Fall 2022 (111-1)

# 控制系統
# Control Systems

## Unit 2G
## Flow Models – Heat and Fluid

Feng-Li Lian

NTU-EE

Sep 2022 – Dec 2022

# Example 2.15 Equations for heat flow

- Heat flow

$$q = \frac{1}{R}(T_1 - T_2)$$

$q =$ heat-energy flow, joules per second (J/sec)

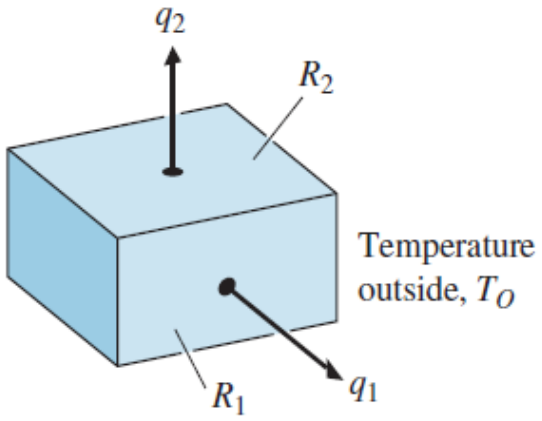
$R =$ thermal resistance, $°C/J{\cdot}\text{sec}$

$T =$ temperature, $°C$

$$\dot{T} = \frac{1}{C}q, \quad (C : \text{thermal capacity})$$

- Model (Equations for heat flow)

$$\dot{T}_I = \frac{1}{C_I}(\frac{1}{R_1} + \frac{1}{R_2})(T_O - T_I)$$




$C_I =$ thermal capacity of air in the room

$T_I =$ temperature inside

$R_2, R_1 =$ thermal resistance of room ceiling and wall, respectively

# Example 2.17 Equations for Describing Water Tank Height

- Incompressible Fluid Flow

$$\dot{m} = w_{in} - w_{out}$$

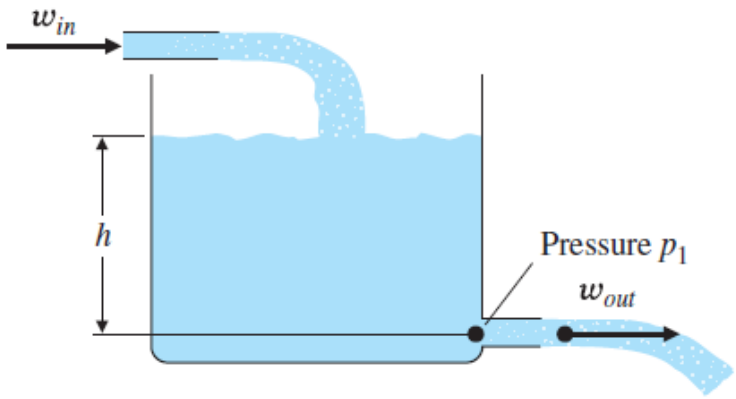
$m =$ fluid mass within a prescribed portion of the system

$w_{in} =$ mass flow rate into the prescribed portion of the system

$w_{out} =$ mass flow rate out of the prescribed portion of the system

- Model (Equations of Water tank height)

$$\dot{h} = \frac{1}{A\rho}(w_{in} - w_{out})$$




$A =$ area of the tank

$\rho =$ density of water

$h = \frac{m}{A\rho} =$ height of water

$m =$ mass of water