ENGR 232 – Linear Engineering Systems

Lab 8: In Class Assignment Summer 2016-17

Version A: Given a LITV matrix equation: $x' = Ax \quad x(0) = \begin{bmatrix} 100 \\ -50 \end{bmatrix}$

Case I	Case II
$A_1 = \begin{bmatrix} 0 & 1 \\ -10 & -2 \end{bmatrix}$	$A_2 = \begin{bmatrix} 0 & 1 \\ -10 & 2 \end{bmatrix}$

Perform the following tasks for each case (label cells Case I-1 thru 3 or Case II-2 thru 3). Hint: you can just copy and paste Case I cells to do Case II.

1. Find the eigenvalues and eigenvectors using the ***eig()*** function in MATLAB. Save these in memory. Is the system stable or unstable? Discuss why.

2. Write down the solution using the eigenvalues, eigenvectors as shown in Eq. (1). Use the solution and the initial conditions to determine the constants $\boldsymbol{c_1}$ and $\boldsymbol{c_2}$ *as shown in class.*

$$x(t) = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = c_1 e^{\lambda_1 t} v_1 + c_2\, e^{\lambda_2 t} v_2 \qquad (1)$$

   - *Write the solution as a **comment** in the cell showing values for c, v and lambda – it is fine if numbers are complex.*

3. Plot the ***analytical solution*** over the time range: t = ***0:0.15:5***
   - ***Plot the two component plots and the phase portrait in an augmented subplot.*** The two component plots should be on the left and the phase plot on the right
     - You may use any method you wish to plot the analytic solution (in line vectorized code, function, for loop, etc.) HOWEVER use the saved values from part 1 not hand copied value to implement the solution.
   - On each plot, make sure the label the initial condition and the equilibrium point for all plots. Make sure to use legend to define the different curves/points in the plots. Title the graph as case I or II

After completing both cases perform the last task below - label this cell Summary Cell

4. In a separate cell (called Summary Cell) compare the results of Case I and Case II in terms of
   a. Stability
   b. Direction of the phase plot with respect to equilibrium point and initial condition
   c. Describe the component plots as time approaches infinity