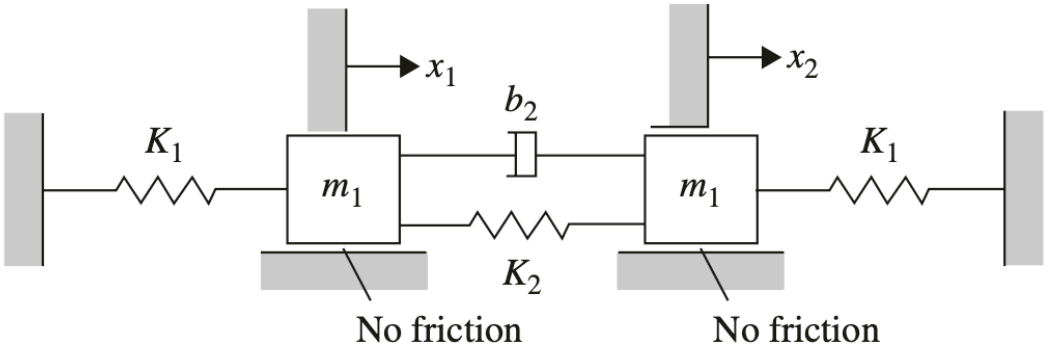
Homework 1 Problems

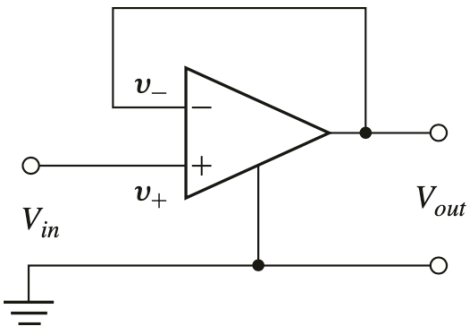
Due: Tuesday, April 13th at 4:00 PM

Problems: 2.2, 2.12, 3.3a, 3.3b, 3.7f, 3.7j, 3.8b, 3.9b, 3.9c

2.2 Write the differential equation for the mechanical system shown in Fig. 2.42. State whether you think the system will eventually decay so that it has no motion at all, given that there are nonzero initial conditions for both masses, and give a reason for your answer.



2.12 Show that the op-amp connection shown in Fig. 2.48 results in $V_{out} = V_{in}$ if the op-amp is ideal. Give the transfer function if the op-amp has the nonideal transfer function of Problem 2.11.



3.3 Find the Laplace transform of the following time functions:

(a) $f(t) = 4\cos 6t$

(b) $f(t) = \sin 3t + 2\cos 3t + e^{-t}\sin 3t$

(c) $f(t) = t^2 + e^{-2t}\sin 3t$

3.7 Find the time function corresponding to each of the following Laplace transforms using partial-fraction expansions:

(a) $F(s) = \frac{1}{s(s+1)}$

(b) $F(s) = \frac{5}{s(s+1)(s+5)}$

(c) $F(s) = \frac{3s+2}{s^2+2s+10}$

(d) $F(s) = \frac{3s^2+6s+6}{(s+1)(s^2+6s+10)}$

(e) $F(s) = \frac{1}{s^2+16}$

(f) $F(s) = \frac{2(s+3)}{(s+1)(s^2+16)}$

(g) $F(s) = \frac{s+1}{s^2}$

(h) $F(s) = \frac{1}{s^6}$

(i) $F(s) = \frac{4}{s^4+4}$

(j) $F(s) = \frac{e^{-s}}{s^2}$

3.8 Find the time function corresponding to each of the following Laplace transforms:

(a) $F(s) = \frac{1}{s(s+1)^2}$

(b) $F(s) = \frac{s^2+s+1}{s^3-1}$

3.9 Solve the following ODEs using Laplace transforms:

(a) $\ddot{y}(t) + \dot{y}(t) + 3y(t) = 0;\ y(0) = 1,\ \dot{y}(0) = 2$

(b) $\ddot{y}(t) - 2\dot{y}(t) + 4y(t) = 0;\ y(0) = 1,\ \dot{y}(0) = 2$

(c) $\ddot{y}(t) + \dot{y}(t) = \sin t;\ y(0) = 1,\ \dot{y}(0) = 2$