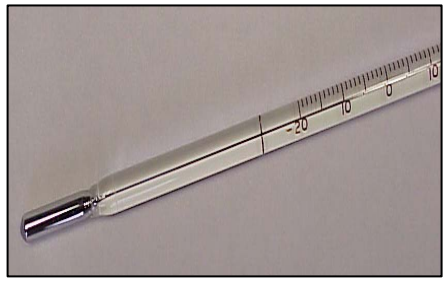
Response Characterization

- The output, y(t), of a *linear* system can be determined by by solving the linear ODE

in which the a's are constant coefficients, n the order of the system, and F(t) the forcing function.

Example First-Order System



• Consider the response of a bulb thermometer that is immersed from room air into hot water.

• Heat is transferred from the hotter water through glass wall into the cooler liquid inside the bulb.

• This thermal energy transfer is governed by the first law of thermodynamics.

• Heat is transferred convectively to the glass from the hot water as

• Assume that all of the heat transferred from the hot water through the glass reaches the liquid inside the bulb, thereby increasing the temperature of the liquid. Conservation of energy requires that

• Combining the previous equations gives

• This is a linear, first-order ordinary differential equation, which is of the form

Lower-Order Systems

- For a zero-order system (n=0),

  Examples: strain gage, pitot-static tube

- For a first-order system (n=1),

  Examples: thermometer, RC circuit

- For a second-order system (n=2),

  Examples: pressure transducer, accelerometer, RLC circuit