4.3-1 (c)

\[ y_0(t) = e^{-3t} \left[ \cos(4t) + \sin(4t) \right] u(t) = \sqrt{2} e^{-3t} \cos(4t - 45^\circ) u(t) \]

\[ y_x(t) = [2 - 2e^{-3t}\cos(4t) + \frac{19}{4} e^{-3t}\sin(4t)] u(t) \]

\[ y(t) = [2 - e^{-3t}\cos(4t) + \frac{23}{4} e^{-3t}\sin(4t)] u(t) = [2 + 5.836 e^{-3t} \cos(4t - 99.86^\circ)] u(t) \]

4.3-5 (b)

\[ H(s) = \frac{3s^2 + 7s + 5}{s^3 + 6s^2 - 11s + 6} \]

4.3-7)

(a)

\[ y(t) = [6 - 6e^{-t}\cos(2t) + 7e^{-t}\sin(2t)] u(t) \]

(i) \[ y(t) = [6 + 9.220 e^{-t}\cos(2t - 130.6^\circ)] u(t) \]

\[ y(t) = [0.6 - 0.6 e^{-(t-5)} \cos(2(t-5)) + 0.7 e^{-(t-5)} \sin(2(t-5))] u(t-5) \]

(ii) \[ y(t) = [0.6 + 0.9220 e^{-(t-5)} \cos(2(t+16.44^\circ))] u(t-5) \]

(b) \[ \frac{d^2y}{dt^2} + 2 \frac{dy}{dt} + 5y = 2 \frac{dx}{dt} + 3x \]

4.3-12)

(a)

(i) BIBO stable, Asymptotic stable

(ii) BIBO unstable, Asymptotic stable

(iii) BIBO unstable, Asymptotic stable

(iv) BIBO unstable, Asymptotic marginally stable

(v) BIBO unstable, Asymptotic unstable
4.4-1) 
\[ y(t) = (t \sin(t)) e^{-t} u(t) \]
\[ H(s) = \frac{1}{s^2 + 2s + 2} \]
\[ \frac{d^2y}{dt^2} + 2 \frac{dy}{dt} + 2y = x \]

The circuit response was simulated using LTSpice. The theoretical response was plotted on the same graph as the simulated response. The responses overlap, verifying the theoretical result.

4.4.7) 
\[ y(t) = e^{-2t} \left[ 3 \cos(3t) - \frac{5}{6} \sin(3t) \right] u(t) \]

or
\[ y(t) = 1.716 e^{-2t} \cos(3t + 29.05^\circ) u(t) \]

The LTSpice simulated response and the theoretical response are plotted on the same graph below. They overlap, verifying the theoretical response.
\[ H(s) = -\frac{s}{s^2 + 8s + 12} \]

An AC analysis can be performed in LTSpice to verify this result. An ideal op amp model was used (with an open-loop gain of 1 MV/V). The simulated and theoretical responses are shown in the graphs below. The magnitude responses are in the top graph while the phase response is in the bottom graph. The simulated and theoretical responses overlap, verifying the theoretical response.