Batch: E-2	**Roll No.: 16010123325**
Experiment / assignment / tutorial No. 5	
Grade: AA / AB / BB / BC / CC / CD /DD	
Signature of the Staff In-charge with date	

Title: Implementation of Queue operations (Static and Dynamic implementation)- Queue, circular queue, priority queue, and deque

Objective: To implement Basic Operations of Queues

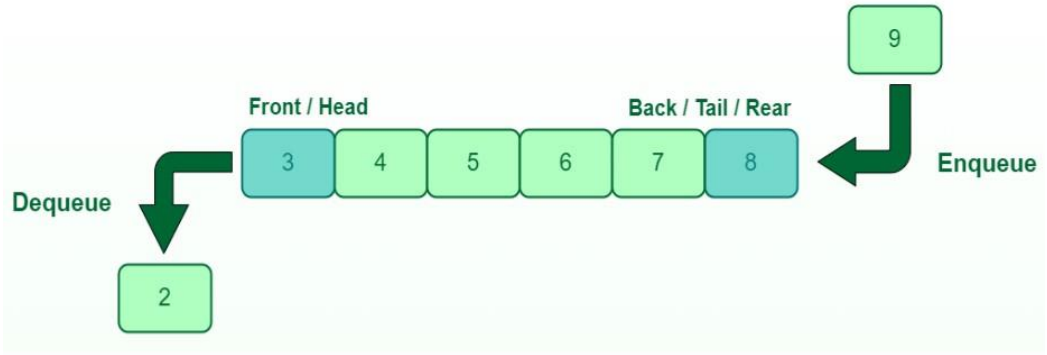
Expected Outcome of Experiment:

CO	Outcome
2	Apply linear and non-linear data structure in application development.

Books/ Journals/ Websites referred:

Introduction:

(diagram of queue)



Queue Data Structure

Program source code:

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

#define MAX_NAME 100

typedef struct Node {
    char name[MAX_NAME];
    struct Node* next;
} Node;

typedef struct Queue {
    Node* head;
    Node* tail;
} Queue;

Node* createNode(char* name) {
    Node* node = malloc(sizeof(Node));
    if (!node) {
        printf("Memory Error");
        return NULL;
    }
    strcpy(node->name, name);
    node->next = NULL;
    return node;
}

void enqueue(Queue* q, char* name) {
    Node* node = createNode(name);
    if (q->tail == NULL) {
        q->head = node;
        q->tail = node;
    } else {
        q->tail->next = node;
        q->tail = node;
    }
    q->tail->next = q->head;
}
```

```c
void dequeue(Queue* q) {
    if (q->head == NULL) {
        printf("Queue is empty\n");
        return;
    }
    Node* temp = q->head;
    if (q->head == q->tail) {
        q->head = NULL;
        q->tail = NULL;
    } else {
        q->head = q->head->next;
        q->tail->next = q->head;
    }
    free(temp);
}

int isEmpty(Queue* q) {
    return (q->head == NULL);
}

void printQueue(Queue* q) {
    Node* temp = q->head;
    if (temp == NULL) {
        printf("Queue is empty\n");
        return;
    }
    do {
        printf("%s ", temp->name);
        temp = temp->next;
    } while (temp != q->head);
    printf("\n");
}

void josephus(Queue* q, int m) {
    Node* p = q->head;
    Node* prev = q->head;
    while (p->next != p) {
        int cnt = 1;
        while (cnt != m) {
            prev = p;
            p = p->next;
            cnt++;
        }
        prev->next = p->next;
        p = prev->next;
    }
    printf("The Last person Standing is %s\n", p->name);
```

```
}


int main() {
    int n, m;
    printf("Enter the number of people: ");
    scanf("%d", &n);
    printf("Enter the position to kill: ");
    scanf("%d", &m);
    Queue* q = malloc(sizeof(Queue));
    q->head = NULL;
    q->tail = NULL;
    for (int i = 1; i <= n; ++i) {
        char name[MAX_NAME];
        printf("Enter Name %d:\n ", i);
        scanf("%s", name);
        enqueue(q, name);
    }
    printf("Initial Queue: ");
    printQueue(q);
    josephus(q, m);
    return 0;
}
```

Output Screenshots:

```
PS C:\Users\Shrey\OneDrive\Desktop\KJSCE\SEM-3> cd "c:\Users\Shrey\OneDrive\Desktop\KJSCE\SEM-3\DS\Programs\" ; if ($?) { gcc j
oshephus.c -o joshephus } ; if ($?) { .\joshephus }
Enter the number of people: 10
Enter the position to kill: 4
Enter Name 1:
 Arya
Enter Name 2:
 Jon
Enter Name 3:
 Robb
Enter Name 4:
 Catelyn
Enter Name 5:
 Rose
Enter Name 6:
 Bran
Enter Name 7:
 Tyrion
Enter Name 8:
 Cersei
Enter Name 9:
 Sansa
Enter Name 10:
 Brienne
Initial Queue: Arya Jon Robb Catelyn Rose Bran Tyrion Cersei Sansa Brienne
The Last person Standing is Rose
```

```
PS C:\Users\Shrey\OneDrive\Desktop\KJSCE\SEM-3> cd "c:\Users\Shrey\OneDrive\Desktop\KJSCE\SEM-3\DS\Programs\" ; if ($?) { gcc j
oshephus.c -o joshephus } ; if ($?) { .\joshephus }
Enter the number of people: 5
Enter the position to kill: 3
Enter Name 1:
 Shrey
Enter Name 2:
 May
Enter Name 3:
 Ross
Enter Name 4:
 Mike
Enter Name 5:
 Dan
Initial Queue: Shrey May Ross Mike Dan
The Last person Standing is Mike
PS C:\Users\Shrey\OneDrive\Desktop\KJSCE\SEM-3\DS\Programs>
```

Conclusion:-

The above program highlights implementation of Max Priority Queue in C using arrays, and showcases its various functions like enqueue, dequeue.

Post lab questions:

1. Implement Queue using 2 stacks. Show the working of Enqueue, Dequeue, display queue operations.

   Code:

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

#define MAX 100

typedef struct {
    int d[MAX];
    int t;
} S;

typedef struct {
    S s1;
    S s2;
} Q;

void initS(S* s) {
    s->t = -1;
}

int isFull(S* s) {
    return s->t == MAX - 1;
}

int isEmpty(S* s) {
    return s->t == -1;
}

void push(S* s, int x) {
    if (!isFull(s)) {
        s->d[++(s->t)] = x;
    } else {
        printf("Stack is full.\n");
    }
}
```

```c
int pop(S* s) {
    if (!isEmpty(s)) {
        return s->d[(s->t)--];
    }
    printf("Stack is empty.\n");
    return -1;
}

void initQ(Q* q) {
    initS(&q->s1);
    initS(&q->s2);
}

void enq(Q* q, int x) {
    push(&q->s1, x);
}

int deq(Q* q) {
    if (isEmpty(&q->s2)) {
        while (!isEmpty(&q->s1)) {
            push(&q->s2, pop(&q->s1));
        }
    }
    return pop(&q->s2);
}

void dispQ(Q* q) {
    if (isEmpty(&q->s2)) {
        while (!isEmpty(&q->s1)) {
            push(&q->s2, pop(&q->s1));
        }
    }

    if (isEmpty(&q->s2)) {
        printf("Queue is empty.\n");
        return;
    }

    printf("Queue elements: ");
    for (int i = q->s2.t; i >= 0; i--) {
        printf("%d ", q->s2.d[i]);
    }
    printf("\n");
}
```

```c
int main() {
    Q q;
    initQ(&q);

    enq(&q, 10);
    enq(&q, 20);
    enq(&q, 30);
    dispQ(&q);

    printf("Dequeued: %d\n", deq(&q));
    dispQ(&q);

    enq(&q, 40);
    dispQ(&q);

    printf("Dequeued: %d\n", deq(&q));
    dispQ(&q);

    return 0;
}
```

Output:

```
PS C:\Users\Shrey\OneDrive\Desktop\KJSCE\SEM-3\DS\Programs> cd "c:\Users\Shrey\OneDrive\Desktop\KJSCE\SEM-3\DS\Programs\" ; if ($?) {
 gcc queue.c -o queue } ; if ($?) { .\queue }
Queue elements: 10 20 30
Dequeued: 10
Queue elements: 20 30
Queue elements: 20 30
Dequeued: 20
Queue elements: 30
PS C:\Users\Shrey\OneDrive\Desktop\KJSCE\SEM-3\DS\Programs>
```

2. Discuss how different types of queues can be used in real-world applications, such as job scheduling, CPU task management, and customer service systems.

Job Scheduling

Simple Queues: Used in first-come, first-served (FCFS) scheduling, where jobs are processed in the order they arrive.

CPU Task Management

Multi-Level Queues: Manage different types of tasks (e.g., foreground vs. background) using various scheduling algorithms.

Customer Service Systems

Priority Queues: Handle urgent calls or requests first, such as in emergency services or tech support.