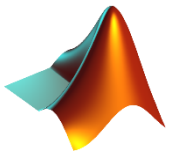
MAT 1011

MATLAB



Digital Assignment – 3

L31+L32

FALL SEMESTER 2019-20

by

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Question 1

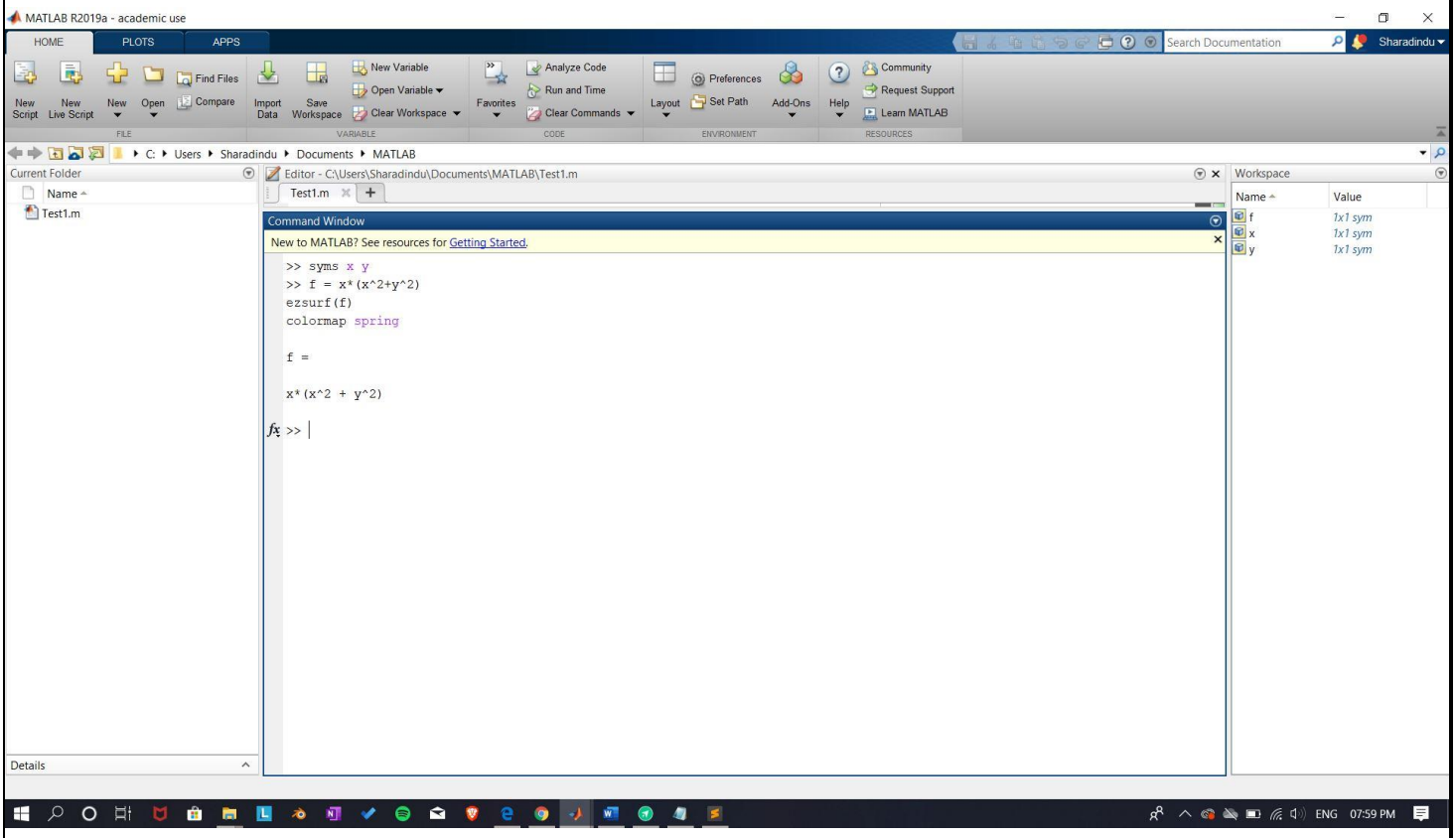
Problem:

Using 'surf' plot the surface $f(x, y) = x(x^2 + y^2)$.

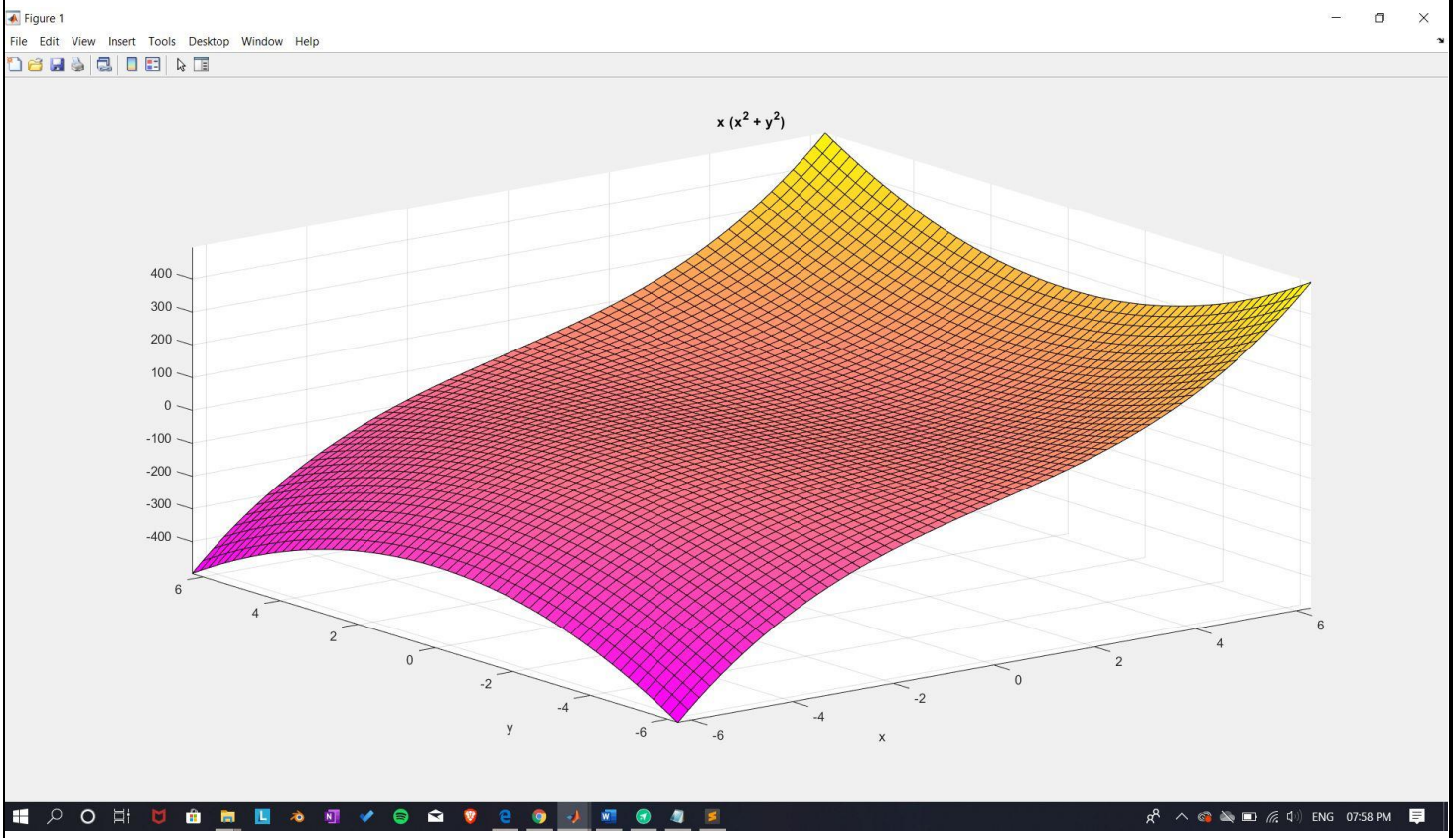
Code & Input:

```
syms x y
f = x*(x^2+y^2)
ezsurf(f)
colormap spring

f =

x*(x^2 + y^2)
```

Screenshot of Code:



Output & Graph:



Question 2

Problem:

Expand $f(x,y) = e^x \ln(1+y)$ in terms of x and y up to the terms of 3rd degree using Taylor series.

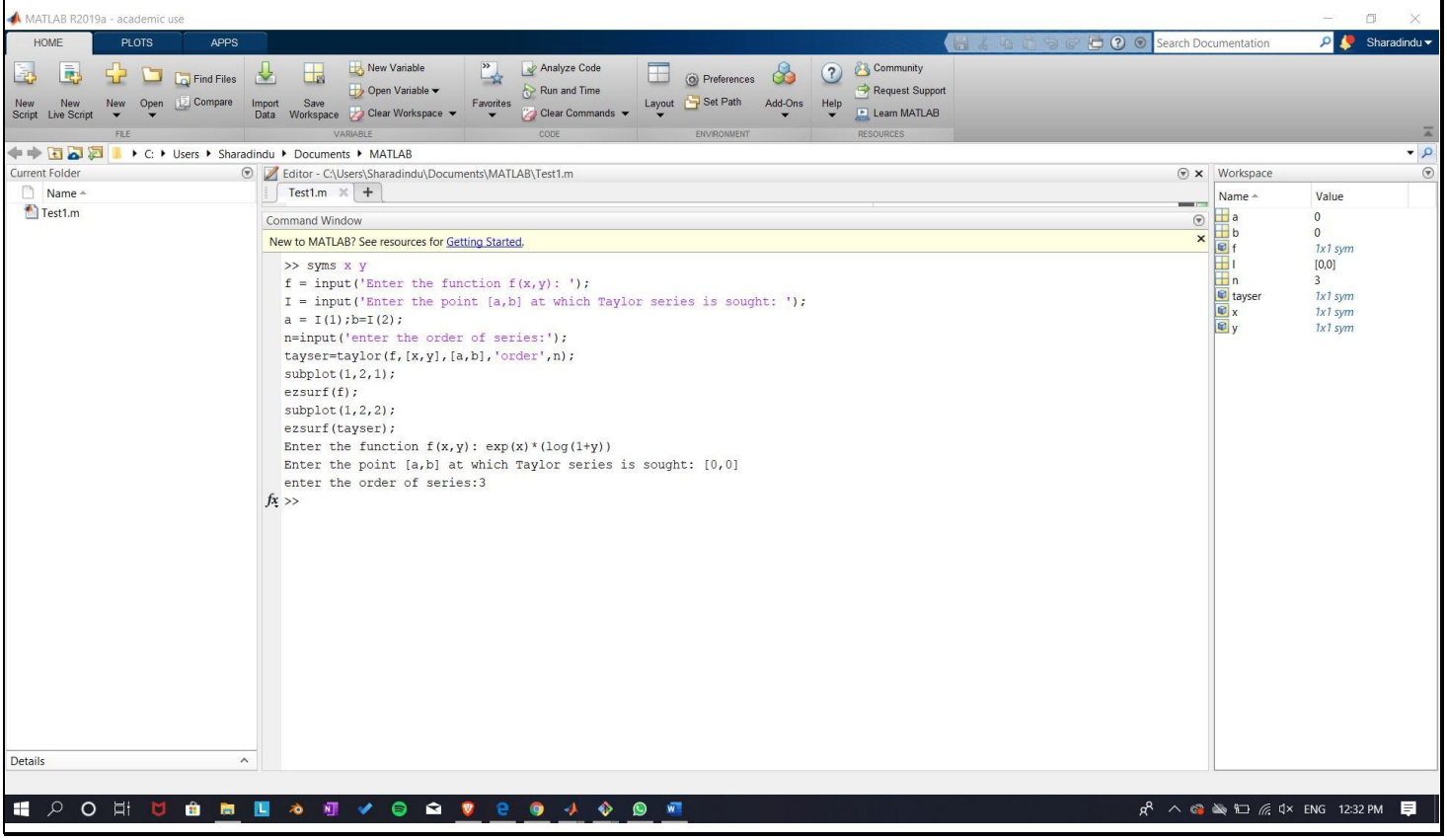
Code in MATLAB:

```
syms x y
f = input('Enter the function f(x,y): ');
I = input('Enter the point [a,b] at which Taylor series is sought: ');
a = I(1);b=I(2);
n=input('enter the order of series:');
tayser=taylor(f,[x,y],[a,b],'order',n);
subplot(1,2,1);
ezsurf(f);
subplot(1,2,2);
ezsurf(tayser);
```

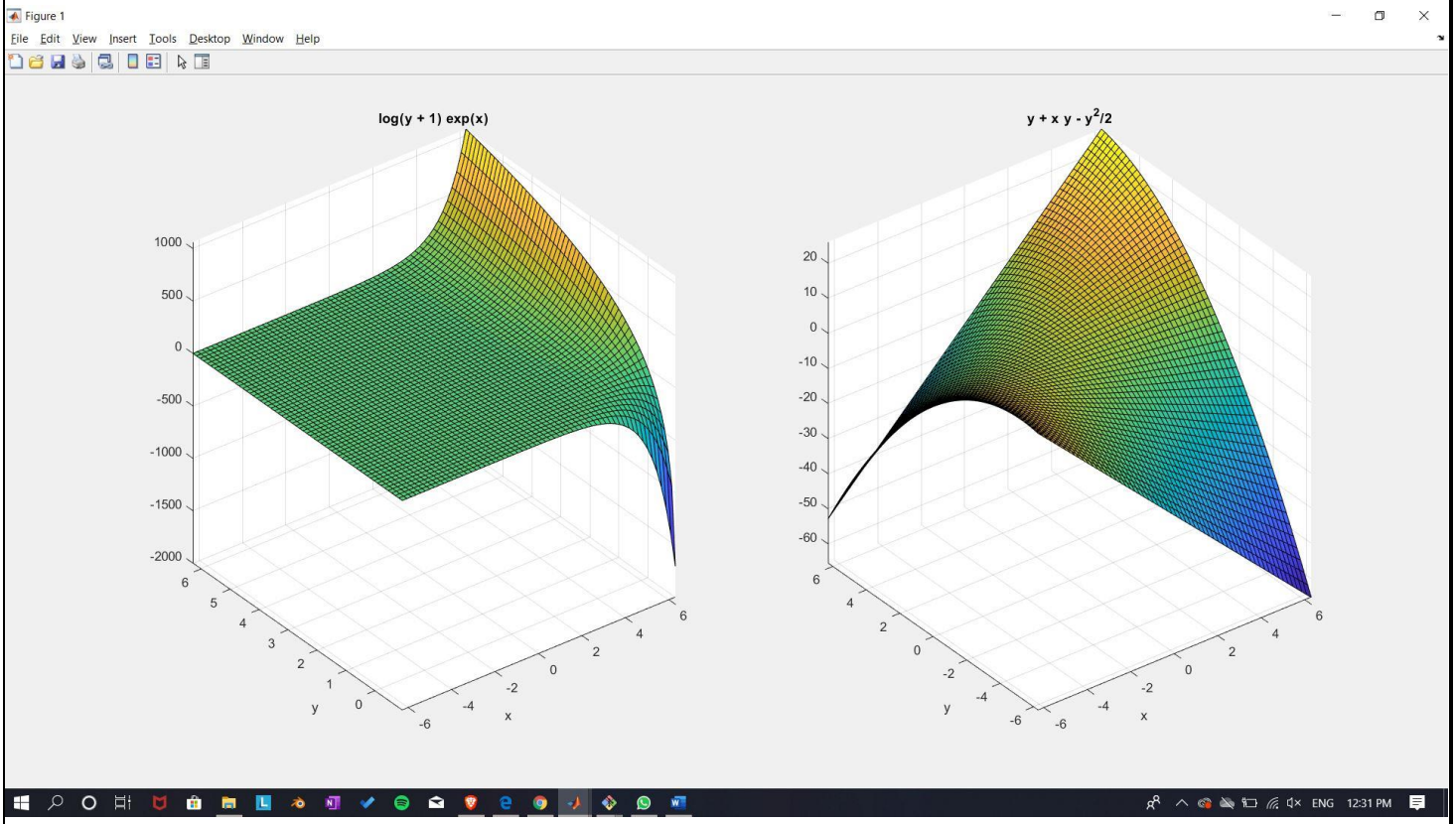
Input:

```
Enter the function f(x,y): exp(x)*(log(1+y))
Enter the point [a,b] at which Taylor series is sought: [0,0]
enter the order of series:3
```

Screenshot of Code:



Output & Graph:



Question 3

Problem:

Find the maxima and minima for the function $f(x,y) = x^4 + y^4 - x^2 - y^2 + 1$

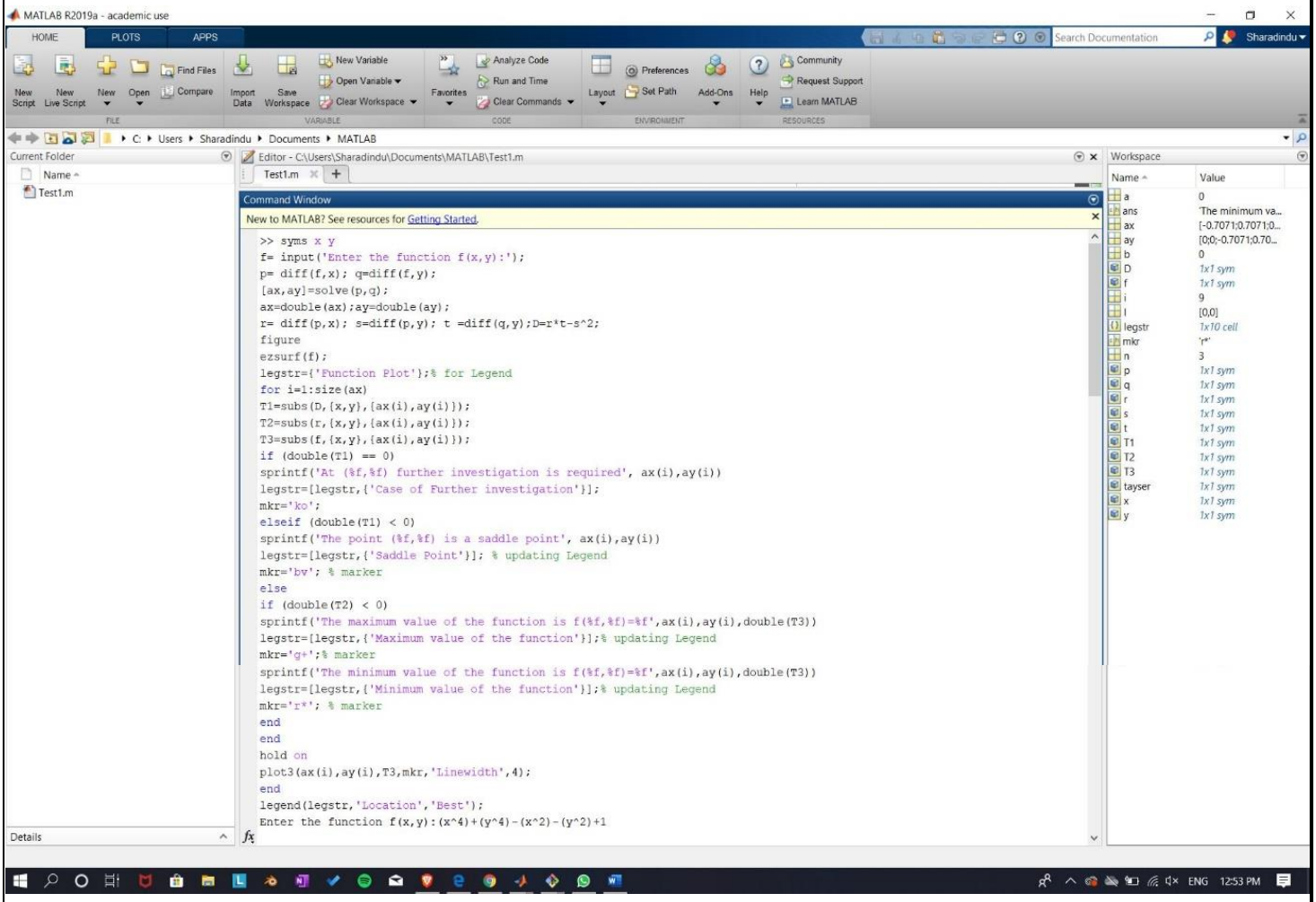
Code in MATLAB:

```
syms x y
f= input('Enter the function f(x,y):');
p= diff(f,x); q=diff(f,y);
[ax,ay]=solve(p,q);
ax=double(ax);ay=double(ay);
r= diff(p,x); s=diff(p,y); t =diff(q,y);D=r*t-s^2;
figure
ezsurf(f);
legstr={'Function Plot'};% for Legend
for i=1:size(ax)
T1=subs(D,{x,y},{ax(i),ay(i)});
T2=subs(r,{x,y},{ax(i),ay(i)});
T3=subs(f,{x,y},{ax(i),ay(i)});
if (double(T1) == 0)
sprintf('At (%f,%f) further investigation is required', ax(i),ay(i))
legstr=[legstr,{'Case of Further investigation'}];
mkr='ko';
elseif (double(T1) < 0)
sprintf('The point (%f,%f) is a saddle point', ax(i),ay(i))
legstr=[legstr,{'Saddle Point'}]; % updating Legend
mkr='bv'; % marker
else
if (double(T2) < 0)
sprintf('The      maximum      value      of      the      function      is
f(%f,%f)=%f',ax(i),ay(i),double(T3))
legstr=[legstr,{'Maximum value of the function'}];% updating Legend
mkr='g+';% marker
else
sprintf('The      minimum      value      of      the      function      is
f(%f,%f)=%f',ax(i),ay(i),double(T3))
legstr=[legstr,{'Minimum value of the function'}];% updating Legend
mkr='r*'; % marker
end
end
hold on
plot3(ax(i),ay(i),T3,mkr,'Linewidth',4);
end
legend(legstr,'Location','Best');
```

Input:

```
Enter the function f(x,y):(x^4)+(y^4)-(x^2)-(y^2)+1
```

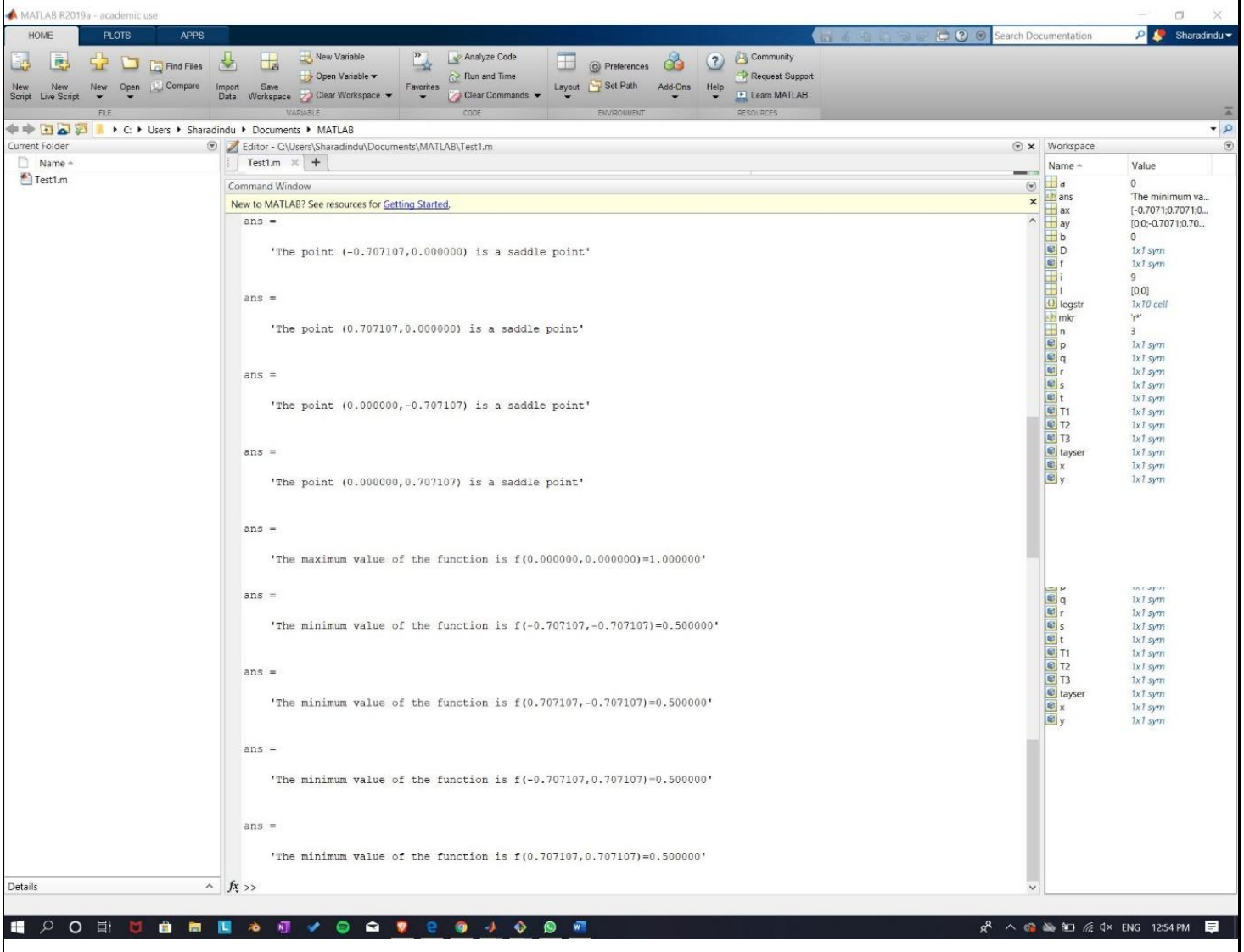
Screenshot of Code:



Output:

```
ans =

    'The point (-0.707107,0.000000) is a saddle point'

ans =

    'The point (0.707107,0.000000) is a saddle point'

ans =

    'The point (0.000000,-0.707107) is a saddle point'

ans =

    'The point (0.000000,0.707107) is a saddle point'
```

```
ans =

    'The maximum value of the function is f(0.000000,0.000000)=1.000000'

ans =

    'The minimum value of the function is f(-0.707107,-0.707107)=0.500000'

ans =

    'The minimum value of the function is f(0.707107,-0.707107)=0.500000'

ans =

    'The minimum value of the function is f(-0.707107,0.707107)=0.500000'

ans =

    'The minimum value of the function is f(0.707107,0.707107)=0.500000'
```



Graph:

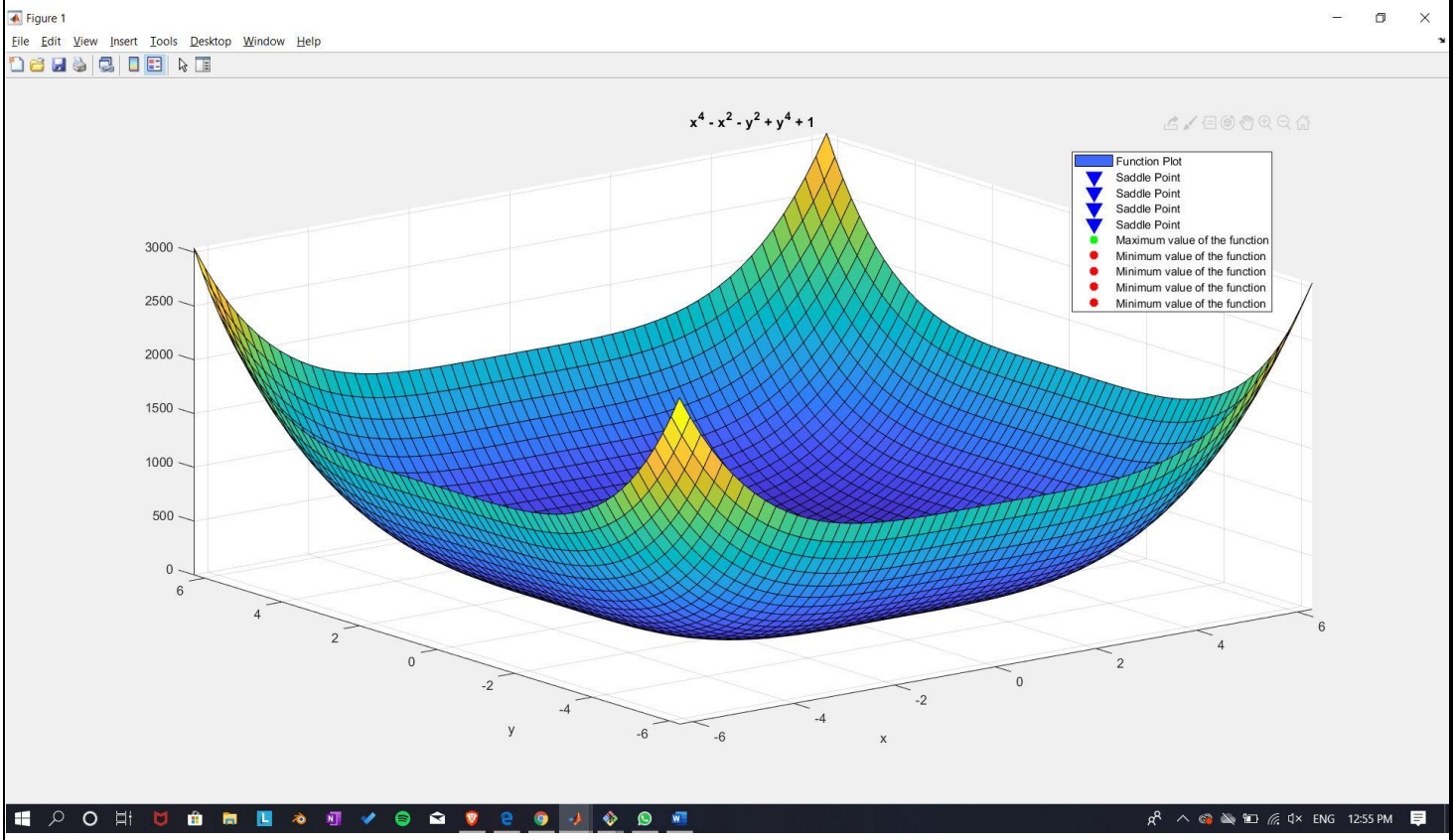


Figure 1
File Edit View Insert Tools Desktop Window Help
$x^4 - x^2 - y^2 + y^4 + 1$
Function Plot
Saddle Point
Saddle Point
Saddle Point
Saddle Point
Maximum value of the function
Minimum value of the function
Minimum value of the function
Minimum value of the function
Minimum value of the function
3000
2500
2000
1500
1000
500
0
6
4
2
0
-2
-4
-6
y
-6
-4
-2
0
2
4
6
x
ENG
12:55 PM

Question 4

Problem:

Find the maxima and minima for the function $f(x,y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$

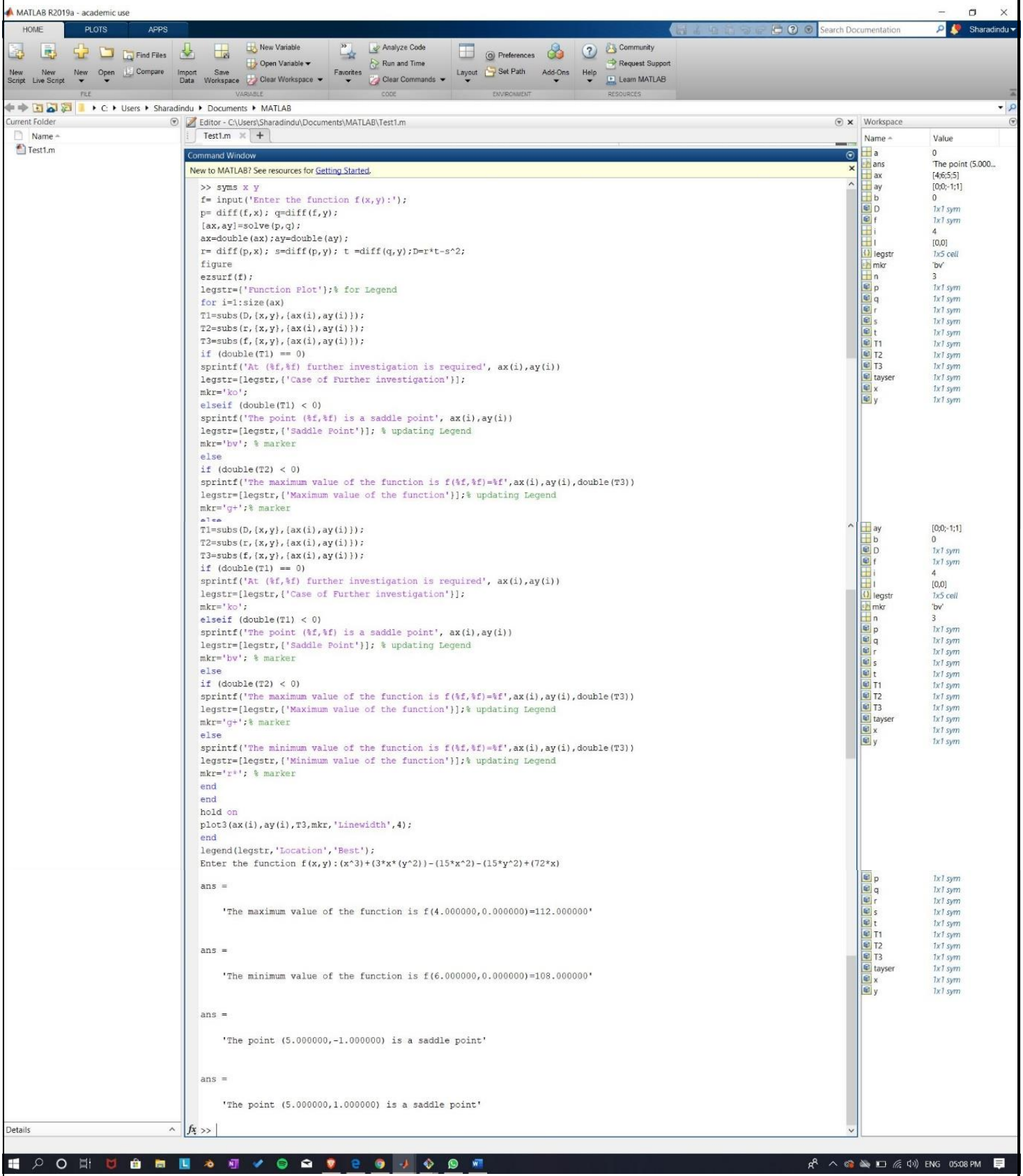
Code in MATLAB:

```
syms x y
f= input('Enter the function f(x,y):');
p= diff(f,x); q=diff(f,y);
[ax,ay]=solve(p,q);
ax=double(ax);ay=double(ay);
r= diff(p,x); s=diff(p,y); t =diff(q,y);D=r*t-s^2;
figure
ezsurf(f);
legstr={'Function Plot'};% for Legend
for i=1:size(ax)
T1=subs(D,{x,y},{ax(i),ay(i)});
T2=subs(r,{x,y},{ax(i),ay(i)});
T3=subs(f,{x,y},{ax(i),ay(i)});
if (double(T1) == 0)
sprintf('At (%f,%f) further investigation is required', ax(i),ay(i))
legstr=[legstr,{'Case of Further investigation'}];
mkr='ko';
elseif (double(T1) < 0)
sprintf('The point (%f,%f) is a saddle point', ax(i),ay(i))
legstr=[legstr,{'Saddle Point'}]; % updating Legend
mkr='bv'; % marker
else
if (double(T2) < 0)
sprintf('The      maximum      value      of      the      function      is
f(%f,%f)=%f',ax(i),ay(i),double(T3))
legstr=[legstr,{'Maximum value of the function'}];% updating Legend
mkr='g+';% marker
else
sprintf('The      minimum      value      of      the      function      is
f(%f,%f)=%f',ax(i),ay(i),double(T3))
legstr=[legstr,{'Minimum value of the function'}];% updating Legend
mkr='r*'; % marker
end
end
hold on
plot3(ax(i),ay(i),T3,mkr,'Linewidth',4);
end
legend(legstr,'Location','Best');
```

Input:

```
Enter the function f(x,y): (x^3)+(3*x*(y^2))-(15*x^2)-(15*y^2)+(72*x)
```

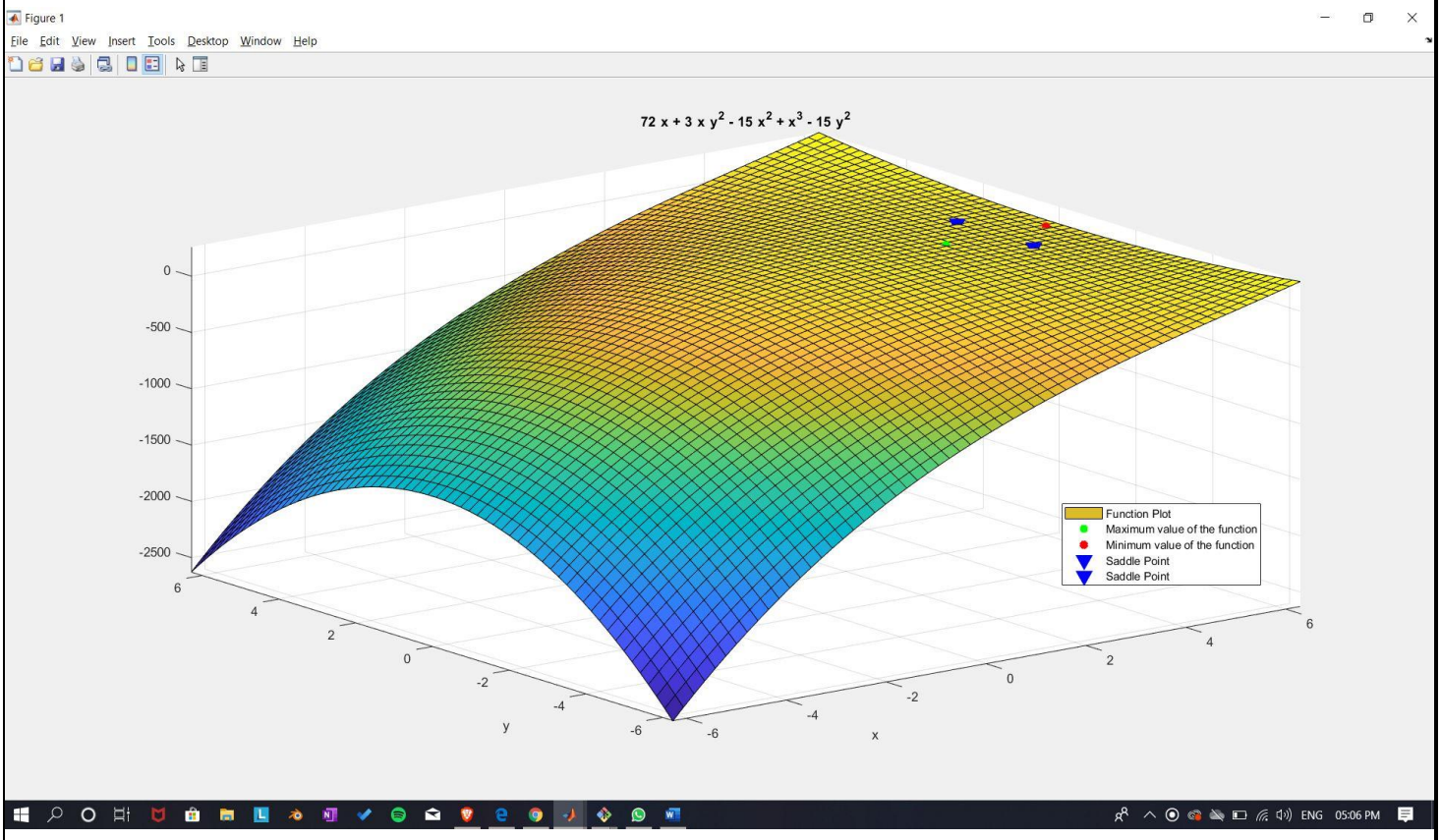
Screenshot of Code:



Output:

```
ans =

    'The maximum value of the function is f(4.000000,0.000000)=112.000000'

ans =

    'The minimum value of the function is f(6.000000,0.000000)=108.000000'

ans =

    'The point (5.000000,-1.000000) is a saddle point'

ans =

    'The point (5.000000,1.000000) is a saddle point'
```

Graph:



End