Part A:

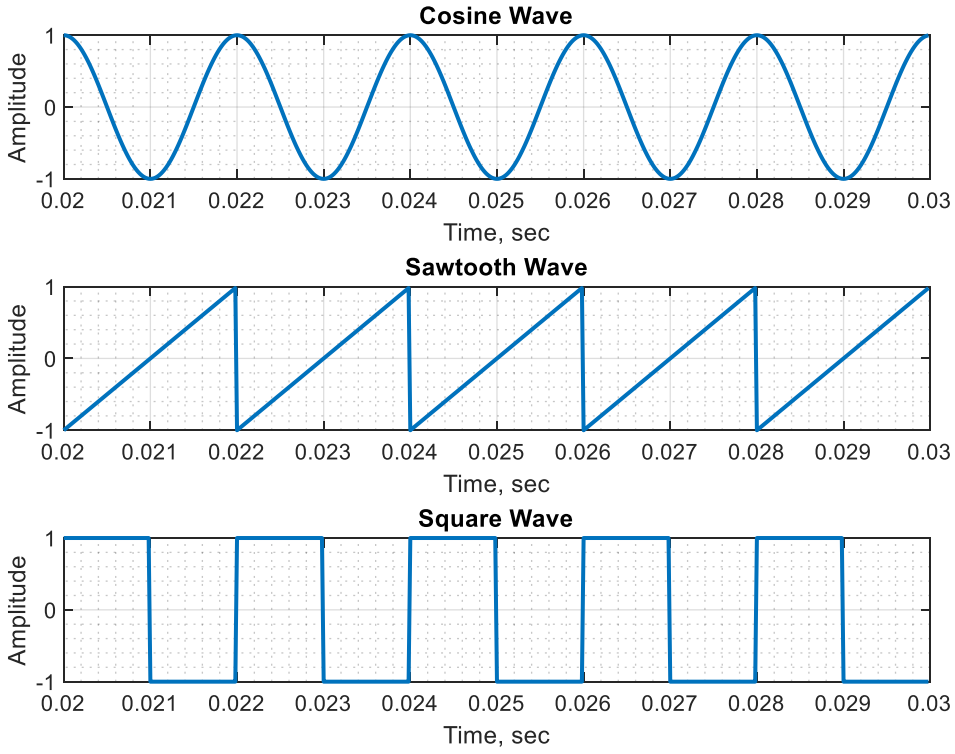
Generating & Plotting Cosine, Sawtooth & Square Signals Using MATLAB:

Consider the MATLAB code, below:

```
clc; close all; clear all;

% Sampling Frequency (Samples/sec)
fs = 5e4;
% Time Period (sec)
T = 1/500;
% Frequency of the signals (Cycles/)
f = 1/T;
% Total time (duration) of signal
t0 = 5;
% time vector
t = 0:1/fs:t0;
% cosine wave
y1 = cos(2*pi*f*t);
% Sawtooth Wave
y2 = mod(2/T*t, 2) - 1;

% f = cycles/sec & fs = samples per sec,
% fs/f = samples per cycle.
% half number of sample be on positive cycle,
% half be on negative cycle, i.e. (fs/f)/2

% one cycle of the Square wave be:
sq_cycle = [ones(1, (fs/f)/2) -ones(1, (fs/f)/2)];
y3 = [];

% By def: Time period = Number cycles / total time
% => number of cycles = total time / time period
for i = 1:t0/T
    y3 = [y3 sq_cycle]; % concatenate cycles
end

%% plotting the Waves:
% Here we consider just plotting 500 samples (from 1001 to 5000)

subplot(311);
plot(t(1001:1500), y1(1001:1500), 'LineWidth', 1.5);
xlabel('Time, sec');
```

Author: Engr. Hayat Ullah
E-mail | GitHub | LinkedIn

```
ylabel('Amplitude');
title('Cosine Wave');
grid on
grid minor

subplot(312);
plot(t(1001:1500), y2(1001:1500), 'LineWidth', 1.5);
xlabel('Time, sec');
ylabel('Amplitude');
title('Sawtooth Wave');
grid on
grid minor

subplot(313);
plot(t(1001:1500), y3(1001:1500), 'LineWidth', 1.5);
xlabel('Time, sec');
ylabel('Amplitude');
title('Square Wave');
grid on
grid minor
```



Author: Engr. Hayat Ullah
E-mail | GitHub | LinkedIn

Playing & Storing the sound files

Consider the code snippet below:

```
disp('Playing Cosine Wave');
sound(y1, fs);
pause(t0);
disp('Playing Done');
pause(0.5)

%-------------------------------------
disp('Playing Sawtooth Wave');
sound(y2, fs);
pause(t0);
disp('Playing Done');
pause(0.5)

%-------------------------------------

disp('Playing Square Wave');
sound(y3, fs);
pause(t0);
disp('Playing Done');
pause(0.5)

if isdir('audio_files')
    rmdir("audiofiles", 's')
end
makdir('audi_files');
audiowrite('\audio_files\cosine.wav', y1, fs);
audiowrite('\audio_files\sawtooth.wav', y2, fs);
audiowrite('\audio_files\square.wav', y3, fs);
```

Author: Engr. Hayat Ullah
E-mail | GitHub | LinkedIn

Explanation:

In case of cosine, single tone was heard, but in case of sawtooth and square waves, multiple tones were heard.
Reason: According to Fourier Series, cosine is single frequency, while sawtooth & square waves are result of summation of different sinusoids or tones.
(Harmonics of the fundamental frequency with varying amplitude).
Fourier Series is described as:

A Fourier series is a sum that represents a periodic function as a sum of sine and cosine waves. The frequency of each wave in the sum, or harmonic, is an integer multiple of the periodic function's fundamental frequency. Each harmonic's phase and amplitude can be determined using harmonic analysis.

Author: Engr. Hayat Ullah
E-mail | GitHub | LinkedIn