Fall Semester, 2025 **Instructor**: M.J. DeJong
CE 225 – Dynamics of Structures

Homework #2

Due: Friday, September 12

1) A mass *m* is initially at rest, partially supported by a spring and partially by stops (see Figure 1). In the position shown, the spring force is *mg*/4. At time *t* = 0 the stops are rotated, suddenly releasing the mass. Determine the motion of the mass.

Main concept: definition of the coordinate system and relation with the form of the equation of motion.

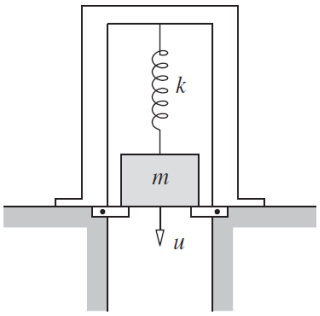

Figure 1

2) The weight of the wooden block shown in Fig. 2 is 20 lb and the spring stiffness is 120 lb/in. The block is initially at rest. A bullet weighing 0.4 lb is fired at a speed of 50 ft/sec into the block and becomes embedded in the block. Determine the resulting motion *u(t)* of the block.

**Hint: Use conservation of momentum.*

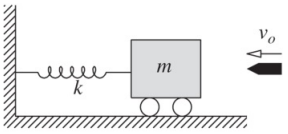

Figure 2

3) The vertical suspension system of an automobile is idealized as a viscously damped SDF system. Under the 3500-lb weight of the car the suspension system deflects 2.1 inches. The suspension is designed to have a damping ratio of $\zeta = 0.7$ with no one in the car.

(a) Calculate the damping and stiffness coefficients of the suspension.

(b) With four 150-lb passengers in the car, what is the effective damping ratio?

(c) Calculate the natural vibration frequency for case (b).

Main concept: static equilibrium position and the vibration properties of a system with damping.

4) Find a linear elastic oscillator, measure its damped natural frequency and determine its percentage of critical damping. Submit a sketch of the system, your measurements, and calculations.

Note: It is up to you how you measure the response. One option is to use your cell phone as an accelerometer.