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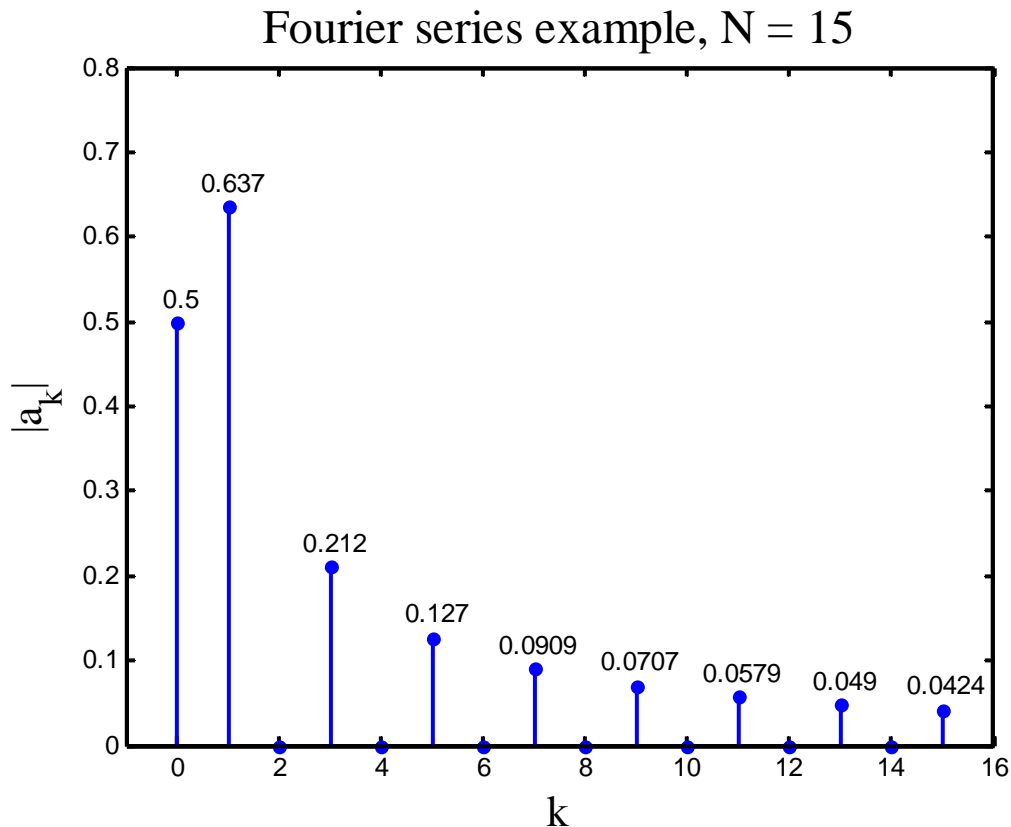
% Chapter 3 Fourier series spectra example
% (chap3_fourier_series1_spectra.m)
%
% Computes amplitude and phase spectra for
% Trigonometric Fourier series for Example 3.2
%
clear;clc;
N = input('Number of harmonics ');
a0 = 0.5; w0 = pi;
for k1 = 1:N,
    ak(k1) = (2/k1/w0).*sin(0.5*k1*w0);
end
k = 0:1:N;
akmag = [a0,abs(ak)];
akang = [angle(a0),angle(ak)];
% ak terms related to mag. of voltage so 20log10() appropriate
akmagdB = 20*log10(akmag);
akmagdBnorm = akmagdB-max(akmagdB); % normalize to max ampl.
%
stem(k,akmag,'b.'), axis([-1 N+1 0 0.8]),
title(['Fourier series example, N = ',num2str(N)],...
    'fontsize',18,'fontname','times')
xlabel('k','fontsize',16,'fontname','times'),
ylabel('|a_k|','fontsize',16,'fontname','times'),
% Label stems
for n=1:N+1, %
    if(akmag(n)>0.0009),
        text(k(n),akmag(n)+0.045,[' ' num2str(akmag(n),3)],...
            'HorizontalAlignment','center','VerticalAlignment','top')
    end
end
figure
stem(k,akmagdB,'b.'), axis([-1 N+1 -50 0]),
title(['Fourier series example, N = ',num2str(N)],...
    'fontsize',18,'fontname','times')
xlabel('k','fontsize',16,'fontname','times'),
ylabel('|a_k| (dB)','fontsize',16,'fontname','times'),
% Label stems
for n=1:N+1,
    if(akang(n)>-50),
        text(k(n),akmagdB(n)-1,[' ' num2str(akmagdB(n),3)],...
            'HorizontalAlignment','center','VerticalAlignment','top')
    end
end
figure
stem(k,akmagdBnorm,'b.'), axis([-1 N+1 -50 0]),
title(['Fourier series example, N = ',num2str(N)];...
    ['max(|a_k|) = ',num2str(max(akmagdB)), ' dB']],...
    'fontsize',16,'fontname','times')

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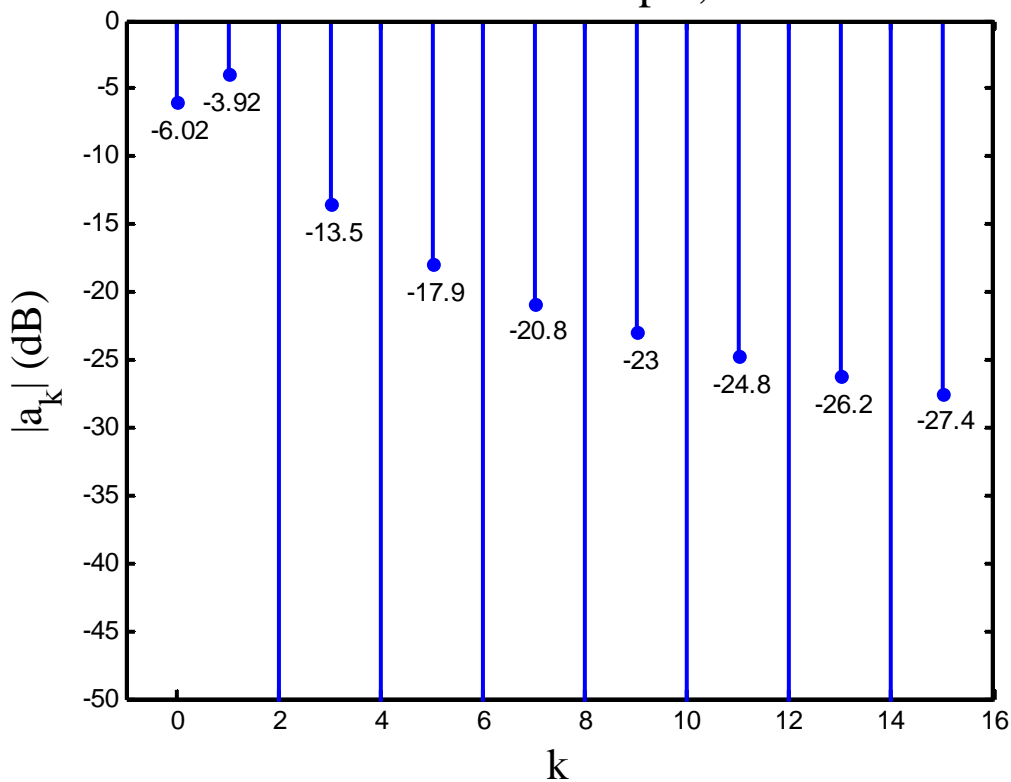
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xlabel('k','fontsize',16,'fontname','times'),
ylabel('Normalized |a_k| = |a_k| - max(|a_k|) (dB)',...
       'fontsize',14,'fontname','times'),
% Label stems
for n=1:N+1,
    if(akang(n)>-50),
        text(k(n),akmagdBnorm(n)-1,[' ' num2str(akmagdBnorm(n),3)],...
             'HorizontalAlignment','center','VerticalAlignment','top')
    end
end
figure
stem(k,akang,'b.'), axis([-1 N+1 -0.5 4]),
title(['Fourier series example, N = ',num2str(N)],...
      'fontsize',18,'fontname','times')
xlabel('k','fontsize',16,'fontname','times'),
ylabel('\angle a_k (rad)','fontsize',16,'fontname','times'),
% Label stems
for n=1:N+1, %
    if(akang(n)>0.1),
        text(k(n),akang(n)+0.3,[' ' num2str(akang(n),3)],...
             'HorizontalAlignment','center','VerticalAlignment','top')
    end
end
end
set(findobj('type','line'),'linewidth',1.5)
set(findobj('type','line'),'markersize',14)
set(findobj('type','axes'),'linewidth',2)

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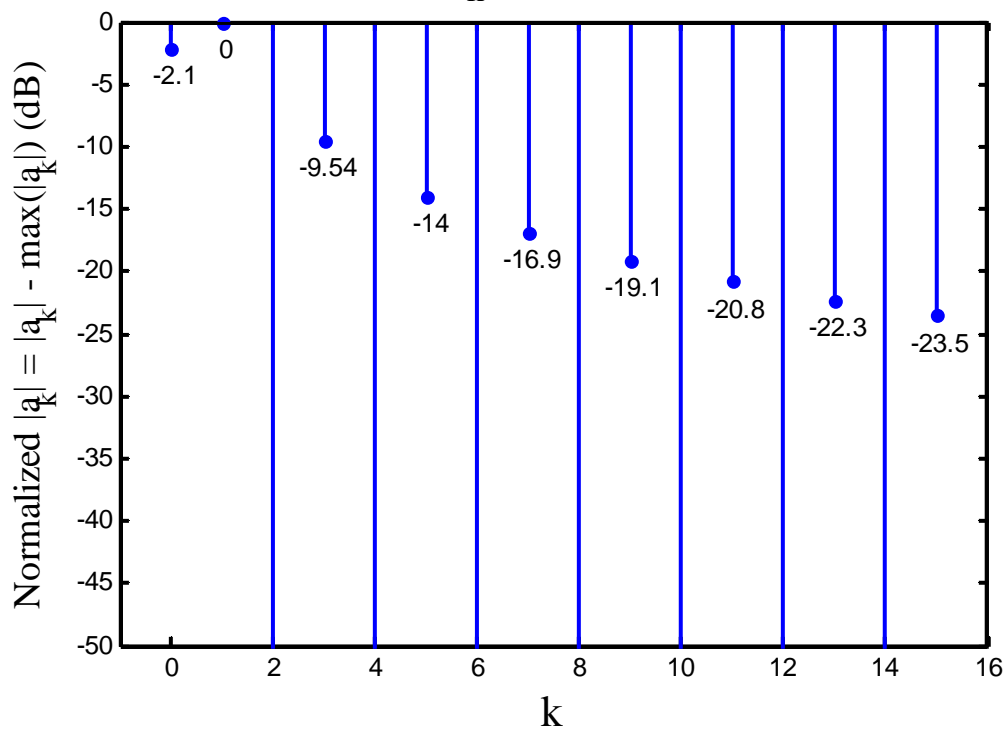


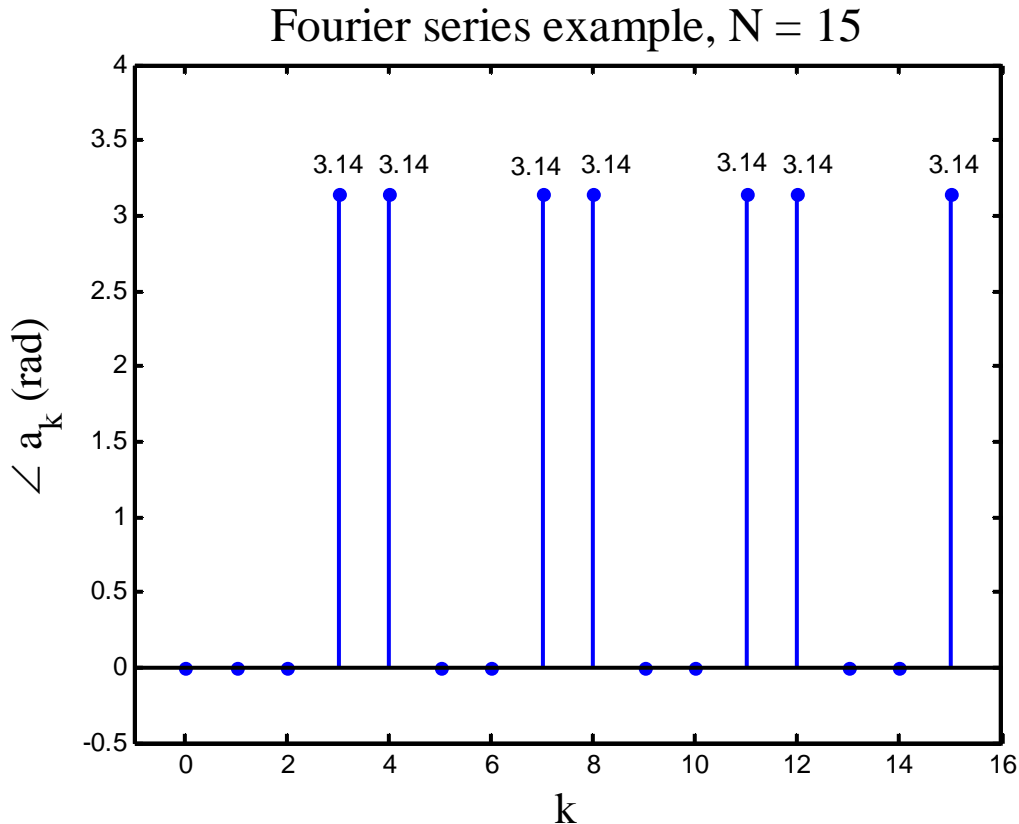
Fourier series example, N = 15



Fourier series example, N = 15

$\max(|a_k|) = -3.9224$ dB



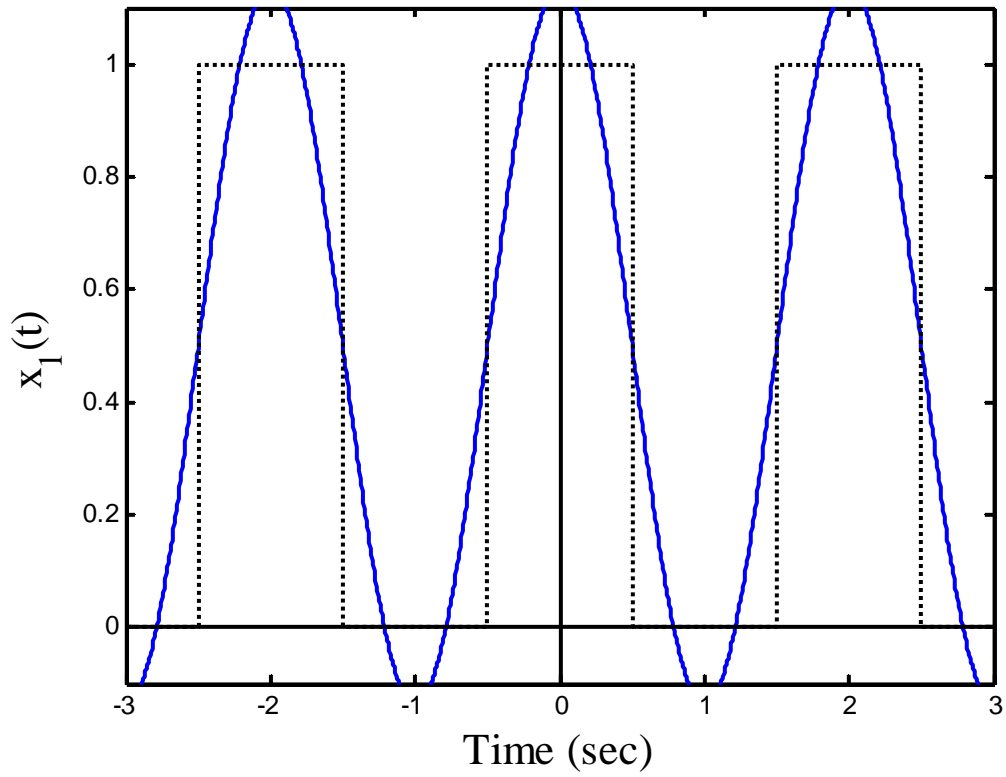


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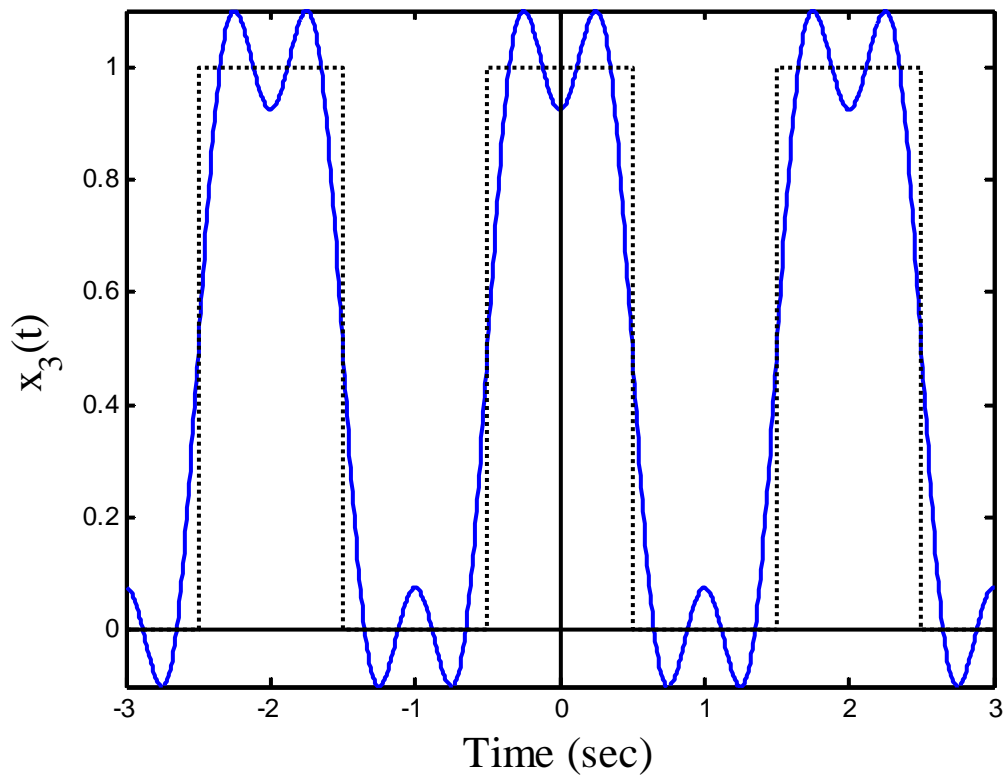
% Chapter 3 Fourier series example (chap3_fourier_series1.m)
%
% Computes Trigonometric Fourier series for Example 3.2
%
clear;clc;
t = -3:6/1000:3;
N = input('Number of harmonics ');
a0 = 0.5; w0 = pi;
xN = a0*ones(1,length(t)); % dc component
for k=1:N,
    ak = (2/k/w0)*sin(0.5*k*w0);
    xN = xN + ak*cos(k*w0*t);
end
xexact = [0 0 1 1 0 0 1 1 0 0 1 1 0 0];
texact = [-3 -2.5 -2.5 -1.5 -1.5 -0.5 -0.5 0.5 0.5 1.5 1.5 2.5 2.5 3];
plot(t,xN,'b-',texact,xexact,'k:',[ -3 3],[0,0],'k-',...
     [0 0],[ -0.1,1.1],'k-'), axis([-3 3 -0.1 1.1]),
title(['Fourier series example, N = ',num2str(N)],...
      'fontsize',18,'fontname','times')
xlabel('Time (sec)','fontsize',16,'fontname','times')
ylabel(['x_{',num2str(N),'}(t)','fontsize',16,'fontname','times')
set(findobj('type','line'),'linewidth',1.5)
set(findobj('type','line'),'markersize',18)
set(findobj('type','axes'),'linewidth',2)

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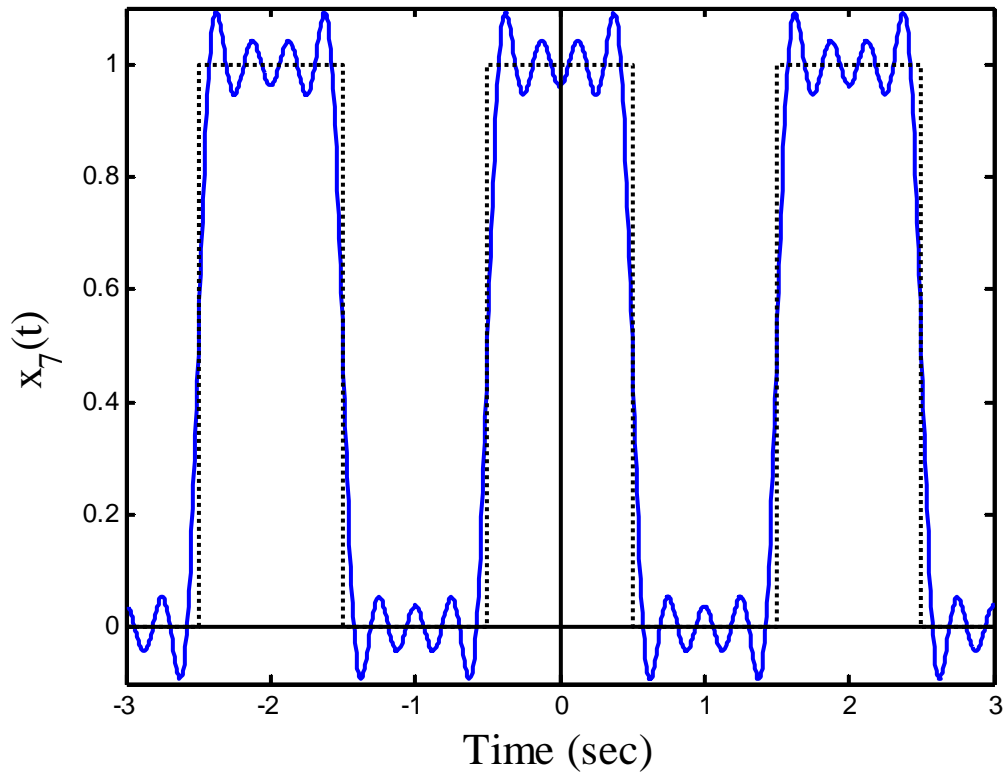
Fourier series example, $N = 1$



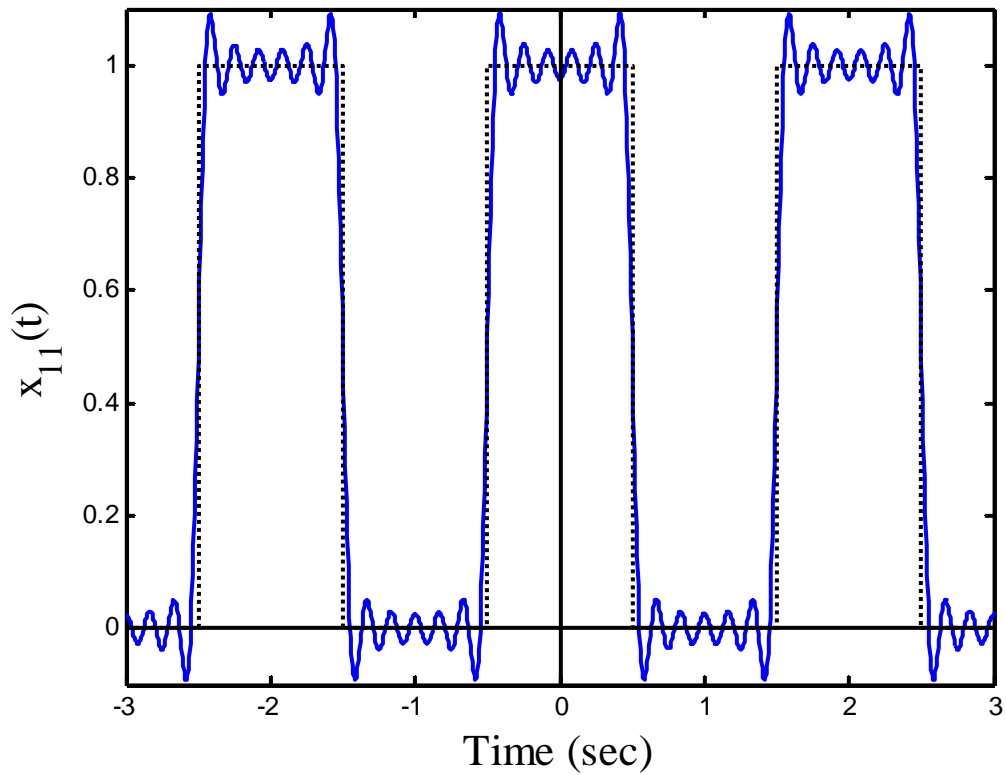
Fourier series example, $N = 3$



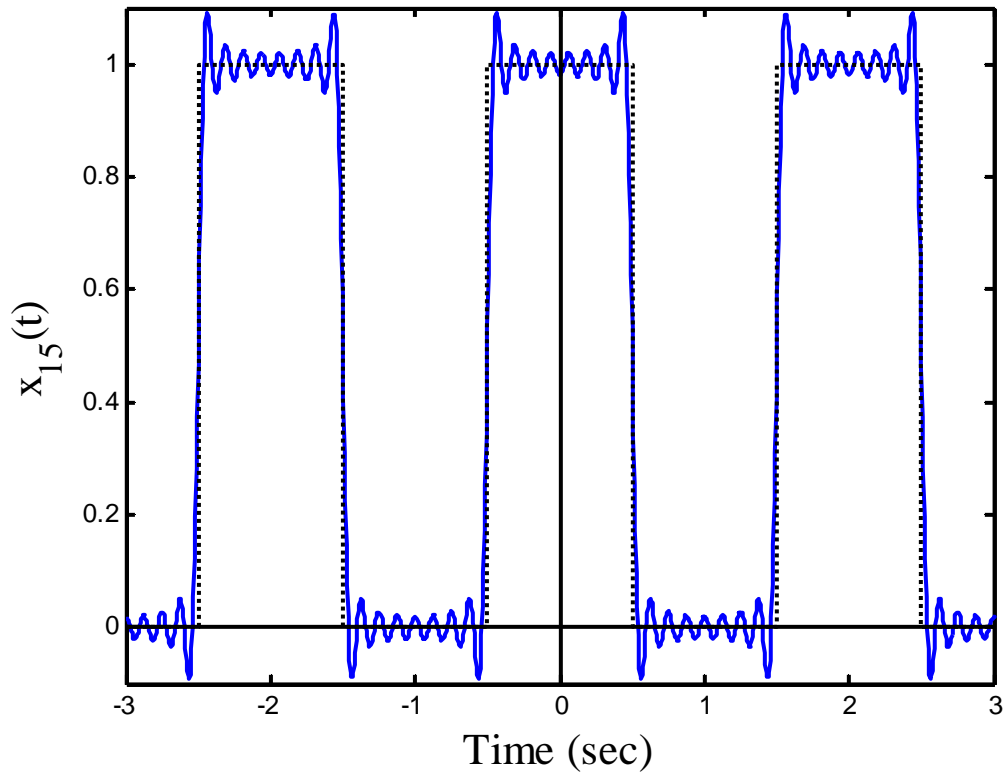
Fourier series example, $N = 7$



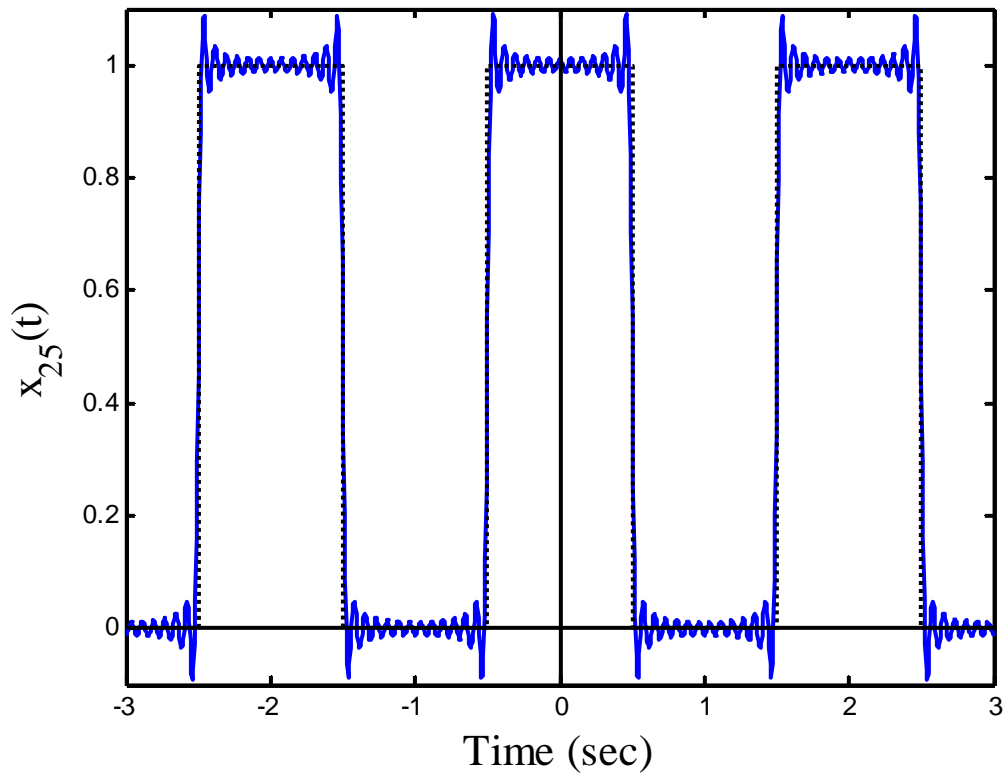
Fourier series example, $N = 11$



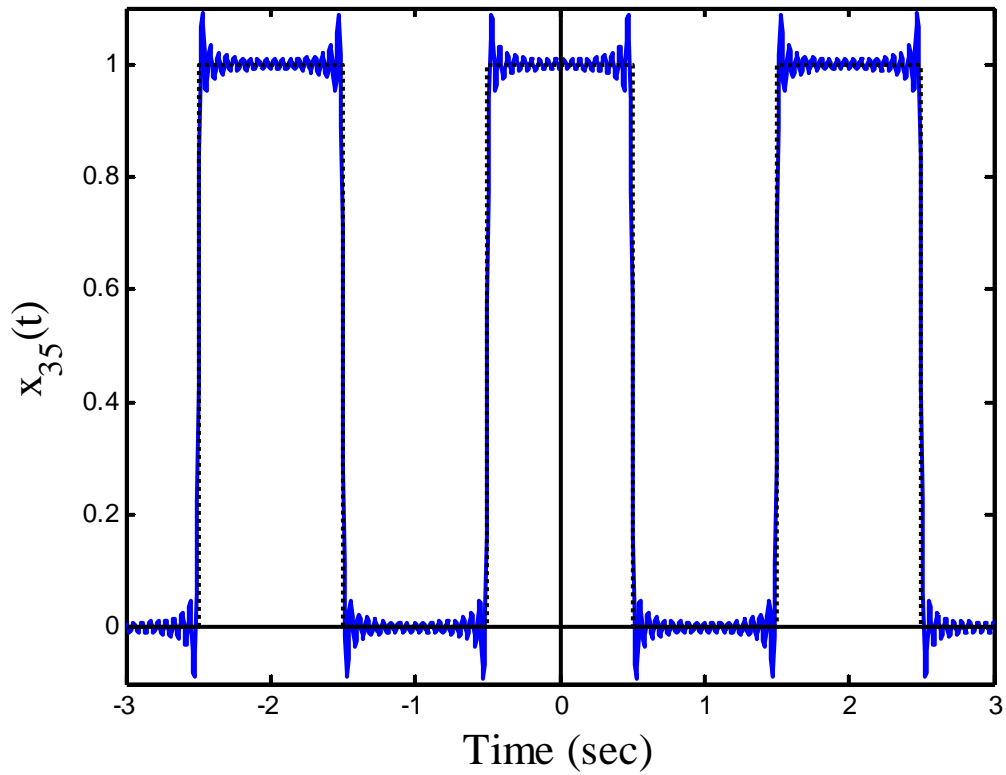
Fourier series example, $N = 15$



Fourier series example, $N = 25$



Fourier series example, $N = 35$



Fourier series example, $N = 45$

