1 Continuous time systems

Which of the following systems are dynamical? Stable? Causal? Time-invariant? Linear?
1. \( y(t) = 5x(t) \)
2. \( y(t) = x(t)^4 \)
3. \( y(t) = x(t - 1)^2 \)
4. \( \frac{dy}{dt} = x(t) \)
5. \( \frac{dy}{dt} = y(t) + x(t) \)
6. \( \frac{dy}{dt} = -y(t) + x(t)^2 \)
7. \( \frac{dy}{dt} = -y(t) + x(t + 4) \)
8. \( \frac{dy}{dt} = tx(t) \)

2 Discrete time systems

Which of the following systems are dynamical? Stable? Causal? Time-invariant? Linear?
1. \( y[k] = 2x[k] \)
2. \( y[k] = x[k + 1]^2 \)
3. \( y[k] - y[k - 1] = x[k] \)
4. \( y[k] - y[k - 1] = x[k] - x[k - 1] \)
5. \( y[k] - y[k - 1] = x[k + 1]^3 \)
6. \( y[k] = ky[k - 1] + x[k] \)
7. \( y[k + 1] - y[k] = x[k + 1] + x[k - 1] \)
8. \( y[k] - y[k - 1] = x[k]/k^2 \)

3 System modeling

Derive the differential equations associated with the following systems

1. Input \( x = v_{\text{in}} \), output \( y = v_{\text{out}} \)

2. Input \( x = V \), output \( y = i_a \)