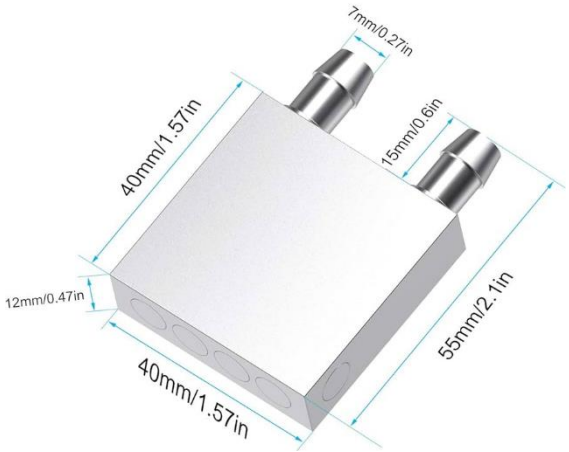
Project Review Assignment B [7 marks]

Title:
Precise Flow Reagent Temperature Control

Brief:

It is generally difficult to precisely control the temperature of reagents that are prepared in a large reactor. One possible approach to overcome this is by passing the reagent in and out from a metal device as shown in the figure (material: aluminium). It is planned for heaters and coolers to be attached on opposite sides of the device to control the temperature to within a range of $\pm 0.2^{o}$C. The temperature of the reagent can be set by the operator to range from 35^{o}C to 50^{o}C. A system simulated using Matlab Simscape, is to be devised to achieve this.



Metal device for reagent flow

Specifications:

System

- It is possible to use more than one device to achieve the temperature range and precision required.
- Must incorporate delivery from a reactor tank that that has 100 litres capacity. The initial temperature of the reagent can be assumed to be 10^{o}C lower than the intended temperature of the reagent.
- The piping from the reactor tank has to fit into the input and output nipples of the device(s). There is no restriction on the length of piping to be used.
- A constant flowrate device can be assumed to be used to deliver the reagent from the tank to the device(s). There is no restriction on the flowrate setting used.

Heating and Cooling

- It is planned for the heater and cooler that are attached to the device to match the dimensions of the device precisely and they should also be commercially available.
- Justifications for their selection as well as their datasheets must be provided in the documentation.

Sensing

- The temperature sensor to be used must be ONE of those that were illustrated in the Remote Laboratory Experiment.
- Justifications for its selection must be provided in the documentation.

Circuitry

- The controller circuit used to maintain the temperature of the heater and cooler can only comprise
    - Resistors
    - Capacitors
    - Op-amps
    - Constant voltage sources
- It should ideally comprise networks that are able to conduct
    - Signal conditioning
    - Error sensing, amplification, and compensation

Simulation

- The Simscape simulation must include integration of the
    - Electrical elements, and
    - Thermal-fluid elements
- Graphs of temperature versus time when using reagent temperature settings of 38^{o}C to 45^{o}C are to be provided in the documentation.

Submission (as a single .zip file):

This is an INDIVIDUAL submission with NO cooperation from anyone else. The deadline for submission is Week 10 Friday 4/10/2024. The submission MUST include:

Video

- Single .mp4 file that includes footages of important aspects of the simulation.
- Not exceeding 3 minutes.
- Clear captions are to be included in the video footages.

Documentation

- Single .pdf file
- Not exceeding 2000 words
- Up to 10 figures are permitted
- Clear and concise explanation of the system, circuitry, and simulation using grammatically correct sentences with no spelling errors

Grading criteria:

Awards:

	Poor (0-0.49)	Acceptable (0.5-0.69)	Good (0.6-0.79)	Excellent (0.8-1.0)
(a) System heater and cooler (the appropriate elements selected with correct justification, and with the necessary datasheet information included) [0.5%]				
(b) System sensor (the appropriate element chosen with correct justification) [0.5%]				
(c) Simulation model (The Simscape model depicts all the elements such that the desired characteristics can be correctly represented) [2%]				
(d) Simulation presentation (The documentation describing the Simscape modelling is well organized and comprehensive. It should also be concisely explained and discussed using figures) [1%]				
(e) Video effectiveness (the video footages recorded are instructive and engaging with good use of captions; they also illustrate the correct achievements of the simulation) [1%]				
(f) Documentation effectiveness (the system, circuitry, and simulation are described, explained and discussed in an organized, logical and succinct fashion) [2%]				

Penalties:

(a) Failure to adhere closely to the specifications.
(b) Grammatical and spelling errors in the documentation.
(c) Poorly constructed and difficult to understand sentences in the documentation.
(d) Hand drawn sketches and unclear images used as figures in the documentation.