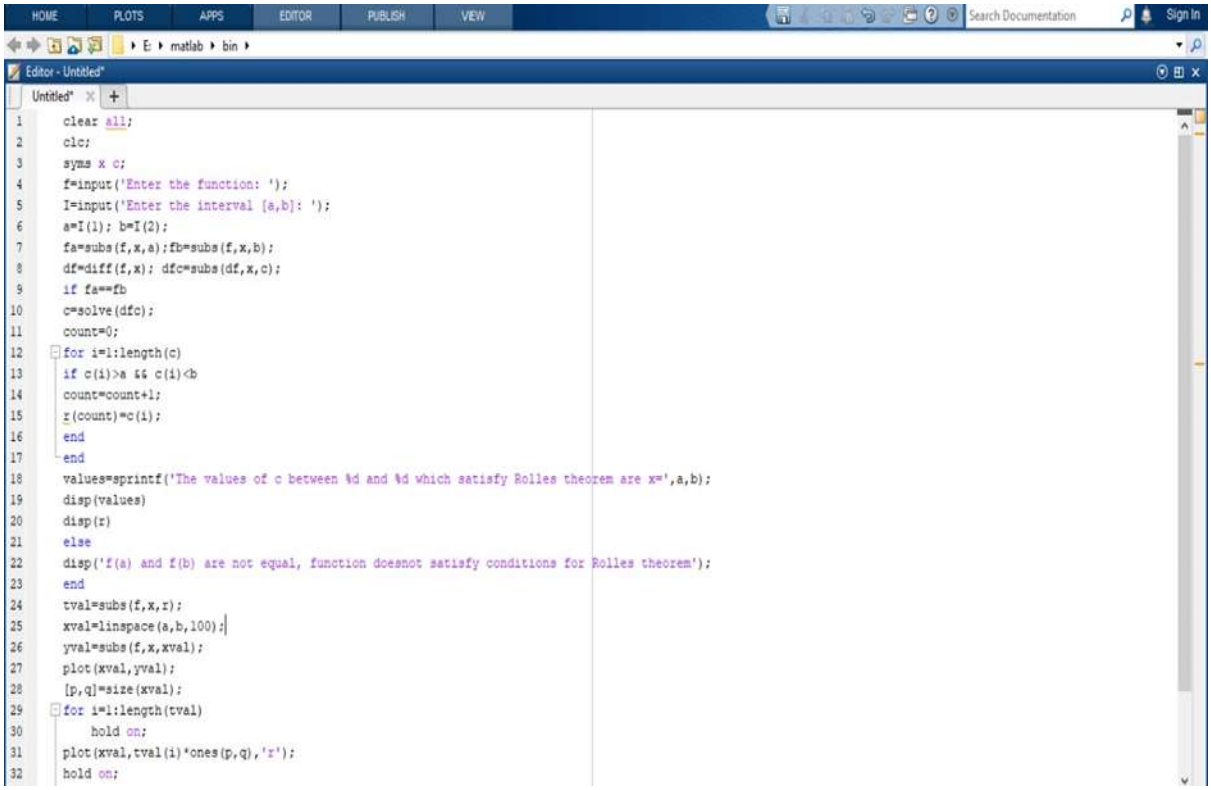
MAT1011-MATLAB-ASSESSMENT 1

PROBLEM 1

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

CODE

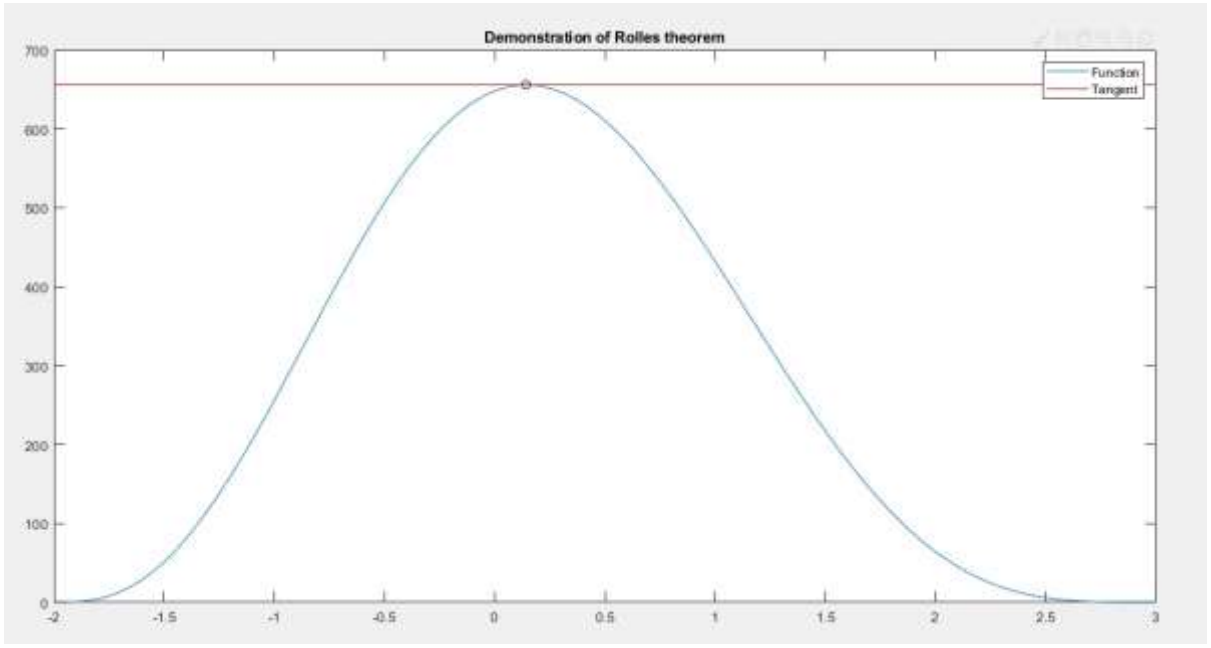


```
clear all;
clc;
syms x c;
f=input('Enter the function: ');
I=input('Enter the interval [a,b]: ');
a=I(1); b=I(2);
fa=subs(f,x,a);fb=subs(f,x,b);
df=diff(f,x); dfc=subs(df,x,c);
if fa==fb
c=solve(dfc);
count=0;
for i=1:length(c)
 if c(i)>a && c(i)<b
 count=count+1;
 r(count)=c(i);
 end
 end
 values=sprintf('The 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 doesnot 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;
```

```
 hold on;
 plot(r(i),tval(i),'ok');
 end
 hold off;
 legend('Function','Tangent');
 title('Demonstration of Rolles theorem');
```

INPUT AND OUTPUT

GRAPH



PROBLEM2

Verify Legrange's mean value theorem for f(x)=x+e^3x in the interval [0,1]. Pot the curve with the secant joining the end points and tangents at points which satisfy LMVT.

CODE

```
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;
```

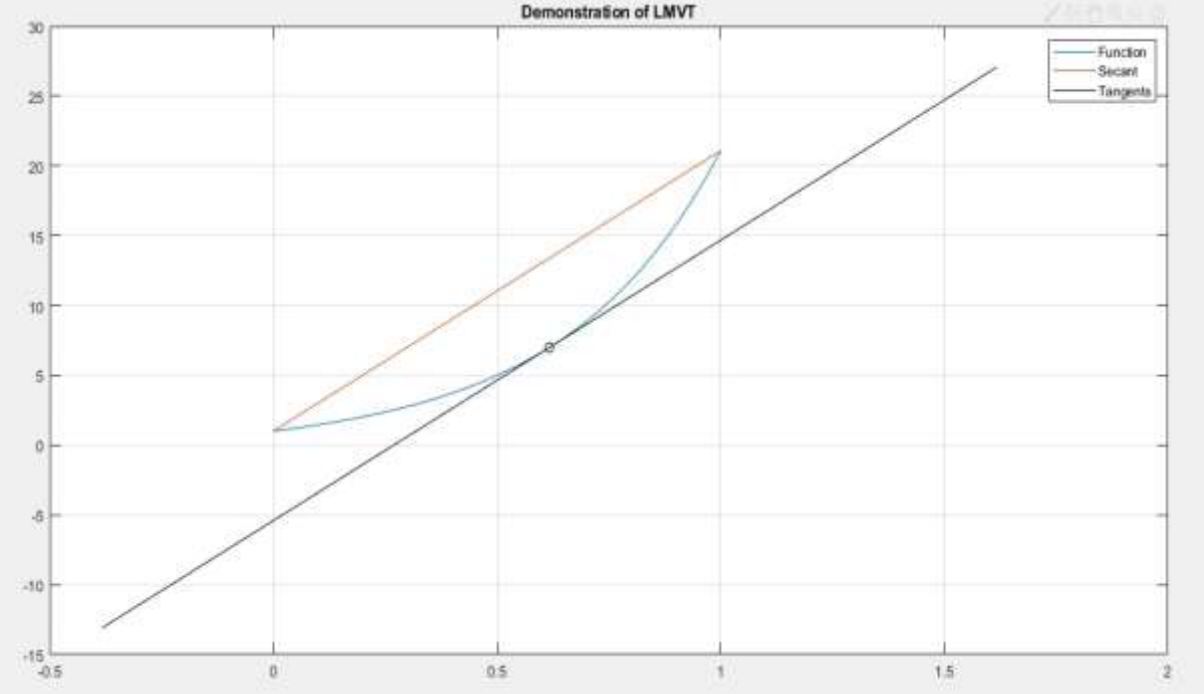
```
hold on;
for i=1:length(tx)
txval=linspace(tx(i)-1,tx(i)+1,20);
t_line=ty(i)+m(i)*(x-tx(i));
tyval=subs(t_line,x,txval);
plot(txval,tyval,'k');
hold on
plot(tx(i),ty(i),'ok');
end
hold off;
grid on
legend('Function','Secant','Tangents');
title('Demonstration of LMVT');
```

INPUT AND OUTPUT

```
Command Window
Enter the function: x+exp(3*x)
Enter the interval [a,b]: [0 1]
The values of c between 0 and 1 which satisfy LMVT are x=    0.6168

fx >>
```

GRAPH



PROBLEM 3

Find the local and global maxima and minima for the function x^3-12x-5,x [-4,4]

CODE

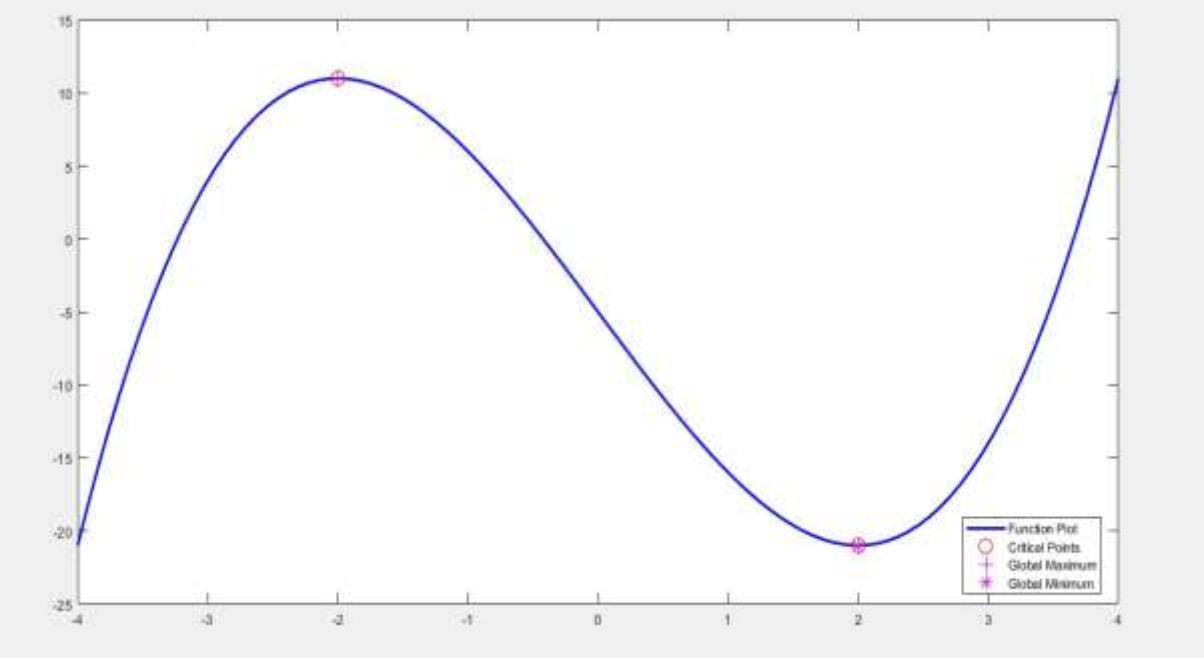
```
clear all
clc
syms x
f = input('Enter the function f(x):');
I = input('Enter the interval: ');
a=I(1);b=I(2);
df = diff(f,x);
ddf = diff(df,x);
f = inline(vectorize(f));
df = inline(vectorize(df));
ddf = inline(vectorize(ddf));
range = linspace(a,b,100);
plot(range,f(range),'-b','LineWidth',2);
legstr = ('Function Plot'); % Legend String
hold on;
%%%%%%%
% Due to limitations in symbolic toolbox we find the zeros of
% f'(x) numerically.
%%%%%%%%%
guesses = linspace(a,b,5);
root = zeros(size(guesses));
for i=1:numel(guesses)
root(i) = fzero(df,guesses(i));
end
root = root(a <= root & root <=b);
root = unique(round(root,4));
plot(root,f(root),'ro','MarkerSize',10);
legstr = [legstr, {'Critical Points'}];
disp(['Critical Points of f(x) are: ',num2str(root)])
%%%%%%%
%We categorize the critical points by the second derivative test
%%%%%%%%%%
maxp = root(ddf(root) < 0);
if(numel(maxp) ~= 0)
disp(['Local maximum of f(x) occurs at: ',num2str(maxp)])
end
minp = root(ddf(root) > 0);
if(numel(minp) ~= 0)
disp(['Local minimum of f(x) occurs at: ',num2str(minp)])
end
fval = f(root);
if(numel(maxp) ~= 0)
gmax = root(fval == max(fval));
disp(['Global maximum of f(x) occurs at: ',num2str(gmax),' and its value is:', num2str(max(fval))])
plot(gmax,f(gmax),'m*','MarkerSize',10);
legstr = [legstr, {'Global Maximum'}];
end
if(numel(minp) ~= 0)
gmin = root(fval == min(fval));
disp(['Global minimum of f(x) occurs at: ',num2str(gmin),' and its value is: ', num2str(min(fval))])
plot(gmin,f(gmin),'m*','MarkerSize',10);
legstr = [legstr, {'Global Minimum'}];
end
legend(legstr,'Location','Best')
```

INPUT AND OUTPUT

```
Command Window

  Enter the function f(x):x^3-12*x-5
  Enter the interval: [-4 4]
  Critical Points of f(x) are: -2  2
  Local maximum of f(x) occurs at: -2
  Local minimum of f(x) occurs at: 2
  Global maximum of f(x) occurs at: -2 and its value is:11
  Global minimum of f(x) occurs at: 2 and its value is: -21
fx >>
```

GRAPH



PROBLEM 4

Find the global extrema of function f(x)= x^2*e^sinx-x/(x^3+1) on interval [0,5].

CODE

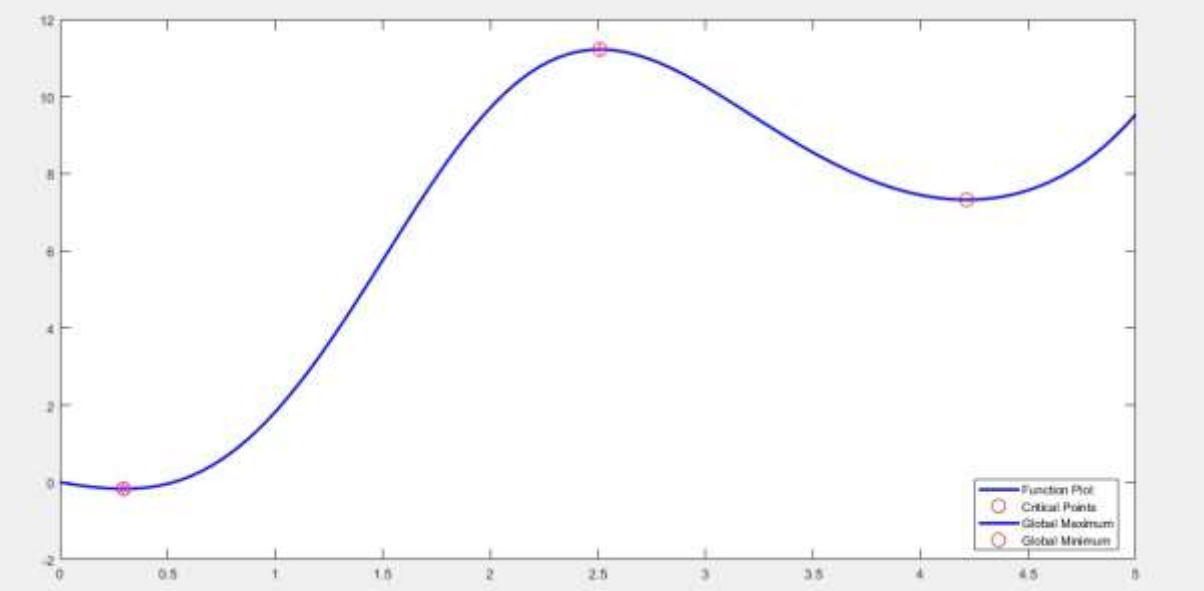
```
clear all
clc
syms x
f = input('Enter the function f(x):');
I = input('Enter the interval: ');
a=I(1);b=I(2);
df = diff(f,x);
ddf = diff(df,x);
f = inline(vectorize(f));
df = inline(vectorize(df));
ddf = inline(vectorize(ddf));
range = linspace(a,b,100);
plot(range,f(range),'-b','LineWidth',2);
legstr = {'Function Plot'};
hold on;
guesses = linspace(a,b,5);
root = zeros(size(guesses));
for i=1:numel(guesses)
root(i) = fzero(df,guesses(i));
end
root = root(a <= root & root <=b);
root = unique(round(root,4));
plot(root,f(root),'ro','MarkerSize',10);
legstr = [legstr, {'Critical Points'}];
disp(['Critical Points of f(x) are: ',num2str(root)])
maxp = root(ddf(root) < 0);
minp = root(ddf(root) > 0);
fval = f(root);
if(numel(maxp) ~= 0)
gmax = root(fval == max(fval));
disp(['Global maximum of f(x) occurs at: ',num2str(gmax),' and its value is:', num2str(max(fval))])
plot(gmax,f(gmax),'m*','MarkerSize',10);
plot(gmax,f(gmax),'m+','MarkerSize',10);
legstr = [legstr, {'Global Maximum'}];
end
if(numel(minp) ~= 0)
gmin = root(fval == min(fval));
disp(['Global minimum of f(x) occurs at: ',num2str(gmin),' and its value is: ', num2str(min(fval))])
plot(gmin,f(gmin),'m*','MarkerSize',10);
legstr = [legstr, {'Global Minimum'}];
end
legend(legstr,'Location','Best')
```

INPUT AND OUTPUT

```
Command Window

Enter the function f(x):x^2*exp(sin(x)) - x/(x^3+1)
Enter the interval: [0 5]
Critical Points of f(x) are: 0.2953      2.5092      4.2139
Global maximum of f(x) occurs at: 2.5092 and its value is:11.2209
Global minimum of f(x) occurs at: 0.2953 and its value is: -0.17123
fx >>
```

GRAPH


12
10
8
6
4
2
0
-2
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Function Plot
Critical Points
Global Maximum
Global Minimum