Due Friday, 6/23/17, start of class

The goal of the project is to design a feedback controller $G_C(s)$ in the frequency domain to improve the performance of a chosen real-world single-input, single-output (SISO) linear system. Your results will be evaluated in MATLAB and/or Simulink simulation. Each individual will choose their own real-world open-loop system for controller design. For real-world project ideas, see Dr. Bob’s Atlas of Models and Transfer Functions, controls textbooks, and Internet sites. Each project topic must be different.

Specific steps to complete:

0) Find a real-world open-loop system to control and approve it with Dr. Bob (first-come, first-approved, starting immediately, but the signup deadline is Fri 5/19/17). Guidelines: SISO, linear (or linearized), real-world system with a clear actuator and sensor. It should not be too simple nor too complex. Be sure you can get the dynamic equation(s); this is required to start the project. It is entirely acceptable to find the equations and/or transfer functions from Dr. Bob’s Atlas of Models and Transfer Functions or another valid source, as long as you reference that source.

1) Perform system modeling and determine the open-loop characteristics. Plot impulse, unit step, unit ramp, and ramped-step responses. Perform the first three response plots using both MATLAB and Simulink to compare. The fourth (ramped-step) is easiest using Simulink.

   Turn in interim report on Friday 6/9/17, covering step 1. Max final grade 70% if not submitted.

2) Design a linear feedback controller $G_C(s)$ to achieve desired performance according to stated specifications (you determine the specifications). Depending on your system, the important considerations are transient response, steady-state error, stability, sensitivity, and disturbance-rejection. You must try at least three different forms/methods for $G_C(s)$ – report them all with one selected as the “best”. Include an output attenuation correction factor and a pre-filter if necessary in each case. Follow the steps for controller design from the ME 3012 NotesBook for each controller – organize your report according to these steps too.

3) Compare the closed-loop output performance to the original open-loop results (only for the most important input function to your real-world project, e.g. unit step). In addition to output response plots, also plot input effort vs. time, with and without the pre-filter; comment on real-world feasibility regarding required input. Also, subject your controllers to a disturbance in simulation and discuss the results. Input efforts and disturbance responses generally help in choosing the “best” controller.

4) Discussion – comment on tradeoffs, difficulties, real-world considerations, etc.

Each individual will present their results orally to the class on Friday 6/23/17 and the final report is due in class on the same day. We will treat these in-class presentations as a learning experience. Presentations are important and will form a part of your project grade. Be sure to plan ahead; use a professional PowerPoint presentation with plenty of graphical results.

Final Written Report Format  (Include lots of images, photos, graphs, etc.)

Memo (serves as your abstract)
1. Objectives
2. Physical System Description and Linear Model
3. Open-Loop Behavior
4. Performance Specifications for Design
5. Controller Designs
6. Open- vs. Closed-Loop Results and Discussion
7. Conclusion

Appendices (Verification of Results, MATLAB code, References, Other, if necessary)