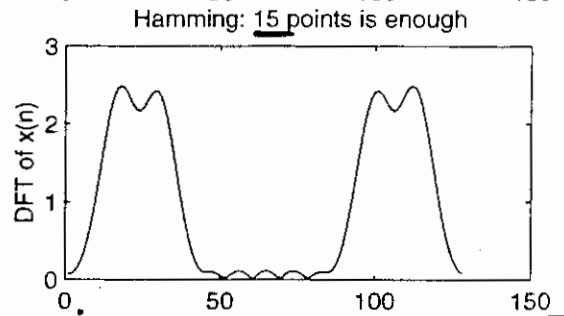
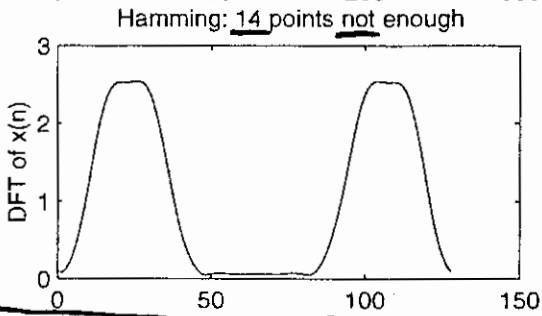
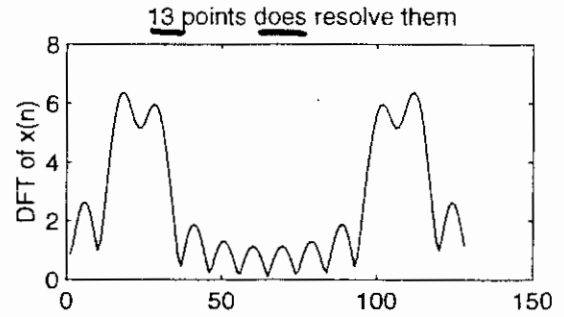
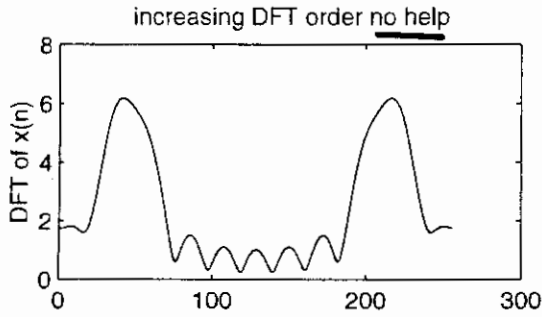
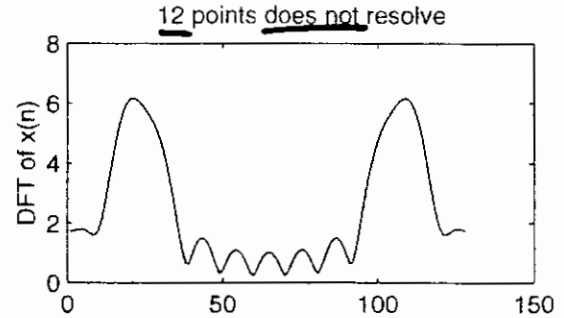
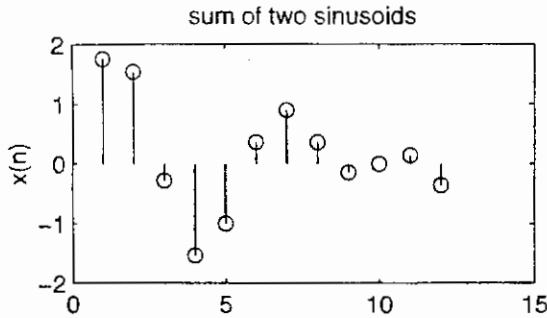
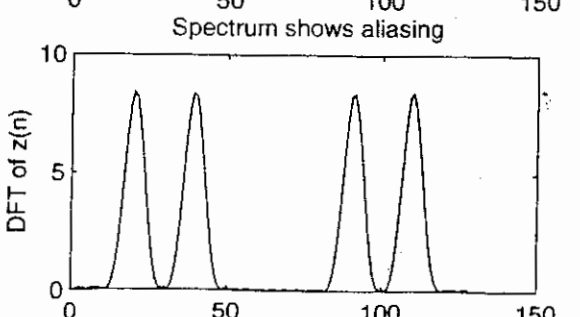
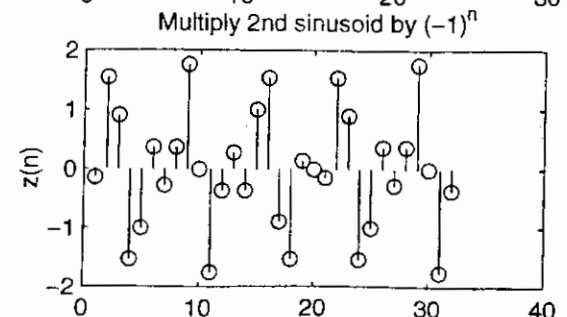
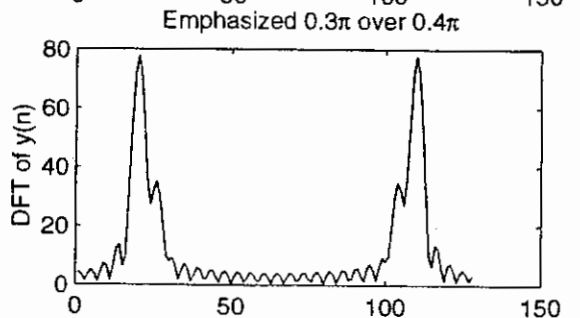
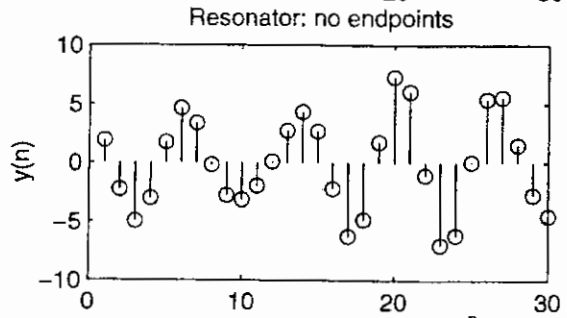
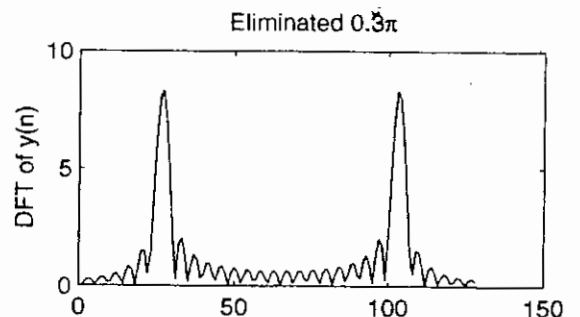
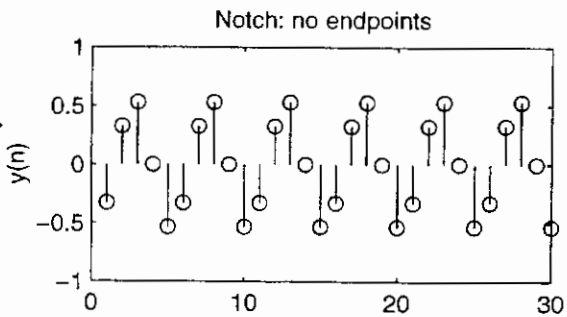


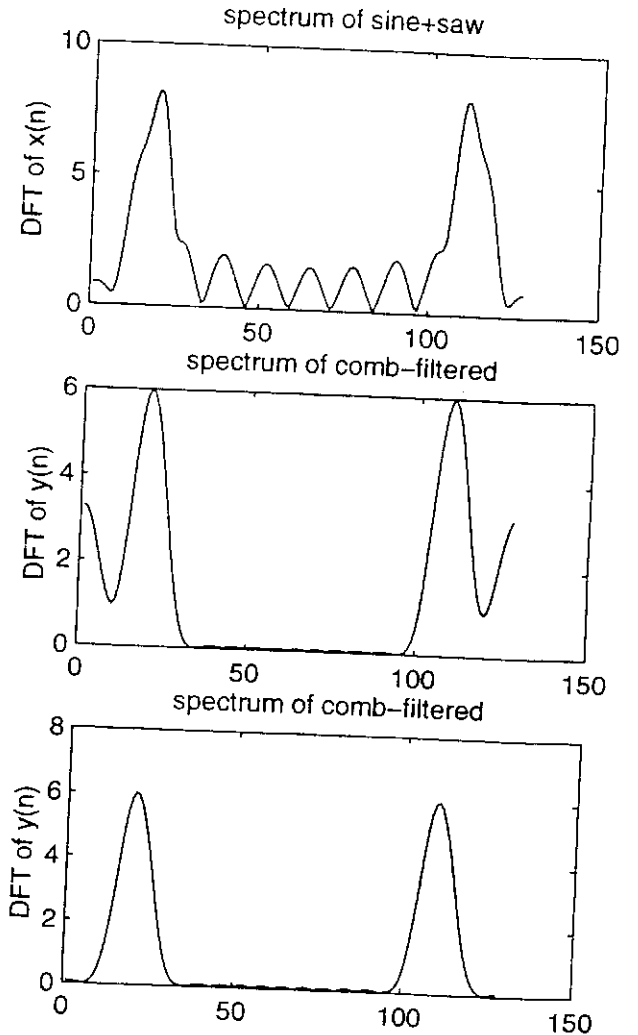
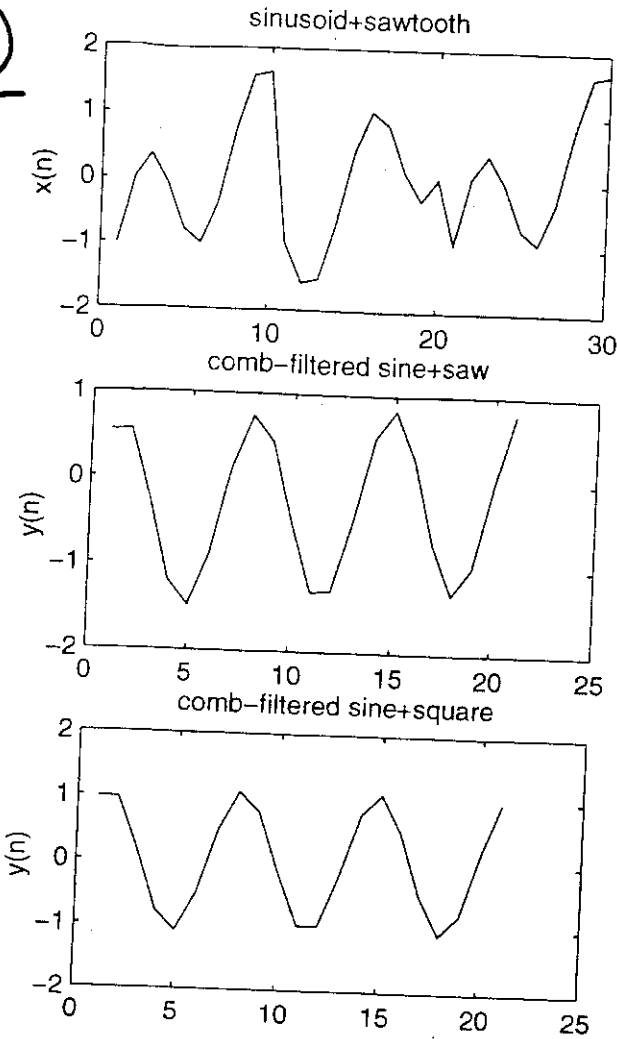
10



2



3



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% Solutions: EECS 451 Prob Set #8, Prob #1
X=sin(0.3*pi*[1:32])+sin(0.4*pi*[1:32]);
subplot(3,2,1), stem(X(1:12));
title('sum of two sinusoids'), ylabel('x(n)')
subplot(3,2,2), plot(abs(fft(X(1:12), 128)))
title('12 points does not resolve'), ylabel('DFT of x(n)')
subplot(3,2,3), plot(abs(fft(X(1:12), 256)))
title('increasing DFT order no help'), ylabel('DFT of x(n)')
subplot(3,2,4), plot(abs(fft(X(1:13), 128)))
title('13 points does resolve them'), ylabel('DFT of x(n)')
Y=X(1:14).*hamming(14);
subplot(3,2,5), plot(abs(fft(Y(1:14), 128)))
title('Hamming: 14 points not enough'), ylabel('DFT of x(n)')
subplot(3,2,6), plot(abs(fft(X(1:15), 128)))
title('Hamming: 15 points is enough'), ylabel('DFT of x(n)')

% Solutions: EECS 451 Prob Set #8, Prob #2
X=sin(0.3*pi*[1:32])+sin(0.4*pi*[1:32]);
H=[1 -2*cos(0.3*pi) 1]; %Notch filter
YY=conv(H,X); Y=YY(3:32); %Discard endpoints
subplot(3,2,1), stem(Y)
title('Notch: no endpoints'), ylabel('y(n)')
subplot(3,2,2), plot(abs(fft(Y, 128)))
title('Eliminated 0.3*pi'), ylabel('DFT of y(n)')
H=[1 -1.8*cos(0.3*pi) 0.81]; %Resonator: r=0.9
YY=filter([1], H, X); Y=YY(3:32); %Implements AR
subplot(3,2,3), stem(Y)
title('Resonator: no endpoints'), ylabel('y(n)')
subplot(3,2,4), plot(abs(fft(Y, 128)))
title('Emphasized 0.3*pi over 0.4*pi'), ylabel('DFT of y(n)')
Z=sin(0.3*pi*[1:32])+((-1).^[1:32]).*sin(0.4*pi*[1:32]);
subplot(3,2,5), stem(Z)
title('Multiply 2nd sinusoid by (-1)^n'), ylabel('z(n)')
Z=Z.*hamming(32); %0.4*pi -> 0.6*pi, double to 0.3*pi
subplot(3,2,6), plot(abs(fft(Z, 128)))
title('Spectrum shows aliasing'), ylabel('DFT of z(n)')

% Solutions: EECS 451 Prob Set #8, Prob #3
X=sin(0.3*pi*[0:29])+sawtooth([0:29]*2/pi);
subplot(3,2,1), plot(X)
title('sinusoid+sawtooth'), ylabel('x(n)')
XX=X.*hamming(30);
subplot(3,2,2), plot(abs(fft(XX, 128)))
title('spectrum of sine+saw'), ylabel('DFT of x(n)')
H=[1 1 1 1 1 1 1 1 1 1]/2; %Comb filter
YY=conv(H,X); Y=YY(10:30);
subplot(3,2,3), plot(Y)
title('comb-filtered sine+saw'), ylabel('y(n)')
YY=Y.*hamming(21);
subplot(3,2,4), plot(abs(fft(Y, 128)))
title('spectrum of comb-filtered'), ylabel('DFT of y(n)')
X=sin(0.3*pi*[0:29])+square([0:29]*2/pi);
YY=conv(H,X); Y=YY(10:30);
subplot(3,2,5), plot(Y)
title('comb-filtered sine+square'), ylabel('y(n)')
YY=Y.*hamming(21);
subplot(3,2,6), plot(abs(fft(Y, 128)))
title('spectrum of comb-filtered'), ylabel('DFT of y(n)')

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Handwritten notes in a box:

ELIMINATES HARMONICS  
 9 ZEROS AND FILTERS DC

$2 - 2\cos(0.3\pi) + \frac{1}{2}$

$1 - 1.8\cos(0.3\pi) + 0.81$

SHIFT SPECTRUM BY  $\pi$

$\rightarrow 0.6\pi$ , DOUBLE  $\neq 0.3\pi$