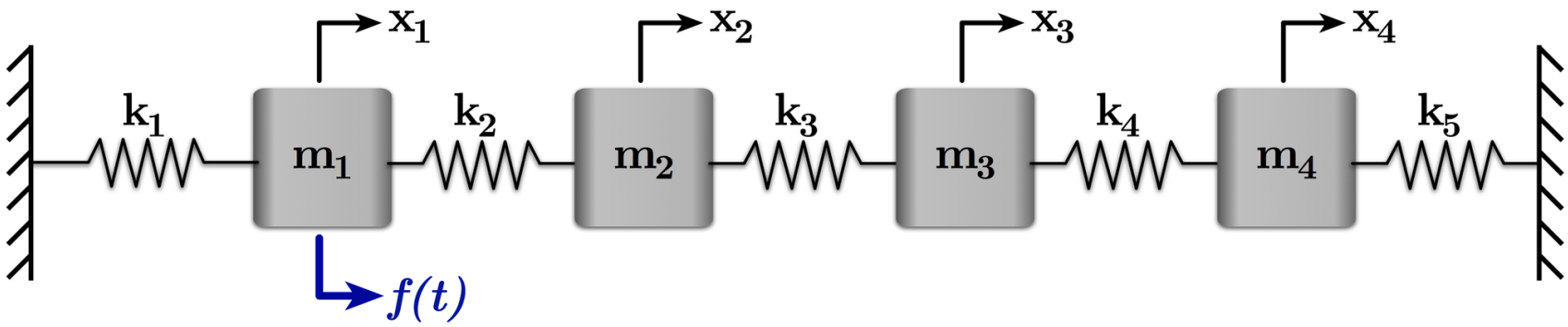
Zeros in a Forced Response (Sec. 4.6)

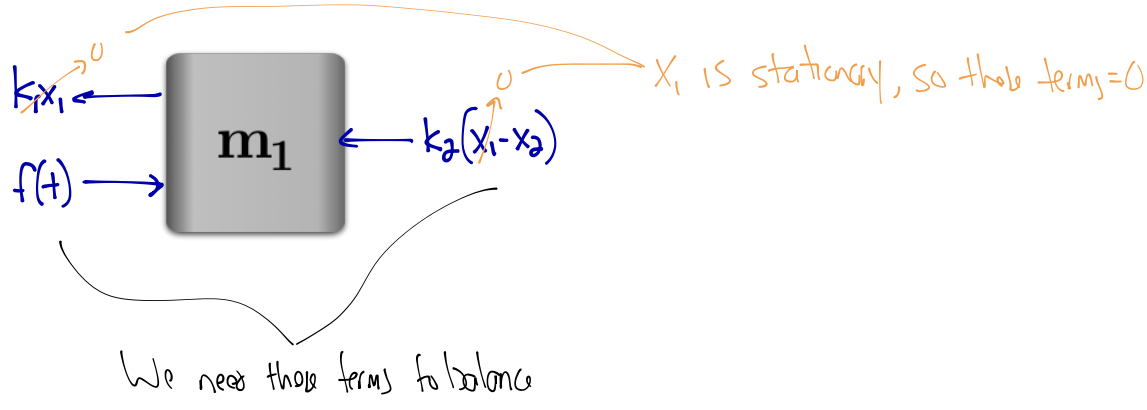


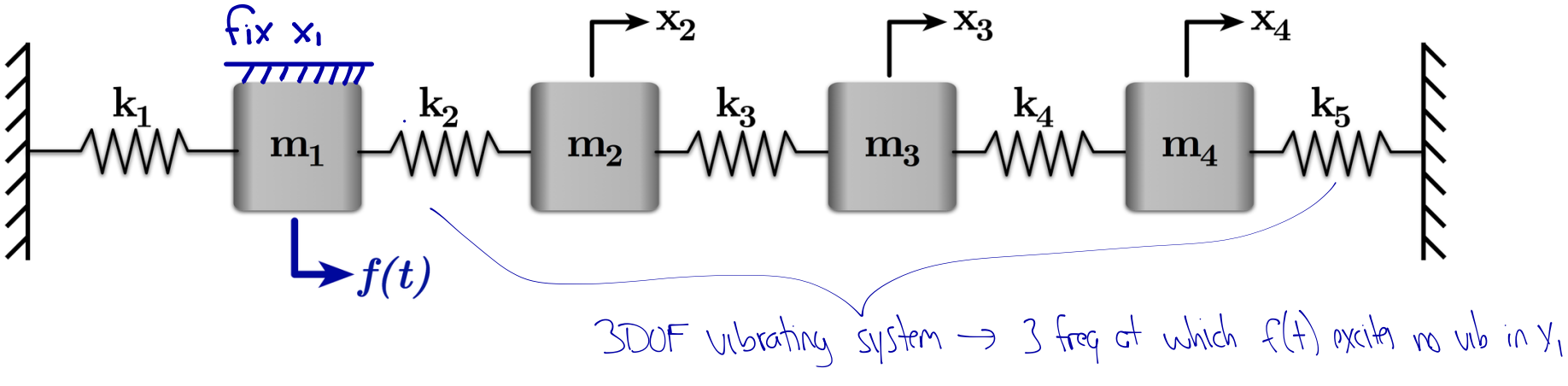
Q: Can we choose k2, k3, k4, k5, m2, m3, and m4 such that m1 is stationary at from frequency (or frequencies) of f(t)? How?

or

To put it another way, at what frequencies of f(t) is m1 stationary, given some set of system parameters?

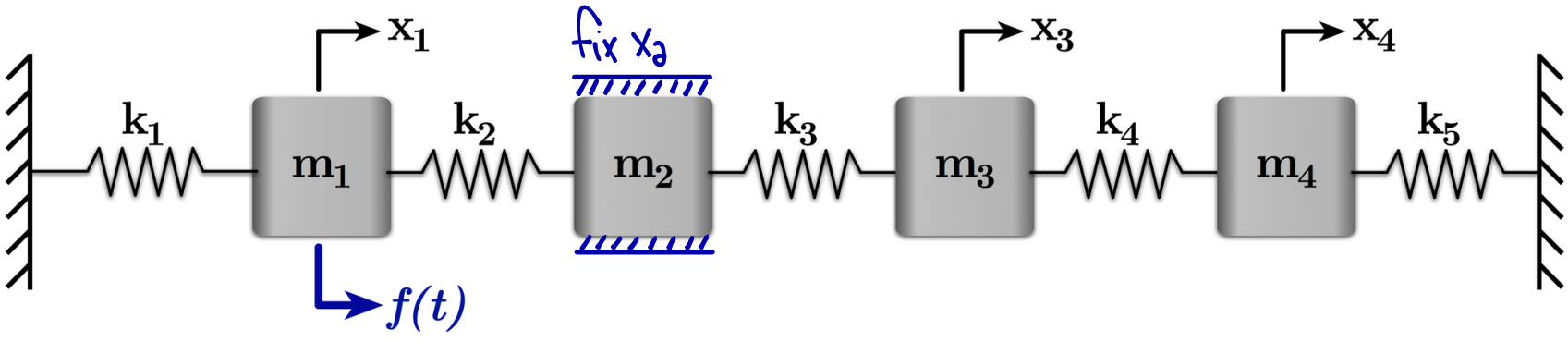
Q: What has to happen for m1 to be stationary?



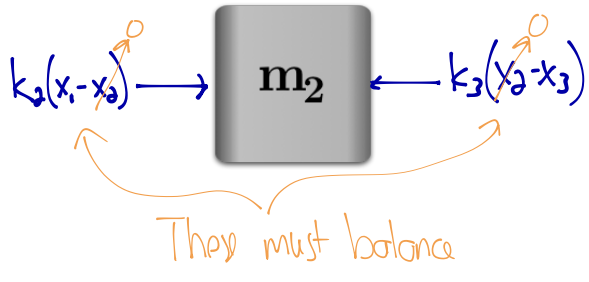


Zeros in a Forced Response (cont.)

Q: Can we have an input at x1 and x2 remain stationary?

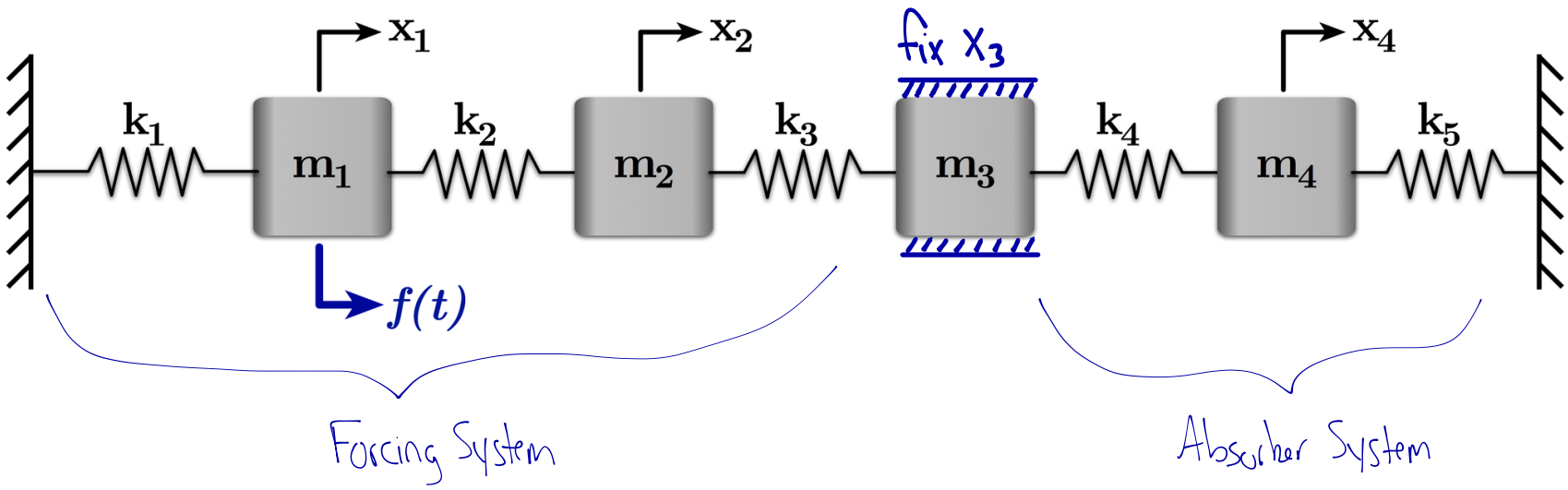


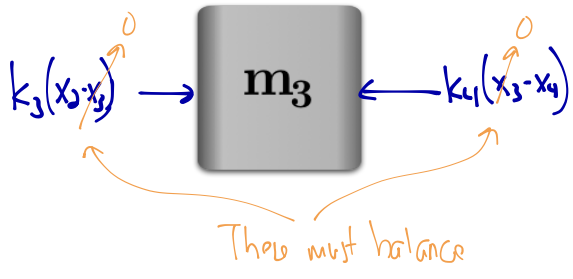
Q: What has to happen for m2 to be stationary?



Notice that we have forces to the left and 2 DOF to the right. So, we have two frequencies at which m2 can be stationary.

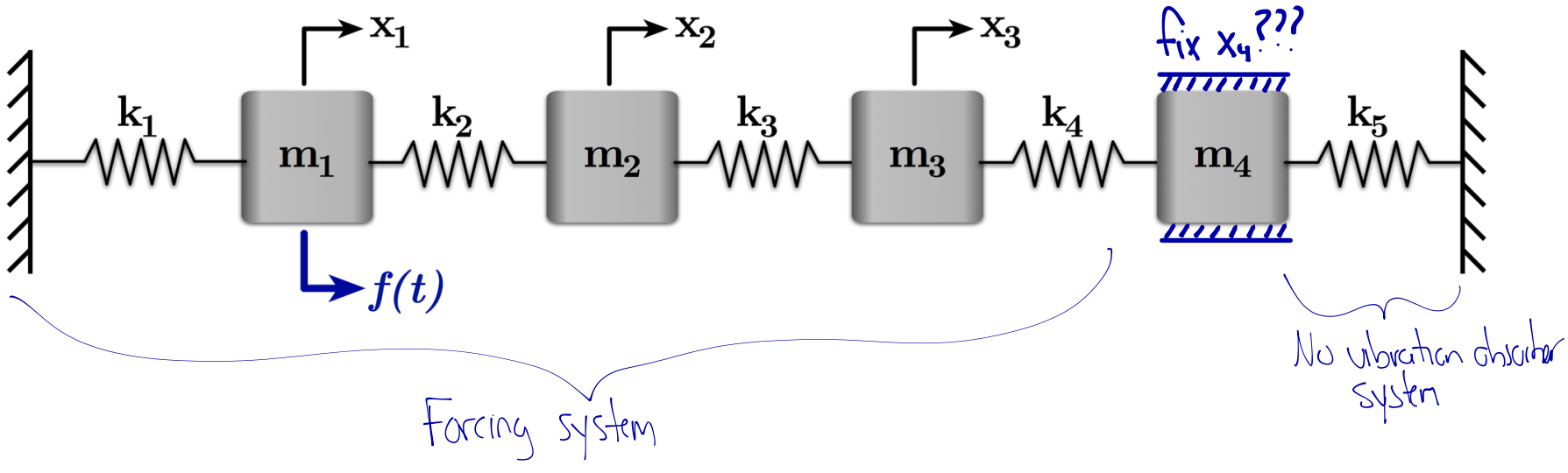
Q: Can we keep m3 stationary?





Zeros in a Forced Response (cont.)

Q: What about m4?



Key Points:

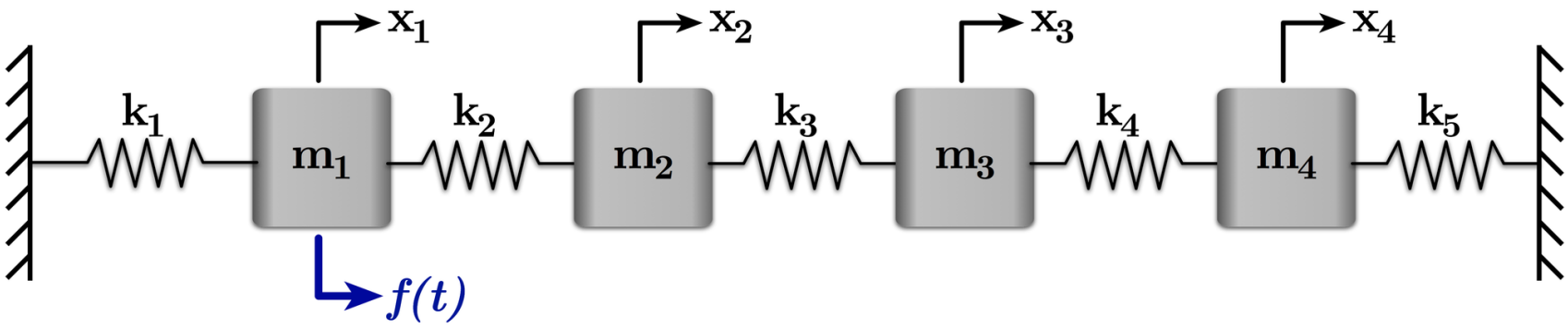
- Consider the forced mass as the "actuated" mass, and the mass we're trying to keep stationary as the "sensed" mass.

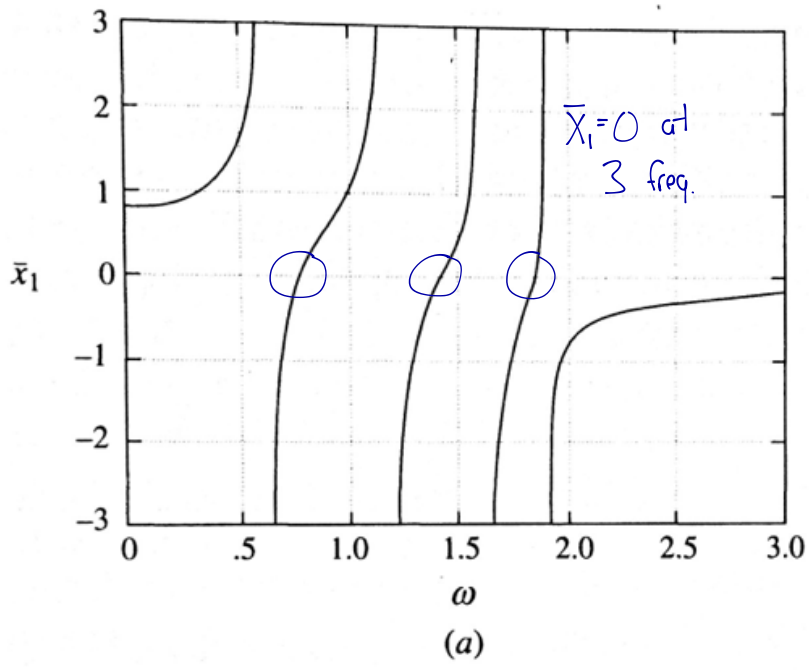
- The closer the sensed mass is to the actuated mass, the better.

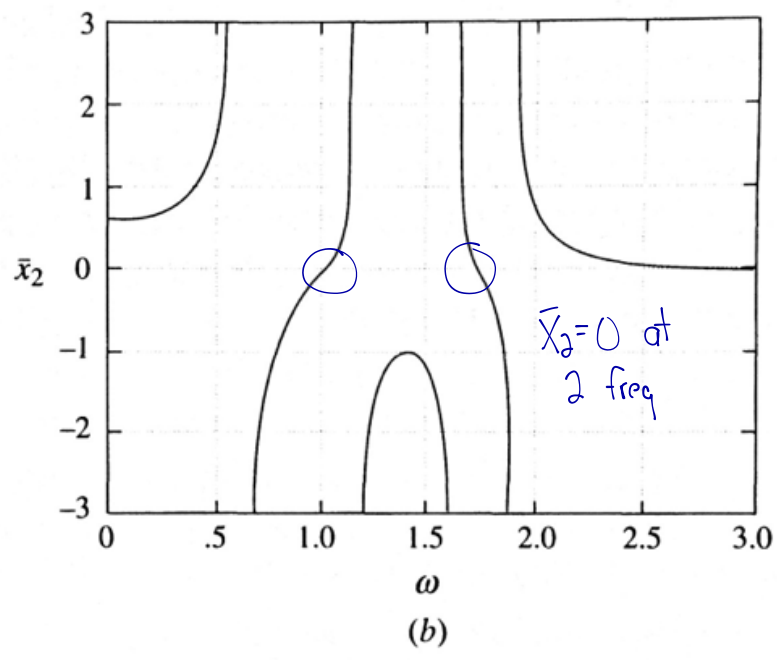
- If the actuated and sensed masses are the same mass, then they are collocated.

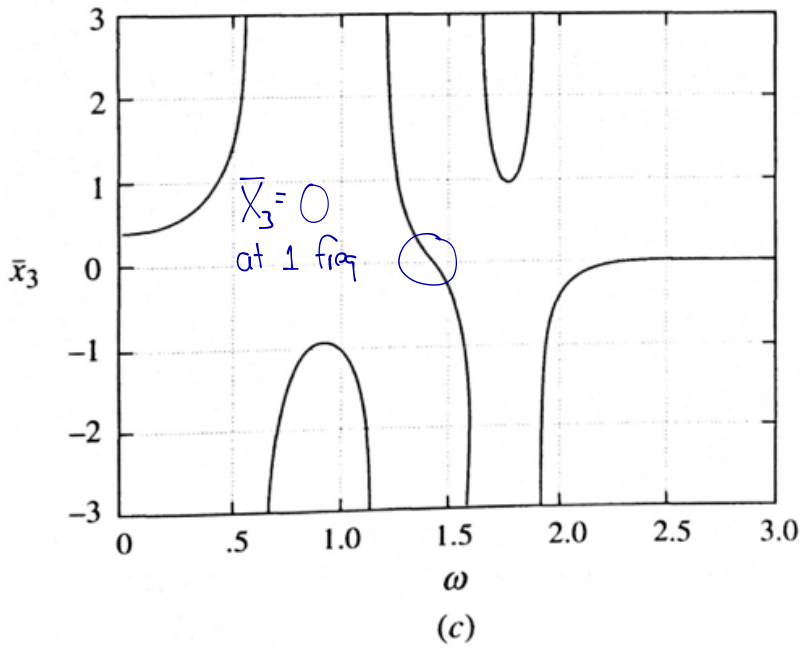
- If not, they are non-collocated. Non-collocated systems are difficult (and sometimes impossible) to control.

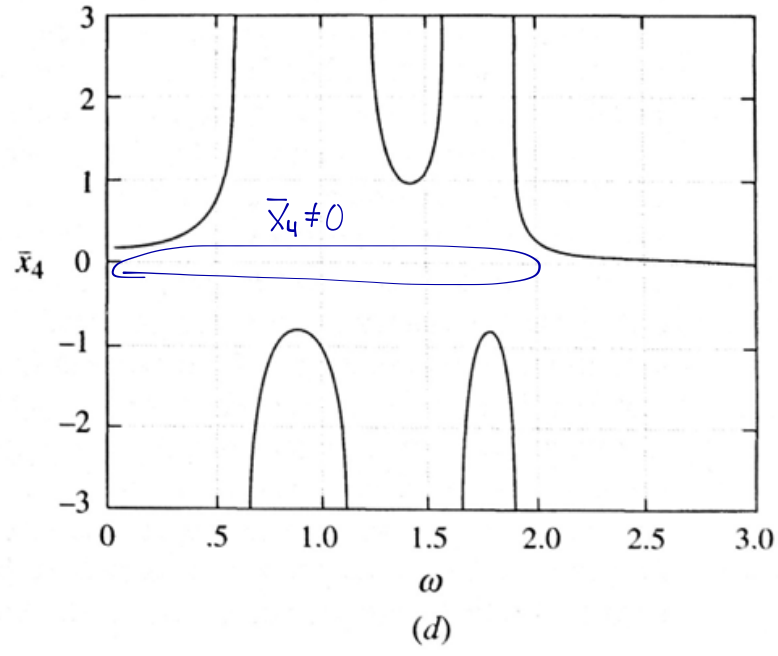
Zeros in a Forced Response (cont.)





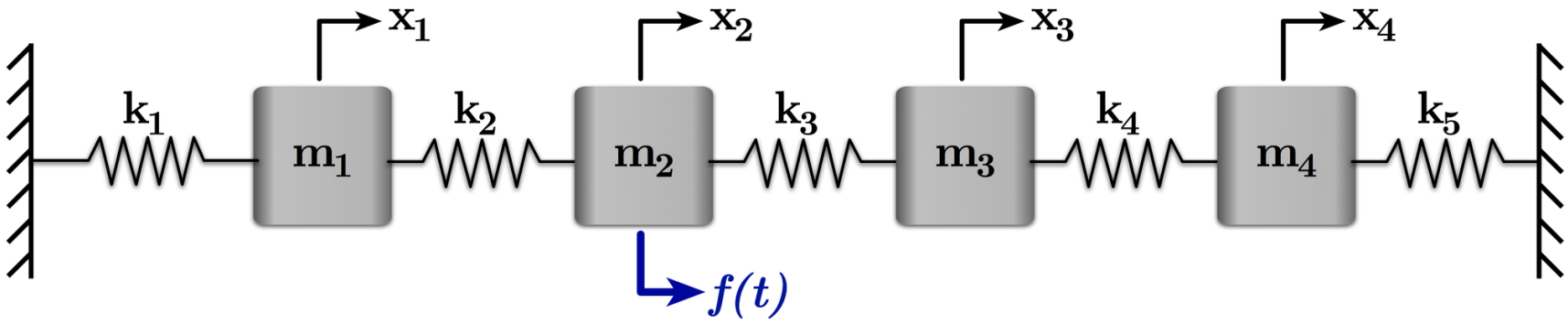






Zeros in a Forced Response (cont.)

Q: What if we change the location of the force? (change the "actuated" mass)



The forced mass of an n-mass system has a zero-magnitude response at n-1 frequencies.

Again, collocated actuator/sensor pairs are best.

For many systems, collocation is not possible or is infeasible. The book mentions golf and fly fishing. Crane payloads and robotic arms are others.