Comment: As I mentioned in class, I strongly encourage you to avoid hunting for formulas on forced response. All of these problems can be solved simply by knowing the differential equation and that the force and steady state response have the form:

$$f(t) = \mathrm{Re}\left(Fe^{i\omega t}\right) \quad \rightarrow \quad x(t) = \mathrm{Re}\left(Xe^{i\omega t}\right)$$

Problem 1: 3.9 from Ginsberg (Hint: assume that the motion of every component of the system is harmonic. Derive the equation(s) of motion and show the full derivation used to obtain the complex amplitude(s) from the equation(s) of motion.)

Problem 2: (3e1) (**20 points**)
A 450 kg generator, modeled as a rigid mass, must be installed on the same floor as some sensitive laboratory equipment. The operation of the generator results in a vertical force, $f(t)$, being applied to the generator (rigid mass) whose amplitude is 20kN and whose frequency is 1800 rpm. Use a damping ratio of $\zeta = 0.03$ for both (a) and (b) below.

a.) Find the stiffness of the support, k, such that the force transmitted to the ground is no more than 2kN.
b.) Take your result from part (a) and compute the amplitude of the generator as the machine starts up. (As the machine starts up, assume that the force amplitude is constant at 20kN, but the frequency increases very slowly from zero to 1800 rpm. Do a worst-case analysis – just assure that the steady-state amplitude of the machine is less than 10mm for any forcing frequency between 0 and 1800 rpm.)
c.) Using your results from (a) and (b), suppose that the startup amplitude must not exceed 10mm. The startup amplitude can be decreased by adding mass to the generator while also increasing the stiffness of the support to keep the natural frequency of the system constant. How much mass must be added to keep the amplitude below 10mm?
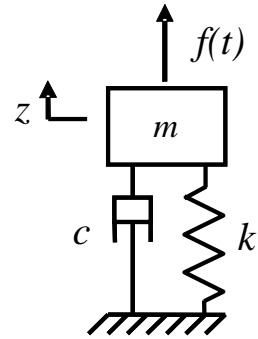
Problem 3: 3.19 from Ginsberg

Problem 4: 3.23 from Ginsberg