Certificate

Name: SANJANA · G · B Class: 7'C'

Roll No: 1RV17CS138 Exam No:

Institution R.V. COLLEGE OF ENGINEERING

This is certified to be the bonafide work of the student in the COMPUTER GRAPHICS *Laboratory during the academic year 20 / 20 .*

No of practicals certified _____ *out of* _____ *in the subject of* _____

.....

Teacher In-charge

.....

Examiner's Signature

.....

Principal

Date: .....

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(N.B: The candidate is expected to retain his/her journal till he/she passes in the subject.)

Index

Sl No.	Name of the Experiment	Page No.	Date of Experiment	Date of Submission	Remarks
1	Generate line using Bresenham's line drawing	1	24-10-20	24-10-20	
2.	Generate a circle using Bresenham's circle drawing	9	24-10-20	24-10-20	
3	Recursively divide a tetrahedron to form 3D sierpinski gasket	21	24-10-20	24-10-20	
4.	Fill a polygon using scan line fill algorithm	25	8-11-20	8-11-20	
5.	Create a house and rotate about a point and reflect about an axis	29	25-11-20	25-11-20	
6.	Implement cohen-sutherland line clipping algorithm	35	25-11-20	25-11-20	
7	Implement liang barsky line clipping algorithm	41	8-12-20	8-12-20	
8	Implement cohen hodgeman polygon clipping algorithm	49	26-12-20	26-12-20	
9	Display car using display list	57	26-12-20	26-12-20	
10	Create color cube and spin using OpenGL transformations	63	26-12-20	26-12-20	
11	Construct limacon, cardoid, three leaf, spiral	69	26-12-20	26-12-20	

Index

Sl No.	Name of the Experiment	Page No.	Date of Experiment	Date of Submission	Remarks
12	Construct Bezier curve	77	26-12-20	26-12-20	

Date 24/10/20

Expt. No. 1

Page No. 1

1. Program 1 - Write a program to generate a line using Bresenham's line drawing technique. Consider slopes greater than one and less than one. User can specify inputs through keyboard / mouse

```
#include <iostream.h>
#include <GL/glut.h>
#include <time.h>
using namespace std;
int x1, x2, y1, y2
void draw_pixel(int x, int y)
{
        glColor3f(1,0,0);
        glBegin(GL_Points);
        glVertex2i(x, y);
        glEnd();
        glFlush();
}
void draw_line()
{
    int dx, dy, i, e, incx, incy, inc1, inc2, x, y;
    dx = x2-x1; dy = y2-y1;
    if (dx<0) dx = -dx;
    if (dy<0) dy = -dy;
    incx = 1;
    if (x2<x1) incx = -1;
    incy = 1;
    if (y2<y1) incy = -1;
    x = x1; y = y1;
```

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```
#include <iostream>
#include <GL/glut.h>
#include <time.h>
using namespace std;
int x1, x2, yc1, y2;
int flag = 0;

void draw_line()
{
        int dx, dy, i, e;
        int incx, incy, inc1, inc2;
        int x, y;
        dx = x2 - x1;
        dy = y2 - yc1;
        if (dx < 0)dx = -dx;
        if (dy < 0)dy = -dy;
        incx = 1;
        if (x2 < x1)
                incx = -1;
        incy = 1;
        if (y2 < yc1)
                incy = -1;
        x = x1;
        y = yc1;
        if (dx > dy)
        {
                draw_pixel(x, y);
                e = 2 * dy - dx;
                inc1 = 2 * (dy - dx);
                inc2 = 2 * dy;
                for (i = 0; i < dx; i++)
                {
                        if (e > 0)
                        {
                                y += incy;
                                e += inc1;
                        }
                        else
                                e += inc2;
                        x += incx;
                        draw_pixel(x, y);
                }
        }
        else
        {
                draw_pixel(x, y);
                e = 2 * dx - dy;
                inc1 = 2 * (dx - dy);
                inc2 = 2 * dx;
                for (i = 0; i < dy; i++)
                {
                        if (e > 0)
                        {
                                x += incx;
                                e += inc1;
                        }
                        else
                                e += inc2;
                        y += incy;

                        draw_pixel(x, y);
                }
        }
        glFlush();
}
void draw_pixel(int x, int y)
{
        glColor3f(1, 0, 0);
        glBegin(GL_POINTS);
        glVertex2i(x, y);
        glEnd();
        glFlush();

}

void myinit()
{
        glClear(GL_COLOR_BUFFER_BIT);
        glClearColor(1, 1, 1, 1);
        gluOrtho2D(-250, 250, -250, 250);
}
```

```
if (dx > dy)
{
    draw_pixel (x,y);
    e = 2*dy - dx;
    inc1 = 2*(dy - dx); inc2 = 2*dy;
    for (i=0; i< dx; i++)
    {
        if (e > 0)
        {
            y += incy;
            e += inc1;
        }
        else  e += inc2
        x += incx;
        draw_pixel (x,y);
    }
}
else
{
    draw_pixel (x,y);
    e = 2*dx - dy;
    inc1 = 2*(dx - dy); inc2 = 2*dx;
    for (i=0; i< dy; i++)
    {
        if (e>0)
        {
            x += incx;
            e += inc1;
        }
```

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```
void MyMouse(int button, int state, int x, int y)
{
        switch (button)
        {
        case GLUT_LEFT_BUTTON:
                if (state == GLUT_DOWN)
                {
                        if (flag == 0)
                        {
                                printf("Defining x1,y1");
                                x1 = x - 250;
                                yc1 = 250 - y;
                                flag++;
                                cout << x1 << " " << yc1 << " \n";
                        }
                        else
                        {
                                printf("Defining x2,y2");
                                x2 = x - 250;
                                y2 = 250 - y;
                                flag = 0;
                                cout << x2 << " " << y2 << " \n";
                                draw_line();

                        }

                }
                break;
        }
}
void display()
{}
int main(int ac, char* av[])
{

        //KEYBOARD
        cout<<"X1\n";
        cin>>x1;
        cout<<"Y1\n";
        cin>>yc1;
        cout<<"X2\n";
        cin>>x2;
        cout<<"Y2\n";
        cin>>y2;

        glutInit(&ac, av);
        glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
        glutInitWindowSize(500, 500);
        glutInitWindowPosition(100, 200);
        glutCreateWindow("LINE");
        myinit();
        glutMouseFunc(MyMouse);
        draw_line();
        glutDisplayFunc(display);
        glutMainLoop();
}
```

```
        else    e+ = inc 2;
        y+ = incy;
        draw_pixel (x, y);
    }
}
    glFlush();
}
void my mouse (int button, int state, int x, int y)
{
    switch (button)
    {
    case GLUT_LEFT_BUTTON:
        if (state == GLUT_DOWN)
        {
            if(flag == 0)
            {
                printf ("Defining x1, y1");
                x1 = x - 250;
                yc1 = 250 - y;
                flag ++;
                cout << x1 << " " << yc1 << "\n";
            }
            else
            {
                printf ("Defining x2, y2");
                x2 = x - 250;
                y2 = 250 - y;
                flag = 0;
                cout << x2 << " " << y2 << "\n";
```

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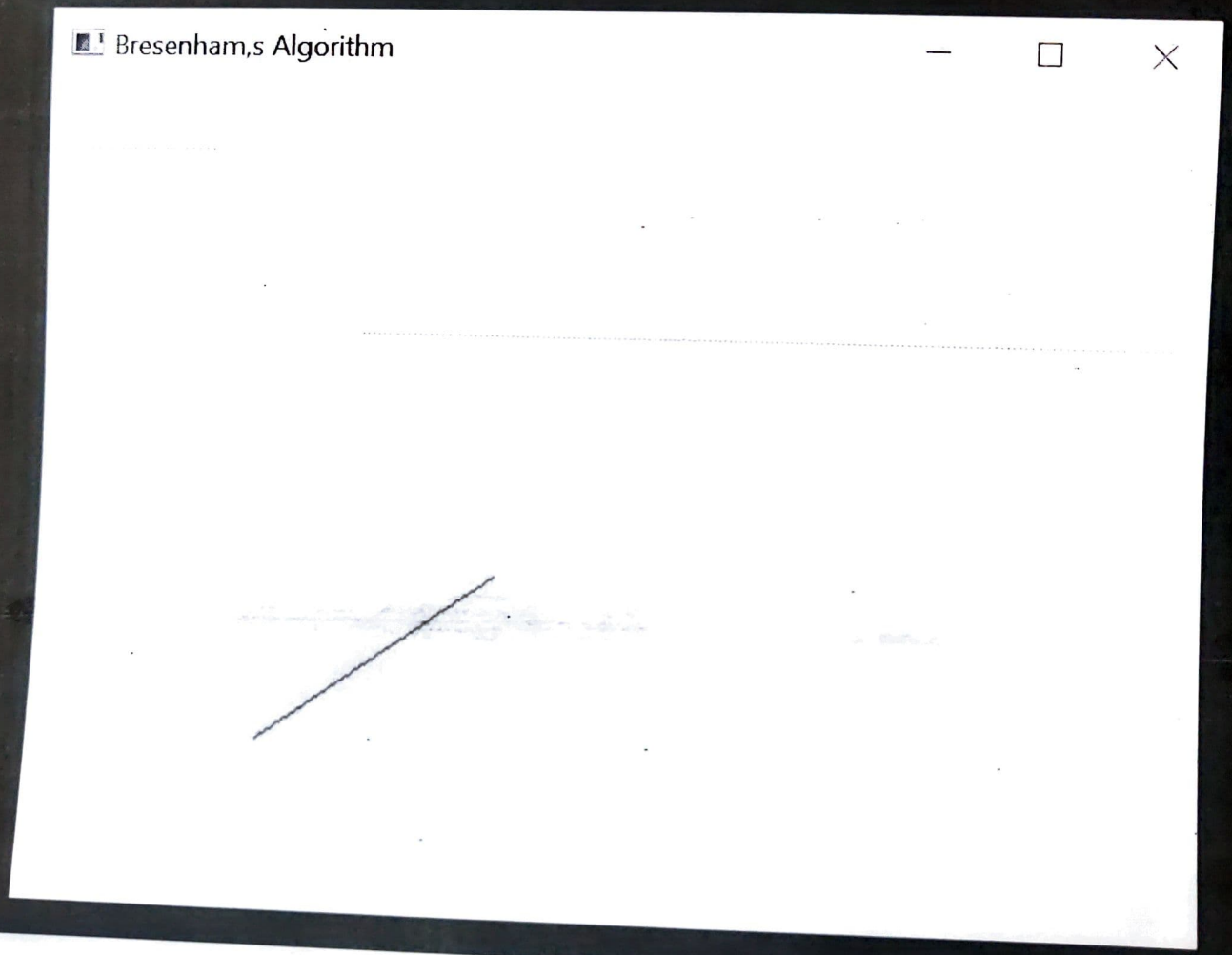
C:\Users\gvsan\Desktop\Sanjana 7th Sem\OpenGL_programs\Sample_Project\Debug\Sample_Project.exe

```
Enter points: x1, y1, x2, y2100 100 200 200
```



```
            draw_line();
        }
    }
    break;
  }
}
int main(int argc, char *argv[])
{
    cout << "X1, Y1, X2, Y2\n";
    cin >> x1 >> y1 >> x2 >> y2;
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
    glutInitWindowSize(500,500);
    glutInitWindowPosition(100,200);
    glutCreateWindow("LINE");
    MyInit();
    glutMouseFunc(MyMouse);
    glutMainLoop();
}
```

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```
#include<gl/glut.h>
#include<stdio.h>
#include<math.h>
int xc, yc, r;
int rx, ry, xce, yce;

//Circle
void draw_circle(int xc, int yc, int x, int y)
{
        glBegin(GL_POINTS);
        glVertex2i(xc + x, yc + y);
        glVertex2i(xc - x, yc + y);
        glVertex2i(xc + x, yc - y);
        glVertex2i(xc - x, yc - y);
        glVertex2i(xc + y, yc + x);
        glVertex2i(xc - y, yc + x);
        glVertex2i(xc + y, yc - x);
        glVertex2i(xc - y, yc - x);
        glEnd();
}

//Generate circle using Bresenham's circle drawing algorithm
void circlebres()
{
        glClear(GL_COLOR_BUFFER_BIT);
        int x = 0, y = r;
        int d = 3 - 2 * r;
        while (x <= y)
        {
                draw_circle(xc, yc, x, y);
                x++;
                if (d < 0)
                        d = d + 4 * x + 6;
                else
                {
                        y--;
                        d = d + 4 * (x - y) + 10;
                }
                draw_circle(xc, yc, x, y);
        }
        glFlush();
}
int p1_x, p2_x, p1_y, p2_y;
int point1_done = 0;
void myMouseFunccircle(int button, int state, int x, int y)
{
        if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN && point1_done == 0)
        {
                p1_x = x - 250;
                p1_y = 250 - y;
                point1_done = 1;
        }
        else if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN)
        {
                p2_x = x - 250;
                p2_y = 250 - y;
                xc = p1_x;
                yc = p1_y;
                float exp = (p2_x - p1_x) * (p2_x - p1_x) + (p2_y - p1_y) * (p2_y - p1_y);
                r = (int)(sqrt(exp));
                circlebres();
                point1_done = 0;
        }
}
//ELLIPSE
void draw_ellipse(int xce, int yce, int x, int y)
{
        glBegin(GL_POINTS);
        glVertex2i(x + xce, y + yce);
        glVertex2i(-x + xce, y + yce);
        glVertex2i(x + xce, -y + yce);
        glVertex2i(-x + xce, -y + yce);
        glEnd();
}

//Generate ellipse using Bresenham's ellipse drawing algorithm
void ellipsebres()
{
        glClear(GL_COLOR_BUFFER_BIT);
        float dx, dy, d1, d2, x, y;
        x = 0;
        y = ry;
```

2. Program 2 - Write a program to generate a circle using Bresenham's technique. User can specify inputs through keyboard // mouse.

```
#include <gl/glut.h>
#include <stdio.h>
#include <math.h>
int xc, yc, r;
int rx, ry, xci, yci;
void draw_circle(int xc, int yc, int x, int y)
{
        glBegin(GL_POINTS);
        glVertex2i(xc+x, yc+y);
        glVertex2i(xc-x, yc+y);
        glVertex2i(xc+x, yc-y);
        glVertex2i(xc-x, yc-y);
        glVertex2i(xc+y, yc+x);
        glVertex2i(xc-y, yc+x);
        glVertex2i(xc+y, yc-x);
        glVertex2i(xc-y, yc-x);
}
void circlebres()
{
    glClear(GL_COLOR_BUFFER_BIT);
    int x=0, y=r;
    int d=3-2*r;
    while(x<=y)
    {
        draw_circle(xc, yc, x, y);
```

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```
        d1 = (ry * ry) - (rx * rx * ry) +
                (0.25 * rx * rx);
        dx = 2 * ry * ry * x;
        dy = 2 * rx * rx * y;
        while (dx < dy)
        {
                draw_ellipse(xce, yce, x, y);
                // Checking and updating value of
                // decision parameter based on algorithm
                if (d1 < 0)
                {
                        x++;
                        dx = dx + (2 * ry * ry);
                        d1 = d1 + dx + (ry * ry);
                }
                else
                {
                        x++;
                        y--;
                        dx = dx + (2 * ry * ry);
                        dy = dy - (2 * rx * rx);
                        d1 = d1 + dx - dy + (ry * ry);
                }
        }
        // Decision parameter of region 2
        d2 = ((ry * ry) * ((x + 0.5) * (x + 0.5))) + ((rx * rx) * ((y - 1) * (y - 1))) - (rx * rx * ry * ry);
        // Plotting points of region 2 (slope>1)
        while (y >= 0)
        {
                // Print points based on 4-way symmetry
                draw_ellipse(xce, yce, x, y);

                // Checking and updating parameter
                // value based on algorithm
                if (d2 > 0)
                {
                        y--;
                        dy = dy - (2 * rx * rx);
                        d2 = d2 + (rx * rx) - dy;
                }
                else
                {
                        y--;
                        x++;
                        dx = dx + (2 * ry * ry);
                        dy = dy - (2 * rx * rx);
                        d2 = d2 + dx - dy + (rx * rx);
                }
        }
        glFlush();
}


int p1e_x, p2e_x, p1e_y, p2e_y, p3e_x, p3e_y;
int point1e_done = 0;
void myMouseFunc(int button, int state, int x, int y)
{
        if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN && point1e_done == 0)
        {
                p1e_x = x - 250;
                p1e_y = 250 - y;
                xce = p1e_x;
                yce = p1e_y;
                point1e_done = 1;
        }
        else if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN && point1e_done == 1)
        {
                p2e_x = x - 250;
                p2e_y = 250 - y;
                float exp = (p2e_x - p1e_x) * (p2e_x - p1e_x) + (p2e_y - p1e_y) * (p2e_y - p1e_y);
                rx = (int)(sqrt(exp));
                point1e_done = 2;
        }
        else if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN && point1e_done == 2)
        {
                p3e_x = x - 250;
                p3e_y = 250 - y;
                float exp = (p3e_x - p1e_x) * (p3e_x - p1e_x) + (p3e_y - p1e_y) * (p3e_y - p1e_y);
                ry = (int)(sqrt(exp));
                ellipsebres();
                point1e_done = 0;
        }
```

```
        x++
        if (d<0) d = d + 4*x + 6;
        else
        {
            y--;
            d = d + 4*(x-y)+10;
        }
        drawcircle(xc, yc, x, y);
    }
    glFlush();
}
int p1_x, p2_x, p1_y, p2_y, point1_done=0;
void myMouseFunction(int button, int state, int x, int
{
  if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN &&
   point1_done == 0)
  {
     p1_x = x-250;
     p1_y = 250-y;
     point1_done = 1;
  }
else if (button == GLUT_LEFT_BUTTON && state == GLUT_DO
  {
     p2_x = x-250; p2_y = 250-y;
     xc = p1_x; yc = p1_y;
     float exp = (p2_x-p1_x)*(p2_x-p1_x)+(p2_y-p1_y)*(p
                 -p1_y);
     r = (int)(sqrt(exp));
     circlebrs(); point1_done=0;
  }
}
```

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```
}
void myDrawing()
{ }
void myDrawingc()
{ }
void minit()
{                                                                                    //Clears t
        glClearColor(1, 1, 1, 1);
color (Fills the white color in background)                                          //Sets the
        glColor3f(1.0, 0.0, 0.0);
Color to Red
        glPointSize(3.0);
        //Sets the display of the graphic to 3.0                                     //Sets the window
        gluOrtho2D(-250, 250, -250, 250);
position
}
void main(int argc, char* argv[])
{                                                                                    //Initialis
        glutInit(&argc, argv);
Glut Window                                                          //Specifies Display Mode
        glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);                                 //Initialise Window
        glutInitWindowSize(500, 500);
size                                                                                 //Specifies Initial
        glutInitWindowPosition(0, 0);
Window position

        //FOR KEYBOARD
        printf("Enter 1 to draw circle , 2 to draw ellipse\n");
        int ch;
        scanf_s("%d", &ch);
        switch (ch) {
        case 1:
                printf("Enter coordinates of centre of circle and radius\n");
                scanf_s("%d%d%d", &xc, &yc, &r);
                glutCreateWindow("Circle");
                                        //Creates window with title "Circle"
                glutDisplayFunc(circlebres);
                                //Executes function circlebres
                break;
        case 2:
                printf("Enter coordinates of centre of ellipse and major and minor radius\n");
                scanf_s("%d%d%d%d", &xce, &yce, &rx, &ry);
                glutCreateWindow("Ellipse");
                                //Creates window with title "Ellipse"
                glutDisplayFunc(ellipsebres);
                                //Executes function ellipsebres
                break;
        }
        //END KEYBOARD
        minit();

                                                //Initialise Window colors and buffer bit
        glutMainLoop();
                                                //Refreshes window
}
```

```
void draw_ellipse (int xc, int yc, int x, int y)
{
    glBegin (GL_POINTS);
    glVertex2i ( x+xc, y+yc ); glVertex2i (-x+xc, y+yc);
    glVertex2i ( x+xc, -y+yc); glVertex2i (-x+xc, y+yc
    glEnd();
}
void midpointellipse ()
{
    glClear ( GL_COLOR_BUFFER_BIT);
    float dx, dy, d1, d2, x, y,
    x=0 ; y= ry;
    d1 = ( ry * ry ) - (rx * rx * y) + (0.25 * rx * rx),
    dx = 2*ry*ry*x ; dy = 2* rx * rx * y;
    while ( dx < dy)
    {
      draw_ellipse (xc, yc, x, y);
      if (d1<0)
      {
        x++ ;
        dx = dx + (2* ry * ry); d1 = d1 + dx + (ry * ry);
      }
      else
      {
          x++; y--;
          dx = dx+(2* ry * ry); dy = dy -(2* rx * rx)
          d1 = d1 + dx - dy + (ry * ry);
      }
}
```

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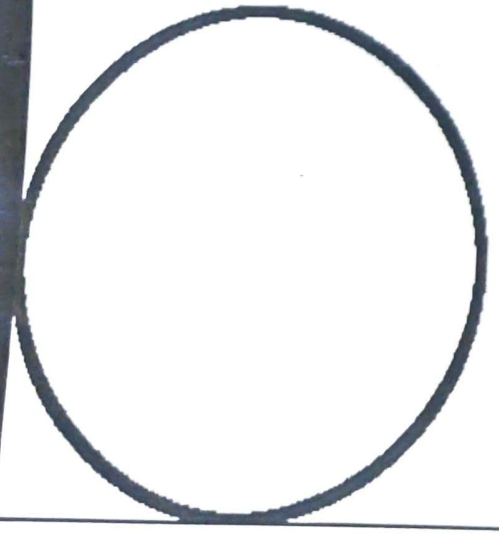
C:\Users\gvsan\Desktop\Sanjana 7th Sem\OpenGL_programs\Sample_Project\Debug\Sample_Project.exe

```
Enter coord of centre of circle & radius: 100
100
100
```

Bresenhams Circle



```
d2 = ((ry * ry) * ((x+0.5)*(x+0.5))) + ((rx * rx) * ((y-1)*(y-1))) - (rx*rx*ry*ry);
while (y>=0)
{
    draw_ellipse(xc, yc, x, y);
    if (d>0)
    {
        y--;
        dy = dy - (2*rx*rx); d2 = d2 + (rx*rx) - dy;
    }
    else
    {
        y--; x++;
        dx = dx + (2*ry*ry); dy = dy - (2*rx*rx);
        d2 = d2 + dx - dy + (rx*rx);
    }
}
glFlush();
}
int p1e_x, p2e_x, p1e_y, p2r_y, p3e_x, p3e_y;
int pointle_done = 0;
void myMouseFunc(int button, int state, int x, int y)
{
    if (button == GLUT_LEFT_BUTTON && state ==
        GLUT_DOWN && pointle_done == 0)
    {
        p1e_x = x-250; p1e_y = 250-y;
        xc = p1e_x; yc = p1e_y;
        pointle_done = 1;
```

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```
else if (button == GLUT_LEFT_DONE && state == GLUT_DOWN
        && pointle_done == 1)
{
  p2c_x = x - 250; p2c_y = 250 - y;
  float exp = (p2c_x - p1c_x)*(p2c_x - p1c_x) + (p2c_y - p1c_y)*(p2c_y - p1c_y);
  rx = (int)(sqrt(exp));
  point_done = 2;
}
else if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN &&
        pointle_done == 2)
{ p3c_x = x - 250; p3c_y = 250 - y;
  float exp = (p3c_x - p1c_x) * (p3c_x - p1c_x) + (p3c_y - p1c_y) *
        (p3c_y - p1c_y);
  ry = (int)(sqrt(exp));
  midptellipse();
  pointle_done = 0;
}
}
void mainit()
{
  glClearColor(1, 1, 1, 1);
  glColor3f (1.0, 0.0, 0.0);
  glPointSize (3.0);
  gluOrtho2D(-250, 250, -250, 250);
}
void main(int argc, char * argv[])
{
  glutInit(&argc, argv);
  glutInitDisplayMode (GLUT_SINGLE | GLUT_RGB
```

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```
glutInitWindowSize (500, 500);
glutInitWindowPosition (0, 0);
printf ("Enter 1 to draw circle, 2 to draw ellipse \n");
scanf ("%d", &ch);
switch (ch) {
case 1:
printf ("Enter circle coordinates, center ");
scanf ("%d%d", &xc, &yc);
scanf ("%d", &r);
glutCreateWindow ("Circle");
glutDisplayFunc (circledraw);
break;
case 2:
printf ("Enter coordinates and major and minor radius");
scanf ("%d %d %d %d", &xc, &yc, &rx, &ry);
glutCreateWindow ("Ellipse");
glutDisplayFunc (midptellipse);
break;
}
myinit ();
glutMainLoop();
}
```

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```
#include <GL\glew.h>
#include <GL\freeglut.h>
#include<iostream>
//#define M 5
typedef float point[3];
point tetra[4] = {
        {0,10,-10},
        {0,0,10},
        {10,-10,-10},
        {-10,-10,-10}
};
int M;

void draw_tetra(point a, point b, point c, point d) {
        glColor3f(0.0, 0.0, 0.0);
        draw_triangle(a, b, c);
        glColor3f(1.0, 0.0, 0.0);
        draw_triangle(a, c, d);
        glColor3f(0.0, 1.0, 0.0);
        draw_triangle(a, b, d);
        glColor3f(0.0, 0.0, 1.0);
        draw_triangle(b, c, d);
}

void draw_triangle(point a, point b, point c) {
        glBegin(GL_TRIANGLES);
        glVertex3fv(a);
        glVertex3fv(b);
        glVertex3fv(c);
        glEnd();
}

void divide_tetra(point a, point b, point c, point d, int i) {
        point v1, v2, v3, v4, v5, v6;
        if (i > 0) {
                for (int j = 0; j < 3; j++) {
                        v1[j] = (a[j] + b[j]) / 2;
                        v2[j] = (a[j] + c[j]) / 2;
                        v3[j] = (a[j] + d[j]) / 2;
                        v4[j] = (b[j] + c[j]) / 2;
                        v5[j] = (b[j] + d[j]) / 2;
                        v6[j] = (c[j] + d[j]) / 2;

                }
                divide_tetra(a, v1, v2, v3, i - 1);
                divide_tetra(v1, b, v4, v5, i - 1);
                divide_tetra(v2, v4, c, v6, i - 1);
                divide_tetra(v3, v5, v6, d, i - 1);

        }
        else
                draw_tetra(a, b, c, d);
}

void tetrahedron() {
        glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
        //glBegin(GL_TRIANGLES);
        divide_tetra(tetra[0], tetra[1], tetra[2], tetra[3], M);
        //glEnd();

        glFlush();
}

void myinit() {
        glClear(GL_COLOR_BUFFER_BIT);
        glClearColor(1, 1, 1, 1);
        glOrtho(-12.0, 12.0, -12.0, 12.0, -12.0, 12.0);
}
int main(int argv, char** argc)
{
        std::cout << "Enter the number of iterations: ";
        std::cin >> M;
        glutInit(&argv, argc);
        glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB | GLUT_DEPTH);
        glutInitWindowSize(900, 900);
        glutCreateWindow("Seirpinski Gasket");
        glutDisplayFunc(tetrahedron);
        glEnable(GL_DEPTH_TEST);
        myinit();
        glutMainLoop();
}
```

3. Program 3 - Write a program to recursively subdivides a tetrahedron to form 3D Sierpinski gasket. Number of steps to be specified during execution.

```
#include <gl/glut.h>
#include <stdio.h>
int n;
typedef float point[3];
point tetra[4] = {{0, 100, -100}, {0, 0, 100}, {100, -100, -100},
                  {-100, -100, -100}};
void tetrahedron(void);
void myinit(void);
void divide_triangle(point a, point b, point c, int m);
void draw_triangle(point p1, point p2, point p3);
int main(int argv, char ** argc)
{
    printf("Enter the number of iterations");
    scanf_s("%d", &n);
    glutInit(&argv, argc);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB | GLUT_DEPT
    glutInitWindowPosition(100, 200);
    glutCreateWindow("Sierpinski Gasket");
    glutDisplayFunc(tetrahedron);
    glEnable(GL_DEPTH_TEST);
    myInit();
    glutMainLoop();
}
void dividetriangle(point a, point b, point c, int
{
```

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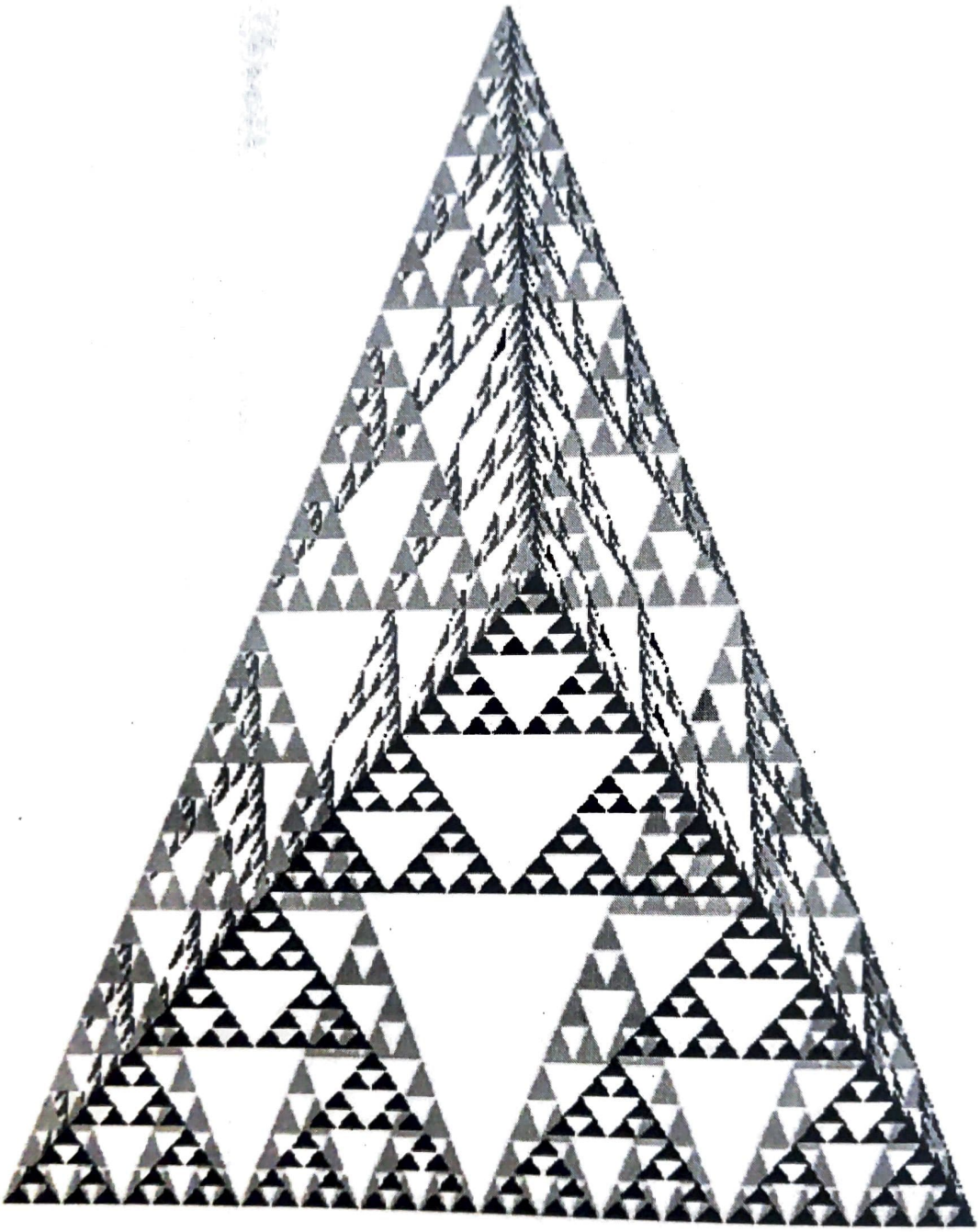
3D Gasket



```
    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] +b[j])/2;
     for(j=0; j<3, j++) v3[j] = (b[j] +c[j])/2;
divide_triangle(a,v1,v2,m-1); divide_triangle(b,v2,v3,m-1); divide_triangle(b,v3,v1,
}
// draw_triangle(a,b,c);
void myinit()
{
    glClearColor(1,1,1,1);
    glOrtho(-500.0, 500.0, -500.0, 500.0, -500.0, 500.0);
}
void tetrahedron(void)
{
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
    glColor3f(1,0,0); divide_triangle(tetra[0], tetra[1], tetra[2], n
    glColor3f(0,1,0); divide_triangle(tetra[3], tetra[2], tetra[1],
    glColor3f(0,0,1); divide_triangle(tetra[0], tetra[3], tetra[1]
    glColor3f(0,0,0); divide_triangle(tetra[0], tetra[2], tetra[3]
    glFlush();
}
void draw_triangle(point p1, point p2, point p3)
{
    glBegin(GL_TRIANGLES);
    glVertex3fv(p1);
    glVertex3fv(p2);
    glVertex3fv(p2);
    glEnd();
}
```

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```
#include<stdlib.h>
#include<gl/glut.h>
#include<algorithm>
#include<iostream>
#include<windows.h>
using namespace std;
float x[100], y[100];
int n, m;
int wx = 500, wy = 500;
static float intx[10] = { 0 };
void draw_line(float x1, float y1, float x2, float y2) {
        Sleep(100);
        glColor3f(1, 0, 0);
        glBegin(GL_LINES);
        glVertex2f(x1, y1);
        glVertex2f(x2, y2);
        glEnd();
        glFlush();

}
void edgeDetect(float x1, float y1, float x2, float y2, int scanline) {
        float temp;
        if (y2 < y1) {
                temp = x1; x1 = x2; x2 = temp;
                temp = y1; y1 = y2; y2 = temp;
        }
        if (scanline > y1 && scanline < y2)
                intx[m++] = x1 + (scanline - y1) * (x2 - x1) / (y2 - y1);
}
void scanfill(float x[], float y[]) {
        for (int s1 = 0; s1 <= wy; s1++) {
                m = 0;
                for (int i = 0; i < n; i++) {

                        edgeDetect(x[i], y[i], x[(i + 1) % n], y[(i + 1) % n], s1);
                }
                sort(intx, (intx + m));
                if (m >= 2)
                        for (int i = 0; i < m; i = i + 2)
                                draw_line(intx[i], s1, intx[i + 1], s1);
        }

}
void display_filled_polygon() {
        glClear(GL_COLOR_BUFFER_BIT);
        glLineWidth(2);
        glBegin(GL_LINE_LOOP);
        for (int i = 0; i < n; i++)
                glVertex2f(x[i], y[i]);
        glEnd();
        scanfill(x, y);
}
void myInit() {
        glClearColor(1, 1, 1, 1);
        glColor3f(0, 0, 1);
        glPointSize(1);
        gluOrtho2D(0, wx, 0, wy);

}
void main(int ac, char* av[]) {
        glutInit(&ac, av);
        printf("Enter no. of sides: \n");
        scanf_s("%d", &n);
        printf("Enter coordinates of endpoints: \n");
        for (int i = 0; i < n; i++)
        {
                printf("X-coord Y-coord: \n");
                scanf_s("%f %f", &x[i], &y[i]);
        }
        glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
        glutInitWindowSize(500, 500);
        glutInitWindowPosition(0, 0);
        glutCreateWindow("scanline");
        glutDisplayFunc(display_filled_polygon);
        myInit();
        glutMainLoop();

}
```

Date

Expt. No. 4 Page No. 25

4. Program 4 - Write a program to fill a given polygon using scan-line area filling algorithm

```
#include<stdlib.h>  #include<gl/glut.h>
#include<algorithm> #include<iostream> #include<windows.h>
using namespace std;
float x[100], y[100];
int n, m, wx=500, wy=500;
static float int x[10]={20};
void draw_line (float x1, float y1, float x2, float y2){
    glColor3f(1,0,0);
    glBegin(GL_LINES);
    glVertex2f(x1, y1); glVertex2f(x2, y2);
    glEnd();
    glFlush();
}
void edgeDetect(float x1, float y1, float x2, float y2, int
    scanline){
float temp;
if (y2<y1){
    temp = x1; x1=x2; x2= temp;
    temp = y1; y1=y2; y2 = temp; }
if (scanline>y1 && scanline<y2) int x[m++] = x1+(scanline-y1)*(x2-x1)/(y2-
}
void scanfill (float x[], float y[]){
  for (int s1=0; s1<=wy; s1++){
    m=0
    for (int i=0; i<n; i++){
      edgeDetect(x[i], y[i], x[(i+1)%n], y[(i+1)%n], s1);
```

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```
#include<gl/glut.h>
#include <math.h>
//#include<stdlib.h>
#include<stdio.h>
//RIGHT CLICK TO SHOW REFLECTED HOUSE
float house[11][2] = { { 100,200 },{ 200,250 },{ 300,200 },{ 100,200 },{ 100,100 },{ 175,100 },{ 175,150 },{ 225,150
},{ 225,100 },{ 300,100 },{ 300,200 } };
int angle;
float m, c, theta;

void display()
{
        glClearColor(1, 1, 1, 0);
        glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
        glMatrixMode(GL_PROJECTION);
        glLoadIdentity();
        gluOrtho2D(-450, 450, -450, 450);
        glMatrixMode(GL_MODELVIEW);
        glLoadIdentity();
        //NORMAL HOUSE
        glColor3f(1, 0, 0);
        glBegin(GL_LINE_LOOP);
        for (int i = 0; i < 11; i++)
                glVertex2fv(house[i]);
        glEnd();
        glFlush();
        //ROTATED HOUSE
        glPushMatrix();
        glTranslatef(100, 100, 0);
        glRotatef(angle, 0, 0, 1);
        glTranslatef(-100, -100, 0);
        glColor3f(1, 1, 0);
        glBegin(GL_LINE_LOOP);
        for (int i = 0; i < 11; i++)
                glVertex2fv(house[i]);
        glEnd();
        glPopMatrix();
        glFlush();
}

void display2()
{
        glClearColor(1, 1, 1, 0);
        glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
        glMatrixMode(GL_PROJECTION);
        glLoadIdentity();
        gluOrtho2D(-450, 450, -450, 450);
        glMatrixMode(GL_MODELVIEW);
        glLoadIdentity();
        //normal house
        glColor3f(1, 0, 0);
        glBegin(GL_LINE_LOOP);
        for (int i = 0; i < 11; i++)
                glVertex2fv(house[i]);
        glEnd();
        glFlush();
        // line
        float x1 = 0, x2 = 500;
        float y1 = m * x1 + c;
        float y2 = m * x2 + c;
        glColor3f(1, 1, 0);
        glBegin(GL_LINES);
        glVertex2f(x1, y1);
        glVertex2f(x2, y2);
        glEnd();
        glFlush();

        //Reflected
        glPushMatrix();
        glTranslatef(0, c, 0);
        theta = atan(m);
        theta = theta * 180 / 3.14;
        glRotatef(theta, 0, 0, 1);
        glScalef(1, -1, 1);
        glRotatef(-theta, 0, 0, 1);
        glTranslatef(0, -c, 0);
        glBegin(GL_LINE_LOOP);
        for (int i = 0; i < 11; i++)
                glVertex2fv(house[i]);
        glEnd();
        glPopMatrix();
        glFlush();
```

5. Write a program to create a house like structure and reflect it about an axis $y = mx + c$ and rotate about given fixed point.

```
#include <gl/glut.h>        #include <stdio.h>
#include <math.h>
float house[11][2] = {{100, 200}, {200,250}, {300, 200}, {100,200},
{100, 100}, {175, 100}, {175, 150}, {225, 150}, {225, 100}, {300,100}, {300,200}};
int angle;
float m, c, theta;
void display() {
  glClearColor(1,1,1,0);
  glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
  glMatrixMode(GL_PROJECTION); glLoadIdentity();
  glOrtho2D(-450, 450, -450, 450);
  glMatrixMode(GL_MODELVIEW); glLoadIdentity();
  glColor3f(1,0,0)
  glBegin(GL_LINE_LOOP);
  for(int i=0; i<11; i++) glVertex2fv(house[i]);
  glEnd();
  glFlush();
  glPushMatrix();
  glTranslatef(100, 100, 0);
  glRotatef(angle, 0, 0, 1);
  glTranslatef(-100, -100, 0);
  glColor3f(1,1,0)
  glBegin(GL_LINE_LOOP);
  for(int i=0; i<11; i++) glVertex2fv(house[i]);
  glEnd();
  glPopMatrix(); }
```

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```
}
void myInit() {
        glClearColor(1.0, 1.0, 1.0, 1.0);
        glColor3f(1.0, 0.0, 0.0);
        glLineWidth(2.0);
        glMatrixMode(GL_PROJECTION);
        glLoadIdentity();
        gluOrtho2D(-450, 450, -450, 450);
}
void mouse(int btn, int state, int x, int y) {
        if (btn == GLUT_LEFT_BUTTON && state == GLUT_DOWN) {
                display();
        }
        else if (btn == GLUT_RIGHT_BUTTON && state == GLUT_DOWN) {
                display2();
        }
}
void main(int argc, char** argv)
{
        printf("Enter the rotation angle\n");
        scanf_s("%d", &angle);
        printf_s("Enter c and m value for line y=mx+c\n");
        scanf_s("%f %f", &c, &m);
        glutInit(&argc, argv);
        glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
        glutInitWindowSize(900, 900);
        glutInitWindowPosition(100, 100);
        glutCreateWindow("House Rotation");
        glutDisplayFunc(display);
        glutMouseFunc(mouse);
        myInit();
        glutMainLoop();
}
```

```
void display2() {
    glClearColor(1,1,1,0);
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
    glMatrixMode(GL_PROJECTION); glLoadIdentity();
    glColor3f(1,0,0);
    glBegin(GL_LINE_LOOP);
    for(int i=0; i<11; i++) glVertex2fv(house[i]);
    glEnd(); glFlush();
    float x1=0, x2=500, y=m*x1+c, y2=m*x2+c;
    glColor3f(1,1,0);
    glBegin(GL_LINES);
    glVertex2f(x1,y1); glVertex2f(x2,y2);
    glEnd(); glFlush();
    glPushMatrix();
    glRotatef(0,0,0);
    theta = atan(m);
    theta = theta * 180/3.14;
    glRotate(theta,0,0,1); glScalef(1,-1,1);
    glRotate(-theta,0,0,1); glTranslatef(0,-c,0);
    glBegin(GL_LINE_LOOP)
    for(int i=0; i<11; i++) glVertex2fv(house[i]);
    glEnd();
    glPopMatrix();
    glFlush();
}
Void myInit() {
    glClearColor(1,1,1,1); glColor3f(1,0,0)
    glLineWidth(2.0); glMatrixMode(GL_PROJECTION)
    glLoadIdentity(); glOrtho2D(-450,450,-450,450);
```

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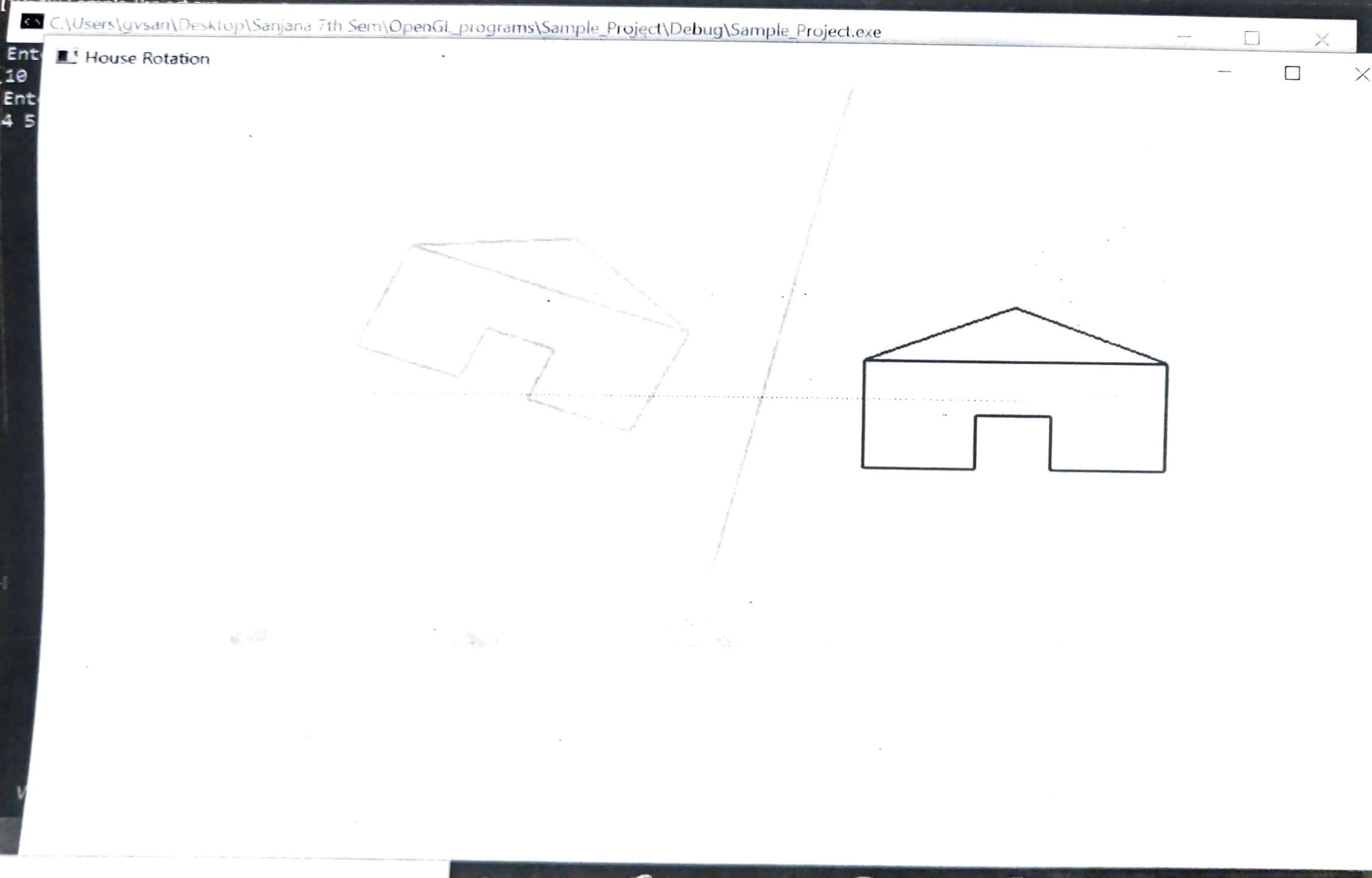
C:\Users\gvsan\Desktop\Sanjana 7th Sem\OpenGL_programs\Sample_Project\Debug\Sample_Project.exe
House Rotation

```
void mouse (int btn, int state, int x, int y){
    if (btn == GLUT_LEFT_BUTTON && state == GLUT_DOWN){
        display();}
    else if (btn == GLUT_RIGHT_BUTTON && state == GLUT_DOWN){
        display2();}
}
void main (int argc, char ** argv)
{
    printf ("Enter angle"); scanf ("%d", &angle);
    printf ("Enter c and m"); scanf ("%f, %f", &c, &m);
    glutInit (&argc, argv);
    glutInitDisplayMode (GLUT_SINGLE | GLUT_RGB);
    glutInitWindowSize (900, 900);
    glutInitWindowPosition (100, 100);
    glutCreateWindow ("House");
    glutDisplayFunc (display);
    glutMouseFunc (mouse);
    myInit();
    glutMainLoop();
}
```

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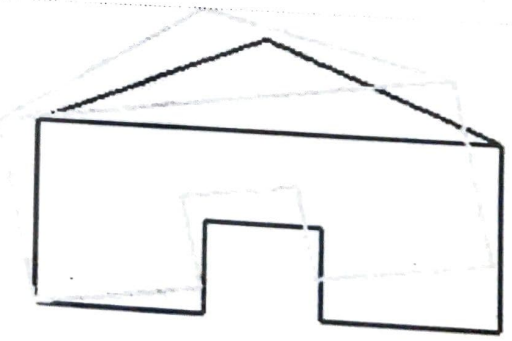
C:\Users\gvsan\Desktop\Sanjana 7th Sem\OpenGL_programs\Sample_Project\Debug\Sample_Project.exe

```
Enter the rotation angle
10
Enter c and m value for line y=mx+c
4 5
```

House Rotation



```
}voi
}vo
}>{
```

```
#include<stdio.h>
#include<stdlib.h>
#include<gl/glut.h>
#define outcode int
#define true 1
#define false 0
double xmin, ymin, xmax, ymax;
double xvmin, yvmin, xvmax, yvmax;
const int RIGHT = 4;
const int LEFT = 8;
const int TOP = 1;
const int BOTTOM = 2;
int n;
struct line_segment {
        int x1;
        int y1;
        int x2;
        int y2;
};
struct line_segment ls[10];
outcode computeoutcode(double x, double y)
{
        outcode code = 0;
        if (y > ymax)
                code |= TOP;
        else if (y < ymin)
                code |= BOTTOM;
        if (x > xmax)
                code |= RIGHT;
        else if (x < xmin)
                code |= LEFT;
        return code;
}
void cohensuther(double x0, double y0, double x1, double y1)
{
        outcode outcode0, outcode1, outcodeout;
        bool accept = false, done = false;
        outcode0 = computeoutcode(x0, y0);
        outcode1 = computeoutcode(x1, y1);
        do
        {
                if (!(outcode0 | outcode1))
                {
                        accept = true;
                        done = true;
                }
                else if (outcode0 & outcode1)
                        done = true;
                else
                {
                        double x, y;
                        outcodeout = outcode0 ? outcode0 : outcode1;
                        if (outcodeout & TOP)
                        {
                                x = x0 + (x1 - x0) * (ymax - y0) / (y1 - y0);
                                y = ymax;
                        }
                        else if (outcodeout & BOTTOM)
                        {
                                x = x0 + (x1 - x0) * (ymin - y0) / (y1 - y0);
                                y = ymin;
                        }
                        else if (outcodeout & RIGHT)
                        {
                                y = y0 + (y1 - y0) * (xmax - x0) / (x1 - x0);
                                x = xmax;
                        }
                        else
                        {
                                y = y0 + (y1 - y0) * (xmin - x0) / (x1 - x0);
                                x = xmin;
                        }

                        if (outcodeout == outcode0)
                        {
                                x0 = x;
                                y0 = y;
                                outcode0 = computeoutcode(x0, y0);
                        }
                        else
                        {
                                x1 = x;
```

6 Program 6 - Write a program to implement Cohen sutherland line clipping algorithm, Make provision to specify the input for multiple lines, window for clipping, viewport for displaying the image.

```
#includ<stdio.h> #includ<stdlib.h> #includ<gl/glut.
#defin outcode int #defin tru 1 #defin fals 0
doubl xmin, ymin, xmax, ymax; xvmin, yvmin, xvmax,
yvmax;
const int RIGHT = 1, LEFT = 1, TOP = 1, BOTTOM = 2,
int n;
struct line_segment {
    int x1, y1, x2, y2;
};
struct line_segment ls[10];
outcode computeoutcod (doubl x, doubl y)
{
    outcode code = 0;
    if (y > ymax) code |= TOP;
    if (y < ymin) code |= BOTTOM;
    if (x > xmax) code |= RIGHT;
    if (x < xmin) code |= LEFT);
    return code;
}
void cohensutherland (doubl x0, doubl y0, doubl x1, dou
{
    outcode code0, code1, outcodeout;
    bool accept, done = fals;
    outcode0 = computeoutcod (x0, y0);
    outcode1 = computeoutcode (x1, y1);
```

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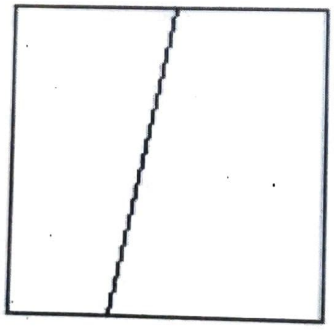
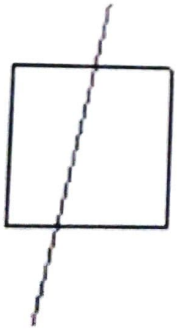
```
                                y1 = y;
                                outcode1 = computeoutcode(x1, y1);
                        }
                }

        } while (!done);
        if (accept)
        {
                double sx = (xvmax - xvmin) / (xmax - xmin);
                double sy = (yvmax - yvmin) / (ymax - ymin);
                double vx0 = xvmin + (x0 - xmin) * sx;
                double vy0 = yvmin + (y0 - ymin) * sy;
                double vx1 = xvmin + (x1 - xmin) * sx;
                double vy1 = yvmin + (y1 - ymin) * sy;
                glColor3f(1, 0, 0);
                glBegin(GL_LINE_LOOP);
                glVertex2f(xvmin, yvmin);
                glVertex2f(xvmax, yvmin);
                glVertex2f(xvmax, yvmax);
                glVertex2f(xvmin, yvmax);
                glEnd();
                glColor3f(0, 0, 1);
                glBegin(GL_LINES);
                glVertex2d(vx0, vy0);
                glVertex2d(vx1, vy1);
                glEnd();
        }
}
void display()
{
        glClear(GL_COLOR_BUFFER_BIT);
        glColor3f(0, 0, 1);
        glBegin(GL_LINE_LOOP);
        glVertex2f(xmin, ymin);
        glVertex2f(xmax, ymin);
        glVertex2f(xmax, ymax);
        glVertex2f(xmin, ymax);
        glEnd();
        for (int i = 0; i < n; i++)
        {
                glBegin(GL_LINES);
                glVertex2d(ls[i].x1, ls[i].y1);
                glVertex2d(ls[i].x2, ls[i].y2);
                glEnd();}
        for (int i = 0; i < n; i++)
                cohensuther(ls[i].x1, ls[i].y1, ls[i].x2, ls[i].y2);

        glFlush();
}
void myinit()
{
        glClearColor(1, 1, 1, 1);
        glColor3f(1, 0, 0);
        glPointSize(1.0);
        glMatrixMode(GL_PROJECTION);
        glLoadIdentity();
        gluOrtho2D(0, 500, 0, 500);
}

void main(int argc, char** argv)
{
        printf("Enter window coordinates (xmin ymin xmax ymax): \n");
        scanf_s("%lf%lf%lf%lf", &xmin, &ymin, &xmax, &ymax);
        printf("Enter viewport coordinates (xvmin yvmin xvmax yvmax) :\n");
        scanf_s("%lf%lf%lf%lf", &xvmin, &yvmin, &xvmax, &yvmax);
        printf("Enter no. of lines:\n");
        scanf_s("%d", &n);
        for (int i = 0; i < n; i++)
        {
                printf("Enter line endpoints (x1 y1 x2 y2):\n");
                scanf_s("%d%d%d%d", &ls[i].x1, &ls[i].y1, &ls[i].x2, &ls[i].y2);
        }
        glutInit(&argc, argv);
        glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
        glutInitWindowSize(500, 500);
        glutInitWindowPosition(0, 0);
        glutCreateWindow("clip");
        myinit();
        glutDisplayFunc(display);
        glutMainLoop();
}
```

```
do{if(!(outcode0|outcode1)){
      accept = true; done = true; }
else if (outcode0 & outcode1) done = true;
else {
    double x, y;
    outcodeout = outcode0 ? outcode0 : outcode1;
    if (outcodeout & TOP) {
    x = x0 + (x1-x0) * (ymax -y0) /(y1-y0); y= ymax;
    }
    else if (outcodeout & BOTTOM) {
     x = x0 + (x1 - x0) *(ymin -y0)/(y1-y0 ; y= ymin;
    }
    else if (outcodeout & RIGHT){
       y = y0 + (y1-y0) *(xmax - x0) /(x1-x0); x= xmax;
    }
    else {
        y = y0 + (y1-y0) *(xmin - x0) / (x1 - x0); x = xmin
    }
    if (outcodeout == outcode0)
    {
        x0 = x; y0 = y; outcode0 = computeoutcode(x0, y
    }
    else
    {
        x1 = y; y1 = y; outcode1 = computeoutcode(x1,
    }
}
} while(!done);
if (accept) {
```

Teacher's Signature : _____

Cohen Suderland Line Clipping Algorithm





```
double sx = (xvmax - xvmin) / (xmax - xmin);
double sy = (yvmax - yvmin) / (ymax - ymin);
double vx0 = xvmin + (x0 - xmin) * sx; vy0 = yvmin + (y0 - ymin) * sy;
double vx1 = xvmin + (x1 - xmin) * sx; vy1 = yvmin + (y1 - ymin) * sy;
glColor3f(1,0,0);
glBegin(GL_LINE_LOOP);
  glVertex2f(xvmin, yvmin); glVertex2f(xvmax, yvmin);
  glVertex2f(xvmax, yvmax); glVertex2f(xvmin, yvmax);
  glEnd(); }
glColor3f(0,0,1);
  glBegin(GL_LINES);
  glVertex2d(vx0, vy0); glVertex2d(vx1, vy1);
  glEnd(); }
}
void display() {
    glColor3f(0,0,1);
    glBegin(GL_LINE_LOOP);
    glVertex2f(xmin, ymin); glVertex2f(xmax, ymin);
    glVertex2f(xmax, ymax); glVertex2f(xmin, ymax);
    glEnd();
    for(i=0; i<n; i++) {
      glBegin(GL_LINES);
      glVertex2d(ls[i].x1, ls[i].y1);
      glVertex2d(ls[i].x2, ls[i].y2);
      glEnd()
  for(int i=0; i<n; i++)
      cohensutherland(ls[i].x1, ls[i].y1, ls[i].x2,
                      ls[i].y2);
  glFlush(); }
```

Teacher's Signature :

```
void myinit ()
{
    glClearColor (1.1,1,1);
    glColor3f (1,0,0);
    glPointSize (1.0);
    glMatrixMode (GL_PROJECTION);
    glLoadIdentity ();
    gluOrtho2D (0, 500, 0, 500);
}

void main (int argc, char ** argv) {
printf ("Enter window and viewport coordinates");
scanf ("%f %f %f %f %f %f %f %f", &xmin, &ymin, &xmax,
&ymax, &xvmin, &xvmax, &yvMax);
printf ("Enter number of lines"); scanf ("%d", &n);
for (int i=0; i<n; i++);
{
    printf ("Enter end points")
    scanf ("%d %d %d %d", &ls[i].x1, &ls[i].x2, &ls[i].y1, &ls[i].
y2
}
glutInit (&argc, argv);
glutInitDisplayMode (GLUT_SINGLE | GLUT_RGB);
glutInitWindowSize (500, 500);
glutInitWindowPosition (0,0);
glutCreateWindow ("clip");
myInit ();
glutDisplayFunc (display);
glutMainLoop ();
}
```

Teacher's Signature : _____

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

double xmin, ymin, xmax, ymax; //50 50 100 100
double xvmin, yvmin, xvmax, yvmax; //200 200 300 300

int n;

struct line_segment {
        int x1;
        int y1;
        int x2;
        int y2;
};
struct line_segment ls[10];
int cliptest(double p, double q, double* u1, double* u2)
{
        double r;
        if (p) r = q / p;  // to check whether p
        if (p < 0.0)    // potentially entry point, update te
        {
                if (r > * u1)*u1 = r;
                if (r > * u2) return(false); // line portion is outside
        }
        else
                if (p > 0.0)    //  Potentially leaving point, update tl
                {
                        if (r < *u2)*u2 = r;
                        if (r < *u1) return(false); // line portion is outside
                }
                else
                        if (p == 0.0)
                        {
                                if (q < 0.0) return(false); // line parallel to edge but outside
                        }
        return(true);
}

void LiangBarskyLineClipAndDraw(double x0, double y0, double x1, double y1)
{
        double dx = x1 - x0, dy = y1 - y0, u1 = 0.0, u2 = 1.0;
        //draw a red colored viewport
        glColor3f(1.0, 0.0, 0.0);
        glBegin(GL_LINE_LOOP);
        glVertex2f(xvmin, yvmin);
        glVertex2f(xvmax, yvmin);
        glVertex2f(xvmax, yvmax);
        glVertex2f(xvmin, yvmax);
        glEnd();
        if (cliptest(-dx, x0 - xmin, &u1, &u2))  // inside test wrt left edge
                if (cliptest(dx, xmax - x0, &u1, &u2)) // inside test wrt right edge
                        if (cliptest(-dy, y0 - ymin, &u1, &u2)) // inside test wrt bottom edge
                                if (cliptest(dy, ymax - y0, &u1, &u2)) // inside test wrt top edge
                                {
                                        if (u2 < 1.0)
                                        {
                                                x1 = x0 + u2 * dx;
                                                y1 = y0 + u2 * dy;
                                        }
                                        if (u1 > 0.0)
                                        {
                                                x0 = x0 + u1 * dx;
                                                y0 = y0 + u1 * dy;
                                        }
                                        // Window to viewport mappings
                                        double sx = (xvmax - xvmin) / (xmax - xmin); // Scale parameters
                                        double sy = (yvmax - yvmin) / (ymax - ymin);
                                        double vx0 = xvmin + (x0 - xmin) * sx;
                                        double vy0 = yvmin + (y0 - ymin) * sy;
                                        double vx1 = xvmin + (x1 - xmin) * sx;
                                        double vy1 = yvmin + (y1 - ymin) * sy;

                                        glColor3f(0.0, 0.0, 1.0); // draw blue colored clipped line
                                        glBegin(GL_LINES);
                                        glVertex2d(vx0, vy0);
                                        glVertex2d(vx1, vy1);
                                        glEnd();
                                }
}// end of line clipping

void display()
{
```

7. Program 7 - Write a program to implement Liang Barsky line clipping algorithm. Make provision to specify the input for multiple lines, window for clipping and viewport for viewing.

```
# include <stdio.h> # include <GL/glut.h>
double xmin, ymin, xmax, ymax, xvmin, yvmin, xvmax, yvmax;
int n;
struct line_segment {
    int x1, y1, x2, y2;
} ls[10];
int clipart (double p, double q, double *u1, double *u2)
{
    double r;
    if (p) r = q/p;
    if (p < 0.0) {
        if (r > *u1) *u1 = r;
        if (r > *u2) return (false);
    }
    else
        if (p > 0.0) {
            if (r < *u2) *u2 = r;
            if (r < *u1) return (false);
        }
        else
            if (p == -0.0)
                if (q < 0.0) return (false);
    return (true);
}
void LiangBarskyLineClipAndDraw (double x0, double y0,
    double x1, double y1) {
```

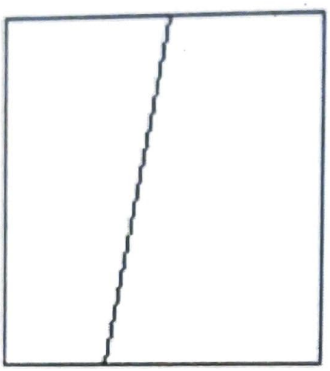
Teacher's Signature : _____

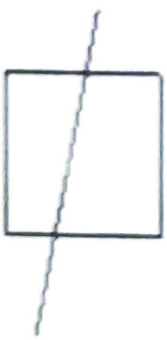
```
        glClear(GL_COLOR_BUFFER_BIT);
        //draw the line with red color
        glColor3f(1.0, 0.0, 0.0);
        for (int i = 0; i < n; i++)
        {
                glBegin(GL_LINES);
                glVertex2d(ls[i].x1, ls[i].y1);
                glVertex2d(ls[i].x2, ls[i].y2);
                glEnd();
        }
        //draw a blue colored window
        glColor3f(0.0, 0.0, 1.0);
        glBegin(GL_LINE_LOOP);
        glVertex2f(xmin, ymin);
        glVertex2f(xmax, ymin);
        glVertex2f(xmax, ymax);
        glVertex2f(xmin, ymax);
        glEnd();
        for (int i = 0; i < n; i++)
                LiangBarskyLineClipAndDraw(ls[i].x1, ls[i].y1, ls[i].x2, ls[i].y2);
        glFlush();
}

void myinit()
{
        glClearColor(1.0, 1.0, 1.0, 1.0);
        glColor3f(1.0, 0.0, 0.0);
        glLineWidth(2.0);
        glMatrixMode(GL_PROJECTION);
        glLoadIdentity();
        gluOrtho2D(0.0, 499.0, 0.0, 499.0);
}

int main(int argc, char** argv)
{
        glutInit(&argc, argv);
        glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
        glutInitWindowSize(500, 500);
        glutInitWindowPosition(0, 0);

        printf_s("Enter window coordinates: (xmin ymin xmax ymax) \n");
        scanf_s("%lf%lf%lf%lf", &xmin, &ymin, &xmax, &ymax);
        printf_s("Enter viewport coordinates: (xvmin yvmin xvmax yvmax) \n");
        scanf_s("%lf%lf%lf%lf", &xvmin, &yvmin, &xvmax, &yvmax);
        printf_s("Enter no. of lines:\n");
        scanf_s("%d", &n);

        for (int i = 0; i < n; i++)
        {
                printf_s("Enter coordinates: (x1 y1 x2 y2)\n");
                scanf_s("%d%d%d%d", &ls[i].x1, &ls[i].y1, &ls[i].x2, &ls[i].y2);
        }
        glutCreateWindow("Liang Barsky Line Clipping Algorithm");
        glutDisplayFunc(display);
        myinit();
        glutMainLoop();
}
```

```
double dx=x1-x0  dy=y1-y0, u1=0.0  u2=1.0
glColor3f(1,0,0);
glBegin(GL_LINE_LOOP);
glVertex2f(xwmin,ywmin); glVertex2f(xwmax,ywmin);
glVertex2f(xwmax,ywmax); glVertex2f(xwmin,ywmax);
glEnd();
if(cliptest(-dx, x0-xwmin, &u1, &u2))
  if(cliptest(dx, xwmax-x0, &u1, &u2))
    if(cliptest(-dy, y0-ywmin, &u1, &u2))
      if(cliptest(dy, ywmax-y0, &u1, &u2))
        {
          if(u2<1.0){
            x1=x0+u2*dx;
            y1=y0+u2*dy;
          if(u1>0.0){
            x0=x0+u1*dx;
            y0=y0+u1*dy;
          double sx=(xwmax-xwmin)/(xmax-xmin)
          double sy=(ywmax-ywmin)/(ymax-ymin);
          double vx0=xwmin+(x0-xmin)*sx;
          double vy0=ywmin+(y0-ymin)*sy;
          double vx1=xwmin+(x1-xmin)*sx;
          double vy1=ywmin+(y1-ymin)*sy;
          glColor3f(0,0,1);
          glBegin(GL_LINES);
          glVertex2d(vx0,vy0); glVertex2d(vx1,vy1);
          glEnd(); }
}
void display(){
```

Teacher's Signature : _____

Liang Barsky Line Clipping Algorithm





```
glClear(GL_COLOR_BUFFER_BIT);
glColor3f(1,0,0);
for(int i=0; i<n; i++){
    glBegin(GL_LINES);
    glVertex2d(ls[i].x1, ls[i].y1);
    glVertex2d(ls[i].x2, ls[i].y2);
    glEnd();}
glColor3f(0,0,1);
glBegin(GL_LINE_LOOP);
glVertex2f(xmin, ymin); glVertex2f(xmax, ymin);
glVertex2f(xmax, ymax); glVertex2f(xmin, ymax);
glEnd();
for(int i=0; i<n; i++)
    LiangBarskyLineClipAndDraw(ls[i].x1, ls[i].y1, ls[i].y2,
                               ls[i].x2);
glFlush();
}
void myinit()
{
glClearColor(1, 1, 1, 1);
glColor3f(1,0,0);
glPointSize(2);
glMatrixMode(GL_Projection);
glLoadIdentity();
gluOrtho2D(0, 499, 0, 499);
}
int main(int argc, char** argv){
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
```

Teacher's Signature : _____

```
glut2InitWindowSize (500, 500);
glut2InitWindowPosition(0, 0);
printf ("Enter window and viewport coordinates");
scanf ("%f %f %f %f %f %f %f %f", &xmin, &ymin,
        &xmax, &ymax, &vxmin, &vymin, &vxmax, &vymax);
printf ("Enter number of lines");
scanf ("%d", &n);
for (int i=0; i<n; i++)
{
    printf ("Enter co-ordinates");
    scanf ("%d %d %d %d", &ls[i].x1, &ls[i].y1,
            &ls[i].x2, &ls[i].y2);
}
glutCreateWindow ("Liang Barsky");
glutDisplayFunc (display);
myinit ();
glutMainLoop();
}
```

```
#include<iostream>
#include<GL/glut.h>
using namespace std;
int poly_size, poly_points[20][2], org_poly_size, org_poly_points[20][2], clipper_size, clipper_points[20][2];
const int MAX_POINTS = 20;

// Returns x-value of point of intersection of two lines
void drawPoly(int p[][2], int n) {
        glBegin(GL_POLYGON);
        for (int i = 0; i < n; i++)
                glVertex2f(p[i][0], p[i][1]);
        glEnd();
}

int x_intersect(int x1, int y1, int x2, int y2,
        int x3, int y3, int x4, int y4)
{
        int num = (x1 * y2 - y1 * x2) * (x3 - x4) -
                (x1 - x2) * (x3 * y4 - y3 * x4);
        int den = (x1 - x2) * (y3 - y4) - (y1 - y2) * (x3 - x4);
        return num / den;
}

// Returns y-value of point of intersectipn of two lines
int y_intersect(int x1, int y1, int x2, int y2,
        int x3, int y3, int x4, int y4)
{
        int num = (x1 * y2 - y1 * x2) * (y3 - y4) -
                (y1 - y2) * (x3 * y4 - y3 * x4);
        int den = (x1 - x2) * (y3 - y4) - (y1 - y2) * (x3 - x4);
        return num / den;
}

// This functions clips all the edges w.r.t one clip
// edge of clipping area
void clip(int poly_points[][2], int& poly_size,
        int x1, int y1, int x2, int y2)
{
        int new_points[MAX_POINTS][2], new_poly_size = 0;

        // (ix,iy),(kx,ky) are the co-ordinate values of
        // the points
        for (int i = 0; i < poly_size; i++)
        {
                // i and k form a line in polygon
                int k = (i + 1) % poly_size;
                int ix = poly_points[i][0], iy = poly_points[i][1];
                int kx = poly_points[k][0], ky = poly_points[k][1];

                // Calculating position of first point
                // w.r.t. clipper line
                int i_pos = (x2 - x1) * (iy - y1) - (y2 - y1) * (ix - x1);

                // Calculating position of second point
                // w.r.t. clipper line
                int k_pos = (x2 - x1) * (ky - y1) - (y2 - y1) * (kx - x1);

                // Case 1 : When both points are inside
                if (i_pos >= 0 && k_pos >= 0)
                {
                        //Only second point is added
                        new_points[new_poly_size][0] = kx;
                        new_points[new_poly_size][1] = ky;
                        new_poly_size++;
                }

                // Case 2: When only first point is outside
                else if (i_pos < 0 && k_pos >= 0)
                {
                        // Point of intersection with edge
                        // and the second point is added
                        new_points[new_poly_size][0] = x_intersect(x1,
                                y1, x2, y2, ix, iy, kx, ky);
                        new_points[new_poly_size][1] = y_intersect(x1,
                                y1, x2, y2, ix, iy, kx, ky);
                        new_poly_size++;

                        new_points[new_poly_size][0] = kx;
                        new_points[new_poly_size][1] = ky;
                        new_poly_size++;
                }
```

8 Program 8 - Write a program to implement the cohen-Hodgeman polygon clipping Algorithm, Make provision to specify the input polygon and window

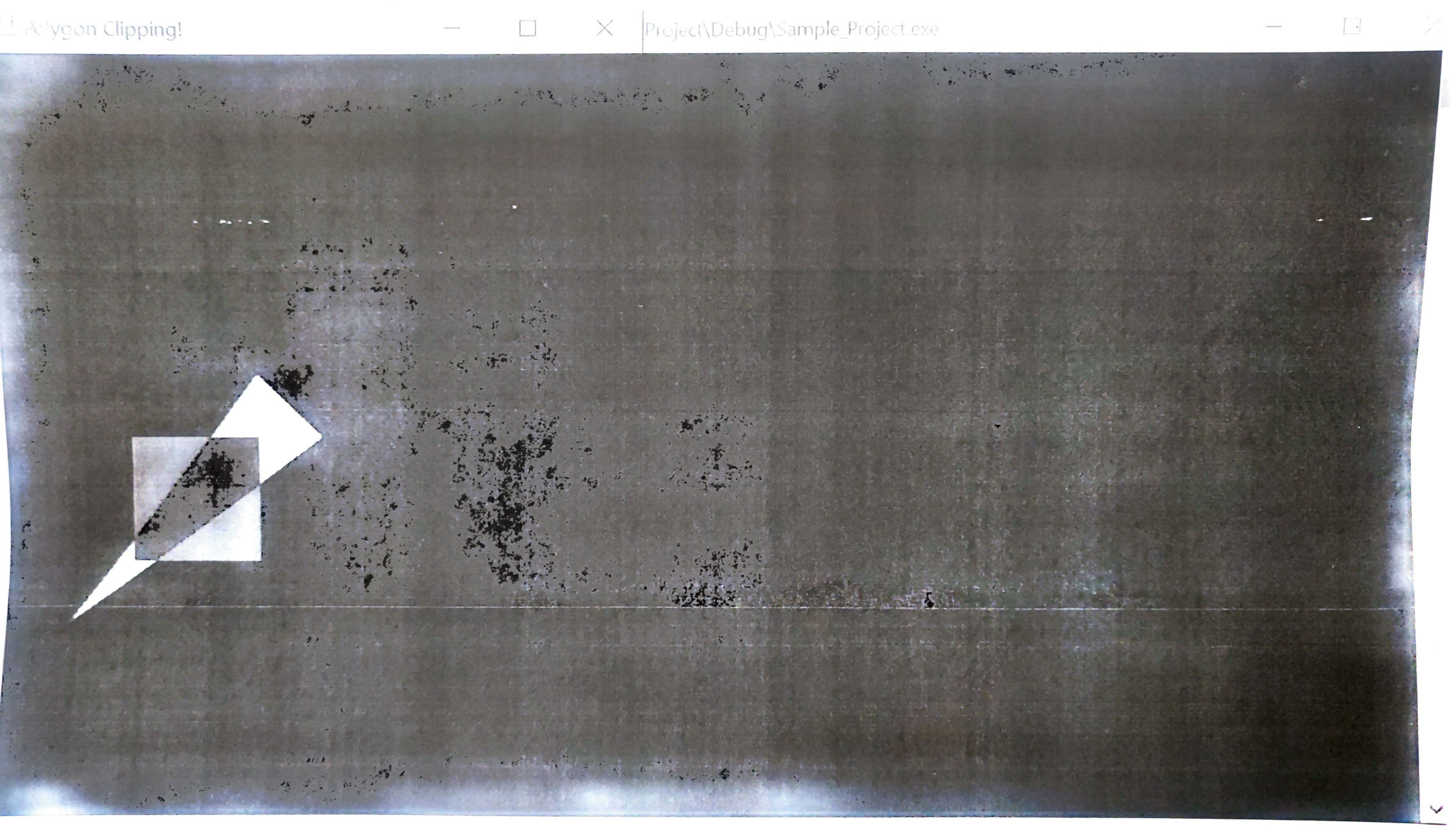
```
#include<iostream.h> #include<GL/glut.h>
using namespace std;
int poly_size, poly_points[20][2], org_poly_size,
org_poly_points[20][2], clipper_size, clipper_points[20][2];
const int MAX_POINTS = 20;
void drawPoly(int p[][2], int n) {
        glBegin(GL_POLYGON);
        for(int i=0; i<n; i++)
                glVertex2f(p[i][0], p[i][1]);
        glEnd(); }
int x_intersect(int x1, int y1, int x2, int y2, int x3,
    int y3, int x4, int y4) {
int num = (x1*y2 - y1*x2) * (x3-x4) - (x1-x2) * (x3
        y4 - y3*x4);
int den = (x1-x2) *(y3-y4) - (y1-y2) * x3 - x4);
return num/den;
}
int y_intersect(int x1, int y1, int x2, int y2, int x3, int y3
    int x4, int y4) {
int num = (x1*y2 - y1*x2) * (y3-y4) - (y1-y2) *
        (x3*y4 - y3*x4);
int den = (x1-x2) *(y3-y4) - (y-y2) *(x3-x4);
return num/den;
}
Void clip(int poly_points[][2], int & poly_size, int x1
    int y1, int x2, int y2) {
```

Teacher's Signature :

```
                // Case 3: When only second point is outside
                else if (i_pos >= 0 && k_pos < 0)
                {
                        //Only point of intersection with edge is added
                        new_points[new_poly_size][0] = x_intersect(x1,
                                y1, x2, y2, ix, iy, kx, ky);
                        new_points[new_poly_size][1] = y_intersect(x1,
                                y1, x2, y2, ix, iy, kx, ky);
                        new_poly_size++;
                }
                // Case 4: When both points are outside
                else
                {}
        }
        poly_size = new_poly_size;
        for (int i = 0; i < poly_size; i++)
        {
                poly_points[i][0] = new_points[i][0];
                poly_points[i][1] = new_points[i][1];
        }
}
void init() {
        glClearColor(0.0f, 0.0f, 0.0f, 0.0f);
        glMatrixMode(GL_PROJECTION);
        glLoadIdentity();
        glOrtho(0.0, 500.0, 0.0, 500.0, 0.0, 500.0);
        glClear(GL_COLOR_BUFFER_BIT);
}
void display()
{
        init();
        glColor3f(1.0f, 0.0f, 0.0f);
        drawPoly(clipper_points, clipper_size);
        glColor3f(0.0f, 1.0f, 0.0f);
        drawPoly(org_poly_points, org_poly_size);
        //i and k are two consecutive indexes
        for (int i = 0; i < clipper_size; i++)
        {
                int k = (i + 1) % clipper_size;

                // We pass the current array of vertices, it's size
                // and the end points of the selected clipper line
                clip(poly_points, poly_size, clipper_points[i][0],
                        clipper_points[i][1], clipper_points[k][0],
                        clipper_points[k][1]);
        }
        glColor3f(0.0f, 0.0f, 1.0f);
        drawPoly(poly_points, poly_size);
        glFlush();
}
int main(int argc, char* argv[])
{
        printf("Enter no. of vertices: \n");
        scanf_s("%d", &poly_size);
        org_poly_size = poly_size;
        for (int i = 0; i < poly_size; i++)
        {
                printf("Polygon Vertex:\n");
                scanf_s("%d%d", &poly_points[i][0], &poly_points[i][1]);
                org_poly_points[i][0] = poly_points[i][0];
                org_poly_points[i][1] = poly_points[i][1];
        }

        printf("Enter no. of vertices of clipping window:");
        scanf_s("%d", &clipper_size);
        for (int i = 0; i < clipper_size; i++)
        {
                printf("Clip Vertex:\n");
                scanf_s("%d%d", &clipper_points[i][0], &clipper_points[i][1]);
        }

        glutInit(&argc, argv);
        glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
        glutInitWindowSize(400, 400);
        glutInitWindowPosition(100, 100);
        glutCreateWindow("Polygon Clipping!");
        glutDisplayFunc(display);
        glutMainLoop();
        return 0;
}
```

```
int new_points[MAX_POINTS][2], new_poly_size=0;
for (int i=0; i<poly_size, i++){
    int k = (i+1) % poly_size;
    int ix = poly_points[i][0], iy = poly_points[i][1];
    int kx = poly_points[k][0], ky = poly_points[k][1];
    int i_pos = (x2-x1)*(iy-y1)-(y2-y1)*(ix-x1);
    int k_pos = (x2-x1)*(ky-y1)-(y2-y1)*(kx-x1);
    if (i_pos >=0 && k_pos >=0){
        new_points[new_poly_size][0] = kx;
        new_points[new_poly_size][1] = ky;
        new_poly_size++; }
    else if (i_pos<0 && k_pos >=0){
        new_points[new_poly_size][0] = x_intersect(x1,
                y1, x2, y2, ix, iy, kx, ky);
        new_points[new_poly_size][1] = y_intersect(x1,
                y1, x2, y2, ix, iy, kx, ky);
        new_poly_size++;
        new_points[new_poly_size][0] = kx;
        new_points[new_poly_size][1] = ky;
        new_poly_size++; }
    else if (i_pos>=0 && k_pos<0){
        new_points[new_poly_size][0] = x_intersect(x1,
                y1, x2, y2, ix, iy, kx, ky);
        new_points[new_poly_size][1] = y_intersect(x1,
                y1, x2, y2, ix, iy, kx, ky);
        new_poly_size++; }
    else { }
}
poly_size = new_poly_size;
```

Teacher's Signature : _____


Polygon Clipping!
Project\Debug\Sample_Project.exe

```
    for (int i=0; i< poly_size ; i++) {
        poly_points[i][0] = new_points[i][0];
        poly_points[i][1] = new_points[i][1]; }
    }
void init() {
    glClearColor (0, 0, 0, 0);
    glMatrixMode (GL_PROJECTION);
    glLoadIdentity ();
    glOrtho (0.0, 500.0, 500.0 , 0.0, 500.0);
    glClear (GL_COLOR_BUFFER_BIT); }
void display()
{
    init ();
    glColor3f (1, 0, 0);
    drawPoly ( clipper_points , clipper_size );
    glColor3f (0,1,0);
    drawPoly ( org_poly_points , org_poly_size );
    for (int i=0; i< clipper_size ; i++) {
        int k = (i+1) % clipper_size ;
        clip ( poly_points , poly_size , clipper_points[i][0]
            clipper_points[i][1] , clipper_points[k][0] ;
            clipper_points[k][1] ); }
    glColor3f (0 , 0, 1);
    drawPoly ( poly_points , poly_size );
    glFlush();
}
int main (int argc , char * argv[] )
{
    printf ("Enter no. of vertices :\n");
```

Teacher's Signature : _____

```
scanf("%d", &poly_size);
org_poly_size = poly_size;
for(int i=0; i<poly_size; i++)
{
    scanf("%d %d", &poly_point[i][0], &poly_point[i][1]);
    org_poly_points[i][0] = poly_points[i][0];
    org_poly_points[i][1] = poly_points[i][1];
}
printf("Enter no. of vertices of clipping window");
scanf("%d", &clipper_size);
for(int i=0; i<clipper_size; i++)
{
    printf("Clip Vertex");
    scanf("%d %d", &clipper_points[i][0],
                   &clipper_points[i][1]);
}
glutInit(&argc, argv);
glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
glutInitWindowSize(400, 400);
glutInitWindowPosition(100, 100);
glutCreateWindow("Polygon Clipping");
glutDisplayFunc(display);
glutMainLoop();
return 0;
}
```

Teacher's Signature : _____

```c
#include<GL/glut.h>
#include<math.h>
#include<stdio.h>
#define CAR 1
#define WHEEL 2
float s = 1;
void carlist() {
        glNewList(CAR, GL_COMPILE);
        glColor3f(1, 1, 1);
        glBegin(GL_POLYGON);
        glVertex3f(0, 25, 0);
        glVertex3f(90, 25, 0);
        glVertex3f(90, 55, 0);
        glVertex3f(80, 55, 0);
        glVertex3f(20, 75, 0);
        glVertex3f(0, 55, 0);
        glEnd();
        glEndList();
}
void wheellist() {
        glNewList(WHEEL, GL_COMPILE_AND_EXECUTE);
        glColor3f(0, 1, 1);
        glutSolidSphere(10, 25, 25);
        glEndList();
}
void mykeyboard(unsigned char key, int x, int y) {
        switch (key) {
        case 't': glutPostRedisplay();
                break;
        case 'q': exit(0);
        default: break;
        }
}
void myInit() {
        glClearColor(0, 0, 0, 0);
        glOrtho(0, 600, 0, 600, 0, 600);
}
void draw_wheel() {
        glColor3f(0, 1, 1);
        glutSolidSphere(10, 25, 25);
}
void moveCar(float s) {
        glTranslatef(s, 0.0, 0.0);
        glCallList(CAR);
        glPushMatrix();
        glTranslatef(25, 25, 0.0);      //move to first wheel position
        glCallList(WHEEL);
        glPopMatrix();
        glPushMatrix();
        glTranslatef(75, 25, 0.0);     //move to 2nd wheel position
        glCallList(WHEEL);
        glPopMatrix();
        glFlush();
}
void myDisp() {
        glClear(GL_COLOR_BUFFER_BIT);
        carlist();
        moveCar(s);
        wheellist();
}
void mouse(int btn, int state, int x, int y) {
        if (btn == GLUT_LEFT_BUTTON && state == GLUT_DOWN) {
                s += 5;
                myDisp();
        }
        else if (btn == GLUT_RIGHT_BUTTON && state == GLUT_DOWN) {
                s += 2;
                myDisp();
        }
}
int main(int argc, char* argv[]) {
        glutInit(&argc, argv);
        glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
        glutInitWindowSize(600, 500);
        glutInitWindowPosition(100, 100);
        glutCreateWindow("car");
        myInit();
        glutDisplayFunc(myDisp);
        glutMouseFunc(mouse);
        glutKeyboardFunc(mykeyboard);
        glutMainLoop();
}
```

9. Program9 - Write a program to model a car using display lists

```
#include <GL/glut.h>
#include <math.h>
#include <stdio.h>
#define CAR 1
#define WHEEL 2
float s = 1;
void carlist() {
    glNewList(CAR, GL_COMPILE);
    glColor3f(1,1,1);
    glBegin(GL_POLYGON);
    glVertex3f(0,25,0); glVertex3f(90,25,0); glVertex3f(90,55,0);
    glVertex3f(80,55,0); glVertex3f(20,75,0); glVertex3f(0,55,0);
    glEnd();
    glEndList();
}
void wheellist() {
    glNewList(WHEEL, GL_COMPILE_AND_EXECUTE);
    glColor3f(0,1,1);
    glutSolidSphere(10,25,25);
    glEndList();
}
void mykeyboard(unsigned char key, int x, int y) {
    switch(key) {
    case 'r': glutPostRedisplay();
              break;
    case 'q': exit(0);
```

Teacher's Signature :


C:\Users\
car

```
        default : break; }
    }
void myInit() {
    glClearColor(0,0,0,0);
    glOrtho(0,600,0,600,0,600);
}
void draw_wheel() {
    glColor3f(0,1,1);
    glutSolidSphere(10,25,25);
}
void movCar(float s) {
    glTranslatef(s,0,0);
    glCallList(CAR);
    glPushMatrix();
    glTranslatef(25,25,0);
    glCallList(WHEEL);
    glPopMatrix();
    glPushMatrix();
    glTranslatef(75,25,0);
    glCallList(WHEEL);
    glPopMatrix();
    glFlush();
}
void myDisp() {
    glClear(GL_COLOR_BUFFER_BIT);
    carlist();
    moveCar(s);
    wheellist();
}
```

Teacher's Signature : _____

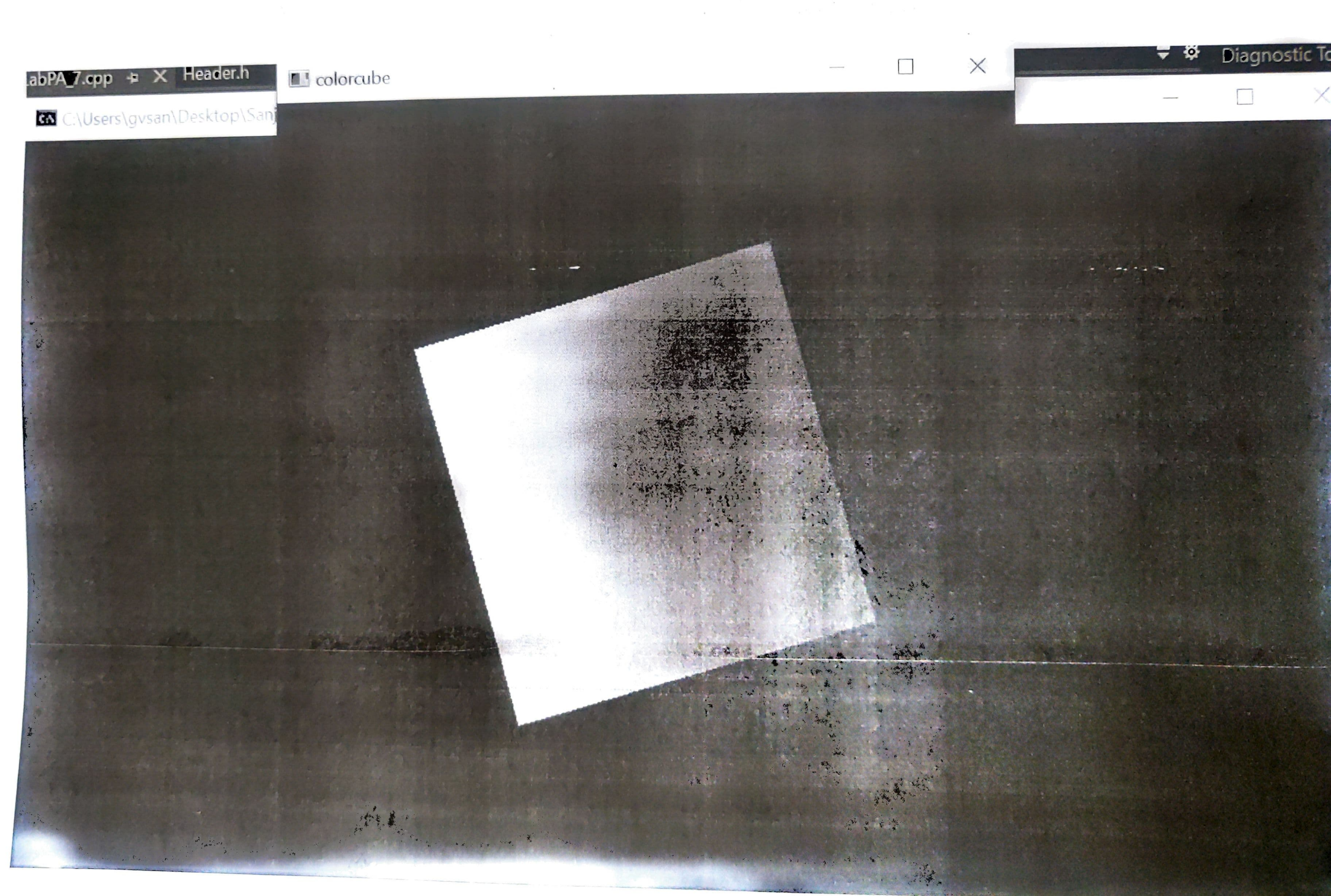
```
void mouse (int btn, int state, int x, int y) {
    if (btn == GLUT_LEFT_BUTTON && state == GLUT_DOWN) {
        St = 5;
        myDisp (); }
    else if (btn == GLUT_RIGHT_BUTTON && state = GLUT_DOWN) {
        St = 2;
        myDisp (); }
}
int main (int argc, char * argv [ ]) {
    glutInit (& argc, argv);
    glutInitDisplayMode (GLUT_SINGLE | GLUT_RGB);
    glutInitWindowSize (600, 500);
    glutInitWindowPosition (100, 100);
    glutCreateWindow ("car");
    myInit ();
    glutDisplayFunc (myDisp);
    glutMouseFunc (mouse);
    glutKeyboardFunc (myKeyboard);
    glutMainLoop ();
}
```

Teacher's Signature : _____

```
#include<gl\GL.h>
#include<gl\GLU.h>
#include <time.h>
GLfloat vertices[] = { -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 };
GLfloat normals[] = { -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 };
GLfloat colors[] = { 0.0,0.0,0.0,1.0,0.0,0.0,
1.0,1.0,0.0, 0.0,1.0,0.0, 0.0,0.0,1.0,
1.0,0.0,1.0, 1.0,1.0,1.0, 0.0,1.0,1.0 };
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 GLfloat beta[] = { 0.0,0.0,0.0 };
static GLint axis = 2;
void delay(float secs)
{
        float end = clock() / CLOCKS_PER_SEC + secs;
        while ((clock() / CLOCKS_PER_SEC) < end);
}
void displaySingle(void)
{
        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);
        glBegin(GL_LINES);
        glVertex3f(0.0, 0.0, 0.0);
        glVertex3f(1.0, 1.0, 1.0);
        glEnd(); glFlush();
}
void spinCube()
{
        delay(0.01);
        theta[axis] += 2.0;
        if (theta[axis] > 360.0) theta[axis] -= 360.0;
        glutPostRedisplay();
}
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 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);
}
Void main(int argc, char** argv)
{
        //window 1
        glutInit(&argc, argv);
        glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
        glutInitWindowPosition(100, 100);
        glutInitWindowSize(500, 500);
        glutCreateWindow("colorcube");
        glutReshapeFunc(myReshape);
        glutDisplayFunc(displaySingle);
        glutIdleFunc(spinCube);
        glutMouseFunc(mouse);
        glEnable(GL_DEPTH_TEST); /* Enable hidden--surface--removal */
        glEnableClientState(GL_COLOR_ARRAY);
        glEnableClientState(GL_NORMAL_ARRAY);
        glEnableClientState(GL_VERTEX_ARRAY);
        glVertexPointer(3, GL_FLOAT, 0, vertices);
        glColorPointer(3, GL_FLOAT, 0, colors);
        glNormalPointer(GL_FLOAT, 0, normals);
        glColor3f(1.0, 1.0, 1.0);
        glutMainLoop();
}
```

10 Program 10 - Write a program to create a color cube and spin it using OpenGL transformations.

```
#include<stdlib.h>          #include<GL/glut.h>
#include<gl\GLU.h>          #include<gl\GLU.h>
#include<time.h>
GLfloat vertices[]={-1,-1,-1,1,-1,-1,1,1,-1,-1,1,-1,-1,
                    -1,1,1,-1,1,1,1,1,-1,1,1};
GLfloat normals[]={-1,-1,-1,1,-1,-1,1,1,-1,-1,1,-1,
                   -1,-1,1,1,-1,1,1,1,1,-1,1,1};
GLfloat colors[]={0,0,0,1,0,0,1,1,0,0,1,0,0,0,1,
                  1,0,1,1,1,1,0,1,1};
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};
static GLfloat beta[]={0,0,0};
static GLint axis=2;
void delay(float secs){
    float end=clock()/CLOCKS_PER_SEC+secs;
    while((clock()/CLOCKS_per_SEC)<end);
}
void displaysingle(void){
  glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT);
  glLoadIdentity();
  glRotatef(theta[0],1,0,0);
  glRotatef(theta[1],0,1,0);
  glRotatef(theta[2],0,0,1);
  glDrawElements(GL_QUADS,24,GL_UNSIGNED_BYTE,cubeIndices);
  glBegin(GL_LINES);
  glVertex3f(0,0,0);
```


LabPA_7.cpp
Header.h
colorcube
C:\Users\gvsan\Desktop\San
Diagnostic To

```
        glVertex3f(1,1,1);
        glEnd();
        glFlush();
}
void spinCube() {
    delay(0.01);
    theta[axis] += 2.0;
    if (theta[axis] > 360.0) theta[axis] -= 360.0;
    glutPostRedisplay();
}
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 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, 10);
    else
        glOrtho(-2.0*(GLfloat)w/(GLfloat)h, 2.0*(GLfloat)w/
                (GLfloat)h, -2, 2, -10, 10);
    glMatrixMode(GL_MODELVIEW);
}
void main(int argc, char **argv)
{
```

Teacher's Signature : _____

```
#include<gl/glut.h>
#include<math.h>
#include<stdio.h>
struct screenPt {
        int x;
        int y;
};
typedef enum { limacon = 1, cardioid = 2, threeLeaf = 3, spiral = 4 } curveName;
int w = 600, h = 500;
int curve = 1;
int red = 0, green = 0, blue = 0;
void myinit(void) {
        glClearColor(1.0, 1.0, 1.0, 1.0);
        glMatrixMode(GL_PROJECTION);
        gluOrtho2D(0.0, 200.0, 0.0, 150.0);
}
void lineSegment(screenPt p1, screenPt p2) {

        glBegin(GL_LINES);
        glVertex2i(p1.x, p1.y);
        glVertex2i(p2.x, p2.y);
        glEnd();
        glFlush();
}
void drawCurve(int curveNum) {
        const double twoPi = 6.283185;
        const int a = 175, b = 60;
        float r, theta, dtheta = 1.0 / float(a);
        int x0 = 200, y0 = 250;
        screenPt curvePt[2];
        curve = curveNum;
        glColor3f(red, green, blue);
        curvePt[0].x = x0;
        curvePt[0].y = y0;
        glClear(GL_COLOR_BUFFER_BIT);
        switch (curveNum) {
        case limacon: curvePt[0].x += a + b; break;
        case cardioid: curvePt[0].x += a + a; break;
        case threeLeaf: curvePt[0].x += a; break;
        case spiral: break;
        default: break;
        }
        theta = dtheta;
        while (theta < twoPi) {
                switch (curveNum) {
                case limacon: r = a * cos(theta) + b; break;
                case cardioid: r = a * (1 + cos(theta)); break;
                case threeLeaf: r = a * cos(3 * theta); break;
                case spiral: r = (a / 4.0) * theta; break;
                default: break;
                }
                curvePt[1].x = x0 + r * cos(theta);
                curvePt[1].y = y0 + r * sin(theta);
                lineSegment(curvePt[0], curvePt[1]);

                curvePt[0].x = curvePt[1].x;
                curvePt[0].y = curvePt[1].y;
                theta += dtheta;
        }
}

void colorMenu(int id) {
        switch (id) {

        case 0:
                break;
        case 1:
                red = 0;
                green = 0;
                blue = 1;

                break;
        case 2:
                red = 0;
                green = 1;
                blue = 0;
                break;

       case 4:
                red = 1;
                green = 0;
                blue = 0;
```

Write a program to construct a limacon, cardiod, three leaf, spiral.

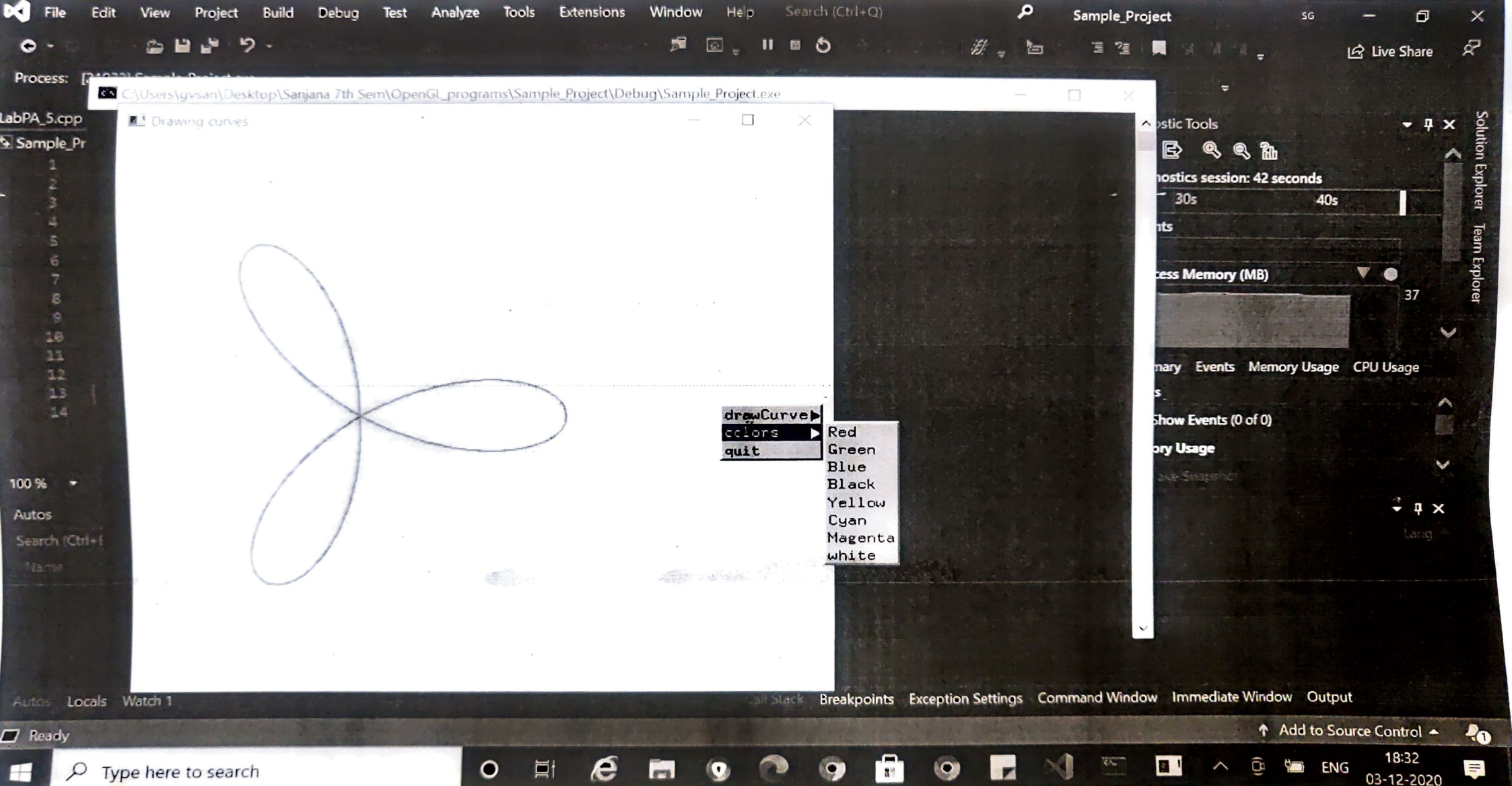
```
#include <gl/glut.h>  #include <math.h>  #include <stdio.h>
struct screenPt {
        int x, y;
};
typedef enum = {limacon = 1, cardiod = 2, threeleaf = 3, spiral = 4}
  curveName;
int w = 600, h = 500, pcurve = 1, red = 0, green = 0, blue = 0;
void myinit (void) {
        glClearColor (1,1,1,1); glMatrixMode (GL_PROJECTION);
        gluOrtho2D(0, 200, 0, 150);
}
void lineSegment ( screenPt p1, screenPt p2) {
        glBegin (GL_LINES);
        glVertex2i (p1.x, p1.y); glVertex2i(p2.x, p2.y);
        glEnd();
        glFlush();
}
void drawCurve (int curveNum) {
 const double twoPi = 6.283185;
 const int a = 175, b=60;
 float r, theta, dtheta = 1 / float(a);
 int x0 = 200, y0 = 250;
 screenPt curvePt[2];
 curve = curveNum;
 glColor3f( red, green, blue);
 curvePt[0].x = x0;
```

Teacher's Signature :

```
                break;
        case 3:
                red = 0;
                green = 1;
                blue = 1;

                break;
        case 5:
                red = 1;
                green = 0;
                blue = 1;
                break;
        case 6:
                red = 1;
                green = 1;
                blue = 0;
                break;
        case 7:
                red = 1;
                green = 1;
                blue = 1;
                break;
        default:
                break;

        }
        drawCurve(curve);
}
void main_menu(int id) {

        switch (id) {

        case 3: exit(0);
        default: break;
        }
}
void mydisplay() {}

void myreshape(int nw, int nh) {
        glMatrixMode(GL_PROJECTION);
        glLoadIdentity();
        gluOrtho2D(0.0, (double)nw, 0.0, (double)nh);
        glClear(GL_COLOR_BUFFER_BIT);
}
void main(int argc, char** argv) {
        glutInit(&argc, argv);
        glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
        glutInitWindowSize(w, h);
        glutInitWindowPosition(100, 100);
        glutCreateWindow("Drawing curves");
        int curveId = glutCreateMenu(drawCurve);
        glutAddMenuEntry("Limacon", 1);
        glutAddMenuEntry("Cardioid", 2);
        glutAddMenuEntry("Threeleaf", 3);
        glutAddMenuEntry("Spiral", 4);
        glutAttachMenu(GLUT_LEFT_BUTTON);
        int colorId = glutCreateMenu(colorMenu);
        glutAddMenuEntry("Red", 4);
        glutAddMenuEntry("Green", 2);
        glutAddMenuEntry("Blue", 1);
        glutAddMenuEntry("Black", 0);
        glutAddMenuEntry("Yellow", 6);
        glutAddMenuEntry("Cyan", 3);
        glutAddMenuEntry("Magenta", 5);
        glutAddMenuEntry("white", 7);
        glutAttachMenu(GLUT_LEFT_BUTTON);
        glutCreateMenu(main_menu);
        glutAddSubMenu("drawCurve", curveId);
        glutAddSubMenu("colors", colorId);
        glutAddMenuEntry("quit", 3);
        glutAttachMenu(GLUT_LEFT_BUTTON);
        myinit();
        glutDisplayFunc(mydisplay);
        glutReshapeFunc(myreshape);

        glutMainLoop();
}
```

```
currPt[0].y = yo;
glClear(GL_COLOR_BUFFER_BIT);
switch(currNum){
case limacon: currPt[0].x += a + b; break;
case cardioid: currPt[0].x += a + a; break;
case threeleaf: currPt[0].x += a; break;
case spiral: break;
default: break;
}
theta = dtheta;
while(theta < twoPi){
 switch(currNum){
 case limacon: r = a*cos(theta) + b; break;
 case cardioid: r = a*(1+cos(theta)); break;
 case threeleaf: r = a*cos(3*theta); break;
 case spiral: r = (a/4.0)*theta; break;
 default break;
}
currPt[1].x = xo + r*cos(theta);
currPt[1].y = yo + r*sin(theta);
lineSegment(currPt[0], currPt[1]);
currPt[0].x = currPt[1].x;
currPt[0].y = currPt[1].y;
theta += dtheta; }
}
void colorMenu(int id){
    switch(id){
     case 0: break;
     case 1: red=0; green=0, blue=1; break;
```

Teacher's Signature : _____


File Edit View Project Build Debug Test Analyze Tools Extensions Window Help
Sample_Project
Live Share
C:\Users\gvsan\Desktop\Sanjana 7th Sem\OpenGL_programs\Sample_Project\Debug\Sample_Project.exe
Drawing curves
drawCurve
colors
quit
Red
Green
Blue
Black
Yellow
Cyan
Magenta
white
Solution Explorer
Team Explorer
Autos
Locals
Watch 1
Breakpoints
Exception Settings
Command Window
Immediate Window
Output
Ready
Add to Source Control
Type here to search
ENG
18:32
03-12-2020

```
case 2 : red = 0; green = 1; blue = 0; break;
case 4 : red = 1; green = 0; blue = 0; break;
case 3 : red = 0; green = 1; blue = 1; break;
case 5 : red = 1; green = 0; blue = 1; break;
case 6 : red = 1; green = 1; blue = 0; break;
case 7 : red = 1; green = 1; blue = 1; break;
default : break; }
drawCurve (curve);
}
void main_menu (int id) {
    switch (id) {
    case 3 : exit(0);
    default : break; }
}
void myreshape (int new, int nh) {
    glMatrixMode (GL_PROJECTION);
    glLoadIdentity ();
    glOrtho2D(0, (double) new, 0, (double) nh);
    glClear (GL_COLOR_BUFFER_BIT);
}
void mydisplay () { }
void main (int argc, char ** argv) {
    glutInit (&argc, argv);
    glutInitDisplayMode (GLUT_SINGLE | GLUT_RGB);
    glutInitWindowSize (w, h);
    glutInitWindowPosition (100, 100);
    glutCreateWindow ("Drawing curves")
    int curveId = glutCreateMenu (drawCurve);
    glutAddMenuEntry ("Lexicon", 1);
```

Teacher's Signature : _____

```
glutAddMenuEntry ("Cardioid", 2);
glutAddMenuEntry ("ThreeLeaf", 3);
glutAddMenuEntry ("Spiral", 4);
glutAttachMenu (GLUT_LEFT_BUTTON);
int colorID = glutCreateMenu (colorMenu);
glutAddMenuEntry ("Red", 4);
glutAddMenuEntry ("Green", 2);
glutAddMenuEntry ("Blue", 1);
glutAddMenuEntry ("Black", 0);
glutAddMenuEntry ("Yellow", 6);
glutAddMenuEntry ("Cyan", 3);
glutAddMenuEntry ("Magenta", 5);
glutAddMenuEntry ("White", 7);
glutAttachMenu (GLUT_LEFT_BUTTON);
glutCreateMenu (main-menu);
glutAddSubMenu ("colors", colorId);
glutAddSubMenu ("draw curve", curveId);
glutAddMenuEntry ("Quit", 3);
glutAttachMenu (GLUT_LEFT_BUTTON);
myInit ();
glutDisplayFunc (mydisplay);
glutReshapeFunc (myreshape);
glutMainLoop ();
}
```

Teacher's Signature :

```
#include<iostream>
#include<math.h>
#include<gl/glut.h>
using namespace std;
float f, g, r, x1[4], yc[4];
int flag = 0;
void myInit() {

	glClearColor(1, 1, 1, 1);
	glColor3f(1, 1, 1);
	glPointSize(5);
	gluOrtho2D(0, 500, 0, 500);
}

void drawPixel(float x, float y) {
	glBegin(GL_POINTS);
	glVertex2f(x, y);
	glEnd();
}

void display() {
	glClear(GL_COLOR_BUFFER_BIT);
	int i;
	double t;
	glColor3f(0, 0, 0);
	glBegin(GL_POINTS);
	for (t = 0; t < 1; t = t + 0.005) {
		double xt = pow(1 - t, 3) * x1[0] + 3 * t * pow(1 - t, 2) * x1[1] + 3 * pow(t, 2) * (1 - t) * x1[2] +
pow(t, 3) * x1[3];
		double yt = pow(1 - t, 3) * yc[0] + 3 * t * pow(1 - t, 2) * yc[1] + 3 * pow(t, 2) * (1 - t) * yc[2] +
pow(t, 3) * yc[3];
		glVertex2f(xt, yt);
	}
	glColor3f(1, 1, 0);
	for (i = 0; i < 4; i++) {
		glVertex2f(x1[i], yc[i]);
		glEnd();
		glFlush();
	}
}
void mymouse(int btn, int state, int x, int y)
{
	if (btn == GLUT_LEFT_BUTTON && state == GLUT_DOWN && flag < 4)
	{
		x1[flag] = x;
		yc[flag] = 500 - y;
		cout << " X: " << x << " Y" << 500 - y;
		glPointSize(3);
		glColor3f(1, 1, 0);
		glBegin(GL_POINTS);
		glVertex2i(x, 500 - y);
		glEnd();
		glFlush();
		flag++;
	}
	if (flag >= 4 && btn == GLUT_LEFT_BUTTON)
	{
		glColor3f(0, 0, 1);
		display();
		flag = 0;
	}
}
int main(int argc, char* argv[]) {
	glutInit(&argc, argv);
	//USE KEYBOARD
	cout << "Enter the x co-ordinates";
	cin >> x1[0] >> x1[1] >> x1[2] >> x1[3];
	cout << "Enter y co-ordinates";
	cin >> yc[0] >> yc[1] >> yc[2] >> yc[3];
	//END KEYBOARD
	glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
	glutInitWindowSize(500, 500);
	glutInitWindowPosition(0, 0);
	glutCreateWindow("BZ");
	glutDisplayFunc(display);
	//glutMouseFunc(mymouse); //INCLUDE FOR MOUSE, REMOVE FOR KEYBOARD
	myInit();
	glutMainLoop();
}
```

Program 12 - Write a program to construct Bezier curve. Control points are supplied through keyboard / mouse

```
#include <iostream>  #include <math.h>
#include <gl/glut.h>
using namespace std;
float t, g, i, x1[4], yc[4];
int flag = 0;
void myInit(){
    glClearColor (1, 1, 1, 1);
    glColor3f (1, 1, 1);
    glPointSize (5);
    gluOrtho2D (0, 500, 0, 500);
}
void drawPixel ( float x, float y){
    glBegin (GL_POINTS);
    glVertex2f (x, y);
    glEnd();
}
void display (){
    glClear ( GL_COLOR_BUFFER_BIT);
    int i;
    double t;
    glColor3f (0, 0, 0);
    glBegin (GL_POINTS);
    for(t=0; t<1; t=t+0.005){
    double xt = pow(1-t,3) * x1[0] + 3*t * pow(1-t,2) * x1[1] + 3* pow(t,2) * (1-t) * x1[2] + pow(t,3) * x1[3];
    double yt = pow(1-t,3) * yc[0] + 3*t * pow(1-t,2)
```

Teacher's Signature : _____

C:\Users\gvsan\Desktop\Sanjana 7th Sem\OpenGL_programs\Sample_Project\Debug\Sample_Project.exe

```
X: 313 Y145 X: 253 Y302 X: 28 Y201 X: 132 Y280 X: 132 Y280 X: 215 Y324 X: 215 Y324 X: 155 Y230 X: 186 Y141 X: 120 Y279
X: 279 Y329 X: 279 Y329 X: 355 Y351 X: 256 Y213 X: 355 Y100 X: 373 Y76 X: 352 Y480
```

BZ

Value

```
*yc[i]+3 * pow(t,2) * (1-t) * yc[2] + pow[t,3) * yc[3];
        glVertex2f(x1, y+);
    }
    glColor3f (1, 1, 0);
    for(i=0; i<4; i++){
        glVertex2f(x1[i], yc[i]);
        glEnd();
        glFlush();
    }
}
void mymouse (int btn, int state, int x, int y)
{
if (btn== GLUT_LEFT_BUTTON && state == GLUT_DOWN && flag<4
{
    x1[flag] = x; y1[flag] = 500-y;
    glPointSize (3);
    glColor3f (1, 1, 0);
    glBegin (GL_POINTS);
    glVertex2i(x, 500-y);
    glEnd();
    glFlush();
    flag++
}
if (flag == 4 && btn == GLUT_LEFT_BUTTON)
{
    glColor3f (0, 0, 1);
    display();
    flag = 0;
}}
```

Teacher's Signature : _____

```
int main (int argc, char * argv[]) {
    glutInit (&argc, argv);
    cout << "Enter x coordinates";
    cin >> x1[0] >> x1[1] >> x1[2] >> x1[3];
    cout << "Enter y coordinates";
    cin >> yc[0] >> yc[1] >> yc[2] >> yc[3];

    glutInitDisplayMode (GLUT_SINGLE | GLUT_RGB);
    glutInitWindowSize (500, 500);
    glutInitWindowPosition (0, 0);
    glutCreateWindow ("BZ");
    glutDisplayFunc (display);
    glutMouseFunc (mymouse);
    myInit ();
    glutMainLoop ();
}
```