ECE 202 - MATLAB Project #1

Here, $a=0$, so this is a Maclaurin series rather than a Taylor series. (The only difference being $a=0$)

Taylor series expansion across $t=0$, i.e.

$$f(t) = \sum_{n=0}^{\infty} \frac{f^{(n)}(0).t^n}{n!}$$

Now, $f(t) = 12\cos(40t)$

Let $f(t)$ be $= \cos(t)$

$$f(t) = f(0) + f'(0)t + \frac{f''(0)}{2}t^2 + \frac{f'''(0)}{6}t^3 + \cdots \infty$$

$$\cos(t) = \cos(0) + (-\sin(0)) + (-\cos(0)) + \sin(0) + \cos(0)) + \cdots \infty$$

$$= f(x) = 1 + 0 - 1 + 0 + 1 + \cdots \infty$$

$$= 1 + \frac{0.t}{1!} + \frac{(-1)t^2}{2!} + \frac{0.t^3}{3!} + \frac{t^4}{4!} + \frac{0.t^5}{5!} + \frac{(-1)t^6}{6!} + \cdots \infty$$

Now, for even n, $1 + \frac{(-1)t^2}{2!} + \frac{t^4}{4!} + \frac{(-1)t^6}{6!} + \cdots \infty$

$$= \sum_{n=0}^{\infty} \frac{(-1)^n.(t)^{2n}}{(2n)!} \quad -① \quad \text{[General expression for } a_n\text{]}$$

for odd n, $a_n = 0$.

Replacing t with $40t$ in eq. ①,

$$\sum_{n=0}^{\infty} \frac{(-1)^n (40t)^{2n}}{(2n)!} \Rightarrow \text{for } 12\cos(40t)$$

$$= \sum_{n=0}^{\infty} \frac{(-1)^n\, 12 \cdot (40t)^{2n}}{(2n)!}$$

So, if $n \,\%\, 2 = 0$, (n divisible by 2) then

$$a_n = \frac{(-1)^{\frac{n}{2}}\, 12\, (t)^n_{\to 40t}}{n!} \quad \text{[General expression for } a_n\text{, non-zero]}$$

$a_n = 0$, otherwise

```
% Kavya Manchanda
% 11/1/2022
% ECE 202: Project 1 - Power Expansion Series

tmin = 0;
tmax = 0.2; % in s
N = 5;    % intervals

t = linspace(tmin, tmax, 401);  % in s

n = [0:2:12]  % number of terms
an = ((-1).^(n/2))*12.*((40).^(n))./factorial(2*n)
f1 = an(1)*t.^n(1);
f2 = f1 + an(2)*t.^n(2);
f3 = f2 + an(3)*t.^n(3);
f4 = f3 + an(4)*t.^n(4);
f5 = f4 + an(5)*t.^n(5);
f6 = f5 + an(6)*t.^n(6);

plot(t,f1,"b",t,f2,"g",t,f3,"k",t,f4,"m",t,f5,"y",t,f6,"r",'LineWidth',1)
ax = gca;
ax.FontSize = 12; % setting the font size of axis' values
ax.GridAlpha = 0.5; % setting the thickness of grid lines
xlabel('time t (ms)','FontSize',14);
ylabel('f(t)','FontSize',14)
ylim([-15,15])
title("ECE 202 Project 1","FontSize",16)
grid on

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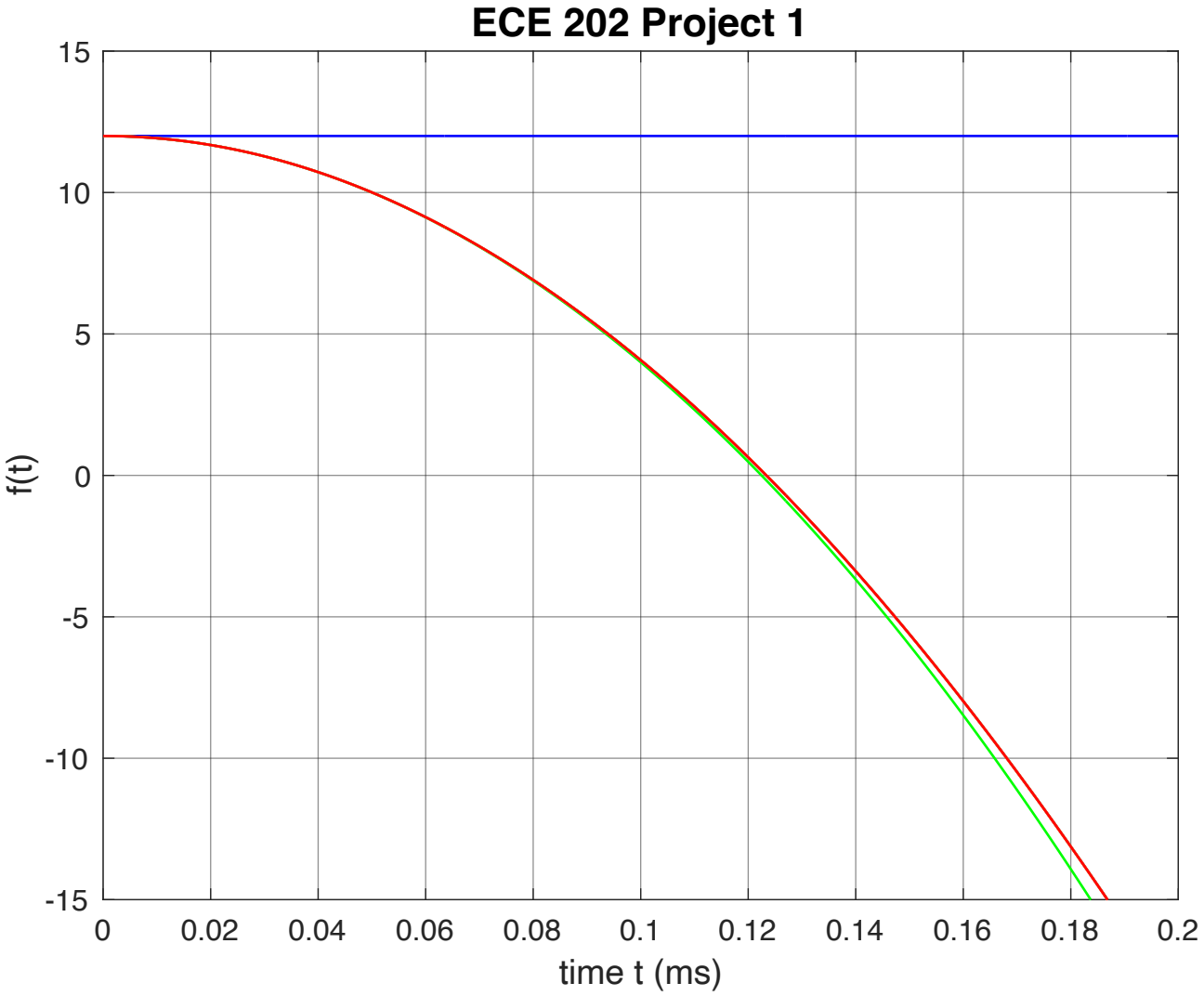
ECE 202 Project 1
15
10
5
0
-5
-10
-15
f(t)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
time t (ms)

```
>> untitlednov2

n =

     0     2     4     6     8    10    12


an =

   12.0000 -800.0000  761.9048 -102.6134    3.7587   -0.0517    0.0003

>>
```