The objective of this lab is to generate complex exponentials, plot their real and imaginary parts, and practice phasor addition rule in MATLAB. This set of instructions is adapted from your textbook (DSP First - A Multimedia Approach), Section C.2.3.

A. Representation of Sinusoids with Complex Exponentials

1. Generate the signal \( x(t) = Ae^{j(\omega_0 t + \phi)} \) for \( A = 5, \phi = -\pi/3 \) and \( \omega_0 = 2\pi(1200) \). Take a range for \( t \) that will cover three periods.

2. Plot the real part of \( x(t) \) versus \( t \) and the imaginary part versus \( t \). Use subplot to put both plots in the same window (two subplots in a column).

3. Verify that the real and imaginary parts are sinusoids, and that they have the correct frequency, phase and amplitude.

B. Addition of Sinusoids Using Complex Exponentials

1. Generate four sinusoids with the following amplitudes and phases:

\[
\begin{align*}
x_1(t) &= 5 \cos(2\pi(10)t + 0.5\pi) \\
x_2(t) &= 4 \cos(2\pi(10)t - 0.25\pi) \\
x_3(t) &= 3 \cos(2\pi(10)t + 0.1\pi) \\
x_4(t) &= 2 \cos(2\pi(10)t - 0.9\pi)
\end{align*}
\]

2. Make plots of all four signals over a range of \( t \) that will exhibit four cycles. Be sure that the plots includes negative time so that the phase at \( t = 0 \) can be measured. In order to get a smooth plot, be sure to have at least 50 samples per period of the wave. Use subplot to make a 4-panel subplot that puts all of these plots on the same figure window (4 subplots in a column).

3. Verify that the phase of all four signals is correct at \( t = 0 \), and also verify that each one has the correct maximum amplitude.
4. Create the sum sinusoid by using: \( x_5(t) = x_1(t) + x_2(t) + x_3(t) + x_4(t) \). Make a plot of \( x_5(t) \) in a new figure window. Use the same range of time values as in part B-2.

5. Measure the magnitude and phase of \( x_5(t) \) directly from the plot. In your lab report, include this plot with sufficient annotation to show how the magnitude and phase were measured.

6. Create the complex amplitudes corresponding the sinusoids \( x_i(t) \):

\[
z_i = A_i e^{j\phi_i} \quad i = 1, 2, 3, 4, 5
\]

7. Verify that \( z_5 = z_1 + z_2 + z_3 + z_4 \), where \( z_5 \) is the complex number that you calculated in part B-6 using the plot of \( x_5(t) \). (Hint: simply display the values of both sides in the command window and check whether they are close or not).

For your report, include your well-commented MATLAB code (M-File content), required plots with sufficient annotations for each section (three plots in total), and a brief explanation about any calculations you perform in parts A-3, B-3, B-5, and B-7.

**Questions: Plot of Phasors**

Given two sinusoid equations:

\[
x_1(t) = 4 \cos(2\pi(15)t + \pi/6) \\
x_2(t) = 5 \cos(2\pi(15)t + \pi/3)
\]

1. Try to calculate corresponding phasors, \( z_1 \), \( z_2 \), and \( z_3 = z_1 + z_2 \) analytically.

2. Write a piece of code to replicate the following plot (plot of phasors):