

```

clear all;

p = zeros(1, 2);
Xc = @(F) (100*pi)./(((11*2*pi).*F + 10).^2 + (20*pi)^2);
F = (-50:0.1:50);
CTFT = Xc(F);

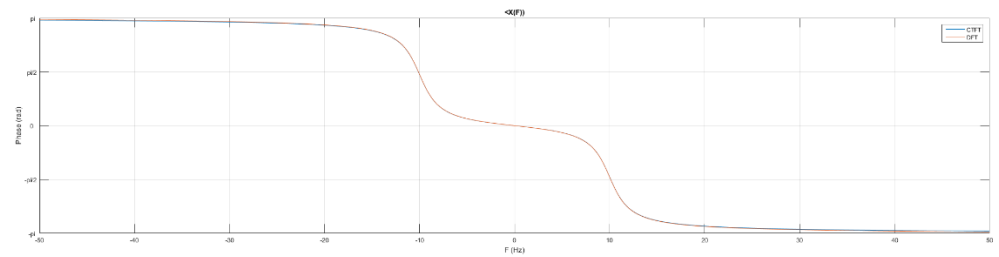
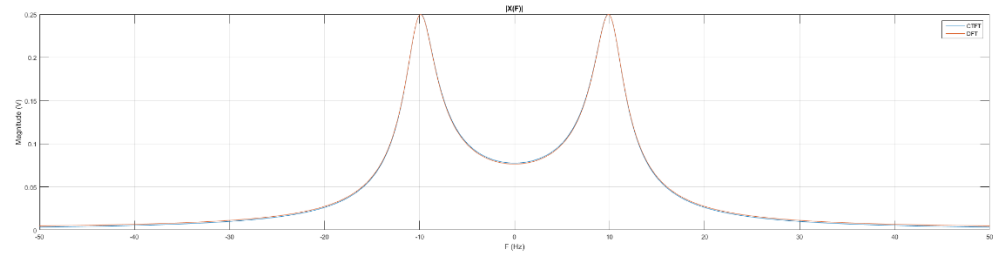
xc = @(t) 5*exp(-10*t).*sin(20*pi*t);
Fs = 150; % round(20*pi*2) = 126
N = 300; n = 0:N-1; t = n/Fs; NFFT = 10*N;
DFT = fftshift(fft(xc(t), NFFT))/Fs;
f = ((0:NFFT-1)/NFFT-0.5) * Fs;

% Plot Magnitude
subplot(2, 1, 1);
p(1) = plot(F, abs(CTFT)); hold on;
p(2) = plot(f, abs(DFT));
legend(p, 'CTFT', 'DFT');
title('|X(F)|'); xlabel('F (Hz)'); ylabel('Magnitude (V)');
grid on; hold off;
xlim([-50 50]);

% Plot Phase
subplot(2, 1, 2);
p(1) = plot(F, angle(CTFT)); hold on;
p(2) = plot(f, angle(DFT));
legend(p, 'CTFT', 'DFT');
title('<X(F)'); xlabel('F (Hz)'); ylabel('Phase (rad)');
grid on; hold off;
xlim([-50 50]);

% Radian y-axis maker
ylim([-pi pi]);
set(gca,'ytick',[-pi,-pi/2,0,pi/2,pi]);
set(gca,'yticklabel',{'-pi ','-pi/2 ',' 0 ',' pi/2 ',' pi '});

```



```

clear all;

p = zeros(1,4);
x = @ (n) n.*(0.9.^n);
X = @ (f) 0.9*exp(-1j*2*pi*f) ./ ((1-0.9*exp(-1j*2*pi*f)).^2);
F = @ (N) (0:N-1)/N - 0.5; % Returns scale for FFT
N = @ (k) 0:k-1; % Returns indexes for k samples

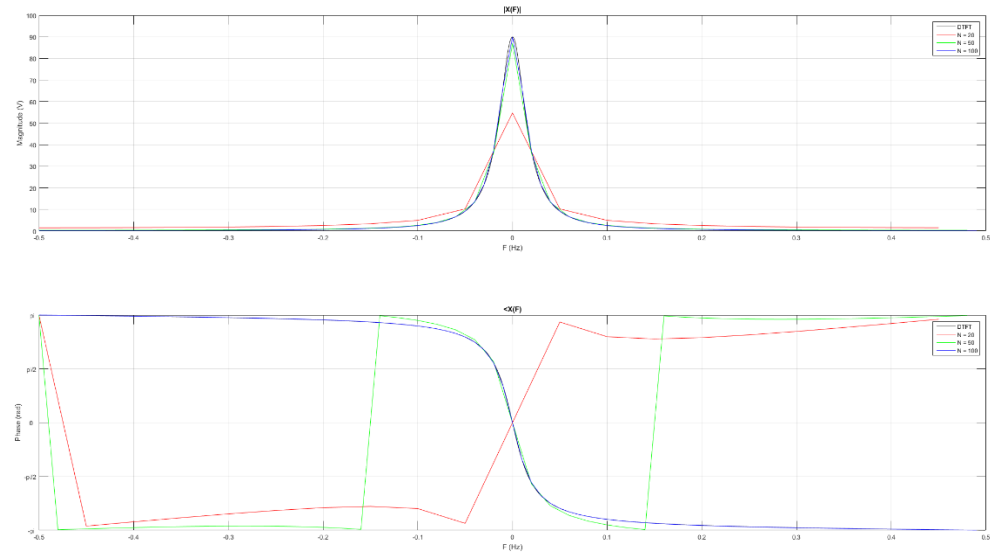
f = F(1024); DTFT = X(f);
f_20 = F(20); X_20 = fftshift(fft(x(N(20))));
f_50 = F(50); X_50 = fftshift(fft(x(N(50))));
f_100 = F(100); X_100 = fftshift(fft(x(N(100))));

% Plot Magnitude
subplot(2, 1, 1);
p(1) = plot(f, abs(DTFT), 'k'); hold on;
p(2) = plot(f_20, abs(X_20), 'r');
p(3) = plot(f_50, abs(X_50), 'g');
p(4) = plot(f_100, abs(X_100), 'b');
legend(p, 'DTFT', 'N = 20', 'N = 50', 'N = 100');
title('|X(F)|'); xlabel('F (Hz)'); ylabel('Magnitude (V)');
grid on; hold off;

% Plot Phase
subplot(2, 1, 2);
p(1) = plot(f, angle(DTFT), 'k'); hold on;
p(2) = plot(f_20, angle(X_20), 'r');
p(3) = plot(f_50, angle(X_50), 'g');
p(4) = plot(f_100, angle(X_100), 'b');
legend(p, 'DTFT', 'N = 20', 'N = 50', 'N = 100');
title('<X(F)'); xlabel('F (Hz)'); ylabel('Phase (rad)');
grid on; hold off;

% Radian y-axis maker
ylim([-pi pi]);
set(gca,'ytick',[-pi,-pi/2,0,pi/2,pi]);
set(gca,'yticklabel',{'-pi','-pi/2','0','pi/2','pi'});

```



```

clear all;

p = zeros(1, 5);
purple = [150 0 250] / 256;
F = @ (N) (0:N-1)/N - 0.5; % Returns scale for FFT
N = @ (k) 0:k-1; % Returns indexes for k samples

% Part a
x_a = @ (n) 4 - n;
f_a = F(8); X_a = fftshift(fft(x_a(N(8)), 8));

% Part b
x_b = @ (n) 4*sin(0.2*pi*n);
f_b = F(10); X_b = fftshift(fft(x_b(N(10))), 10));

% Part c
x_c = @ (n) 6*cos(0.2*pi*n).*cos(0.2*pi*n);
f_c = F(10); X_c = fftshift(fft(x_c(N(10))), 10));

% Part d
x_d = @ (n) 5*(0.8.^n);
f_d = F(16); X_d = fftshift(fft(x_d(N(16))), 16));

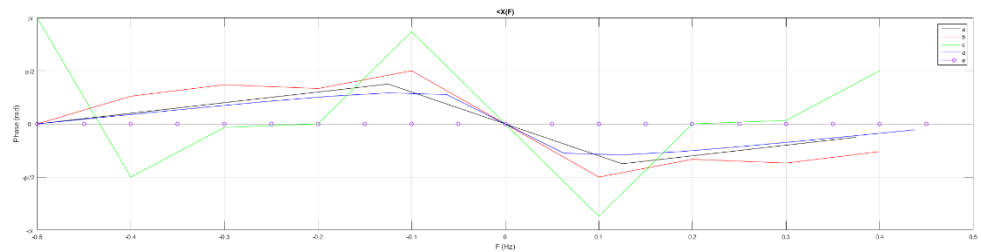
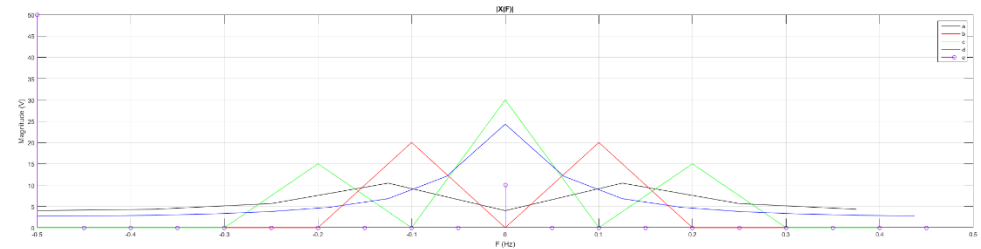
% Part e
x_e = [ ...
    3, -2, 3, -2, 3, -2, 3, -2, ...
    3, -2, 3, -2, 3, -2, 3, -2];
f_e = F(20); X_e = fftshift(fft(x_e, 20));

% Plot Magnitude
subplot(2, 1, 1);
p(1) = plot(f_a, abs(X_a), 'k'); hold on;
p(2) = plot(f_b, abs(X_b), 'r');
p(3) = plot(f_c, abs(X_c), 'g');
p(4) = plot(f_d, abs(X_d), 'b');
p(5) = stem(f_e, abs(X_e), 'Color', purple);
legend(p, 'a', 'b', 'c', 'd', 'e');
title('|X(F)|'); xlabel('F (Hz)'); ylabel('Magnitude (V)');
grid on; hold off;

% Plot Phase
subplot(2, 1, 2);
p(1) = plot(f_a, angle(X_a), 'k'); hold on;
p(2) = plot(f_b, angle(X_b), 'r');
p(3) = plot(f_c, angle(X_c), 'g');
p(4) = plot(f_d, angle(X_d), 'b');
p(5) = stem(f_e, angle(X_e), 'Color', purple);
legend(p, 'a', 'b', 'c', 'd', 'e');
title('<X(F)'); xlabel('F (Hz)'); ylabel('Phase (rad)');
grid on; hold off;

% Radian y-axis maker
ylim([-pi pi]);
set(gca, 'ytick', [-pi, -pi/2, 0, pi/2, pi]);
set(gca, 'yticklabel', ['-pi', '-pi/2', '0', 'pi/2', 'pi']);

```



## Problem 14

```

clear all;

x1 = [1,2,3,4,5];
x2 = [2,-1,1,-1];
y = cconv(x1,x2,5);
X = ifft(fft(x1).*fft(x2, 5));

```