ME 1020 Engineering Programming with MATLAB

Problem 5.19:

19. Oscillations in mechanical structures and electric circuits can often be described by the function

$$y(t) = e^{-t/\tau} \sin(\omega t + \phi)$$

where t is time and ω is the oscillation frequency in radians per unit time. The oscillations have a period of $2\pi/\omega$, and their amplitudes decay in time at a rate determined by τ, which is called the *time constant*. The smaller τ is, the faster the oscillations die out.

a. Use these facts to develop a criterion for choosing the spacing of the t values and the upper limit on t to obtain an accurate plot of $y(t)$. (*Hint:* Consider two cases: $4\tau > 2\pi/\omega$ and $4\tau < 2\pi/\omega$.)

b. Apply your criterion, and plot $y(t)$ for $\tau = 10$, $\omega = \pi$, and $\phi = 2$.

c. Apply your criterion, and plot $y(t)$ for $\tau = 0.1$, $\omega = 8\pi$, and $\phi = 2$.

Problem setup:

Simply plot the function versus t for the two values of tau.

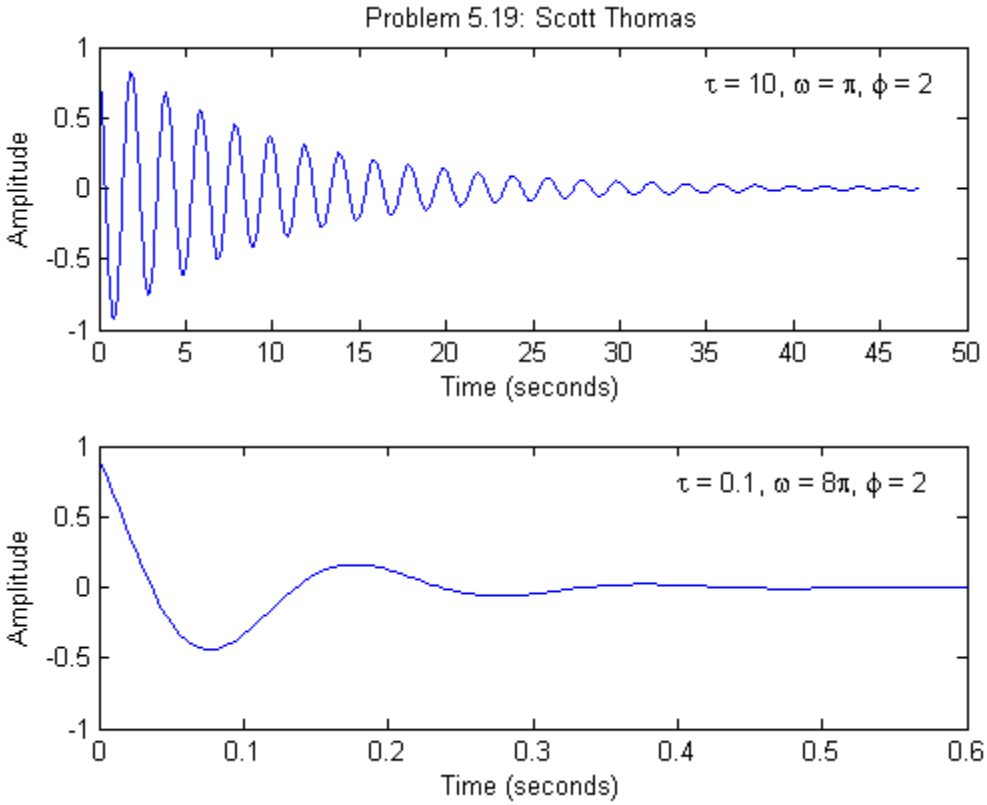
```
% Problem 5.19
clear
clc
disp('Problem 5.19: Scott Thomas')

phi = 2;% radians
omega = [pi 10*pi];
tau = [10 0.1];

N = 1000;
t1 = linspace(0,15*pi,N);
t2 = linspace(0,1*pi,N);
y1 = exp(-t1/tau(1)).*sin(omega(1).*t1 + phi);
y2 = exp(-t2/tau(2)).*sin(omega(2).*t2 + phi);

subplot(2,1,1)
plot(t1, y1)
xlabel('Time (seconds)'), ylabel('Amplitude')
text(35,0.75,'\tau = 10, \omega = \pi, \phi = 2')
title('Problem 5.19: Scott Thomas')

subplot(2,1,2)
plot(t2, y2)
xlabel('Time (seconds)'),ylabel('Amplitude')
text(0.4,0.75,'\tau = 0.1, \omega = 8\pi, \phi = 2')
axis([0 0.6 -1 1])
```


Problem 5.19: Scott Thomas
τ = 10, ω = π, ϕ = 2
Amplitude
Time (seconds)
τ = 0.1, ω = 8π, ϕ = 2
Amplitude
Time (seconds)