1.2 Obtaining a computer-generated plot of a continuous-time signal requires some care in choosing the time increment Δt (the spacing between points). As mentioned in Section 1.1, too large of an increment will cause a jagged plot. Moreover, a very large time increment may introduce a phenomenon known as aliasing, which distorts the information given in the signal. (Aliasing is covered in greater detail in Chapter 5.) To avoid aliasing when defining a computer-generated sinusoid such as $x(t) = \cos(\omega t + b)$, choose $\Delta t \le \pi/\omega$. A rule of thumb in the case of a decaying sinusoid such as $x(t) = e^{-at}\cos(\omega t + b)$ is to choose $\Delta t \le \pi/\left(4\sqrt{a^2 + \omega^2}\right)$. (Choosing even smaller values of Δt creates smoother plots.)

(c) Compute the maximum time increment for plotting $x(t) = e^{-t}\cos(\pi t/4)$. Verify your result by plotting $x(t)$ for $t = 0$ to $t = 10$ sec with $\Delta t = 0.1, 1, 2,$ and 3 sec.

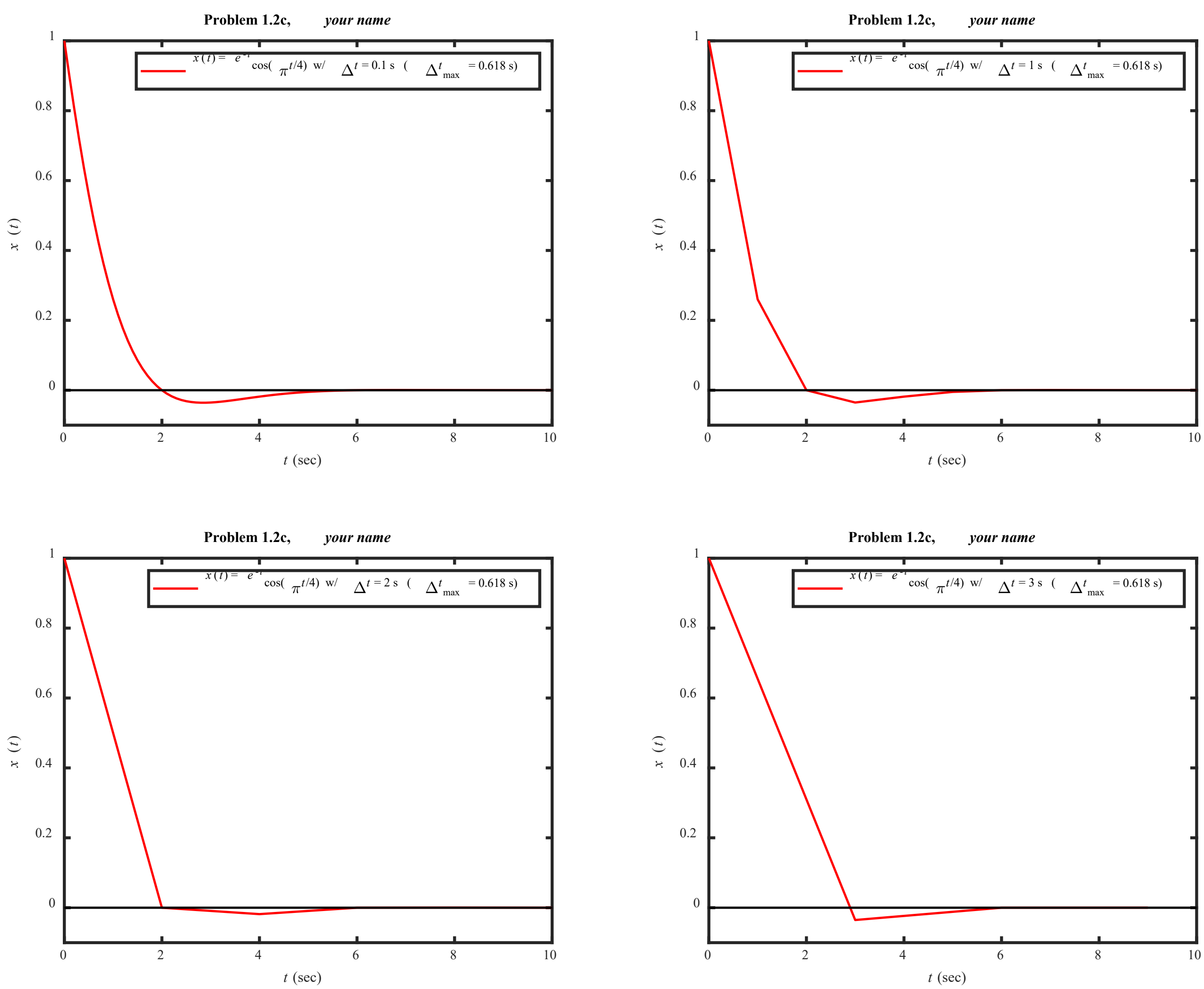
The problem with aliasing exists not only with plotting, but with all digital processing of continuous-time signals. A computer program that emulates a continuous-time system needs to have an input signal defined so that the signal has very little aliasing.

Per equation given - $\Delta t_{max} \le \dfrac{\pi}{4\sqrt{a^2+\omega^2}} = \dfrac{\pi}{4\sqrt{1^2+(\pi/4)^2}} = 0.61767\text{ s}$

Matlab code

```
% Problem 1.2c (p1_02c.m)
%  EE 313 Signals and Systems, Dr. Thomas Montoya
%  Generate plots of x(t)= e^(-t)*cos(pi*t/4)  0 <= t <= 10 s
%  for time steps of Dt= 0.1, 1, 2, & 3 sec
%
clear; clc; close all
t1 = 0:0.1:10; t2 = 0:1:10; t3 = 0:2:10; t4 = 0:3:10;
x1 = exp(-t1).*cos(pi*t1/4); x2 = exp(-t2).*cos(pi*t2/4);
x3 = exp(-t3).*cos(pi*t3/4); x4 = exp(-t4).*cos(pi*t4/4);
% Dt = 0.1 sec plot
plot(t1,x1,'r-',[0 10],[0 0],'k-'), axis([0 10 -0.1 1]);
ylabel('{\itx }({\itt})','fontsize',16,'fontname','times')
xlabel('{\itt} (sec)','fontsize',16,'fontname','times')
title('Problem 1.2c, {\ityour name}','fontsize',16,'fontname','times')
legend([' {\itx}({\itt}) = {\ite}^{-{\itt}}cos(\pi{\itt}/4)',...
    '  w/ \Delta{\itt} = 0.1 s   (\Delta{\itt}_{max} = 0.618 s)'])
set(findobj('type','axes'),'fontname','times','fontsize',14)
% Dt = 1 sec plot
figure,plot(t2,x2,'r-',[0 10],[0 0],'k-'), axis([0 10 -0.1 1]);
ylabel('{\itx }({\itt})','fontsize',16,'fontname','times')
xlabel('{\itt} (sec)','fontsize',16,'fontname','times')
title('Problem 1.2c, {\ityour name}','fontsize',16,'fontname','times')
legend([' {\itx}({\itt}) = {\ite}^{-{\itt}}cos(\pi{\itt}/4)',...
    '  w/ \Delta{\itt} = 1 s   (\Delta{\itt}_{max} = 0.618 s)'])
% Dt = 2 sec plot
figure,plot(t3,x3,'r-',[0 10],[0 0],'k-'), axis([0 10 -0.1 1]);
ylabel('{\itx }({\itt})','fontsize',16,'fontname','times')
```

```
xlabel('{\itt} (sec)','fontsize',16,'fontname','times')
title('Problem 1.2c, {\ityour name}','fontsize',16,'fontname','times')
legend([' {\itx}({\itt}) = {\ite}^{-{\itt}}cos(\pi{\itt}/4)',...
    '  w/ \Delta{\itt} = 2 s   (\Delta{\itt}_{max} = 0.618 s)'])
% Dt = 3 sec plot
figure,plot(t4,x4,'r-',[0 10],[0 0],'k-'), axis([0 10 -0.1 1]);
ylabel('{\itx }({\itt})','fontsize',16,'fontname','times')
xlabel('{\itt} (sec)','fontsize',16,'fontname','times')
title('Problem 1.2c, {\ityour name}','fontsize',16,'fontname','times')
legend([' {\itx}({\itt}) = {\ite}^{-{\itt}}cos(\pi{\itt}/4)',...
    '  w/ \Delta{\itt} = 3 s   (\Delta{\itt}_{max} = 0.618 s)'])
set(findobj('type','line'),'linewidth',1.5)
set(findobj('type','axes'),'linewidth',2,'fontsize',12,'fontname','times')
```



- The plot using $\Delta t = 0.1$ s $< \Delta t_{max} = 0.618$ s looks like an exponentially decaying sinusoid. The other plots, w/ $\Delta t > \Delta t_{max}$, showed aliasing distortion to varying degrees.