2) Graph traversal technique BFS (using queue)

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

#define MAX 100

#define initial 1
#define waiting 2
#define visited 3

int n; /*Number of vertices in the graph*/
int adj[MAX][MAX]; /*Adjacency Matrix*/
int state[MAX]; /*can be initial, waiting or visited*/

void create_graph();
void BF_Traversal();
void BFS(int v);

int queue[MAX], front = -1,rear = -1;
void insert_queue(int vertex);
int delete_queue();
int isEmpty_queue();

int main()
{
 create_graph();
 BF_Traversal();
```

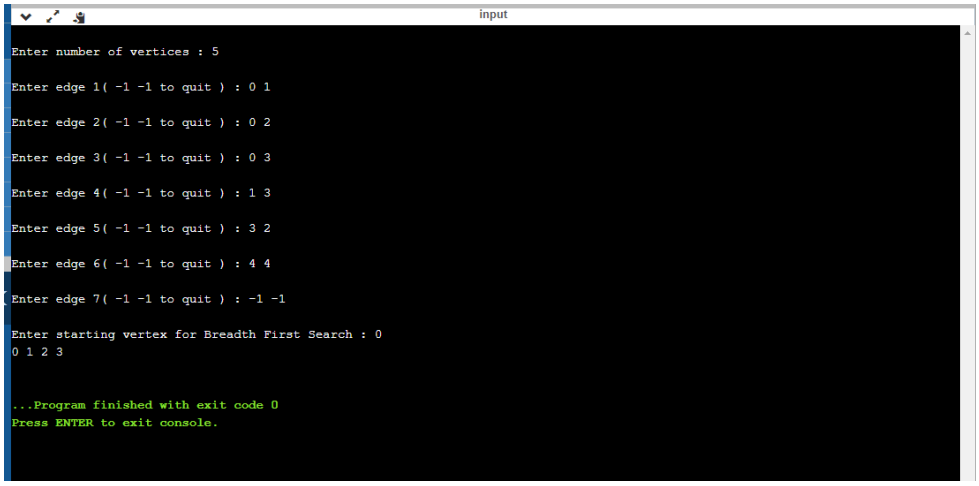
```
 return 0;

}/*End of main()*/

void BF_Traversal()
{
 int v;

 for(v=0; v<n; v++)
 state[v] = initial;

 printf("\nEnter starting vertex for Breadth First Search : ");
 scanf("%d", &v);
 BFS(v);
}/*End of BF_Traversal()*/

void BFS(int v)
{
 int i;

 insert_queue(v);
 state[v] = waiting;

 while(!isEmpty_queue())
 {
 v = delete_queue( );
 printf("%d ",v);
 state[v] = visited;
```

```
 for(i=0; i<n; i++)
 {
 /*Check for adjacent unvisited vertices */
 if(adj[v][i] == 1 && state[i] == initial)
 {
 insert_queue(i);
 state[i] = waiting;
 }
 }
 }
 printf("\n");
}/*End of BFS()*/

void insert_queue(int vertex)
{
 if(rear == MAX-1)
 printf("\nQueue Overflow\n");
 else
 {
 if(front == -1) /*If queue is initially empty */
 front = 0;
 rear = rear+1;
 queue[rear] = vertex ;
 }
}/*End of insert_queue()*/

int isEmpty_queue()
```

```
{
 if(front == -1 || front > rear)
 return 1;
 else
 return 0;
}/*End of isEmpty_queue()*/

int delete_queue()
{
 int del_item;
 if(front == -1 || front > rear)
 {
 printf("\nQueue Underflow\n");
 exit(1);
 }

 del_item = queue[front];
 front = front+1;
 return del_item;
}/*End of delete_queue() */

void create_graph()
{
 int i,max_edges,origin,destin;

 printf("\nEnter number of vertices : ");
 scanf("%d",&n);
 max_edges = n*(n-1);
```

```
for(i=1; i<=max_edges; i++)
{
printf("\nEnter edge %d( -1 -1 to quit ) : ",i);
scanf("%d %d",&origin,&destin);

if((origin == -1) && (destin == -1))
break;

if(origin>=n || destin>=n || origin<0 || destin<0)
{
printf("\nInvalid edge!\n");
i--;
}
else
{
adj[origin][destin] = 1;
}
}
}
```

Output:


input
Enter number of vertices : 5
Enter edge 1(-1 -1 to quit) : 0 1
Enter edge 2(-1 -1 to quit) : 0 2
Enter edge 3(-1 -1 to quit) : 0 3
Enter edge 4(-1 -1 to quit) : 1 3
Enter edge 5(-1 -1 to quit) : 3 2
Enter edge 6(-1 -1 to quit) : 4 4
Enter edge 7(-1 -1 to quit) : -1 -1
Enter starting vertex for Breadth First Search : 0
0 1 2 3
...Program finished with exit code 0
Press ENTER to exit console.