**20.11.2018**

**MECE 441 Control System Design Laboratory**

1. Given the system of figure below, design an ideal derivative compensator to yield a 16% overshoot, with a threefold reduction in settling time.



Figure 1 Feedback control system for question1 and question2

Use MATLAB, the Control System Toobox, and the following steps to use SISOTOOL to perform the design.

1. Type SISOTOOL in the MATLAB Command Window.
2. Select Import in the File menu of the **SISO Design for SISO Design Task Window**.
3. In the Data field for G, type zpk([],[0,-4,-6],1) and hit ENTER on the keyboard.
4. On the Edit menu choose SISO Tool Preferences and select Zero/pole/gain: under the Options tab.
5. Right-click on the root locus white space and choose Design Requirements/New.
6. Choose Percent overshoot and type in 16.
7. Right-click on the root locus white space and choose Design Requirements/New.
8. Choose Settling time drag the settling time vertical line to the intersection of the root locus and 16% overshoot radial line.
9. Read the settling time at the bottom of the window.
10. Drag the settling time vertical line to a settling time that is 1/3 of the value found in Step 8.
11. Click on a red zero icon in the menu bar. Place the zero on the root locus real axis by clicking again on the real axis.
12. Left-click on the real-axis zero and drag it along the real axis until the root locus intersects the settling time and percent overshoot lines.
13. Drag a red square along the root locus until it is at the intersection of the root locus, settling time line, and the percent overshoot line.
14. Click the Compensator Editor tab of the Control and Estimation Tools Manager window to see the resulting compensator, including the gain.
15. Design three lead compensators for the system of Figure 1 that will reduce the settling time by a factor of 2 while maintaining 30% overshoot. Compare the system characteristics between three designs.