

MIE301 – Pre-Lab 4: Force Analysis

The purpose of this Pre-Lab is to:

1. Learn how to create and format legend on a plot.
2. Learn to do numerical integration and differentiation using MATLAB
3. Learn to append the vector by any number
4. Learn nested if-else along with use of AND and OR operators.

The TA will guide you through these steps at the beginning of the Practical:

1. **Objective 1: Create a figure with multiple overlapping plots (sine, cosine, tangent and cotangent) with a legend.**

- a. Create a vector theta from 0 to 2π .
`theta = linspace(0,2*pi,100);`
- b. Plot the sine, cosine, tangent and cotangent of theta on the same figure.
`figure(1); hold on;`
`plot(theta, sin(theta), 'r');`
`plot(theta, cos(theta), 'b');`
`plot(theta, tan(theta), 'g');`
`plot(theta, cot(theta), 'k');`
- c. Now create a legend displaying the different signals present in the figure. The legend should be in two columns and be present in the top left corner of the plot.
`legend('sin','cos','tan','cot','Location','northwest','NumColumns',2);`

2. **Objective 2: Learn to do numerical integration in MATLAB. Integrate the function $f(\theta) = \sin(\theta)$ between the intervals of theta from 0 to π .**

- a. Create a vector theta from 0 to 2π .
`theta = linspace(0,2*pi,100);`
- b. Create a vector for storing sine values of theta.
`signal = sin(theta);`
- c. Find the minimum and maximum index values in theta vector.
`minIndex = find(theta >= 0, 1, 'first');`
`maxIndex = find(theta <= pi, 1, 'last');`
- d. Initialize a variable to store the added integral values at each step.
`integral_val = 0;`
- e. Perform the integration from minIndex to maxIndex.
`for i = minIndex:maxIndex`
 `partial = signal(i) * (theta(i+1)-theta(i));`
 `integral_val = integral_val + partial;`
`end`
`disp(integral_val);`
- f. Compare the obtained result using MATLAB with manual evaluation of the integral (on paper).

3. Objective 3: Learn to do numerical differentiation using diff command

- a. Differentiate signal with respect to theta

```
Signal_diff=diff(signal)./diff(theta)
```

4. Objective 4: Learn to prepend the vector by any number

- a. Now prepend 0 at the beginning of Signal_diff vector

```
New_signal=[0 Signal_diff]
```

5. Objective 5: Learn nested if-else condition and use of AND/OR operator

- a. Write a condition where if theory OR practical marks are greater than 90, display 'A+', while if theory marks are >80 AND practical less than 90, display 'A', else display 'A-'. Marks in theory and practical are 80.5 and 87, respectively.

```
theory=83;  
practical=87;  
if theory > 90 || practical > 90  
    disp('A+')  
elseif theory > 80 && practical<90  
    disp('A')  
else  
    disp('A-')  
end
```

6. Clear all variables from workspace except theory and practical

```
clearvars -except theory practical
```