% Carlos Lazo

% ECE 503

% Homework 4

%% 1) Fourier Series

clear all; close all; clc;

% a. P&M 4.6 a) --- Find Fourier Series coefficients -

syms k;

% Since function has N = 6, develop function from n = 0..5

N = 6;

n = 0:(N-1);

% Develop the generic expression for each Fourier Series coefficient:

c\_k = (4/N) \* sum( sin((2\*pi\*(n-2))/N) .\* exp((-2\*j\*pi\*k\*n)/N) );

% Substitute into the generic expression to figure out c\_k values:

c\_0 = subs(c\_k, 'k', 0);

c\_1 = subs(c\_k, 'k', 1);

c\_2 = subs(c\_k, 'k', 2);

c\_3 = subs(c\_k, 'k', 3);

c\_4 = subs(c\_k, 'k', 4);

c\_5 = subs(c\_k, 'k', 5);

fprintf(['Coefficient for c\_0 is:\n\t' num2str(c\_0) '\n\n']);

fprintf(['Coefficient for c\_1 is:\n\t' num2str(c\_1) '\n\n']);

fprintf(['Coefficient for c\_2 is:\n\t' num2str(c\_2) '\n\n']);

fprintf(['Coefficient for c\_3 is:\n\t' num2str(c\_3) '\n\n']);

fprintf(['Coefficient for c\_4 is:\n\t' num2str(c\_4) '\n\n']);

fprintf(['Coefficient for c\_5 is:\n\t' num2str(c\_5) '\n\n']);

% \*\*\*\*\*\*\*\*\*\*\*\*\*\*

% \*\*\* OUTPUT \*\*\*

% \*\*\*\*\*\*\*\*\*\*\*\*\*\*

%

% Coefficient for c\_0 is:

% 8.1643e-17

%

% Coefficient for c\_1 is:

% -1.7321+1i

%

% Coefficient for c\_2 is:

% 2.9225e-16-4.0317e-17i

%

% Coefficient for c\_3 is:

% -8.1643e-17+1.4141e-16i

%

% Coefficient for c\_4 is:

% -6.5144e-16-2.3724e-16i

%

% Coefficient for c\_5 is:

% -1.7321-1i

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%% 1) Fourier Series

clear all; close all; clc;

% a. P&M 4.6 b) --- Find Fourier Series coefficients -

syms k;

% Since function has N = 15, develop function from n = 0..14

% c\_k1 has N = 3 and c\_k2 has N = 5

N = 15;

n = 0:(N-1);

N1 = 3;

N2 = 5;

% Develop the generic expression for each Fourier Series coefficient:

c\_k1 = (1/N) \* sum( cos((2\*pi\*n)/N1) .\* exp((-2\*j\*pi\*k\*n)/N) );

c\_k2 = (1/N) \* sum( sin((2\*pi\*n)/N2) .\* exp((-2\*j\*pi\*k\*n)/N) );

% Form the c\_k vector by doing the variable substitution and addition

% of both c\_k expressions. Save into a vector from n = 0..N-1

for ii = 0:(N-1)

c\_k(ii+1) = subs(c\_k1, 'k', ii) + subs(c\_k2, 'k', ii);

end

for ii = 0:(N-1)

fprintf(['Coefficient for c\_' num2str(ii) ' is:\n']);

fprintf(['\t' num2str(c\_k(ii+1)) '\n\n']);

end

% \*\*\*\*\*\*\*\*\*\*\*\*\*\*

% \*\*\* OUTPUT \*\*\*

% \*\*\*\*\*\*\*\*\*\*\*\*\*\*

%

% Coefficient for c\_0 is:

% -3.2613e-16

%

% Coefficient for c\_1 is:

% 0-1.8215e-16i

%

% Coefficient for c\_2 is:

% -1.5613e-16-1.3878e-17i

%

% Coefficient for c\_3 is:

% 1.1102e-16-0.5i

%

% Coefficient for c\_4 is:

% -2.3766e-16-2.7062e-16i

%

% Coefficient for c\_5 is:

% 0.5-2.7409e-16i

%

% Coefficient for c\_6 is:

% 1.8041e-16+6.9389e-18i

%

% Coefficient for c\_7 is:

% 3.1225e-16-2.9751e-16i

%

% Coefficient for c\_8 is:

% -2.6368e-16+2.1944e-16i

%

% Coefficient for c\_9 is:

% -2.3245e-16-7.2858e-17i

%

% Coefficient for c\_10 is:

% 0.5+5.2736e-16i

%

% Coefficient for c\_11 is:

% 7.7629e-16-3.8858e-16i

%

% Coefficient for c\_12 is:

% -1.2178e-15+0.5i

%

% Coefficient for c\_13 is:

% 4.7184e-16-3.4001e-16i

%

% Coefficient for c\_14 is:

% 8.3961e-16+1.4364e-15i

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%% 3) Frequency Response and System Functions

clear all; close all; clc;

% a. Problem 5.4, part j)

[H1,w1] = freqz([.25 .25 .25 .25], 1);

% Plot the magnitude and phase response of the system from 0 to pi.

figure

subplot(2,1,1);

plot(w1, abs(H1));

xlabel('Frequency in Radians (0 to \pi)'); ylabel('Magnitude');

title('|H[e\^(jw)]|');

subplot(2,1,2);

plot(w1, angle(H1)\*180/pi);

xlabel('Frequency in Radians (0 to \pi)'); ylabel('Phase in Degrees');

title('Phase of H[e\^(jw)]');

% a. Problem 5.4, part k)

[H2,w2] = freqz([(1/8) (3/8) (3/8) (1/8)], 1);

% Plot the magnitude and phase response of the system from 0 to pi.

figure

subplot(2,1,1);

plot(w2, abs(H2));

xlabel('Frequency in Radians (0 to \pi)'); ylabel('Magnitude');

title('|H[e\^(jw)]|');

subplot(2,1,2);

plot(w2, angle(H2)\*180/pi);

xlabel('Frequency in Radians (0 to \pi)'); ylabel('Phase in Degrees');

title('Phase of H[e\^(jw)]');



