

**Program: Computer Engineering and Software Systems**

***Course Code: ECE251***

***Course Name: Signals and Systems***

***Submitted to***

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**Ain Shams University**

**Faculty of Engineering**

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**MATLAB Project**

**Students Personal Information**

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T = 2;

E = 2;

% Define the signal f(t)

f = @(t) E\*(mod(t,T) <= (T/6)) - E\*((mod(t,T) >= (T/3)) & (mod(t,T) <= (2\*T/3))) + E\*((mod(t,T) >= (5\*T/6)) & (t <= T));

% Define the time vector for one period of the signal

t\_period = linspace(0, T, 1000);

% Calculate a1, a2, and a3 using the Fourier series formulas

a1 = round((2/T) \* trapz(t\_period, f(t\_period) .\* cos(2\*pi\*t\_period/T)), 2);

a2 = round((2/T) \* trapz(t\_period, f(t\_period) .\* cos(4\*pi\*t\_period/T)), 2);

a3 = round((2/T) \* trapz(t\_period, f(t\_period) .\* cos(6\*pi\*t\_period/T)), 2);

% Calculate P1, P2, and P3 using the Fourier series formulas

P1 = round((a1^2)/2, 2);

P2 = round((a2^2)/2, 2);

P3 = round((a3^2)/2, 2);

% Calculate PT using the Parseval's theorem

N = 100;

a = zeros(1, N+1);

b = zeros(1, N+1);

for n = 0:N

cosTerm = cos(2\*pi\*n\*t\_period/T);

sinTerm = sin(2\*pi\*n\*t\_period/T);

a(n+1) = round((2/T) \* trapz(t\_period, f(t\_period) .\* cosTerm), 2);

b(n+1) = round((2/T) \* trapz(t\_period, f(t\_period) .\* sinTerm), 2);

end

stem(0:N, a)

hold on

stem(0:N, b)

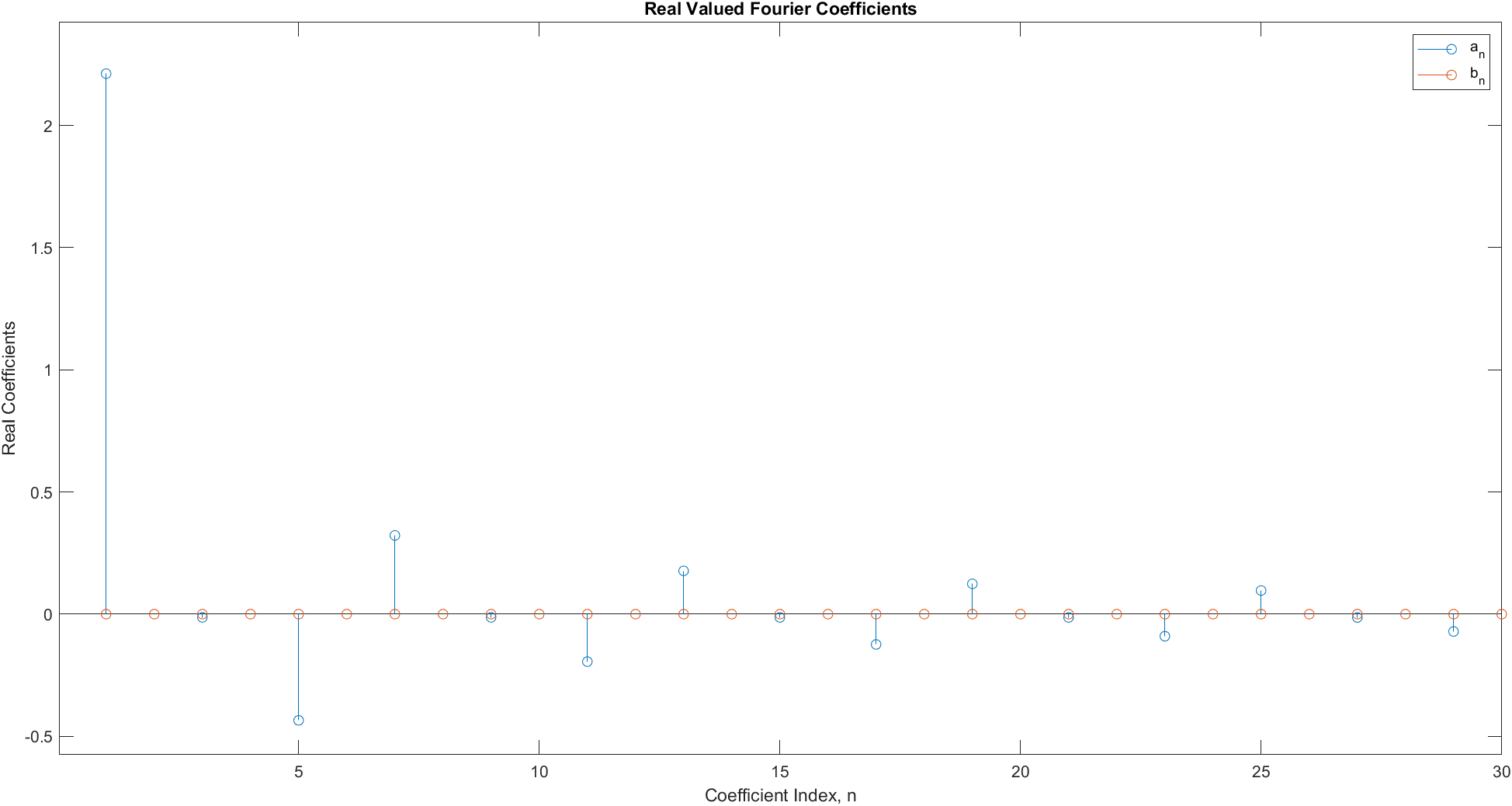
hold off

xlabel ('Coefficient Index, n' )

ylabel( 'Real Coefficients')

legend('a\_n','b\_n')

title('Real Valued Fourier Coefficients')



PT = round((1/T) \* sum(abs(a).^2 + abs(b).^2), 2);

% Calculate the ratios of P3/PT and P2/PT

ratio\_P1 = round((P1/PT)\*100, 2);

ratio\_P3 = round((P3/PT)\*100, 2);

ratio\_P2 = round((P3/PT)\*100, 2);

% Plot both the original signal and its Fourier series approximation

f\_periodic = repmat(f(t\_period), 1, 3);

f\_s = zeros(size(t\_period));

for n = 0:N

cosTerm = cos(2\*pi\*n\*t\_period/T);

sinTerm = sin(2\*pi\*n\*t\_period/T);

f\_s = f\_s + a(n+1)\*cosTerm + b(n+1)\*sinTerm;

end

figure;

subplot(2,1,1);

plot(linspace(0, 3\*T, length(f\_periodic)), f\_periodic);

xlabel('t (seconds)');

ylabel('f(t)');

title('Signal f(t) with periodic repetition');

grid on;

subplot(2,1,2);

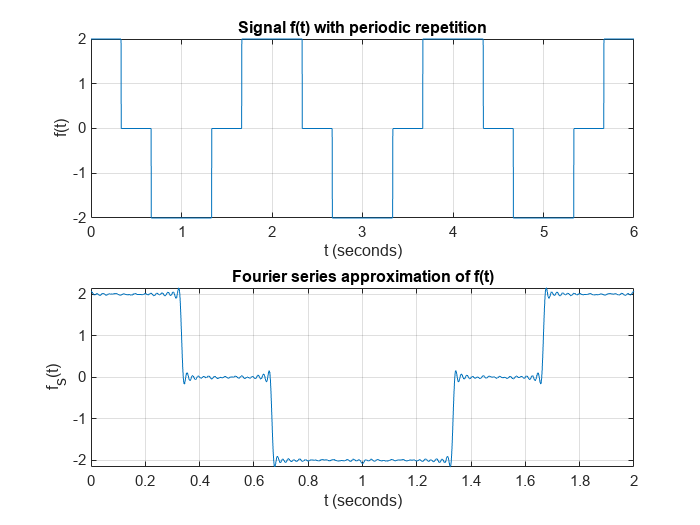
plot(t\_period, f\_s);

xlabel('t (seconds)');

ylabel('f\_s(t)');

title('Fourier series approximation of f(t)');

grid on;



% Display the results

disp(['a1 = ', num2str(a1)]);

a1 = 2.21

disp(['a2 = ', num2str(a2)]);

a2 = 0

disp(['a3 = ', num2str(a3)]);

a3 = 0

disp(['P1 = ', num2str(P1)]);

P1 = 2.44

disp(['P2 = ', num2str(P2)]);

P2 = 0

disp(['P3 = ', num2str(P3)]);

P3 = 0

disp(['P1/PT = ', num2str(ratio\_P1),'%']);

P1/PT = 91.39%

disp(['P3/PT = ', num2str(ratio\_P3),'%']);

P3/PT = 0%

disp(['P2/PT = ', num2str(ratio\_P2),'%']);

P2/PT = 0%

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