GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL of ELECTRICAL and COMPUTER ENGINEERING

# EE 2200 Winter 1999
# Problem Set #2

Assigned: 15 Jan 1998
Due Date: 22 Jan 1998 (FRIDAY)

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Reading: In *DSP First*, Appendix A on *Complex Numbers*, pp. 378–398; and Ch. 2 on *Sinusoids*, pp. 9–43.

The web site: `http://webct.ece.gatech.edu/SCRIPT/WIN99EE2200/scripts/serve_home`
Your initial password = SSN(4:8), but you should change it. Please check the "Bulletin Board" often.

**ALL** of the **STARRED** problems will have to be turned in for grading.

Some of the problems have solutions that can be found on the CD-ROM. Next week a solution will be posted to the web. After 2:00 PM on Friday, the homework is considered late and will be given a zero.

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## PROBLEM 2.1:

Simplify the following and give the answer in polar form. Make a plot of the vectors involved in the complex addition.

(a) $z_a = \sqrt{2}\, e^{-j(3\pi/4)} + e^{j\pi/2}$

(b) $z_b = e^{j(3\pi/2)} + \sqrt{3} e^{j6\pi}$

(c) In addition, write the MATLAB statements that will perform the addition and also display the magnitude and phase of the result.

## PROBLEM 2.2*:

Simplify the following and give the answer as a single sinusoid.

(a) $x_a(t) = \sqrt{2}\cos(7\pi t - 3\pi/4) + \cos(7\pi t + \pi/2)$

(b) $x_b(t) = \cos(33\pi t + 3\pi/2) + \sqrt{3}\cos(33\pi t + 6\pi)$

(c) $x_c(t) = \cos(\pi t + 3\pi/2) + \cos(\pi t + 5\pi/6) + \cos(\pi t + \pi/6)$

## PROBLEM 2.3*:

Define $x(t)$ as

$$x(t) = 50\cos(\omega_0 t - 5\pi/6) - 25\sin(\omega_0 t)$$

(a) Find a complex-valued signal $z_1(t)$ such that $\Re e\{z_1(t)\} = 50\cos(\omega_0 t - 5\pi/6)$.

(b) Find a complex-valued signal $z_2(t)$ such that $\Re e\{z_2(t)\} = -25\sin(\omega_0 t)$.

(c) Express $x(t)$ in the form $x(t) = A\cos(\omega_0 t + \phi)$

(d) Find a complex-valued signal $z(t)$ such that $x(t) = \Re e\{z(t)\}$.

## PROBLEM 2.4*:

Suppose that MATLAB is used to plot a sinusoidal signal. The following MATLAB code generates the signal and makes the plot. Draw a sketch of the plot that will be done by MATLAB.

```
J = sqrt(-1);
dt = 1;
tt = -10 : dt : 20;
Fo = 0.05;
xx = 50*real( exp( J*(2*pi*Fo*tt  - 5*pi/6) ) );
%
plot( tt, xx ),   grid
title( 'SECTION of a SINUSOID' ),    xlabel('TIME   (sec)')
```

## PROBLEM 2.5*:

Solve the following simultaneous equations for $z_1$, $z_2$ and $z_3$:

$$\begin{aligned} z_1 + j2z_2 &= e^{-j2\pi} \\ -j2z_1 - z_3 &= 2e^{j3\pi/2} \\ j3z_2 + z_3 &= e^{-j2\pi/3} \end{aligned}$$

Use MATLAB to do the numerical work, but explain how you set up the problem. Use `help mldivide` and `help inv` to find operators that solve simultaneous equations.

## PROBLEM 2.6*:

Solve the following simultaneous equations via the phasor method. Is the answer for $A_1$, $A_2$, $A_3$, $\phi_1$, $\phi_2$, $\phi_3$ unique?

$$\begin{aligned} \cos(\omega_0 t - 2\pi) &= A_1\cos(\omega_0 t + \phi_1) + 2A_2\cos(\omega_0 t + \phi_2 + \pi/2) \\ 2\cos(\omega_0 t + 3\pi/2) &= 2A_1\cos(\omega_0 t + \phi_1 - \pi/2) - A_3\cos(\omega_0 t + \phi_3) \\ \cos(\omega_0 t - 2\pi/3) &= 3A_2\cos(\omega_0 t + \phi_2 + \pi/2) + A_3\cos(\omega_0 t + \phi_3) \end{aligned}$$

Use MATLAB as much as possible to do the numerical calculations, but explain how to set up the problem.