MAT 1011

MATLAB



Digital Assignment – 3

L31+L32
FALL SEMESTER 2019-20

by

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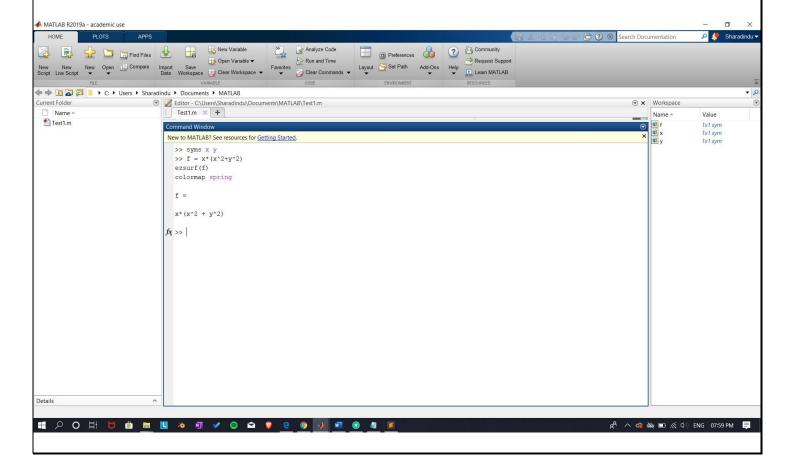
Problem:

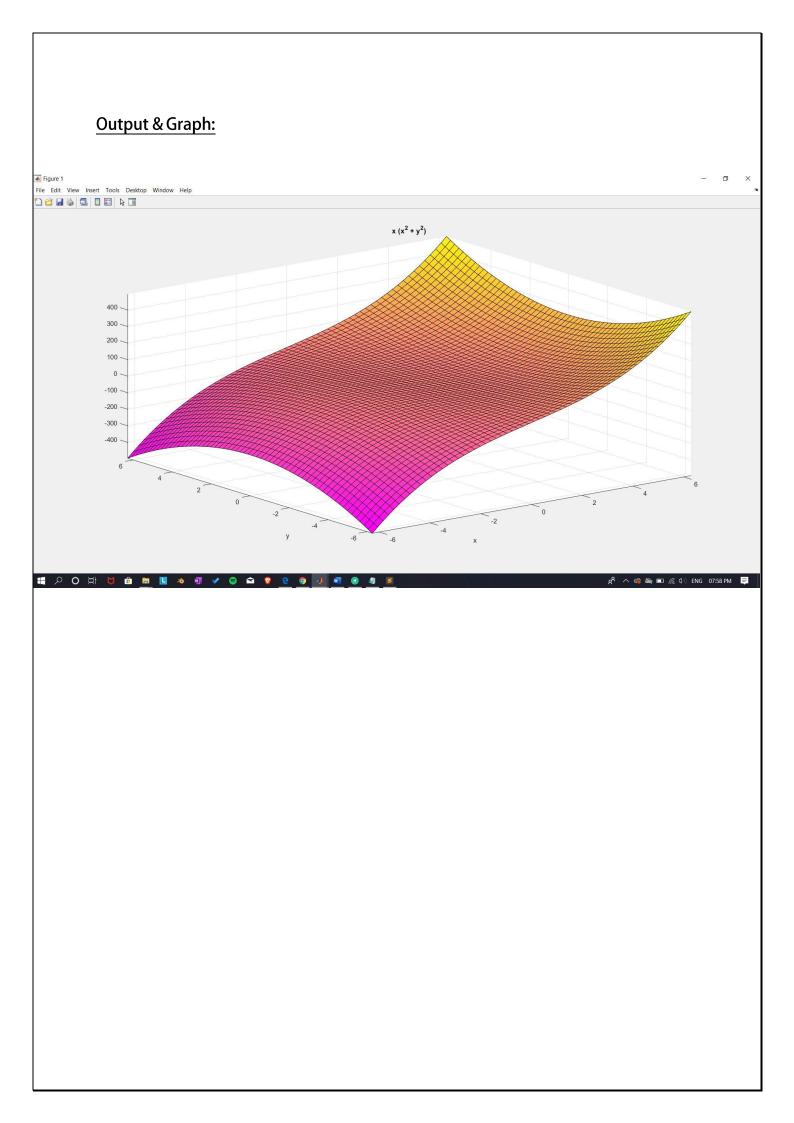
Using 'surf' plot the surface $f(x, y) = x(x^2 + y^2)$.

Code & Input:

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

Screenshot of Code:





Problem:

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

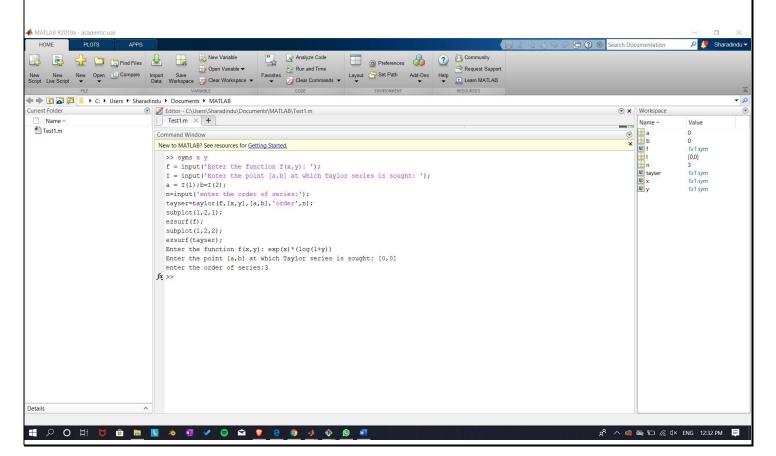
Code in MATLAB:

```
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: Figure 1 File Edit View Insert Iools Desktop Window Help $y + x y - y^2/2$ log(y + 1) exp(x)1000 20 . 500 0 0. -10 -20 -500 -1000 -40 -50 -1500 -2000

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)
\begin{array}{l} \text{T1=subs}(D,\{x,y\},\{ax(i),ay(i)\});\\ \text{T2=subs}(r,\{x,y\},\{ax(i),ay(i)\}); \end{array}
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)</pre>
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);
legend(legstr, 'Location', 'Best');
```

Input:

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

Screenshot of Code: Find Files Wew Variable Analyze Code Layout Set Path Add-Ons Help Learn MATLAB Import Save Data Workspace → Clear Workspace → Favorites → Clear Commands → 🔷 🧼 🛅 🔊 🎏 👂 C: 🕨 Users 🕨 Sharadindu 🕨 Documents 🕨 MATLAB + 3 Editor - C:\Users\Sharadindu\Documents\MATLAB\Test1.m Name Name -Value Test1.m New to MATLAB? See resources for Getting Started. I-0.7071:0.7071:0... >> syms x y f= input('Enter the function f(x,y):'); [0;0;-0.7071;0.70... 1x1 sym 1x1 sym p= diff(f,x); q=diff(f,y); [ax,ay]=solve(p,q); $\begin{aligned} & \texttt{ax=double}\,(\texttt{ax})\,; \texttt{ay=double}\,(\texttt{ay})\,; \\ & \texttt{r=}\,\, \texttt{diff}\,(\texttt{p},\texttt{x})\,;\,\, \texttt{s=diff}\,(\texttt{p},\texttt{y})\,;\,\, \texttt{t=diff}\,(\texttt{q},\texttt{y})\,; \texttt{D=r*t-s^2}; \end{aligned}$ [0,0] 1x10 cell figure legstr={'Function Plot'};% for Legend 1x1 sym 1x1 sym for i=1:size(ax) T1=subs(D, {x,y}, {ax(i),ay(i)}); T2=subs(r, {x,y}, {ax(i),ay(i)}); $$\begin{split} &T3=subs\{f,\{x,y\},\{ax(i),ay(i)\}\};\\ &if\;(double(T1) == 0)\\ &sprintf('At\;(\$f,\$f)\;further\;investigation\;is\;required',\;ax(i),ay(i)) \end{split}$$ 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 else 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 Lege $sprintf('The \ minimum \ value \ of \ the \ function \ is \ f(\$f,\$f)=\$f',ax(i),ay(i),double(T3))$ legstr=[legstr,{'Minimum value of the function'}];% updating Leg end end hold on plot3(ax(i),ay(i),T3,mkr,'Linewidth',4); end legend(legstr, 'Location', 'Best'); Enter the function $f(x,y):(x^4)+(y^4)-(x^2)-(y^2)+1$ ^ fx Details **■ 夕 ○ 計 ♥ 命 ■ ■ ▲ 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 =

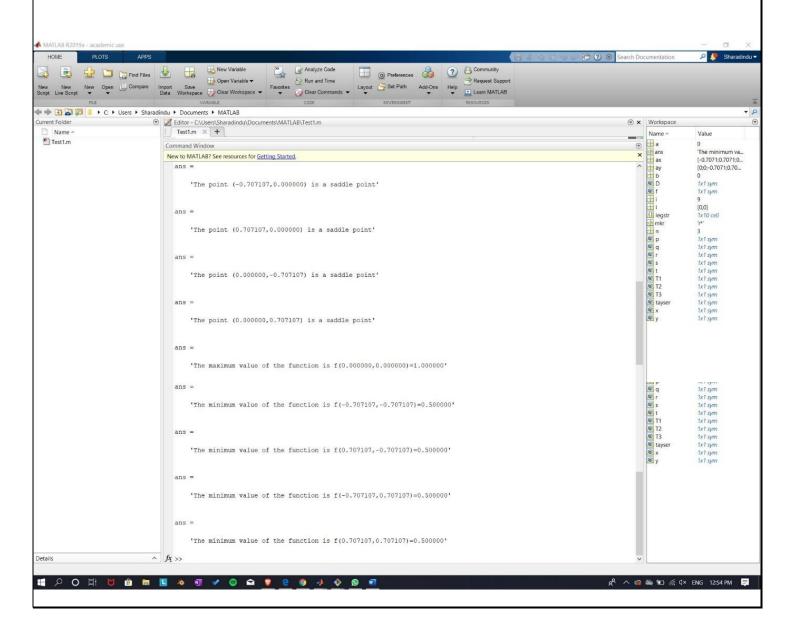
'The minimum value of the function is f(0.707107,-0.707107)=0.500000'

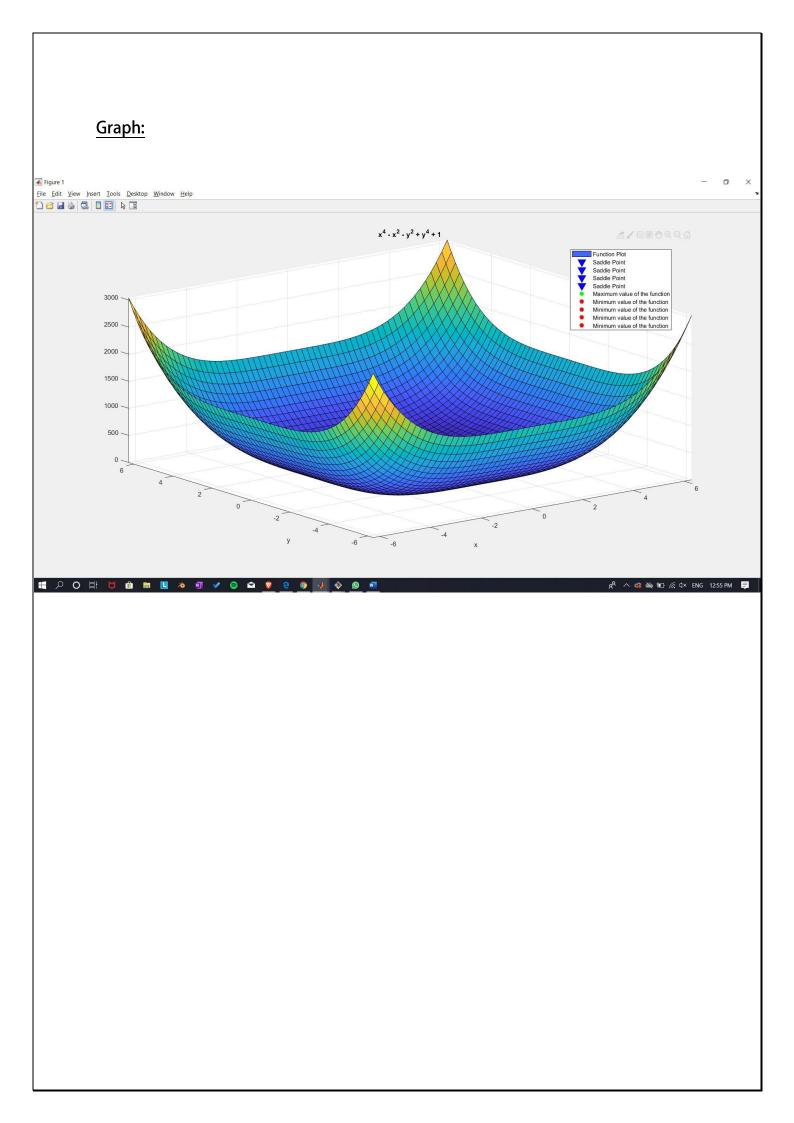
ans =

'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)=0.5000000'





Problem:

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

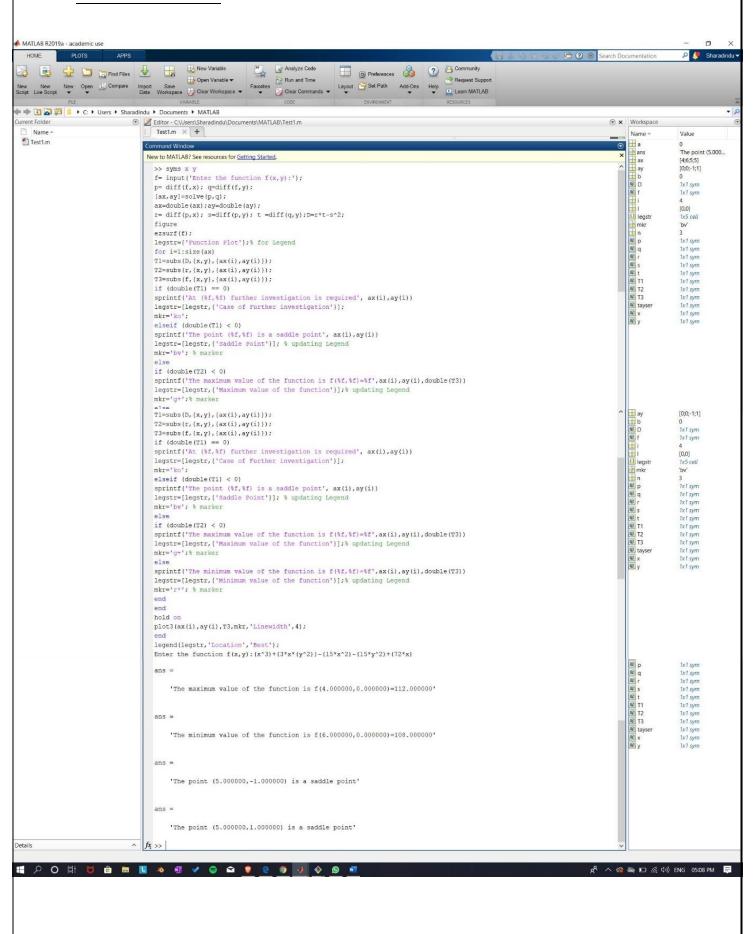
Code in MATLAB:

```
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)
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
                                value
                                           of
                                                   the
                                                             function
                                                                           is
                  maximum
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
                                           of
                                                   the
                                                             function
                                                                           is
                  minimum
                                value
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);
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:

