1.7-7)
   a) Causal, \( y(t) \) depends on the input two seconds ago.
   b) Noncausal, \( y(-2) = x(+2) \)
   c) Noncausal, \( y(1) = x(2) \) if \( a = 2 \).

1.7-8)
   a) Invertible, \( x(t) = \frac{dy}{dt} \)
   d) Invertible, \( x(t) = y(t/3 + 2) \)
   e) Noninvertible, If \( x(t) = X + 2\pi \), then \( y(t) = \cos(X) \)

1.8-2)
\[
\frac{d^2 y_1}{dt^2} + 2 \frac{dy_1}{dt} + 2 y_1 = \frac{dx}{dt}
\]
\[
\frac{d^2 y_2}{dt^2} + 2 \frac{dy_2}{dt} + 2 y_2 = x
\]

1.8-5)
\[
\frac{dq_o}{dt} + \frac{R}{A} q_o = q_i
\]
\[
\frac{dh}{dt} + \frac{R}{A} h = \frac{1}{R} q_i
\]

2.2-2)
   a) Characteristic polynomial: \( Q(\lambda) = \lambda^2 + 4\lambda + 4 \)
   Characteristic equation: \( \lambda^2 + 4\lambda + 4 = 0 \)
   Characteristic roots: \( \lambda_1 = -2, \quad \lambda_2 = -2 \)
   Characteristic modes: \( c_1 e^{-2t}, \quad c_2 t e^{-2t} \)
   b) \( y_o(t) = 3e^{-2t} + 2t e^{-2t} \)

2.2-5)
Characteristic polynomial: \( Q(\lambda) = \lambda^2 + 4\lambda + 13 \)

Characteristic equation: \( \lambda^2 + 4\lambda + 13 = 0 \)

Characteristic roots: \( \lambda_1 = -2 + j3, \quad \lambda_2 = -2 - j3 \)

Characteristic modes: \( ce^{(-2+j3)t}, \quad c^*e^{(-2-j3)t} \)

b) \[ y_0(t) = 10e^{-2t}\cos(3t - 66.66^\circ) \]

2.2-8)

a) No. The characteristic equation must have roots at -1 and 0.

b) Yes. This equation has roots at -1 and 0.

c) Yes. This equation has a double root at -1 and a root at 0. The initial conditions could be such that the coefficient of the \( t e^{-t} \) term is zero.

2.3-2)

\[ h(t) = \delta(t) + (e^{-2t} + e^{-3t})u(t) \]

2.4-5)

a) \( u(t) * u(t) = tu(t) \)

b) \[ [e^{-at}u(t)] * [e^{-at}u(t)] = te^{-at}u(t) \]

c) \[ [tu(t)] * u(t) = \frac{1}{2} t^2u(t) \]

2.4-9)

\[ y(t) = t e^{-2t}u(t) \]

To verify this result I computed the convolution using Octave (\texttt{ct_conv}) and plotted the result (solid line below) and then plotted the theoretical result (the equation above) on the same graph (the 'o' points).
a) \[ y(t) = \frac{4}{\sqrt{13}} [\cos(\Phi) - e^{-2t} \cos(3t-\Phi)] u(t), \text{ where } \Phi = \tan^{-1}(-3/2) \]

b) \[ y(t) = \frac{4}{\sqrt{10}} [\cos(\Phi) e^{-t} - e^{-2t} \cos(3t-\Phi)] u(t), \text{ where } \Phi = \tan^{-1}(-3) \]