MAT 1011

MATLAB

Digital Assignment – 1

L31+L32

FALL SEMESTER 2019-20

by

SHARADINDU ADHIKARI

19BCE2105

Question 1

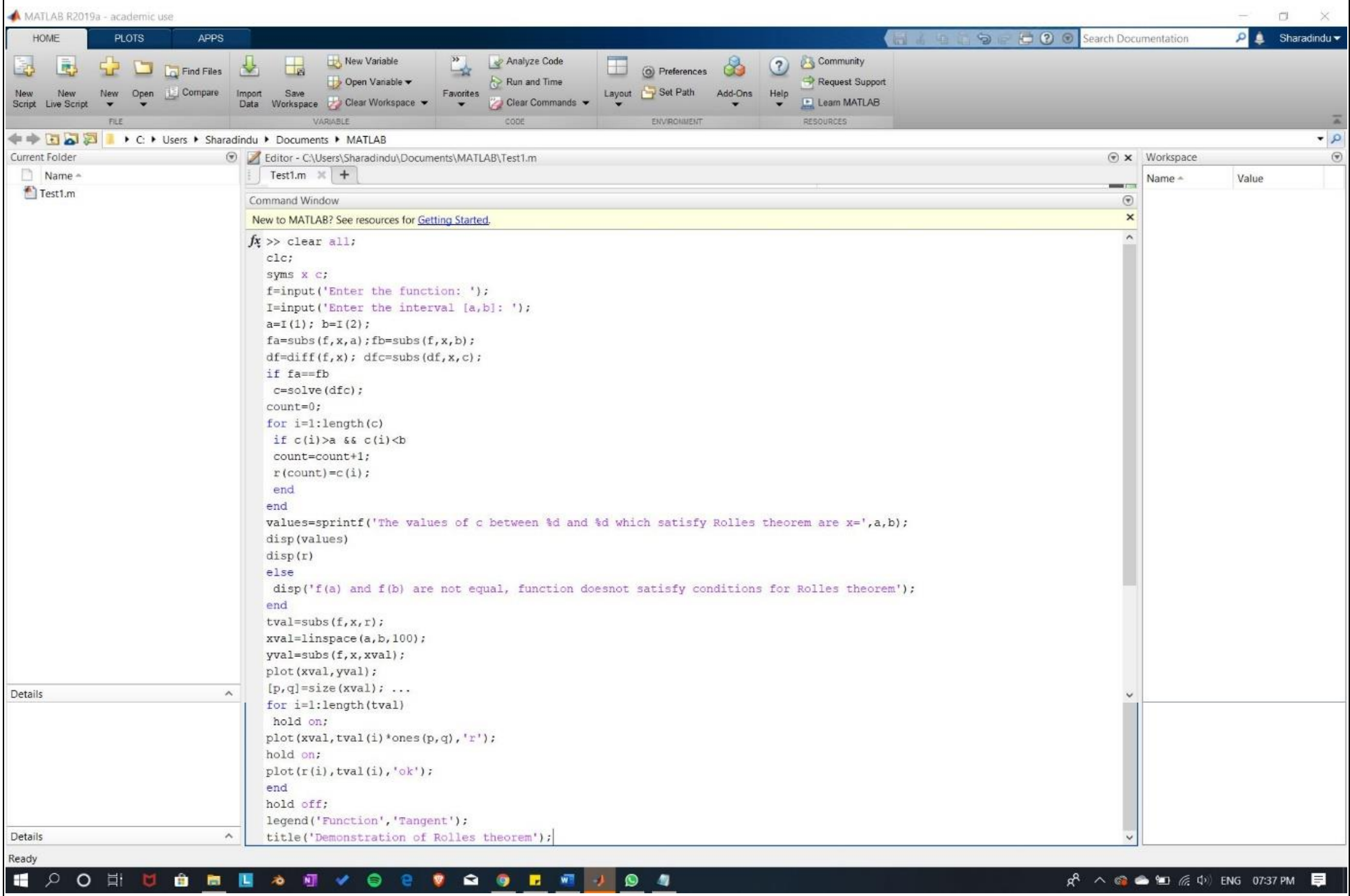
Problem:

Verify Rolle's Theorem for the function $(x+2)^3(x-3)^4$ in the interval $[-2,3]$. Plot the curve along with the secant joining the end points and the tangents at points which satisfy Rolle's Theorem.

Code in MATLAB:

```
clear all;
clc;
syms x c;
f=input('Enter the function: ');
I=input('Enter the interval [a,b]: ');
a=I(1); b=I(2);
fa=subs(f,x,a);fb=subs(f,x,b);
df=diff(f,x); dfc=subs(df,x,c);
if fa==fb
 c=solve(dfc);
count=0;
for i=1:length(c)
 if c(i)>a && c(i)<b
 count=count+1;
 r(count)=c(i);
 end
end
values=sprintf('The values of c between %d and %d which satisfy Rolles theorem are x=',a,b);
disp(values)
disp(r)
else
 disp('f(a) and f(b) are not equal, function does not satisfy conditions for Rolles theorem');
end
tval=subs(f,x,r);
xval=linspace(a,b,100);
yval=subs(f,x,xval);
plot(xval,yval);
[p,q]=size(xval);
for i=1:length(tval)
 hold on;
plot(xval,tval(i)*ones(p,q),'r');
hold on;
plot(r(i),tval(i),'ok');
end
hold off;
legend('Function','Tangent');
title('Demonstration of Rolles theorem');
```

Screenshot of Code:



Input:

```
Enter the function: ((x+2)^3)*((x-3)^4)
Enter the interval [a,b]: [-2,3]
```

Output:

```
The values of c between -2 and 3 which satisfy Rolles theorem are x =
1/7
```

Graph:

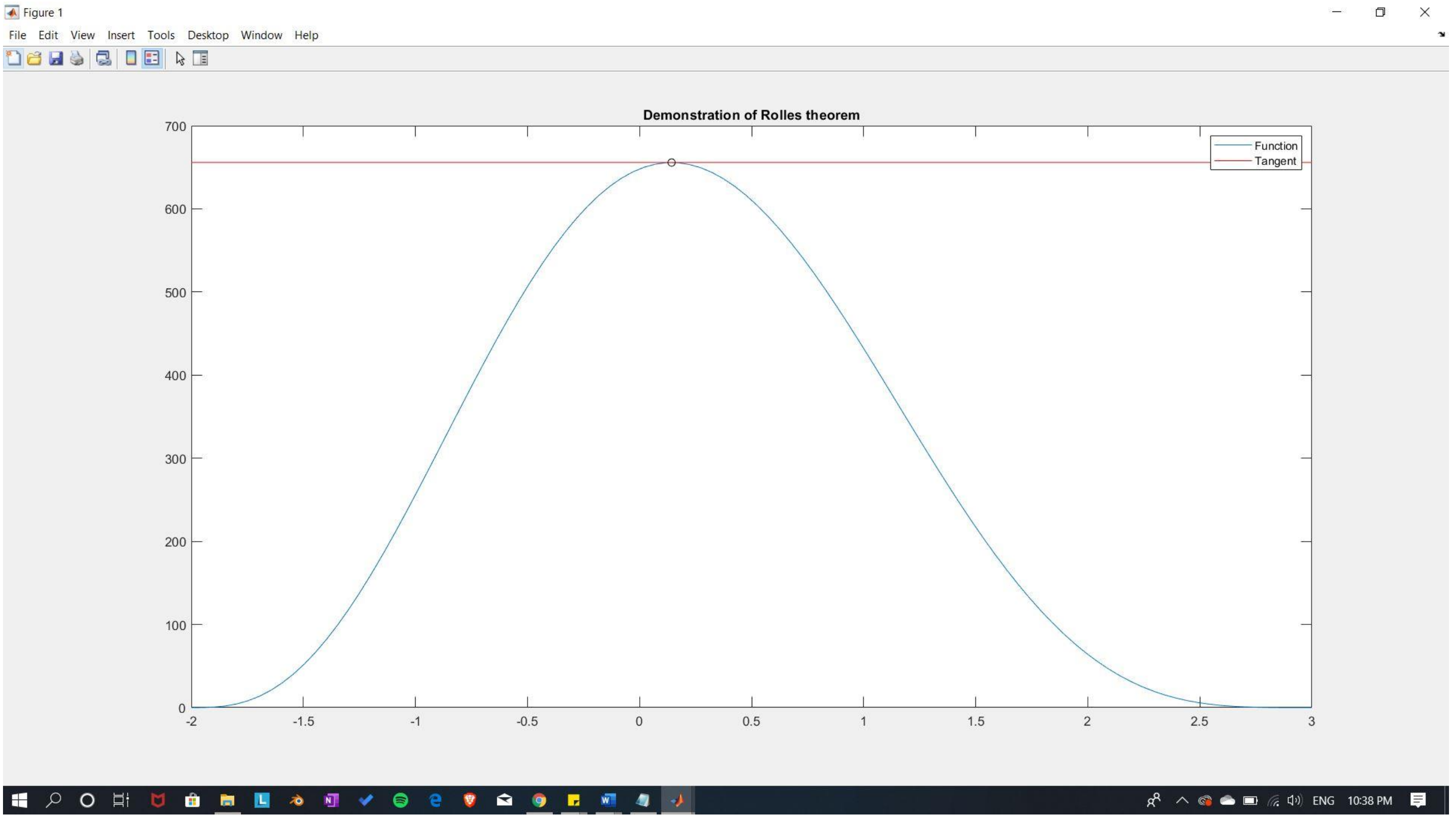


Figure 1
File Edit View Insert Tools Desktop Window Help
Demonstration of Rolles theorem
Function
Tangent
700
600
500
400
300
200
100
0
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
3
ENG
10:38 PM

Question 2

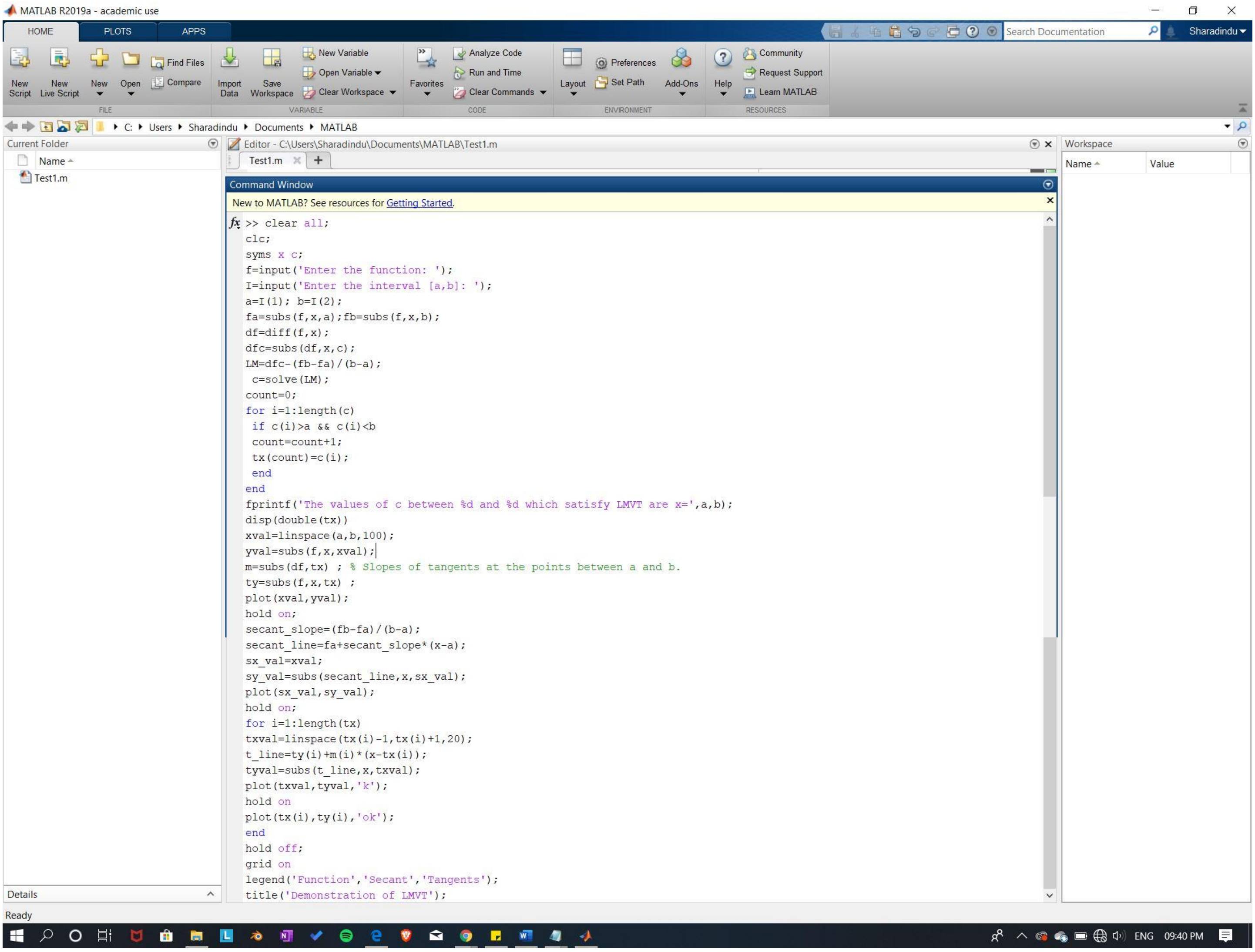
Problem:

Verify Lagrange's Mean Value Theorem for the function $f(x) = x^2 + e^{3x}$ in the interval $[0,1]$. Plot the curve along with the secant joining the end points and the tangents at points which satisfy Lagrange's Mean Value Theorem.

Code in MATLAB:

```
clear all;
clc;
syms x c;
f=input('Enter the function: ');
I=input('Enter the interval [a,b]: ');
a=I(1); b=I(2);
fa=subs(f,x,a);fb=subs(f,x,b);
df=diff(f,x);
dfc=subs(df,x,c);
LM=dfc-(fb-fa)/(b-a);
 c=solve(LM);
count=0;
for i=1:length(c)
 if c(i)>a && c(i)<b
 count=count+1;
 tx(count)=c(i);
 end
end
fprintf('The values of c between %d and %d which satisfy LMVT are x=',a,b);
disp(double(tx))
xval=linspace(a,b,100);
yval=subs(f,x,xval);
m=subs(df,tx) ; % Slopes of tangents at the points between a and b.
ty=subs(f,x,tx) ;
plot(xval,yval);
hold on;
secant_slope=(fb-fa)/(b-a);
secant_line=fa+secant_slope*(x-a);
sx_val=xval;
sy_val=subs(secant_line,x,sx_val);
plot(sx_val,sy_val);
hold on;
for i=1:length(tx)
txval=linspace(tx(i)-1,tx(i)+1,20);
t_line=ty(i)+m(i)*(x-tx(i));
tyval=subs(t_line,x,txval);
plot(txval,tyval,'k');
hold on
plot(tx(i),ty(i),'ok');
end
hold off;
grid on
legend('Function','Secant','Tangents');
title('Demonstration of LMVT');
```

Screenshot of Code:



Input:

```
Enter the function: x+exp(3*x)
Enter the interval [a,b]: [0,1]
```

Output:

```
The values of c between 0 and 1 which satisfy LMVT are x =    0.6168
```

Graph:

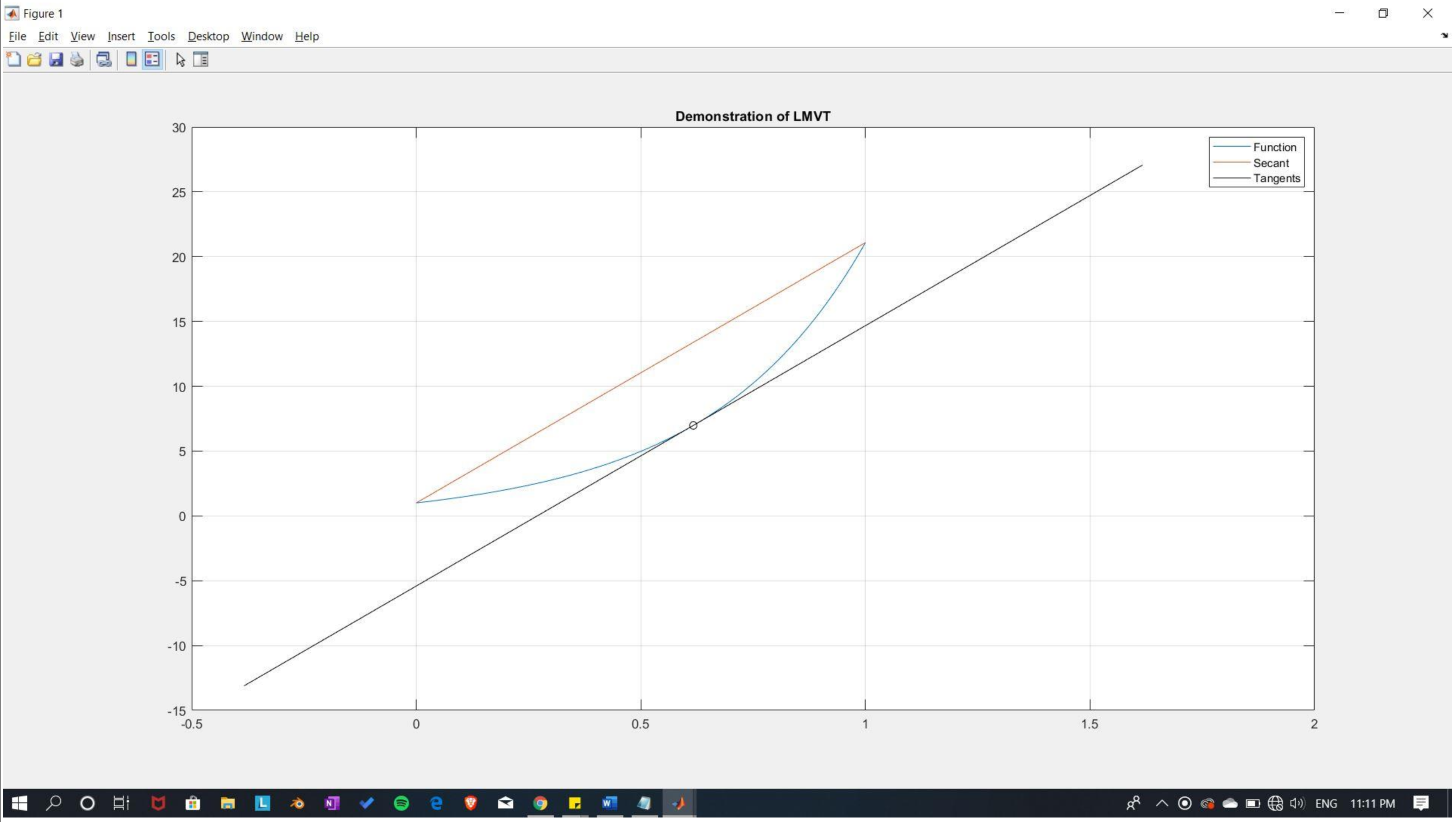


Figure 1
File Edit View Insert Tools Desktop Window Help
Demonstration of LMVT
Function
Secant
Tangents
30
25
20
15
10
5
0
-5
-10
-15
-0.5
0
0.5
1
1.5
2
ENG
11:11 PM

Question 3

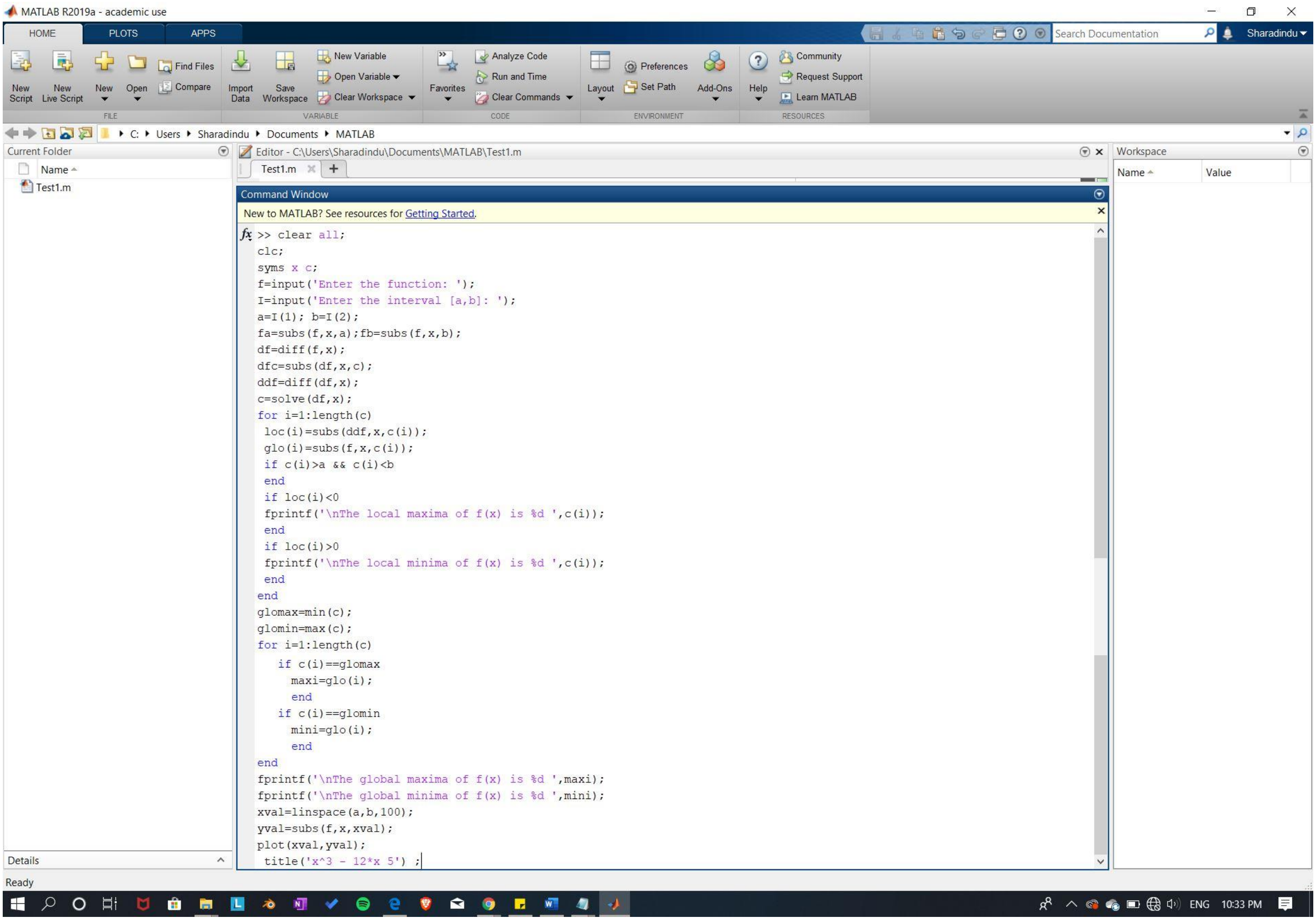
Problem:

Find the local and global maxima and minima for the function $x^3 - 12x - 5,\ x \in (-4,4)$.

Code in MATLAB:

```
clear all;
clc;
syms x c;
f=input('Enter the function: ');
I=input('Enter the interval [a,b]: ');
a=I(1); b=I(2);
fa=subs(f,x,a);fb=subs(f,x,b);
df=diff(f,x);
dfc=subs(df,x,c);
ddf=diff(df,x);
c=solve(df,x);
for i=1:length(c)
 loc(i)=subs(ddf,x,c(i));
 glo(i)=subs(f,x,c(i));
 if c(i)>a && c(i)<b
 end
 if loc(i)<0
 fprintf('\nThe local maxima of f(x) is %d ',c(i));
 end
 if loc(i)>0
 fprintf('\nThe local minima of f(x) is %d ',c(i));
 end
end
glomax=min(c);
glomin=max(c);
for i=1:length(c)
   if c(i)==glomax
     maxi=glo(i);
     end
   if c(i)==glomin
     mini=glo(i);
     end
end
fprintf('\nThe global maxima of f(x) is %d ',maxi);
fprintf('\nThe global minima of f(x) is %d ',mini);
xval=linspace(a,b,100);
yval=subs(f,x,xval);
plot(xval,yval);
 title('x^3 - 12*x - 5') ;
```

Screenshot of Code:



Input:

```
Enter the function: x^3 - 12*x - 5
Enter the interval [a,b]: [-4,4]
```

Output:

```
The local maxima of f(x) is -2
The local minima of f(x) is 2
The global maxima of f(x) is 11
The global minima of f(x) is -21
```

Graph:

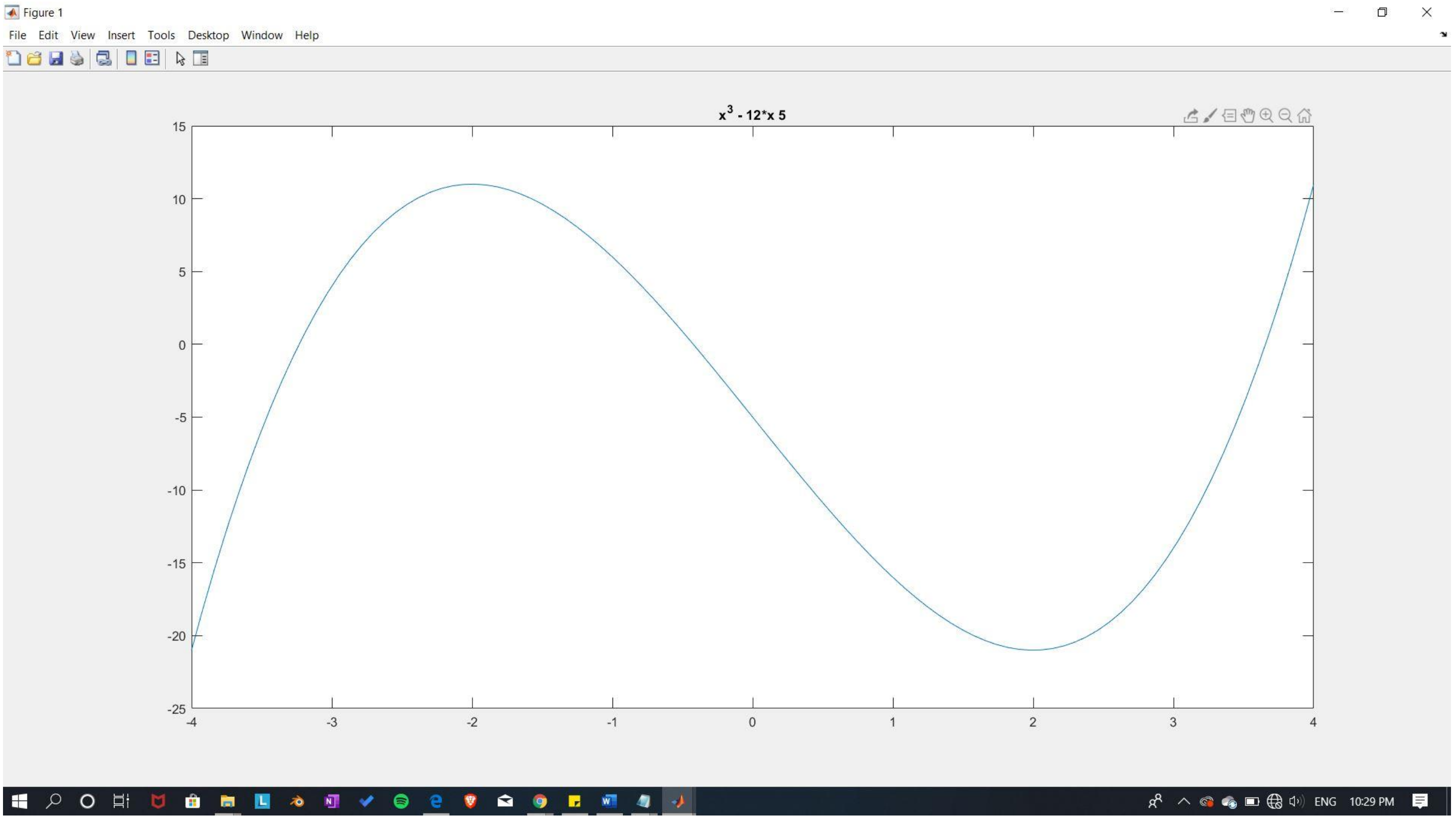


Figure 1
File Edit View Insert Tools Desktop Window Help
x^3 - 12*x 5
15
10
5
0
-5
-10
-15
-20
-25
-4
-3
-2
-1
0
1
2
3
4
ENG
10:29 PM

Question 4

Problem:

Find the global extrema of the function $f(x) = x^2 e^{sinx} - \frac{x}{x^3+1}$ on the interval $[0,5]$.

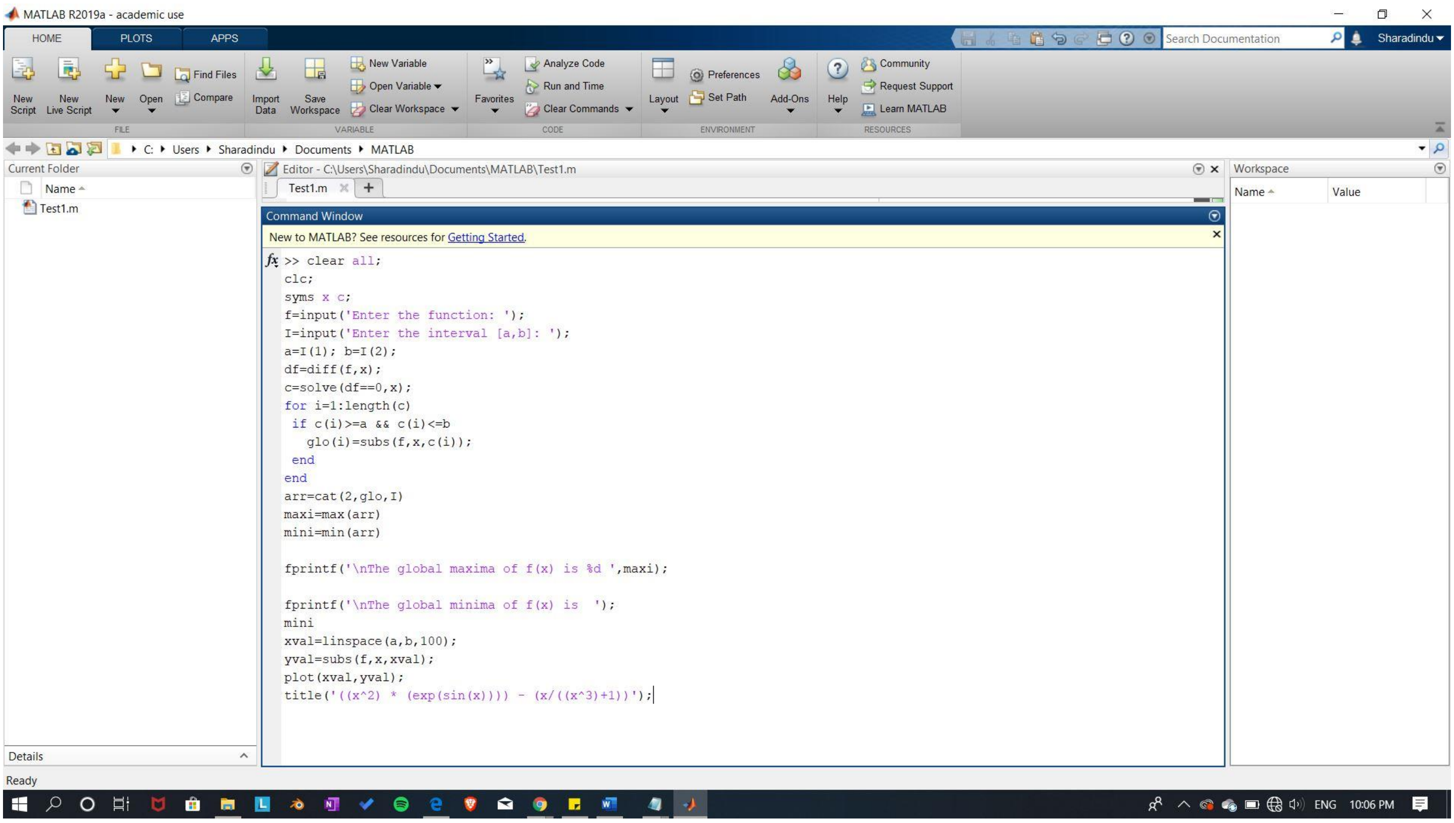
Code in MATLAB:

```
clear all;
clc;
syms x c;
f=input('Enter the function: ');
I=input('Enter the interval [a,b]: ');
a=I(1); b=I(2);
df=diff(f,x);
c=solve(df==0,x);
for i=1:length(c)
 if c(i)>=a && c(i)<=b
   glo(i)=subs(f,x,c(i));
 end
end
arr=cat(2,glo,I)
maxi=max(arr)
mini=min(arr)

fprintf('\nThe global maxima of f(x) is %d ',maxi);

fprintf('\nThe global minima of f(x) is  ');
mini
xval=linspace(a,b,100);
yval=subs(f,x,xval);
plot(xval,yval);
title('((x^2) * (exp(sin(x)))) - (x/((x^3)+1))');
```

Screenshot of Code:



Input:

```
Enter the function: (x^2)*exp(sin(x)) - (x/(x^3 + 1))
Enter the interval [a,b]: [0,5]
```

Output:

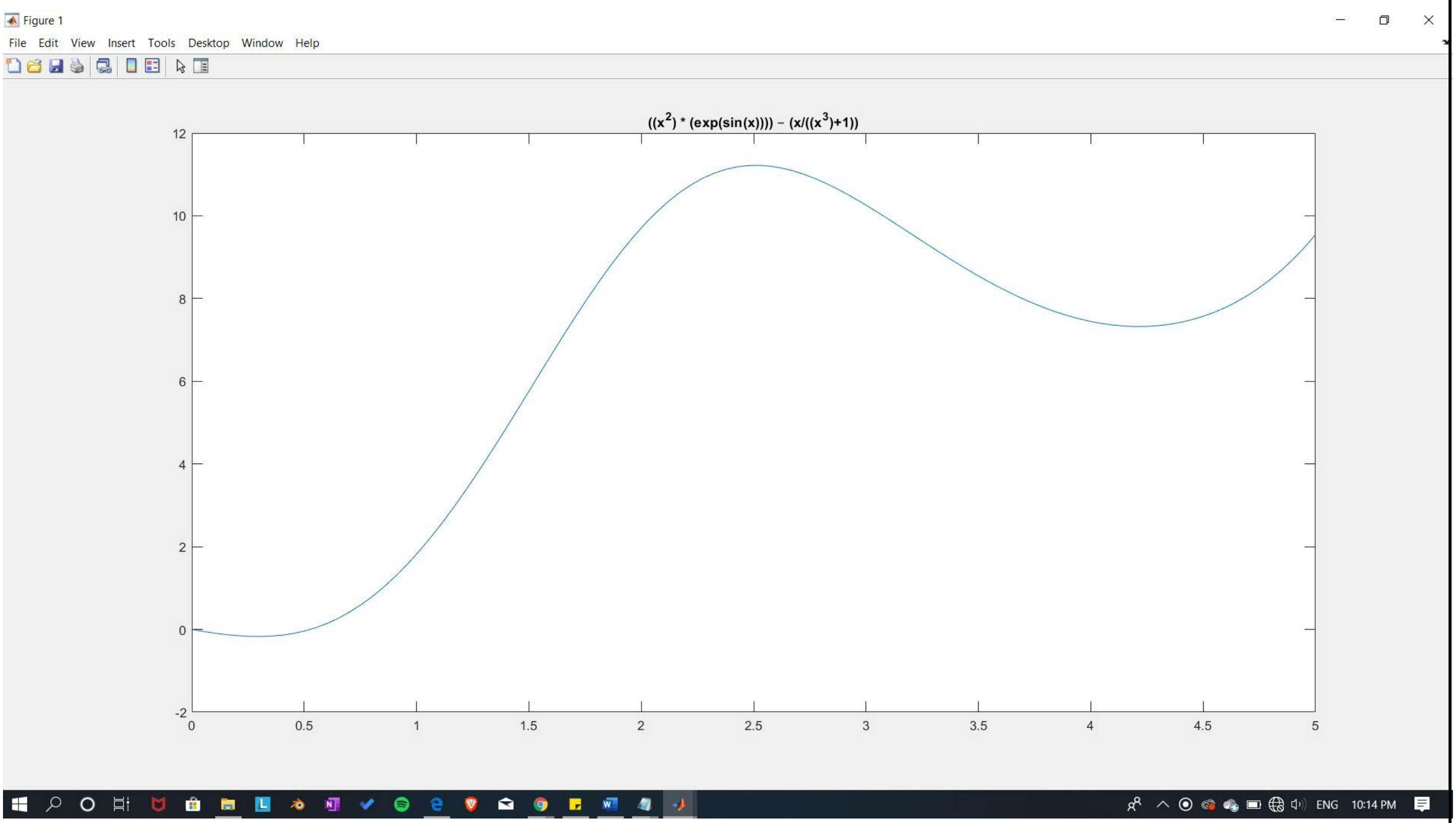
```
arr = [-0.17122769633059279113146995518666, 0, 5]

maxi = 5

mini = -0.17122769633059279113146995518666

The global maxima of f(x) is 5
The global minima of f(x) is -0.17122769633059279113146995518666
```

Graph:



End