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4. a) convert a system d.e into standard form; i.e $\frac{d^2x}{dt^2} + \frac{c}{m} \frac{dx}{dt} + \frac{k}{m} x = \frac{F}{m}$

$$\text{So } 2\zeta\omega_n = \frac{c}{m} \quad \text{and} \quad \omega_n^2 = \frac{k}{m}$$

$$\therefore \omega_n = \sqrt{\frac{k}{m}} = \sqrt{\frac{300}{7.5}} = 6.325 \text{ Hz}$$

$$\text{Now, } \zeta = \frac{c}{2\omega_n m} = \frac{40}{2 \times 6.325 \times 7.5} = 0.422$$

Hence system is underdamped

$$\begin{aligned} \text{b) \% peak overshoot} &= \left(\exp \left(\frac{-0.422\pi}{\sqrt{1-0.422^2}} \right) \right) \times 100\% \\ &= 23.17\% \end{aligned}$$