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
(Autonomous Institution under VTU)

BENGALURU-560019
Sep-2024 to Jan-2025

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CERTIFICATE

This is to certify that the Lab work entitled "Data Structures using C Lab (23CS3PCDST)"carried out by **SAMIR CHAUDHARY (1BM23CS294),** 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.

Lab faculty Incharge Name Assistant Professor Department of CSE, BMSCE	Dr. kavitha Sooda Professor & HOD Department of CSE, BMSCE

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Github Link: https://github.com/SAMIR-1BM23CS294/Data-Structure

Program 1

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

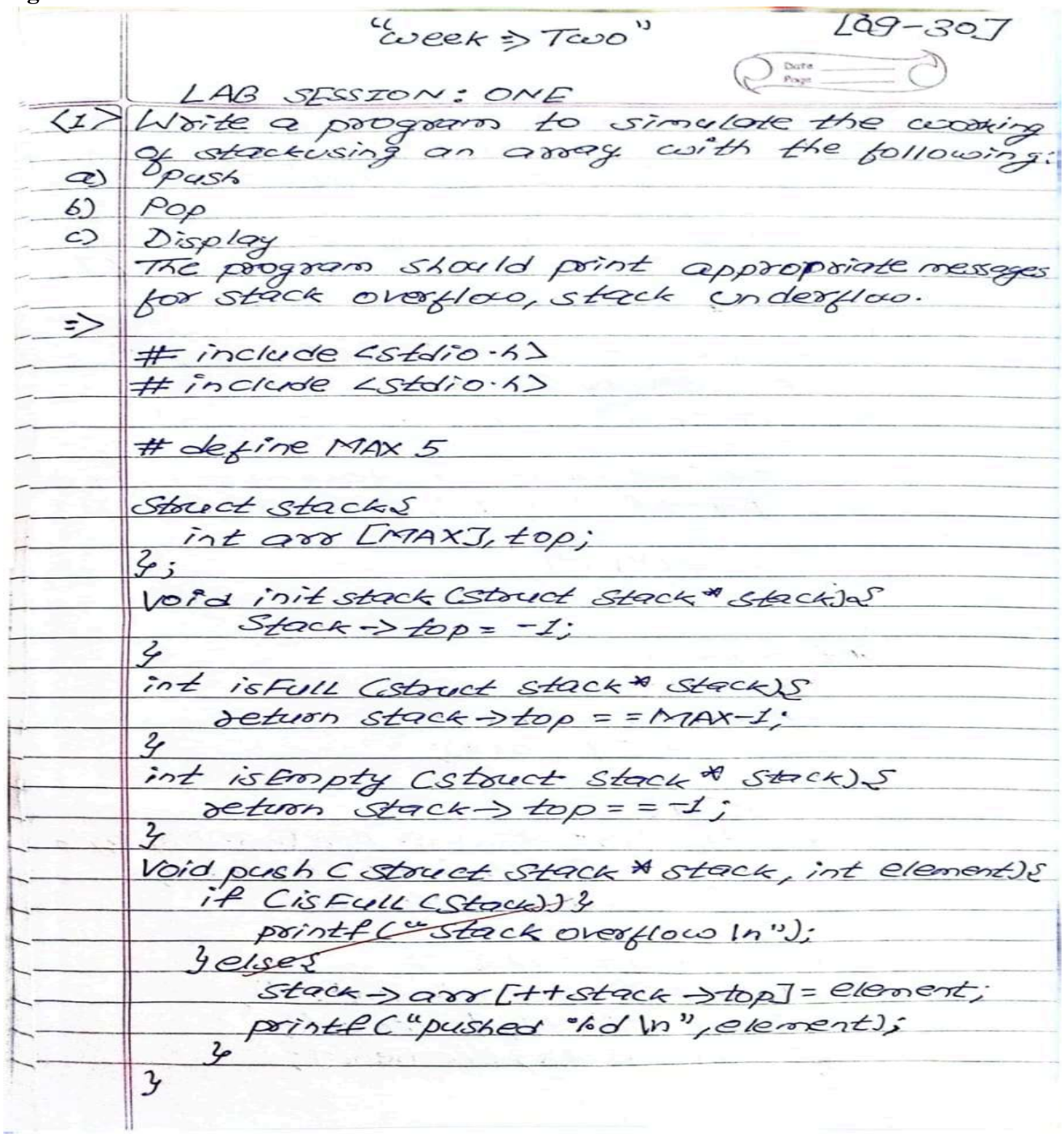
a) Push

b) Pop

c) Display

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

Algorithm:



"Week => Two" [09-30]

LAB SESSION: ONE

(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.

=>

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

#define MAX 5

Struct stack{
   int arr[MAX], top;
};
Void initstack(struct stack* stack){
      Stack->top = -1;
}
int isFull(struct stack* stack){
    return stack->top == MAX-1;
}
int isEmpty(struct stack* stack){
    return stack->top == -1;
}
Void push(struct stack* stack, int element){
    if(isFull(Stack)){
        printf("stack overflow\n");
    }else{
        stack->arr[++stack->top] = element;
        printf("pushed %d\n", element);
    }
}
```

```
void pop (struct stack* stack){
  if (isEmpty (stack)){
    printf ("Stack Underflow\n");
  }else{
    printf ("popped %d\n",
        stack->arr [stack->top--]);
  }
}
Void display (struct stack* stack){
  if (isEmpty (stack)){
    printf ("stack is empty\n");
  }else{
    for (int i=0; i<=stack->top; i++){
      printf ("%d", stack->arr [i]);
    }
    printf("\n");
  }
}
int main (){
  struct stack stack;
  int choice, element;
  initstack (&stack);

  while (1){
    printf ("\n1. Push\n2. pop\n3. Display\n
          4. Exit\n Enter choice: ");
    scanf ("%d", &choice);

    if (choice == 1){
      printf ("Enter element: ");
      scanf ("%d", &element);
      push (&stack, element);
```

```
} elseif (choice == 2) {
    pop (&stack);
} elseif (choice == 3) {
    display (&stack);
} elseif (choice == 4) {
    printf("Exiting ---\n");
    break;
} else {
    printf("Invalid choice\n");
}
return 0;
}
```

Output:-

```
1. Push
2. pop
3. Display
4. Exit
Enter choice : 1
Enter element : 10
Pushed 10

1. push
2. pop
3. Display
4. Exit
Enter choice : 1
Enter element: 20
Pushed 20
```

1. Pushed
2. Pop
3. Display
4. Exit
Enter choice: 1
Enter element: 30
pushed 30

1. Pushed
2. Pop
3. Display
4. Exit
Enter choice: 3
10 20 30

1. Pushed
2. Pop
3. Display
4. Exit
Enter choice: 2
popped 30

1. Pushed
2. Pop
3. Display
4. Exit
Enter choice: 3
10 20

Enter choice: 4
Exiting---

Code:

```
#include <stdio.h>
#include <stdlib.h>
#define MAX 5
struct Stack {
   int arr[MAX], top;
};
void initStack(struct Stack *stack) {
   stack->top = -1;
}

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

int isEmpty(struct Stack *stack) {
   return stack->top == -1;
}

void push(struct Stack *stack, int element) {
   if (isFull(stack)) {
      printf("Stack Overflow\n");
   } else {
      stack->arr[++stack->top] = element;
      printf("Pushed %d\n", element);
   }
}

void pop(struct Stack *stack) {
   if (isEmpty(stack)) {
      printf("Stack Underflow\n");
   } else {
      printf("Popped %d\n", stack->arr[stack->top--]);
   }
}

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

```
int main() {
    struct Stack stack;
    int choice, element;
    initStack(&stack);

    while (1) {
        printf("\n1. Push\n2. Pop\n3. Display\n4. Exit\nEnter choice: ");
        scanf("%d", &choice);

        if (choice == 1) {
            printf("Enter element: ");
            scanf("%d", & element);
            push(&stack, element);
        } else if (choice == 2) {
            pop(&stack);
        } else if (choice == 3) {
            display(&stack);
        } else if (choice == 4) {
            printf("Exiting...\n");
            break;
        } else {
            printf("Invalid choice\n");
        }
    }

    return 0;
}
```

Output:

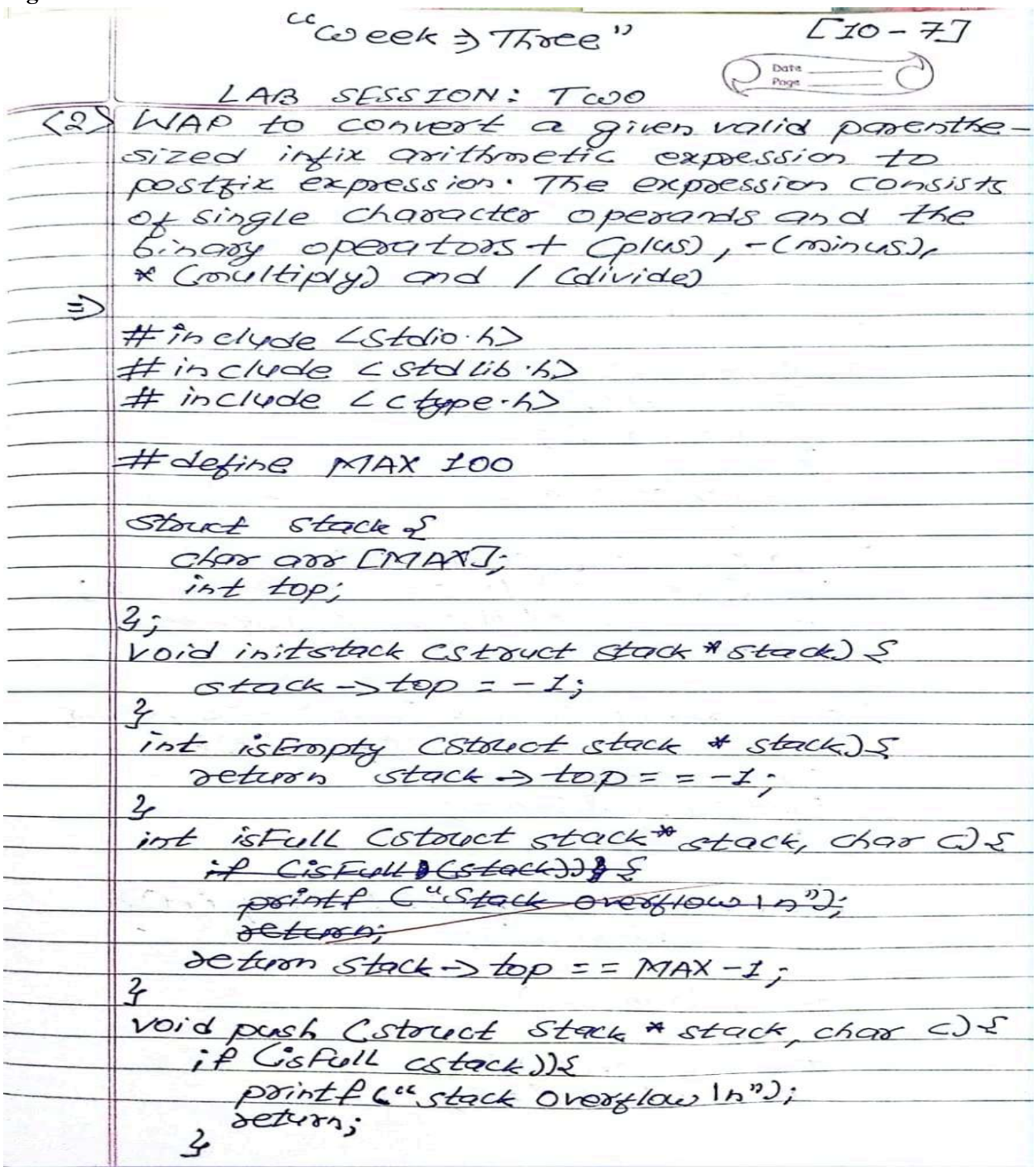
```
1. Push
2. Pop
3. Display
4. Exit
Enter choice: 1
Enter element: 10
Pushed 10

1. Push
2. Pop
3. Display
4. Exit
Enter choice: 1
Enter element: 20
Pushed 20

1. Push
2. Pop
3. Display
4. Exit
Enter choice: 1
Enter element: 30
Pushed 30

1. Push
2. Pop
3. Display
4. Exit
Enter choice: 3
10 20 30
```

```
1. Push
2. Pop
3. Display
4. Exit
Enter choice: 2
Popped 30

1. Push
2. Pop
3. Display
4. Exit
Enter choice: 3
10 20

1. Push
2. Pop
3. Display
4. Exit
Enter choice: 4
Exiting...
```

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).

Algorithm:



```
"Week 3 Three"                                   [10-7]
LAB SESSION: Two
(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 <ctype.h>

#define MAX 100

struct stack {
    char arr[MAX];
    int top;
};
void initstack (struct stack *stack) {
    stack->top = -1;
}
int isEmpty (struct stack * stack) {
    return stack->top == -1;
}
int isFull (struct stack* stack, char c) {
    return stack->top == MAX-1;
}
void push (struct stack * stack, char c) {
    if (isFull (stack)) {
        printf ("stack overflow \n");
        return;
    }
```

```
    stack->arr[++stack->top] = c;
}
char pop(struct stack *stack){
    if (isEmpty(stack)) {
        return -1;
    }
    return stack->arr[stack->top--];
}
char peek(struct stack *stack) {
    if (isEmpty(stack)) {
        return -1;
    }
    return stack->arr[stack->top];
}
int precedence(char c){
    if (c == '+' || c == '-') return 1;
    if (c == '*' || c == '/') return 2;
    return 0;
}
Void infixTOpostfix(char *infix, char
                        *postfix){
    struct stack stack;
    initstack(&stack);
    int k=0;

for(int i=0; infix[i] != '\0'; i++){
    char c = infix[i];

if(isalnum(c)){

if(isalnum(c)){
    postfix[k++] = c;
```

```
    } else if (c == '(') {
        push(&stack, c);
    } else if (c == ')') {
        while (!isEmpty(&stack) && peek(&stack) !=
                                        '(') {
            postfix[k++] = pop(&stack);
        }
        pop(&stack);
    } else if (c == '+' || c == '-' || c == '*' ||
                                    c == '/') {
        while (!isEmpty(&stack) && precedence
            (peek(&stack)) >= precedence(c)) {
            postfix[k++] = pop(&stack);
        }
        push(&stack, c);
    }
}
while (!isEmpty(&stack)) {
    postfix[k++] = pop(&stack);
}
postfix[k] = '\0';
}
int main() {
    char infix[MAX], postfix[MAX];

    printf("Enter a valid infix expression: ");
    scanf("%s", infix);

    infixToPostfix(infix, postfix);
    printf("postfix expression: %s\n", postfix);
    return 0;
}
```

Output:-

Case: 1 Enter a valid infix expression: (a+b)*(c-d)

Postfix expression: ab+cd-*

case:2 Enter a valid infix expression: a*(b+c)/d

Postfix expression: abc+*d/

case:3 Enter a valid infix expression: a+b*c

Postfix expression: abc*+

Code:

```
#include <stdio.h>
#include <stdlib.h>
#include <ctype.h>
#define MAX 100
struct Stack {
   char arr[MAX];
   int top;
};
void initStack(struct Stack *stack) {
   stack->top = -1;
}

int isEmpty(struct Stack *stack) {
   return stack->top == -1;
}

int isFull(struct Stack *stack) {
   return stack->top == MAX - 1;
}
void push(struct Stack *stack, char c) {
   if (isFull(stack)) {
      printf("Stack overflow\n");
      return;
   }
   stack->arr[++stack->top] = c;
}

char pop(struct Stack *stack) {
   if (isEmpty(stack)) {
      return -1;
   }
   return stack->arr[stack->top--];
}

char peek(struct Stack *stack) {
   if (isEmpty(stack)) {
      return -1;
   }
   return stack->arr[stack->top];
}

int precedence(char c) {
   if (c == '+' || c == '-') return 1;
   if (c == '*' || c == '/') return 2;
   return 0;
}
void infixToPostfix(char *infix, char *postfix) {
```

```
    struct Stack stack;
    initStack(&stack);
    int k = 0;

    for (int i = 0; infix[i] != '\0'; i++) {
        char c = infix[i];

        if (isalnum(c)) {
            postfix[k++] = c;
        } else if (c == '(') {
            push(&stack, c);
        } else if (c == ')') {
            while (!isEmpty(&stack) && peek(&stack) != '(') {
                postfix[k++] = pop(&stack);
            }
            pop(&stack);
        } else if (c == '+' || c == '-' || c == '*' || c == '/') {
            while (!isEmpty(&stack) && precedence(peek(&stack)) >= precedence(c)) {
                postfix[k++] = pop(&stack);
            }
            push(&stack, c);
        }
    }
    while (!isEmpty(&stack)) {
        postfix[k++] = pop(&stack);
    }

    postfix[k] = '\0';
}
int main() {
    char infix[MAX], postfix[MAX];

    printf("Enter a valid infix expression: ");
    scanf("%s", infix);

    infixToPostfix(infix, postfix);

    printf("Postfix expression: %s\n", postfix);

    return 0;
}
```

Output:

```
Enter a valid infix expression: (a+b)*(c-d)
Postfix expression: ab+cd-*
```

Program 3

A) 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.

Algorithm:

"Week 3 Four" [10-14]

LAB SESSION : THREE (Part-A)

(3) Write a program to stimulate 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.

=>

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

#define MAX 5 //Maximum size of the queue

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

// Function to create a queue
Queue* CreateQueue(){
   Queue* q = (Queue*)malloc(sizeof(Queue));
    q->front = -1;
    q-> rear = -1;
    return q;
}

// Function to check if the queue is full
int isFull(Queue* q){
   return q-> rear == MAX-1;
}
```

```
// Function to check if the queue is empty
int isEmpty(Queue* q) {
    return q->front == -1 || q->front > q->rear;
}

// Function to insert an element into the queue
void enqueue(Queue* q, int value) {
    if (isFull(q)) {
        printf("Queue overflow! Unable to
                insert %d\n", value);
        return;
    }
    if (q->front == -1) {
        q->front = 0; // Initialize front for the
                      first element
    }
    q->rear++;
    q->items[q->rear] = value;
    printf("%d inserted into the queue.\n", value);
}

// Function to delete an element from the queue
int dequeue(Queue* q) {
    if (isEmpty(q)) {
        printf("Queue empty! Unable to delete an
                element.\n");
        return -1;
    }
    int item = q->items[q->front];
    q->front++;
    if (q->front > q->rear) {
        q->front = -1; // Reset the queue
```

```
        q->rear = -1;
    }
    printf("%d deleted from the queue.\n",
                                    item);
    return item;
}

// Function to display the elements of queue
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");
}

// main function
int main() {
    Queue* q = createQueue();
    int choice, value;

    do {
        printf("\n Queue Menu:\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 an integer to insert: ");
    scanf("%d", &value);
    enqueue(q, value);
    break;
case 2:
    dequeue(q);
    break;
case 3:
    display(q);
    break;
case 4:
    printf("Exiting---\n");
    break;
default:
    printf("Invalid choice! Please try again.\n");
}
} while (choice != 4);

free(q); // free the allocated memory for the queue

return 0;
}
```

Seen
04/10/24

Output:-

Queue menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
~~Enter the value to insert: 10~~
Enter an integer to insert: 10
10 inserted into the queue.

Queue menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter an integer to insert: 20
20 inserted into the queue.

Queue menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Queue elements: 10 20

Queue menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
10 deleted from the queue.

Queue menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Queue elements : 20

Queue menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 4
Exiting the program.

Code:

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

#define MAX 5

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

Queue* CreateQueue() {
   Queue* q = (Queue*)malloc(sizeof(Queue));
   q->front = -1;
   q->rear = -1;
   return q;
}

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

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

void enqueue(Queue* q, int value) {
   if (isFull(q)) {
      printf("Queue Overflow! Unable to insert %d.\n", value);
      return;
   }
   if (q->front == -1) {
      q->front = 0;
   }
   q->rear++;
   q->items[q->rear] = value;
   printf("%d inserted into the queue.\n", value);
}

int dequeue(Queue* q) {
   if (isEmpty(q)) {
      printf("Queue Empty! Unable to delete an element.\n");
      return -1;
   }
   int item = q->items[q->front];
   q->front++;
```

```
    if (q->front > q->rear) {
        q->front = q->rear = -1;
    }
    printf("%d deleted from the queue.\n", item);
    return item;
}

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");
}

int main() {
    Queue* q = CreateQueue();
    int choice, value;

    do {
        printf("\nQueue Menu:\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 an integer to insert: ");
                scanf("%d", &value);
                enqueue(q, value);
                break;
            case 2:
                dequeue(q);
                break;
            case 3:
                display(q);
                break;
            case 4:
                printf("Exiting the program.\n");
                break;
```

```
            default:
                printf("Invalid choice! Please try again.\n");
        }
    } while (choice != 4);

    free(q);
    return 0;
}
```

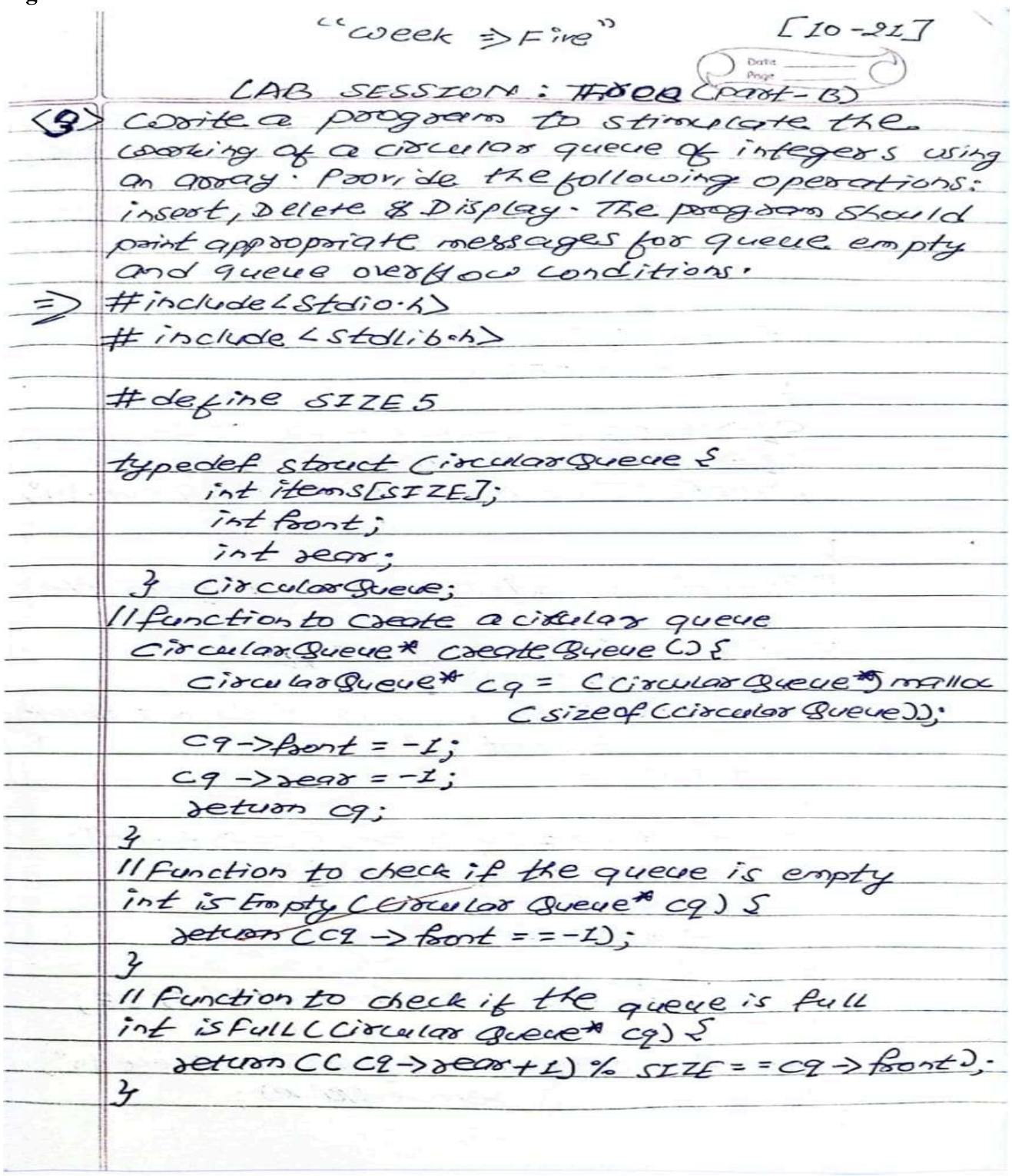
Output:

```
Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter an integer to insert: 10
10 inserted into the queue.

Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter an integer to insert: 20
20 inserted into the queue.

Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Queue elements: 10 20

Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
10 deleted from the queue.
```

```
Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Queue elements: 20

Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 4
Exiting the program.
```

B) 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.

Algorithm:



"Week ⇒ Five" [10-21]

LAB SESSION : 10 (Part-B)

(3) Write a program 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.

⇒

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

#define SIZE 5

typedef struct circularQueue {
    int items[SIZE];
    int front;
    int rear;
} circularQueue;
// function to create a circular queue
circularQueue* createQueue() {
    circularQueue* cq = (circularQueue*) malloc
                        (sizeof(circularQueue));
    cq->front = -1;
    cq->rear = -1;
    return cq;
}
// Function to check if the queue is empty
int isEmpty(circularQueue* cq) {
    return (cq->front == -1);
}
// Function to check if the queue is full
int isFull(circularQueue* cq) {
    return ((cq->rear + 1) % SIZE == cq->front);
}
```

```
// Function to insert an element into the queue
void insert(CircularQueue* cq, int value){
  if(isFull(cq)){
    printf("Queue Overflow: Cannot insert
            element.\n");
    return;
  }
  if(isEmpty(cq)){
    cq->front = 0;
  }
  cq->rear = (cq->rear+1) % SIZE;
  cq->items[cq->rear] = value;
  printf("Inserted %d into the queue.\n",
                value);
}
// Function to delete an element from the
queue
void delete(CircularQueue* cq){
  if(isEmpty(cq)){
    printf("Queue underflow: Cannot delete
            element.\n");
    return;
  }
int removedValue = cq->items[cq->front];
if(cq->front == cq->rear){
    cq->front = -1;
    cq->rear = -1;
} else{
    cq->front = (cq->front+1) % SIZE;
}
printf("Deleted %d from the queue.\n",
            removedValue);
}
```

```
// Function to display the queue elements
void display(CircularQueue *cq){
    if(isEmpty(cq)){
      printf("Queue is empty.\n");
      return;
    }
  printf("Queue elements are: ");
  int i=cq->front;
  while(1){
      printf("%d", cq->items[i]);
      if(i==cq->rear){
        break;
      }
      i=(i+1)%SIZE;
    }
  printf("\n");
}
// Main function to display the circular
queue operations
int main(){
      CircularQueue cq;
      initializeQueue(&cq);
      int choice, value;

  do{
          printf("\n Circular Queue menu: \n");
          printf("\n1. 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 integer to insert:");
    scanf("%d", &value);
    insert(&cq, value);
    break;
case 2:
    delete(&cq);
    break;
case 3:
    display(&cq);
    break;
case 4:
    printf("Exiting the program.\n");
    exit(0);
default:
    printf("Invalid choice.
            Please try again.\n");
    }
}
return 0 while(choice!=4);
free(cq);
return 0;
}
```

Output :-

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter an integer to insert: 10
Inserted 10 into the queue.

~~Circular Qu~~
Enter your choice: 1
Enter an integer to insert: 20
Inserted 20 into the queue.

Enter your choice: 3
Queue elements are: 10 20

Enter your choice: 2
Deleted 10 from the queue.

Enter your choice: 3
Queue elements are: 20

Enter your choice: 1
Enter an integer to insert: 30
Inserted 30 into the queue.

Enter your choice: 1
Enter an integer to insert: 40
Inserted 40 into the queue.

Enter your choice: 1
Enter an integer to insert: 50
Inserted 50 into the queue.

Enter your choice: 1
Enter an integer to insert: 60
Inserted 60 into the queue.

Enter your choice: 3
Queue elements are: 20 30 40 50

Enter your choice: 2
Deleted 20 from the queue.

Enter your choice: 3
Queue elements are: 30 40 50

Enter your choice: 2
Deleted 30 from the queue.

Enter your choice: 2
Deleted 40 from the queue.

Enter your choice: 2
Deleted 50 from the queue

Enter your choice: 2
Queue underflow: Cannot delete element.

Enter your choice: 4
Exiting the program.

Code:

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

#define SIZE 5

typedef struct CircularQueue {
   int items[SIZE];
   int front;
   int rear;
} CircularQueue;

CircularQueue* createQueue() {
   CircularQueue* cq = (CircularQueue*)malloc(sizeof(CircularQueue));
   cq->front = -1;
   cq->rear = -1;
   return cq;
}

int isEmpty(CircularQueue* cq) {
   return (cq->front == -1);
}

int isFull(CircularQueue* cq) {
   return ((cq->rear + 1) % SIZE == cq->front);
}

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

void delete(CircularQueue* cq) {
   if (isEmpty(cq)) {
      printf("Queue Underflow: Cannot delete element.\n");
      return;
   }
   int removedValue = cq->items[cq->front];
   if (cq->front == cq->rear) {
```

```
        cq->front = -1;
        cq->rear = -1;
    } else {
        cq->front = (cq->front + 1) % SIZE;
    }
    printf("Deleted %d from the queue.\n", removedValue);
}

void display(CircularQueue* cq) {
    if (isEmpty(cq)) {
        printf("Queue is empty.\n");
        return;
    }
    printf("Queue elements are: ");
    int i = cq->front;
    while (1) {
        printf("%d ", cq->items[i]);
        if (i == cq->rear) {
            break;
        }
        i = (i + 1) % SIZE;
    }
    printf("\n");
}

int main() {
    CircularQueue* cq = createQueue();
    int choice, value;

    do {
        printf("\nCircular Queue Menu:\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 an integer to insert: ");
                scanf("%d", &value);
                insert(cq, value);
                break;
            case 2:
                delete(cq);
                break;
```

```
            case 3:
                display(cq);
                break;
            case 4:
                printf("Exiting the program.\n");
                break;
            default:
                printf("Invalid choice! Please try again.\n");
        }
    } while (choice != 4);

    free(cq);
    return 0;
}
```

Output:

```
Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter an integer to insert: 10
Inserted 10 into the queue.

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter an integer to insert: 20
Inserted 20 into the queue.

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Queue elements are: 10 20

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted 10 from the queue.
```

```
Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Queue elements are: 20

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter an integer to insert: 30
Inserted 30 into the queue.

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter an integer to insert: 40
Inserted 40 into the queue.

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter an integer to insert: 50
Inserted 50 into the queue.
```

```
Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter an integer to insert: 60
Inserted 60 into the queue.

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Queue elements are: 20 30 40 50 60

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted 20 from the queue.

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Queue elements are: 30 40 50 60

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted 30 from the queue.
```

```
Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted 40 from the queue.

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted 50 from the queue.

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted 60 from the queue.

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Queue Underflow: Cannot delete element.

Circular Queue Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 4
Exiting the program.
```

Program 4:

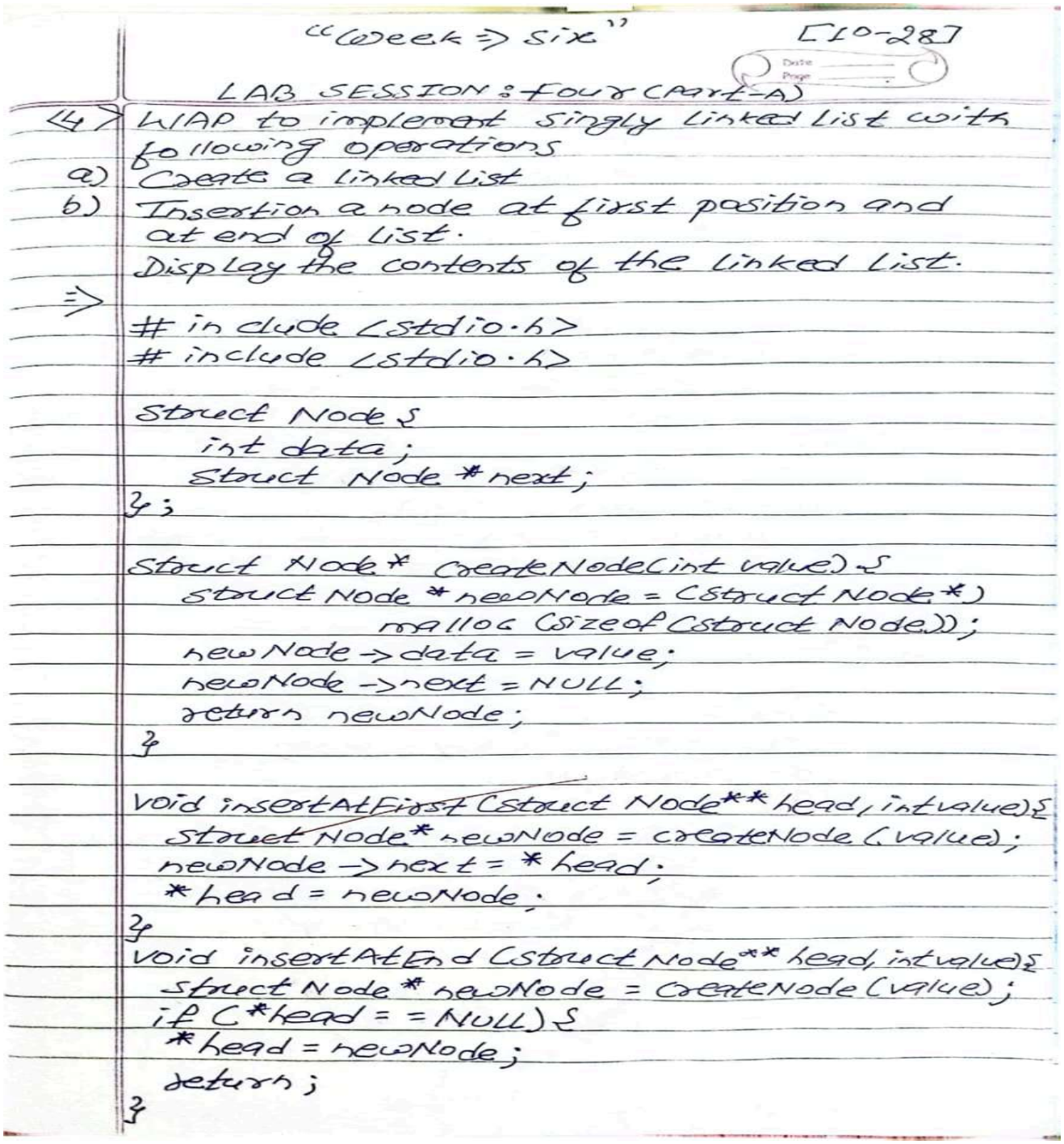
A)WAP to Implement Singly Linked List with following operations:

a) Create a linked list.

b) Insertion of a node at first position, at any position and at end of list.

Display the contents of the linked list.

Algorithm:



"Week ⇒ Six" [10-28]

LAB SESSION : four (Part-A)

<4> WAP to implement singly linked list with following operations

a) Create a linked list

b) Insertion a node at first position and at end of list.

Display the contents of the linked list.

⇒

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

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

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

void insertAtFirst(struct Node** head, int value){
  struct Node* newNode = createNode(value);
  newNode->next = *head;
  *head = newNode;
}
void insertAtEnd(struct Node** head, int value){
  struct Node *newNode = createNode(value);
  if(*head == NULL){
   *head = newNode;
   return;
}
```

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

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

int main() {
    struct Node* head = NULL;
    int choice, value;
    do {
        printf("\n menu:\n");
        printf("1. Insert at first\n");
        printf("2. Insert at end\n");
        printf("3. Display list\n");
        printf("4. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
```

```
switch(choice){
    case 1:
        printf("Enter value to insert
                at the beginning: ");
        scanf("%d", &value);
        insertAtFirst(&head, value);
        break;
    case 2:
        printf("Enter value to insert at the
                end: ");
        scanf("%d", &value);
        insertAtEnd(&head, value);
        break;
    case 3:
        printf("Contents of the linked list:
        displayList(head);
        break;
    case 4:
        printf("Exiting program...\n");
        break;
    default:
        printf("Invalid choice! Please try
                again.\n");
    }
} while(choice!=4);

  return 0;
}
```

Output:-

```
menu:
1. Insert at first
2. Insert at end
3. Display list
4. Exit
Enter your choice: 1
Enter value to insert at the beginning : 10

menu:
1. Insert at first
2. Insert at end
3. Display list
4. Exit
Enter your choice: 2
Enter value to insert at the end: 20

menu:
1. Insert at first
2. Insert at end
3. Display list
4. Exit
Enter your choice: 3
Contents of the linked list: 10 -> 20 -> NULL

Enter your choice: 1
Enter value to insert at beginning : 5

Enter your choice: 2
Enter value to insert at end : 25

Enter your choice: 3
contents of the linked list: 5 -> 10 -> 20 -> 25 -> NULL
```

Code:

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


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


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


void insertAtFirst(struct Node** head, int value) {
   struct Node* newNode = createNode(value);
   newNode->next = *head;
   *head = newNode;
}


void insertAtEnd(struct Node** head, int value) {
   struct Node* newNode = createNode(value);
   if (*head == NULL) {
      *head = newNode;
      return;
   }

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

   temp->next = newNode;
}


void displayList(struct Node* head) {
   if (head == NULL) {
      printf("The list is empty.\n");
      return;
   }
```

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

    int choice, value;

    do {
        printf("\nMenu:\n");
        printf("1. Insert at first\n");
        printf("2. Insert at end\n");
        printf("3. Display list\n");
        printf("4. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch(choice) {
            case 1:
                printf("Enter value to insert at the beginning: ");
                scanf("%d", &value);
                insertAtFirst(&head, value);
                break;
            case 2:
                printf("Enter value to insert at the end: ");
                scanf("%d", &value);
                insertAtEnd(&head, value);
                break;
            case 3:
                printf("Contents of the linked list: ");
                displayList(head);
                break;
            case 4:
                printf("Exiting program...\n");
                break;
            default:
                printf("Invalid choice! Please try again.\n");
        }
    } while (choice != 4);

    return 0;
}
```

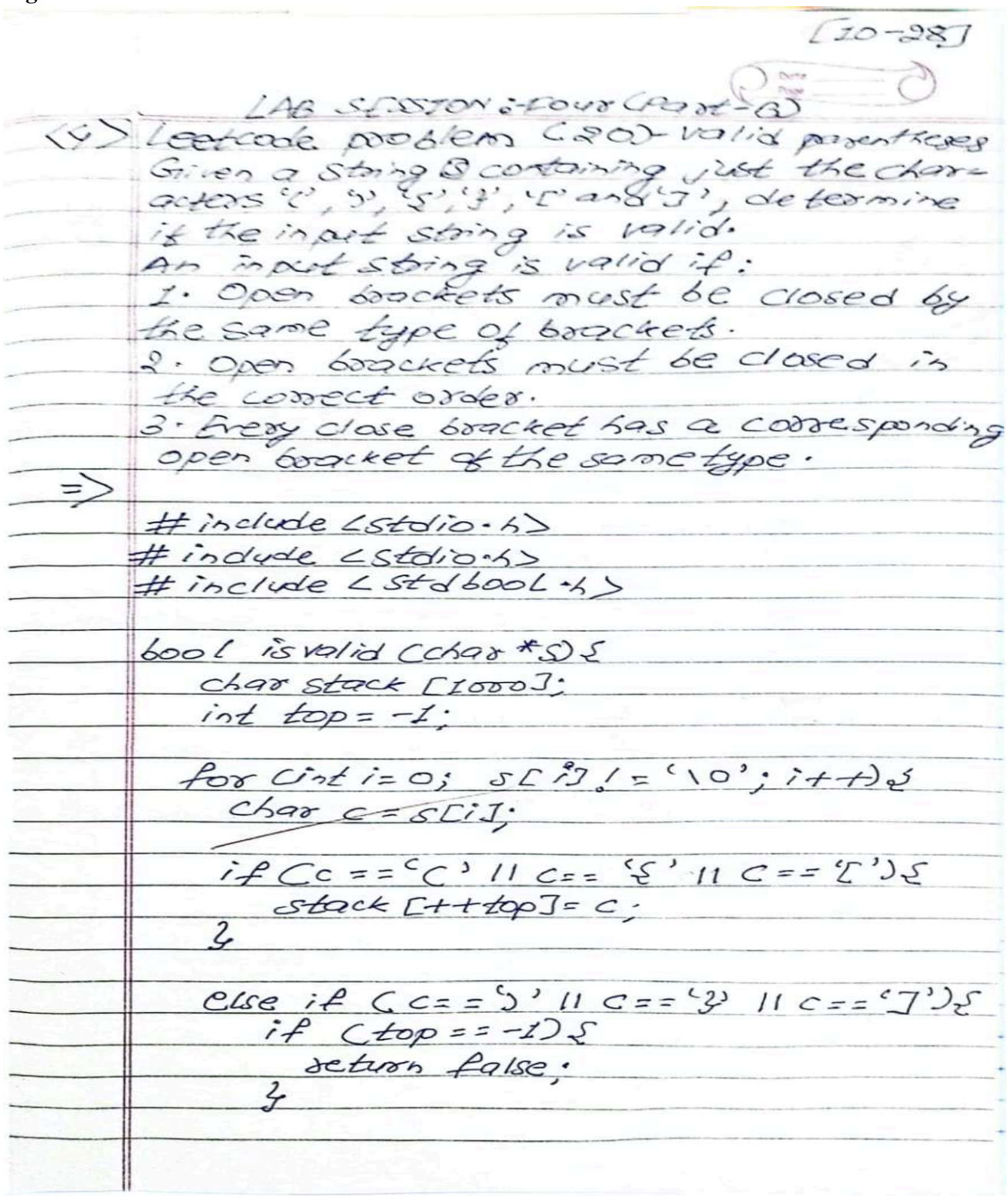
Output:

```
Menu:
1. Insert at first
2. Insert at end
3. Display list
4. Exit
Enter your choice: 1
Enter value to insert at the beginning: 10

Menu:
1. Insert at first
2. Insert at end
3. Display list
4. Exit
Enter your choice: 2
Enter value to insert at the end: 20

Menu:
1. Insert at first
2. Insert at end
3. Display list
4. Exit
Enter your choice: 3
Contents of the linked list: 10 -> 20 -> NULL
```

```
Menu:
1. Insert at first
2. Insert at end
3. Display list
4. Exit
Enter your choice: 1
Enter value to insert at the beginning: 5

Menu:
1. Insert at first
2. Insert at end
3. Display list
4. Exit
Enter your choice: 2
Enter value to insert at the end: 25

Menu:
1. Insert at first
2. Insert at end
3. Display list
4. Exit
Enter your choice: 3
Contents of the linked list: 5 -> 10 -> 20 -> 25 -> NULL

Menu:
1. Insert at first
2. Insert at end
3. Display list
4. Exit
Enter your choice: 4
Exiting program...
```

B)Program - Leetcode platform (Valid Parenthesis).

Algorithm:



[10-28]

LAB SESSION-FOUR (Part-B)

(i) Leetcode problem (20) Valid parentheses
Given a string S containing just the characters '(', ')', '{', '}', '[' and ']', determine if the input string is valid.
An input string is valid if:
1. Open brackets must be closed by the same type of brackets.
2. Open brackets must be closed in the correct order.
3. Every close bracket has a corresponding open bracket of the same type.

=>

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

bool isValid(char *s){
    char stack[1000];
    int top = -1;

    for(int i=0; s[i]!='\0'; i++){
        char c=s[i];

        if(c=='(' || c=='{' || c=='['){
            stack[++top]=c;
        }

        else if(c==')' || c=='}' || c==']'){
            if(top==-1){
                return false;
            }
```

```
        char lastopened=stack[top--];

        if ((c==')' && lastopened!='(') ||
            (c=='}' && lastopened!='{') ||
            (c==']' && lastopened!='[')) {
            return false;
        }
    }
}
return top==-1;
}

int main(){
    char s[1000];

    printf("Enter a string of parentheses:");
    scanf("%s", s);

    if (isValid(s)) {
        printf("The string is valid.\n");
    } else {
        printf("The string is invalid.\n");
    }
    return 0;
}
```

Output :-

Enter a string of parentheses:
("Welcome to BMSCE").
The string is invalid.

Enter a string of parentheses:
("Samir")
The string is valid.

Code:

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

bool isValid(char *s) {
    char stack[1000];
    int top = -1;
    for (int i = 0; s[i] != '\0'; i++) {
        char c = s[i];
        if (c == '(' || c == '{' || c == '[') {
            stack[++top] = c;
        } else if (c == ')' || c == '}' || c == ']') {
            if (top == -1) {
                return false;
            }
            char lastOpened = stack[top--];

            if ((c == ')' && lastOpened != '(') ||
                (c == '}' && lastOpened != '{') ||
                (c == ']' && lastOpened != '[')) {
                return false;
            }
        }
    }

    return top == -1;
}
int main() {
    char s[1000];
   printf("Enter a string of parentheses: ");
    scanf("%s", s);

    if (isValid(s)) {
        printf("The string is valid.\n");
    } else {
        printf("The string is invalid.\n");
    }

    return 0;
}
```

Output:

```
Enter a string of parentheses: ("Welcome to BMSCE")
The string is invalid.
```

Program 5:

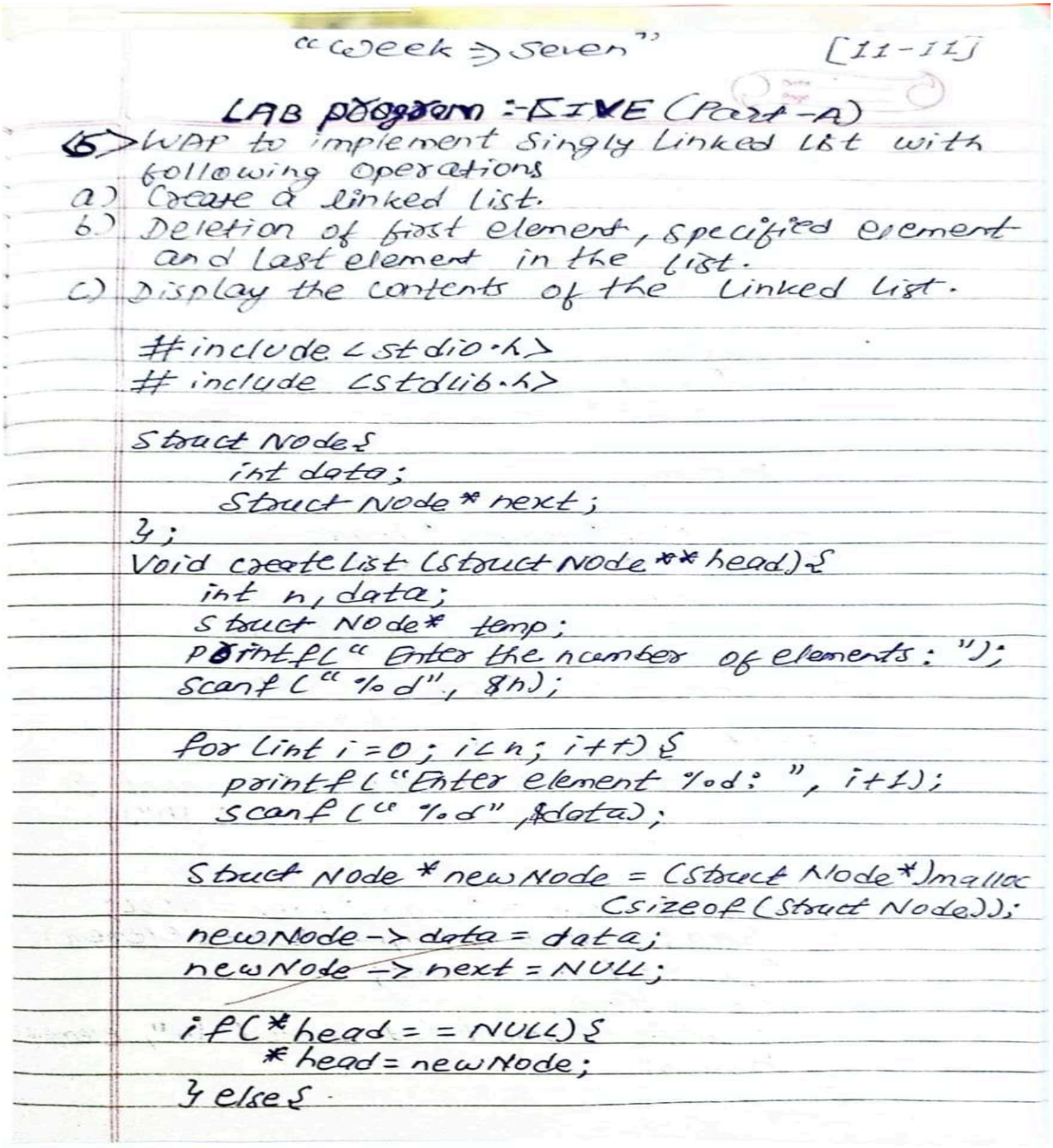
A)WAP to Implement Singly Linked List with following operations:

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.

Algorithm:



"Week ⇒ Seven" [11-11]

LAB program :- FIVE (Part-A)

6> 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.

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

Struct Node{
    int data;
    Struct Node * next;
};
Void createList (Struct Node ** head){
    int n, data;
    Struct Node* temp;
    printf(" Enter the number of elements: ");
    scanf("%d", &n);

    for (int i=0; i<n; i++){
        printf("Enter element %d: ", i+1);
        scanf("%d", &data);

    Struct Node * newNode = (Struct Node*)malloc
                            (sizeof(Struct Node));
    newNode -> data = data;
    newNode -> next = NULL;

    if(*head == NULL){
        *head = newNode;
    } else{
```

```
        temp = *head;
        while (temp->next != NULL){
            temp = temp->next;
        }
        temp->next = newNode;
    }
}
void deleteFirst (struct Node **head) {
    if(*head == NULL){
        printf("List is empty. No element to
                                delete.\n");
        return;
    }
    struct Node *temp = *head;
    *head = (*head)->next;
    free (temp);
    printf("First element deleted.\n");
}
void deleteSpecified(struct Node **head, int
                                element){
    if(*head == NULL){
        printf("List is empty. No element to
                                delete.\n");
        return;
    }
    struct Node *temp = *head, *prev = NULL;
    if (temp != NULL && temp->data == element){
        *head = temp->next;
        free (temp);
        printf("Element %d deleted.\n", element
        return;
}
```

```
while (temp != NULL && temp -> data != element){
    prev = temp;
    temp = temp -> Next;
}
if (temp == NULL){
    printf("Element %d not found. \n", element);
    return;
}
prev -> next = temp -> next;
free (temp);
printf("Element %d deleted. \n", element);
}
void deletelast (struct Node ** head){
  if (* head == NULL){
      printf("List is empty. No element to
                          delete. \n");
      return;
  }
  Struct Node * temp = * head, * prev = NULL;
  if (temp -> next == NULL){
      free (temp);
      * head = NULL;
      printf("Last element deleted - \n");
      return;
  }
  while (temp -> next != NULL){
      prev = temp;
      temp = temp -> next;
  }
  prev -> next = NULL;
  free (temp);
  printf(" last element deleted. \n");
}
```

```
Void display(struct Node * head) {
    if (head == NULL) {
        printf("List is empty.\n");
        return;
    }
    Struct Node * temp = head;
    printf("Linked list contents: ");
    while (temp != NULL) {
        printf("%d -> ", temp -> data);
        temp = temp -> next;
    }
    printf("NULL\n");
}
int main() {
    Struct Node * head = NULL;
    int choice, element;
    while (1) {
        printf("\n Menu:\n");
        printf("1. Create Linked list\n");
        printf("2. Delete First Element\n");
        printf("3. Delete Specified Element\n");
        printf("4. Delete Last Element\n");
        printf("5. Display Linked List\n");
        printf("6. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", & choice);

        Switch (choice) {
            case 1:
                createList(&head);
                break;
```

```
        case 2:
            deleteFirst(&head);
            break;
        case 3:
            printf("Enter the element to delete:
                                        ");
            scanf("%d", &element);
            deleteSpecified(&head, element);
            break;
        case 4:
            deleteLast(&head);
            break;
        case 5:
            display(head);
            break;
        case 6:
            printf("Exiting the program.\n");
            exit(0);
        default:
            printf("Invalid choice. Please try
                                    again.\n");
    }
}
return 0;
}
```

Output :-

```
Menu:
1. Create Linked List
2. Delete First Element
3. Delete Specified Element
4. Delete Last Element
5. Display Linked List
6. Exit
Enter your choice : 1
Enter the number of elements : 5
Enter element 1 : 10
Enter element 2 : 20
Enter element 3 : 30
Enter element 4 : 40
Enter element 5 : 50

Enter your choice : 2
First element deleted

Enter your choice : 5
Linked list elements : 20 -> 30 -> 40 -> 50
                       -> NULL

Enter your choice : 3
Enter the element to delete : 30
Element 30 deleted

Enter your choice : 5
Linked list contents : 20 -> 40 -> 50 -> NULL

Enter your choice : 4
Last element deleted.
```

Enter your choice: 5
Linked List contents: 20 → 40 → NULL

Enter your choice: 6
Exiting the program.

Code:

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

// Definition of a node in the linked list
struct Node {
   int data;
   struct Node* next;
};

// Function to create a linked list
void createList(struct Node** head) {
   int n, data;
   struct Node* temp;

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

   for (int i = 0; i < n; i++) {
      printf("Enter element %d: ", i + 1);
      scanf("%d", &data);

      struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
      newNode->data = data;
      newNode->next = NULL;

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

// Function to delete the first element
void deleteFirst(struct Node** head) {
   if (*head == NULL) {
      printf("List is empty. No element to delete.\n");
      return;
   }
   struct Node* temp = *head;
   *head = (*head)->next;
   free(temp);
```

```
    printf("First element deleted.\n");
}

// Function to delete a specified element
void deleteSpecified(struct Node** head, int element) {
    if (*head == NULL) {
        printf("List is empty. No element to delete.\n");
        return;
    }

    struct Node *temp = *head, *prev = NULL;
    if (temp != NULL && temp->data == element) {
        *head = temp->next;
        free(temp);
        printf("Element %d deleted.\n", element);
        return;
    }

    while (temp != NULL && temp->data != element) {
        prev = temp;
        temp = temp->next;
    }

    if (temp == NULL) {
        printf("Element %d not found.\n", element);
        return;
    }

    prev->next = temp->next;
    free(temp);
    printf("Element %d deleted.\n", element);
}

// Function to delete the last element
void deleteLast(struct Node** head) {
    if (*head == NULL) {
        printf("List is empty. No element to delete.\n");
        return;
    }

    struct Node *temp = *head, *prev = NULL;
    if (temp->next == NULL) {
        free(temp);
        *head = NULL;
        printf("Last element deleted.\n");
        return;
    }
```

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

    prev->next = NULL;
    free(temp);
    printf("Last element deleted.\n");
}

// Function to display the list
void display(struct Node* head) {
    if (head == NULL) {
        printf("List is empty.\n");
        return;
    }

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

// Main function
int main() {
    struct Node* head = NULL;
    int choice, element;

    while (1) {
        printf("\nMenu:\n");
        printf("1. Create Linked List\n");
        printf("2. Delete First Element\n");
        printf("3. Delete Specified Element\n");
        printf("4. Delete Last Element\n");
        printf("5. Display Linked List\n");
        printf("6. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                createList(&head);
                break;
```

```
            case 2:
                deleteFirst(&head);
                break;
            case 3:
                printf("Enter the element to delete: ");
                scanf("%d", &element);
                deleteSpecified(&head, element);
                break;
            case 4:
                deleteLast(&head);
                break;
            case 5:
                display(head);
                break;
            case 6:
                printf("Exiting the program.\n");
                exit(0);
            default:
                printf("Invalid choice. Please try again.\n");
        }
    }

    return 0;
}
```

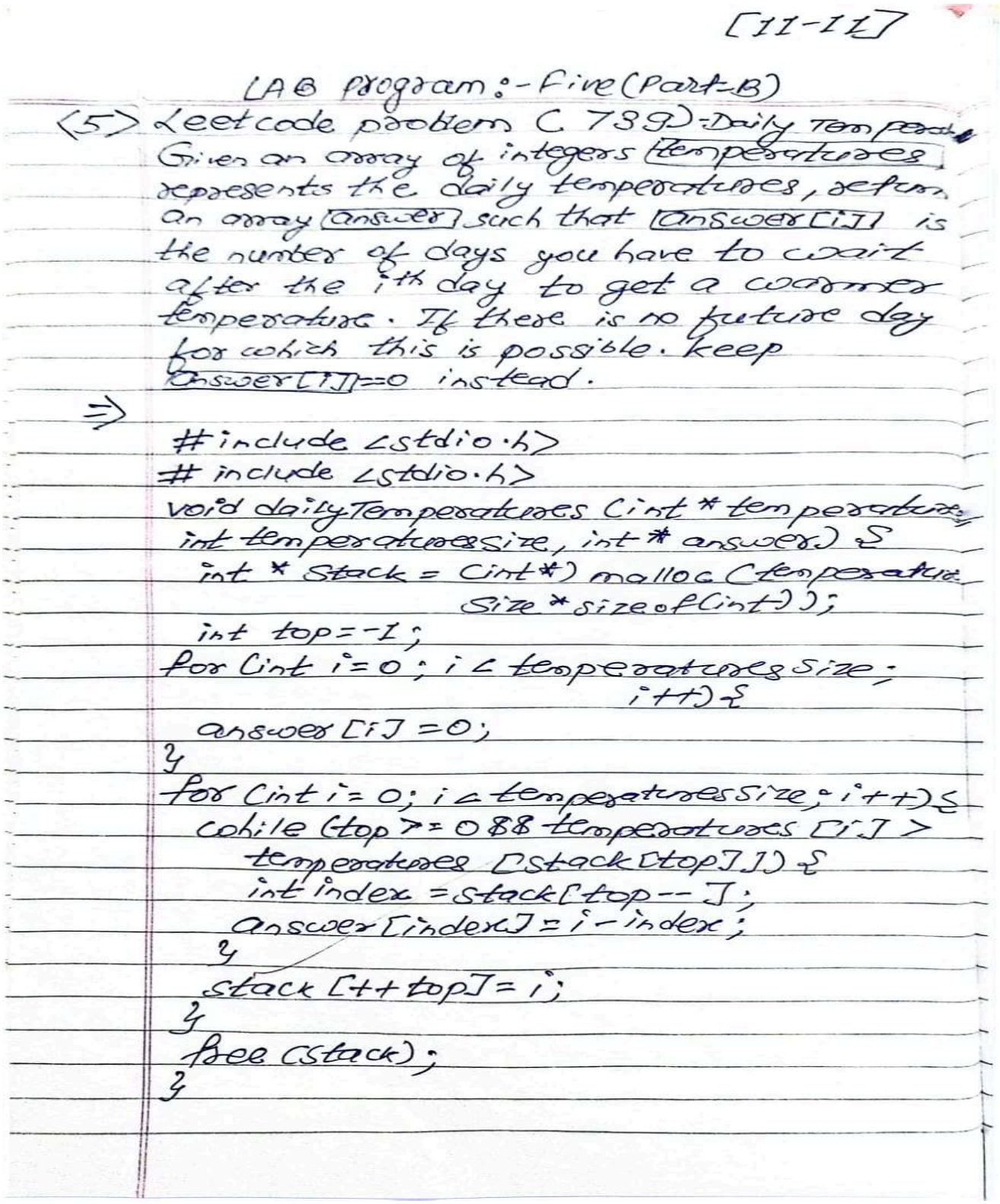
Output:

```
Menu:
1. Create Linked List
2. Delete First Element
3. Delete Specified Element
4. Delete Last Element
5. Display Linked List
6. Exit
Enter your choice: 1
Enter the number of elements: 5
Enter element 1: 10
Enter element 2: 20
Enter element 3: 30
Enter element 4: 40
Enter element 5: 50

Menu:
1. Create Linked List
2. Delete First Element
3. Delete Specified Element
4. Delete Last Element
5. Display Linked List
6. Exit
Enter your choice: 2
First element deleted.

Menu:
1. Create Linked List
2. Delete First Element
3. Delete Specified Element
4. Delete Last Element
5. Display Linked List
6. Exit
Enter your choice: 5
Linked List contents: 20 -> 30 -> 40 -> 50 -> NULL
```

```
Menu:
1. Create Linked List
2. Delete First Element
3. Delete Specified Element
4. Delete Last Element
5. Display Linked List
6. Exit
Enter your choice: 3
Enter the element to delete: 30
Element 30 deleted.

Menu:
1. Create Linked List
2. Delete First Element
3. Delete Specified Element
4. Delete Last Element
5. Display Linked List
6. Exit
Enter your choice: 5
Linked List contents: 20 -> 40 -> 50 -> NULL

Menu:
1. Create Linked List
2. Delete First Element
3. Delete Specified Element
4. Delete Last Element
5. Display Linked List
6. Exit
Enter your choice: 4
Last element deleted.

Menu:
1. Create Linked List
2. Delete First Element
3. Delete Specified Element
4. Delete Last Element
5. Display Linked List
6. Exit
Enter your choice: 5
Linked List contents: 20 -> 40 -> NULL
```

B)Program - Leetcode platform (Daily Temperature).

Algorithm:



[II-II]

LAB program:- Five (Part-B)

(5) Leetcode problem (739) :- Daily Temperatures

Given an array of integers temperatures represents the daily temperatures, return an array answer such that answer[i] is the number of days you have to wait after the i^{th} day to get a warmer temperature. If there is no future day for which this is possible, keep answer[i]==0 instead.

⇒

```
#include <stdio.h>
#include <stdio.h>
void dailyTemperatures (int * temperatures,
 int temperaturesSize, int * answer) {
  int * stack = (int*) malloc (temperaturesSize * sizeof(int));
  int top=-1;
for (int i=0; i < temperaturesSize;
                                  i++) {
  answer [i] =0;
}
for (int i= 0; i < temperaturesSize; i++) {
  while (top >= 0 && temperatures [i] >
     temperatures [stack[top]]) {
     int index = stack[top--];
     answer[index] = i - index;
  }
  stack [++top] = i;
}
 free (stack);
}
```

```
int main(){
  int n;
  printf("Enter the number of days: ");
  scanf("%d", &n);
  int * temperatures = (int *) malloc
                    (n * sizeof(int));
  int * answer = (int *) malloc (n * sizeof
                    (int));
  printf("Enter the temperatures for
              each day: \n");
  for(int i = 0; i<n; i++){
     printf("Day %d: ", i+1);
     scanf("%d", &temperatures[i]);
  }
  dailyTemperatures(temperatures, n, answer);
  printf("Number of days to wait for a
          warmer temperature: \n");
  for(int i=0; i<n; i++){
     printf("%d ", answer[i]);
  }
  printf("\n");

  free(temperatures);
  free(answer);

  return 0;
}
```

Output:-

```
Enter the number of days: 6
Enter the temperatures for each day:
Day 1: 20
Day 2: 21
Day 3: 22
Day 4: 23
Day 5: 24
Day 6: 25
Number of days to wait for a warmer temperature:
1 1 1 1 1 0
```

Code:

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

void dailyTemperatures(int* temperatures, int temperaturesSize, int* answer) {
    int* stack = (int*)malloc(temperaturesSize * sizeof(int));
    int top = -1;

    for (int i = 0; i < temperaturesSize; i++) {
        answer[i] = 0;
    }

    for (int i = 0; i < temperaturesSize; i++) {
        while (top >= 0 && temperatures[i] > temperatures[stack[top]]) {
            int index = stack[top--];
            answer[index] = i - index;
        }
        stack[++top] = i;
    }

    free(stack);
}
int main() {
    int n;

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

    int* temperatures = (int*)malloc(n * sizeof(int));
    int* answer = (int*)malloc(n * sizeof(int));

    printf("Enter the temperatures for %d days: \n", n);
    for (int i = 0; i < n; i++) {
        scanf("%d", &temperatures[i]);
    }
    dailyTemperatures(temperatures, n, answer);
    printf("Answer (Number of days to wait for warmer temperature): \n");
    for (int i = 0; i < n; i++) {
        printf("%d ", answer[i]);
    }
    printf("\n");

    free(temperatures);
    free(answer);

    return 0;
}
```

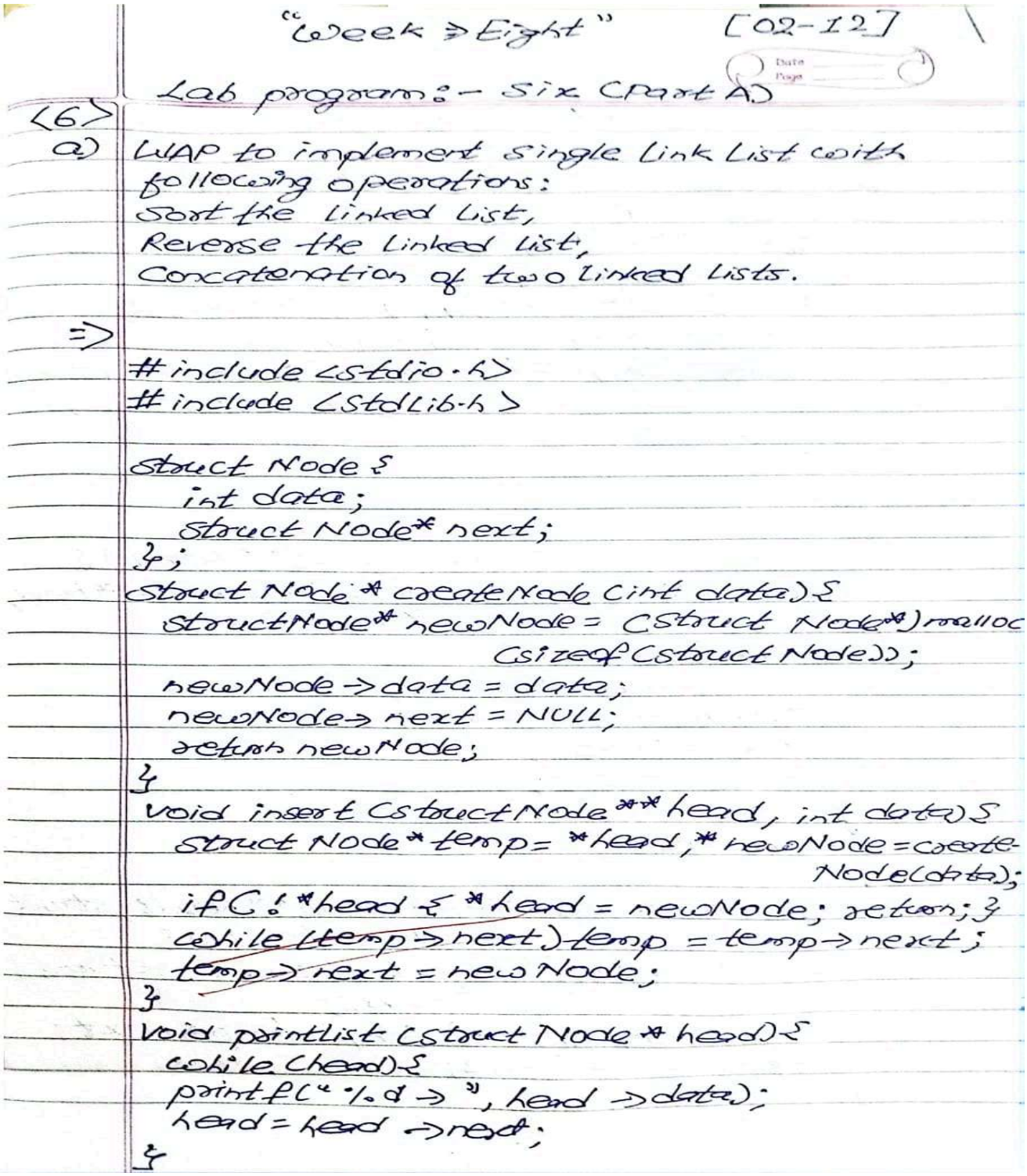
Output:

```
Enter the number of days: 6
Enter the temperatures for 6 days:
20
21
22
23
24
25
Answer (Number of days to wait for warmer temperature):
1 1 1 1 1 0
```

Program:6

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

Algorithm:



"Week ⇒ Eight" [02-12]

Lab program:- six (part A)

(6)

a) WAP to implement single link List with following operations:
Sort the linked list,
Reverse the linked list,
Concatenation of two linked lists.

⇒

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

struct Node {
    int data;
    struct Node* next;
};
struct Node * createNode (int data) {
    structNode* newNode = (struct Node*) malloc
                          (sizeof(struct Node));
    newNode -> data = data;
    newNode -> next = NULL;
    return newNode;
}
void insert (struct Node **head, int data) {
    struct Node * temp = *head, * newNode = create-
                                            Node(data);
    if(!*head) { *head = newNode; return; }
    while (temp -> next) temp = temp -> next;
    temp -> next = newNode;
}
void printlist (struct Node * head) {
    while (head) {
    printf("%d -> ", head -> data);
    head = head -> next;
}
```

```
    printf("NULL\n");
}
void sortList(struct Node* head){
    if(!head) return;
    struct Node *i, *j;
    for(i=head; i; i=i->next){
        for(j=i->next; j; j=j->next){
            if(i->data > j->data){
                int temp = i->data; i->data = j->data;
                                    j->data = temp;
            }
        }
    }
}
void reverseList(struct Node** head){
    struct Node *prev = NULL, *current = *head,
                              *next = NULL;
    while(current){
        next = current->next;
        current->next = prev;
        prev = current;
        current = next;
    }
    *head = prev;
}
void concatenate(struct Node** head1, struct
                                  Node* head2){
    if(!*head1){*head1 = head2; return;}
    struct Node* temp = *head1;
    while(temp->next) temp = temp->next;
    temp->next = head2;
}
```

```
int main()
{
struct Node *list1 = NULL, *list2 = NULL;
int n, m, data;

printf("Enter number of elements in list1:");
scanf("%d", &n);
printf("Enter elements for list 1:");
while(n--) {scanf("%d", &data); insert
                    (&list1, data); }

printf("Enter number of elements in list2:");
scanf("%d", &m);
printf("Enter elements for list 2:");
while(m--) {scanf("%d", &data);
                    insert(&list2, data);}

printf("\nOriginal list1:");
printList(list1);
printf("Original list 2:");
printlist(list2);

sortlist(list1);
printf("Sorted list1:"); printlist(list1);

reverselist(&list1);
printf("Reversed list 1:"); printlist(list1);

concatenate(&list1, list2);
printf("Concatenated list:"); printlist(list1);

return 0;
}
```

Output:-

```
Enter number of elements in List1: 4
Enter elements for list1: 10 30 20 5
Enter number of elements in List2: 2
Enter elements for list2: 50 40

Original List1 : 10 -> 30 -> 20 -> 5 -> NULL
Original List2 : 50 -> 40 -> NULL
sorted List1 : 5 -> 10 -> 20 -> 30 -> NULL
Reversed List1 : 30 -> 20 -> 10 -> 5 -> NULL
Concatenated list : 30 -> 20 -> 10 -> 5 -> 50 ->
                    40 -> NULL
```

Code:

```
#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 insert(struct Node** head, int data) {
   struct Node* temp = *head, *newNode = createNode(data);
   if (!*head) { *head = newNode; return; }
   while (temp->next) temp = temp->next;
   temp->next = newNode;
}

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

void sortList(struct Node* head) {
   if (!head) return;
   struct Node *i, *j;
   for (i = head; i; i = i->next) {
      for (j = i->next; j; j = j->next) {
         if (i->data > j->data) {
            int temp = i->data; i->data = j->data; j->data = temp;
         }
      }
   }
}

void reverseList(struct Node** head) {
   struct Node *prev = NULL, *current = *head, *next = NULL;
```

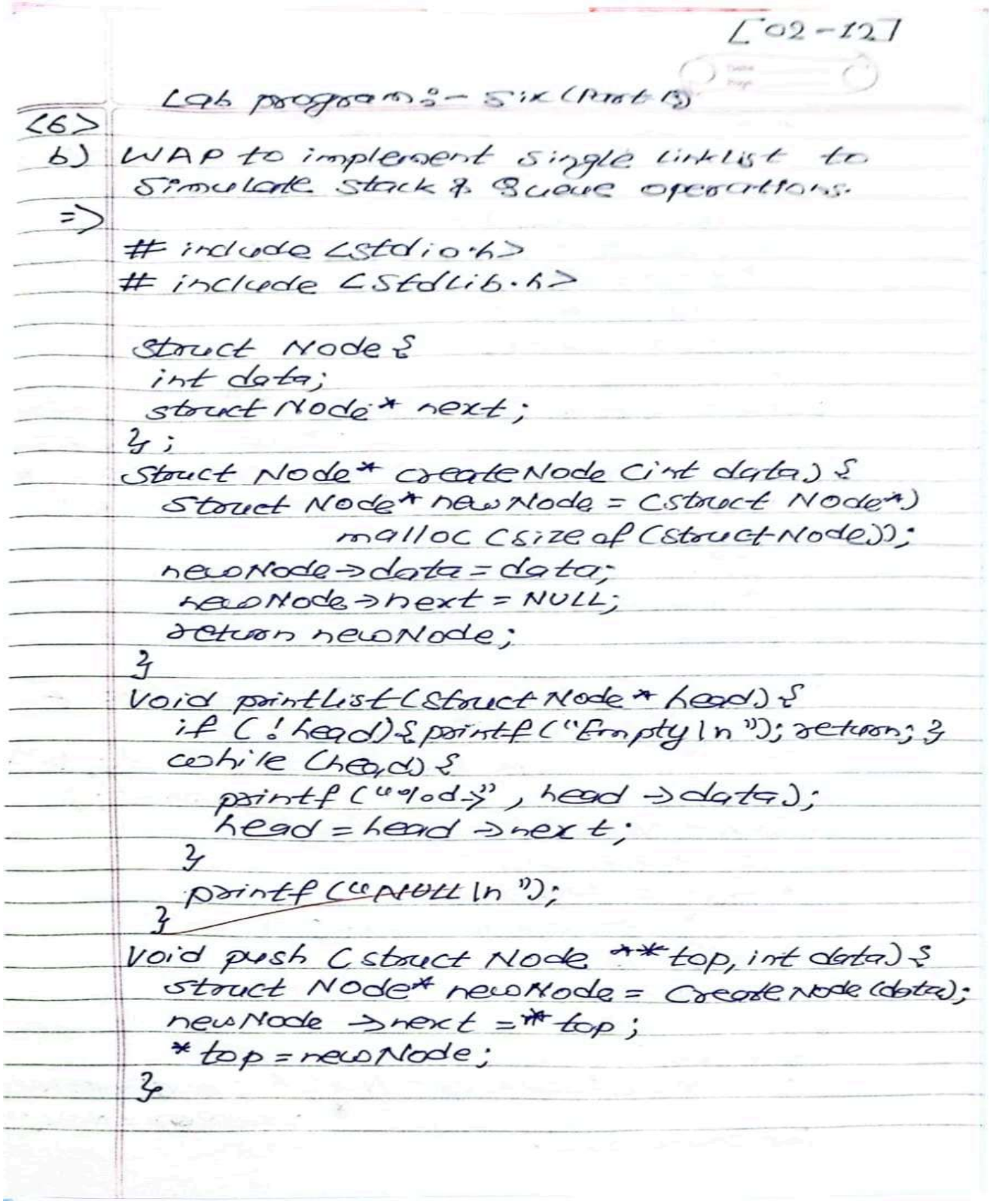
```
    while (current) {
        next = current->next;
        current->next = prev;
        prev = current;
        current = next;
    }
    *head = prev;
}

void concatenate(struct Node** head1, struct Node* head2) {
    if (!*head1) { *head1 = head2; return; }
    struct Node* temp = *head1;
    while (temp->next) temp = temp->next;
    temp->next = head2;
}

int main() {
    struct Node *list1 = NULL, *list2 = NULL;
    int n, m, data;

    printf("Enter number of elements in List 1: ");
    scanf("%d", &n);
    printf("Enter elements for List 1: ");
    while (n--) { scanf("%d", &data); insert(&list1, data); }

    printf("Enter number of elements in List 2: ");
    scanf("%d", &m);
    printf("Enter elements for List 2: ");
    while (m--) { scanf("%d", &data); insert(&list2, data); }

    printf("\nOriginal List 1: "); printList(list1);
    printf("Original List 2: "); printList(list2);

    sortList(list1);
    printf("Sorted List 1: "); printList(list1);

    reverseList(&list1);
    printf("Reversed List 1: "); printList(list1);

    concatenate(&list1, list2);
    printf("Concatenated List: "); printList(list1);

    return 0;
}
```

Output:

```
Enter number of elements in List 1: 4
Enter elements for List 1: 10 30 20 5
Enter number of elements in List 2: 2
Enter elements for List 2: 50 40

Original List 1: 10 -> 30 -> 20 -> 5 -> NULL
Original List 2: 50 -> 40 -> NULL
Sorted List 1: 5 -> 10 -> 20 -> 30 -> NULL
Reversed List 1: 30 -> 20 -> 10 -> 5 -> NULL
Concatenated List: 30 -> 20 -> 10 -> 5 -> 50 -> 40 -> NULL
```

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

Algorithm:



```
[02-12]

Lab program 5 - Six (Part B)

(6)
b) WAP to implement single linklist to
simulate stack & queue operations.
=>

#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 printList(struct Node* head) {
  if(!head){printf("Empty\n"); return;}
  while(head) {
     printf("%d->", head->data);
     head = head->next;
  }
  printf("NULL\n");
}
Void push(struct Node **top, int data) {
  struct Node* newNode = createNode(data);
  newNode->next = *top;
  *top = newNode;
}
```

```
int pop (struct Node** top){
  if (!*top) {printf("Stack empty!\n");
                    return -1;}
  struct Node *temp = *top;
  int data = temp->data;
  *top = temp->next;
  free(temp);
  return data;
}
void enqueue (struct Node** front, struct
                Node** rear, int data){
  struct Node * newNode = createNode(data);
  if(!*rear) *front = *rear = newNode;
  else{
    (*rear)->next = newNode;
    *rear = newNode;
  }
}
int dequeue (struct Node** front, struct
              Node** rear){
  if(!*front) {printf("Queue empty!\n");
                    return -1;}
  struct Node *temp = *front;
  int data = temp->data;
  *front = temp->next;
  if(!*front) *rear = NULL;
  free(temp);
  return data;
}
int main(){
  struct Node *stackTop = NULL, *queueFront = NU
                          *queueRear = NULL;
  int choice, data;
```

```
while(1){
  printf("\n1. Push to stack\n2. Pop from
stack\n3. Enqueue to queue\n4. Dequeue
from queue\n5. Print stack\n6. Print queue\n
7. Exit\n Enter choice: ");
scanf("%d", &choice);

Switch (choice){
 case 1:
    printf("Enter data to push: ");
    scanf("%d", &data);
    push (&stackTop, data);
    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);
    break;
case 4:
    data = dequeue(&queueFront, &queue
                                Rear);
    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:
    exit(0);
default:
    printf("Invalid choice! \n");
  }
}
return 0;
}
```

Output :-

```
1. push to stack
2. pop from stack
3. Enqueue to Queue
4. Dequeue from Queue
5. Print Stack
6. print Queue
7. Exit
Enter choice : 1
Enter data to push : 10

1. push to stack
2. pop from stack
3. Enqueue to Queue
4. Dequeue from Queue
5. print stack
6. print Queue
7. Exit
```

Enter choice: 3
Enter data to enqueue: 20

1. push to stack
2. pop from stack
3. Enqueue to Queue
4. Dequeue from Queue
5. Print stack
6. Print Queue
7. Exit
Enter choice: 5
Stack: 10 -> NULL

Enter choice: 6
Queue: 20 -> NULL

Enter choice: 4
Dequeued from Queue: 20

Seen
02/12/24
Enter choice: 5
Stack: 10 -> NULL
~~Queue: Empty~~
Enter choice: 6
Queue: Empty

Code:

```
#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 printList(struct Node* head) {
   if (!head) { printf("Empty\n"); return; }
   while (head) {
      printf("%d -> ", head->data);
      head = head->next;
   }
   printf("NULL\n");
}
void push(struct Node** top, int data) {
   struct Node* newNode = createNode(data);
   newNode->next = *top;
   *top = newNode;
}
int pop(struct Node** top) {
   if (!*top) { printf("Stack empty!\n"); return -1; }
   struct Node* temp = *top;
   int data = temp->data;
   *top = temp->next;
   free(temp);
   return data;
}
void enqueue(struct Node** front, struct Node** rear, int data) {
   struct Node* newNode = createNode(data);
   if (!*rear) *front = *rear = newNode;
   else {
      (*rear)->next = newNode;
      *rear = newNode;
   }
}

int dequeue(struct Node** front, struct Node** rear) {
   if (!*front) { printf("Queue empty!\n"); return -1; }
```

```
    struct Node* temp = *front;
    int data = temp->data;
    *front = temp->next;
    if (!*front) *rear = NULL;
    free(temp);
    return data;
}
int main() {
    struct Node *stackTop = NULL, *queueFront = NULL, *queueRear = NULL;
    int choice, data;
    while (1) {
        printf("\n1. Push to Stack\n2. Pop from Stack\n3. Enqueue to Queue\n4. Dequeue from
Queue\n5. Print Stack\n6. Print Queue\n7. Exit\nEnter choice: ");
        scanf("%d", &choice);
        switch (choice) {
            case 1:
                printf("Enter data to push: ");
                scanf("%d", &data);
                push(&stackTop, data);
                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);
                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:
                exit(0);
            default:
                printf("Invalid choice!\n");
        }
    }
    return 0;
}
```

Output:

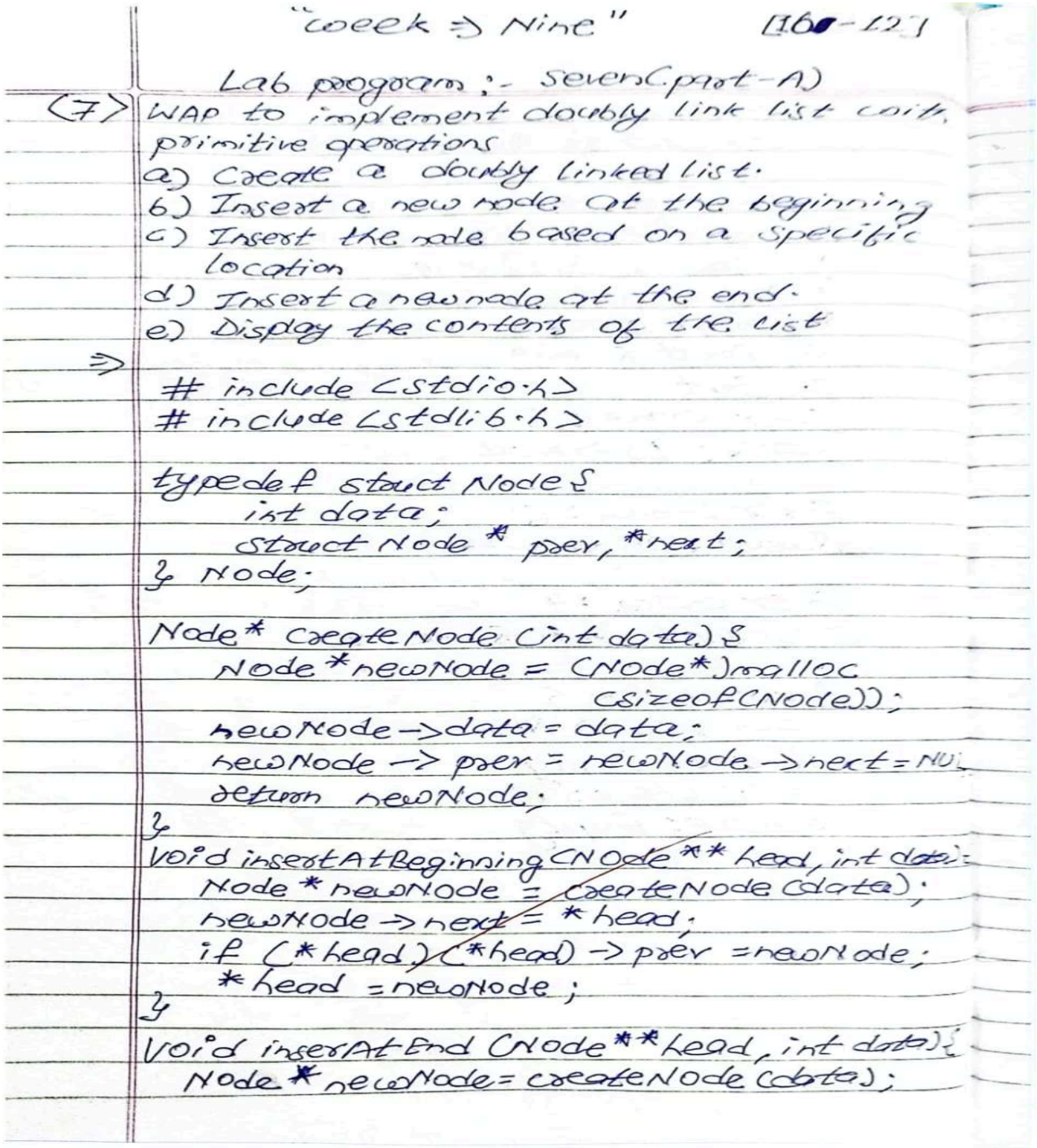
```
1. Push to Stack
2. Pop from Stack
3. Enqueue to Queue
4. Dequeue from Queue
5. Print Stack
6. Print Queue
7. Exit
Enter choice: 1
Enter data to push: 10

1. Push to Stack
2. Pop from Stack
3. Enqueue to Queue
4. Dequeue from Queue
5. Print Stack
6. Print Queue
7. Exit
Enter choice: 3
Enter data to enqueue: 20

1. Push to Stack
2. Pop from Stack
3. Enqueue to Queue
4. Dequeue from Queue
5. Print Stack
6. Print Queue
7. Exit
Enter choice: 5
Stack: 10 -> NULL
```

```
1. Push to Stack
2. Pop from Stack
3. Enqueue to Queue
4. Dequeue from Queue
5. Print Stack
6. Print Queue
7. Exit
Enter choice: 6
Queue: 20 -> NULL

1. Push to Stack
2. Pop from Stack
3. Enqueue to Queue
4. Dequeue from Queue
5. Print Stack
6. Print Queue
7. Exit
Enter choice: 4
Dequeued from Queue: 20

1. Push to Stack
2. Pop from Stack
3. Enqueue to Queue
4. Dequeue from Queue
5. Print Stack
6. Print Queue
7. Exit
Enter choice: 5
Stack: 10 -> NULL

1. Push to Stack
2. Pop from Stack
3. Enqueue to Queue
4. Dequeue from Queue
5. Print Stack
6. Print Queue
7. Exit
Enter choice: 6
Queue: Empty
```

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 .

Algorithm:



"week => Nine" [16B-12]

Lab program :- seven(part-A)

(7) WAP to implement doubly link list with primitive operations

a) Create a doubly linked list.
b) Insert a new node at the beginning
c) Insert the node based on a specific location
d) Insert a new node at the end.
e) Display the contents of the list

=>

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

typedef struct Node {
    int data;
    struct Node * prev, *next;
} Node;

Node* createNode (int data) {
    Node *newNode = (Node*)malloc
                    (sizeof(Node));
    newNode->data = data;
    newNode -> prev = newNode -> next = NU
    return newNode;
}
void insertAtBeginning(Node ** head, int data
    Node *newNode = createNode(data);
    newNode -> next = *head;
    if (*head) (*head) -> prev = newNode;
    *head = newNode;
}
Void insertAtEnd (Node **head, int data){
  Node *newNode = createNode(data);
```

```
    if (*head == NULL) *head = newNode;
    else {
        Node *temp = *head;
        while (temp->next) temp = temp->next;
        temp->next = newNode;
        newNode->prev = temp;
    }
}
void insertAtPosition(Node **head, int data,
                      int pos){
    if (pos == 1) return insertAtBeginning
                         (head, data);
    Node *newNode = createNode(data);
    Node *temp = *head;
    for (int i = 1; temp && i < pos-1; i++)
        temp = temp->next;
    if (temp == NULL) return;
    newNode->next = temp->next;
    if (temp->next) temp->next->prev =
                                newNode;
    temp->next = newNode;
    newNode->prev = temp;

void displayCNode *head) {
    while (head) {
        printf("%d", head->data);
        head = head->next;
    }
    printf("\n");
```

```
int main(){
    Node *head = NULL;
    int choice, data, position;
    while(1){
        printf("\n1. Insert at Beginning
\n2. Insert at End \n3. Insert at position.
\n4. Display \n5. Exit \n");
        printf("Enter choice : ");
        scanf("%d", &choice);

    switch(choice){
    case 1:
        printf("Enter data:");
        scanf("%d", &data);
        insertAtBeginning(&head, data);
        break;
    case 2:
        printf("Enter data: ");
        scanf("%d", &data);
        insertAtEnd(&head, data);
        break;
    case 3:
        printf("Enter data and position: ");
        scanf("%d %d", &data, &position);
        insertAtposition(&head, data, position);
        break;
    case 4:
        display(head);
        break;
    case 5:
        return 0;
    default
        print("Invalid choice\n");
    }
}
```

Output:-

1. Insert at Beginning
2. Insert at End
3. Insert at position
4. Display
5. Exit
Enter choice: 1
Enter data: 10

1. Insert at Beginning
2. Insert at End
3. Insert at position
4. Display
5. Exit
Enter choice: 1
Enter data: 20

1. Insert at Beginning
2. Insert at End
3. Insert at position
4. Display
5. Exit
Enter choice: 1
Enter data: 30

1. Insert at Beginning
2. Insert at End
3. Insert at position

4. Display
5. Exit
Enter choice: 3
Enter data and position: 25 2

.

1. Insert at beginning
2. Insert at End
3. Insert at position
4. Display
5. Exit
Enter choice: 4
30 25 20 10

1. Insert at Beginning
2. Insert at End
3. Insert at position
4. Display
5. Exit
Enter choice: 5
Exit

Seen
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Code:

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

typedef struct Node {
   int data;
   struct Node *prev, *next;
} Node;

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

void insertAtBeginning(Node **head, int data) {
   Node *newNode = createNode(data);
   newNode->next = *head;
   if (*head) (*head)->prev = newNode;
   *head = newNode;
}

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

void insertAtPosition(Node **head, int data, int pos) {
   if (pos == 1) return insertAtBeginning(head, data);
   Node *newNode = createNode(data);
   Node *temp = *head;
   for (int i = 1; temp && i < pos - 1; i++) temp = temp->next;
   if (temp == NULL) return;  // Invalid position
   newNode->next = temp->next;
   if (temp->next) temp->next->prev = newNode;
   temp->next = newNode;
   newNode->prev = temp;
}

void display(Node *head) {
```

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

int main() {
    Node *head = NULL;
    int choice, data, position;

    while (1) {
        printf("\n1. Insert at Beginning\n2. Insert at End\n3. Insert at Position\n4. Display\n5.
Exit\n");
        printf("Enter choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter data: ");
                scanf("%d", &data);
                insertAtBeginning(&head, data);
                break;
            case 2:
                printf("Enter data: ");
                scanf("%d", &data);
                insertAtEnd(&head, data);
                break;
            case 3:
                printf("Enter data and position: ");
                scanf("%d %d", &data, &position);
                insertAtPosition(&head, data, position);
                break;
            case 4:
                display(head);
                break;
            case 5:
                return 0;
            default:
                printf("Invalid choice\n");
        }
    }
}
```

Output:

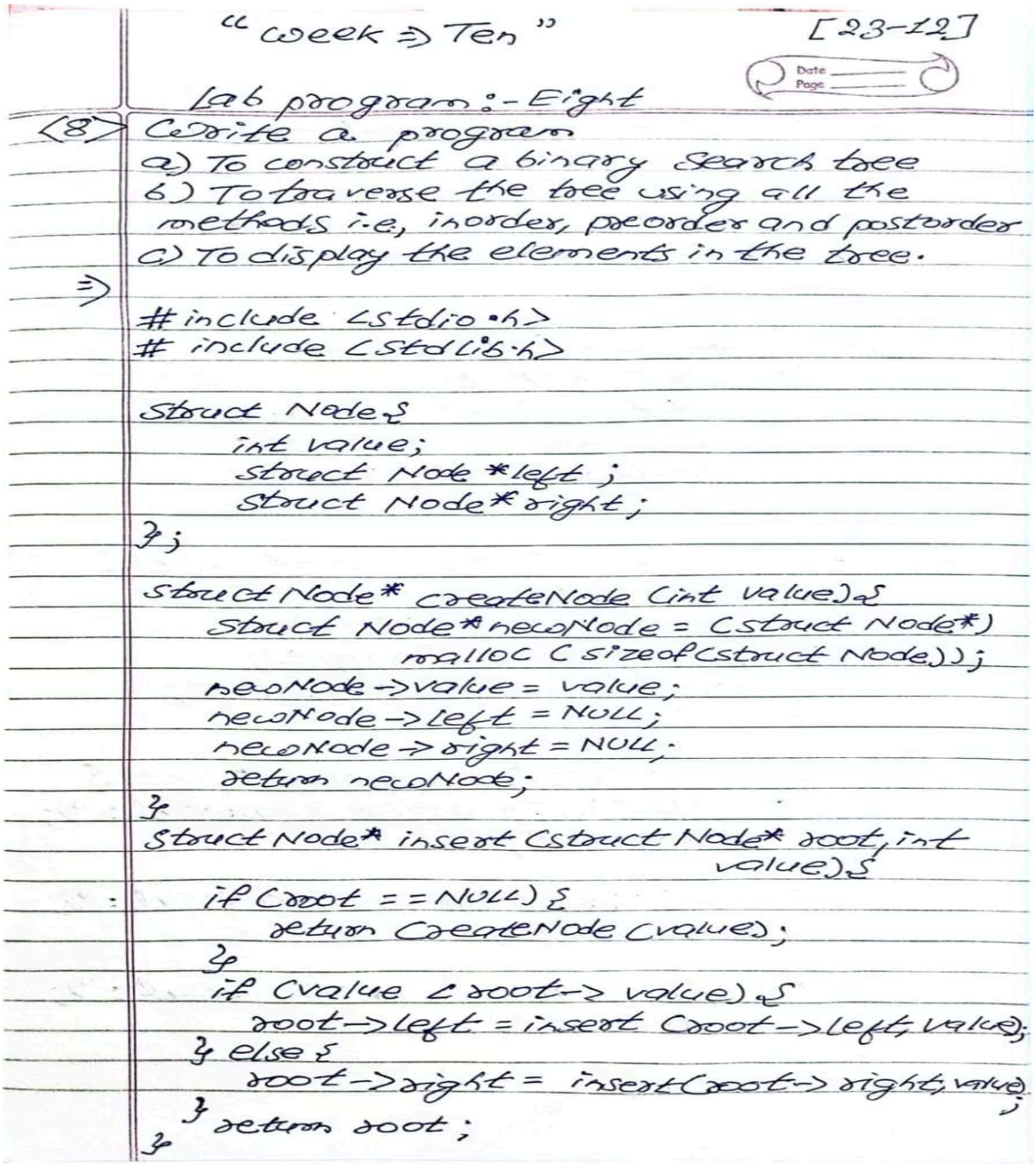
```
1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Display
5. Exit
Enter choice: 1
Enter data: 10

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

1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Display
5. Exit
Enter choice: 1
Enter data: 30
```

```
1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Display
5. Exit
Enter choice: 3
Enter data and position: 25 2

1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Display
5. Exit
Enter choice: 4
30 25 20 10

1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Display
5. Exit
Enter choice: 5
```

Program 8:

Write a program a) To construct a binary Search tree. b) To traverse the tree using all the methods i.e., in order, preorder and post order c) To display the elements in the tree.

Algorithm:



"Week ⇒ Ten" [23-12]

Lab program :- Eight

(8) Write a program
a) To construct a binary search tree
b) To traverse the tree using all the methods i.e, inorder, preorder and postorder
c) To display the elements in the tree.

⇒

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

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

struct Node* createNode(int value){
    struct Node* newNode = (struct Node*)
            malloc(sizeof(struct Node));
    newNode->value = value;
    newNode->left = NULL;
    newNode->right = NULL;
    return newNode;
}
struct Node* insert(struct Node* root, int
                                value){
    if(root == NULL){
        return createNode(value);
    }
    if (value < root->value){
        root->left = insert(root->left, value);
    } else{
        root->right = insert(root->right, value);
    }
    return root;
}
```

```
void inorder(struct Node* root){
    if(root != NULL){
        inorder(root->left);
        printf("%d ", root->value);
        inorder(root->right);
    }
}
void preorder(struct Node* root){
    if(root != NULL){
        printf("%d", root->value);
        preorder(root->left);
        preorder(root->right);
    }
}
void postorder(struct Node* root){
    if(root != NULL){
        postorder(root->left);
        postorder(root->right);
        printf("%d", root->value);
    }
}
void displayTree(struct Node* root){
    printf("\n In-order Traversal: ");
    inorder(root);

    printf("\n Pre-order Traversal: ");
    preorder(root);

    printf("\n post-order Traversal: ");
    postorder(root);
}
int main(){
```

```
struct Node* root = NULL;
int n, value;

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

printf("Enter the elements of the tree:\n");
for(int i=0; i<n; i++){
    scanf("%d", &value);
    root=insert(root, value);
}
displayTree(root);
return 0;
}
```

Output:-

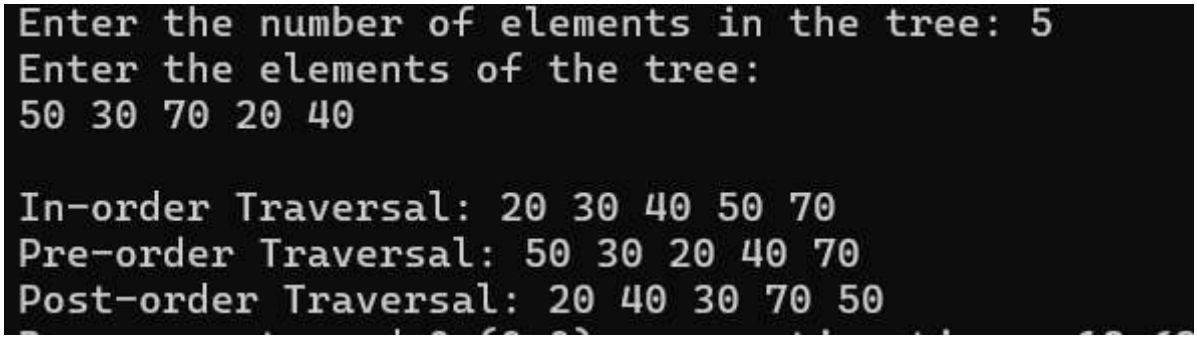
```
Enter the number of elements in the tree: 5
Enter the elements of the tree:
50 30 70 20 40

In-order Traversal: 20 30 40 50 70
pre-order Traversal: 50 30 20 40 70
Post-order Traversal: 20 40 30 70 50
```

Code:

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

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

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

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

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

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

void postorder(struct Node* root) {
```

```
    if (root != NULL) {
        postorder(root->left);
        postorder(root->right);
        printf("%d ", root->value);
    }
}

void displayTree(struct Node* root) {
    printf("\nIn-order Traversal: ");
    inorder(root);

    printf("\nPre-order Traversal: ");
    preorder(root);

    printf("\nPost-order Traversal: ");
    postorder(root);
}

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

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

    printf("Enter the elements of the tree:\n");
    for (int i = 0; i < n; i++) {
        scanf("%d", &value);
        root = insert(root, value);
    }

    displayTree(root);

    return 0;
}
```

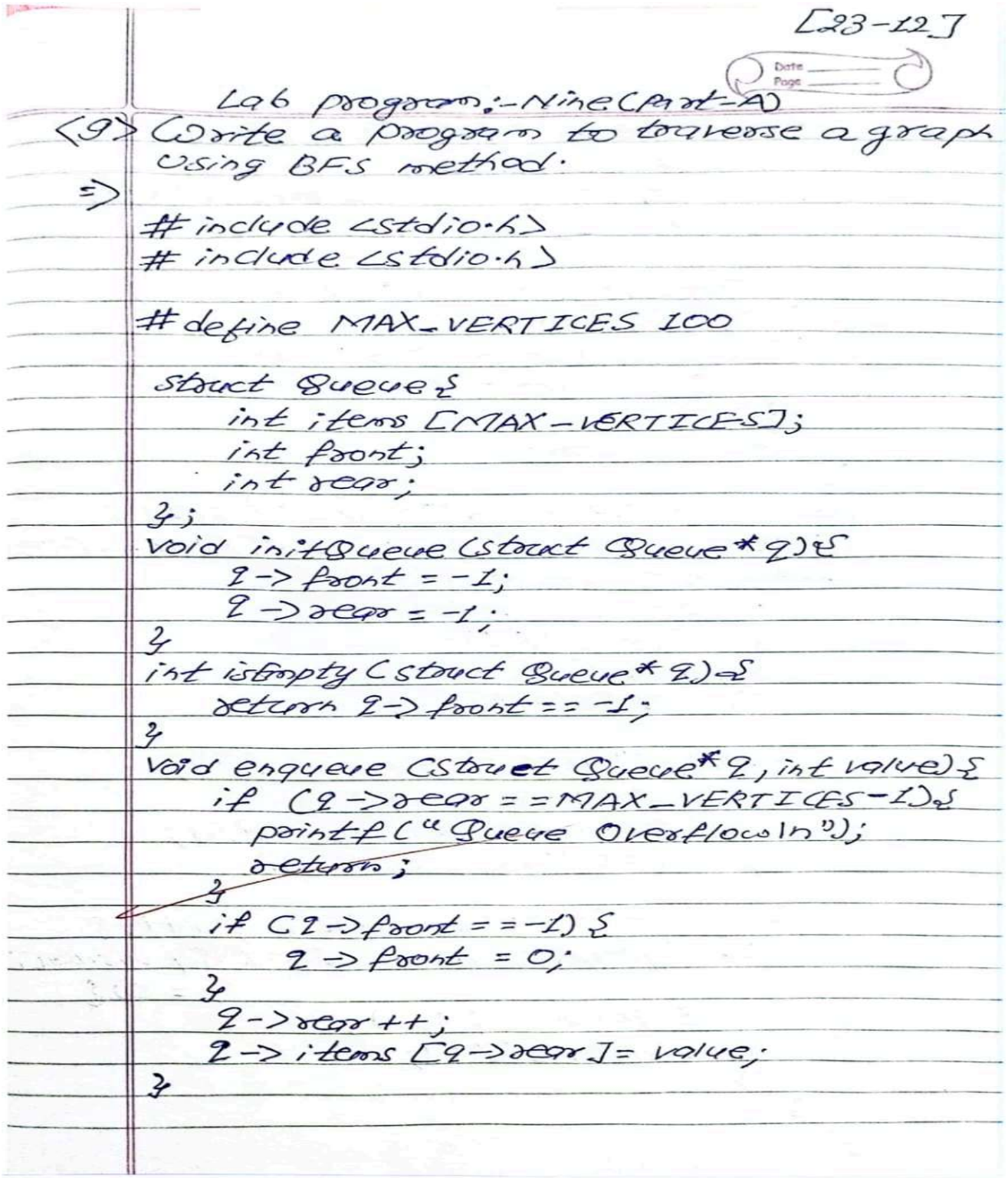
Output:


Enter the number of elements in the tree: 5
Enter the elements of the tree:
50 30 70 20 40
In-order Traversal: 20 30 40 50 70
Pre-order Traversal: 50 30 20 40 70
Post-order Traversal: 20 40 30 70 50

Program 9:

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

Algorithm:



```
[23-12-]

Lab program:- Nine(Part-A)

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

=>

#include <stdio.h>
#include <stdio.h>

#define MAX_VERTICES 100

struct Queue{
    int items [MAX-VERTICES];
    int front;
    int rear;
};
void initQueue (struct Queue* q){
    q -> front = -1;
    q -> rear = -1;
}
int isEmpty (struct Queue* q){
    return q -> front == -1;
}
void enqueue (struct Queue* q, int value){
    if (q -> rear == MAX_VERTICES-1){
        printf("Queue Overflow\n");
        return;
    }
    if (q -> front == -1){
        q -> front = 0;
    }
    q -> rear++;
    q -> items [q -> rear] = value;
}
```

```
int dequeue (struct Queue* q) {
    if (isEmpty (q)) {
        printf ("Queue Underflow\n");
        return -1;
    }
    int item = q->items[q->front];
    q->front++;
    if (q->front > q->rear) {
        q->front = q->rear = -1;
    }
    return item;
}
void BFS (int graph [MAX_VERTICES
[MAX_VERTICES], int visited [MAX_VERTICES
int start, int vertices) {
    struct Queue q;
    initQueue (&q);
    enqueue (&q, start);
    visited [start] = 1;

    printf ("BFS Traversal : ");
    while (!isEmpty (&q)) {
        int current = dequeue (&q);
        printf ("%d ", current);

        for (int i = 0; i < vertices ; i++) {
            if (graph [current][i] == 1 && visited[i]
                                        == 0) {
                enqueue (&q, i);
                visited [i] = 1;
            }
        }
    }
```

```
    printf("\n");
}
int main(){
    int vertices, edges, src, dest;

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

    int graph[MAX_VERTICES][MAX_VERTICES]
                                    = {0};
    int visited[MAX_VERTICES] = {0};

    printf("Enter the edges (source destination)
                                    :\n");
    for(int i=0; i<edges; i++){
        scanf("%d %d", &src, &dest);
        graph[src][dest] = 1;
        graph[dest][src] = 1;
    }
    int start;
    printf("Enter the starting vertex for
                                    BFS: ");
    scanf("%d", &start);

    BFS(graph, visited, start, vertices);

    return 0;
}
```

Output :-

```
Enter the number of vertices : 5
Enter the number of edges : 6
Enter the edges (source destination) :
0 1
0 2
1 3
1 4
2 4
3 4
Enter the starting vertex for BFS : 0
BFS Traversal : 0 1 2 3 4
```

Code:

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

#define MAX_VERTICES 100

struct Queue {
   int items[MAX_VERTICES];
   int front;
   int rear;
};

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

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

void enqueue(struct Queue* q, int value) {
   if (q->rear == MAX_VERTICES - 1) {
      printf("Queue Overflow\n");
      return;
   }
   if (q->front == -1) {
      q->front = 0;
   }
   q->rear++;
   q->items[q->rear] = value;
}

int dequeue(struct Queue* q) {
   if (isEmpty(q)) {
      printf("Queue Underflow\n");
      return -1;
   }
   int item = q->items[q->front];
   q->front++;
   if (q->front > q->rear) {
      q->front = q->rear = -1;
   }
   return item;
}

void BFS(int graph[MAX_VERTICES][MAX_VERTICES], int visited[MAX_VERTICES], int
```

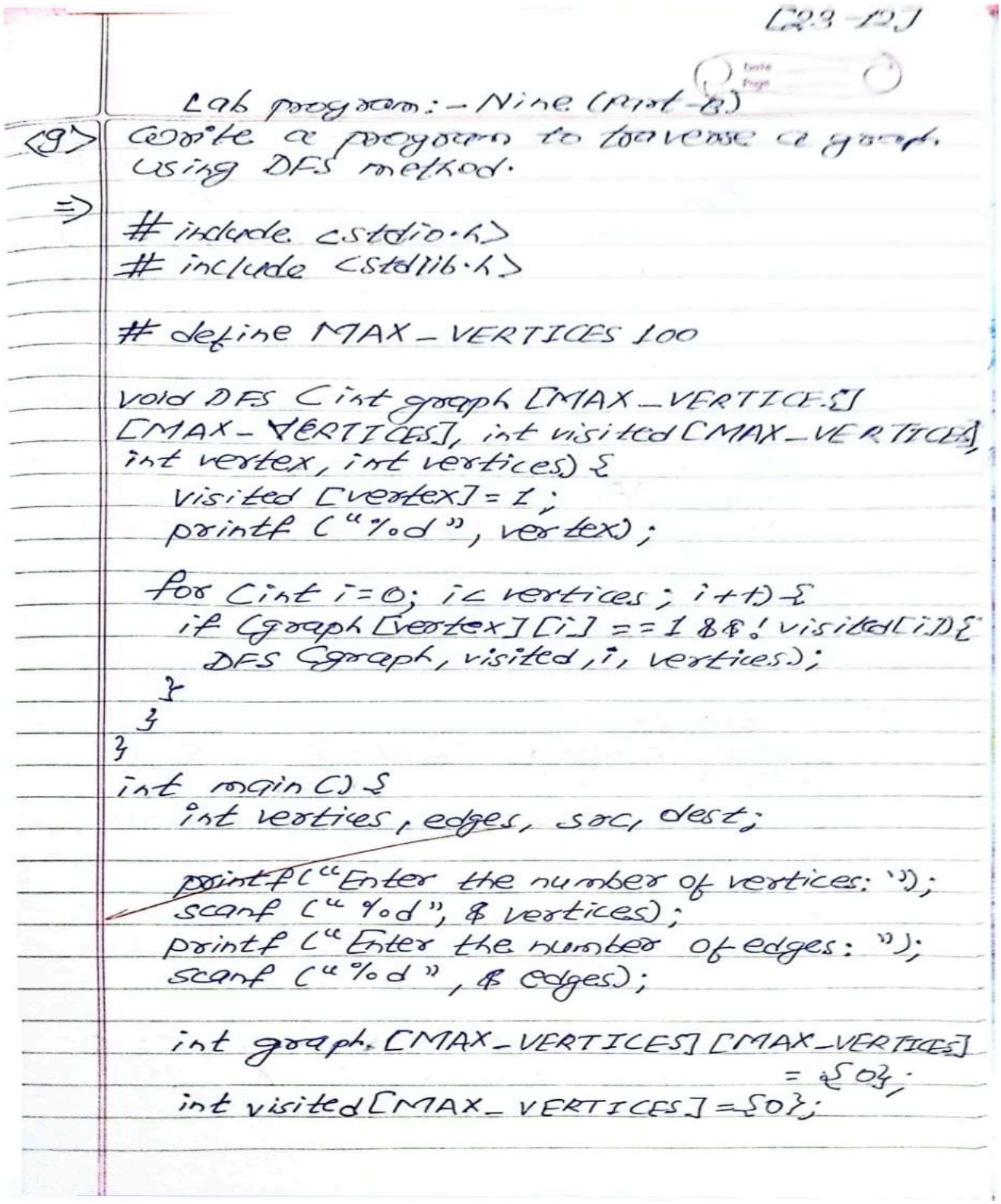
```
start, int vertices) {
    struct Queue q;
    initQueue(&q);
    enqueue(&q, start);
    visited[start] = 1;

    printf("BFS Traversal: ");
    while (!isEmpty(&q)) {
        int current = dequeue(&q);
        printf("%d ", current);

        for (int i = 0; i < vertices; i++) {
            if (graph[current][i] == 1 && visited[i] == 0) {
                enqueue(&q, i);
                visited[i] = 1;
            }
        }
    }
    printf("\n");
}

int main() {
    int vertices, edges, src, dest;

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

    int graph[MAX_VERTICES][MAX_VERTICES] = {0};
    int visited[MAX_VERTICES] = {0};

    printf("Enter the edges (source destination):\n");
    for (int i = 0; i < edges; i++) {
        scanf("%d %d", &src, &dest);
        graph[src][dest] = 1;
        graph[dest][src] = 1;
    }

    int start;
    printf("Enter the starting vertex for BFS: ");
    scanf("%d", &start);

    BFS(graph, visited, start, vertices);

    return 0;
}
```

Output:

```
Enter the number of vertices: 5
Enter the number of edges: 6
Enter the edges (source destination):
0 1
0 2
1 3
1 4
2 4
3 4
Enter the starting vertex for BFS: 0
BFS Traversal: 0 1 2 3 4
```

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

Algorithm:



Lab program:- Nine (Part-B)

(9) Write a program to traverse a graph using DFS method.

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

#define MAX_VERTICES 100

void DFS (int graph [MAX_VERTICES]
[MAX_VERTICES], int visited [MAX_VERTICES],
int vertex, int vertices) {
    visited [vertex] = 1;
    printf ("%d", vertex);

    for (int i=0; i< vertices ; i++) {
      if (graph [vertex] [i] == 1 && ! visited [i]) {
        DFS (graph, visited, i, vertices);
      }
    }
}
int main () {
    int vertices, edges, src, dest;

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

    int graph [MAX_VERTICES] [MAX_VERTICES]
                                = {0};
    int visited [MAX_VERTICES] = {0};
```

```
    printf("Enter the edges (source destination):
                                        \n");
    for (int i=0; i<edges; i++){
        scanf("%d %d", &src, &dest);
    graph [src] [dest] = 1;
    graph [dest] [src] = 1;
}
int start;
printf ("Enter the starting vertex for
                                    DFS: ");
scanf ("%d", &start);
printf("DFS Traversal: ");
DFS (graph, visited, start, vertices);
printf ("\n");

return 0;
}
```

Output:-

```
Enter the number of vertices: 5
Enter the number of edges: 6
Enter the edges (source destination):
0 1
0 2
1 3
1 4
2 4
3 4
Enter the starting vertix for DFS: 0
DFS Traversal: 0 1 3 4 2
```

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Code:

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

#define MAX_VERTICES 100

void DFS(int graph[MAX_VERTICES][MAX_VERTICES], int visited[MAX_VERTICES], int
vertex, int vertices) {
   visited[vertex] = 1;
   printf("%d ", vertex);

   for (int i = 0; i < vertices; i++) {
      if (graph[vertex][i] == 1 && !visited[i]) {
         DFS(graph, visited, i, vertices);
      }
   }
}

int main() {
   int vertices, edges, src, dest;

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

   int graph[MAX_VERTICES][MAX_VERTICES] = {0};
   int visited[MAX_VERTICES] = {0};

   printf("Enter the edges (source destination):\n");
   for (int i = 0; i < edges; i++) {
      scanf("%d %d", &src, &dest);
      graph[src][dest] = 1;
      graph[dest][src] = 1;
   }

   int start;
   printf("Enter the starting vertex for DFS: ");
   scanf("%d", &start);

   printf("DFS Traversal: ");
   DFS(graph, visited, start, vertices);
   printf("\n");

   return 0;
}
```

Output:

```
Enter the number of vertices: 5
Enter the number of edges: 6
Enter the edges (source destination):
0 1
0 2
1 3
1 4
2 4
3 4
Enter the starting vertex for DFS: 0
DFS Traversal: 0 1 3 4 2
```