LAB MANUAL

COMPUTER GRAPHICS

//1.Program to recursively subdivide a tetrahedron to from 3D Sierpinski gasket. The number of recursive steps is to be specified by the user.

```
//Program1-Sierpinski gasket
#include <GL/glut.h>
#include <stdlib.h>
#include<stdio.h>
typedef   float  point[3];
point v[]={ {0.0,0.0,1.0},
     {0.0,0.943,-0.33},
     {-0.816,-0.471,-0.33},
     {0.816,-0.471,0.33}};
int n;
void triangle(point a,point b,point c)
{
          glBegin(GL_POLYGON);
          glNormal3fv(a);
          glVertex3fv(a);
          glVertex3fv(b);
          glVertex3fv(c);
          glEnd();
}
void divide_tri(point a,point b,point c,int m)
{
          point v1,v2,v3;
          int j;
          if (m>0)
```

```
        {
                for(j=0;j<3;j++)
                        v1[j]=(a[j]+b[j])/2;


                        for(j=0;j<3;j++)
                        v2[j]=(a[j]+c[j])/2;


                for(j=0;j<3;j++)
                        v3[j]=(b[j]+c[j])/2;
                divide_tri(a,v1,v2,m-1);
                divide_tri(c,v2,v3,m-1);
                divide_tri(b,v3,v1,m-1);
        }
else
        triangle(a,b,c);
}
void tetrahedron(int m)
{
        glColor3f(1.0,0.0,0.0);
        divide_tri(v[0],v[1],v[2],m);
        glColor3f(0.0,1.0,0.0);
        divide_tri(v[3],v[2],v[1],m);
        glColor3f(0.0,0.0,1.0);
        divide_tri(v[0],v[3],v[1],m);
        glColor3f(0.0,0.0,0.0);
```

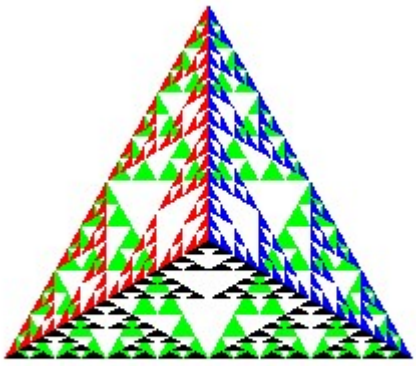
```
        divide_tri(v[0],v[2],v[3],m);
}
void display(void)
{
        glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT);
   glLoadIdentity();
        tetrahedron(n);
        glFlush();
}
void  myReshape(int w,int h)
{
        glViewport(0,0,w,h);
        glMatrixMode(GL_PROJECTION);
        glLoadIdentity();
        if(w<=h)
                glOrtho(-2.0,2.0,-2.0*(GLfloat)h/(GLfloat)w,2.0*(GLfloat)h/(GLfloat)w,-
10.0,10.0);
        else
       glOrtho(-2.0*(GLfloat)w/(GLfloat)h,2.0*(GLfloat)w/(GLfloat)h,-2.0,2.0,-10.0,10.0);
        glMatrixMode(GL_MODELVIEW);
        glutPostRedisplay();
}
int  main(int argc,char **argv)
{
        printf("Enter the number of recursive steps you want\n");
```

```
    scanf("%d", &n);
    glutInit(&argc,argv);
    glutInitDisplayMode(GLUT_SINGLE|GLUT_RGB|GLUT_DEPTH);
    glutInitWindowSize(500,500);
    glutCreateWindow("3d gasket");
    glutReshapeFunc(myReshape);
    glutDisplayFunc(display);
    glEnable(GL_DEPTH_TEST);
    glClearColor(1.0,1.0,1.0,1.0);
    glutMainLoop();
}
```

Output:

Enter the number the number of recursive steps you want

4



2. Program to implement Liang-Barsky line clipping algorithm.

```
//Program2-Liang Barskey Line Clipping Algorithm
#include<GL/glut.h>
#define true 1
#define false 0
GLdouble xmin=50,ymin=50,xmax=100,ymax=100;
GLdouble xvmin=250,yvmin=250,xvmax=300,yvmax=300;
int cliptest(GLdouble p,GLdouble q,GLdouble *te,GLdouble*tl)
{
GLdouble t=q/p;
if(p<0.0)
{
if(t>*te) *te=t;
if(t>*tl)
return(false);
}
if(p>0.0)
{
if(t<*tl) *tl=t;
if(t<*te) return(false);
}
if(p==0.0)
{
if(q<0.0)return(false);
}
```

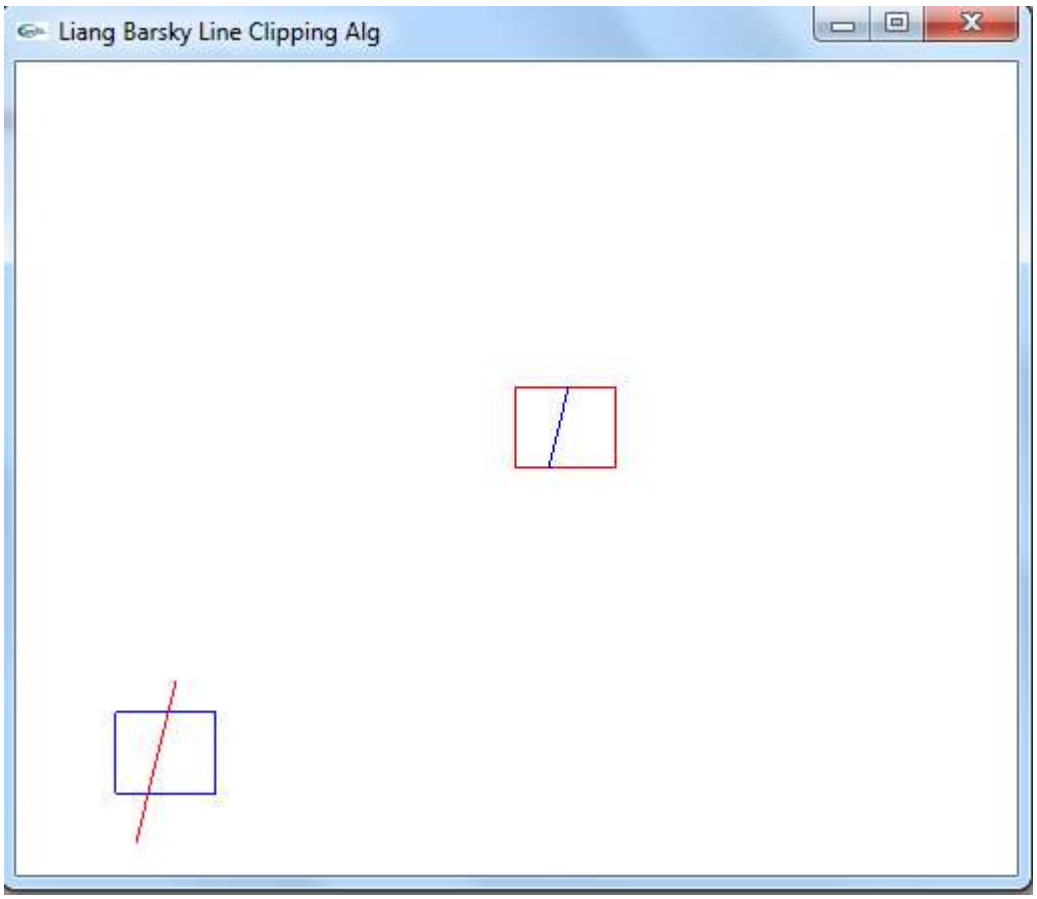
```
return(true);
}
void LBLineClipDraw(GLdouble x0,GLdouble y0,GLdouble
x1,GLdouble y1)
{
GLdouble dx=x1-x0,dy=y1-y0,te=0.0,tl=1.0;
if(cliptest(-dx,x0-xmin,&te,&tl)!=false)
{
if(cliptest(dx,xmax-x0,&te,&tl)!=false)
{
if(cliptest(-dy,y0-ymin,&te,&tl)!=false)
{
if(cliptest(dy,ymax-y0,&te,&tl)!=false)
{
if(tl<1.0)
{
x1=x0+tl*dx;
y1=y0+tl*dy;
}

if(te>0.0)
{
x0=x0+te*dx;
y0=y0+te*dy;
}
```

```
}
}
}
}
glColor3f(1.0,0.0,0.0);
glBegin(GL_LINE_LOOP);
glVertex2f(xvmin,yvmin);
glVertex2f(xvmax,yvmin);
glVertex2f(xvmax,yvmax);
glVertex2f(xvmin,yvmax);
glEnd();
GLdouble vx0=x0+200;
GLdouble vy0=y0+200;
GLdouble vx1=x1+200;
GLdouble vy1=y1+200;
glColor3f(0.0,0.0,1.0);
glBegin(GL_LINES);
glVertex2d(vx0,vy0);
glVertex2d(vx1,vy1);
glEnd();
}
void display()
{
glClear(GL_COLOR_BUFFER_BIT); //TO CLEAR THE LAST OUTPUT AND AVOID
TRANSPARENCY
```

```
glClearColor(1.0,1.0,1.0,1.0); //TO SET BACKGROUND COLOR
GLdouble x0=60,y0=20,x1=80,y1=120;
glColor3f(0.0,0.0,1.0);
glBegin(GL_LINE_LOOP);
glVertex2f(xmin,ymin);
glVertex2f(xmax,ymin);
glVertex2f(xmax,ymax);
glVertex2f(xmin,ymax);
glEnd();
glColor3f(1.0,0.0,0.0);
glBegin(GL_LINES);
glVertex2d(x0,y0);
glVertex2d(x1,y1);
glEnd();
LBLineClipDraw(x0,y0,x1,y1);
glFlush();
}
void init()
{
glMatrixMode(GL_PROJECTION);
gluOrtho2D(0.0,500.0,0.0,500.0);
}
void main(int argc,char **argv)
{
glutInit(&argc,argv);
```

```
glutInitWindowSize(500,500);
glutInitWindowPosition(0,0);
glutCreateWindow("Liang Barsky Line Clipping Alg");
init();
glutDisplayFunc(display);
glutMainLoop();
}
```

Output:



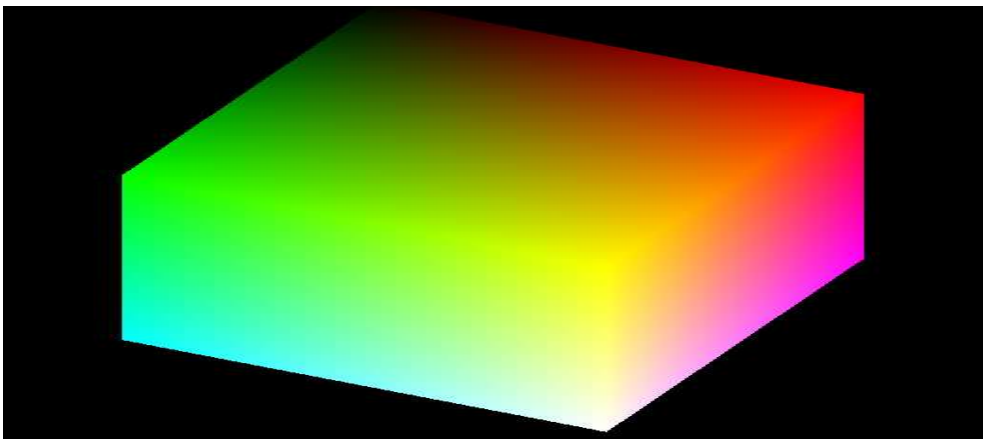
3. Program to draw a color cube and spin it using OpenGL transformation matrices.

```
//Program 3-spin cube

#include<GL/glut.h>

GLfloat vertices[][3]={{-1.0,-1.0,-1.0},{1.0,-1.0,-1.0},

{1.0,1.0,-1.0},{-1.0,1.0,-1.0},{-1.0,-

1.0,1.0},

{1.0,-1.0,1.0},{1.0,1.0,1.0},{-

1.0,1.0,1.0}}; //VERTICES OF THE CUBE

GLfloat colors[][3]={{-1.0,-1.0,-1.0},{1.0,-1.0,-1.0},

{1.0,1.0,-1.0},{-1.0,1.0,-1.0},{-1.0,-

1.0,1.0},

{1.0,-1.0,1.0},{1.0,1.0,1.0},{-

1.0,1.0,1.0}}; //COLOR ASSOCIATED WITH EACH VERTEX

GLubyte

cubeIndices[]={0,3,2,1,2,3,7,6,0,4,7,3,1,2,6,5,4,5,6,7,0,1,5,4

};

static GLfloat theta[]={0.0,0.0,0.0};

static GLint axis=2;

void display()

{

glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT);

glLoadIdentity();

glRotatef(theta[0],1.0,0.0,0.0);

glRotatef(theta[1],0.0,1.0,0.0);

glRotatef(theta[2],0.0,0.0,1.0);
```

```
glDrawElements(GL_QUADS,24,GL_UNSIGNED_BYTE,cubeIndices);
glutSwapBuffers();
glFlush();
}
void spincube()
{
theta[axis]+=2.0;
if(theta[axis]>360.0)
{
theta[axis]-=360.0;
}
display();
}
void mouse(int btn,int state,int x,int y)
{
if(btn==GLUT_LEFT_BUTTON && state==GLUT_DOWN)axis=0;
if(btn==GLUT_MIDDLE_BUTTON && state==GLUT_DOWN)axis=1;
if(btn==GLUT_RIGHT_BUTTON && state==GLUT_DOWN)axis=2;
}
void init()
{
glMatrixMode(GL_PROJECTION);
glOrtho(-2.0,2.0,-2.0,2.0,-10.0,10.0);
glMatrixMode(GL_MODELVIEW);
}
```

```
void main(int argc,char **argv)
{
glutInit(&argc,argv);
glutInitDisplayMode(GLUT_DOUBLE);
glutInitWindowSize(600,600);
glutCreateWindow("Spin a colorcube");
init();
glutDisplayFunc(display);
glutIdleFunc(spincube);
glutMouseFunc(mouse);
glEnable(GL_DEPTH_TEST);
glEnableClientState(GL_VERTEX_ARRAY);
glVertexPointer(3,GL_FLOAT,0,vertices);
glEnableClientState(GL_COLOR_ARRAY);
glColorPointer(3,GL_FLOAT,0,colors);
glutMainLoop();
}
```

Output:



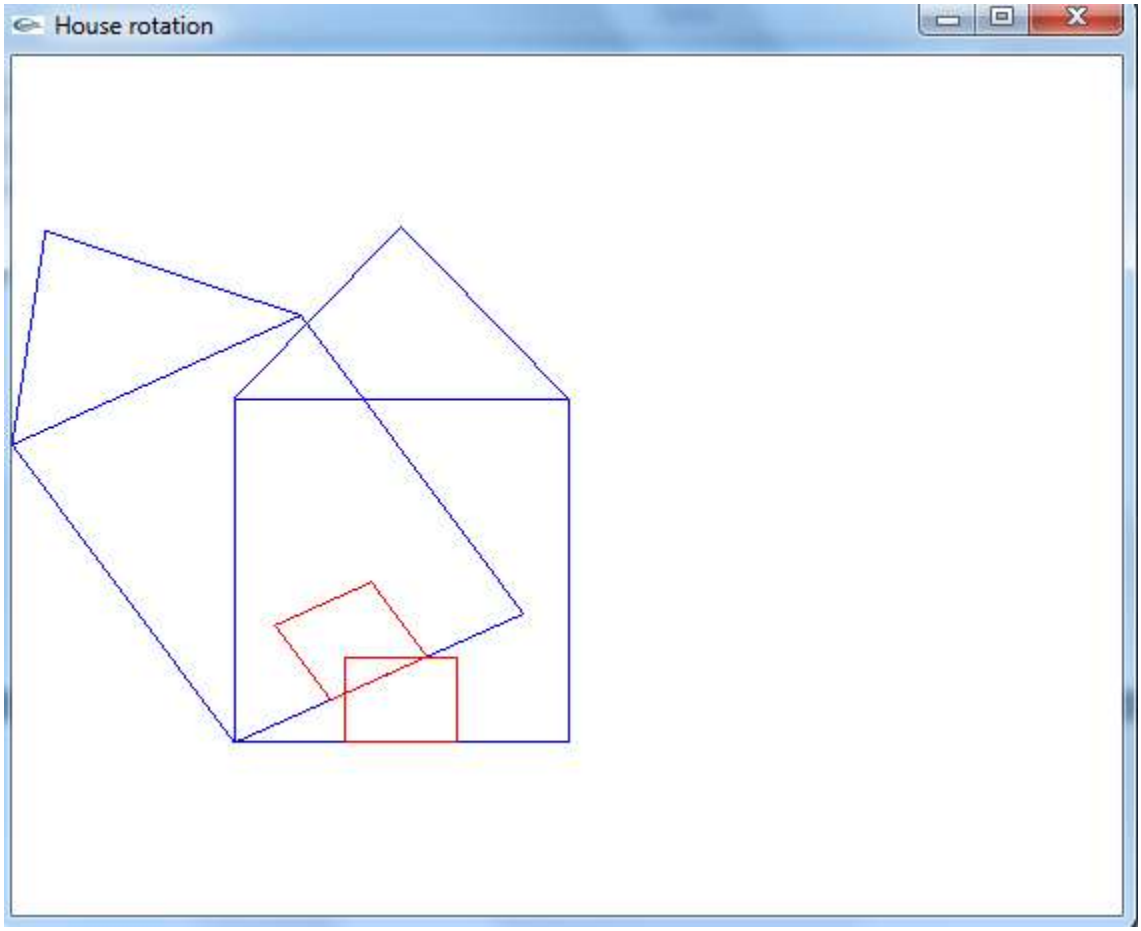
4. Program to create a house like figure and rotate it about a given fixed point using OpenGL functions.

```
//Program4-Rotating House
#include<stdio.h>
#include<math.h>
#include<GL/glut.h>
GLfloat house[3][9]={
{100.0,100.0,175.0,250.0,250.0,150.0,150.0,200.0,200.0},
{100.0,300.0,400.0,300.0,100.0,100.0,150.0,150.0,100.0},
{1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0}
};
GLfloat rot_mat[3][3];
GLfloat result[3][9];
GLfloat h=100.0;
GLfloat k=100.0;
GLfloat theta;
void multiply()
{
int i,j,k;
for(i=0;i<3;i++)
{
for(j=0;j<9;j++)
{
result[i][j]=0;
for(k=0;k<3;k++)
{
result[i][j]=result[i][j]+rot_mat[i][k]*house[k][j];
}
}
}
}
void rotate()
{
GLfloat m,n;
m=-h*(cos(theta)-1)+k*(sin(theta));
n=-k*(cos(theta)-1)-h*(sin(theta));
rot_mat[0][0]=cos(theta);
rot_mat[0][1]=-sin(theta);
rot_mat[0][2]=m;
rot_mat[1][0]=sin(theta);
rot_mat[1][1]=cos(theta);
rot_mat[1][2]=n;
```

```
rot_mat[2][0]=0;
rot_mat[2][1]=0;
rot_mat[2][2]=1;
multiply();
}
void drawhouse()
{
glColor3f(0.0,0.0,1.0);
glBegin(GL_LINE_LOOP);
glVertex2f(house[0][0],house[1][0]);
glVertex2f(house[0][1],house[1][1]);
glVertex2f(house[0][3],house[1][3]);
glVertex2f(house[0][4],house[1][4]);
glEnd();
glColor3f(1.0,0.0,0.0);
glBegin(GL_LINE_LOOP);
glVertex2f(house[0][5],house[1][5]);
glVertex2f(house[0][6],house[1][6]);
glVertex2f(house[0][7],house[1][7]);
glVertex2f(house[0][8],house[1][8]);
glEnd();
glColor3f(0.0,0.0,1.0);
glBegin(GL_LINE_LOOP);
glVertex2f(house[0][1],house[1][1]);
glVertex2f(house[0][2],house[1][2]);
glVertex2f(house[0][3],house[1][3]);
glEnd();
}
void drawrotatedhouse()
{
glColor3f(0.0,0.0,1.0);
glBegin(GL_LINE_LOOP);
glVertex2f(result[0][0],result[1][0]);
glVertex2f(result[0][1],result[1][1]);
glVertex2f(result[0][3],result[1][3]);
glVertex2f(result[0][4],result[1][4]);
glEnd();
glColor3f(1.0,0.0,0.0);
glBegin(GL_LINE_LOOP);
glVertex2f(result[0][5],result[1][5]);
glVertex2f(result[0][6],result[1][6]);
glVertex2f(result[0][7],result[1][7]);
```

```
glVertex2f(result[0][8],result[1][8]);
glEnd();
glColor3f(0.0,0.0,1.0);
glBegin(GL_LINE_LOOP);
glVertex2f(result[0][1],result[1][1]);
glVertex2f(result[0][2],result[1][2]);
glVertex2f(result[0][3],result[1][3]);
glEnd();
}
void display()
{
glClear(GL_COLOR_BUFFER_BIT);//to avoid previous output
glClearColor(1.0,1.0,1.0,1.0);//to set background color
drawhouse();
rotate();
drawrotatedhouse();
glFlush();
}
void init()
{
//glColor3f(1.0,0.0,0.0);
//glPointSize(1.0);
glMatrixMode(GL_PROJECTION);
glLoadIdentity();
gluOrtho2D(0.0,499.0,0.0,499.0);
}
void main(int argc,char **argv)
{
printf("\nEnter the rotation angle: ");
scanf("%f",&theta);
theta=theta*(3.14/180.0);
glutInit(&argc,argv);
glutInitWindowSize(600,600);
glutInitWindowPosition(0,0);
glutCreateWindow("House rotation");
init();
glutDisplayFunc(display);
glutMainLoop();
}
```

Output:



5. Program to implement the Cohen-Sutherland line-clipping algorithm. Make provision to specify the input line, window for clipping and view port for displaying the clipped image

```
//Program 5-Cohen sutheland line clipping

#include<GL/glut.h>

//#define outcode int

GLdouble xmin=50,ymin=50,xmax=100,ymax=100;

GLdouble xvmin=250,yvmin=250,xvmax=300,yvmax=300;

const int RIGHT=8;

const int TOP=4;

const int LEFT=2;

const int BOTTOM=1;

int computeoutcode(GLdouble x, GLdouble y)

{

int code=0;

if(y>ymax)

{

code=code|TOP;

}if(y<ymin)

{

code=code|BOTTOM;

}if(x>xmax)

{

code=code|RIGHT;

}if(x<xmin)

{
```

```
code=code|LEFT;
}return code;
}
void CSlineclipdraw(GLdouble x0,GLdouble y0,GLdouble x1,GLdouble y1)
{
int outcode0,outcode1,outcodeout;
bool accept=false;
bool done=false;
outcode0=computeoutcode(x0,y0);
outcode1=computeoutcode(x1,y1);
do
{
if((outcode0|outcode1)==0000)
{
accept=true;
done=true;
}else if((outcode0 & outcode1)!=0000)
{
accept=false;
done=true;
}
else
{
   GLdouble x,y;
if(outcode0!=0000)
```

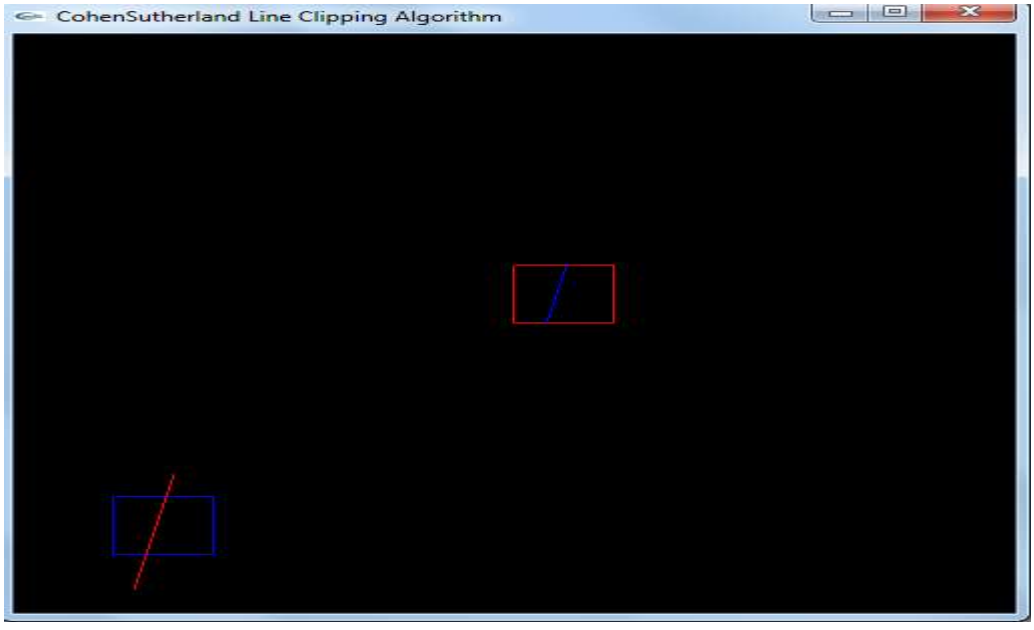
```
{
outcodeout=outcode0;
}else
{
outcodeout=outcode1;
}if(outcodeout & TOP)
{
x=x0+(x1-x0)*(ymax-y0)/(y1-y0);
y=ymax;
}if(outcodeout & BOTTOM)
{
x=x0+(x1-x0)*(ymin-y0)/(y1-y0);
y=ymin;
}if(outcodeout & RIGHT)
{
x=xmax;
y=y0+(y1-y0)*(xmax-x0)/(x1-x0);
}if(outcodeout & LEFT)
{
x=xmin;
y=y0+(y1-y0)*(xmin-x0)/(x1-x0);
}if(outcodeout==outcode0)
{
x0=x;
y0=y;
```

```
outcode0=computeoutcode(x0,y0);
}if(outcodeout==outcode1)
{
x1=x;
y1=y;
outcode1=computeoutcode(x1,y1);
}
}
}while(!done);
if(accept=true)
{
glColor3f(1.0,0.0,0.0);
glBegin(GL_LINE_LOOP);
glVertex2f(xvmin,yvmin);
glVertex2f(xvmax,yvmin);
glVertex2f(xvmax,yvmax);
glVertex2f(xvmin,yvmax);
glEnd();
GLdouble vx0=x0+(xvmin-xmin);
GLdouble vy0=y0+(yvmin-ymin);
GLdouble vx1=x1+(xvmin-xmin);
GLdouble vy1=y1+(yvmin-ymin);
glColor3f(0.0,0.0,1.0);
glBegin(GL_LINES);
glVertex2d(vx0,vy0);
```

```
glVertex2d(vx1,vy1);
glEnd();
}
}
void display()
{
glClear(GL_COLOR_BUFFER_BIT); //TO CLEAR THE LAST OUTPUT AND
AVOID TRANSPARENCY
glClearColor(1.0,1.0,1.0,1.0); //TO SET BACKGROUND COLOR
GLdouble x0=60,y0=20,x1=80,y1=120;
glColor3f(0.0,0.0,1.0);
glBegin(GL_LINE_LOOP);
glVertex2f(xmin,ymin);
glVertex2f(xmax,ymin);
glVertex2f(xmax,ymax);
glVertex2f(xmin,ymax);
glEnd();
glColor3f(1.0,0.0,0.0);
glBegin(GL_LINES);
glVertex2d(x0,y0);
glVertex2d(x1,y1);
glEnd();
CSlineclipdraw(x0,y0,x1,y1);
glFlush();
}
```

```
void init()
{
glMatrixMode(GL_PROJECTION);
gluOrtho2D(0.0,500.0,0.0,500.0);
}
void main(int argc,char **argv)
{
glutInit(&argc,argv);
glutInitWindowSize(500,500);
glutInitWindowPosition(0,0);
glutCreateWindow("CohenSutherland Line Clipping Algorithm");
init();
glutDisplayFunc(display);
glutMainLoop();
}
```

Output:



6.Program to create a cylinder and a parallelepiped by extruding a circle and quadrilateral respectively. Allow the user to specify the circle and the quadrilateral.

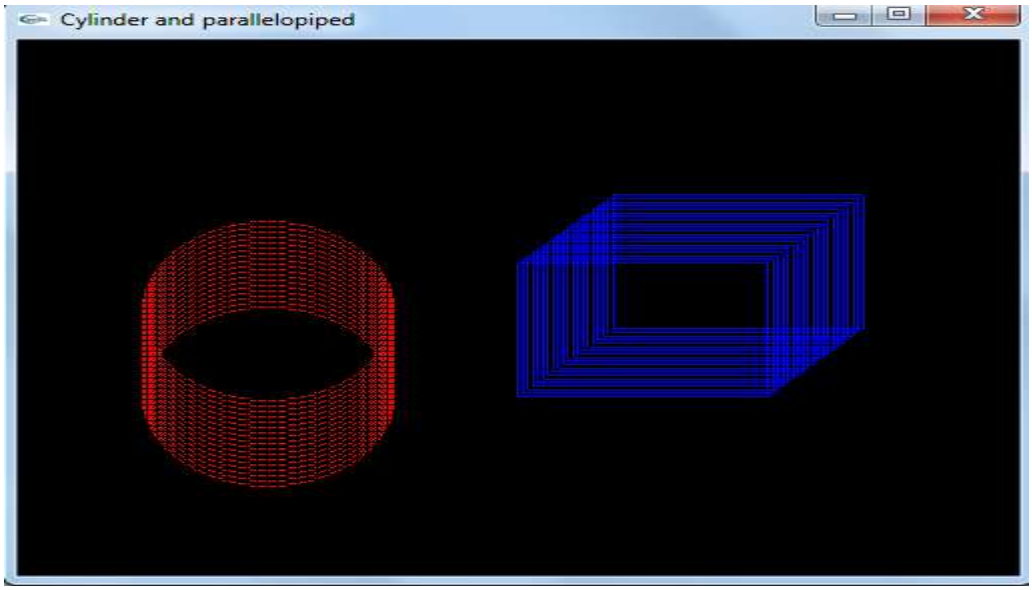
```
//Program 6-cylinde and parallelpiped

#include<GL/glut.h>

void draw_pixel(GLint m,GLint n)

{

glColor3f(1.0,0.0,0.0);

glBegin(GL_POINTS);

glVertex2i(m,n);

glEnd();

}

void plotpixels(GLint h,GLint k,GLint x,GLint y)

{

draw_pixel(x+h,y+k);

draw_pixel(-x+h,y+k);

draw_pixel(x+h,-y+k);

draw_pixel(-x+h,-y+k);

draw_pixel(y+h,x+k);

draw_pixel(-y+h,x+k);

draw_pixel(y+h,-x+k);

draw_pixel(-y+h,-x+k);

}

void circle_draw(GLint h,GLint k,GLint r)

{

GLint d=1-r,x=0,y=r;

plotpixels(h,k,x,y);
```

```
while(y>x)
{
if(d<0)
{
d+=2*x+3;
}
else
{
d+=2*(x-y)+5;
--y;
}
++x;
plotpixels(h,k,x,y);
}
}
void cylinder_draw()
{
GLint h=100,k=100,r=50;
GLint i,n=50;
for(i=0;i<n;i+=3)
{
circle_draw(h,k+i,r);
}
}
void rectangle_draw(GLint x1,GLint x2,GLint y1,GLint y2)
```

```
{
glColor3f(0.0,0.0,1.0);
glBegin(GL_LINE_LOOP);
glVertex2i(x1,y1);
glVertex2i(x2,y1);
glVertex2i(x2,y2);
glVertex2i(x1,y2);
glEnd();
}
void parallelopiped_draw()
{
GLint x1=200,x2=300,y1=100,y2=175;
GLint i,n=40;
for(i=0;i<n;i+=2)
{
rectangle_draw(x1+i,x2+i,y1+i,y2+i);
}
}
void init()
{
glMatrixMode(GL_PROJECTION);
gluOrtho2D(0.0,400.0,0.0,300.0);
}
void display()
{
```

```
glClear(GL_COLOR_BUFFER_BIT); //TO CLEAR THE LAST OUTPUT AND AVOID TRANSPARENCY

glClearColor(1.0,1.0,1.0,1.0); //TO SET BACKGROUND COLOR

cylinder_draw();

parallelopiped_draw();

glFlush();

}

void main(int argc,char**argv)

{

glutInit(&argc,argv);

glutInitWindowPosition(50,50);

glutInitWindowSize(500,400);

glutCreateWindow("Cylinder and parallelopiped");

init();

glutDisplayFunc(display);

glutMainLoop();

}
```

Output:



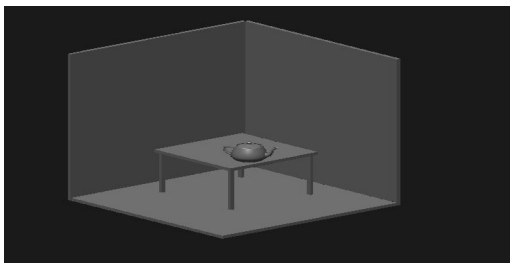
7. Program, using OpenGL functions, to draw a simple shaded scene consisting of a tea pot on a table. Define suitably the position and properties of the light source along with the properties of the properties of the surfaces of the solid object used in the scene.

```
//Program7-tea pot

#include <GL/glut.h>
#include <stdio.h>
#include <stdlib.h>


void wall(double thickness)
{
	glPushMatrix();
		glTranslated(0.5,0.5*thickness,0.5);
		glScaled(1.0,thickness,1.0);
		glutSolidCube(1.0);
	glPopMatrix();
}


void tableleg(double thick,double len)
{
	glPushMatrix();
		glTranslated(0,len/2,0);
		glScaled(thick,len,thick);
		glutSolidCube(1.0);
	glPopMatrix();
}


void table(double topw,double topt,double legt,double legl)
{
	glPushMatrix();
		glTranslated(0,legl,0);
		glScaled(topw,topt,topw);
		glutSolidCube(1.0);
	glPopMatrix();

	double dist=0.95*topw/2.0-legt/2.0;

	glPushMatrix();

		glTranslated(dist,0,dist);
		tableleg(legt,legl);

		glTranslated(0,0,-2*dist);
```

```
                tableleg(legt,legl);

                glTranslated(-2*dist,0,2*dist);
                tableleg(legt,legl);

                glTranslated(0,0,-2*dist);
                tableleg(legt,legl);
        glPopMatrix();
  }



void displaysolid(void)
{
        GLfloat mat_ambient[]={0.7f,0.7f,0.7f,1.0f};
         GLfloat mat_diffuse[]={0.5f,0.5f,0.5f,1.0f};
        GLfloat mat_specular[]={1.0f,1.0f,1.0f,1.0f};
        GLfloat mat_shininess[]={50.0f};

        glMaterialfv(GL_FRONT,GL_AMBIENT,mat_ambient);
        glMaterialfv(GL_FRONT,GL_DIFFUSE,mat_diffuse);
        glMaterialfv(GL_FRONT,GL_SPECULAR,mat_specular);
        glMaterialfv(GL_FRONT,GL_SHININESS,mat_shininess);

        GLfloat lightint[]={0.7f,0.7f,0.7f,1.0f};
        GLfloat lightpos[]={2.0f,6.0f,3.0f,0.0f};

        glLightfv(GL_LIGHT0,GL_POSITION,lightpos);
        glLightfv(GL_LIGHT0,GL_DIFFUSE,lightint);

        glMatrixMode(GL_PROJECTION);
        glLoadIdentity();
        double winht=1.0;
        glOrtho(-winht*64/48.0,winht*64/48.0,-winht,winht,0.1,100.0);
        glMatrixMode(GL_MODELVIEW);
        glLoadIdentity();
        gluLookAt(2.3,1.3,2.0,0.0,0.25,0.0,0.0,1.0,0.0);
        glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT);

        glPushMatrix();
                glRotated(90.0,0.0,0.0,1.0);
                wall(0.02);
        glPopMatrix();
                wall(0.02);
        glPushMatrix();
```

```
                glRotated(-90.0,1.0,0.0,0.0);
                wall(0.02);
        glPopMatrix();

        glPushMatrix();
                        glTranslated(0.4,0,0.4);
                table(0.6,0.02,0.02,0.3);
         glPopMatrix();



         glPushMatrix();
                glTranslated(0.6,0.38,0.5);
                glRotated(30,0,1,0);
                glutSolidTeapot(0.08);
         glPopMatrix();

        glFlush();

}


int main(int argc,char**argv)
{
        glutInit(&argc,argv);
        glutInitDisplayMode(GLUT_SINGLE|GLUT_RGB|GLUT_DEPTH);
        glutInitWindowSize(500,500);
        glutInitWindowPosition(0,0);
        glutCreateWindow("teapot");
        glutDisplayFunc(displaysolid);
        glEnable(GL_LIGHTING);
        glEnable(GL_LIGHT0);
        glShadeModel(GL_SMOOTH);
        glEnable(GL_DEPTH_TEST);
        glEnable(GL_NORMALIZE);
        glClearColor(0.1,0.1,0.1,0.0);
        glViewport(0,0,640,480);
        glutMainLoop();
}
```

Output:



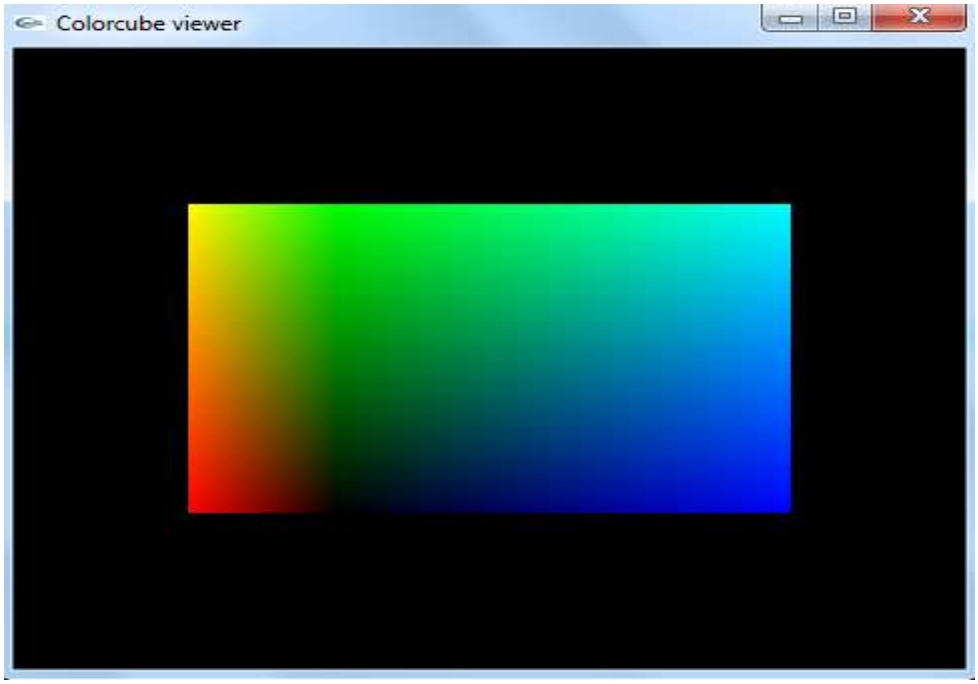
8. Program to draw a color cube and allow the user to move the camera suitably to experiment with perspective viewing. Use OpenGL functions.

```
//Program8-color cube
#include<GL/glut.h>
GLfloat vertices[][3]={{-1.0,-1.0,-1.0},{1.0,-1.0,-1.0},
{1.0,1.0,-1.0},{-1.0,1.0,-1.0},{-1.0,-
1.0,1.0},
{1.0,-1.0,1.0},{1.0,1.0,1.0},{-
1.0,1.0,1.0}}; //VERTICES OF THE CUBE
GLfloat colors[][3]={{-1.0,-1.0,-1.0},{1.0,-1.0,-1.0},
{1.0,1.0,-1.0},{-1.0,1.0,-1.0},{-1.0,-
1.0,1.0},
{1.0,-1.0,1.0},{1.0,1.0,1.0},{-
1.0,1.0,1.0}}; //COLOR ASSOCIATED WITH EACH VERTEX
GLubyte
cubeIndices[]={0,3,2,1,2,3,7,6,0,4,7,3,1,2,6,5,4,5,6,7,0,1,5,4
};
static GLfloat theta[]={0.0,0.0,0.0};
static GLint axis=2;
static GLint viewer[]={0.0,0.0,5.0};
void display()
{
glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT);
glLoadIdentity();
gluLookAt(viewer[0],viewer[1],viewer[2],0.0,0.0,0.0,0.0,1.0,0.0);
glRotatef(theta[0],1.0,0.0,0.0);
```

```
glRotatef(theta[1],0.0,1.0,0.0);
glRotatef(theta[2],0.0,0.0,1.0);
glDrawElements(GL_QUADS,24,GL_UNSIGNED_BYTE,cubeIndices);
glutSwapBuffers();
glFlush();
}
void mouse(int btn,int state,int x,int y)
{
if(btn==GLUT_LEFT_BUTTON && state==GLUT_DOWN)axis=0;
if(btn==GLUT_MIDDLE_BUTTON && state==GLUT_DOWN)axis=1;
if(btn==GLUT_RIGHT_BUTTON && state==GLUT_DOWN)axis=2;
theta[axis]=theta[axis]+2.0;
if(theta[axis]>360.0)
{
theta[axis]=theta[axis]-360.0;
display();
}
void keys(unsigned char key,int x,int y)
{
if(key=='x')viewer[0]=viewer[0]-1.0;
if(key=='X')viewer[0]=viewer[0]+1.0;
if(key=='y')viewer[1]=viewer[1]-1.0;
if(key=='Y')viewer[1]=viewer[1]+1.0;
if(key=='z')viewer[2]=viewer[2]-1.0;
if(key=='Z')viewer[2]=viewer[2]+1.0;
```

```
display();
}
void init()
{
glMatrixMode(GL_PROJECTION);
glOrtho(-2.0,2.0,-2.0,2.0,-10.0,10.0);
glMatrixMode(GL_MODELVIEW);
}
void main(int argc,char **argv)
{
glutInit(&argc,argv);
glutInitDisplayMode(GLUT_DOUBLE);
glutInitWindowSize(600,600);
glutCreateWindow("Colorcube viewer");
init();
glutDisplayFunc(display);
glutMouseFunc(mouse);
glutKeyboardFunc(keys);
glEnable(GL_DEPTH_TEST);
glEnableClientState(GL_VERTEX_ARRAY);
glVertexPointer(3,GL_FLOAT,0,vertices);
glEnableClientState(GL_COLOR_ARRAY);
glColorPointer(3,GL_FLOAT,0,colors);
glutMainLoop();
}
```

Output:



9. Program to fill any given polygon using scan-line area filling algorithm. (Use appropriate data structures.)

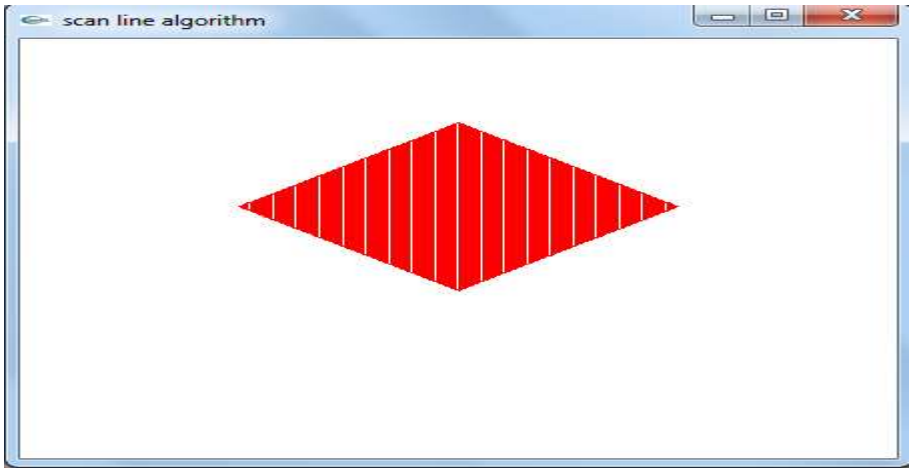
```
//Program 9-scanfill
#include<GL/glut.h>
GLint x1=200,x2=100,x3=200,x4=300,y1=200,y2=300,y3=400,y4=300;
void edgedetect(GLint x1,GLint y1,GLint x2,GLint y2,GLint *le,GLint *re)
{
float mx,x,temp;
int i;
if((y2-y1)<0)
{
temp=y1;y1=y2;y2=temp;
temp=x1;x1=x2;x2=temp;
}
if((y2-y1)!=0)
{
mx=(x2-x1)/(y2-y1);
}else
{
mx=x2-x1;
}
x=x1;
for(i=y1;i<y2;i++)
{
if(x<le[i])
{
```

```
le[i]=x;
}
if(x>re[i])
{
re[i]=x;
}x
+=mx;
}
}
void draw_pixel(int m,int n)
{
glColor3f(1.0,0.0,0.0);
glBegin(GL_POINTS);
glVertex2i(m,n);
glEnd();
}
void scanfill()
{
int le[500],re[500];
int i,y;
for(i=0;i<500;i++)
{
le[i]=500;
re[i]=0;
}
```

```
edgedetect(x1,y1,x2,y2,le,re);
edgedetect(x2,y2,x3,y3,le,re);
edgedetect(x3,y3,x4,y4,le,re);
edgedetect(x4,y4,x1,y1,le,re);
for(y=0;y<500;y++)
{
for(i=le[y];i<=re[y];i++)
{
draw_pixel(i,y);
}
}
}
void display()
{
glClear(GL_COLOR_BUFFER_BIT); //TO AVOID TRANSPARENCY AND REMOVE LAST OUTPUT
glClearColor(1.0,1.0,1.0,0.0); //TO SET BACKGROUND COLOR
glBegin(GL_LINE_LOOP);
glVertex2f(x1,y1);
glVertex2f(x2,y2);
glVertex2f(x3,y3);
glVertex2f(x4,y4);
glEnd();
scanfill();
glFlush();
```

```
}

void init()

{

glMatrixMode(GL_PROJECTION);

gluOrtho2D(0.0,400.0,0.0,500.0); //these 4 parameters will give us a RHOMBUS,
whereas(0.0,400.0,0.0,300.0) will give a triangle

}

void main(int argc,char **argv)

{

glutInit(&argc,argv);

glutInitWindowPosition(50,50);

glutInitWindowSize(800,600);

glutCreateWindow("scan line algorithm");

glutDisplayFunc(display);

init();

glutMainLoop();

}
```

Output:



10. Program to display a set of values {fij} as a rectangular mesh.

```
//Program10-Mesh

#include<GL/glut.h>
#define maxx 20
#define maxy 25
#define dx 15
#define dy 10
GLint x[maxx],y[maxy];
GLint x0=50,y0=50;
GLint i,j;
void init()
{
glClearColor(1.0,1.0,1.0,1.0); //TO SET BACKGROUND COLOR
glMatrixMode(GL_PROJECTION);
gluOrtho2D(0.0,500.0,0.0,400.0);
}
void display()
{
glClear(GL_COLOR_BUFFER_BIT); //TO AVOID TRANSPARENCY
for(i=0;i<maxx;i++)
{
x[i]=x0+i*dx;
}for(j=0;j<maxy;j++)
{
y[j]=y0+j*dy;
}
for(i=0;i<maxx-1;i++)
{
for(j=0;j<maxy-1;j++)
{
glColor3f(0.0,0.0,1.0);
glBegin(GL_LINE_LOOP);
glVertex2i(x[i],y[j]);
glVertex2i(x[i],y[j+1]);
glVertex2i(x[i+1],y[j+1]);
glVertex2i(x[i+1],y[j]);
glEnd();
glFlush();
}
}
}
void main(int argc,char **argv)
{
glutInit(&argc,argv);
glutInitWindowPosition(0,0);
```

```
glutInitWindowSize(500,400);
glutCreateWindow("rectangular Mesh");
init();
glutDisplayFunc(display);
glutMainLoop();
}
```

Output: