20BCE1548-TIRTH VISHALBHAI DAVE

EXP-9

Q1

Find the local maximum and minimum values of f(x,y)=2(x2-y2)-x4+y4

CODE: -

```
clc
clear all
close all
format compact
%%
syms x y real
f =input('Enter the function f(x,y): ');
fx = diff(f,x)
fy = diff(f,y)
[ax ay] = solve(fx,fy)
fxx = diff(fx,x)
D = fxx*diff(fy,y) - diff(fx,y)^2%ln-m^2
%% Collecting critical points
r=1;
for k=1:1:size(ax)
    if ((imag(ax(k))==0)&&(imag(ay(k))==0))
        ptx(r)=ax(k);
        pty(r)=ay(k);
        r=r+1;
    end
end
%% Visulalizing the function
a1=max(double(ax))
a2=min(double(ax))
b1=max(double(ay))
b2=min(double(ay))
ezsurf(f,[a2-.5,a1+.5,b2-.5,b1+.5])
colormap('summer');
shading interp
hold on
```

```
%% Finding the maximum and minimum values of the
function and their visulaization
for r1=1:1:(r-1)
    T1=subs(subs(D,x,ptx(r1)),y,pty(r1))
    T2=subs(subs(fxx,x,ptx(r1)),y,pty(r1))
    if (double(T1) == 0)
        sprintf('The point (x,y) is (%d,%d) and
need further investigation',
double(ptx(r1)),double(pty(r1)))
    elseif (double(T1) < 0)
        T3=subs(subs(f,x,ptx(r1)),y,pty(r1))
        sprintf('The point (x,y) is (%d,%d) a
saddle point', double(ptx(r1)),double(pty(r1)))

plot3(double(ptx(r1)),double(pty(r1)),double(T3),'
b.','markersize',30);
    else
        if (double(T2) < 0)
            sprintf('The maximum point(x,y) is
(%d, %d)', double(ptx(r1)),double(pty(r1)))
            T3=subs(subs(f,x,ptx(r1)),y,pty(r1))
            sprintf('The value of the function is
%d', double(T3))

plot3(double(ptx(r1)),double(pty(r1)),double(T3),'
r+','markersize',30);
        else
            sprintf('The minimum point(x,y) is
(%d, %d)', double(ptx(r1)),double(pty(r1)))
            T3=subs(subs(f,x,ptx(r1)),y,pty(r1))
            sprintf('The value of the function is
%d', double(T3))

plot3(double(ptx(r1)),double(pty(r1)),double(T3),'
m*','markersize',30);
        end
    end
end
```

OUTPUT:-

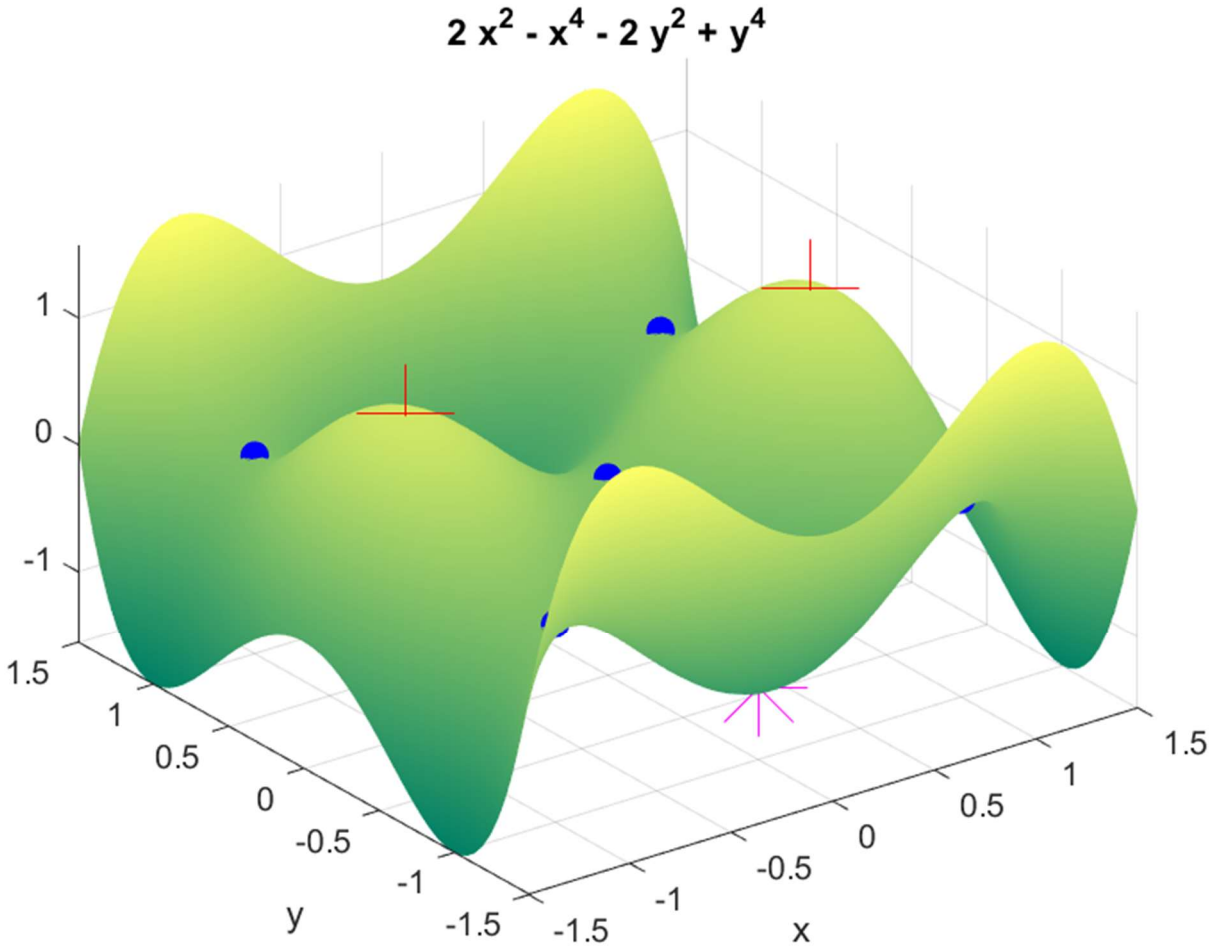
```
Enter the function f(x,y): 2*(x^2-y^2)-x^4+y^4
fx =
- 4*x^3 + 4*x
fy =
4*y^3 - 4*y
ax =
 0
-1
 1
 0
 0
-1
 1
-1
 1
ay =
 0
 0
 0
-1
 1
-1
-1
```

```
 1

 1

fxx =

4 - 12*x^2

D =

-(12*x^2 - 4)*(12*y^2 - 4)

a1 =

     1

a2 =

    -1

b1 =

     1

b2 =

    -1

T1 =

-16

T2 =

4

T3 =

0

ans =

    'The point (x,y) is (0,0) a saddle point'

T1 =

32
```

```
T2 =

-8

ans =

    'The maximum point(x,y) is (-1, 0)'

T3 =

1

ans =

    'The value of the function is 1'

T1 =

32

T2 =

-8

ans =

    'The maximum point(x,y) is (1, 0)'

T3 =

1

ans =

    'The value of the function is 1'

T1 =

32

T2 =

4

ans =

    'The minimum point(x,y) is (0, -1)'
```

```
T3 =

-1

ans =

    'The value of the function is -1'

T1 =

32

T2 =

4

ans =

    'The minimum point(x,y) is (0, 1)'

T3 =

-1

ans =

    'The value of the function is -1'

T1 =

-64

T2 =

-8

T3 =

0

ans =

    'The point (x,y) is (-1,-1) a saddle point'

T1 =

-64
```

```
T2 =

-8

T3 =

0

ans =

    'The point (x,y) is (1,-1) a saddle point'

T1 =

-64

T2 =

-8

T3 =

0

ans =

    'The point (x,y) is (-1,1) a saddle point'

T1 =

-64

T2 =

-8

T3 =

0

ans =

    'The point (x,y) is (1,1) a saddle point'
```


$2x^2 - x^4 - 2y^2 + y^4$
1
0
-1
1.5
1
0.5
0
-0.5
-1
-1.5
y
-1.5
-1
-0.5
0
0.5
1
1.5
x

Q2-

Find the local maximum and minimum value of the following function

F(x,y)= 2x3+xy^2+5x2+y2CODE: -

```
clc
clear all
close all
format compact
%%
syms x y real
f =input('Enter the function f(x,y): ');
fx = diff(f,x)
fy = diff(f,y)
[ax ay] = solve(fx,fy)
fxx = diff(fx,x)
D = fxx*diff(fy,y) - diff(fx,y)^2%ln-m^2
%% Collecting critical points
r=1;
for k=1:1:size(ax)
    if ((imag(ax(k))==0)&&(imag(ay(k))==0))
        ptx(r)=ax(k);
        pty(r)=ay(k);
        r=r+1;
    end
end
%% Visulalizing the function
a1=max(double(ax))
a2=min(double(ax))
b1=max(double(ay))
b2=min(double(ay))
ezsurf(f,[a2-.5,a1+.5,b2-.5,b1+.5])
colormap('summer');
shading interp
hold on
%% Finding the maximum and minimum values of the
function and their visulaization
for r1=1:1:(r-1)
    T1=subs(subs(D,x,ptx(r1)),y,pty(r1))
```

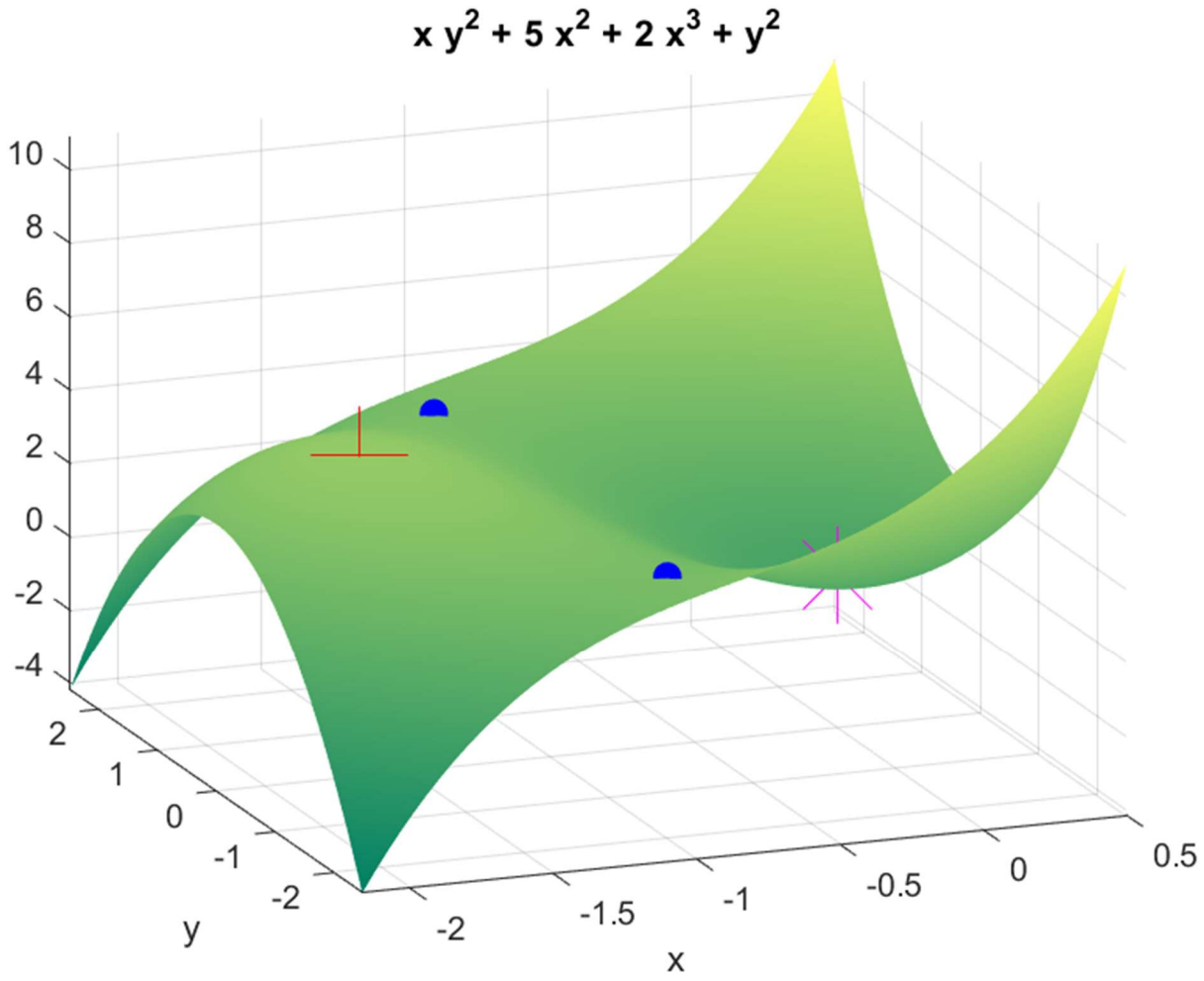
```
    T2=subs(subs(fxx,x,ptx(r1)),y,pty(r1))
    if (double(T1) == 0)
        sprintf('The point (x,y) is (%d,%d) and
need further investigation',
double(ptx(r1)),double(pty(r1)))
    elseif (double(T1) < 0)
        T3=subs(subs(f,x,ptx(r1)),y,pty(r1))
        sprintf('The point (x,y) is (%d,%d) a
saddle point', double(ptx(r1)),double(pty(r1)))

plot3(double(ptx(r1)),double(pty(r1)),double(T3),'
b.','markersize',30);
    else
        if (double(T2) < 0)
            sprintf('The maximum point(x,y) is
(%d, %d)', double(ptx(r1)),double(pty(r1)))
            T3=subs(subs(f,x,ptx(r1)),y,pty(r1))
            sprintf('The value of the function is
%d', double(T3))

plot3(double(ptx(r1)),double(pty(r1)),double(T3),'
r+','markersize',30);
        else
            sprintf('The minimum point(x,y) is
(%d, %d)', double(ptx(r1)),double(pty(r1)))
            T3=subs(subs(f,x,ptx(r1)),y,pty(r1))
            sprintf('The value of the function is
%d', double(T3))

plot3(double(ptx(r1)),double(pty(r1)),double(T3),'
m*','markersize',30);
        end
    end
end
```

OUTPUT: -

```
Enter the function f(x,y): 2*x^3+x*y^2+5*x^2+y^2
fx =
6*x^2 + 10*x + y^2
fy =
2*y + 2*x*y
ax =
   0
  -1
  -1
-5/3
ay =
 0
-2
 2
 0
fxx =
12*x + 10
D =
- 4*y^2 + (2*x + 2)*(12*x + 10)
a1 =
     0
a2 =
   -1.6667
```

```
b1 =
     2
b2 =
    -2
T1 =
20
T2 =
10
ans =
    'The minimum point(x,y) is (0, 0)'
T3 =
0
ans =
    'The value of the function is 0'
T1 =
-16
T2 =
-2
T3 =
3
ans =
    'The point (x,y) is (-1,-2) a saddle point'
T1 =
-16
```

```
T2 =
-2
T3 =
3
ans =
    'The point (x,y) is (-1,2) a saddle point'
T1 =
40/3
T2 =
-10
ans =
    'The maximum point(x,y) is (-1.666667e+00, 0)'
T3 =
125/27
ans =
    'The value of the function is 4.629630e+00'
```


x y^2 + 5 x^2 + 2 x^3 + y^2
10
8
6
4
2
0
-2
-4
2
1
0
-1
-2
y
-2
-1.5
-1
-0.5
0
0.5
x