# ECE 417 --- ROBOTICS
# Homework 4, Spring 2021

**Write the solution for each of the following in terms of atan2 before giving your final answer (e.g., $\theta$ = atan2(a,b) = ... )**

1. If $sin\ \theta = -1/2$ and $cos\ \theta = \sqrt{3}/2$ what is $\theta$?
2. If $-k\ sin\ \theta = 3$ and k $cos\ \theta = 3\ \sqrt{3}$ what is $\theta$?
3. If $sin\ \phi\ sin\ \theta = 0.2$ and $sin\ \phi\ cos\ \theta = -0.3$ and $sin\ \phi > 0$ what is $\theta$? Repeat for $sin\ \phi < 0$.
4. If $-sin\ \phi\ sin\ \theta = 0.2$ and $sin\ \phi\ cos\ \theta = 0.3$ and $sin\ \phi > 0$ what is $\theta$? Repeat for $sin\ \phi < 0$.
5. Using the System II matrix solve for $\phi + \psi$ in terms of the matrix elements $r_{ij}$ if $\theta = 0$ degrees. Also solve for $\phi - \psi$ if $\theta = 180$ degrees.
6. Using the System I matrix (given below) solve for $\phi$, $\theta$, and $\psi$ in terms of the matrix elements $r_{ij}$. Include solutions for the special cases for $\theta$.

## System I

$$\left[ \begin{matrix} cos\phi\ cos\psi - sin\phi\ cos\theta\ sin\psi & -cos\phi\ sin\psi - sin\phi\ cos\theta\ cos\psi & sin\phi\ sin\theta \\ sin\phi\ cos\psi + cos\phi\ cos\theta\ sin\psi & -sin\phi\ sin\psi + cos\phi\ cos\theta\ cos\psi & -cos\phi\ sin\theta \\ sin\theta\ sin\psi & sin\theta\ cos\psi & cos\theta \end{matrix} \right]$$