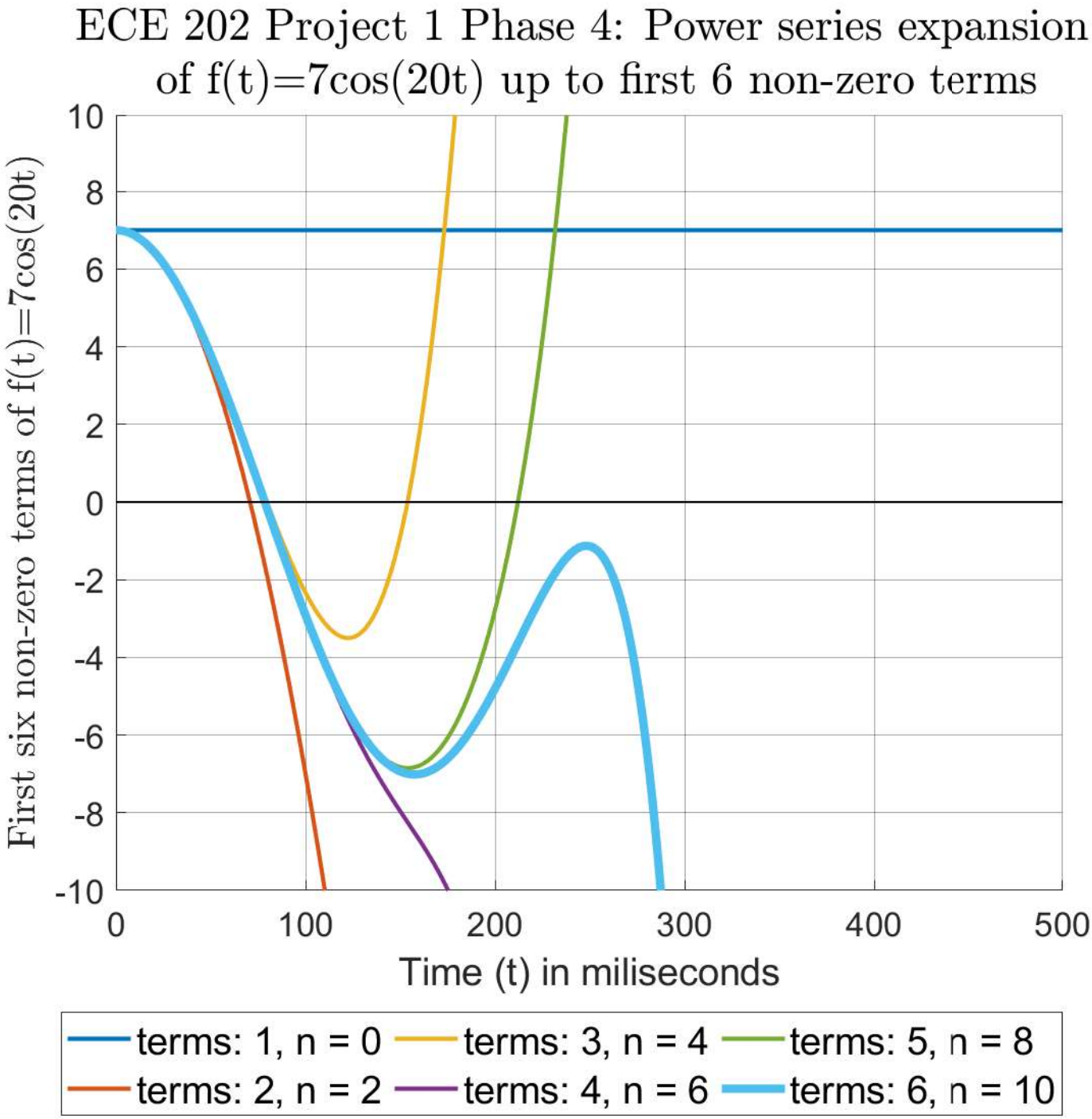
```
% Adi Nelson
% 11/10/23
% ECE 202: Project 1 phase 4

format shortG
clear
clc

% ---- Setup ----

A = 7; % Amplitude of the sinusoid

w = 20; % Angular frequency of the sinusoid

num_terms = 6; % Number of non-zero terms

tmin = 0; % Minimum time in ms

tmax = 500; % Max time in ms

intervals = 1000; % Number of points for plotting

t_ms = linspace(tmin,tmax,intervals); % Time t in seconds from 0ms to 500ms

t = t_ms/1000; % Time t in ms from 0s to 0.5s

n = [0:2:(2*6)-2]; % n values of non-zero coefficients

a_n = (-1).^(n/2).*(w.^n)*A./factorial(n); % a_n values of non-zero coefficients

T = table(n',a_n','VariableNames', {'n values', ...
    'a_n values (Non-zero coefficients)'})

% ---- Old Calculations ----

f1 = a_n(1)*t.^n(1); % First term
f2 = f1 + a_n(2)*t.^n(2); % First and second term
f3 = f2 + a_n(3)*t.^n(3); % First through third terms
f4 = f3 + a_n(4)*t.^n(4); % First through fourth terms
f5 = f4 + a_n(5)*t.^n(5); % First through fifth terms
f6 = f5 + a_n(6)*t.^n(6); % First through sixth terms

% ---- New Calculations and Plotting ----

f = zeros([1 intervals]);

hold on
for k = 1:num_terms
    f = f + a_n(k)*t.^n(k);
```

```
    if k < 6
        p(k)=plot(t_ms,f,'LineWidth', 2);
    else
        p(k)=plot(t_ms,f,'LineWidth', 4);
        plot([tmin,tmax], [0,0], 'k', 'LineWidth', 1)
    end
end

hold off
grid on
ax = gca;
ax.GridAlpha = 0.4;
ax.FontSize = 16;

title(sprintf("ECE 202 Project 1 Phase 4: Power series expansion \n of " + ...
    "f(t)=%gcos(%gt) up to first %g non-zero " + ...
    "terms",A,w,num_terms),Interpreter='latex',FontSize=21)
xlabel(sprintf("Time (t) in miliseconds"),Fontsize=18)
ylabel(sprintf("First six non-zero terms of " + ...
    "f(t)=%gcos(%gt)",A,w),Interpreter='latex',FontSize=18)
ylim([-1*(A+3) A+3])

legend_terms = [1:6];

legend(p,"terms: "+ legend_terms + ", " + ...
    "n = " + n,Location="southoutside",FontSize=18,NumColumns=3)

checkf = sum(f-f6) % Checks the difference between old and new final function
% Check should be equal to zero
```

```
T =

  6×2 table

    n values    a_n values (Non-zero coefficients)
    ________    __________________________________

        0                              7
        2                          -1400
        4                          46667
        6                     -6.2222e+05
        8                      4.4444e+06
       10                     -1.9753e+07


checkf =

     0

>>
```


ECE 202 Project 1 Phase 4: Power series expansion of f(t)=7cos(20t) up to first 6 non-zero terms
First six non-zero terms of f(t)=7cos(20t)
10
8
6
4
2
0
-2
-4
-6
-8
-10
0
100
200
300
400
500
Time (t) in miliseconds
terms: 1, n = 0
terms: 3, n = 4
terms: 5, n = 8
terms: 2, n = 2
terms: 4, n = 6
terms: 6, n = 10