DATA STRUCTURES LABORATORY
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2015 -2016)
SEMESTER - III

Laboratory	15CSL38	Code IA Marks	20
Number of Lecture	Hours/Week 01I + 02P	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

Implement all the experiments in C Language under Linux / Windows environment.
Laboratory Experiments:

1. Design, Develop and Implement a menu driven Program in C for the following **Array** operations
   a. Creating an Array of **N** Integer Elements
   b. Display of Array Elements with Suitable Headings
   c. Inserting an Element (**ELEM**) at a given valid Position (**POS**)
   d. Deleting an Element at a given valid Position(**POS**)
   e. Exit.

Support the program with functions for each of the above operations.

2. Design, Develop and Implement a Program in C for the following operations on **Strings**
   a. Read a main String (**STR),** a Pattern String (**PAT**) and a Replace String (**REP**)
   b. Perform Pattern Matching Operation: Find and Replace all occurrences of **PAT** in **STR** with **REP** if **PAT** exists in **STR.** Report suitable messages in case **PAT** does not exist in **STR**

Support the program with functions for each of the above operations. Don't useBuilt-in functions.

3. Design, Develop and Implement a menu driven Program in C for the followingoperations on **STACK** of Integers (Array Implementation of Stack with maximumsize **MAX**)
a. ***Push*** an Element on to Stack
b. ***Pop*** an Element from Stack
c. Demonstrate how Stack can be used to check ***Palindrome***
d. Demonstrate ***Overflow*** and ***Underflow*** situations on Stack
e. Display the status of Stack
f. Exit

Support the program with appropriate functions for each of the above operations

4. Design, Develop and Implement a Program in C for converting an InfixExpression to Postfix Expression. Program should support for both parenthesizedand free parenthesized expressions with the operators: **+, -, *, /, %(Remainder),^(Power)** and **alphanumeric** operands**.**

5. Design, Develop and Implement a Program in C for the following StackApplications
a. Evaluation of **Suffix expression** with single digit operands and operators:**+, -, *, /, %,** ^
b. Solving **Tower of Hanoi** problem with **n** disks

6. Design, Develop and Implement a menu driven Program in C for the followingoperations on **Circular QUEUE** of Characters (Array Implementation of Queuewith maximum size **MAX**)
a. Insert an Element on to Circular QUEUE
b. Delete an Element from Circular QUEUE
c. Demonstrate ***Overflow*** and ***Underflow*** situations on Circular QUEUE
d. Display the status of Circular QUEUE
e. Exit
Support the program with appropriate functions for each of the above operations
Continued:

7. Design, Develop and Implement a menu driven Program in C for the followingoperations on **Singly Linked List (SLL)** of Student Data with the fields: ***USN,Name, Branch, Sem, PhNo***
a. Create a **SLL** of **N** Students Data by using ***front insertion***.
b. Display the status of **SLL** and count the number of nodes in it
c. Perform Insertion / Deletion at End of **SLL**
d. Perform Insertion / Deletion at Front of **SLL(Demonstration of stack)**
e. Exit

8. Design, Develop and Implement a menu driven Program in C for the followingoperations on **Doubly Linked List (DLL)** of Employee Data with the fields: ***SSN,Name, Dept, Designation, Sal, PhNo***
a. Create a **DLL** of **N** Employees Data by using ***end insertion***.
b. Display the status of **DLL** and count the number of nodes in it
c. Perform Insertion and Deletion at End of **DLL**
d. Perform Insertion and Deletion at Front of **DLL**
e. Demonstrate how this **DLL** can be used as **Double Ended Queue**
f. Exit

9. Design, Develop and Implement a Program in C for the following operationson**Singly Circular Linked List (SCLL)** with header nodes
a. Represent and Evaluate a Polynomial **P(x,y,z) = 6x2y2z-4yz5+3x3yz+2xy5z-2xyz3**
b. Find the sum of two polynomials **POLY1(x,y,z)** and **POLY2(x,y,z)** andstore the result in **POLYSUM(x,y,z)**
Support the program with appropriate functions for each of the above operations

10. Design, Develop and Implement a menu driven Program in C for the followingoperations on **Binary Search Tree (BST)** of Integers
a. Create a BST of **N** Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2
b. Traverse the BST in Inorder, Preorder and Post Order
c. Search the BST for a given element (**KEY**) and report the appropriate message
e. Exit

11. Design, Develop and Implement a Program in C for the following operations on**Graph(G)** of Cities
a. Create a Graph of **N** cities using Adjacency Matrix.
b. Print all the nodes **reachable** from a given starting node in a digraph usingDFS/BFS method

12. Given a File of **N** employee records with a set **K** of Keys(4-digit) which uniquelydetermine the records in file **F**. Assume that file **F** is maintained in memory by aHash Table(HT) of **m** memory locations with **L** as the set of memory addresses (2-digit) of locations in HT. Let the keys in **K** and addresses in **L** are Integers. Designand develop a Program in C that uses Hash function **H: K** □**L** as H(**K**)=**K** mod**m (remainder** method), and implement hashing technique to map a given key **K**
to the address space **L.** Resolve the collision (if any) using **linear probing**.

PROGRAM 1.

1. Design, Develop and Implement a menu driven Program in C for the following Array operations

a. Creating an Array of N Integer Elements
b. Display of Array Elements with Suitable Headings
c. Inserting an Element (ELEM) at a given valid Position (POS)
d. Deleting an Element at a given valid Position(POS) e. Exit.

Support the program with functions for each of the above operations.

```
#include<stdio.h>
#include<stdlib.h>
#define MAX 10
int a[MAX],n;
void create(),display(),insert(),delete();
void main()
{
 int ch;
 printf("\nIMPLEMENTATION OF OPERATIONS ON ARRAY\n");
 for(;;)
{
        printf("\nMENU\n");
        printf("\n1:CREATE \n2:DISPLAY\n3:INSERT\n4:DELETE\n");
        printf("\nEnter your choice::");
        scanf("%d",&ch);
        switch(ch)
         {
            case 1:create();
                   break;
            case 2:display();
                   break;
            case 3:insert();
                   break;
           case 4:delete();
                  break;
           case 5:exit(0);
        }/*end of switch */
 } /*end of for */
 } /*end of main */
```

```
void create()
{
 int i;
 printf("\nARRAY CREATION\n");
 printf("\nEnter the number of elements in array::");
 scanf("%d",&n);
 printf("\nEnter the elements\n");
 for(i=0;i<n;i++)
          scanf("%d",&a[i]);
}
void display()
{
  int i;
  printf("\nARRAY ELEMENTS ARE::\n");
  for(i=0;i<n;i++)
           printf("%d\t",a[i]);
}
void insert()
{
  int i,ele,pos;
  printf("\nELEMENT INSERTION\n");
  if(n==MAX)
         printf("\nARRAY IS FULL, INSERSION IS NOT POSSIBLE\n");
  else
 {
          printf("\nEnter the position less or equal to n+1 to insert the element::");
         scanf("%d",&pos);
          if(pos<=n+1)
         {
                  printf("\nEnter the element to insert::");
                 scanf("%d",&ele);
                  for(i=n-1;i>=pos-1;i--)
                          a[i+1]=a[i];
                 a[pos-1]=ele;
                 ++n;
          }/*end of if*/
         else
                 printf("\nInvalid position\n");
} /*end of else*/
}/*end of insert function*/
```

```
void delete()
{
 int item,i,pos;
 printf("\nELEMENT DELETION\n");
 if(n==0)
          printf("\nARRAY IS EMPTY DELETION NOT POSSIBLE\n");
else
{
         printf("\nEnter the position less than or equal to n to detele element::");
         scanf("%d",&pos);
         if(pos<=n)
         {
                  item=a[pos-1];
                  printf("\nDETETED ITEM IS::%d\n",item);
                  --n;
                  for(i=pos-1;i<n;i++)
                           a[i]=a[i+1];
         }/*end of if*/
         else
                   printf("\nInvalid position\n");
}/*end of else*/
}/*end of delete function*/
```

OUTPUT

IMPLEMENTATION OF OPERATIONS ON ARRAY

MENU

1:CREATE
2:DISPLAY
3:INSERT
4:DELETE

Enter your choice::1

ARRAY CREATION

Enter the number of elements in array::5

Enter the elements
12 13 14 15 16

MENU

```
1:CREATE
2:DISPLAY
3:INSERT
4:DELETE

Enter your choice::2

ARRAY ELEMENTS ARE::
12      13      14      15      16
MENU

1:CREATE
2:DISPLAY
3:INSERT
4:DELETE

Enter your choice::3

ELEMENT INSERTION

Enter the position less or equal to n+1 to insert the element::4

Enter the element to insert::100

MENU

1:CREATE
2:DISPLAY
3:INSERT
4:DELETE

Enter your choice::2

ARRAY ELEMENTS ARE::
12      13      14      100     15      16
MENU

1:CREATE
2:DISPLAY
3:INSERT
4:DELETE

Enter your choice::3

ELEMENT INSERTION
```

Enter the position less or equal to n+1 to insert the element::9

Invalid position

MENU

1:CREATE
2:DISPLAY
3:INSERT
4:DELETE

Enter your choice::4

ELEMENT DELETION

Enter the position less than or equal to n to detele element::7

Invalid position

MENU

1:CREATE
2:DISPLAY
3:INSERT
4:DELETE

Enter your choice::4

ELEMENT DELETION

Enter the position less than or equal to n to detele element::4

DETETED ITEM IS::100

MENU

1:CREATE
2:DISPLAY
3:INSERT
4:DELETE

Enter your choice::2

ARRAY ELEMENTS ARE::
12 13 14 15 16

PROGRAM 2.

2. Design, Develop and Implement a Program in C for the following operations on Strings

a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP)

b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR Support the program with functions for each of the above operations. Don't use Built-in functions.

```
#include<stdio.h>
#include<conio.h>
void read(char str[],char pat[],char rep[])
{
printf("\nEnter a string:: \n");
gets(str);
printf("\nEnter a pattern string:: \n");
gets(pat);
printf("\nEnter a replace string ::\n");
gets(rep);
}
void patreplace(char str[],char pat[],char rep[],char ans[])
{
int i,m,c,j,count,k;
i=m=c=j=count=0;
while ( str[c] != '\0')
{
        if ( str[m] == pat[i] )
        {
                i++;
                m++;
                 if ( pat[i] == '\0')
                 {
                        count++;
                         for(k=0; rep[k] != '\0';k++,j++)
                                ans[j] = rep[k];
                        i=0;
                        c=m;
                }/*end of inner if*/
        }/*end of outer if*/
        else
        {
                ans[j] = str[c];
                j++;
                c++;
                m = c;
                i=0;
        }/*end of else*/
}/*end of while*/
```

```
ans[j] = '\0';
if(count==0)
        printf("No pattern in the string\n");
else
         printf("\nThe resultant string is\n%s" ,ans);
}/*end of patternreplace function*/

void main()
{
char str[100],pat[100],rep[100],ans[100];
printf("Read main string, pattern string and replace string\n");
read(str,pat,rep);
patreplace(str,pat,rep,ans);
}
```

OUTPUT

Read main string, pattern string and replace string

O/P1
Enter a string::
KSITRNSIT
Enter a pattern string::
SIT
Enter a replace string ::
AAAAA
The resultant string is
KAAAAARNAAAAA
Read main string, pattern string and replace string

O/P1
Enter a string::
KSITRNSIT
Enter a pattern string::
IIT
Enter a replace string ::
BBBBB
No pattern in the string

PROGRAM 3.

3. Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX)

a. *Push* an Element on to Stack
b. *Pop* an Element from Stack
c.* Demonstrate how Stack can be used to check *Palindrome
d. Demonstrate *Overflow* and *Underflow* situations on Stack
e. Display the status of Stack
f. Exit

```
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
#define max 5
void push(),pop(),display(),overflow_underflow(),palindrome();
int stack[max],top=-1,top1=-1;
void main()
{
 int ch,item;
 printf("\nStack Operations\n");
 for(;;)
{
        printf("\n1.Push\n2.Pop\n3.Character Stack to check palindrome\n
                        4. Overflow_Underflow\n5.Display\n6:Exit\n");
        printf("\nEnter your Choice:");
        scanf("%d",&ch);
        switch(ch)
        {
                case 1:push();
                        break;
                case 2: pop();
                        break;
                case 3:palindrome();
                        break;
                case 4:overflow_underflow();
                        break;
                case 5:display();
                        break;
                case 6: exit(0);
        }/*end of switch*/
}/*end of for*/
} /* end of main*/
```

```
void push()
{
 int ele;
 if(top==max-1)
        printf("\nstack overflow\n");
 else
{
        printf("\nEnter element to push:");
        scanf("%d",&ele);
         stack[++top]=ele;
}/*end of else*/
} /*end of push function*/

void pop()
{
 int num;
if(top==-1)
        printf("\nUnderflow\n");
  else
 {
         num=stack[top--];
        printf("\nPoped element::%d\n",num);
} /*end of  else*/
}/* end of pop function*/

void overflow_underflow()
{
if(top==max-1)
        printf("\nStack full\n");
 if(top==-1)
        printf("\nStack underflow\n");
}
void display()
{
 int i;
if(top==-1)
        printf("\nStack is Empty\n");
 else
 {
         printf("\n Elements on stack are::\n");
        for(i=top;i>=0;i--)
                printf("%d\n",stack[i]);
} /*end of else*/
} /*end of display function*/
```

```
void palindrome()
{
 int i=0,j=0;
char s[10],st[10],rev[10];
 printf("\nEnter the string to check palindrome::");
 scanf("%s",s);
while(s[i]!='\0')
{
          st[++top1]=s[i];
          i++;
 }/* end of while*/
while(top1!=-1)
 {
         rev[j]=st[top1--];
          j++;
 }/* end of while*/
 rev[j]='\0';
 if(strcmp(s,rev)==0)
          printf("\nString %s is palindrome\n",s);
else
         printf("\nString %s is not palindrome\n",s);
}/* end of palindrome function*/
```

OUTPUT

Stack Operations

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:1

Enter element to push:10

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:1

Enter element to push:20

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:1

Enter element to push:30

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:1

Enter element to push:40

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:1

Enter element to push:50

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:1

stack overflow

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:5

Elements on stack are::
50
40
30
20
10

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:2

Poped element::50

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:2

Poped element::40

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

```
Enter your Choice:5

 Elements on stack are::
30
20
10

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:3

Enter the string to check palindrom::bharath

String bharath is not palindrom

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:3

Enter the string to check palindrom::dad

String dad is palindrom

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:2

Poped element::30

1.Push
```

2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:2

Poped element::20

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:2

Poped element::10

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:4

Stack underflow

1.Push
2.Pop
3.Character Stack to check palindrom
4.Overflow_Underflow
5.Display
6:Exit

Enter your Choice:

PROGRAM 4:

4. Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, %(Remainder), ^(Power) and alphanumeric operands.

```
#include<stdio.h>

typedef enum{lparen,rparen,plus,minus,mul,div,mod,pow,eos,op}pred;
```

/* enum data pred gives value to (,), +,-,*, /, %,^ lparen is 0, rparen is 1, plus is 2 Minus is 3, mul is 4, div is 5, mod is 6, pow is 7, eos is 8, op(operand) is 9 program uses these value ex: in place of lparen it uses 0, ex: in place of plus it uses 2 so on isp stands for In Stack Priority and icp stands for In Coming Priority*/

```
int isp[ ]={0,19,12,12,13,13,13,14,0}; /* priority of operator when it is in stack*/
int icp[ ]={20,19,12,12,13,13,13,15,0}; /* priority of operator when it is out of stack*/
char exp[50],symbol; /* infix expression*/
pred stack[50]; /*  stack contains only value of type enum pred*/
int top=0,n=0;
pred readtoken() /* to read character from infix expression*/
{
symbol=exp[n++];
 switch(symbol)
{
          case '(':return lparen;
          case ')':return rparen;
          case '+':return plus;
         case'-': return minus;
         case '*':return mul;
         case'/':return div;
         case '%':return mod;
         case '^':return pow;
         case'\0':return eos;
         default:return op;
}
}

void displaytoken(pred token)
{
 switch(token)
{
         case plus:printf("+");
                        break;
```

```
        case minus:printf("-");
                        break;
         case mul:printf("*");
                         break;
        case div:printf("/");
                        break;
         case mod:printf("%%");
                        break;
        case pow:printf("^");
                         break;
}
}
void push(pred item)
{
 stack[++top]=item;
}
pred pop()
{
 return stack[top--];
}
void infixtopost()
{
 pred token,token1;
 stack[0]=eos;
 token=readtoken();
 while(token!=eos) /*  while loop to read the token*/
 {
         if(token==op) /*  if character is operand copy to postfix*/
        {
                printf("%c",symbol);
        }
  /*if character is right parenthesis pop stack until left paranenthesis on stack*/
         else if(token==rparen)
        {
               while(stack[top]!=lparen)
               {
                        token1=pop();
                        displaytoken(token1);
               }
                        pop(); /*pop left paranenthesis from stack and ignore it*/
        }
```

```
        else
        {
                while(isp[stack[top]]>=icp[token])
/*if  priority of operator on stack is > =priority of incoming operator pop stack until operator with less priority comes on stack */
                {
                        token1=pop();
                        displaytoken(token1);
                }       /* copy poped  character to postfix ie display*/
                push(token);/* push incoming character to stack*/
        }

token=readtoken(symbol,n);
}
   /*once end of infix expression if any operators remains on stack, pop all operators copy to postfix ie display
while((token=pop())!=eos)
{
        displaytoken(token);
  }
 printf("\n");
}

void  main()
{
        printf("PROGRAM TO CONVER INFIX EXP TO POSTFIX EXP\n\n");
        printf("Enter infix expression:");
        gets(exp);
        printf("Postfix expression:");
        infixtopost();
}
```

OUTPUT

PROGRAM TO CONVER INFIX EXP TO POSTFIX EXP

Enter infix expression:a^(b+c%d)+e
Postfix expression:abcd%+^e+

PROGRAM TO CONVER INFIX EXP TO POSTFIX EXP

Enter infix expression:a+(b*c-(d/e)+f)
Postfix expression:abc*de/-f++

PROGRAM 5.

5. Design, Develop and Implement a Program in C for the following Stack Applications
a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^
b. Solving Tower of Hanoi problem with n disks

a. Evaluation of Suffix expression

```
#include<stdio.h>
#include<string.h>
#include<ctype.h>
#include<math.h>
#include<stdlib.h>
#define STACK_SIZE 50
/* isnum() function checks whether a character is an alphanumeric  character(a-z or A-Z,0-9)*/
/* isdigit() function checks whether character is numeric character(0-9) or not*/
/* atoi() converts string to integer*/

int stack[STACK_SIZE];
int top = -1;

void push(int a)
{
        stack[++top] = a;
        return;
}
int pop()
{
        return (stack[top--]);
}

int eval(char s[])
{
        int i;
        int temp, op1, op2, result;
        char symbol[1];
        for(i = 0; i < strlen(s); i++)
        {
                if(isalnum(s[i]))
                {
                        if(isdigit(s[i]))
                        {
                                symbol[0] = s[i];
                                temp = atoi(symbol);
                                push(temp);
                        }/*end of inner if*
```

```
                else
                {
                        printf("\n\nEnter a value of %c::",s[i]);
                        scanf("%d", &temp);
                        push(temp);
                }/*end of else of inner if*/
        }/* end of outer if */
        else
        {
                op2 = pop();
                op1 = pop();
                 switch(s[i])
                {
                         case '^': result = pow(op1, op2);
                                                break;
                        case '*': result = op1 * op2;
                                                break;
                        case '/': if(op2==0)
                                  {
                                        printf("Divide by zero error\n\n");
                                        exit(0);
                                   }/*end of if*/
                                  else
                                        result = op1 / op2;
                                                        break;
                        case '%':   if(op2==0)
                                    {
                                         printf("Divide by zero error\n\n");
                                         exit(0);
                                    }
                                    else
                                        result = op1 %op2;
                                                        break;
                        case '+': result = op1 + op2;
                                                        break;
                        case '-': result = op1 - op2;
                                                         break;
                        default:
                                        printf("Invalid Expression\n");
                                        exit(0);
                }/*end of switch*/
        push(result);
        }/*end of else*/
    }/*end of for*/
result = pop();
```

```
if(top != -1)
        {
                printf("Invalid Expression\n");
                exit(0);
        }
return result;
}/*end of  eval function */

void main()
{
        char s[50];
        printf("\t\tEVALUATION OF POSTFIX EXPRESSION\n");
        printf("\n\nEnter the postfix expression\n");
        gets(s);
        printf("\n\nThe result of the evaluation is: %d\n", eval(s));
        return;
}
```

OUTPUT

```
EVALUATION OF POSTFIX EXPRESSION

Enter the postfix expression
ab*cd/+
Enter a value of a::2

Enter a value of b::3

Enter a value of c::8

Enter a value of d::4

The result of the evaluation is: 8

 EVALUATION OF POSTFIX EXPRESSION

Enter the postfix expression
ab%cd^+e+

Enter a value of a::9


Enter a value of b::4

Enter a value of c::2
```

Enter a value of d::3

Enter a value of e::9

The result of the evaluation is: 18

EVALUATION OF POSTFIX EXPRESSION

Enter the postfix expression
93%24^+

The result of the evaluation is: 16

5b. Solving Tower of Hanoi problem with n disks

```
#include<stdio.h>
int tower(int n,char s, char t, char d)
{
      if(n==0)
          return 0;
     tower(n-1,s,d,t);
     printf("\n Move disk %d  from %c to %c\n",n,s,d);
     tower(n-1,t,s,d);
     return 0;
}
void main()
{
      char A,B,C;
      int n;
      printf("Enter the number of elements\n\n");
      scanf("%d",&n);
      printf("\n Sequence of disk\n");
      tower(n,'A','B','C');
      printf("\n");
}
```

OUTPUT:

1.Enter the number of disks:3

Sequence of disk
Move disk 1 from A to C

Move disk 2 from A to B

Move disk 1 from C to B
Move disk 3 from A to C

Move disk 1 from B to A

Move disk 2 from B to C

Move disk 1 from A to C

PROGRAM 6.

6. Design, Develop and Implement a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX)a. Insert an Element on to Circular QUEUE
b. Delete an Element from Circular QUEUE
c. Demonstrate *Overflow* and *Underflow* situations on Circular QUEUE
d. Display the status of Circular QUEUE
e. Exit.Support the program with appropriate functions for each of the above operations

```
#include <stdio.h>
#include<stdlib.h>
#define max 5
int front=0,rear=-1,count=0;
char circularq[max];
void insert(),delete(),display();
void main()
{
        int choice;
        for(;;)
        {
                printf(" \nIMPLEMENTATION OF CIRCULAR QUEUE\n");
                printf("\nMENU\n");
                printf("\n1.INSERT\n 2.DELETE\n 3.DISPLAY\n 4.EXIT\n\n");
                printf("\nEnter Your Choice::");
                scanf("%d",&choice);
                switch(choice)
                {
                        case 1:
                                insert();
                                break;
                        case 2:
                                delete();
                                break;
                        case 3:
                                display();
                                break;
                        default: exit(0);
                }/*end of switch*/
        }/*end of for*/
 }/*end of main*/

void insert()
{
char item;
if(count==max)
        printf("\nCIRCULAR QUEUE IS FULL\n");
```

```
else
{
        printf("\nEnter the item to be inserted::");
        fflush(stdin);
        scanf("%c",&item);
         rear=(rear+1)%max;
        circularq[rear]=item;
        count++;
}/*end of else*/
}/*end of insert function*/
void delete()
{
 char ch;
 if(count==0)
        printf("\nCIRCULAR QUEUE IS EMPTY\n");
else
{
         ch=circularq[front];
         printf("\nThe deleted element is::");
         putch(ch);
         front=(front+1)%max;
         count--;
}/*end of else*/
}/*end of delete function*/
void display()
{
int i,j;
char item;
if(count==0)
        printf("CIRCULAR QUEUE IS EMPTY\n");
else
 {
         printf("\nContents of the circular queue are:\n");
         j=front;
         for(i=1;i<=count;i++)
         {
                item=circularq[j];
                putch(item);
                j=(j+1)%max;
               printf("\t");
         }/*end of for*/
}/*end of else*/
}/*end of display function*/
```

OUTPUT:

```
IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::1

Enter the item to be inserted::a

IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::1

Enter the item to be inserted::b

IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::1

Enter the item to be inserted::c

IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
```

2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::3

Contents of the circular queue are:
a b c
IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::1

Enter the item to be inserted::d

IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::1

Enter the item to be inserted::f

IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::3

Contents of the circular queue are:

a b c d f
IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::1

CIRCULAR QUEUE IS FULL

IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::2

The deleted element is::a
IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::2

The deleted element is::b
IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::1

Enter the item to be inserted::x

IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::1

Enter the item to be inserted::y

IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::1

CIRCULAR QUEUE IS FULL

IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::3

Contents of the circular queue are:

c d f x y
IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::2

The deleted element is::c
IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::2

The deleted element is::d
IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::2

The deleted element is::f
IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::1

Enter the item to be inserted::z

IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::3

Contents of the circular queue are:
x y z
IMPLEMENTATION OF CIRCULAR QUEUE

MENU

1.INSERT
2.DELETE
3.DISPLAY
4.EXIT

Enter Your Choice::4

PROGRAM 7.

7. Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: *USN, Name, Branch, Sem, PhNo*

a. Create a SLL of N Students Data by using *front insertion*.
b. Display the status of SLL and count the number of nodes in it
c. Perform Insertion / Deletion at End of SLL
d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack)
e. Exit

```
#include<stdio.h>
#include<stdlib.h>
struct node
{
        char usn[12],name[20],branch[10],phno[15];
        int sem;
        struct node *link;
};

 typedef struct node* NODE;
 NODE start=NULL;
NODE start1=NULL;

NODE create_node()
{
 NODE ptr;
 ptr=(NODE)malloc(sizeof(struct node));
 if(ptr==NULL)
{
        printf("\nINSUFFICIENT MEMORY\n");
        exit(0);
 }/*end of if*/
  printf("\n\nEnter student data such as USN, NAME,BRANCH,PHNO,SEM\n\n");
  scanf("%s%s%s%s%d",ptr->usn,ptr->name,ptr->branch,ptr->phno,&ptr->sem);
  ptr->link=NULL;
 return ptr;
}/*end of  function create_node*/
```

```
NODE insert_front(NODE start)
{
NODE ptr;
ptr=create_node();
if(start== NULL)
        start= ptr;
else
{
        ptr->link = start;
        start = ptr;
 }/*end of else*/
 return start;
}/*end of insert_front function*/
NODE insert_end(NODE start)
{
 NODE ptr,temp;
 ptr=create_node();
 if(start==NULL)
        start=ptr;
 else
{
        temp=start;
        while(temp->link!=NULL)
        {
                temp=temp->link;
        }
        temp->link=ptr;
}/*end of else*/
 return start;
}/*end of function insert_end*/
NODE delete_front(NODE start)
{
 NODE  temp;
 if(start == NULL)
        printf("\n\nLIST EMPTY\n\n");
else
{
         temp = start;
        start= start->link;
         printf("\n\nDeleted node is\n");
         printf(" |%s|%s|%s|%s|%d|\n\n",temp->usn,temp->name,temp->branch,temp->phno,
        temp->sem);
        free(temp);
}/*end of else*/
 return start;
}/*end of function delete_front*
```

```
NODE delete_end(NODE start)
{
 NODE  p,temp;
 if(start==NULL)
{
          printf("\n\nLIST EMPTY\n\n");
           return;
}
temp=start;
if(temp->link==NULL) /*list with only one node*/
{
           start=NULL;
}/*end of if*/
else /*list with multiple nodes */
 {
           temp=start;
           while(temp->link!=NULL)
          {
               p=temp;
               temp=temp->link;
          }/*end of while*/
          p->link=NULL;
  }/*end of else*/
  printf("\n\nDeleted node is\n");
  printf("\n\n |%s|%s|%s|%s|%d|",temp->usn,temp->name,temp->branch, temp->phno,temp>sem);
  free(temp);
  return start;
  }/*end of function delete_front*/

void display(NODE start)
{
 NODE temp;
  if(start== NULL)
          printf("\n\nLIST EMPTY\n\n");
 else
{
          int count=0;
           temp = start;
          printf("\n\nSINGLY LINKED LIST IS: \n\n");
          while(temp != NULL)
          {
                    printf("|%s|%s|%s|%s|%d|->",temp->usn,temp->name,temp->branch,
                       temp->phno,temp->sem);
                   temp=temp->link;
                  count++;
            }/*end of while*/
```

```
        printf("\n\nNUMBER OF NODE IN LIST::%d\n\n",count);
}/*end of else*/
}/*end of function display*/
NODE list_stack(NODE stsart1)
{
 int choice;
 printf("\n\nOPERATIONS ON STACK\n\n");
 for(;;)
{
        printf("\n\nLIST AS STACK\n\n");
        printf("\n1:PUSH\n2:POP\n3:DISPLAY\n4:EXIT\n");
        printf("\nEnter choice::\n");
        scanf("%d",&choice);
        switch(choice)
        {
                case 1:start1=insert_front(start1);
                                                break;
                case 2:start1=delete_front(start1);
                                                break;
                case 3:display(start1);
                                                break;
                default:exit(0);;
        }/*end of switch*/
}/*end of for*/
}
void main()
{
 int ch,n,i;
 for(;;)
 {
        printf("\nSINGLY LINKED LIST OPERATIONS\n");
        printf("\nMENU\n");
        printf("\n\n1:List creation using Insert front\n2:Display and count\n3:Insert at end\n
                        4:Delete at end\n5:List as Stack\n");
        printf("Enter choice::");
        scanf("%d",&ch);
        switch(ch)
        {
          case 1:printf("\n\nEnter  how many student information you want enter::");
                        scanf("%d",&n);
                        for(i=1;i<=n;i++)
                        {
                            printf("\n\nEnter infomation of student %d\n\n",i);
                           start=insert_front(start);
                        }
                           break;
```

```
                case 2:  display(start);
                          break;
                case 3:start= insert_end(start);
                          break;
                case 4:start=delete_end(start);
                         break;
                case 5: start1=list_stack(start1);
                          break;
                 default:exit(0);
          }/*end of switch*/
}/*end of for*/
}/*end of function main*/
```

OUTPUT:

SINGLY LINKED LIST OPERATIONS

MENU

1:List creation using Insert front
2:Display and count
3:List as Stack
4:Insert at end
5:Delete at end

Enter choice::1

Enter how many student information you want to enter:3

Enter information of student 1

Enter student data such as USN, NAME,BRANCH ,SEM, PHNO

1ks13cs001
Raj
CSE
1
9288891919

Enter information of student 2

Enter student data such as USN, NAME,BRANCH, SEM, PHNO
1KS13CS002
Sharath
CSE
2

8991791829

Enter information of student 3

Enter student data such as USN, NAME,BRANCH, SEM, PHNO
1KS13CS004
Bharath
CSE
4
7822781426

SINGLY LINKED LIST OPERATIONS

MENU

1:List creation using Insert front
2:Display and count
3:List as Stack
4:Insert at end
5:Delete at end

Enter choice::2

SINGLY LINKED LIST IS:

|1KS13CS004|Bharath|CSE|4|7822781426|->|1KS13CS002|Sharath|CSE|2|8991791829|->|
1ks13cs001|Raj|CSE|1|9288891919|->

NUMBER OF NODE IN LIST::3

SINGLY LINKED LIST OPERATIONS

MENU

1:List creation using Insert front
2:Display and count
3:List as Stack
4:Insert at end
5:Delete at end

Enter choice::4

Enter student data such as USN, NAME,BRANCH,PHNO,SEM

1KS13CS005
Chinnu

CSE
9838712347
4

SINGLY LINKED LIST OPERATIONS

MENU

1:List creation using Insert front
2:Display and count
3:List as Stack
4:Insert at end
5:Delete at end

Enter choice::2

SINGLY LINKED LIST IS:

|1KS13CS004|Bharath|CSE|7822781426|4|->|1KS13CS002|Sharath|CSE|8991791829|2|->|
1ks13cs001|Raj|CSE|9288891919|1|->|1KS13CS005|Chinnu|CSE|9838712347|4|->

NUMBER OF NODE IN LIST::4

SINGLY LINKED LIST OPERATIONS

MENU

1:List creation using Insert front
2:Display and count
3:List as Stack
4:Insert at end
5:Delete at end

Enter choice::5

Deteted node is
|1KS13CS005|Chinnu|CSE|9838712347|4|

SINGLY LINKED LIST OPERATIONS

MENU

1:List creation using Insert front
2:Display and count
3:List as Stack
4:Insert at end

5:Delete at end

Enter choice::2

SINGLY LINKED LIST IS:

|1KS13CS004|Bharath|CSE|7822781426|4|->|1KS13CS002|Sharath|CSE|8991791829|2|->|
1ks13cs001|Raj|CSE|9288891919|1|->

NUMBER OF NODE IN LIST::3

SINGLY LINKED LIST OPERATIONS

MENU

1:List creation using Insert front
2:Display and count
3:List as Stack
4:Insert at end
5:Delete at end

Enter choice::5

Deteted node is
|1ks13cs001|Raj|CSE|9288891919|1|

SINGLY LINKED LIST OPERATIONS

MENU

1:List creation using Insert front
2:Display and count
3:List as Stack
4:Insert at end
5:Delete at end

Enter choice::2

SINGLY LINKED LIST IS:

|1KS13CS004|Bharath|CSE|7822781426|4|->|1KS13CS002|Sharath|CSE|8991791829|2|->

NUMBER OF NODE IN LIST::2

SINGLY LINKED LIST OPERATIONS

MENU

1:List creation using Insert front
2:Display and count
3:List as Stack
4:Insert at end
5:Delete at end

Enter choice::3

OPERATIONS ON STACK

LIST AS STACK

1:PUSH
2:POP
3:DISPLAY
4:EXIT
Enter choice::
1

Enter student data such as USN, NAME,BRANCH,PHNO,SEM
1KS13CS006
VINU
CSE
3
8927679912

LIST AS STACK

1:PUSH
2:POP
3:DISPLAY
4:EXIT

Enter choice::
1

Enter student data such as USN, NAME,BRANCH,PHNO,SEM

1KS13CS008
DURUTH
CSE
5
8292777826

LIST AS STACK

1:PUSH
2:POP
3:DISPLAY
4:EXIT

Enter choice::
1

Enter student data such as USN, NAME,BRANCH,PHNO,SEM

IKS13CS010
BHARATH
CSE
8977561328
7
LIST AS STACK

1:PUSH
2:POP
3:DISPLAY
4:EXIT

Enter choice::
3

SINGLY LINKED LIST IS:

|IKS13CS010|BHARATH|CSE|8977561328|7|->|1KS13CS008|DURUTH|CSE|8292777826|5|->|
1KS13CS006|VINU|CSE|8927679912|3|->

NUMBER OF NODE IN LIST::3

LIST AS STACK

1:PUSH
2:POP
3:DISPLAY
4:EXIT

Enter choice::
2

Deteted element is |IKS13CS010|BHARATH|CSE|8977561328|7|

LIST AS STACK

1:PUSH
2:POP
3:DISPLAY
4:EXIT

Enter choice::4

PROGRAM 8.

8. Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: *SSN, Name, Dept, Designation, Sal, PhNo*

a. Create a DLL of N Employees Data by using *end insertion*.
b. Display the status of DLL and count the number of nodes in it
c. Perform Insertion and Deletion at End of DLL
d. Perform Insertion and Deletion at Front of DLL
e. Demonstrate how this DLL can be used as Double Ended Queue f. Exit

```
#include<stdio.h>
#include<stdlib.h>
 struct node
{
        struct node *llink;
        int ssn;
        char name[20],dept[20],desi[20], phno[12];
        float sal;
        struct node *rlink;
};
typedef struct node* NODE;
NODE start=NULL;
NODE create_node()
{
NODE ptr;
ptr=(NODE)malloc(sizeof(struct node));
if(ptr==NULL)
 {
         printf("\n\nINSUFFICIENT MEMORY\n\n");
         exit(0);
}
 printf("Enter employee data such as SSN, NAME,DEPARTMENT,DESIGNATION,
           PHONENO AND SALARY\n");
 scanf("%d%s%s%s%s%f",&ptr->ssn,ptr->name,ptr->dept,ptr->desi,ptr->phno,&ptr->sal);
 ptr->llink=NULL;
 ptr->rlink=NULL;
 return ptr;
}/*end of create_node function*/

NODE insert_front(NODE start)
{
NODE ptr;
ptr=create_node();
if(start==NULL)
       start=ptr;
```

```
else
    {
        ptr->rlink=start;
        start->llink=ptr;
        start=ptr;
     }/*end of else*/
 return start;
 }/*end of insert_front function*/
NODE insert_end(NODE start)
{
NODE ptr,temp;
ptr=create_node();
if(start==NULL)
        start=ptr;
else
{
         temp=start;
        while(temp->rlink!=NULL)
         {
                temp=temp->rlink;
         }
         temp->rlink=ptr;
        ptr->llink=temp;
}/*end of else*/
 return start;
}/*end of insert_end function*/
NODE delete_front(NODE start)
{
NODE temp;
if(start==NULL)
        printf("\n\nDoubly linked List is empty:\n\n");
else
{
         temp=start;
         start=start->rlink;
         if(start!=NULL) /*if dll contains more that one node this condition satisfies other wise
                                if dll contains only one node on moving start it becomes null */
         {
              start->llink=NULL;
         }
         printf("\n\nDELETED FRONT NODE IS::\n\n");
         printf("\n\n|%d|%s|%s|%s|%s|%f|\n\n",temp->ssn,temp->name,temp->dept,
                                temp->desi,temp->phno,temp->sal);
         free(temp);
 }/*end of else*/
 return start; }/*end of delete_front function*/
```

```
NODE delete_end(NODE start)
{
NODE temp,p;
if(start==NULL)
{
        printf("\n\nDoubly linked List is empty:\n\n");
        return;
}
temp=start;
if(temp->rlink==NULL) /* only one node in list */
{
         start=NULL;
} /*end of if*/
else /* Multiple nodes in list */
{
        while(temp->rlink!=NULL)
        {
                temp=temp->rlink;
         }
         p=temp->llink;
         p->rlink=NULL;
 }/* end of else */
 printf("\n\nDELETED END NODE IS::\n\n");
 printf("|%d|%s|%s|%s|%s|%f|",temp->ssn,temp->name,temp->dept,
        temp->desi,temp>phno,temp->sal);
free(temp);
return start;
}/* end of   delete_end function*/
void display(NODE start)
{
NODE temp;
int count=0;
if(start==NULL)
{
        printf("\n\nDoubly linked List is empty:\n\n");
        return;
}
temp=start;
printf("\n\nThe nodes of the doubly linked list are:\n\n");
while(temp!=NULL)
{
         printf("<->|%d|%s|%s|%s|%s|%f|",temp->ssn,temp->name,temp->dept,
                                                temp->desi,temp->phno,temp->sal);
         temp=temp->rlink;
         count++;
}/* end of while */
```

```
printf("\n\nNumber of node in doubly link list are::%d",count);
}/* end of display function */
 void main()
{
int ch,n,i;
for( ;;)
{
        printf("\n\nMENU\n\n");
        printf("\n1:CREATE DLL of N EMPLOYEE USING INSERT END\n2:DISPLAY
                and COUNT\n3:INSERT END\n4:DELETE END\n5:INSERT FRONT\n
               6:DELETE FRONT\n7:DLL AS EQUEUE\n8:EXIT\n\n");
        printf("\nEnter the choice:: ");
        scanf("%d",&ch);
        switch(ch)
        {
                case 1: printf("\n\nEnter how many employee information you want to enter::");
                        scanf("%d",&n);
                        for(i=1;i<=n;i++)
                        {
                                printf("\n\nEnter infornamtion of employee %d\n",i);
                                start=insert_end(start);
                         }
                                break;
                 case 2:display(start);
                                 break;
                 case 3:start=insert_end(start);
                                break;
                 case 4:start=delete_end(start);
                                break;
                 case 5:start=insert_front(start);
                                break;
                 case 6: start= delete_front(start);
                                break;
                 case 7:printf("\n\nDEQUEUE INSERTION AND DELETION AT
                                BOTHENDS\n\n");
                        printf("\n\nINSERTION AT FRONT OF DEQUEUE\n\n");
                        start=insert_front(start);
                        display(start);
                        printf("\n\nINSERTION AT END OF DEQUEUE\n\n");
                        start=insert_end(start);
                        display(start);
                        printf("\n\nDELETION AT FRONT OF DEQUEUE\n\n");
                        start=delete_front(start);
                        display(start);
                        printf("\n\nDELETION AT END OF DEQUEUE\n\n");
                        start=delete_end(start);
```

```
                    display(start);
                    break;
                default:exit(0);
        }/* end of switch */
}/* end of for */
}/* end of main*/
```

OUTPUT:

MENU

1:CREATE DLL of N EMPLOYEE USING INSERT END

2:DISPLAY and COUNT

3:INSERT END

4:DELETE END

5:INSERT FRONT

6:DELETE FRONT

7:DLL AS DEQUEUE

8:EXIT

Enter the choice :: 3

Enter employee data such as SSN,NAME,DEPARTMENT,DESIGNATION,PHONENO AND SALARY

300

UVW

SALES

DIRECTOR

85693214

30000

MENU

1:CREATE DLL of N EMPLOYEE USING INSERT END

2:DISPLAY and COUNT

3:INSERT END

4:DELETE END

5:INSERT FRONT

6:DELETE FRONT

7:DLL AS DEQUEUE

8:EXIT

Enter the choice :: 5

Enter employee data such as SSN,NAME,DEPARTMENT,DESIGNATION,PHONENO AND SALARY

50

DEF

PRODUCTION

MANAGER

85265452

25000

MENU

1:CREATE DLL of N EMPLOYEE USING INSERT END

2:DISPLAY and COUNT

3:INSERT END

4:DELETE END

5:INSERT FRONT

6:DELETE FRONT

7:DLL AS DEQUEUE

8:EXIT

Enter the choice :: 2

The nodes of the doubly linked list are :

<->|50|DEF|PRODUCTION|MANAGER|85265452|25000.000000|

<->|100|ABC|SALES|MANAGER|96586985|25000.000000|

<->|200|XYZ|PRODUCTION|DIRECTOR|74125896|25000.000000|

<->|300|UVW|SALES|DIRECTOR|85693214|30000.000000|

Number of nodes in doubly link list are :: 4

MENU

1:CREATE DLL of N EMPLOYEE USING INSERT END

2:DISPLAY and COUNT

3:INSERT END

4:DELETE END

5:INSERT FRONT

6:DELETE FRONT

7:DLL AS DEQUEUE

8:EXIT

Enter the choice :: 4

DELETED END NODE IS ::

|300|UVW|SALES|DIRECTOR|85693214|30000.000000|

MENU

1:CREATE DLL of N EMPLOYEE USING INSERT END

2:DISPLAY and COUNT

3:INSERT END

4:DELETE END

5:INSERT FRONT

6:DELETE FRONT

7:DLL AS DEQUEUE

8:EXIT

Enter the choice :: 6

DELETED FRONT NODE IS ::

|50|DEF|PRODUCTION|MANAGER|85265452|25000.000000|

MENU

1:CREATE DLL of N EMPLOYEE USING INSERT END

2:DISPLAY and COUNT

3:INSERT END

4:DELETE END

5:INSERT FRONT

6:DELETE FRONT

7:DLL AS DEQUEUE

8:EXIT

Enter the choice :: 2

The nodes of the doubly linked list are :

<->|100|ABC|SALES|MANAGER|96586985|25000.000000|

<->|200|XYZ|PRODUCTION|DIRECTOR|74125896|25000.000000|

Number of nodes in doubly link list are :: 2

MENU

1:CREATE DLL of N EMPLOYEE USING INSERT END

2:DISPLAY and COUNT

3:INSERT END

4:DELETE END

5:INSERT FRONT

6:DELETE FRONT

7:DLL AS DEQUEUE

8:EXIT

Enter the choice :: 7

DEQUEUE INSERTION AND DELETION AT BOTH ENDS

INSERTION AT FRONT OF DEQUEUE

Enter employee data such as SSN,NAME,DEPARTMENT,DESIGNATION,PHONENO AND SALARY

25

KLM

SALES

EMPLOYEE

96396396

20000

The nodes of the doubly linked list are :

<->|25|KLM|SALES|EMPLOYEE|96396396|20000.000000|

<->|100|ABC|SALES|MANAGER|96586985|25000.000000|

<->|200|XYZ|PRODUCTION|DIRECTOR|74125896|25000.000000|

Number of nodes in doubly link list are :: 3

INSERTION AT END OF DEQUEUE

Enter employee data such as SSN,NAME,DEPARTMENT,DESIGNATION,PHONENO AND SALARY

250

STR

PRODUCTION

EMPLOYEE

78945602

20000

The nodes of the doubly linked list are :

<->|25|KLM|SALES|EMPLOYEE|96396396|20000.000000|

<->|100|ABC|SALES|MANAGER|96586985|25000.000000|

<->|200|XYZ|PRODUCTION|DIRECTOR|74125896|25000.000000|

<->|250|STR|PRODUCTION|EMPLOYEE|78945602|20000.000000|

Number of nodes in doubly link list are :: 4

DELETION AT FRONT OF DEQUEUE

DELETED FRONT NODE IS ::

|25|KLM|SALES|EMPLOYEE|96396396|20000.000000|

The nodes of the doubly linked list are :

<->|100|ABC|SALES|MANAGER|96586985|25000.000000|

<->|200|XYZ|PRODUCTION|DIRECTOR|74125896|25000.000000|

<->|250|STR|PRODUCTION|EMPLOYEE|78945602|20000.000000|

Number of nodes in doubly link list are :: 3

DELETION AT END OF DEQUEUE

DELETED END NODE IS ::

|250|STR|PRODUCTION|EMPLOYEE|78945602|20000.000000|

The nodes of the doubly linked list are :

<->|100|ABC|SALES|MANAGER|96586985|25000.000000|

<->|200|XYZ|PRODUCTION|DIRECTOR|74125896|25000.000000|

Number of nodes in doubly link list are :: 2

MENU

1:CREATE DLL of N EMPLOYEE USING INSERT END

2:DISPLAY and COUNT

3:INSERT END

4:DELETE END

5:INSERT FRONT

6:DELETE FRONT

7:DLL AS DEQUEUE

8:EXIT

Enter the choice :: 8

9. Design, Develop and Implement a Program in C for the following operations on Singly circular

Linked List (SCLL) with header nodes

a. Represent and Evaluate a Polynomial P(x,y,z) = $6x^2y^2z-4yz^5+3x^3yz+2xy^5z-2xyz^3$

b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z)Support the program with appropriate functions for each of the above operations

```
#include<stdio.h>
#include<stdlib.h>
#include<math.h>
 struct node
{
      int cf,px,py,pz,flag;
      struct node *link;
};
typedef struct node *NODE;

NODE  create_node()
{
NODE  ptr;
ptr=(NODE) malloc (sizeof(struct node));
if(ptr==NULL)
{
          printf("Insufficient memory\n");
          exit(0);
}
 return ptr;
}/*end of create_node*/

NODE insert_end(int cf,int  x ,int  y,int z,NODE head)
{
 NODE temp,ptr;
 ptr=create_node();
 ptr->cf=cf;
 ptr->px=x;
 ptr->py=y;
 ptr->pz=z;
 ptr->flag=0;
 if(head->link==head)
 {
          head->link=ptr;
          ptr->link=head;
 }
```

```
else
{
        temp=head->link;
        while(temp->link!=head)
                temp=temp->link;
        temp->link=ptr;
        ptr->link=head;
 }/*end of insert_end*/
 return head;
}

void display(NODE head)
{
NODE  temp;
if(head->link==head)
        printf("\n\nPolynominal empty\n");
 else
{
        temp=head->link;
         while(temp!=head)
         {
                if(temp->cf<0)
                      printf("%dx^%dy^%dz^%d",temp->cf,temp->px,temp->py,temp->pz);
                else
                      printf("+%dx^%dy^%dz^%d",temp->cf,temp->px,temp->py,temp->pz);
                temp=temp->link;
          }/*end of while*/
 }
 }/*end of display function*/

NODE  add_poly(NODE h1,NODE h2, NODE h3)
{
NODE p1,p2;
int cof;
p1=h1->link;
while(p1!=h1)
{
        p2=h2->link;
        while(p2!=h2)
        {
                if(p1->px==p2->px &&  p1->py==p2->py && p1->pz==p2->pz)
                        break;
                p2=p2->link;
         }/*end of inner while*/
```

```
        if(p2!=h2)
        {
                cof=p1->cf+p2->cf;
                p2->flag=1;
                if(cof!=0)
                        h3=insert_end(cof,p1->px,p1->py,p1->pz,h3);
        }/*end of if*/
        else
                h3=insert_end(p1->cf,p1->px,p1->py,p1->pz,h3);
       p1=p1->link;
}/*end of outer while*/
p2=h2->link;
while(p2!=h2)
{
        if(p2->flag==0)
                h3=insert_end(p2->cf,p2->px,p2->py,p2->pz,h3);
        p2=p2->link;
 }/*end of while*/
return h3;
}/*end of add_poly*/

NODE read_poly(NODE head)
{
int i,cf,x,y,z;
printf("\n\nEnter the coeffecient and exponents to stop polynomial reading enter -999\ n\n");
for(i=1;;i++)
{
        printf("\nEnter the %d term\n",i);
        printf("coeff=");
        scanf("%d",&cf);
        if(cf==-999)
                break;
        printf("pow x=");
        scanf("%d",&x);
        printf("pow y=");
        scanf("%d",&y);
        printf("pow z=");
        scanf("%d",&z);
        head=insert_end(cf,x,y,z,head);
}/*end of for*/
return head;
}/*end of read_poly*/
```

```
void polysum()
{
 NODE h1,h2,h3;
 h1=create_node();
 h2=create_node();
 h3=create_node();
 h1->link=h1;
 h2->link=h2;
 h3->link=h3;
 printf("\n\nEnter the first polynominal\n\n");
 h1=read_poly(h1);
 printf("\n\nEnter the second polynominal\n\n");
 h2=read_poly(h2);
 h3=add_poly(h1,h2,h3);
 printf("\n\nThe first polynominal is\n\n");
 display(h1);
 printf("\n\nSecond polynominal is\n\n");
 display(h2);
 printf("\n\nThe sum of two polynominal is\n\n");
display(h3);
}/*end of polysum*/

void eval()
{
 NODE h,temp;
 int x,y,z,sum=0;
 h=create_node();
 h->link=h;
 printf("\n\nEnter the polynominal\n");
 h=read_poly(h);
 printf("\n\nPolynominal is\n\n");
 display(h);
  printf("\n\nEnter the values of  variables x,y and z\n\n");
 scanf("%d%d%d",&x,&y,&z);
 temp=h->link;
while(temp!=h)
{
        sum+=temp->cf*pow(x,temp->px)*pow(y,temp->py)*pow(z,temp->pz);
        temp=temp->link;
 }/*end of while*/
printf("\n\nThe total sum is:: %d\n",sum);
}/*end of eval function*/
```

```
void main()
{
int ch;
for(;;)
{
          printf("\n\n1.Represent and Evaluate\n2.Add Two poly\n3.Exit");
          printf("\n\nEnter Your Choice:");
         scanf("%d",&ch);
         switch(ch)
         {
                  case 1: eval();   break;
                  case 2:polysum(); break;
                 default: exit(0);
         }/*end of switch*/
}/*end of for*/
}/*end of main*/
```

OUTPUT:

```
1.Represent and Evaluate
2.Add Two poly
3.Exit

Enter Your Choice  : 1

Enter the polynominal

Enter the coeffecient and stop polynomial reading enter -999
Enter the 1 term
coeff=6
pow x=2
pow y=2
pow z=1
Enter the 2 term
coeff=-4
pow x=0
pow y=1
pow z=5
Enter the 3 term
coeff=3
pow x=3
pow y=1
pow z=1
Enter the 4 term
```

```
coeff=2
pow x=1
pow y=5
pow z=1
Enter the 5 term
coeff=-2
pow x=1
pow y=1
pow z=3
Enter the 6 term
coeff=-999

Polynominal i s
+6x^2y^2z^1-4x^0y^1z^5+3x^3y^1z^1+2x^1y^5z^1-2x^1y^1z^3

Enter the values of  variables x,y and z
2 2 3

The total sum is:: -1344

1.Represent and Evaluate
2.Add Two poly
3.Exit

Enter Your Choice  : 2

Enter the first polynominal

Enter the coeffecient and stop polynomial reading enter -999
Enter the 1 term
coeff=4
pow x=2
pow y=3
pow z=3
Enter the 2 term
coeff=-6
pow x=2
pow y=2
pow z=2
Enter the 3 term
coeff=4
pow x=1
pow y=1
pow z=1
Enter the 4 term
coeff=10
```

```
pow x=0
pow y=0
pow z=0
Enter the 5 term
coeff=-999

Enter the second polynominal

Enter the coeffecient and stop polynomial reading enter -999
Enter the 1 term
coeff=5
pow x=0
pow y=3
pow z=5
Enter the 2 term
coeff=4
pow x=2
pow y=2
pow z=2
Enter the 3 term
coeff=8
pow x=1
pow y=1
pow z=1
Enter the 4 term
coeff=-999

The first polynominal is
+4x^2y^3z^3-6x^2y^2z^2+4x^1y^1z^1+10x^0y^0z^0

Second polynominal is
+5x^0y^3z^5+4x^2y^2z^2+8x^1y^1z^1

The sum of two polynominal is
+4x^2y^3z^3-2x^2y^2z^2+12x^1y^1z^1+10x^0y^0z^0+5x^0y^3z^5

1.Represent and Evaluate
2.Add Two poly
3.Exit

Enter Your Choice  : 3
```

PROGRAM 10

Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers
a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2
b. Traverse the BST in Inorder, Preorder and Post Order
c. Search the BST for a given element (KEY) and report the appropriate message
e. Exit

```
#include<stdio.h>
 #include<stdlib.h>
  struct node
{
        struct node *lchild;
        int data;
        struct node *rchild;
};
typedef struct node* NODE;
NODE root=NULL;

NODE create_node()
{
NODE ptr;
 ptr=(NODE)malloc(sizeof(struct node));
 if(ptr==NULL)
{
         printf("Insufficient memory\n");
        exit(0);
}
 else
{
         printf("Enter data:: ");
        scanf("%d",&ptr->data);
        ptr->lchild=ptr->rchild=NULL;
}/* end of else*/
 return ptr;
}/* end of create_node function*/

NODE create_bst(NODE root)
{
 NODE ptr, temp, p;
 ptr=create_node();
if(root==NULL)
{
        root=ptr;
        return root;
  }/* end of if*/
```

```
 p=NULL;
 temp=root;
 while(temp!=NULL)
 {
          p=temp;
          if(ptr->data==temp->data)
          {
                   printf("Duplicate items are not allowed\n\n");
                   free(ptr);
                   return root;
           }/* end of if*/
           if(ptr->data<temp->data)
                temp=temp->lchild;
           else
                temp=temp->rchild;
  }/* end of while*/
 if(ptr->data<p->data)
          p->lchild=ptr;
else
         p->rchild=ptr;
return root;
}/* end of create_bst*/

void inorder(NODE t)
{
if(t!=NULL)
{
          inorder(t->lchild);
          printf("%d\t",t->data);
          inorder(t->rchild);
}/* end of if*/
}/* end of inorder*/

void preorder(NODE t)
{
if(t!=NULL)
{
          printf("%d\t",t->data);
          preorder(t->lchild);
          preorder(t->rchild);
}/* end of if*/
}/* end of preorder*/
```

```
void postorder(NODE t)
{
if(t!=NULL)
{
        postorder(t->lchild);
        postorder(t->rchild);
        printf("%d\t",t->data);
}/* end of if*/
}/* end of postorder*/

void traverse(NODE root)
{
if(root==NULL)
        printf("Empty tree\n\n");
else
{
        printf("\n\nPreorder traversal:\t");
        preorder(root);
        printf("\n\nInorder traversal:\t");
        inorder(root);
        printf("\n\nPostorder traversal:\t");
        postorder(root);
}/* end of else*/
}/* end of traversal function*/
void search_bst(NODE root)
{
 int key,flag=0;
 NODE temp;
 printf("Enter key to search in bst::");
 scanf("%d",&key);
 if(root==NULL)
{
         printf("BST IS EMPTY\n\n ");
         return;
 }
else
{
        temp=root;
         while(temp!=NULL)
         {
              if(key==temp->data)
             {
                   printf("Key found\n\n");
                   flag=1;
                   break;
             }/* end of if*/
```

```
        else if(key<temp->data)
                temp=temp->lchild;
        else
                temp=temp->rchild;
       }/* end ofwhile*/
}/* end of else*/
 if(flag==0)
       printf("Key not found\n\n");
}/* end of search function*/

void main()
{
 int ch;
 for(;;)
 {
       printf("\n\nOPERATIONS ON BST\n\n");
       printf("\n\n1:CREATE BST \n2:TRAVERSE BST\n3:SEARCH\n4:EXIT\n\n");
        printf("Enter your  choice::");
        scanf("%d",&ch);
        switch(ch)
        {
              case 1:root=create_bst(root);
                     break;
              case 2: traverse(root);
                     break;
              case 3:search_bst(root);
                    break;
             default:exit(0);
       }/* end of switch*/
    }/* end of for*/
}/* end of main*/
```

OUTPUT:

```
OPERATIONS ON BST

1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT
Enter your  choice::1
Enter data:: 6

OPERATIONS ON BST
```

1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT
Enter your choice::1
Enter data:: 9

OPERATIONS ON BST

1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT
Enter your choice::1
Enter data:: 5

OPERATIONS ON BST

1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT
Enter your choice::1
Enter data:: 2

OPERATIONS ON BST

1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT
Enter your choice::1
Enter data:: 8

OPERATIONS ON BST

1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT
Enter your choice::1
Enter data:: 15
OPERATIONS ON BST

1:CREATE BST
2:TRAVERSE BST

```
3:SEARCH
4:EXIT
Enter your  choice::1
Enter data:: 24

OPERATIONS ON BST

1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT
Enter your  choice::1
Enter data:: 14

OPERATIONS ON BST

1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT
Enter your  choice::1
Enter data:: 7

OPERATIONS ON BST

1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT
Enter your  choice::1
Enter data:: 8
Duplicate items are not allowed

OPERATIONS ON BST

1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT
Enter your  choice::1
Enter data:: 5
Duplicate items are not allowed
OPERATIONS ON BST

1:CREATE BST
2:TRAVERSE BST
```

```
3:SEARCH
4:EXIT
Enter your  choice::1
Enter data:: 2
Duplicate items are not allowed

OPERATIONS ON BST

1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT
Enter your  choice::2

Preorder traversal:   6    5    2    9    8    7    1514    24

Inorder traversal:    2    5    6    7    8    9    1415    24

Postorder traversal:  2    5    7    8    14   24   159   6

OPERATIONS ON BST
1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT

Enter your  choice::3
Enter key to search in bst::24
Key found

OPERATIONS ON BST
1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT

Enter your  choice::3
Enter key to search in bst::10
Key not found
OPERATIONS ON BST
1:CREATE BST
2:TRAVERSE BST
3:SEARCH
4:EXIT

Enter your  choice::4
```

PROGRAM 11

11. Design, Develop and Implement a Program in C for the following operations on Graph(G) of Cities
a. Create a Graph of N cities using Adjacency Matrix.
b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS method

11 a) BFS PROGRAM

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

void bfs(int a[10][10],int n,int u)
{
 int front,rear,q[10],visited[10],v,i;
for(i=0;i<n;i++)
visited[i]=0;
 front=0;
 rear=-1;
printf("\nThe nodes visited from %d are::\n",u);
 q[++rear]=u;
 visited[u]=1;
 printf("%d\t",u);
 while(front<=rear)
{
        u=q[front++];
        for(v=0;v<n;v++)
        {
                if(a[u][v]==1&&visited[v]==0)
                {
                        printf("%d\t",v);
                        visited[v]=1;
                        q[++rear]=v;
                }/* end of if*/
        }/* end of for*/
 }/* end of while*/
}/* end of bfs function*/
void main()
{
  int a[10][10],n,source,i,j;
  printf("\nEnter number of vertices::");
  scanf("%d",&n);
  printf("\nEnter the graph as adjacency matrix\n");
```

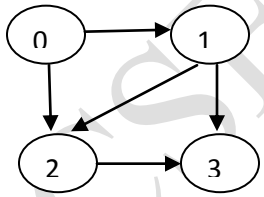
```
 for(i=0;i<n;i++)
{
        for(j=0;j<n;j++)
                scanf("%d",&a[i][j]);
  }
 printf("Enter source vertex::");
        scanf("%d",&source);
printf("\nBFS OF GIVEN GRAPH\n");
bfs(a,n,source);
}
```

OUTPUT:

1)
Enter number of vertices::4

Enter the graph as adjacency matrix
0 1 1 0
0 0 1 1
0 0 0 1
0 0 0 0
Enter source vertex::0

Graph 1



BFS OF GIVEN GRAPH

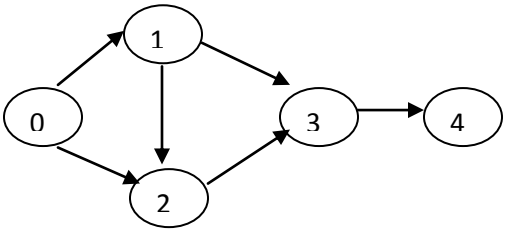
The nodes visited from 0 are::
0 1 2 3

2)

Enter number of vertices::5

Enter the graph as adjacency matrixGraph 2

0 1 1 0 0
0 0 1 1 0
0 0 0 1 0
0 0 0 0 1
0 0 0 0 0
Enter source vertex::1



BFS OF GIVEN GRAPH

The nodes visited from 1 are::
1 2 3 4

11 b) DFS PROGRAM

```
#include<stdio.h>
int a[10][10],visited[10],n;

void dfs(int u)
{
int v;
visited[u]=1;
printf("%d\t",u);
for(v=0;v<n;v++)
{
        if(a[u][v]==1&&visited[v]==0)
                dfs(v); }/* end of if*/
}/* end of dfs*/

void main()
{
int source,i,j;
printf("Enter number of vertices::");
scanf("%d",&n);
 printf("\n\nEnter graph as adjacency matrix form\n\n");
 for(i=0;i<n;i++)
{
        for(j=0;j<n;j++)
                scanf("%d",&a[i][j]);
}/* end of for*/
for(i=0;i<n;i++)
        visited[i]=0;
printf("\n\nEnter source vertex::");
scanf("%d",&source);
printf("\nDFS of given graph\n");
printf("Node visited from source node %d are::\n",source);
dfs(source);
}
```

OUTPUT:

1)
Enter number of vertices::4

Enter graph as adjacency matrix form

0 1 1 0
0 0 1 1 (for Graph 1)
0 0 0 1

0 0 0 0

Enter source vertex::0

DFS of given graph
Node visited from source node 0 are::
0 1 2 3

2)
Enter number of vertices::5

Enter graph as adjacency matrix form

0 1 1 0 0
0 0 1 1 1
0 0 0 1 0 (for Graph 2)
0 0 0 0 1
0 0 0 0 0

Enter source vertex::0

DFS of given graph
Node visited from source node 0 are::
0 1 2 3 4

PROGRAM 12.

Given a File of N employee records with a set K of Keys(4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table(HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Design and develop a Program in C that uses Hash function H: K →L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

```
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
struct record
{
    int empno,flag;// employee number is the key- K with 4 digits
    char name[10];
}emp[100];
int hash(int m)
{
 int r;
 r=m%100;
 return r;
}
void main()
{
 int m,k,eno,loc,i,n,j;
 char name[10];
 FILE *in;
 printf("\nEnter no of records to read from file: ");
 scanf("%d",&n);
 in = fopen("input.txt", "r");
 if(n<=10)
 {
        for(k=0;k<100;k++)
              emp[k].flag=0;
        for(i=0;i<n;i++)
        {
             fscanf(in,"%d%s",&eno,name);
             loc=hash(eno);
             if(emp[loc].flag==0)
             {
                        printf("\nRecord:%d is mapped to address:%d\n",i,loc);
                        emp[loc].empno=eno;
                        emp[loc].flag=1;
                        strcpy(emp[loc].name,name);
             }/* end of if*/
```

```
                else
                {
                        printf("\n\nCollision occured for record %d resolved using
                           linear  probing\n\n",i);
                        for(j=loc+1;j<100;j++)
                        {
                                if(emp[j].flag==0)
                                {
                                        printf("\nRecord:%d is at address:%d\n",i,j);
                                        strcpy(emp[j].name,name);
                                        emp[j].empno=eno;
                                        emp[j].flag=1;
                                        break;
                                }/* end of if*/
                        }/* end of for*/
                         if(j>=100)
                        {
                                printf("HASH TABLE IS FULL\n");
                                printf("\n----------------------\n");
                         }/* end of if*/
                }/* end of else*/
        }/* end of for*/
        fclose(in);
        printf("\n\nThe Hash Table Content is: ");
         for(i=0;i<100;i++)
        {
                if(emp[i].flag==1)
                        printf("\n%d\t%d\t%s",i,emp[i].empno,emp[i].name);
                 else
                printf("\n####");
        }/* end of for*/
 }
else
         printf("\nFile is containing only 10 records\n\n");
}/* end of main*/
```

OUTPUT:

```
Enter no of records to read from file: 10
Record:0 is mapped to address:1
Record:1 is mapped to address:10
Collision occured for record 2 resolved using linear probing
Record:2 is at address:11
Collision occured for record 3 resolved using linear probing
Record:3 is at address:12
Record:4 is mapped to address:36
```

9999Collision occured for record 5 resolved using linear probing
Record:5 is at address:37
Record:6 is mapped to address:56
Collision occured for record 7 resolved using linear probing
Record:7 is at address:57
Record:8 is mapped to address:66
Record:9 is mapped to address:89

The Hash Table Content is:

Address Empno Name
####
1 1201 aaa
####
####
####
####
####
####
####
####
10 2410 bbb
11 3510 ccc
12 4610 ddd
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####

####
####
36 7836 eee
37 8936 fff
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####
56 1356 ggg
57 3456 hhh
####
####
####
####
####
####
####
####
66 1466 iii
####
####
####
####
####
####
####
####
####
####
####
####
####
####
####

####
####
####
####
####
####
####
####
####
89 4589 jjj
####
####
####
####
####
####
####
####
####
####

Possible Viva questions

1. What are some of the applications for the tree data structure?

1- Manipulation of the arithmetic expressions.
2- Symbol table construction.
3- Syntax analysis.

2. What is the data structures used to perform recursion?

Stack. Because of its LIFO (Last In First Out) property it remembers its 'caller' so knows whom toreturn when the function has to return. Recursion makes use of system stack for storing the returnaddresses of the function calls.

3. Convert the expression ((A + B) * C - (D - E) ^ (F + G)) to equivalent Prefix and Postfix notations.

1. **Prefix Notation:** ^ - * +ABC - DE + FG
2. **Postfix Notation:** AB + C * DE - - FG + ^

4. In tree construction which is the suitable efficient data structure?

Linked list is the suitable efficient data structure.

5. What are the types of Collision Resolution Techniques and the methods used in each of the type?

1. **Open addressing (closed hashing),** The methods used include: Overflow block.
2. **Closed addressing (open hashing),** The methods used include: Linked list, Binary tree.

6. **List out the areas in which data structures are applied extensively?**

1. Compiler Design,
2. Operating System,
3. Database Management System,
4. Statistical analysis package,
5. Numerical Analysis,
6. Graphics,
7. Artificial Intelligence,
8. Simulation

7. What is a linked list?

A linked list is a linear collection of data elements, called nodes, where the linear order is given by pointers. Each node has two parts first part contain the information of the element second part contains the address of the next node in the list.

8. What are the advantages of linked list over array (static data structure)?

The disadvantages of array are unlike linked list it is expensive to insert and delete elements in the array One can't double or triple the size of array as it occupies block of memory space. In linked list each element in list contains a field, called a link or pointer which contains the address of the next element Successive element's need not occupy adjacent space in memory.

9. Can we apply binary search algorithm to a sorted linked list, why?

No we cannot apply binary search algorithm to a sorted linked list, since there is no way of indexing the middle element in the list. This is the drawback in using linked list as a data structure

10. What do you mean by overflow and underflow?

When new data is to be inserted into the data structure but there is no available space i.e. free storage list is empty this situation is called overflow.
When we want to delete data from a data structure that is empty this situation is called underflow.

11. What is a queue?1 A queue is an ordered collection of items from which items may be deleted at one end (front end) and items inserted at the other end (rear end).It obeys FIFO rule there is no limit to the number of elements a queue contains.
12. What is a priority queue? The priority queue is a data structure in which the intrinsic ordering of the elements (numeric or alphabetic) Determines the result of its basic operation. It is of two types i) Ascending priority queue- Here smallest item can be removed (insertion is arbitrary) ii) Descending priority queue- Here largest item can be removed (insertion is arbitrary)
13. What are the disadvantages of sequential storage?
    .Fixed amount of storage remains allocated to the data structure even if it contains less element. No more than fixed amount of storage is allocated causing overflow
14. Define circular list?

In linear list the next field of the last node contain a null pointer, when a next field in the last node contain a pointer back to the first node it is called circular list.
Advantages – From any point in the list it is possible to reach at any other point

15. What are the disadvantages of circular list?
    i) We can't traverse the list backward ii) If a pointer to a node is given we cannot delete the node
16. Define double linked list?

It is a collection of data elements called nodes, where each node is divided into three parts

i) An info field that contains the information stored in the node
ii) Left field that contain pointer to node on left side
iii) Right field that contain pointer to node on right side

16. For an undirected graph with n vertices and e edges, the sum of the degree of each vertex is equal to Ans:2e
17. A full binary tree with 2n+1 nodes contain
    Ans: n non-leaf nodes
18. If a node in a BST has two children, then its inorder predecessor has
    Ans: no right child
19. A binary tree in which if all its levels except possibly the last, have the maximum number of nodes and all the nodes at the last level appear as far left as possible, is known as
    Ans: complete binary tree
20. A linear list of elements in which deletion can be done from one end (front) and insertion can take place only at the other end (rear) is known as a
    Ans: queue
21. In a circular linked list
    Ans: there is no beginning and no end.
22. The data structure required for Breadth First Traversal on a graph is
    Ans: queue

23. The data structure required to evaluate a postfix expression is (A) queue (B) stack (C) array (D) linked-list
    Ans: Stack
24. The data structure required to check whether an expression contains balanced parenthesis is
    Ans: Stack

25. The number of leaf nodes in a complete binary tree of depth d is
    Ans: 2d
26. A linear collection of data elements where the linear node is given by means of pointer is called (Ans: linked list
27. Representation of data structure in memory is known as:
    Ans: abstract data type
28. If the address of A[1][1] and A[2][1] are 1000 and 1010 respectively and each element occupies 2 bytes then the array has been stored in _____ order.
    Ans: row major
29. An adjacency matrix representation of a graph cannot contain information of :
    Ans: parallel edges