

Problems

Vibrations - 2

Given the system in the figure below, where $K=2500$ N/m, $M=1$ kg, $C=20$ N-sec/m, $F(t) = 200 - 120 \sin(\omega t)$ N, $\omega = 63$ rad/sec, and $X(t)$ is measured from the static equilibrium position, do the following:

- (10 points) Show the Free Body Diagram (assume $+X$ is down)
- (10 points) Find the equation of motion of the system
- (10 points) Find the undamped natural frequency of the system, ω_n (include units)
- (10 points) Find the damped natural frequency of the system, ω_d (include units)
- (10 points) Find the critical damping, C_c (include units)
- (10 points) Is the system critically damped, underdamped, or overdamped? Why?
- (20 points) Solve for the steady-state response (show your work). Show your answer as a function of time.
- (20 points) What is the total steady-state response magnitude at $t = 15.0$ sec (include units)?

