1. A system model was derived as $6\dot{x} + 2x = 3f(t)$, where $f(t)$ is a unit step and $x(0) = 0$.
   (a) What is the time constant of the system?
   (b) How long does it take for the system to reach 98% of its final value?
   (c) How long does it take for the system to reach 80% of its steady-state value?

2. A SDOF mass-spring-damper system has $m = 1$ kg, $c = 6$ Ns/m, and $k = 13$ N/m with the initial conditions $x(0) = \dot{x}(0) = 0$. A step force of 20 N is applied at $t = 0$.
   (a) Find the response of the system.
   (b) Indicate the transient and the steady-state responses.
   (c) Indicate the natural and forced responses.

3. Show the allowable region in the s-plane for the poles of a transfer function of a system if the system response requirements are $t_s \leq 2$ sec and $M_p \leq 3\%$. In your equation derivation, clearly show the directions of the inequalities.

4. Consider the single-mass full car model shown to the right. The mass is 1200 kg and the spring constant is 6000 N/m.
   (a) If we need to design the damper such that the car shows less than 5% overshoot, what would be the smallest value for $c$?
   (b) Using the damping coefficient found in (a), show the location of the system poles in the **S-plane** with the corresponding semi-circle (natural frequency) and lines (damping ratio).