ECE 2050 Autmumn 2023 Homework 1
Due 5:00 pm, Friday Sept 1, 2023
upload to Carmen as a single PDF document

BC:1.1 Express each of the complex numbers below in Cartesian form (evaluate any trigonometric expressions as decimal approximations). If using a calculator with complex number capability, you do not need to show your work, just state which calculator you used to find the answer.

a.) $100\angle\text{-}135^o$

b.) $1.2e^{j\pi/12}$

c.) $16\exp(-j\pi/3) + (17\angle\text{-}45^o)/j - 12$

d.) $(100 + j112) \times (-2 + 75j)$

e.) $(15e^{\text{-}j17^o})/\left(2.5\angle\frac{\text{-}5\pi}{2}\right)$

BC:1.2 Express each of the complex numbers below in polar form with the angle in degrees (evaluate any trigonometric expressions as decimal approximations). If using a calculator with complex number capability, you do not need to show your work, just state which calculator you used to find the answer.

a.) $-150 - j65$

b.) $(25 - 15j)/(j - 3)$

c.) $(2.5\angle\text{-}1.25\pi) + 21e^{\text{-}j43^o}$

d.) $(-1.3 + j7.5) \times (2.5 - 3j)$

e.) $(19\angle\text{-}288^o) \times 13\exp(j3.6\pi)$

BC:1.3 The data for this problem can be found on the Canvas site under

`Content` → `Homework` → `Homework 1 Data`

and should be saved as a file to your own directory where you use Matlab. Once in your directory, the data can be loaded into Matlab using the commands:

```
load('prob1_3.mat')
```

This will generate two vectors, `t` (a time vector that is the independent variable), and `g` (a signal vector that has the same length as `t`). These vectors simulate the shifted sinusoidal relationship:

$$g(t) = A + M\cos(2\pi ft + \theta)$$

where A is a constant offset, M is the peak magnitude of the sinusoid, f is the cyclic frequency in Hz, and θ is a phase angle offset for the sinusoid.

Use Matlab with the `plot()` command and the data cursor tool to find the values for A, M, f, and θ. Express θ in degrees in the range between -180^o and +180^o.

For credit, include the figure showing all datacursor points used in the calculation. (It is possible to put multiple datacursor points on the same plot, and you can save the plot/figure as a PDF file to incorporate in your homework document.) Briefly explain how you use the data points to calculate the values of A, M, f, and θ. (Note you do not need to attach Matlab source code for this problem).

BC:1.4 For the expression

$$g(t) = g_1(t) + g_2(t) + g_3(t) = A\cos(2\pi ft + \theta_A)$$

where

$$g_1(t) = 4\cos(2\pi ft - 17^o)$$
$$g_2(t) = 6\cos(2\pi ft + 21^o)$$
$$g_3(t) = 5\sin(2\pi ft - 90^o)$$

and $f = 5000$ Hz,

a.) Find a phasor expression in polar form for $g_1(t) \leftrightarrow \tilde{G}_1$. Express the angle in degrees. (use a calculator to evaluate any trigonometric expressions)

b.) Find a phasor expression in polar form for $g_2(t) \leftrightarrow \tilde{G}_2$. Express the angle in degrees. (use a calculator to evaluate any trigonometric expressions)

c.) Find a phasor expression in polar form for $g_3(t) \leftrightarrow \tilde{G}_3$. Express the angle in degrees. (use a calculator to evaluate any trigonometric expressions)

d.) Find the values of A and θ_A in the expression for $g(t)$ above find its phasor expression in polar form with the angle in degrees. Hint: first find the phasor of $g(t) \leftrightarrow \tilde{G}$

e.) Use Matlab to plot $g_1(t)$, $g_2(t)$, $g_3(t)$ and $g(t)$ vs time. Use Matlab to calculate the sum of these three time functions and plot $g(t)$ as a function of time. Apply the technique used in Problem 1.3 to verify the values of A and θ_A from your Matlab plot of $g(t)$. Use the datacursor tool to show data points on your plot for key locations used to find A and θ_A. Attach your Matlab source code (script) and your plot (with labeled key datapoints) for credit. (Note you can use the `subplot()` command on Matlab to make multiple plots in the same figure to reduce the number of pages needed)