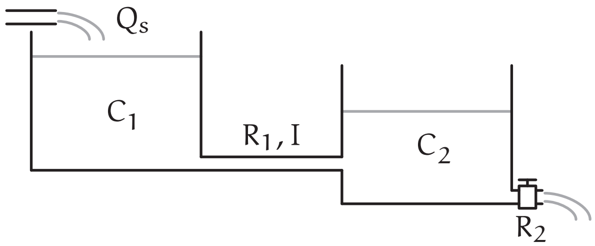
08.6 thermoflu.exe Exercises for Chapter 08 thermoflu

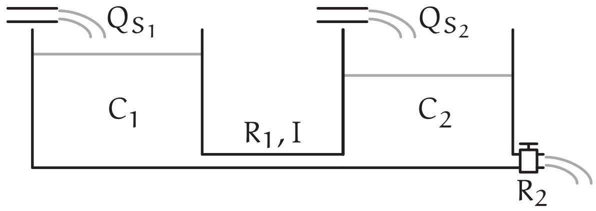
Exercise 08.1 tinker

Draw a linear graph of the fluid system with schematic below.



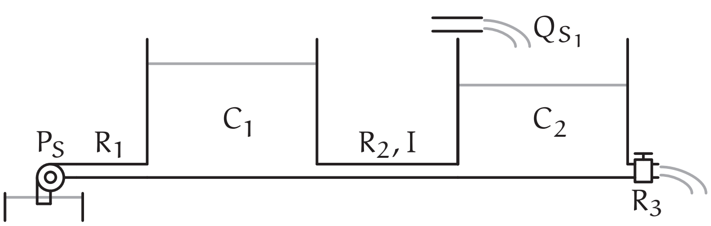
Exercise 08.2 tailor

Draw a linear graph of the fluid system with schematic below.



Exercise 08.3 soldier

(a) Draw a linear graph of the fluid system with schematic below. (b) Draw a normal tree and identify the state variables and system order.



Exercise 08.4 tpain

Consider an apparatus with two chambers filled with gas at potentially different temperatures illustrated in Fig. exe.1. Temperature sensors are embedded in the two "sensor blocks," made of copper for low thermal resistance and made large enough to provide enough thermal capacitance to smooth out temperature fluctuations.[4] The "structural conduit" is made of steel, less thermally conductive, but conductive nonetheless. The conduit provides structure to the apparatus and is hollow to allow the sensor wires to run through. ______/ 25 p.

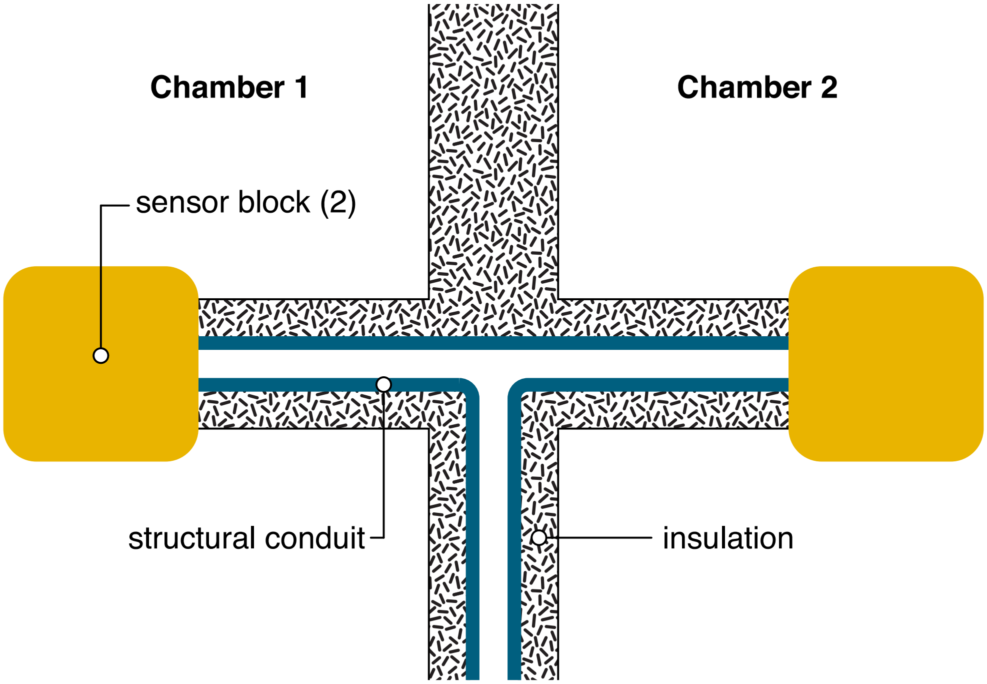


Figure exe.1: a diagram of the two-chamber apparatus.

A concern with this apparatus is that the temperature in one chamber will affect the temperature in the other, most conspicuously by heat conducting through the structural conduit.

[4]This technique of adding capacitance for smoothing a signal is useful in all energy domains!

We will begin an analysis of the thermal isolation of the two chambers and temperature measurements. Develop a thermal lumped-parameter model as follows.

a. Describe the lumped-parameter elements you will use to model the system.
b. Draw a linear graph of the lumped-parameter model.
c. Superimpose a normal tree on the graph, identify the system order, and choose the state variables.

Exercise 08.5 dramp

Consider a device with four amplifiers in an array on a printed circuit board (PCB), as illustrated in Fig. exe.2. The amplifiers generate significant heat (as a byproduct), and they must be cooled. For this reason, each amplifier has mounted on top a heat sink device with fins. A fan forces airflow over the fins to dissipate the heat via convection.

_____/ 25 p.

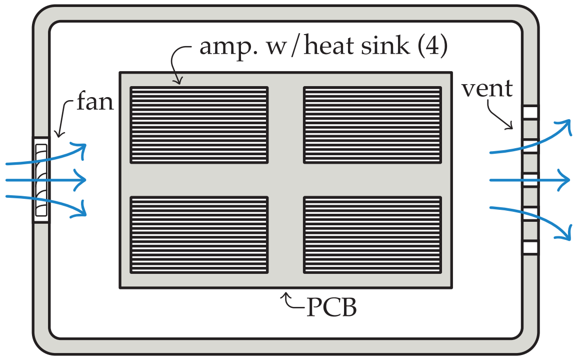


Figure exe.2: Top view of four amplifiers in a chassis.

As the designer of the chassis housing the amplifiers, you would like to develop a lumped-parameter thermal model of the system to ensure that, under different heat generation loads, the amplifiers remain within their acceptable temperature range.

a. Describe the lumped-parameter elements you will use to model the system, including inputs.

b. Draw a linear graph of the lumped-parameter model.
c. Superimpose a normal tree on the graph, identify the system order, and choose the state variables.

Part IV

Fourier analysis

09 four