ENGR 133, Final Exam

Table of Contents

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Problem 1

```
clear
close all
clc

% Problem Presentation
%{
%}

% Pseudocode
% Initialize variables
% Perform calculations
% Display results

% Initialize variables
syms x y
y = -x^5+10*x^3-30*x+2;
x_1 = (-3:0.01:3);
% Perform calculations
% solve for the first & second derivatives
dydx = diff(y);
d2ydx2 = diff(dydx);

% solve for the x and y points
x_points = solve(dydx);
y_points = subs(y,x,x_points);

% Determine the nature of zero points
for k = 1:length(x_points)
    eval(k) = subs(d2ydx2,x,x_points(k));
    if double(eval(k)) > 0
        outcomes(k) = "local minima";
    elseif double(eval(k)) == 0
        outcomes(k) = "inflection points";
    else
        outcomes(k) = "local maximum";
    end
end
```

```
% Display results
for k = 1:length(x_points)
     fprintf('\nA %s exists at x = %4.2f, y = %4.2f.\n
\n',outcomes{1,k}, double(x_points(k)),double(y_points(k)))
end
% fplot(y,[double(x_points(1)) double(x_points(length(x_points)))
% grid minor
% xlabel('(x) axis')
% ylabel('(y) axis')
% title('Graph of f(x)= -x^5 + 10x^3 - 30x + 2')
% it was not working
```

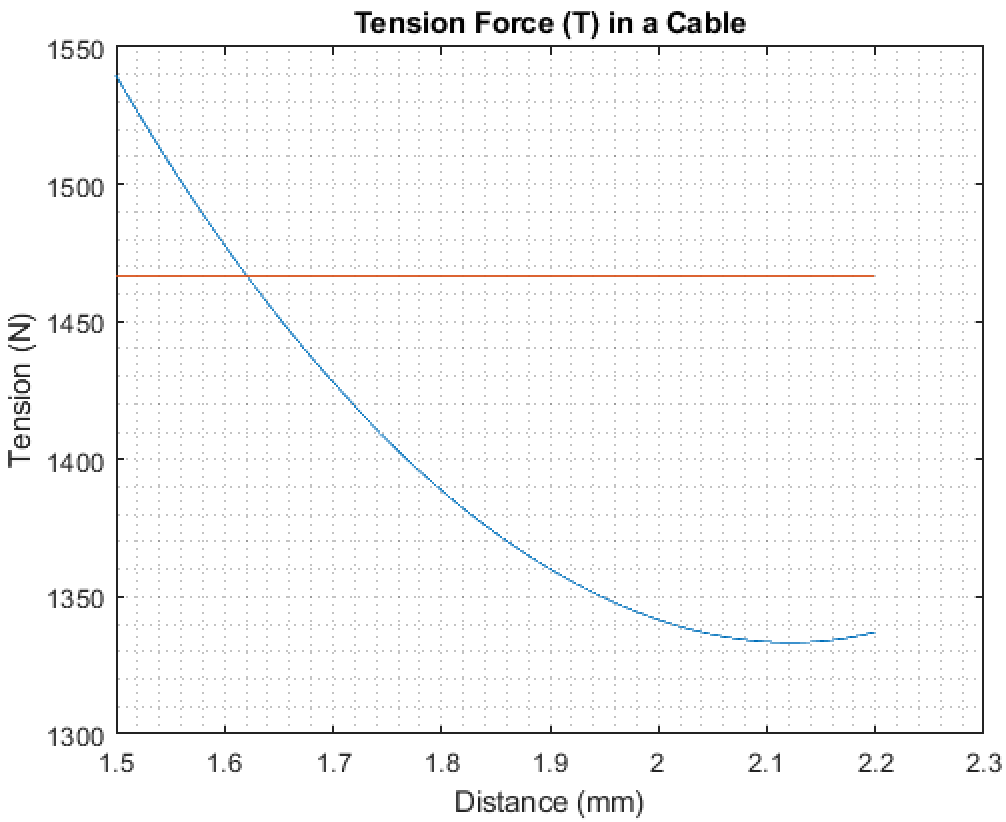
```
A local maximum exists at x = 2.18, y = -9.03.


A local minima exists at x = -2.18, y = 13.03.


A local minima exists at x = 1.13, y = -19.31.


A local maximum exists at x = -1.13, y = 23.31.
```

Problem 2

```
clear
close all
clc

% Problem presentation
%{
%}

% Pseudocode
% Initialize variables
% Perform calculations
% Display results

% Initialize variables
x = 10;
W = 400;
Lb = 3;
Lc = 5;
D = (0:0.01:Lb);

% Perform calculations
% part a:
T = Lb*Lc*W./(D.*sqrt(Lb^2-D.^2));
[minT,k] = min(T);
minD = D(k);
tension_min = T(k);
```

```
distance_min = D(k);

% Display results
% part a
fprintf('The value D that minimizes the tension T is: %4.2f \n',minD)
% part b
Dplot = (1.5:0.001:2.2);
upper = 1.1*min(T);
Tplot = Lb*Lc*W./(Dplot.*sqrt(Lb^2-Dplot.^2));
plot(Dplot,Tplot,[1.5,2.2],[upper,upper])
title('Tension Force (T) in a Cable')
xlabel('Distance (mm)')
ylabel('Tension (N)')
grid minor
```

The value D that minimizes the tension T is: 2.12



Problem 3

```
clear
close all
clc

% Problem Presentation
%{
Using numerical methods techniques, estimate the area of the state of
```

```
Virginia shown in the figure below:
%}

% Pseudocode
% Intialize variables
% Perform calculations
% Display results

% Intialize variables
distance = (0:40:440); % measured in km
depth = [0, 40, 96, 140, 147, 121, 117, 139, 140, 62, 17, 0];%
 measured in km

% Perform calculations
area = trapz(distance,depth);

% Display results
fprintf('The approximate area of Virginia is %5.0f feet.\n\n',area)
```

```
The approximate area of Virginia is 40760 feet.
```

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