DELHI TECHNOLOGICAL UNIVERSITY

MATHEMATICS –III (MC-203)

PRACTICAL FILE

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AIM

Write a program for plotting equipotential lines u = constant of a harmonic function u and its conjugate v on the same axes. Apply for:

1. $u=x^2-y^2$ and $v=2xy$
2. $u=x^3-3xy^2$ and $v=3x^2y-y3$
3. $u=e^x\cos y$ and $v=e^x\sin y$

THEORY

If a function is analytic, its real and imaginary part both separately are harmonic functions and are conjugate to each other. The product of slopes at the intersection points of these functions is -1, i.e. the curves are orthogonal.

Contour plots are a way to show a three-dimensional surface on a two-dimensional plane. It graphs two predictor variables X Y on the y-axis and a response variable Z as contours. These contours are sometimes called z-slices or iso-response values.

SOURCE CODE

1. $u = x^2-y^2$, $v = 2xy$

```
close all;
clear all;
%specifying limits of x and y
x = linspace(-15,20);
y = linspace(-15,20);


%matrix of x and y
[X,Y] = meshgrid(x,y);
```

```
%complex number z
z= X + (1i*Y);

%u= x^2-y^2, v=2xy
%f=x^2 + (iy)^2 + 2xyi
%f=z^2
%harmonic function f
f= z^2;

%equipotential lines: contour plot
contour(X,Y,imag(f),'r');
hold on
contour(X,Y,real(f),'b');
grid on
legend("Red = Imaginary Part, Blue = Real Part")
```

2. $u = x^3 – 3xy^2$, $v = 3x^2y – y^3$

```
clear all;
close all;

%specifying limits of x and y
x = linspace(-15,20);
y = linspace(-15,20);

%matrix of x and y
[X,Y] = meshgrid(x,y);

%defining u and v
u=(X^3) - 3*X*(Y^2);
v=3*Y*(X^2)- (Y^3);

%equipotential lines: contour plot
```

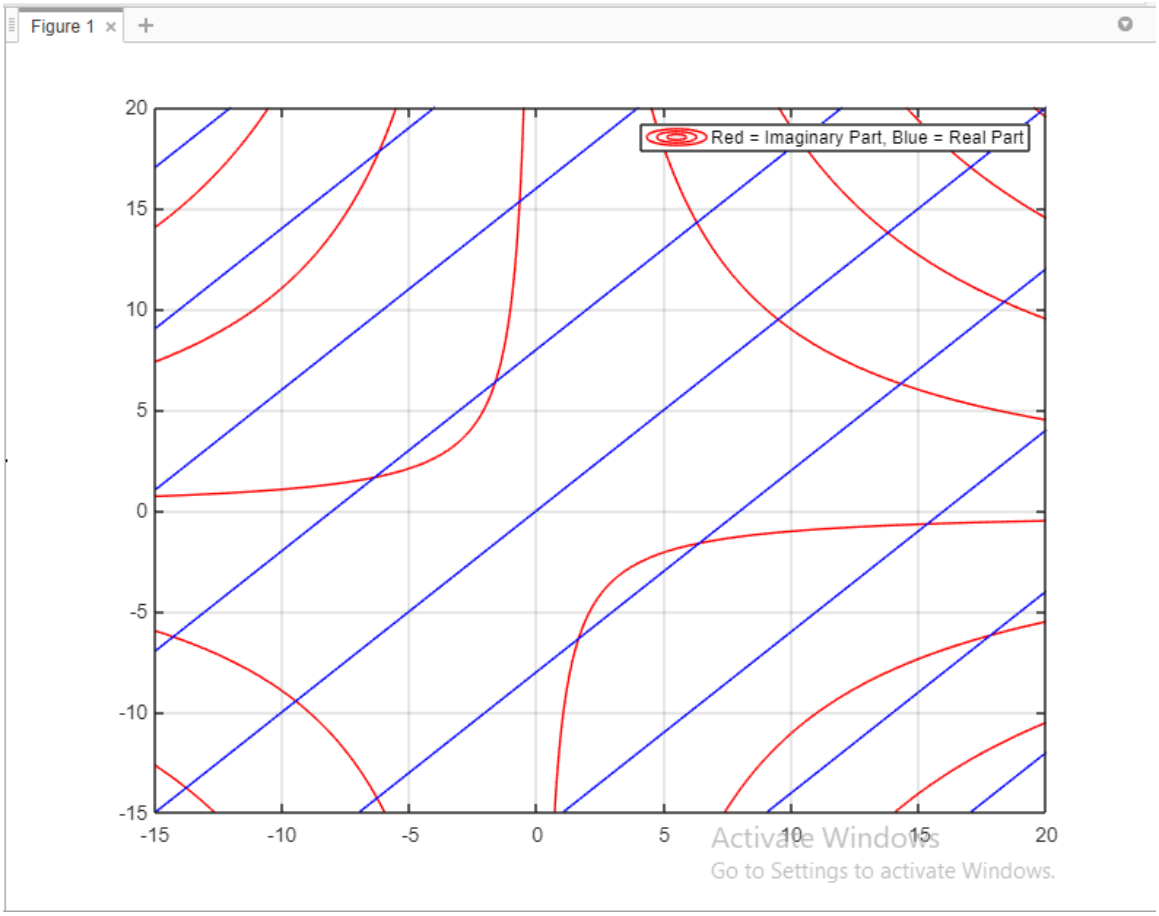
```
contour(X,Y,v,'r');
hold on
contour(X,Y,u,'b');
grid on
legend("Red = Imaginary Part, Blue = Real Part")
```

3. $u = e^x \cos y$, $v = e^x \sin y$

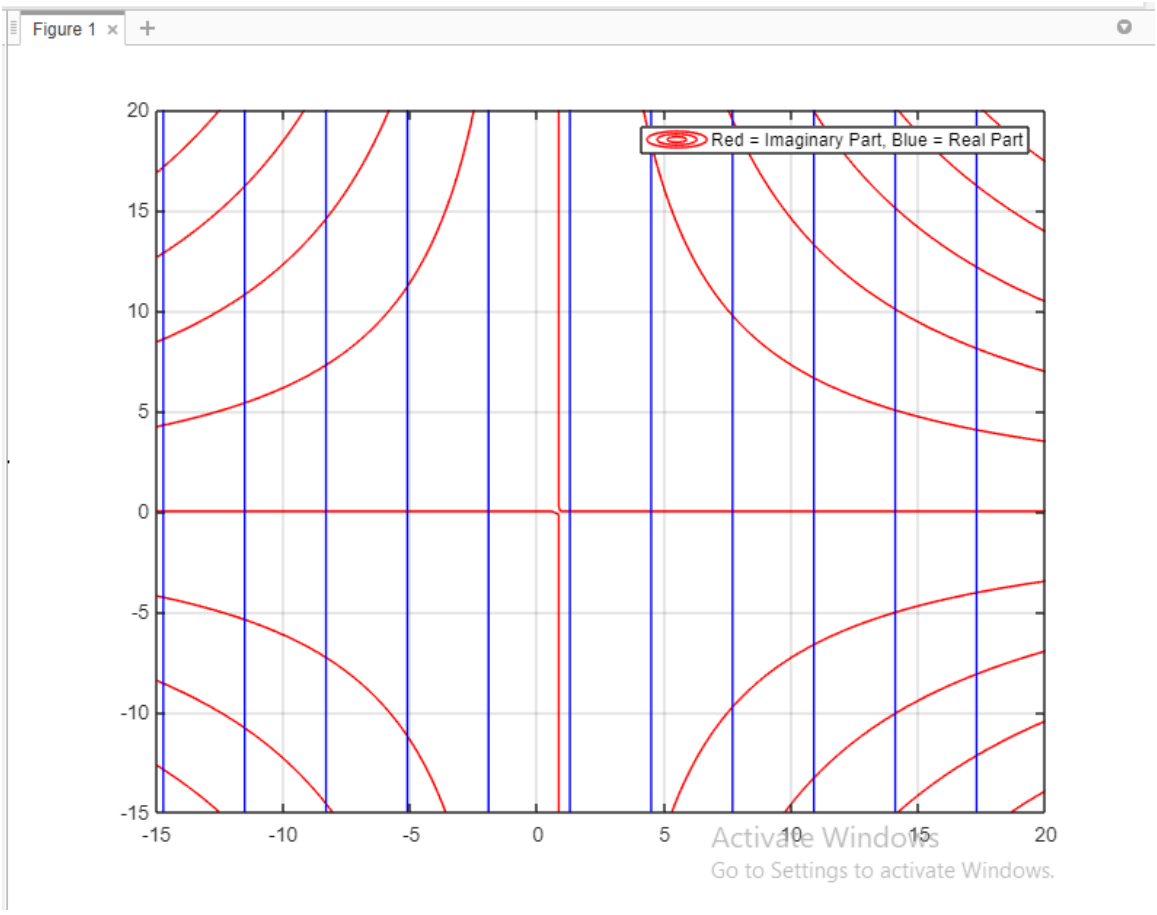
```
clear all;
close all;

%specifying limits of x and y
x = linspace(10,20);
y = linspace(10,20);

%matrix of x and y
[X,Y] = meshgrid(x,y);

%complex number z
z= X + (1i*Y);

%u= (cosy)e^x, v=(siny)e^x
%f=(cosy + isiny)e^x= e^(x+iy)
%f=e^z
%harmonic function f
f= exp(z);

%equipotential lines: contour plot
contour(X,Y,imag(f),'r');
hold on
contour(X,Y,real(f),'b');
grid on
legend("Red = Imaginary Part, Blue = Real Part")
```

OUTPUT

1. $u = x^2-y^2$, $v = 2xy$



2. $u = x^3 – 3xy^2$, $v = 3x^2y – y^3$



3. $u = e^x \cos y$, $v = e^x \sin y$

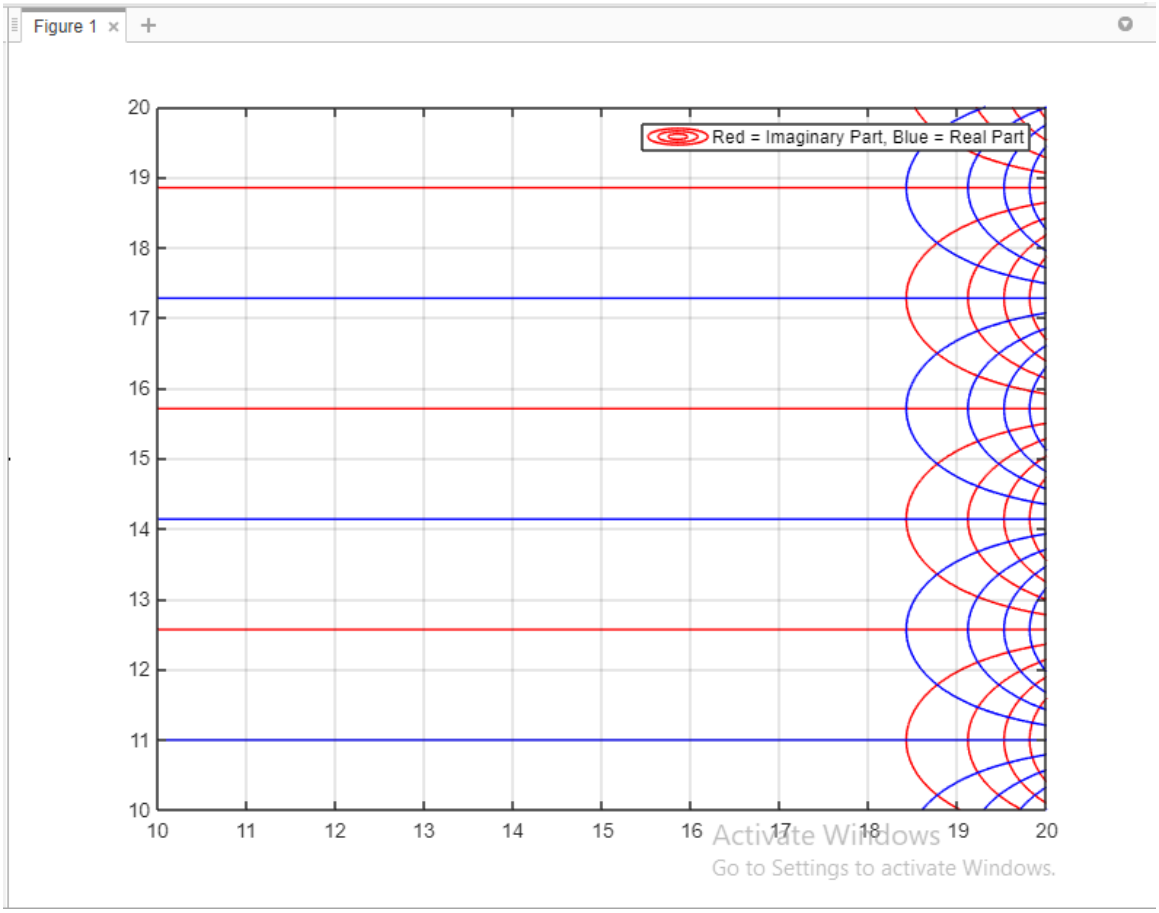


Figure 1
Red = Imaginary Part, Blue = Real Part
20
19
18
17
16
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10
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12
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14
15
16
17
18
19
20
Activate Windows
Go to Settings to activate Windows.