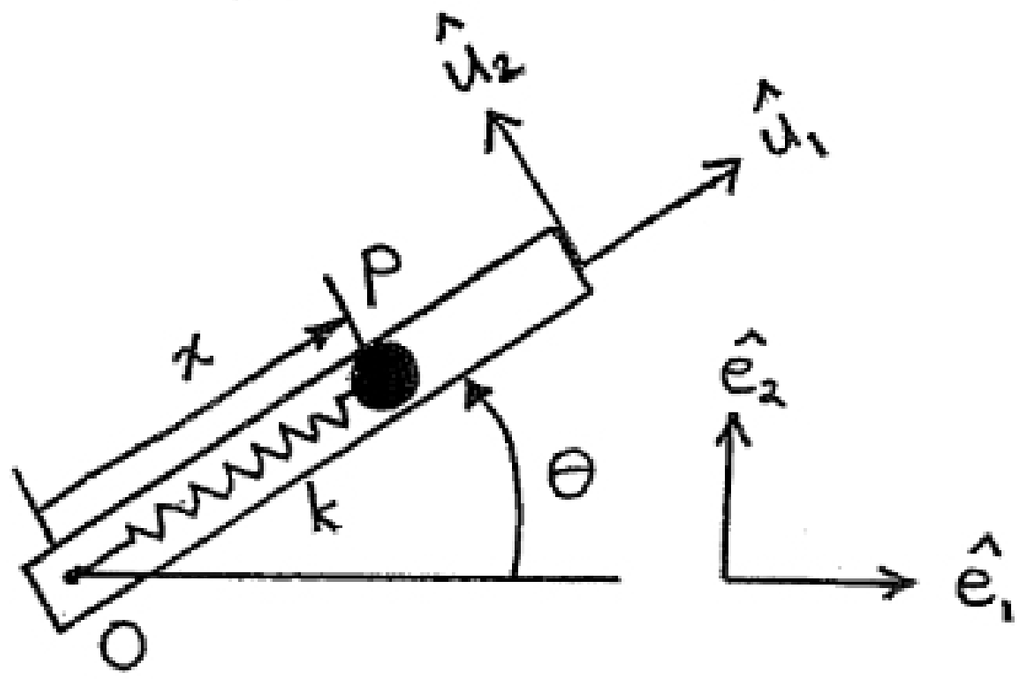
AAE 340
Homework #1
Due Friday, Aug. 25, 2017 at 9:30 AM
(Note: HW turned in after 9:45 AM will be given a zero.)

1. Mass-Spring Problem



A particle, P, of mass m slides without friction in a tube which rotates at a constant rate, dθ/dt. The spring has a constant of k and an unstretched length of l_o. Assume there is no gravity and that the motion takes place in the $\hat{e}_1$-$\hat{e}_2$ plane.

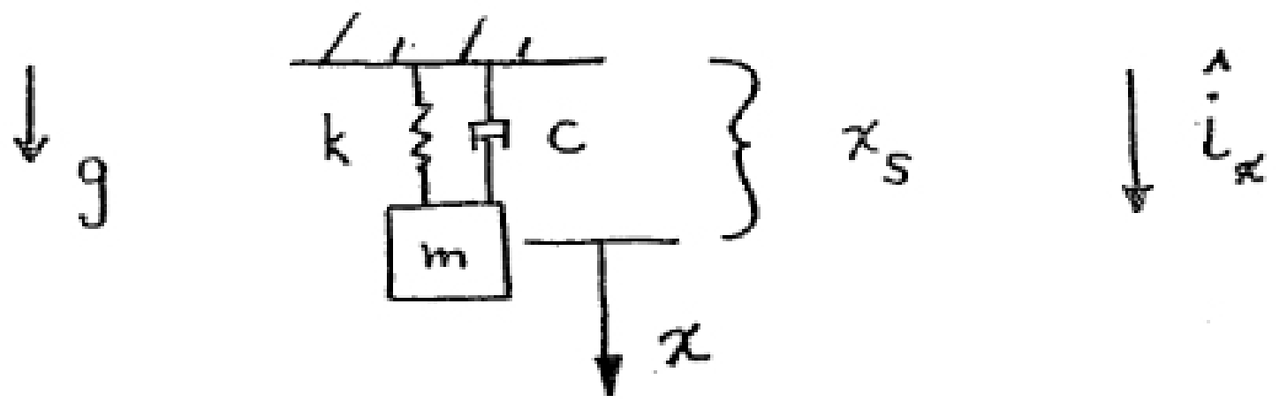
1a. Use the four steps described in the lecture notes to find the EOM in terms of x. Note that x is the distance from O to P including the unstretched length, l_o.

1b. Give an expression for the constraint force along $\hat{u}_2$.

1c. Give the condition under which the motion of P within the tube is oscillatory.

Note: 1a and 1b are review problems from AAE 203. See pp. 83-90 of AAE 340 Lecture Notes for a similar problem and as a reminder of how to label Steps 1 through 4. (Also see AAE 203 Review Material on Blackboard.)

2. Mass-Spring-Damper Problem



2a. Derive the EOM in terms of x. Note that x_S is the position of static equilibrium.

2b. Put the EOM in the classical form

$$\ddot{x} + 2\zeta\omega_n\dot{x} + \omega_n^2 x = 0 \qquad (1)$$

Define and give expressions for ω_n and ζ.

3. Look up Euler's Equations of Motion (e.g. in a dynamics text in the Engineering Library) and write them down. Be sure to refer to Euler's equations that pertain to *rigid body motion*—no credit for fluid dynamics equations. Give the reference in the proper AIAA format (including page number) for example:

Longuski, J. M., "How to Write a Technical Report," *Advice to Rocket Scientists*, American Institute of Aeronautics and Astronautics, Inc., Reston, Virginia, January 2004, pp. 49-52.

4. Follow the MATLAB instructions in the Appendix of the Lecture Notes to work out EXAMPLES 1-6. Hand in your output from pages 1-4, including the plot. Put your name in the title.