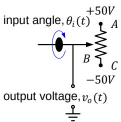
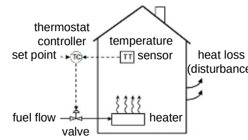
1.1 The resistance of a potentiometer is varied by moving a wiper arm along a fixed resistance. The resistance from A to C is fixed, but the resistance from B to C varies with the position of the wiper arm. It takes 10 turns to move the wiper arm from A to C



Draw a block diagram of the potentiometer

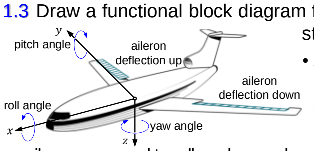
1.2 A temperature control system operates by

- sensing the difference between the thermostat setting and the actual temperature
- opening a fuel valve an amount proportional to this difference



Draw a functional closed-loop block diagram identifying the input and output transducers, the controller, and the plant. Further, identify the input and output signals of all subsystems previously described

1.3 Draw a functional block diagram for a closed-loop system that stabilizes the roll as follows



- system measures the actual roll angle with a gyro and compares the actual roll angle with the desired roll angle
- ailerons respond to roll angle error by undergoing an angular deflection
- aircraft responds to this angular deflection, producing a roll angle rate

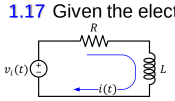
Identify the input and output transducers, the controller, and the plant. Further, identify the nature of each signal

1.8 Bathtub is a control system that keeps the water level constant. A constant flow from the tap yields a constant water level, because the flow rate through the drain increases as the water level increases, and decreases as the water level decreases. After equilibrium has been reached, the level can be controlled by controlling the input flow rate. A low input flow rate yields a lower level, while a higher input flow rate yields a higher level

a. Sketch a control system that uses this principle to precisely control the fluid level in a tank. Show the intake and drain valves, the tank, any sensors and transducers, and the interconnection of all components

b. Draw a functional block diagram of the system, identifying the input and output signals of each block

1.17 Given the electric network shown in the figure

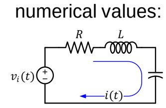


a. Write the differential eq. for the network if $v(t) = u(t)$, a unit step

b. Solve the differential eq. for the current $i(t)$ if there is no initial energy in the network

c. Make a plot of your solution if $R/L = 1$

1.18 Given the electric network shown in the figure with the numerical values: $R = 2\Omega$, $L = 1H$, $1/LC = 25$



a. Write the differential eq. for the network if $v(t) = u(t)$, a unit step

b. Solve the differential eq. for the current, $i(t)$, if there is no initial energy in the network

c. Make a plot of your solution

1.19 Solve the following differential equations using classical methods. Assume zero initial conditions

a. $\frac{dx}{dt} + 7x = 5cos2t$

b. $\frac{d^2x}{dt^2} + 6\frac{dx}{dt} + 8x = 5sin3t$

c. $\frac{d^2x}{dt^2} + 8\frac{dx}{dt} + 25x = 10u(t)$

1.20 Solve the following differential equations using classical methods and the given initial conditions

a. $\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + 2x = sin2t \qquad x(0) = 2, \frac{dx}{dt}(0) = -3$

b. $\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + x = -3 \qquad x(0) = 2, \frac{dx}{dt}(0) = 1$

c. $\frac{d^2x}{dt^2} + 4x = t^2 \qquad x(0) = 1, \frac{dx}{dt}(0) = 2$