Dequeued : 5
Dequeued : 6
Dequeued : 7
Queue is underflow.

CODE :

```c
#include <stdio.h>
#include <stdlib.h>
#define SIZE 10000

void enqueue(int n, int arr[], int *rear);
int dequeue(int arr[], int *front, int *rear);
void display(int arr[], int front, int rear);

int main() {
    int arr[SIZE];
    int front = 0;
    int rear = 0;


    enqueue(5, arr, &rear);
    enqueue(10, arr, &rear);
    display(arr, front, rear);
    printf("Dequeued: %d\n", dequeue(arr, &front, &rear));
    display(arr, front, rear);

    return 0;
}

void enqueue(int n, int arr[],int *rear) {
    if (*rear == SIZE) {
        printf("Queue is full\n");
    } else {
        printf("Enter element to enqueue: ");
        scanf("%d", &n);
        arr[*rear] = n;
        (*rear)++;
    }
}

int dequeue(int arr[], int *front, int *rear) {
    if (*front == *rear) {
        printf("Queue is empty\n");
        return -1;
    } else {
        int m = arr[*front];
        (*front)++;
        return m;
```

```
    }
}

void display(int arr[], int front, int rear) {
    if (front == rear) {
        printf("Queue is empty\n");
    } else {
        printf("Queue elements: ");
        for (int i = front; i < rear; i++) {
            printf("%d ", arr[i]);
        }
        printf("\n");
    }
}
```

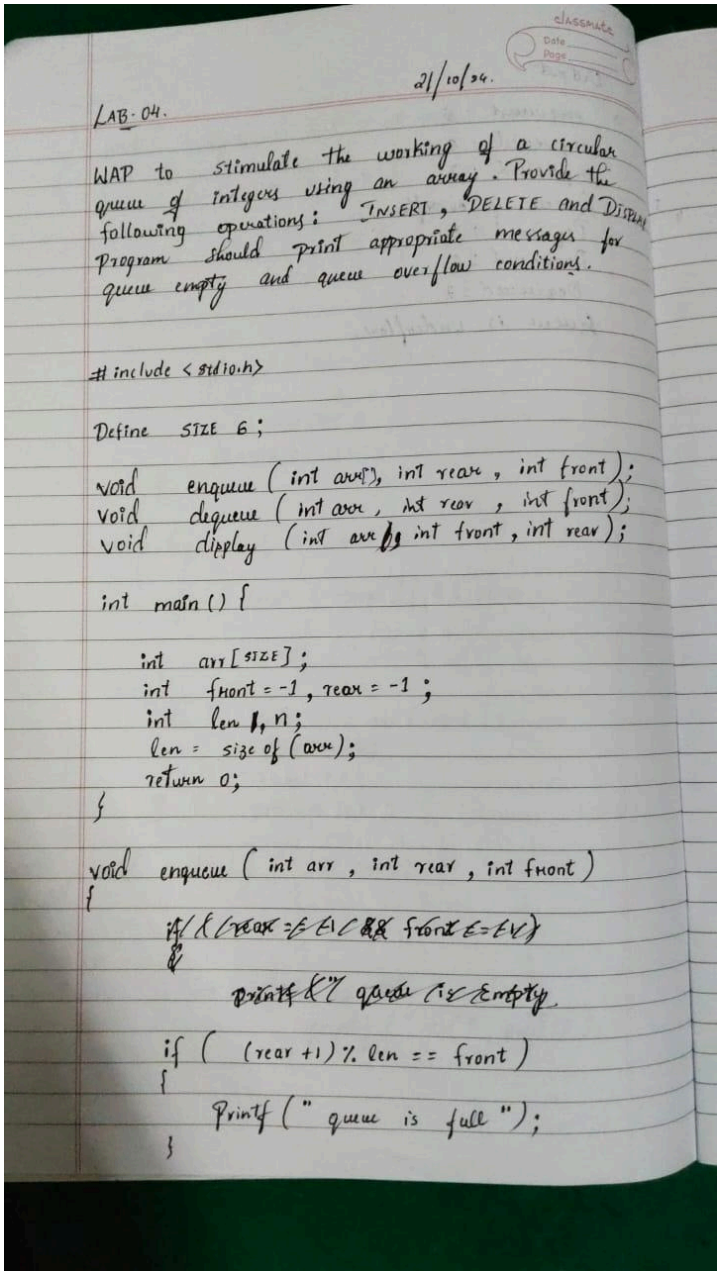
OUTPUT :

```
e } ; if ($?) { .\tempCodeRunnerFile }
Enter element to enqueue: 5
Enter element to enqueue: 6
Enter element to enqueue: 2
Queue is full
Queue elements: 5 6 2
Dequeued: 5
Dequeued: 6
Dequeued: 2
Queue is empty
PS C:\Users\bmsce\Desktop\1BM23CS302>
```

PROGRAM 3B

WAP to simulate the working of a circular queue of integers using an array. Provide the following operations:
Insert,
Delete,
Display,
The program should print appropriate messages for queue empty and queue overflow conditions

SOFT COPY



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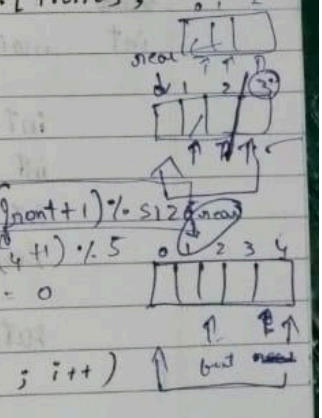
LAB-04.

WAP to stimulate the working of a circular queue of integers using an array. Provide the following operations: INSERT, DELETE and Display. Program should print appropriate messages for queue empty and queue overflow conditions.

```
#include <stdio.h>

Define SIZE 6;

void enqueue (int arr[], int rear, int front);
void dequeue (int arr, int rear, int front);
void display (int arr[], int front, int rear);

int main() {

    int arr[SIZE];
    int front = -1, rear = -1;
    int len, n;
    len = size of (arr);
    return 0;
}

void enqueue (int arr, int rear, int front)
{
    if ((rear == -1 && front == -1)
    {
        printf("queue is empty
    if ( (rear +1) % len == front )
    {
        Printf (" queue is full ");
    }
```

```
    else {
            printf (" Enter Element to Enqueue : ");
            scanf (" %d \n ", &n);

            arr[rear] = n ;
            rear ++ ;
        }
}.

void dequeue ( int arr , int rear , int front )
{
    if ( front == -1 && rear == -1 )
    {
        printf (" queue is empty ");
    }

    else {
            int element = arr[front];
            front ++ ;

            return element ;
        }
}.

void display ( int arr )
{
    for ( int i=fro ; i<= SIZE ; i++ )
    {
        printf (" %d ", arr[i]);
    }
}
```



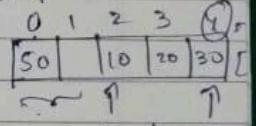
```
void display ( int arr , int rear ; int front )
{       front == 0 ; rear == SIZE - 1 ;
        for ( int i = front ; i <= rear ; i++ )
                printf ( " %d " , arr[i] );
}
```

Modify and rewrite the code.

⇒

```
#include <stdio.h>

Define SIZE 5;

void enqueue ( int arr[] , int front , int rear );
Void dequeue ( int arr[] , int front , int rear );
void display ( int arr[] , int front , int rear );

void
int main () {

        int arr[SIZE];
        int front == -1 , rear == -1 ;
        int len , n ;
        len = size of (arr);

        return 0;
}
```

```
void enqueue ( int arr[], int front, int rear)
{
    if ( (rear + 1) % len == front )
    {
        printf (" queue is full ") ✓
    }

    else { front == -1 ; rear == -1;
                                front = rear = 0
        printf (" enter element : ");
        scanf (" %d ", &n);
        arr[rear] = n;
        rear ++ ;
        rear = (rear+1) % SIZE
    }
}
```



(4 + 1) % 5 rear = SIZE - 1
5 % 5 == 0 5 - 1 = 4

arr[rear] = n

```
void dequeue ( int arr[], int front, int rear)
{
    if ( rear == -1 && front == -1 )
    {
        printf (" queue is empty ");
    }
    else {
        int ele = arr[front];
        front = (front + 1) % len;
        return ele;
    }
}
```

```
Void display (int arr[], int rear, int front)
{
    front == 0 ; rear == SIZE - 1 ;   ⇒ overflow
    for( int i = front ; i <= rear ; i = (front + 1) % len)
    {
        Printf (" %d " , arr [i]);
    }
}
```

CODE :

```c
#include <stdio.h>
#define MAX 5

typedef struct {
    int items[MAX];
    int front, rear;
} Queue;


void initializeQueue(Queue *q);
int isFull(Queue *q);
int isEmpty(Queue *q);
void insert(Queue *q, int value);
int delete(Queue *q);
void display(Queue *q);

int main() {
    Queue q;
    initializeQueue(&q);
    int choice, value;

    while (1) {
        printf("\nQueue Operations:\n");
        printf("1. Insert\n");
        printf("2. Delete\n");
        printf("3. Display\n");
        printf("4. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter the value to insert: ");
                scanf("%d", &value);
                insert(&q, value);
                break;
            case 2:
                value = delete(&q);
                if (value != -1) {
                    printf("Deleted value: %d\n", value);
```

```
                }
                break;
            case 3:
                display(&q);
                break;
            case 4:
                printf("Exiting...\n");
                return 0;
            default:
                printf("Invalid choice! Try again.\n");
        }
    }
}

void initializeQueue(Queue *q) {
    q->front = -1;
    q->rear = -1;
}

int isFull(Queue *q) {
    return q->rear == MAX - 1;
}

int isEmpty(Queue *q) {
    return q->front == -1 || q->front > q->rear;
}


void insert(Queue *q, int value) {
    if (isFull(q)) {
        printf("Queue Overflow! Cannot insert.\n");
        return;
    }
    if (q->front == -1) {
        q->front = 0;
    }
    q->items[++q->rear] = value;
    printf("Inserted %d into the queue.\n", value);
}
```

```c
int delete(Queue *q) {
    if (isEmpty(q)) {
        printf("Queue Underflow! Queue is empty.\n");
        return -1;
    }
    return q->items[q->front++];
}


void display(Queue *q) {
    if (isEmpty(q)) {
        printf("Queue is empty.\n");
        return;
    }
    printf("Queue elements: ");
    for (int i = q->front; i <= q->rear; i++) {
        printf("%d ", q->items[i]);
    }
    printf("\n");
}
```

OUTPUT:

Output

```
Queue Operations:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter the value to insert: 23
Inserted 23 into the queue.

Queue Operations:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter the value to insert: 25
Inserted 25 into the queue.

Queue Operations:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Queue elements: 23 25

Queue Operations:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted value: 23
```

```
Queue Operations:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter the value to insert: 56
Inserted 56 into the queue.

Queue Operations:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter the value to insert: 78
Queue Overflow! Cannot insert.
```

Output

```
Queue Operations:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Queue Underflow! Queue is empty.

Queue Operations:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice:
```

PROGRAM 4

WAP to Implement Singly Linked List with following operations
a) Createalinkedlist.
b) Insertion of a node at first position, at any position and at end of list.
c) Display the contents of the linked list.

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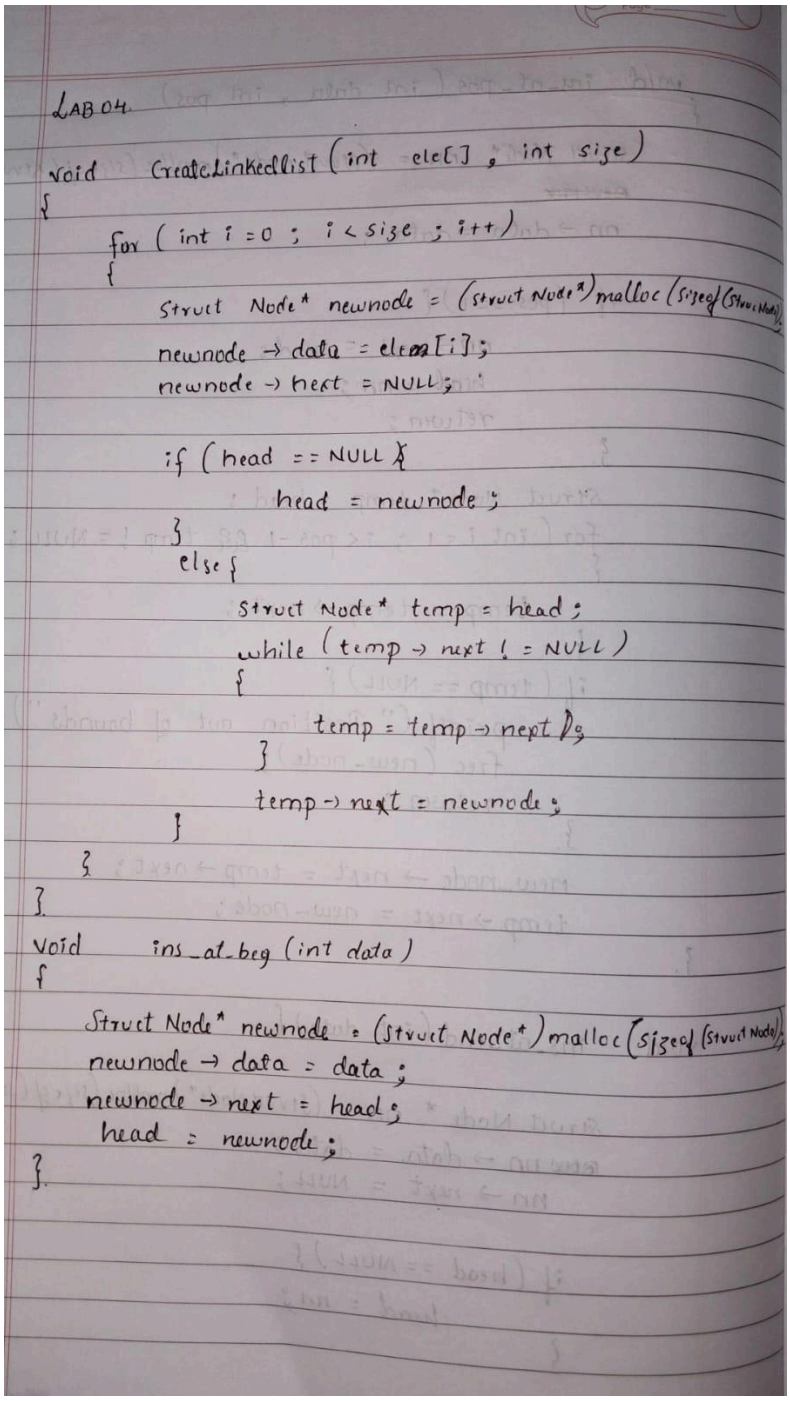


```
LAB 04

void CreateLinkedlist (int ele[], int size)
{
    for (int i=0; i<size; i++)
    {
        Struct Node* newnode = (struct Node*)malloc(sizeof(StructNode));
        newnode -> data = elem[i];
        newnode -> next = NULL;

        if (head == NULL){
            head = newnode;
        }
        else{
            Struct Node* temp = head;
            while (temp -> next != NULL)
            {
                temp = temp -> next;
            }
            temp -> next = newnode;
        }
    }
}
void ins_at_beg (int data)
{
    Struct Node* newnode = (Struct Node*)malloc(sizeof(Struct Node));
    newnode -> data = data;
    newnode -> next = head;
    head = newnode;
}
```

```
void ins_at_pos ( int data , int pos)

    Struct Node* nn = (struct node*) malloc (sizeof (struct Node));
    ~~newnode~~
    nn → data = data ;

    if (pos == 1) {
            nn → next = head ;
            head = nn ;
            return ;
    }.
    Struct Node* temp = head ;
    for ( int i = 1 ; i < pos - 1 && temp != NULL ; i++)
    {
        temp = temp → next ;
    }.
    if ( temp == NULL) {
        printf (" Position out of bounds ");
        free (new_node);
        return ;
    }.
    new_node → next = temp → next ;
    temp -> next = new_node ;
}.

void ins_at_end (int data) {

    Struct Node * nn = (Struct Node*) malloc (sizeof (Struct No
    nn → data = data ;
    nn → next = NULL ;

    if (head == NULL) {
            head = nn ;
    }
```

```
    struct Node* temp = head;
    while (temp -> next != NULL)
    {
        temp = temp -> next;
    }
    temp -> next = nn;
}.

void display() {

    struct Node* temp = head;
    while ( temp != NULL)
    {
        printf (" %d ", temp -> data);
        temp = temp -> next;
    }
    printf ("\n");
}.
```

Output

```
1. Insert at Begginning
2. Insert at position
3. Insert at end
4. Display list
5. Exit
Enter your choice : 1
Enter data : 21

1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display list
5. Exit.
Enter your choice : 2
Enter data : 20
Enter position : 1

1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display list
5. Exit
Enter your choice : 3
Enter data : 22

1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display list
5. Exit
Enter your choice : 4
20 21 22
```

Seen
16/12/24

CODE :

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


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


struct Node* head = NULL;


void createLinkedList(int elements[], int size) {
    for (int i = 0; i < size; i++) {
        struct Node* new_node = (struct Node*)malloc(sizeof(struct Node));
        new_node->data = elements[i];
        new_node->next = NULL;

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


void insertAtBeginning(int data) {
    struct Node* new_node = (struct Node*)malloc(sizeof(struct Node));
    new_node->data = data;
    new_node->next = head;
    head = new_node;
}


void insertAtPosition(int data, int position) {
```

```
    struct Node* new_node = (struct Node*)malloc(sizeof(struct Node));
    new_node->data = data;

    if (position == 1) {
        new_node->next = head;
        head = new_node;
        return;
    }

    struct Node* temp = head;
    for (int i = 1; i < position - 1 && temp != NULL; i++) {
        temp = temp->next;
    }

    if (temp == NULL) {
        printf("Position out of bounds\n");
        free(new_node);
        return;
    }

    new_node->next = temp->next;
    temp->next = new_node;
}


void insertAtEnd(int data) {
    struct Node* new_node = (struct Node*)malloc(sizeof(struct Node));
    new_node->data = data;
    new_node->next = NULL;

    if (head == NULL) {
        head = new_node;
        return;
    }

    struct Node* temp = head;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = new_node;
}
```

```c
void displayLinkedList() {
    struct Node* temp = head;
    while (temp != NULL) {
        printf("%d -> ", temp->data);
        temp = temp->next;
    }
    printf("NULL\n");
}

int main() {
    int choice, data, position, size;

    while (1) {
        printf("\nMenu:\n");
        printf("1. Create Linked List\n");
        printf("2. Insert at Beginning\n");
        printf("3. Insert at Position\n");
        printf("4. Insert at End\n");
        printf("5. Display Linked List\n");
        printf("6. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter the number of elements: ");
                scanf("%d", &size);
                int elements[size];
                printf("Enter the elements: ");
                for (int i = 0; i < size; i++) {
                    scanf("%d", &elements[i]);
                }
                createLinkedList(elements, size);
                break;

            case 2:
                printf("Enter the data to insert: ");
                scanf("%d", &data);
                insertAtBeginning(data);
```

```
                break;

            case 3:
                printf("Enter the data to insert: ");
                scanf("%d", &data);
                printf("Enter the position: ");
                scanf("%d", &position);
                insertAtPosition(data, position);
                break;

            case 4:
                printf("Enter the data to insert: ");
                scanf("%d", &data);
                insertAtEnd(data);
                break;

            case 5:
                displayLinkedList();
                break;

            case 6:
                printf("Exiting...\n");
                exit(0);

            default:
                printf("Invalid choice, please try again.\n");
        }
    }

    return 0;
}
```

OUTPUT

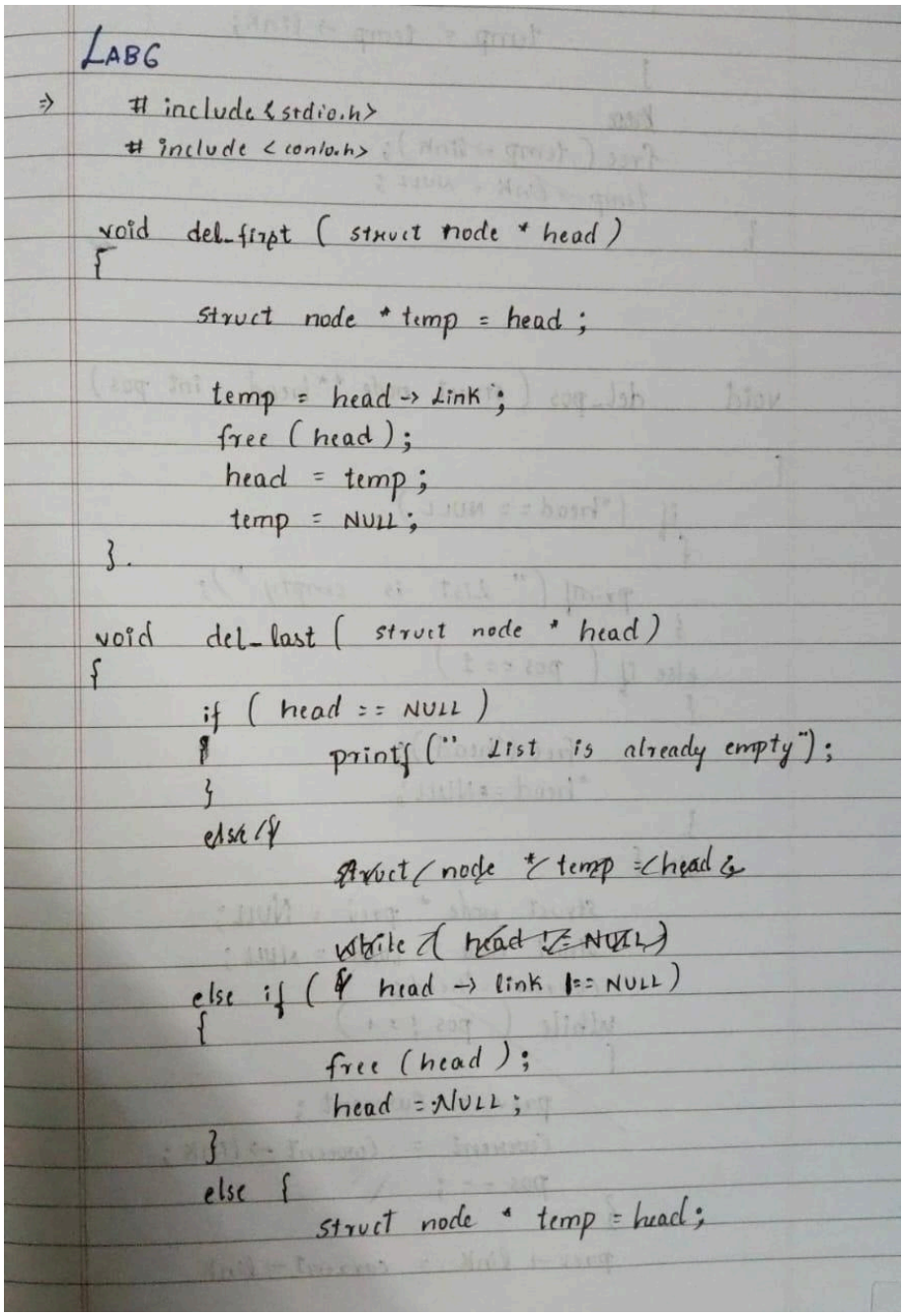
```
Menu:
1. Create Linked List
2. Insert at Beginning
3. Insert at Position
4. Insert at End
5. Display Linked List
6. Exit
Enter your choice: 1
Enter the number of elements: 2
Enter the elements: 1 3

Menu:
1. Create Linked List
2. Insert at Beginning
3. Insert at Position
4. Insert at End
5. Display Linked List
6. Exit
Enter your choice: 2
Enter the data to insert at the beginning: 0

Menu:
1. Create Linked List
2. Insert at Beginning
3. Insert at Position
4. Insert at End
5. Display Linked List
6. Exit
Enter your choice: 2
Enter the data to insert at the beginning: 0
```

```
Menu:
1. Create Linked List
2. Insert at Beginning
3. Insert at Position
4. Insert at End
5. Display Linked List
6. Exit
Enter your choice: 3
Enter the data to insert: 3
Enter the position: 3

Menu:
1. Create Linked List
2. Insert at Beginning
3. Insert at Position
4. Insert at End
5. Display Linked List
6. Exit
Enter your choice: 4
Enter the data to insert at the end: 4

Menu:
1. Create Linked List
2. Insert at Beginning
3. Insert at Position
4. Insert at End
5. Display Linked List
6. Exit
Enter your choice: 5
Linked List: 0 -> 0 -> 3 -> 1 -> 3 -> 4 -> NULL
```

PROGRAM 5

WAP to Implement Singly Linked List with following operations
a) Create a linked list.
b) Deletion of first element, specified element and last element in the list.
c) Display the contents of the linked list

SOFT COPY :



```
LABG
#include<stdio.h>
#include<conio.h>

void del_first ( struct node * head )
{
        struct node * temp = head ;

        temp = head -> Link ;
        free ( head );
        head = temp ;
        temp = NULL ;
}.

void del_last ( struct node * head )
{
        if ( head == NULL )
        {
                printf (" List is already empty");
        }
        else if
                struct node * temp = head ;
                while ( head != NULL )
        else if ( head -> link != NULL )
        {
                free ( head );
                head = NULL ;
        }
        else {
                struct node * temp = head ;
```

```
while ( temp -> link -> link != NULL )
{
        temp = temp -> link;
}
free ( temp -> link );
temp -> link = NULL;
}.

void    del_pos ( struct node **head, int pos)
{
    if (*head == NULL)
    {
        printf (" List is empty ");
    }
    else if ( pos == 1 )
    {
        free (*head);
        *head = NULL;
    }.
    else {
        struct node * prev = NULL;
        struct node * curr = NULL;
        current = *head;
        while ( pos != 1 )
        {
            prev = current;
            current = current -> link;
            pos --;
        }
        prev -> link = current -> link
```

```
    free (current);
    Curr = NULL;
}
```

Seen
o/p seen.

CODE :

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

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

void insert_to_end(struct node* head,int data){
    struct node * ptr, *temp;
    ptr = head;
    temp = (struct node*)malloc(sizeof(struct node));
    temp->data = data;
    temp->link = NULL;
    while(ptr->link != NULL){
        ptr = ptr->link;
    }
   ptr->link = temp;
}

struct node* del_first(struct node* head){
    struct node* curr = head;
    if(head == NULL){
        printf("list id empty");
    }
    else{
            head = curr->link;
            free(curr);
            curr = NULL;
        }
    return head;
}

struct node* del_last(struct node* head){

    if(head == NULL){
        printf("list is already empty");
    }
    else if(head->link == NULL){
        free(head);
```

```
        head = NULL;
    }
    else{
        struct node* curr = head;
        while(curr->link->link != NULL){
            curr = curr->link;
        }
        free(curr->link);
        curr->link = NULL;
    }

    return head;
}

struct node* del_pos(struct node**head, int pos){

    struct node * prev = *head;
    struct node * curr = *head;

    if(head == NULL){
        printf("list is already empty");
    }
    else if(pos == 1){
        *head = curr->link;
        free(curr);
        curr = NULL;
    }
    else{
        while(pos != 1){
            prev = curr;
            curr = curr->link;
            pos--;
        }
        prev->link = curr->link;
        free(curr);
        curr = NULL;
    }
    return *head;
}

void display_data(struct node* head){
```

```
    struct node* ptr = head;
    while(ptr != NULL){
        printf("%d\t",ptr->data);
        ptr = ptr->link;
    }
}

int main(){
    int num;
    struct node* head = malloc(sizeof(struct node));

    head->data = 45;
    head->link = NULL;

    while(1){
    printf("\n enter your choice:\n1.insert to list\n2.delete first
node\n3.delete last node\n4.delete at certain position\n5.exit\n");
    scanf("%d",&num);

    switch(num){

        case 1:
                int a;
                printf("enter data to insert: ");
                scanf("%d",&a);
                insert_to_end(head,a);

                break;
        case 2:
                head = del_first(head);
                break;
        case 3:
                head = del_last(head);
                break;
        case 4:
                int b;
                printf("enter the position of the data to delete: ");
                scanf("%d",&b);
                head = del_pos(&head,b);
                break;
```

```
        case 5: printf("program exceuted sucessfully");
                exit(0);
                break;
        default:
                printf("invalid input");
         }

         display_data(head);
    }

}
```

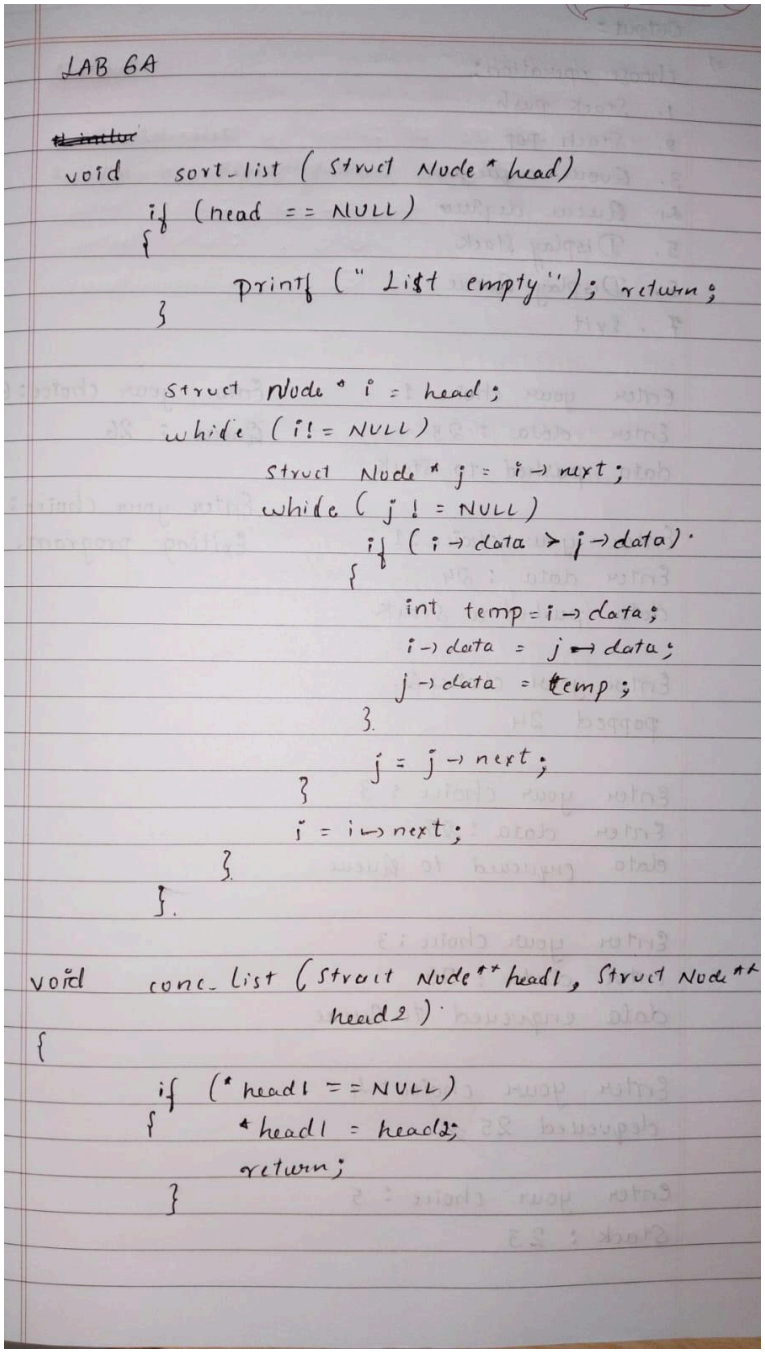
OUTPUT :

```
 enter your choice:
1.insert to list
2.delete first node
3.delete last node
4.delete at certain position
5.exit
1
enter data to insert: 67
45  23  90  67
 enter your choice:
1.insert to list
2.delete first node
3.delete last node
4.delete at certain position
5.exit
2
23  90  67
 enter your choice:
1.insert to list
2.delete first node
3.delete last node
4.delete at certain position
5.exit
3
23  90
```

PROGRAM 6A

WAP to Implement Single Link List with following operations:
Sort the linked list,
Reverse the linked list,
Concatenation of two linked lists.

SOFT COPY :



```
LAB 6A

void sort_list ( struct Node * head)
    if (head == NULL)
    {
        printf (" List empty "); return ;
    }

    struct Node * i = head ;
    while ( i != NULL )
        struct Node * j = i -> next ;
        while ( j != NULL )
            if ( i -> data > j -> data).
            {
                int temp = i -> data ;
                i -> data = j -> data ;
                j -> data = temp ;
            }.
            j = j -> next ;
        }
        i = i -> next ;
    }
}.

void conc_list (struct Node ** head1, struct Node **
                head2 ).
{
    if (* head1 == NULL)
    {   * head1 = head2;
        return ;
    }
```

```
    struct Node* temp = *head1;
    while (temp->next != NULL)
    {
        temp = temp->next;
    }
    temp->next = head2;
}

void rev_list (struct Node **head)
{
    struct Node * prev = NULL;
    struct Node * curr = *head;
    struct Node * next = NULL;

    while (current != NULL)
    {
        next = curr->next;
        curr->next = prev;
        prev = curr;
        curr = ~~next~~ curr->next;
    }
    *head = prev;
}
```

Output

```
Enter Element of list1: 10 30 20
Enter Element of list2: 3 6 5
Sorted list1: 10 20 30
Sorted list2: 3 5 6
Concatenated list: 3 5 6 10 20 30
```

CODE :

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


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


struct Node* create_node(int data) {
    struct Node* new_node = (struct Node*)malloc(sizeof(struct Node));
    new_node->data = data;
    new_node->next = NULL;
    return new_node;
}

void insert_end(struct Node** head, int data) {
    struct Node* new_node = create_node(data);
    if (*head == NULL) {
        *head = new_node;
        return;
    }
    struct Node* temp = *head;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = new_node;
}

void print_list(struct Node* head) {
    struct Node* temp = head;
    while (temp != NULL) {
        printf("%d\t ", temp->data);
        temp = temp->next;
    }
```

```
    printf("\n");
}

void sort_list(struct Node* head) {
    if (head == NULL) return;
    struct Node* i = head;
    struct Node* j = NULL;
    int temp;
    while (i != NULL) {
        j = i->next;
        while (j != NULL) {
            if (i->data > j->data) {
                temp = i->data;
                i->data = j->data;
                j->data = temp;
            }
            j = j->next;
        }
        i = i->next;
    }
}

void reverse_list(struct Node** head) {
    struct Node* prev = NULL;
    struct Node* current = *head;
    struct Node* next = NULL;
    while (current != NULL) {
        next = current->next;
        current->next = prev;
        prev = current;
        current = next;
    }
    *head = prev;
}


void concatenate_lists(struct Node** head1, struct Node* head2) {
    if (*head1 == NULL) {
        *head1 = head2;
        return;
    }
```

```
    struct Node* temp = *head1;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = head2;
}

int main() {
    struct Node* list1 = NULL;
    struct Node* list2 = NULL;

    insert_end(&list1, 4);
    insert_end(&list1, 2);
    insert_end(&list1, 3);
    insert_end(&list1, 1);


    printf("Original List 1: ");
    print_list(list1);


    reverse_list(&list1);
    printf("Reversed List 1: ");
    print_list(list1);

    sort_list(list1);
    printf("Sorted List 1: ");
    print_list(list1);


    insert_end(&list2, 6);
    insert_end(&list2, 7);
    insert_end(&list2, 8);


    printf("Original List 2: ");
    print_list(list2);

    concatenate_lists(&list1, list2);
    printf("Concatenated List: ");
    print_list(list1);
```

```
    return 0;

}
```

OUTPUT :

```
Output

Original List 1: 4   2   3   1
Reversed List 1: 1   3   2   4
Sorted List 1: 1     2   3   4
Original List 2: 6   7   8
Concatenated List: 1     2   3   4   6   7   8
```

PROGRAM 6B

WAP to Implement Single Link List to simulate Stack & Queue Operations.

SOFT COPY :

```
void push (Stack *s, int value){
    if (isFull(s)) {
        printf ("Stack Overflow")
    else {
        s-> arr[++(s->top)] = value;
        printf ("Pushed %d onto stack ", value);
    }
}

void pop (Stack *s) {
    if (isEmpty(s)) {
        printf ("Stack Underflow");
        return -1;
    }
    else {
        int value = s-> arr[(s->top)--];
        printf ("popped %d from Stack", value);
        return value;
    }

void display (Stack *s) {
    if (isEmpty(s)) {
        printf ("Stack is Empty");
    }
    else {
        printf ("Stack Elements: ");
        for (int i=0; i<=s->top; i++)
        {   printf ("%d", s->arr[i]); }
        printf ("\n");
}
```

```
void enqueue (int n, int arr[]) {
    if ( rear == size-1) {
        printf(" Stack Overflow ");
    }
    else {
        int n;
        scanf(" Enter element to Enqueue : %d ",
        int arr[rear] = n;
        rear ++;
    }

void dequeue ( int arr[] )
    if ( front == -1 && rear == -1) {
        printf (" Stack full ")
    }
    else { int ele = arr[front];
        front ++;
        return ele; }

void display ( int arr[]) {
    int i;
    for ( i=front; i<= rear ; i++)
        printf (" %d ", arr[i])
}
```

14/10/24

Output :

=)

```
choose operation:
1. Stack push
2. Stack pop
3. Queue enqueue
4. Queue dequeue
5. Display stack
6. Display Queue
7. Exit.

Enter your choice 1
Enter data : 23
data pushed to stack

Enter your choice : 1
Enter data : 24
data pushed to stack

Enter your choice: 2.
popped 24

Enter your choice : 3
Enter data : 25
data enqueued to Queue

Enter your choice : 3
enter data : 26
data enqueued to Queue

Enter your choice : 4
dequeued 25

Enter your choice : 5
Stack : 23

Enter your choice: 6
Queue : 26

Enter your choice: 7
Exiting program.
```

CODE :

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


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


struct Node* createNode(int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = data;
    newNode->next = NULL;
    return newNode;
}


void push(struct Node** top, int data) {
    struct Node* newNode = createNode(data);
    newNode->next = *top;
    *top = newNode;
}


int pop(struct Node** top) {
    if (*top == NULL) {
        printf("Stack Underflow\n");
        return -1;
    }
    struct Node* temp = *top;
    int poppedData = temp->data;
    *top = (*top)->next;
    free(temp);
    return poppedData;
}


void enqueue(struct Node** front, struct Node** rear, int data) {
    struct Node* newNode = createNode(data);
```

```
    if (*rear == NULL) {
        *front = *rear = newNode;
        return;
    }
    (*rear)->next = newNode;
    *rear = newNode;
}


int dequeue(struct Node** front, struct Node** rear) {
    if (*front == NULL) {
        printf("Queue Underflow\n");
        return -1;
    }
    struct Node* temp = *front;
    int dequeuedData = temp->data;
    *front = (*front)->next;
    if (*front == NULL) {
        *rear = NULL;
    }
    free(temp);
    return dequeuedData;
}


void printList(struct Node* head) {
    if (head == NULL) {
        printf("List is empty\n");
        return;
    }
    struct Node* temp = head;
    while (temp != NULL) {
        printf("%d\t", temp->data);
        temp = temp->next;
    }
    printf("\n");
}


int main() {
    struct Node* stackTop = NULL;
```

```c
    struct Node* queueFront = NULL;
    struct Node* queueRear = NULL;


    int choice, data;


    while (1) {
        printf("\nChoose operation:\n");
        printf("1. Stack Push\n");
        printf("2. Stack Pop\n");
        printf("3. Queue Enqueue\n");
        printf("4. Queue Dequeue\n");
        printf("5. Display Stack\n");
        printf("6. Display Queue\n");
        printf("7. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);


        switch (choice) {
            case 1:
                printf("Enter data to push: ");
                scanf("%d", &data);
                push(&stackTop, data);
                printf("Data is pushed to stack.\n");
                break;
            case 2:
                data = pop(&stackTop);
                if (data != -1) {
                    printf("Popped from stack: %d\n", data);
                }
                break;
            case 3:
                printf("Enter data to enqueue: ");
                scanf("%d", &data);
                enqueue(&queueFront, &queueRear, data);
                printf("Data is enqueued.\n");
                break;
            case 4:
                data = dequeue(&queueFront, &queueRear);
```

```
                if (data != -1) {
                    printf("Dequeued from queue: %d\n", data);
                }
                break;
            case 5:
                printf("Stack: ");
                printList(stackTop);
                break;
            case 6:
                printf("Queue: ");
                printList(queueFront);
                break;
            case 7:
                printf("Exiting the Program.....\n");
                exit(0);
            default:
                printf("Invalid choice, please try again.\n");
        }
    }


    return 0;
}
```

OUTPUT :

Output

```
Choose operation:
1. Stack Push
2. Stack Pop
3. Queue Enqueue
4. Queue Dequeue
5. Display Stack
6. Display Queue
7. Exit
Enter your choice: 1
Enter data to push: 23
data is pushed to stack

Choose operation:
1. Stack Push
2. Stack Pop
3. Queue Enqueue
4. Queue Dequeue
5. Display Stack
6. Display Queue
7. Exit
Enter your choice: 1
Enter data to push: 24
data is pushed to stack
```

Output

```
data is enqueued

Choose operation:
1. Stack Push
2. Stack Pop
3. Queue Enqueue
4. Queue Dequeue
5. Display Stack
6. Display Queue
7. Exit
Enter your choice: 2
Popped from stack: 25

Choose operation:
1. Stack Push
2. Stack Pop
3. Queue Enqueue
4. Queue Dequeue
5. Display Stack
6. Display Queue
7. Exit
Enter your choice: 2
Popped from stack: 24
```

Output

```
6. Display Queue
7. Exit
Enter your choice: 1
Enter data to push: 26
data is pushed to stack

Choose operation:
1. Stack Push
2. Stack Pop
3. Queue Enqueue
4. Queue Dequeue
5. Display Stack
6. Display Queue
7. Exit
Enter your choice: 5
Stack: 26    25  23

Choose operation:
1. Stack Push
2. Stack Pop
3. Queue Enqueue
4. Queue Dequeue
5. Display Stack
6. Display Queue
7. Exit
Enter your choice: 6
Queue: 26    26  28
```

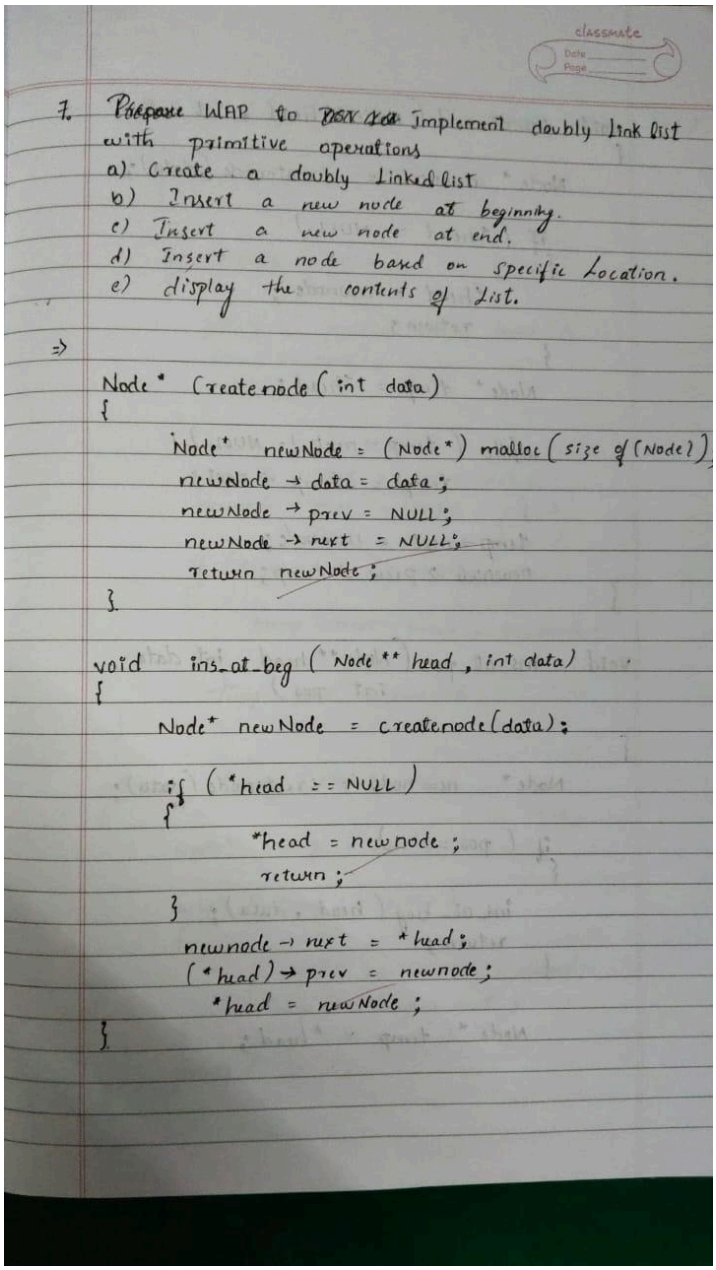
Output

```
data is pushed to stack

Choose operation:
1. Stack Push
2. Stack Pop
3. Queue Enqueue
4. Queue Dequeue
5. Display Stack
6. Display Queue
7. Exit
Enter your choice: 3
Enter data to enqueue: 26
data is enqueued

Choose operation:
1. Stack Push
2. Stack Pop
3. Queue Enqueue
4. Queue Dequeue
5. Display Stack
6. Display Queue
7. Exit
Enter your choice: 3
Enter data to enqueue: 26
data is enqueued
```

PROGRAM 7

WAP to Implement doubly link list with primitive operations
a) Create a doubly linked list.
b) Insert a new node to the left of the node.
c) Delete the node based on a specific value
d) Display the contents of the list

SOFT COPY :



7. Prepare WAP to Implement doubly link list with primitive operations
a) Create a doubly linked list
b) Insert a new node at beginning.
c) Insert a new node at end.
d) Insert a node based on specific location.
e) display the contents of list.

=>

```
Node* Createnode(int data)
{
    Node* newNode = (Node*) malloc(sizeof(Node));
    newNode -> data = data;
    newNode -> prev = NULL;
    newNode -> next = NULL;
    return newNode;
}

void ins_at_beg (Node** head, int data)
{
    Node* newNode = createnode(data);

    if (*head == NULL)
    {
        *head = newnode;
        return;
    }
    newnode -> next = *head;
    (*head) -> prev = newnode;
    *head = newNode;
}
```

```
void ins_at_end ( Node ** head , int data)
{
    Node * newnode = createnode (data);

    if ( *head == NULL )
    {
        *head = newnode ;
        return ;
    }
    Node * temp = *head ;

    while ( temp -> next != NULL ) {
            temp = temp -> next ;
    }
    temp -> next = newnode ;
    newnode -> prev = temp ;
}

void ins_at_pos ( Node ** head , int data ,
                  int pos )

{
    Node * newnode = createnode (data);

    if ( pos == 1 )
    {
        ins_at_beg ( head , data);
        return ;
    }

    Node * temp = *head ;
```

```
for (int i = 1 ; i < pos - 1 && temp != NULL ; i++)
{
        temp = temp -> next;
}

if (temp == NULL)
{
    printf (" position out of bound ");
    free (newnode);
    return;
}

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

if (temp -> next != NULL)
{
        temp -> next -> prev = newnode;
}
    temp -> next = newnode;
}

void display (Node * head)
{
    Node * temp = head;

    while (temp != NULL)
    {
        printf (" %d ", temp -> data);
        temp = temp -> next;
    }
    printf ("\n");
}
```

Output

1. Insert at Beginning
2. Insert at position
3. Insert at end
4. Display list
5. Exit

Enter your choice : 1
Enter data : 21

1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display list
5. Exit.

Enter your choice : 2
Enter data : 20
Enter position : 1

1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display list
5. Exit

Enter your choice : 3
Enter data : 22

Seen
16/12/24

1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display list
5. Exit

Enter your choice : 4
20 21 22

CODE :

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

struct Node {
    int data;
    struct Node* prev;
    struct Node* next;
};
struct Node* createNode(int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = data;
    newNode->prev = NULL;
    newNode->next = NULL;
    return newNode;
}
void insertAtBeginning(struct Node** head, int data) {
    struct Node* newNode = createNode(data);
    newNode->next = *head;
    if (*head != NULL) {
        (*head)->prev = newNode;
    }
    *head = newNode;
}
void insertAtPosition(struct Node** head, int data, int position) {
    struct Node* newNode = createNode(data);
    if (position == 1) {
        insertAtBeginning(head, data);
        return;
    }

    struct Node* temp = *head;
    for (int i = 1; i < position - 1 && temp != NULL; i++) {
        temp = temp->next;
    }

    if (temp == NULL) {
        printf("Position out of bounds\n");
        free(newNode);
        return;
    }
```

```
    newNode->next = temp->next;
    newNode->prev = temp;

    if (temp->next != NULL) {
        temp->next->prev = newNode;
    }
    temp->next = newNode;
}
void insertAtEnd(struct Node** head, int data) {
    struct Node* newNode = createNode(data);
    if (*head == NULL) {
        *head = newNode;
        return;
    }

    struct Node* temp = *head;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = newNode;
    newNode->prev = temp;
}
void displayList(struct Node* head) {
    struct Node* temp = head;
    while (temp != NULL) {
        printf("%d ", temp->data);
        temp = temp->next;
    }
    printf("\n");
}
int main() {
    struct Node* head = NULL;
    int choice, data, position;

    while (1) {
        printf("\n1. Insert at Beginning\n");
        printf("2. Insert at Position\n");
        printf("3. Insert at End\n");
        printf("4. Display List\n");
        printf("5. Exit\n");
        printf("Enter your choice: ");
```

```
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter data: ");
                scanf("%d", &data);
                insertAtBeginning(&head, data);
                printf("data entered at beginning \n");
                break;
            case 2:
                printf("Enter data: ");
                scanf("%d", &data);
                printf("Enter position: ");
                scanf("%d", &position);
                insertAtPosition(&head, data, position);
                printf("data entered at position no %d\n",position);
                break;
            case 3:
                printf("Enter data: ");
                scanf("%d", &data);
                insertAtEnd(&head, data);
                printf("data entered at end\n");
                break;
            case 4:
                displayList(head);
                break;
            case 5:
                exit(0);
            default:
                printf("Invalid choice\n");
        }
    }

    return 0;

}
```

OUTPUT :

```
1. Insert at Beginning
2. Insert at Position
3. Insert at End
4. Display List
5. Exit
Enter your choice: 1
Enter data: 22
data entered at beginning

1. Insert at Beginning
2. Insert at Position
3. Insert at End
4. Display List
5. Exit
Enter your choice: 1
Enter data: 20
data entered at beginning

1. Insert at Beginning
2. Insert at Position
3. Insert at End
4. Display List
5. Exit
Enter your choice: 3
Enter data: 24
data entered at end

1. Insert at Beginning
2. Insert at Position
3. Insert at End
4. Display List
5. Exit
Enter your choice: 3
Enter data: 21
data entered at end

1. Insert at Beginning
2. Insert at Position
3. Insert at End
4. Display List
5. Exit
Enter your choice: 2
Enter data: 21
Enter position: 2
data entered at position no 2

1. Insert at Beginning
2. Insert at Position
3. Insert at End
4. Display List
5. Exit
Enter your choice: 4
20 21 22 23 24 21
```

PROGRAM 8

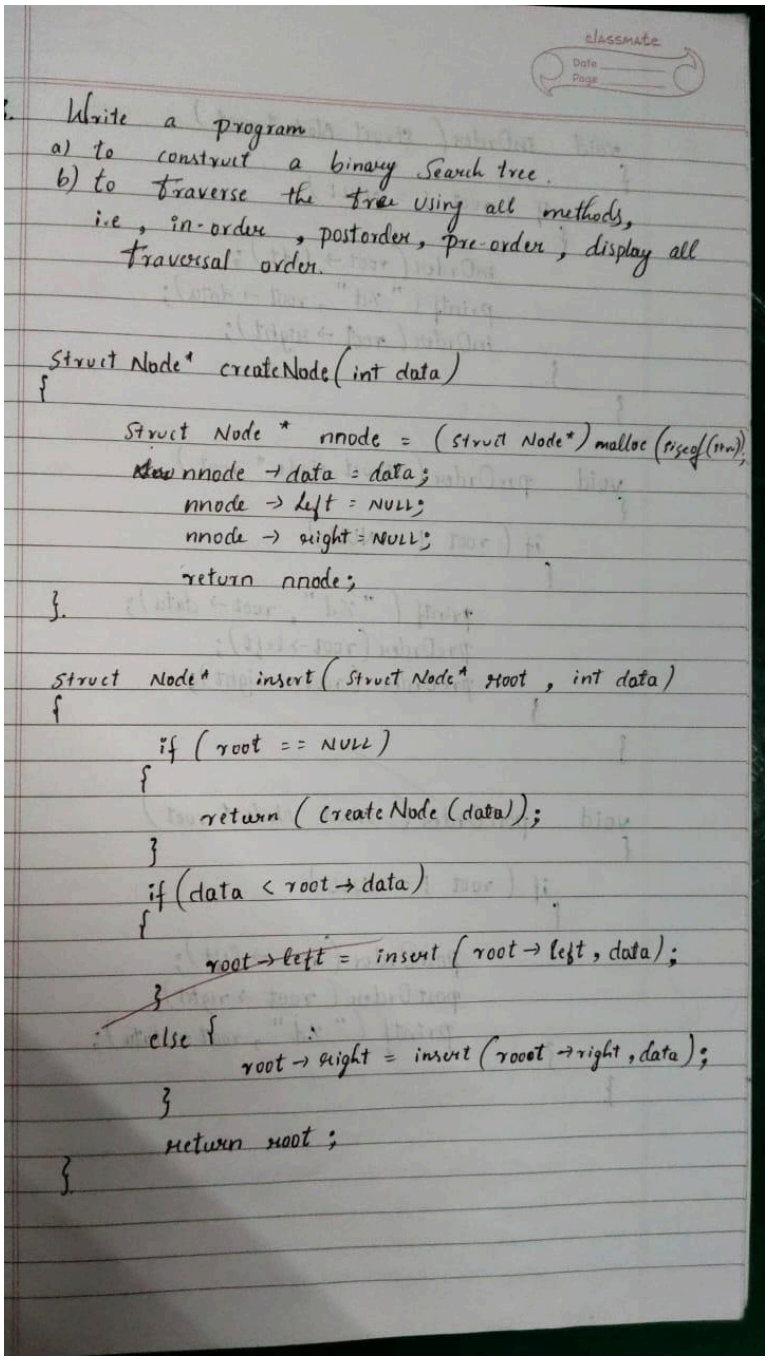
Write a program

a) ToconstructabinarySearchtree.

b) To traverse the tree using all the methods i.e., inorder, preorder and post order

c) To display the elements in the tree.

SOFT COPY :



```
1. Write a program
a) to construct a binary Search tree.
b) to traverse the tree using all methods,
   i.e, in-order, postorder, pre-order, display all
   traversal order.

Struct Node* createNode(int data)
{
    Struct Node * nnode = (struct Node*) malloc (sizeof(nn));
    nnode -> data = data;
    nnode -> left = NULL;
    nnode -> right = NULL;
    return nnode;
}

Struct Node* insert(Struct Node* root, int data)
{
    if (root == NULL)
    {
        return (CreateNode(data));
    }
    if (data < root -> data)
    {
        root -> left = insert(root -> left, data);
    }
    else {
        root -> right = insert(rooot -> right, data);
    }
    return root;
}
```

```
void inOrder( struct Node * root )
{
    if ( root != NULL )
    {
        inOrder( root -> left );
        printf ( " %d " , root -> data );
        inOrder( root -> right );
    }
}

void preOrder ( struct Node * root )
{
    if ( root != NULL )
    {
        printf ( " %d " , root -> data );
        preOrder (root -> left );
        preOrder ( root -> right );
    }
}

void postOrder ( struct Node * root )
{
    if ( root != NULL )
    {
        postOrder ( root -> left );
        postOrder ( root -> right );
        printf ( " %d " , root -> data );
    }
}
```

Q WAP to traverse a g

O/P

Enter no. of elements : 3

Enter Elements : 1 2 3

In-order traversal : 1 2 3
pre-order traversal : 1 2 3
post-order traversal : 3 2 1

CODE :

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

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

struct Node* createNode(int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = data;
    newNode->left = NULL;
    newNode->right = NULL;
    return newNode;
}

struct Node* insert(struct Node* root, int data) {
    if (root == NULL) {
        return createNode(data);
    }
    if (data < root->data) {
        root->left = insert(root->left, data);
    } else if (data > root->data) {
        root->right = insert(root->right, data);
    }
    return root;
}

void inorderTraversal(struct Node* root) {
    if (root != NULL) {
        inorderTraversal(root->left);
        printf("%d ", root->data);
        inorderTraversal(root->right);
    }
}

void preorderTraversal(struct Node* root) {
    if (root != NULL) {
        printf("%d ", root->data);
        preorderTraversal(root->left);
```

```
        preorderTraversal(root->right);
    }
}

void postorderTraversal(struct Node* root) {
    if (root != NULL) {
        postorderTraversal(root->left);
        postorderTraversal(root->right);
        printf("%d ", root->data);
    }
}

int main() {
    struct Node* root = NULL;
    int choice, value;

    printf("Binary Search Tree Operations\n");
    while (1) {
        printf("\n1. Insert\n2. Inorder Traversal\n3. Preorder Traversal\n4.
Postorder Traversal\n5. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter value to insert: ");
                scanf("%d", &value);
                root = insert(root, value);
                break;
            case 2:
                printf("Inorder Traversal: ");
                inorderTraversal(root);
                printf("\n");
                break;
            case 3:
                printf("Preorder Traversal: ");
                preorderTraversal(root);
                printf("\n");
                break;
            case 4:
                printf("Postorder Traversal: ");
```

```
                postorderTraversal(root);
                printf("\n");
                break;
            case 5:
                printf("Exiting program.\n");
                exit(0);
            default:
                printf("Invalid choice. Please try again.\n");
        }
    }

    return 0;
}
```

OUTPUT :

Output

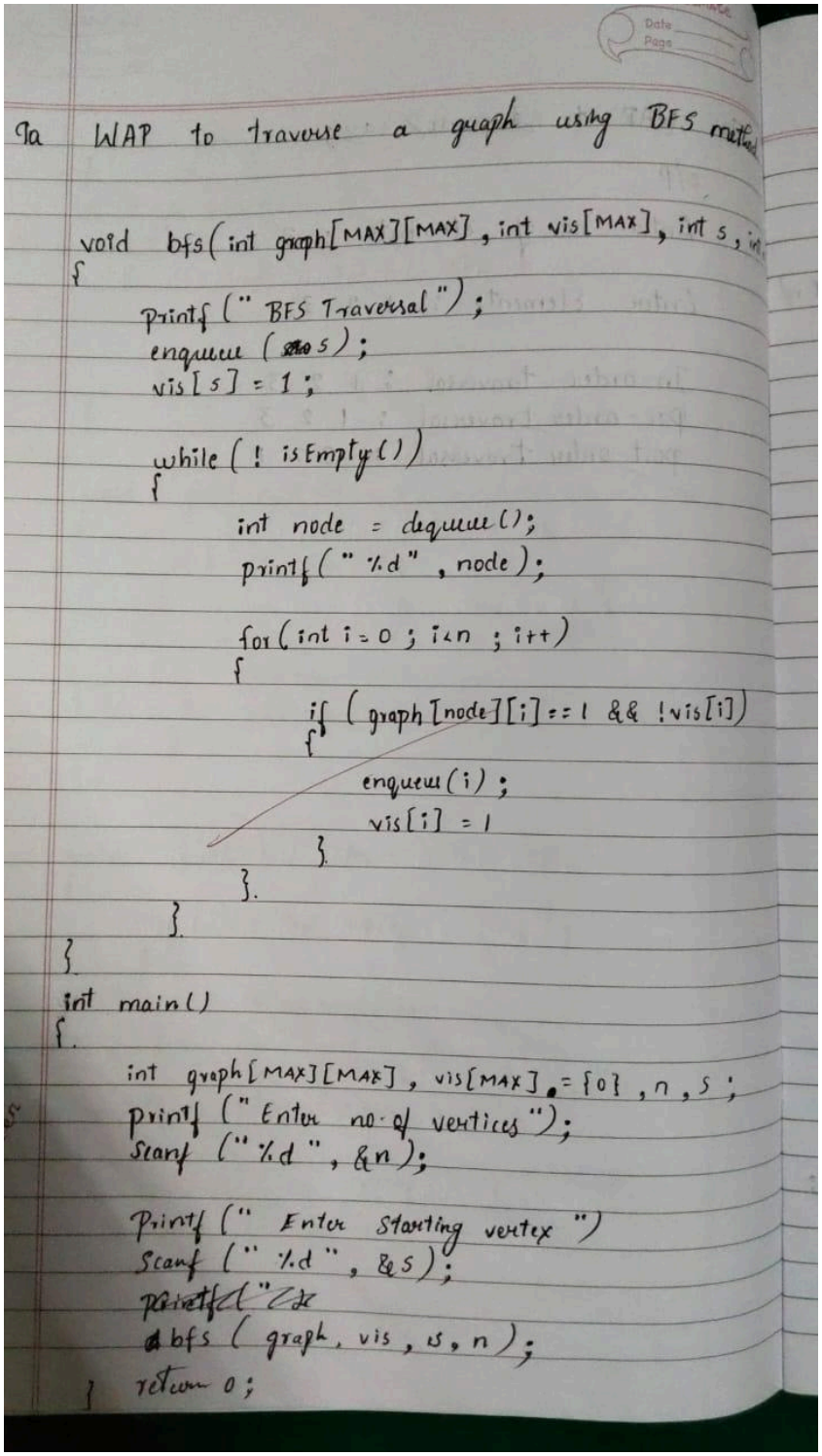
```
Binary Search Tree Traversals:
Inorder Traversal: 20 30 40 50 60 70 80
Preorder Traversal: 50 30 20 40 70 60 80
Postorder Traversal: 20 40 30 60 80 70 50


=== Code Execution Successful ===
```

PROGRAM 9

a) Write a program to traverse a graph using BFS method.

b) Write a program to check whether given graph is connected or not using DFS method

SOFT COPY



```
9a  WAP to traverse a graph using BFS meth

void bfs(int graph[MAX][MAX], int vis[MAX], int s, in
{
    Printf (" BFS Traversal ");
    enqueue (s);
    vis[s] = 1;

    while ( ! isEmpty() )
    {
        int node = dequeue();
        printf(" %d", node);

        for(int i=0 ; i<n ; i++)
        {
            if ( graph[node][i]==1 && !vis[i])
            {
                enqueue(i);
                vis[i] = 1
            }
        }
    }
}
int main()
{
    int graph[MAX][MAX], vis[MAX]={0}, n, s;
    printf ("Enter no. of vertices");
    Scanf ("%d", &n);

    Printf (" Enter Starting vertex ")
    Scanf (" %d ", &s);
    bfs ( graph, vis, s, n );
    return 0;
}
```

Output

Enter no. of vertices : 2
Enter adjacency matrix :
0 1
3 2
Enter staring point : 1
BFS traversal : 0 2 1

Qb. WAP to Traverse a graph using DFS method.

```
void dfs (int graph[MAX][MAX], int vis[MAX], int s, int n)
{
    vis[s] = 1
    printf("%d", s);

    for (int i=0 ; i<n ; i++)
    {
        if (graph[start][i] == 1 && !vis[i])
        {
            dfs(graph, vis, i, n);
        }
    }
}

int main() {

  int graph[MAX][MAX], vis[MAX] = {0}, n, s ;

  printf (" Enter noo. of vertices");
   Scanf ("%d", &n);

  Printf (" Enter adjacency matrix ")
  for (int i=0 ; i<n ; i++)
   {   for (int j=0 ; j<n ; j++)
        {
            scanf ("%d", & graph[i][j]);
        }
   {
```

```
    printf(" Enter the Starting vertex ");
    scanf(" %d ", &s);

    printf(" DFS Traversal ");
    dfs(graph, vis, s, n);

    return 0;
}
```

Output /

Enter no of vertices : 4
Enter adjacenty matrix :

```
0 1 1 0
1 0 1 1
0 1 1 0
1 0 1 0
```

Enter the Starting point : 3
DFS Traversal : 3 0 1 2

CODE :

```c
#include <stdio.h>
#include <stdlib.h>
#define MAX 100

void bfs(int graph[MAX][MAX], int visited[], int n, int start) {
    int queue[MAX], front = -1, rear = -1;
    printf("BFS Traversal starting from vertex %d: ", start);

    queue[++rear] = start;
    visited[start] = 1;

    while (front != rear) {
        int current = queue[++front];
        printf("%d ", current);

        for (int i = 0; i < n; i++) {
            if (graph[current][i] == 1 && !visited[i]) {
                queue[++rear] = i;
                visited[i] = 1;
            }
        }
    }
    printf("\n");
}

void dfs(int graph[MAX][MAX], int visited[], int n, int start) {
    visited[start] = 1;
    printf("%d ", start);
    for (int i = 0; i < n; i++) {
        if (graph[start][i] == 1 && !visited[i]) {
            dfs(graph, visited, n, i);
        }
    }
}

int isConnected(int graph[MAX][MAX], int n) {
    int visited[MAX] = {0};

    dfs(graph, visited, n, 0);

    for (int i = 0; i < n; i++) {
```

```
        if (!visited[i]) {
            return 0;
        }
    }
    return 1;
}

int main() {
    int graph[MAX][MAX], visited[MAX], n, start;

    printf("Enter the number of vertices: ");
    scanf("%d", &n);

    printf("Enter the adjacency matrix of the graph:\n");
    for (int i = 0; i < n; i++) {
        for (int j = 0; j < n; j++) {
            scanf("%d", &graph[i][j]);
        }
    }

    printf("Enter the starting vertex for BFS: ");
    scanf("%d", &start);
    for (int i = 0; i < n; i++) {
        visited[i] = 0;
    }
    bfs(graph, visited, n, start);
    printf("--------END-------\n");

    printf("Enter the starting vertex for DFS: ");
    scanf("%d", &start);
    for (int i = 0; i < n; i++) {
        visited[i] = 0;
    }
    printf("DFS Traversal starting from vertex %d: ", start);
    dfs(graph, visited, n, start);
    printf("\n");

    if (isConnected(graph, n)) {
        printf("The graph is connected.\n");
    } else {
        printf("The graph is not connected.\n");
```

```
    }

    return 0;
}
```

OUTPUT

Output Clear

```
Enter the number of vertices: 4
Enter the adjacency matrix of the graph:
1 0 1 0
1 0 1 1
1 1 1 0
0 1 0 1
Enter the starting vertex for BFS: 3
BFS Traversal starting from vertex 3: 3 1 0 2
--------END-------
Enter the starting vertex for DFS: 2
DFS Traversal starting from vertex 2: 2 0 1 3
    --------END-------

0 2 1 3 The graph is connected.
```