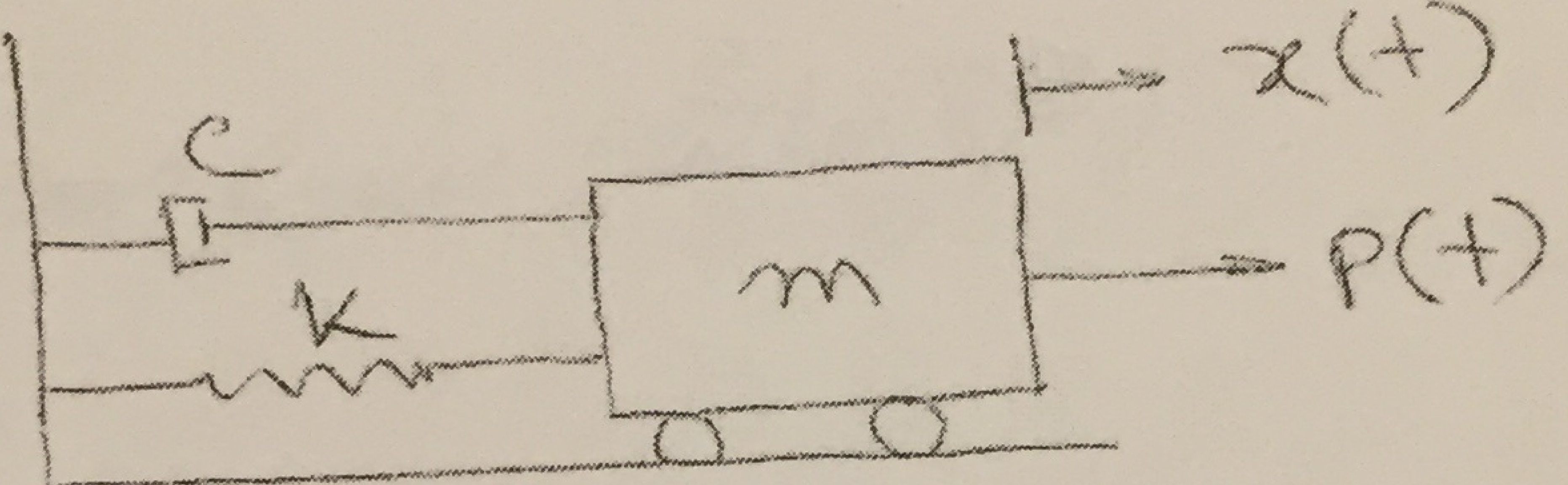
EM 633

H. W #3

1. Consider the basic system ~~of Fig. 2-1a~~ shown below with the following properties: $m = 2\ kips \cdot sec^2/in$ and $k = 20\ kips/in$. If this system is subjected to resonant harmonic loading ($\bar{\omega} = \omega$) starting from "at rest" conditions, determine the value of the response ratio $R(t)$ after four cycles ($\bar{\omega}t = 8\pi$), assuming:
   (a) $c = 0$
   (b) $c = 0.5\ kips \cdot sec/in$
   (c) $c = 2.0\ kips \cdot sec/in$



2. A control console containing delicate instrumentation is to be located on the floor of a test laboratory where it has been determined that the floor slab is vibrating vertically with an amplitude of 0.03 in at 20 Hz. If the weight of the console is 800 lb, determine the stiffness of the vibration isolation system required to reduce the vertical-motion amplitude of the console to 0.005 in.

3. A machine is supported on four steel springs for which damping can be neglected. The natural frequency of vertical vibration of the machine–spring system is 200 cycles per minute. The machine generates a vertical force $p(t) = p_0 \sin \omega t$. The amplitude of the resulting steady-state vertical displacement of the machine is $u_o = 0.2$ in. when the machine is running at 20 revolutions per minute (rpm), 1.042 in. at 180 rpm, and 0.0248 in. at 600 rpm. Calculate the amplitude of vertical motion of the machine if the steel springs are replaced by four rubber isolators which provide the same stiffness, but introduce damping equivalent to $\zeta = 25\%$ for the system. Comment on the effectiveness of the isolators at various machine speeds.