

## 2.14/2.140 Problem Set 1

**Assigned:** Wed. Feb. 5, 2014

**Due:** Wed. Feb. 12, 2014, in class

**Reading:** FPE Chapters 1 and 2, review as needed

This problem set is a review of material on modeling and analysis of electrical, mechanical, electromechanical, fluid, and thermal dynamic systems. The problems from Franklin, Powell, and Emami-Naeini, *Feedback Control of Dynamic Systems, 6th Ed.* are referenced by FPE Chapter.Problem#. The Problem Archive can be downloaded as a complete pdf file from the course web page; see the problem numbers therein (pdf bookmarks will help you find them). Note that the problem archive also contains solutions to many of the problems. Please do not consult these solutions initially. Refer to the solutions if you are stuck, or to check your analysis.

**The following problems are assigned to both 2.14 and 2.140 students.**

**Problem 1** FPE 2.5

**Problem 2** FPE 2.10

**Problem 3** FPE 2.15, a only

**Problem 4** FPE 2.25

**Problem 5** Archive Problem 4.24

**Problem 6** Archive Problem 10.6

**Problem 7** Archive Problem 14.3

**Problem 8** Archive Problem 14.10

**The following problems are assigned to only 2.140 students. Students in 2.14 are welcome to work these, but no extra credit will be given.**

**Problem G1** FPE 2.9 Write the equations of motion in state-space form in terms of state variables  $x$ ,  $\dot{x}$ ,  $y$ , and  $\dot{y}$ , and with input  $u$ , and output  $y$ . Then eliminate variables in the state equations to find the transfer function from input  $u$  to output  $y$ . What are the locations of the poles and zeros of this transfer function?

**Problem G2** FPE 2.12

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2.14 / 2.140 Analysis and Design of Feedback Control Systems  
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