Homework 4, ECE 1570/2595 Robot Control, Spring 2022
(Due Wednesday Feb. 23)

Problem 1. Please make modifications to the MATLAB codes shown below and reproduce the simulation results on Slides 41 (k_P = 0.5) and Slides 42 (k_P = 2) of Lecture 5. You only need to submit two plots for this problem.

```
clear all;

T = 12;          % Time of simulation
dt = 0.01;       % Sampling time interval
x(1) = 0;        % Initial x location
y(1) = 0;        % Initial y location
phi(1) = pi;     % Initial heading
v0 = 10;         % Speed of the mobile robot

k_P = 0.5;       % Gain of P control

x_d = 40;        % Desired x location
y_d = 40;        % Desired y location

plot(x_d, y_d, 'rd'); hold on;          % Plot the target location as a red diamond

%%%% Start simulation:

for i = 1 : T/dt

        % Controller:

        phi_d = atan((y_d-y(i))/(x_d-x(i)));

        u(i) = k_P*(phi_d-phi(i));  % This might cause angle problem!

        % Dynamics of mobile robot:

        x(i+1) = x(i) + dt*v0*cos(phi(i));
        y(i+1) = y(i) + dt*v0*sin(phi(i));
        phi(i+1) = phi(i) + dt*u(i);

        plot(x(i),y(i),'b.'); hold on;  % Plot the trajectory of the mobile robot

end
```

Problem 2. Consider an LTI system: $\dot{\mathbf{x}} = \begin{bmatrix} 3 & -2 \\ 4 & -3 \end{bmatrix}\mathbf{x} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u;\ \ y = [1\ \ 1]\mathbf{x}$.

Given $\mathbf{x}(0) = [3, 3]'$ and $u(t) = 3 \cdot 1(t)$, please compute $y(t)$.