% Electrical Stimulation and FFT Analysis

% Parameters

fs = 100000; % Sampling frequency (Hz)

t = 0:1/fs:0.1; % Time vector (0.1 seconds duration)

amplitude = 5; % Stimulation amplitude (mA)

frequency = 50; % Stimulation frequency (Hz)

% Generate Waveforms

sin\_wave = amplitude \* sin(2 \* pi \* frequency \* t); % Sinusoidal waveform

rect\_wave = amplitude \* square(2 \* pi \* frequency \* t); % Rectangular waveform

tri\_wave = amplitude \* (2 \* sawtooth(2 \* pi \* frequency \* t, 0.5) - 1); % Triangular waveform

% FFT Analysis

n = length(t); % Number of samples

f = (0:n-1) \* (fs / n); % Frequency vector

fft\_sin = abs(fft(sin\_wave)) / n; % Normalized FFT for sine wave

fft\_rect = abs(fft(rect\_wave)) / n; % Normalized FFT for rectangular wave

fft\_tri = abs(fft(tri\_wave)) / n; % Normalized FFT for triangular wave

% Plot Time-Domain Waveforms

figure;

subplot(3,2,1);

plot(t, sin\_wave, 'r', 'LineWidth', 2);

title('Sinusoidal Waveform (Time Domain)');

xlabel('Time (s)');

ylabel('Amplitude (mA)');

xlim([0 0.02]); % Zoom in for better visualization

grid on;

subplot(3,2,3);

plot(t, rect\_wave, 'b', 'LineWidth', 2);

title('Rectangular Waveform (Time Domain)');

xlabel('Time (s)');

ylabel('Amplitude (mA)');

xlim([0 0.02]);

grid on;

subplot(3,2,5);

plot(t, tri\_wave, 'g', 'LineWidth', 2);

title('Triangular Waveform (Time Domain)');

xlabel('Time (s)');

ylabel('Amplitude (mA)');

xlim([0 0.02]);

grid on;

% Plot FFT Results

subplot(3,2,2);

plot(f(1:n/2), fft\_sin(1:n/2), 'r', 'LineWidth', 2);

title('FFT of Sinusoidal Waveform');

xlabel('Frequency (Hz)');

ylabel('Magnitude');

xlim([0 500]); % Focus on key frequencies

grid on;

subplot(3,2,4);

plot(f(1:n/2), fft\_rect(1:n/2), 'b', 'LineWidth', 2);

title('FFT of Rectangular Waveform');

xlabel('Frequency (Hz)');

ylabel('Magnitude');

xlim([0 500]);

grid on;

subplot(3,2,6);

plot(f(1:n/2), fft\_tri(1:n/2), 'g', 'LineWidth', 2);

title('FFT of Triangular Waveform');

xlabel('Frequency (Hz)');

ylabel('Magnitude');

xlim([0 500]);

grid on;

% Display Message

disp('Waveforms and FFT analysis have been successfully plotted.');

