3.16) 
(a) \( x_1(t) = [2e^{-6t} - 4t e^{-2t}]u(t) \)
(b) \( x_2(t) = [2e^{-t} - 48t^2 e^{-4t}]u(t) \)
(c) \( x_3(t) = [-2 + 8 e^{-4t} \sin(2t)]u(t) \)

3.38) 
\( g(t) = \delta(t) - e^{-t} \sin(t)u(t) \)

3.43) 
(a) \( H(\omega) = \frac{2 + j\omega}{(12 - \omega^2) + j7\omega} \)
(b) Poles at \( s = -3, -4 \). Zeros at \( s = -2 \).
(c) \( h(t) = [-e^{-3t} + 2e^{-4t}]u(t) \)
(d) \( y(t) = [e^{-3t} - e^{-4t}]u(t) \)

3.45) 
(a) \( H(\omega) = \frac{3 + j\omega}{(2 - \omega^2) + j3\omega} \)
(b) Poles at \( s = -1, -2 \). Zeros at \( s = -3 \).
(c) \( \frac{d^2y}{dt^2} + 3 \frac{dy}{dt} + 2y = \frac{dx}{dt} + 3x \)
(d) \( h(t) = [2e^{-t} - e^{-2t}]u(t) \)

3.6) 
a) \( X_1(s) = 60 \frac{s}{s^2 - 9} \)
b) \( X_2(s) = 5 \left( \frac{1}{s^2} - \frac{3}{s} \right) e^{-3s} \)
c) \( X_3(s) = 4e^{-2} \frac{e^{-4s}}{s+2} \)
3.14) 
   a) \( x_1(t) = [4 - e^{-t} - 2e^{-5t}]u(t) \)
   b) \( x_2(t) = [2e^{-2t} - 2e^{-3t}\sin(t)]u(t) \)
   c) \( x_3(t) = 2t^2e^{-2t}u(t) \)

3.44) 
   a) \( H(\omega) = \frac{2 + j\omega}{(13 - \omega^2) + j4\omega} \)
   b) Poles at \( s = -2 \pm j\,3 \). Zero at \( s = -2 \).
   c) \( h(t) = e^{-2t}\cos(3t)u(t) \)
   d) \( y(t) = \frac{1}{3}e^{-2t}\sin(3t)u(t) \)

3.48) 
   a) \( H(\omega) = \frac{4}{3 + j\omega} \)
   b) Pole at \( s = -3 \).
   c) \( \frac{dy}{dt} + 3y = 4x \)
   d) \( h(t) = 4e^{-3t}u(t) \)

4.13) 
   \( v_c(t) = 100000[1 + e^{-t}]u(t) \)

The circuit was simulated using LTSpice. The impulse input was translated into an initial voltage on the capacitor. The schematic and plot of the output voltage are shown below. The theoretical response was graphed in the same plot window as the simulated response. The two overlap.
The circuit was simulated using LTSpice. The schematic and plot of the output voltage are shown below. The theoretical response was graphed in the same plot window as the simulated response. The two overlap.

\[ i(t) = \left[ \frac{2}{3} + \frac{16}{723} e^{-15t} + \frac{75}{241} \cos(4t) + \frac{20}{241} \sin(4t) \right] u(t) \]

or
\[ i(t) = \left[ \frac{2}{3} + \frac{16}{723} e^{-15t} + \frac{5}{\sqrt{241}} \cos(4t - 14.93^\circ) \right] u(t) \]